

**U.S. ENGINEERING COMPANY
STANDARD ONE YEAR WARRANTY**

Poudre School District
2445 LaPorte Avenue
Fort Collins, CO 80521

9-26-14

Attention: **Ruth Boothe**

Re: Beattie Elementary School

U.S. Engineering Company will furnish and install, without charge, replacement parts for, or make field repairs to products covered herein, which prove defective in material or workmanship, under normal and proper use, within one (1) year from date hereinafter specified, provided the customer gives U.S. Engineering Company written notice of such defects, and provided that inspection by U.S. Engineering Company establishes the validity of the claim.

Repairs or replacements as provided by the foregoing paragraphs shall constitute fulfillment of all U.S. Engineering Company's obligations with respect to this warranty. This warranty will not apply to any products or parts thereof that have been subject to accident, misuse, or unauthorized alteration or where U.S. Engineering Company's installation and service requirements have not been followed. Warranty does not include maintenance of equipment or consequential damages.

The owner shall accept full responsibility for proper operation and maintenance of equipment immediately upon acceptance of the mechanical system for beneficial use. The foregoing warranty is in lieu of all other warranties expressed or implied. In no event shall U.S. Engineering Company be liable for consequential damages.

The warranty date has been established to extend from 9-26-14 to 9-26-15. For warranty service during the performance of this agreement contact Ben Bradford at 970-669-1666, Ben.Bradford@usengineering.com

Please acknowledge receipt to this notice by signing below, and returning to U.S. Engineering Company as soon as possible.

Sincerely,

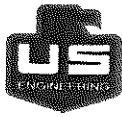
U.S. Engineering Company

We acknowledge receipt and accept the warranty period notification above.

(Company)

(Signature)

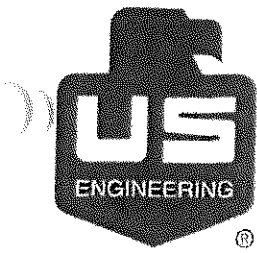
(Date)



Beattie Elementary O & M Manual Table of Contents

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2	23 21 13	Hydronic Pumps O&M/Warranty/Product Submittal Data P-3 (Bell & Gossett) P-4 (Bell & Gossett)	Mcnevin Company	Eugene Mitchell	303-322-0165	emitchell@mcnevinco.com
3	23 25 00	HVAC Water Treatment Dolphin Unit (Dolphin)	Long & Associates	John Stumph	303-975-2118	jstumph@long.com
4	23 25 00 M-0.2	HVAC Water Treatment O&M/Warranty/Product Submittal Data Bypass Feeder (Neptune) Glycol Feeder (Advantage Controls) Chemical MSDS	Summit Labs	Doug Gordon	303-293-9862	drg@summitlaboratories.com
5	23 36 00	Air Terminal Units O&M/Warranty/Product Submittal Data	Air Purification Company	John Eha	303-428-2800	je@airpurificationcompany.com
6	23 38 13	Commercial Kitchen Hoods O&M/Warranty/Product Submittal Data EH-1 (Captive-Aire) EH-2 (Captive-Aire)	Air Purification Company	John Eha	303-428-2801	je@airpurificationcompany.com
7	23 57 00	Heat Exchangers for HVAC O&M/Warranty/Product Submittal Data HX-1 (Alfa Laval)	CFM Company	Justin Dunkin	970-493-7293	justind@cfmcompany.com
8	23 65 00	Cooling Towers CT-1 (Baltimore Aircoil)	CFM Company	Justin Dunkin	970-493-7294	justind@cfmcompany.com
9	23 73 23	Modular Outdoor Central Station Air Handling Units O&M/Warranty/Product Submittal Data RTU-6 (Daikin)	Long & Associates	John Stumph	303-975-2118	jstumph@long.com
10	23 74 33	Packaged, Outdoor, Heating and Cooling Makeup Unit O&M/Warranty/Product Submittal Data MAU-1 (Captive-Aire)	Air Purification Company	John Eha	303-428-2801	je@airpurificationcompany.com
11	23 82 16	Air Coils O&M/Warranty/Product Submittal Data C-1, C-3, C-4, C-5 (Daikin)	Long & Associates	John Stumph	303-975-2118	jstumph@long.com
12	M-0.2	Air Separator O&M/Warranty/Product Submittal Data AS-1 (Rolairtrol)	Mcnevin Company	Eugene Mitchell	303-322-0165	emitchell@mcnevinco.com
13	M-0.2	Expansion Tank O&M/Warranty/Product Submittal Data ET-1 (Bell & Gossett)	Mcnevin Company	Eugene Mitchell	303-322-0165	emitchell@mcnevinco.com
14	22 40 00	Plumbing Fixtures O&M/Warranty/Product Submittal Data WC-1 (American Standard, Sloan Royal, Church) WC-2 (American Standard, Sloan Royal, Church) WC-3 (American Standard, Sloan Royal, Church) UR-1 (American Standard, Sloan Royal)	Wholesale Specialties	Terri McMahon	303-296-2212	tcmahon@wholesalespecialties.com
15	M-0.2	Exhaust Fan O&M/Warranty/Product Submittal Data EF-8 (Captive-Aire)	Air Purification Company	John Eha	303-428-2801	je@airpurificationcompany.com
16	M-0.3	Backflow Preventer Watts-LF-909QTU	Wholesale Specialties	Terri McMahon	303-296-2212	tcmahon@wholesalespecialties.com
17	23 05 93	Testing, Adjusting and Balancing for HVAC	TAB Services	Josh Uncapher	303-649-1213	juncapher@tabservicescolorado.com
18		USE Valve Tag Schedule	USE			
19	23 09 00 23 09 93	Instrumentation & Control/Sequence of Operation	DRA	Jeff Strickland	303-934-2076	jeff@drallc.net
20		As-Built Information-Attached CD	USE			
		USE Service/Warranty Contact	USE	Ben Bradford	970-669-1666	Ben.Bradford@usengineering.com

TAB-17,18,19 and 20 are still pending, information to be provided when finalized.



Tab-1

Specification Section: 23 05 13

Common Motor and VFD

RTU-1 7.5hp/2hp motors and 5hp VFD
(US Motors and ABB)

RTU-2 7.5hp/2hp motors and 5hp VFD
(US Motors and ABB)

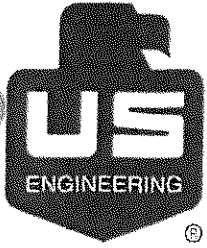
RTU-3 7.5hp/2hp motors and 5hp VFD
(US Motors and ABB)

RTU-4 7.5hp/2hp motors and 5hp VFD
(US Motors and ABB)

RTU-5 7.5hp/2hp motors and 5hp VFD
(US Motors and ABB)

**BEATTIE
ELEMENTARY
SCHOOL**

3100 MEADOWLARK AVE
FORT COLLINS, CO 80526

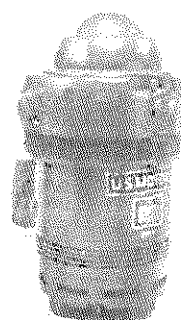
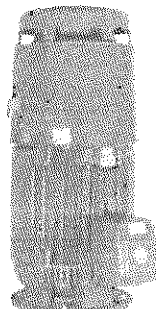
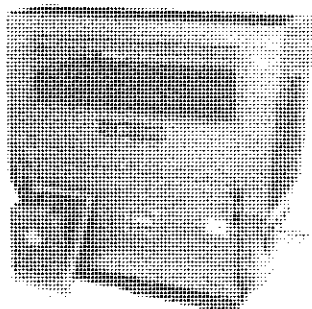
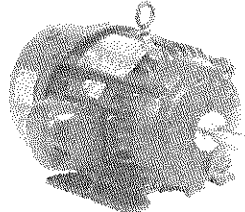
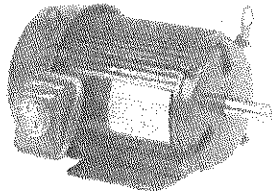
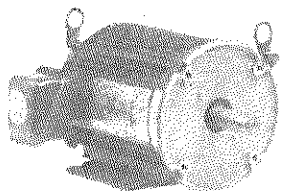
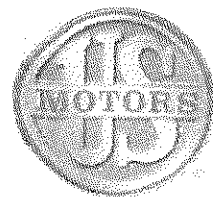


US Motors O&M and
Warranty Information:
RTU-1 7.5hp/2hp motors
RTU-2 7.5hp/2hp motors
RTU-3 7.5hp/2hp motors
RTU-4 7.5hp/2hp motors
RTU-5 7.5hp/2hp motors

**BEATTIE
ELEMENTARY
SCHOOL**

1000 MEADOWLARK AVE
FORT COLLINS CO 80526

Installation, Operation & Maintenance Instructions



HORIZONTAL MOTORS

TITAN MOTORS

VERTICAL MOTORS

For your safety, read and retain this manual.

NIDEC MOTOR CORPORATION

3050 W. Florissant Avenue | PO Box 36912

St. Louis, MO 63136

www.udmotors.com

SAFETY FIRST

⚠ DANGER

High voltage and rotating parts can cause serious or fatal injury. Safe installation, operation and maintenance must be performed by qualified personnel. Familiarization with, and adherence to, NEMA MG2, the National Electrical Code (NEC), and local codes is required. It is important to observe safety precautions to protect personnel from possible injury.

PERSONNEL SHOULD BE INSTRUCTED TO:

1. Be familiar with the equipment and read all instructions thoroughly before installing or working on equipment.
2. Avoid contact with energized circuits or rotating parts.
3. Disconnect all power sources before initiating any maintenance or repair.
4. Act with care in accordance with prescribed procedures in handling and lifting this equipment.
5. Be sure unit is electrically grounded in accordance with code requirements.
6. Be sure equipment is properly enclosed or protected to prevent access by children or other unauthorized personnel to prevent possible accidents.
7. Be sure shaft key is fully captive before unit is energized.
8. Avoid contact with capacitors until safe discharge procedures have been completed.
9. Provide proper guarding for personnel against rotating parts and applications involving high inertia loads which can cause overspeed.
10. Avoid extended exposure to equipment with high noise levels.

INSPECTION AND HANDLING

Inspect unit to make sure no damage has occurred during shipment. Check nameplate for correct speed, horsepower, voltage, hertz and phase for conformance with power supply and equipment.

⚠ WARNING

Units should be lifted using all eyebolts or lugs if provided. These eyebolts or lugs are provided for lifting this unit only and must not be used to lift any additional weight. Lifting angle, from shank of eyebolt, must not exceed 30 degrees for machines with single and 45 degrees for machines with multiple lifting means. Replacement eyebolts must be per ASTM A489 or equivalent. All eyebolts must be securely tightened. Be careful not to touch overhead power lines with lifting equipment. Failure to observe this warning may result in serious personal injury.

STORAGE

Units should be stored indoors, in a clean, dry location & winding should be protected from excessive moisture absorption. NOTE: If motors are to be stored for over one year, refer to Nidec Motor Corporation (NMC). If motors are to be stored for over one year and if gear and belt transmission units are to be stored for over six months, refer to Nidec Motor Corporation.

LOCATION

⚠ WARNING

Use only UL Listed Hazardous Location Motors for service in Hazardous Locations as defined in Article 500 of the NEC. Units should be located in a clean, well-ventilated area. Units should be located in a suitable enclosure or protected to prevent access by children or other unauthorized personnel to prevent possible accidents.

INSTALLATION / MOUNTING

Mount unit on a firm, flat surface sufficiently rigid to prevent vibration. Drive belts and chains should be tensioned in accordance with supplier recommendations. Couplings should be properly aligned and balanced. For belt, chain and gear drive selection refer to the drive or equipment manufacturer. For application of drive equipment refer to applicable information in NEMA MG1.

Motors have been dynamically balanced using a half key the same length as the full key shipped with the motor. If pulley length keyway is less than this length, rework long key by removing one-half of excess length between pulley and end of key to maintain balance.

Do not restrict motor ventilation. Unless otherwise specified on nameplate, motor is designed for operation in accordance with NEMA MG1 "Usual Service Conditions" which states an ambient temperature range of -15° C to 40° C (5° F to 104° F). Standard grease lubricated units are suitable for operation within this temperature range. Special lubricants may be required for ambient temperatures outside of this range. Note: Motors operating under rated load and allowable ambient conditions may feel hot when touched; this is normal and should not be cause for concern. When in doubt, measure frame surface temperature and confer with nearest office. Enclosed motors normally have condensation drain openings. Insure that drain openings are properly located and open (plugs removed) for the motor mounting position. Drain openings should be at lowest point of end brackets, frame housing and terminal housing when the motor is installed. This may require modification of motor to accomplish. If unit appears wet, and/or has been stored in a damp location, dry out thoroughly and check for adequate insulation resistance to ground before operating.

⚠ WARNING

Guards should be provided for all exposed rotating parts to prevent possible personal injury. Keep fingers and foreign objects away from ventilation and other openings. Applications involving high inertia loads may damage this equipment due to motor overspeed during coast shutdown. Such applications should be referred to Nidec Motor Corporation.

⚠ CAUTION

Do not force drive coupling or other equipment onto shaft, as bearing damage may result.

POWER SUPPLY AND CONNECTIONS

The power supply must agree with values on nameplate. Terminal voltage should not vary more than $\pm 10\%$ of nameplate voltage at rated frequency. Unbalanced line voltage, greater than one percent, can cause overheating. Do not exceed the rated load amperes on the nameplate. Starting controls and overload protection should be properly sized in accordance with the NEC and the control manufacturer's recommendations.

Motor connections should be made by following instructions on connection diagram. Determine direction of rotation before connecting driven equipment. If direction of rotation label is supplied, operate only in specified direction. Rotation may be reversed on three phase motors by interchanging any two line connections. On single phase motors interchange leads per connection diagram on motor. Wiring of units, controls and grounding shall be in accordance with local and NEC requirements.

⚠ WARNING

Failure to properly ground unit may cause serious injury to personnel. Where unexpected starting could be hazardous to personnel, do not use automatic reset starting devices.

USE OF VARIABLE FREQUENCY DRIVES

Electric motors can be detrimentally affected when applied with variable frequency drives (VFD's). The non-sinusoidal waveforms of VFD's have harmonic content which causes additional motor heating; and high voltage peaks.

Other effects of VFD's on motor performance include reduced efficiency, increased load current, vibration and noise. Standard motors utilized with VFD's must be limited to those application considerations defined in NEMA MG-1 Part 30. For most current guidelines on installing and applying a US Motors product refer to <http://www.usmotors.com/guidelines>. This information takes precedence over previous published information.

NEMA MG-1 Part 31 defines performance and application considerations for Definite-Purpose Inverter Fed Motors. To insure satisfactory performance and reliability, Nidec Motor Corporation offers and recommends nameplated inverter duty motor products which meet the requirements of NEMA MG-1 Part 31. The use of non-inverter duty motors may result in unsatisfactory performance or premature failure, which may not be warrantable under the Terms and Conditions of Sale. Contact your Nidec Motor Corporation Field Sales Engineer for technical assistance for motor selection, application and warranty details.

OIL LUBRICATION

Most oil lubricated units are shipped without oil. Refer to Instruction Manual with unit for specific type and grade of oil to be used, change interval and level. If lubrication instructions specify synthetic oil, do not substitute.

⚠ WARNING *For applications in the food and drug industry (including animal food), consult the petroleum supplier for lubricants that are acceptable to the Food and Drug Administration and other governing bodies.*

MAINTENANCE

Inspect units at regular intervals. Keep units clean and ventilation openings clear of dust, dirt or other debris. Lubricate units per this operating instruction folder and instruction plate on unit. Excessive lubrication may damage the unit. Do not over grease.

⚠ WARNING *Disconnect all power sources to the unit and discharge all parts which may retain an electrical charge before attempting any maintenance or repair. Screen and covers must be maintained in place when unit is in operation. Failure to observe this warning may result in personal injury.*

U.L. Listed Motors for use in Hazardous Locations: Repair of these motors must be made by the manufacturer or manufacturer's authorized service station approved to repair U.L. Listed Motors. The U.L. listing applies to the electric motor only and not the belt or gear transmissions or other devices that may be connected to the motor.

COOLING TOWER DUTY MOTORS

During installation, insure drain plugs are removed from lower drain holes in bracket and outlet box. All upper drain holes must be plugged at all times. External umbrella seal must be in place for shaft up applications. Motors with Bearing numbers "XXXX-2RS" are double sealed and not to be re-lubricated.

GREASE LUBRICATION INSTRUCTIONS

Units are prelubricated at the factory and do not require initial lubrication. Relubricating interval depends upon speed, type of bearing and service. Refer to Table 1 for suggested regreasing intervals. Operating conditions may dictate more frequent lubrication. Motor must be at rest and electrical controls should be locked open to prevent energizing while motor is being serviced (refer to section on Safety). If motor is being taken out of storage, refer to storage procedures.

To relubricate bearings, remove the drain plug. Inspect grease drain and remove any blockage with a mechanical probe taking care not to damage bearing.

CAUTION Under no circumstances should a mechanical probe be used while the motor is in operation. Add new grease at the grease inlet, refer to Table 1 for replenishment quantities. New grease must be compatible with grease in the motor (See Caution Note). Run the motor for 15 to 30 minutes with the drain plug removed to allow purging of any excess grease. Shut off unit and replace the drain plug. Return motor to service. Some motors have sealed bearings and are not regreasable.

Over greasing can cause excessive bearing temperatures, premature lubricant breakdown and bearing failure. Care should be exercised against over greasing.

ENGLISH

Table 1
Recommended Grease Replenishment Quantities & Intervals
(For lubrication of units in service)

Bearing Number				Bearing Type	Grease FL Oz.	Lubrication Interval		
Common	63XX	XXBC62	XXBC03			1801-3600 RPM	1201-1800 RPM	0-1200 RPM
62XX	63XX	XXBC62	XXBC03	Ball	0.2	2 Years	3 Years	3 Years
6203-6207	6303-6306	17-35	17-39		0.4	1 Year	2 Years	2 Years
6209-6212	6307-6309	40-60	35-45		0.6	1 Year	2 Years	2 Years
6213-6215	6310-6311	65-75	50-55		1.0	6 Mos.	1 Year	2 Years
6216-6219	6312-6315	80-95	60-75		1.8	3 Mos.	1 Year	1 Year
6220-6228	6316-6320	100-140	80-100		0.3	N/A	6 Mos.	1 Year
NJ307		35RU03			0.4			
NJ309		46RU03		0.6				
NJ311		55RU03		0.6				
NJ215		75RU02		1.0				
NJ315		76RU03		1.1				
NJ220		100RU02		1.4				
NJ222		110RU02		1.6	N/A	3 Mos.	6 Mos.	
NJ226		130RU02		1.8				
NJ228		140RU02		1.9				
C2211 CARB		N/A		0.4				
C2213 CARB		N/A		0.6				
C2216 CARB		N/A		1.8				
C2223 CARB		N/A		1.4				
C2222 CARB		N/A		1.8	N/A	3 Mos.	6 Mos.	
C2226 CARB		N/A		2.5				

For motors mounted vertically or in hostile environments, reduce intervals shown by 50 percent.

Refer to motor nameplate for bearings provided on a specific motor.

For bearings not listed in table above, the amount of grease required may be calculated by the formula:

$$G = 0.11 \times D \times B$$

Where;

G = Quantity of grease in fluid ounces.

D = Outside diameter of bearing in inches.

B = Width of bearing in inches.

Table 2 RECOMMENDED GREASES

THE FOLLOWING GREASES ARE INTERCHANGEABLE WITH THE GREASE AS PROVIDED IN UNITS SUPPLIED FROM FACTORY (UNLESS STATED OTHERWISE ON A LUBRICATION NAMEPLATE PROVIDED ON MOTOR).

MANUFACTURER	GREASE (NLGI No. 2)
MOBIL CORP.	POLYREX - EM
CHEVRON U.S.A. INC.	SRI NO. 2

CAUTION Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. When necessary, prevent such intermixing by disassembling the motor, removing all old grease from bearings and housings (including all grease fill and drain holes). Inspect and replace damaged bearings. Fill bearing housings and bearing approximately 30% full of new grease. Remove any excess grease extending beyond the edges of the bearing races and retainers. Refer to Table 2 for recommended greases.

WARRANTY

LIMITED WARRANTY

All Nidec Motor Corporation products are warranted against defects in workmanship and materials for 12 months from date of installation, not to exceed 18 months from date of shipment from NMC. Some of Nidec Motor Corporation products carry a warranty period longer than 12 months. Please refer to the current price catalog or to NMC for details on specific products. This limited warranty does not apply to any product which has been subject to misuse, misapplication, neglect (including without limitation, inadequate maintenance), accident, improper installation, modification, adjustment, or repair. This constitutes NMC's only warranty in connection with this sale and is in lieu of all other warranties, expressed or implied, written or oral. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE THAT APPLY TO THIS SALE. No employee, agent, dealer or other person is authorized to give any warranties on behalf of NMC nor to assume for NMC any other liability in connection with any of its products.

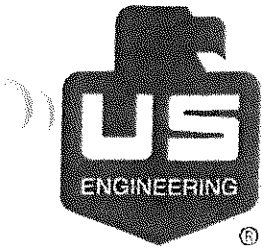
EXCLUSIVE REMEDY

NMC's liability shall be limited exclusively to repairing or replacing any product found by NMC to be defective, or at NMC's option, to refund the purchase price of its product. Such product shall be returned, freight prepaid, to the nearest Nidec Motor Corporation authorized service station or NMC factory. It is agreed that such replacement, repair, or refund be the sole and exclusive remedies available from NMC. NMC shall not be liable for damages of any sort whatsoever beyond these exclusive remedies including incidental and consequential damages regardless of whether any claim is based upon contract, negligence, strict liability, tort, warranty, or other basis. The repair or replacement of the product, or the refund of the purchase price, at NMC's option, constitutes fulfillment of all liabilities of NMC to the buyer for defective products.

RENEWAL PARTS AND WARRANTY SERVICE

When inquiring for renewal parts, call the nearest Nidec Motor Corporation Parts Stocking Distributor. For warranty service, call the nearest Nidec Motor Corporation Authorized Service Station. Give them complete Nameplate data, including identification number, etc.

Request installation and maintenance manuals by product name.



**ABB VFD O&M and Warranty
Information:**

RTU-1 7.5hp/2hp motor VFD's

RTU-2 7.5hp/2hp motor VFD's

RTU-3 7.5hp/2hp motor VFD's

RTU-4 7.5hp/2hp motor VFD's

RTU-5 7.5hp/2hp motor VFD's

**BEATTIE
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2000 NE ALPINE AVE
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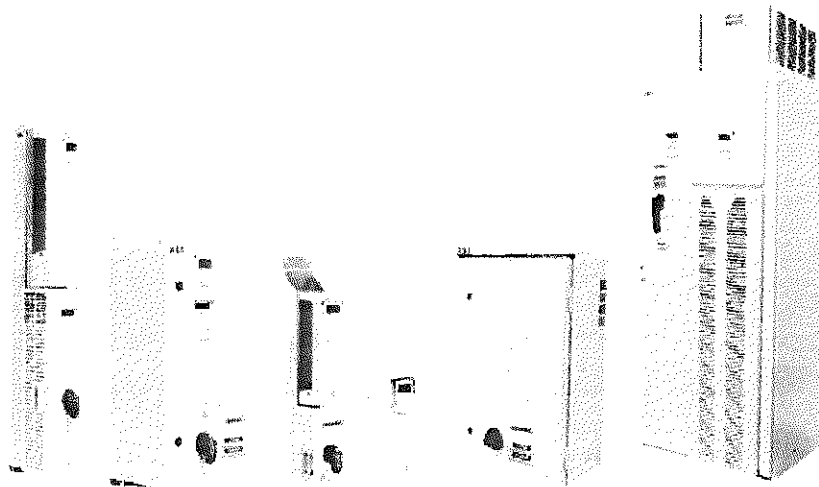
ACH550

Installation, Operation and Maintenance Manual (I, O & M)

ACH550-UH HVAC Drives (1...550 HP)

ACH550-BCR/BDR/VCR/VDR E-Clipse Bypass Drives (1...400 HP)

ACH550-PCR/PDR Packaged Drives with Disconnect (1...550 HP)



ABB

Safety

Use of warnings and notes

There are two types of safety instructions throughout this manual:

- Notes draw attention to a particular condition or fact, or give information on a subject.
- Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment. They also tell you how to avoid the danger. The warning symbols are used as follows:



Electricity warning warns of hazards from electricity which can cause physical injury and/or damage to the equipment.

- **WARNING!** The ACH550 adjustable speed AC drive should ONLY be installed by a qualified electrician.
- **WARNING!** Even when the motor is stopped, dangerous voltage is present at the power circuit terminals U1, V1, W1 (L1, L2, L3) and U2, V2, W2 (T1, T2 T3) and, depending on the frame size, UDC+ and UDC-, or BRK+ and BRK-.
- **WARNING!** Dangerous voltage is present when input power is connected. After disconnecting the supply, wait at least 5 minutes (to let the intermediate circuit capacitors discharge) before removing the cover.
- **WARNING!** Even when power is switched off from the input terminals of the ACH550, there may be dangerous voltage (from external sources) on the terminals of the relay outputs.
- **WARNING!** When the control terminals of two or more drives are connected in parallel, the auxiliary voltage for these control connections must be taken from a single source which can either be one of the drives or an external supply.
- **WARNING!** Disconnect the internal EMC filter when installing the drive on an IT system (an ungrounded power system or a

high-resistance-grounded [over 30 ohm] power system).

- **WARNING!** Do not attempt to install or remove EM1, EM3, F1 or F2 screws while power is applied to the drive's input terminals.



General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.

- **WARNING!** Do not control the motor with the disconnecting device (disconnecting means); instead, use the control panel keys or commands via the I/O board of the drive. The maximum allowed number of charging cycles of the DC capacitors (i.e. power-ups by applying power) is five in ten minutes.
- **WARNING!** Never attempt to repair a malfunctioning ACH550; contact the factory or your local Authorized Service Center for repair or replacement.
- **WARNING!** The ACH550 will start up automatically after an input voltage interruption if the external run command is on.
- **WARNING!** The heat sink may reach a high temperature.




Note: For more technical information, contact the factory or your local ABB representative.

Contents

This manual is the Operation and Maintenance Manual for the ACH550 Drives. Complete technical details and programming information are available in the *ACH550 User's Manual*, publication number 3AUA0000081823.

- To determine the type of your drive, refer to its construction code on either:

- Serial number label attached on upper part of the chokeplate between the mounting holes.
- Type code label attached on the heat sink – on the side of the enclosure.

Input Voltage (U1) Current (I1n)	3 PH 48...63 Hz 200...240 Vac 55.4 A	1 PH 4...63 Hz 200...240 Vac 55.4 A	ABB Inc. Made in USA of foreign parts    LISTED
Output Voltage (U2) Current (I2n)	3 PH 0...500 Hz 0...11 Vac 59.4 A	3 PH 0...500 Hz 0...11 Vac 28 A	
Power (Pn)	20 HP	10 HP	

SW: V.2.06B
2030700001

ACH550-UH-059A-2

S/N 2030700001

ABB Inc.
Made in USA of foreign parts

Mfg. Date: 01-December-2005 Org. Firmware: V.2.06B

S/N 2030700001

ACH550-UH-059A-2

Construction code

- According to the construction code, proceed to your drive's installation, operation, diagnostics and maintenance information:
 - UH – Below.
 - VCR, VDR, BCR, BDR (E-Clipse Bypass) – page 39.
 - PCR, PDR (Packaged Drives with Disconnect) – page 79.

ACH550-UH

Installation

Study these installation instructions carefully before proceeding. **Failure to observe the warnings and instructions may cause a malfunction or personal hazard.**



WARNING! Before you begin read *Safety* on page 2.

Note: Keep a minimum of 50 mm (2") of free space on each side and 200 mm (8") of free space above and below all units from non-heat producing sources. Double these distances from heat producing sources.

1. Prepare for installation

Lifting R1...R6

Lift the drive only by the metal chassis.

Lifting R7...R8



WARNING! Handle and ship floor mounted enclosures only in the upright position. These units are not designed to be laid on their backs.

1. Use a pallet truck to move the transport package/enclosure to the installation site.
2. Remove the cabinet side panels for access to the cabinet/pallet mounting bolts. (6 torx screws hold each cabinet side panel in place. Leave the side panels off until later.)
3. Remove the 4 bolts that secure the cabinet to the shipping pallet.



WARNING! Use the lifting lugs/bars at the top of the unit to lift R7/R8 drives.

4. Use a hoist to lift the drive. (Do not place drive in final position until mounting site is prepared.)

Unpack the drive

1. Unpack the drive.
2. Check for any damage and notify the shipper immediately if damaged components are found.
3. Check the contents against the order and the shipping label to verify that all parts have been received.

Tools required

To install the ACH550 you need the following:

- Screwdrivers (as appropriate for the mounting hardware used)
- Wire stripper
- Tape measure
- Drill
- Frame sizes R5...R8 with UL type 12 enclosure: Punch for conduit mounting holes
- Frame sizes R7/R8: pallet truck and hoist
- For installations involving frame size R6...R8: The appropriate crimping tool for power cable lugs.

- Mounting hardware: screws or nuts and bolts, four each. The type of hardware depends on the mounting surface and the frame size:

Frame Size	Mounting Hardware		Note
R1...R4	M5	#10	
R5	M6	1/4 in	
R6	M8	5/16 in	
R7...R8	M10	7/16	Secures free standing cabinets if required.

- For installations involving frame size R7...R8: Hoist.



WARNING! Before installing the ACH550, ensure the input power supply to the drive is off.



WARNING! Metal shavings or debris in the enclosure can damage electrical equipment and create a hazardous condition. Where parts, such as conduit plates require cutting or drilling, first remove the part. If that is not practical, cover nearby electrical components to protect them from all shavings or debris.

Flange Mounting Instructions

Frame size	IP21 / UL type 1		IP54 / UL type 12	
	Kit	Code (English)	Kit	Code (English)
R1	FMK-A-R1	100000982	FMK-B-R1	100000990
R2	FMK-A-R2	100000984	FMK-B-R2	100000992
R3	FMK-A-R3	100000986	FMK-B-R3	100000994
R4	FMK-A-R4	100000988	FMK-B-R4	100000996
R5	AC8-FLNGMT-R5	ACS800-PNTG01U-EN	-	-
R6	AC8-FLNGMT-R6		-	-

2. Prepare the mounting location

1. Mark the position of the mounting holes.

Note: Frame sizes R3 and R4 have four holes along the top. Use only two. If possible, use the two outside holes (to allow room to remove the fan for maintenance).

Note: ACH400 drives can be replaced using the original mounting holes. For R1 and R2 frame sizes, the mounting holes are identical. For R3 and R4 frame sizes, the inside mounting holes on the top of ACH550 drives match ACH400 mounts.

Note: Frame sizes R7 and R8 have mounting holes inside the enclosure base.

Where it is not possible to use either mounting hole at the back of the base, use an L-bracket at the top of the enclosure to secure the cabinet to a wall or to the back of another enclosure. Bolt the L-bracket to the enclosure using the lifting lug bolt hole on the top of the enclosure.

2. Drill holes of appropriate size in the mounting location.

3. Remove front cover

R1...R6, UL type 1

1. Remove the control panel, if attached.
2. Loosen the captive screw at the top.
3. Pull near the top to remove the cover.

R1...R6, UL type 12

1. If hood is present: Remove screws (2) holding the hood in place.
2. If hood is present: Slide hood up and off of the cover.
3. Loosen the captive screws around the edge of the cover.
4. Remove the cover.

R7...R8, Cabinet Door

1. To open the cabinet door, loosen the quarter-turn screws that hold the cabinet door closed.

R7...R8, Side Panels

The side panels were removed to take the cabinet off the pallet. Installation access is easier if these panels are kept off throughout the installation.

4. Mount the drive

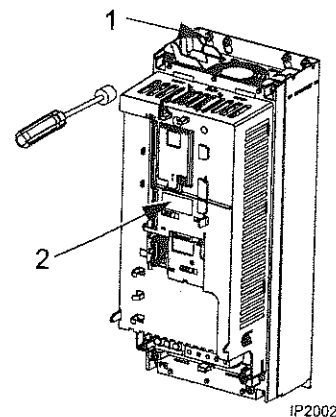
R1...R6, UL type 1

1. Position the ACH550 onto the mounting screws or bolts and securely tighten in all four corners.

Note: Use mounting hardware that permits fan replacement without removal.

Note: Lift the ACH550 by its metal chassis.

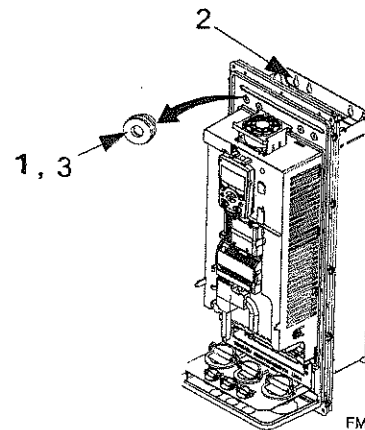
2. Non-English speaking locations: Add a warning sticker in the appropriate language over the existing warning on the top of the module.



R1...R6, UL type 12

For the UL type 12 enclosures, rubber plugs are **required** in the holes provided for access to the drive mounting slots.

1. As required for access, remove the rubber plugs. Push plugs out from the back of the drive.
2. R5 & R6: Align the sheet metal hood (not shown) in front of the drive's top mounting holes. (Attach as part of next step.)
3. Position the ACH550 onto the mounting screws or bolts and securely tighten in all four corners.



Note: Lift the ACH550 by its metal chassis (frame size R6 by the lifting holes on both sides at the top).

4. Re-install the rubber plugs.
5. Non-English speaking locations: Add a warning sticker in the appropriate language over the existing warning on the top of the module.

R7...R8

1. Use a hoist to move the cabinet into position.

Note: If the cabinet location does not provide access to the cabinet sides, be sure to re-mount side panels before positioning cabinet.

2. Install and tighten mounting bolts.

5. Install wiring

WARNING! Ensure the motor is compatible for use with the ACH550. The ACH550 must be installed by a competent person. If in doubt, contact your local ABB sales or service office.

Conduit kit

Wiring R1...R6 drives with the UL type 1 Enclosure requires a conduit kit with the following items:

- conduit box
- screws
- cover

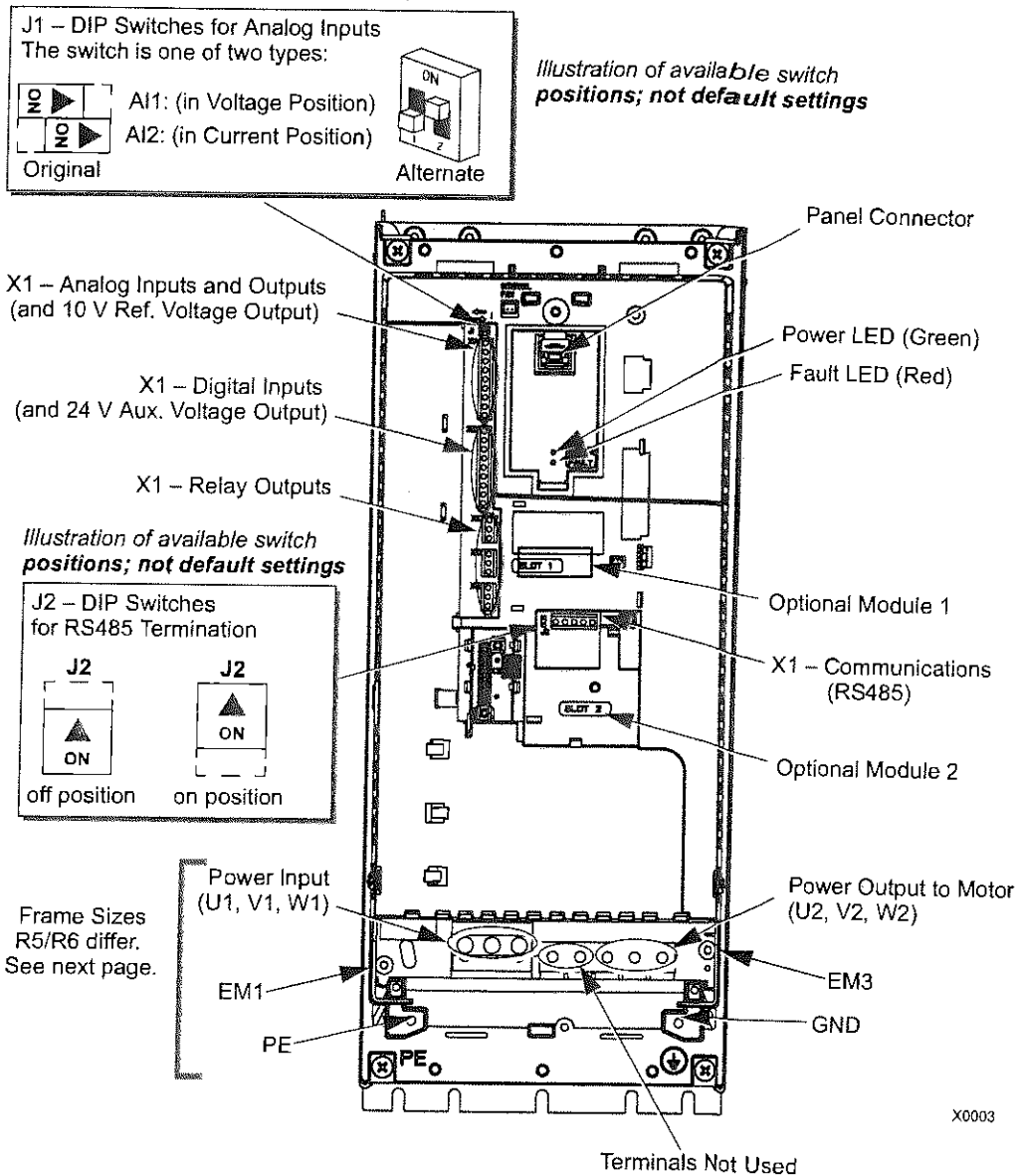
The kit is included with UL type 1 Enclosures.

Connection diagrams

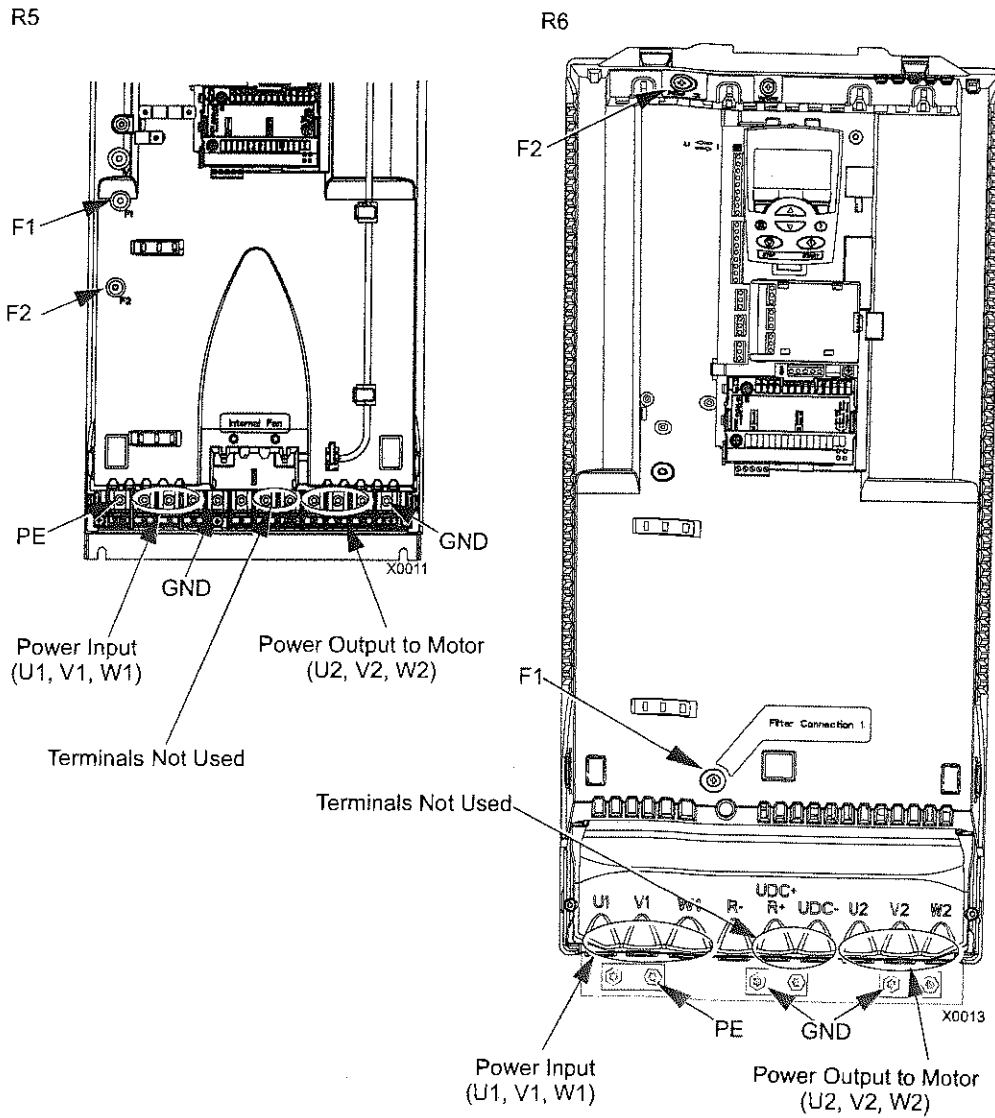
The following diagrams show:

- The terminal layout for frame size R3, which, in general, applies to frame sizes R1...R6, except for the R5/R6 power and ground terminals.
- The R5/R6 power and ground terminals.
- The terminal layout for R7/R8.

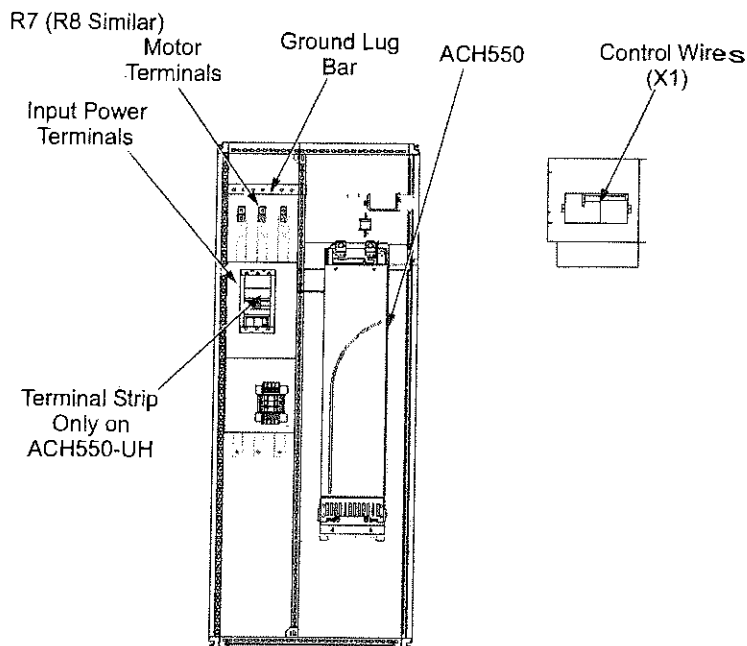
R1...R4 (Diagram shows the R3 frame.)



WARNING! To avoid danger, or damage to the drive, on IT systems and corner grounded TN systems, see section *Disconnecting the internal EMC filter* on page 10.



WARNING! To avoid danger, or damage to the drive, on IT systems and corner grounded TN systems, see section *Disconnecting the internal EMC filter* on page 10.



Disconnecting the internal EMC filter

On certain types of systems, you must disconnect the internal EMC filter, otherwise the system will be connected to ground potential through the EMC filter capacitors, which might cause danger, or damage the drive.

Note: When the internal EMC filter is disconnected, the drive is not EMC compatible.

The following table shows the installation rules for the EMC filter screws in order to connect or disconnect the filter, depending on the system type and the frame size. For more information on the different system types, see *Floating networks* on page 12 and *Unsymmetrically grounded networks* on page 11.

The locations of screws EM1 and EM3 are shown in the diagram on page 8. The locations of screws F1 and F2 are shown in the diagram on page 9.

Frame sizes	Screw	Symmetrically grounded TN systems (TN-S systems)	Corner grounded TN systems	IT systems (ungrounded or high-resistance-grounded [$> 30 \text{ ohm}$])
R1...R3	EM1	x	x	•
	EM3	x	•	•
R4	EM1	x	x	—
	EM3	x	—	—
R5...R6	F1	x	x	—
	F2	x	x	—

x = Install the screw. (EMC filter will be connected.)
 • = Replace the screw with the provided polyamide screw. (EMC filter will be disconnected.)
 — = Remove the screw. (EMC filter will be disconnected.)
 EM1 and EM3 screws are M4 x 12
 F1 and F2 screws are M4 x 16

Ground connections

For personnel safety, proper operation and to reduce electromagnetic emission/pick-up, the drive and the motor must be grounded at the installation site.

- Conductors must be adequately sized as required by safety regulations.
- Power cable shields must be connected to the drive PE terminal in order to meet safety regulations.
- Power cable shields are suitable for use as equipment grounding conductors only when the shield conductors are adequately sized as required by safety regulations.
- In multiple drive installations, do not connect drive terminals in series.

Unsymmetrically grounded networks



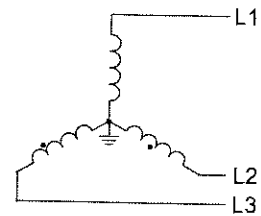
WARNING! Do not attempt to install or remove EM1 or EM3 screws while power is applied to the drive's input terminals.

Unsymmetrically grounded networks are defined in the following table. In such networks, the internal connection provided by the EM3 screw (on frame sizes R1...R4 only) must be disconnected by removing EM3. If the grounding configuration of the network is unknown, remove EM3.

Note: ACH550-UH drives are shipped with the screw removed (but included in the conduit box).

Unsymmetrically Grounded Networks – EM3 Must Be Out			
Grounded at the corner of the delta		Grounded at the mid point of a delta leg	
Single phase, grounded at an end point		Three phase "Variac" without solidly grounded neutral	

EM3 (an M4x16 screw) makes an internal ground connection that reduces electro-magnetic emission. Where EMC (electro-magnetic compatibility) is a concern, and the network is symmetrically grounded, EM3 may be installed. For reference, the diagram at right illustrates a symmetrically grounded network.



Floating networks



WARNING! Do not attempt to install or remove EM1, EM3, F1 or F2 screws while power is applied to the drive's input terminals.

For floating networks (also known as IT, ungrounded, or impedance/resistance grounded networks):

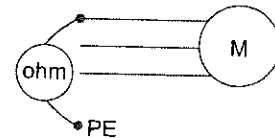
- Disconnect the ground connection to the internal RFI filters:
 - Frame sizes R1...R4: Remove the EM1 screw (unit is shipped with EM3 removed, see *Connection diagrams* on page 8).
 - Frame sizes R5...R6: Remove both the F1 and F2 screws (see page 9).
- Where EMC requirements exist, check for excessive emission propagated to neighboring low voltage networks. In some cases, the natural suppression in transformers and cables is sufficient. If in doubt, use a supply transformer with static screening between the primary and secondary windings.
- Do NOT install an external RFI/EMC filter. Using an RFI filter grounds the input power through the filter capacitors, which could be dangerous and could damage the unit.

Checking motor and motor cable insulation



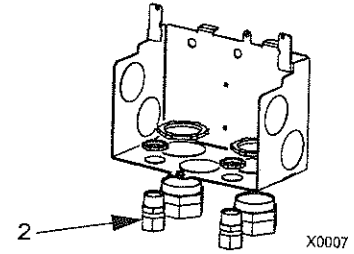
WARNING! Check the motor and motor cable insulation before connecting the drive to input power. For this test, make sure that motor cables are NOT connected to the drive.

1. Complete motor cable connections to the motor, but NOT to the drive output terminals (U2, V2, W2).
2. At the drive end of the motor cable, measure the insulation resistance between each motor cable phase and Protective Earth (PE): Apply a voltage of 1 kV DC and verify that resistance is greater than 1 Mohm.

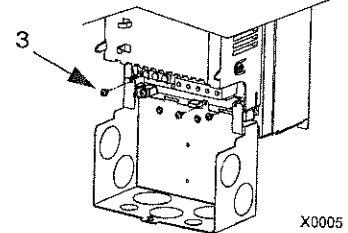


R1...R6, wiring UL type 1 enclosure

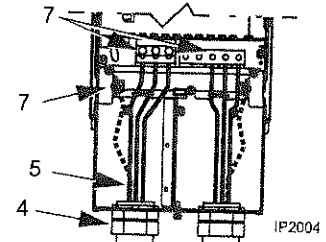
1. Open the appropriate knockouts in the conduit box. (See *Conduit kit* on page 7.)
2. Install thin-wall conduit clamps (not supplied).



3. Install conduit box.
4. Connect conduit runs for input power, motor and control cables to the box.

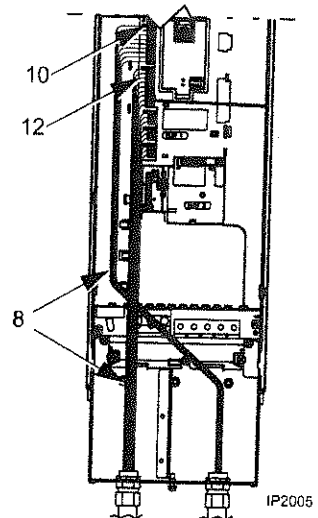


5. Route input power and motor wiring through separate conduits.
6. Strip wires.
7. Connect power, motor, and ground wires to the drive terminals.



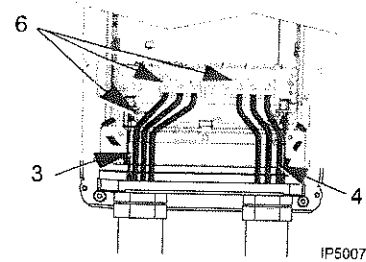
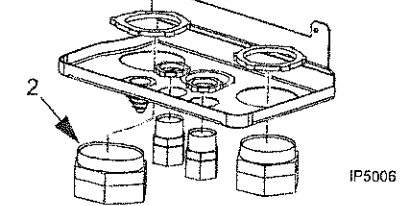
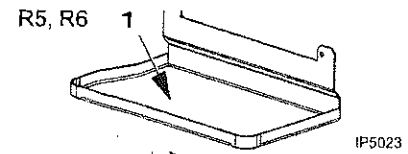
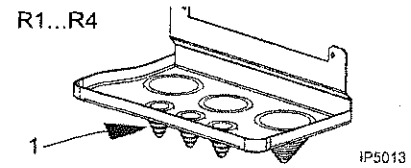
Note: For R5 frame size, the minimum power cable size is 25 mm² (4 AWG). For R6 frame size, refer to *Power terminal considerations – R6 Frame size* on page 16.

8. Route the control cables through the conduit (not the same conduit as either input power or motor wiring).
9. Use available secure points and tie strap landings to permanently secure control wiring at a minimum distance of 6 mm (1/4") from power wiring.
10. Strip the control cable sheathing and twist the copper screen into a pig-tail.
11. Connect the ground screen pig-tail for digital and analog I/O cables at X1-1. (Ground only at drive end.)
12. Connect the ground screen pig-tail for RS485 cables at X1-28 or X1-32. (Ground only at drive end.)
13. Strip and connect the individual control wires to the drive terminals.
14. Install the conduit box cover (1 screw).



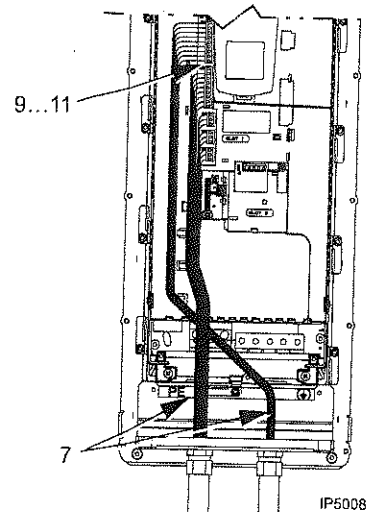
R1...R6, wiring UL type 12 enclosure

1. Step depends on Frame Size:
 - Frame Sizes R1...R4: Remove and discard the cable seals where conduit will be installed. (The cable seals are cone-shaped, rubber seals on the bottom of the drive.)
 - Frame Sizes R4 and R5: Use punch to create holes for conduit connections as needed.
2. For each conduit run (input power, motor and control wiring must be separate), install liquid tight conduit connectors (not supplied).
3. Route the power wiring through conduit.
4. Route the motor wiring through conduit (not the same conduit as input power wiring run).
5. Strip the wires.
6. Connect the power, motor, and ground wires to the drive terminals.



Note: For R5 frame size, the minimum power cable size is 25 mm² (4 AWG). For R6 frame size, refer to *Power terminal considerations – R6 Frame size* on page 16.

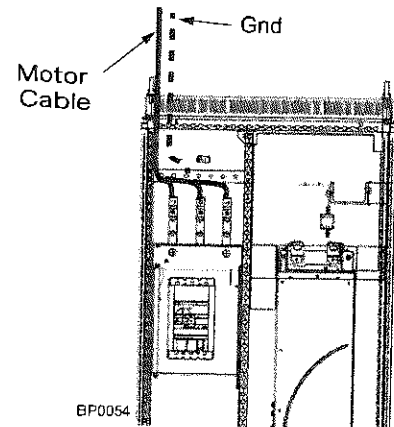
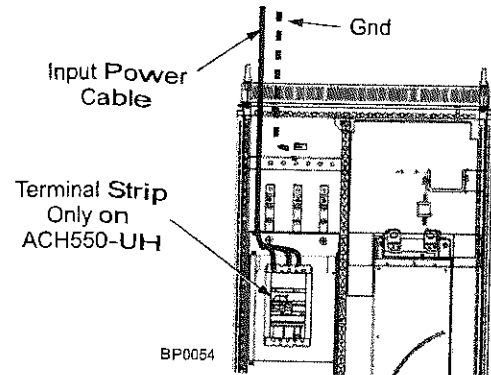
7. Route the control cables through the conduit (not the same conduit as either input power or motor wiring runs).
8. Use available secure points and tie strap landings to permanently secure control wiring at a minimum distance of 6 mm (1/4") from power wiring.
9. Strip the control cable sheathing and twist the copper screen into a pig-tail.
10. Connect the ground screen pig-tail for digital and analog I/O cables at X1-1. (Ground only at drive end.)
11. Connect the ground screen pig-tail for RS485 cables at X1-28 or X1-32. (Ground only at drive end.)
12. Strip and connect the individual control wires to the drive terminals.
13. Install the conduit box cover (1 screw).



R7...R8, wiring (both enclosure types)

The figures show connections in the R7 cabinet, the R8 cabinet is similar.

1. Remove the conduit connection plate from the top of the left bay.
2. Route the input power, motor and control cables to the top of the cabinet. Each cable type (input power, motor, and control) must be in separate conduit.
3. Use punch to create holes for conduit connections as needed.
4. UL type 12 Enclosure: For each conduit run (input power, motor and control wiring must be separate), install liquid tight conduit connectors (not supplied).
5. Connect input power and motor cables to the bus terminals.
6. Connect grounds to ground bar.
7. Use available secure points and tie strap landings to permanently secure control wiring at a minimum distance of 6 mm (1/4") from power wiring.
8. Strip the control cable sheathing and twist the copper screen into a pig-tail.
9. Connect the ground screen pig-tail for digital and analog I/O cables at X1-1. (Ground only at drive end.)
10. Connect the ground screen pig-tail for RS485 cables at X1-28 or X1-32. (Ground only at drive end.)
11. Strip and connect the individual control wires to the drive terminals.



Drive's power connection terminals

The following table provides specifications for the drive's power connection terminals.

Frame Size	U1, V1, W1 U2, V2, W2 BRK±, UDC± Terminals						Earthing PE Terminal			
	Min. Wire Size		Max. Wire Size		Torque		Max. Wire Size		Torque	
	mm ²	AWG	mm ²	AWG	Nm	lb-ft	mm ²	AWG	Nm	lb-ft
R1 ^{Note 1}	0.75	18	16	6	1.3	1	16	6	1.3	1
R2 ^{Note 1}	0.75	18	16	6	1.3	1	16	6	1.3	1
R3 ^{Note 1}	2.5	14	25	3	2.7	2	25	3	2.7	2
R4 ^{Note 1}	10	8	50	1/0	5.6	4	50	1/0	5.6	4
R5	16	6	70	2/0	15	11	70	2/0	15	11
R6	95 ^{Note 2}	3/0	185	350 MCM	40	30	185	350 MCM	40	30
R7	16	6	185	350 MCM	40	30	Attach appropriate ring lugs to ground wires and mount with, up to five 13/32 bolts.			
R8	16	6	2x240	2x500 MCM	57	42				

1. Do not use aluminum cable with frame sizes R1...R4.
2. See the following section for smaller wire sizes on frame size R6.

Power terminal considerations – R6 Frame size

WARNING! For R6 power terminals, if compression lugs are supplied, they can only be used for wire sizes that are 95 mm² (3/0 AWG) or larger. Smaller wires will loosen and may damage the drive, and require ring lugs as described below.

On the R6 frame size, if the cable size used is less than 95 mm² (3/0 AWG) or if no compression lugs are supplied, use ring lugs.

Drive's control connection terminals

The following table provides specifications for the drive's control terminals









Frame Size	Control			
	Maximum Wire Size		Torque	
	mm ²	AWG	Nm	lb-ft
All	1.5	16	0.4	0.3

Control terminal descriptions

The following full-page diagram provides a general description of the control terminals on the drive.

Note: Terminals 3, 6, and 9 are at the same potential.

Note: For safety reasons the fault relay signals a "fault" when the ACH550 is powered down.

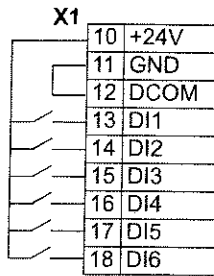
X1		Drive Control Terminal Description		
Analog I/O	1	SCR	Terminal for signal cable screen. (Connected internally to chassis ground.)	
	2	AI1	Analog input channel 1, programmable. Default ² = external reference. Resolution 0.1%, accuracy ±1%. J1:AI1 OFF: 0(2)...10 V (R _i = 312 kΩ)  — or, for OFF  for ON 	
			J1:AI1 ON: 0(4)...20 mA (R _i = 100 Ω) 	
	3	AGND	Analog input circuit common (connected internally to chassis gnd. through 1 MΩ).	
	4	+10 V	Potentiometer reference source: 10 V ±2%, max. 10 mA (1kΩ ≤ R ≤ 10kΩ).	
	5	AI2	Analog input channel 2, programmable. Default ² = PID feedback. Resolution 0.1%, accuracy ±1%. J1:AI2 OFF: 0(2)...10 V (R _i = 312 kΩ)  — or, for OFF  for ON 	
			J1:AI2 ON: 0(4)...20 mA (R _i = 100 Ω) 	
	6	AGND	Analog input circuit common (connected internally to chassis gnd. through 1 MΩ).	
7	AO1	Analog output, programmable. Default ² = frequency. 0...20 mA (load < 500 Ω). Accuracy ±3% full scale.		
8	AO2	Analog output, programmable. Default ² = current. 0...20 mA (load < 500 Ω). Accuracy ±3% full scale.		
9	AGND	Analog output circuit common (connected internally to chassis gnd. through 1 MΩ).		
Digital Inputs ¹	10	+24V	Auxiliary voltage output 24 VDC / 250 mA (reference to GND), short circuit protected.	
	11	GND	Auxiliary voltage output common (connected internally as floating).	
	12	DCOM	Digital input common. To activate a digital input, there must be ≥+10 V (or ≤-10 V) between that input and DCOM. The 24 V may be provided by the ACH550 (X1-10) or by an external 12...24 V source of either polarity.	
	13	DI1	Digital input 1, programmable. Default ² = start/stop.	
	14	DI2	Digital input 2, programmable. Default ² = not configured.	
	15	DI3	Digital input 3, programmable. Default ² = constant (preset) speed.	
	16	DI4	Digital input 4, programmable. Default ² = safety interlock.	
	17	DI5	Digital input 5, programmable. Default ² = not configured.	
Relay Outputs	19	RO1C	Relay output 1, programmable. Default ² = Ready Maximum: 250 VAC / 30 VDC, 2 A Minimum: 500 mW (12 V, 10 mA)	
		20		RO1A
		21		RO1B
	22	RO2C	Relay output 2, programmable. Default ² = Running Maximum: 250 VAC / 30 VDC, 2 A Minimum: 500 mW (12 V, 10 mA)	
		23		RO2A
		24		RO2B
	25	RO3C	Relay output 3, programmable. Default ² = Fault (-1) Maximum: 250 VAC / 30 VDC, 2 A Minimum: 500 mW (12 V, 10 mA)	
		26		RO3A
		27		RO3B

1 Digital input impedance 1.5 kΩ. Maximum voltage for digital inputs is 30 V.

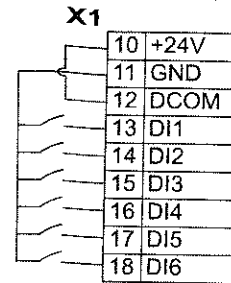
2 Default values depend on the macro used. Values specified are for the HVAC default macro.

You can wire the digital input terminals in either a PNP or NPN configuration.

PNP connection (source)



NPN connection (sink)



Serial communications

Terminals 28...32 provide RS485 serial communication connections used to control or monitor the drive from a fieldbus controller.

6. Check installation

Before applying power, perform the following checks.

✓	Check
	Installation environment conforms to the drive's specifications for ambient conditions.
	The drive is mounted securely.
	Space around the drive meets the drive's specifications for cooling.
	The motor and driven equipment are ready for start.
	For floating networks (R1...R6): The internal RFI filter is disconnected (screws EM1 & EM3 or F1 & F2).
	The drive is properly grounded.
	The input power voltage matches the drive nominal input voltage range.
	The input power connections at U1, V1, and W1 are connected and tightened as specified.
	The input power branch circuit protection is installed.
	The motor connections at U2, V2, and W2 are connected and tightened as specified.
	The input power, motor and control wiring are routed through separate conduit runs.
	NO power factor compensation capacitors are in the motor cable.
	The control connections are connected and tightened as specified.
	NO tools or foreign objects (such as drill shavings) are inside the drive.
	NO alternate power source for the motor (such as a bypass connection) is connected – no voltage is applied to the output of the drive.

7. Re-install cover

8. Apply power

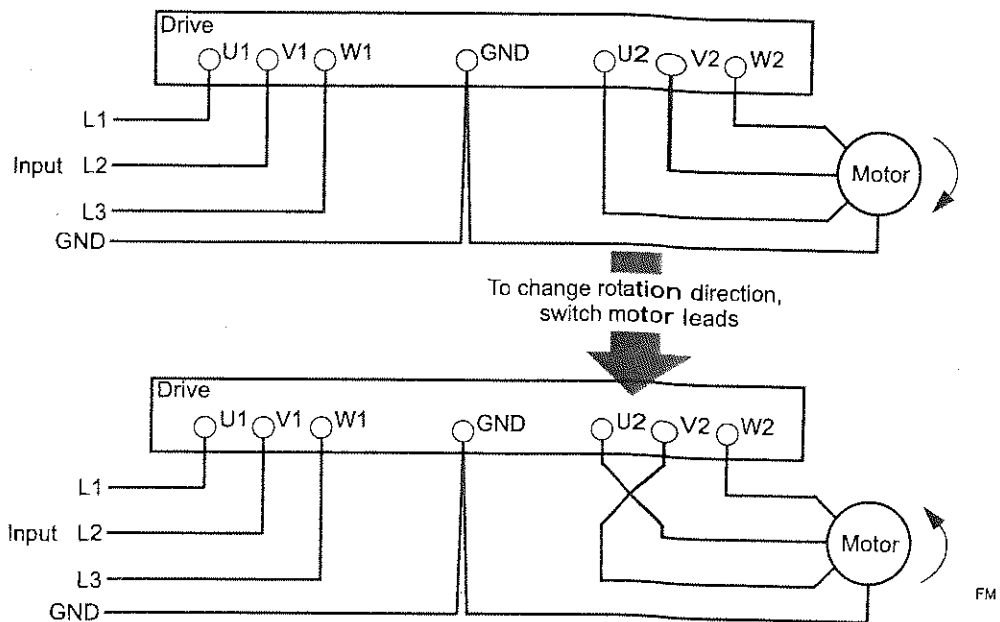
Always re-install the covers before turning power on.



WARNING! The ACH550 will start up automatically at power up, if the external run command is on.

Apply input power. When power is applied to the ACH550, the green LED comes on.

Note: Before increasing motor speed, check that the motor is running in the desired direction. To change rotation direction, switch motor leads as shown below.



9. Before Start-up

The ACH550 has default parameter settings that are sufficient for many situations. However, review the following situations. Perform the associated procedures as appropriate.

Spin motor

When first installed and started the control panel displays a welcome screen with the following options.

- Press Exit to commission the drive as described in section *Start-up by changing the parameters individually* on page 23.
- Press Enter to move to the following options:
 - Select “Commission Drive” to commission the drive as described in section *Start-Up by Start-up by using the Start-Up Assistant* on page 23.
 - Select “Spin Motor” to operate the motor prior to commissioning. This option

operates the motor without any commissioning, except entry of the motor data as described below. Spin Motor is useful, for example, to operate ventilation fans prior to commissioning.

Note: When using Spin Motor, the motor speed is limited to the range 1/3...2/3 of maximum speed. Also, no interlocks are activated. Finally, once the drive is commissioned, the welcome screen and this option no longer appear.

Motor data

The motor data on the ratings plate may differ from the defaults in the ACH550. The drive provides more precise control and better thermal protection if you enter the rating plate data.

1. Gather the following from the motor ratings plate:
 - Voltage
 - Nominal motor current
 - Nominal frequency
 - Nominal speed
 - Nominal power
2. Edit parameters 9905...9909 to the correct values.
 - Assistant Control Panel: The Start-Up Assistant walks you through this data entry.
 - Basic Control Panel: Refer to *ACH550 User's Manual*, for parameter editing instructions.

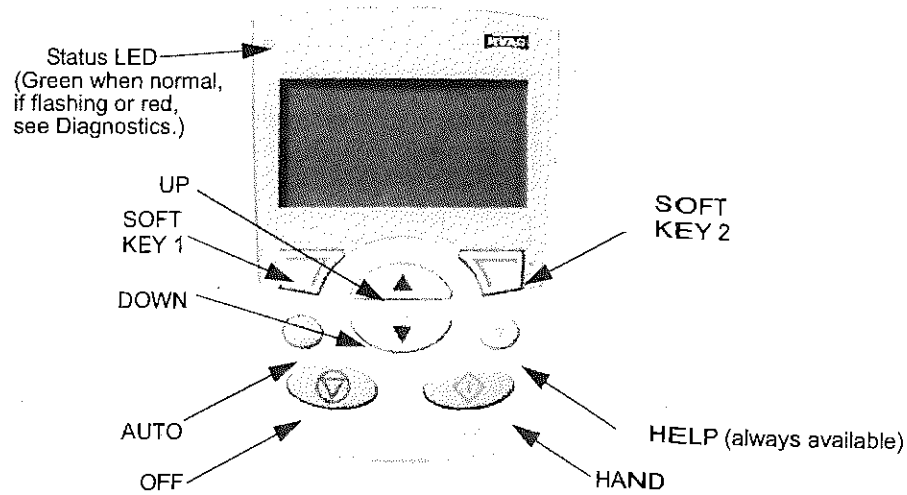
Fault and alarm adjustments

The ACH550 can detect a wide variety of potential system problems. For example, initial system operation may generate faults or alarms that indicate set-up problems.

1. Faults and alarms are reported on the control panel with a number. Note the number reported.
2. Review the description provided for the reported fault/alarm:
 - Use the fault and alarm listings on pages 24 and 29 respectively, or
 - Press the help key (Assistant Control Panel only) while fault or alarm is displayed.
3. Adjust the system or parameters as appropriate.

Operation

The ACH550 HVAC control panel (ACS-CP-B) features:






X0201

General display features

Soft key functions

The soft key functions are defined by text displayed just above each key.

Display contrast

To adjust display contrast, simultaneously press  and  or , as appropriate.



HVAC control panel modes

The HVAC control panel has several different modes for configuring, operating and diagnosing the drive. To reach the Standard Display Mode, press EXIT until the LCD display shows status information. Select MENU and use UP/DOWN buttons to select other modes. The modes are:

- **Standard Display Mode** – Shows drive status information and operates the drive.
- **Parameters Mode** – Edits parameter values individually.
- **Start-up Assistant Mode** – Guides the start-up and configuration.
- **Changed Parameters Mode** – Shows changed parameters.
- **Fault Logger Mode** – Shows the drive fault history.
- **Drive Parameter Backup Mode** – Stores or uploads the parameters.
- **Clock Set Mode** – Sets the time and date for the drive.
- **I/O Settings Mode** – Checks and edits the I/O settings.
- **Alarm Mode** – Reporting mode triggered by drive alarms.

Operating the drive

AUTO/HAND – The very first time the drive is powered up, it is in the auto control (AUTO) mode, and is controlled from the Control terminal block X1.

To switch to hand control (HAND) and control the drive using the control panel, press and hold the  or  button.

- Pressing the HAND button switches the drive to hand control while keeping the drive running.
- Pressing the OFF button switches to hand control and stops the drive.

To switch back to auto control (AUTO), press and hold the  button.

Hand/Auto/Off – To start the drive press the HAND or AUTO buttons, to stop the drive press the OFF button.










Reference – To modify the reference (only possible if the display in the upper right corner is in reverse video) press the UP or DOWN buttons (the reference changes immediately).

The reference can be modified in the local control mode (HAND/OFF), and can be parameterized (using Group 11 reference select) to also allow modification in the remote control mode.

Note: The Start/Stop, Shaft direction and Reference functions are only valid in local control (HAND/OFF) mode.

Start-up by using the Start-Up Assistant








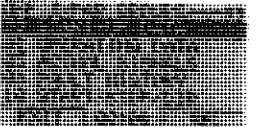




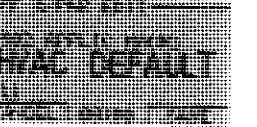





To start the Start-Up Assistant, follow these steps:

1	Select MENU to enter the main menu.		
2	Select ASSISTANTS with the Up/Down buttons and select ENTER.	 	
3	Scroll to COMMISSION DRIVE with the Up/Down buttons.		
4	Change the values suggested by the assistant to your preferences and then press SAVE after every change.		

The Start-Up Assistant will guide you through the start-up.

Start-up by changing the parameters individually

To change the parameters, follow these steps:

1	Select MENU to enter the main menu.		
2	Select the Parameters mode with the UP/DOWN buttons and select ENTER to select the Parameters mode.	 	
3	Select the appropriate parameter group with the UP/DOWN buttons and select SEL	 	
4	Select the appropriate parameter in a group with the UP/DOWN buttons. Select EDIT to change the parameter value.	 	
5	Press the UP/DOWN buttons to change the parameter value.		
6	Select SAVE to store the modified value or select CANCEL to leave the set mode. Any modifications not saved are cancelled.		
7	Select EXIT to return to the listing of parameter groups, and again to return to the main menu.	 	

Complete the control connections by manually entering the parameters.

Note: The current parameter value appears below the highlighted parameter. To view the default parameter value, press the UP/DOWN buttons simultaneously. To restore the default factory settings, select the application macro HVAC Default.

Diagnostics

Fault listing

Fault Code	Fault Name In Panel	Description and Recommended Corrective Action
1	OVERCURRENT	Output current is excessive. Check for and correct: <ul style="list-style-type: none"> Excessive motor load. Insufficient acceleration time (parameters 2202 ACCELER TIME 1 and 2205 ACCELER TIME 2). Faulty motor, motor cables or connections. Output disconnect device not interlocked. Interaction with external input filter.
2	DC OVERVOLT	Intermediate circuit DC voltage is excessive. Check for and correct: <ul style="list-style-type: none"> Static or transient overvoltages in the input power supply. Insufficient deceleration time (parameters 2203 DECELER TIME 1 and 2206 DECELER TIME 2). Verify that overvoltage controller is ON (using parameter 2005). Interaction with external input filter.
3	DEV OVERTEMP	Drive heatsink is overheated. Temperature is at or above limit. R1...R4 & R7/R8: 115 °C (239 °F) R5/R6: 125 °C (257 °F) Check for and correct: <ul style="list-style-type: none"> Fan failure. Obstructions in the air flow. Dirt or dust coating on the heat sink. Excessive ambient temperature. Excessive motor load.
4	SHORT CIRC	Fault current. Check for and correct: <ul style="list-style-type: none"> A short-circuit in the motor cable(s) or motor. Supply disturbances.
5	RESERVED	Not used.
6	DC UNDERVOLT	Intermediate circuit DC voltage is not sufficient. Check for and correct: <ul style="list-style-type: none"> Missing phase in the input power supply. Blown fuse. Undervoltage on mains.
7	AI1 LOSS	Analog input 1 loss. Analog input value is less than AI1FLT LIMIT (3021). Check for and correct: <ul style="list-style-type: none"> Source and connection for analog input. Parameter settings for AI1FLT LIMIT (3021) and 3001 AI<MIN FUNCTION.
8	AI2 LOSS	Analog input 2 loss. Analog input value is less than AI2FLT LIMIT (3022). Check for and correct: <ul style="list-style-type: none"> Source and connection for analog input. Parameter settings for AI2FLT LIMIT (3022) and 3001 AI<MIN FUNCTION.
9	MOT TEMP	Motor is too hot, based on either the drive's estimate or on temperature feedback. <ul style="list-style-type: none"> Check for overloaded motor. Adjust the parameters used for the estimate (3005...3009). Check the temperature sensors and Group 35 parameters.

Fault Code	Fault Name in Panel	Description and Recommended Corrective Action
10	PANEL LOSS	Panel communication is lost and either: <ul style="list-style-type: none"> • Drive is in local control mode (the control panel displays HAND or OFF), or • Drive is in remote control mode (AUTO) and is parameterized to accept start/stop, direction or reference from the control panel. To correct check: <ul style="list-style-type: none"> • Communication lines and connections • Parameter 3002 PANEL COMM ERROR. • Parameters in Group 10: START/STOP/DIR and Group 11: REFERENCE SELECT (if drive operation is AUTO).
11	ID RUN FAIL	The motor ID run was not completed successfully. Check for and correct: <ul style="list-style-type: none"> • Motor connections • Motor parameters 9905...9909 do not match motor nameplate.
12	MOTOR STALL	Motor or process stall. Motor is operating in the stall region. Check for and correct: <ul style="list-style-type: none"> • Excessive load. • Insufficient motor power. • Parameters 3010...3012.
14	EXTERNAL FLT 1	Digital input defined to report first external fault is active. See parameter 3003 EXTERNAL FAULT 1.
15	EXTERNAL FLT 2	Digital input defined to report second external fault is active. See parameter 3004 EXTERNAL FAULT 2.
16	EARTH FAULT	Possible ground fault detected in the motor or motor cables. The drive monitors for ground faults while the drive is running and while the drive is not running. Detection is more sensitive when the drive is not running and can produce false positives. Possible corrections: <ul style="list-style-type: none"> • Check for/correct faults in the input wiring. • Verify that motor cable does not exceed maximum specified length. • A delta grounded input power supply and motor cables with high capacitance may result in erroneous error reports during non-running tests. To disable response to fault monitoring when the drive is not running, use parameter 3023 WIRING FAULT. To disable response to all ground fault monitoring, use parameter 3017 EARTH FAULT.
17	UNDERLOAD	Motor load is lower than expected. Check for and correct: <ul style="list-style-type: none"> • Disconnected load. • Group 37: USER LOAD CURVE.
18	THERM FAIL	Internal fault. The thermistor measuring the internal temperature of the drive is open or shorted. Contact your local ABB sales representative.
19	OPEX LINK	Internal fault. A communication-related problem has been detected on the fiber optic link between the OITF and OINT boards. Contact your local ABB sales representative.
20	OPEX PWR	Internal fault. Low voltage condition detected on OINT power supply. Contact your local ABB sales representative.
21	CURR MEAS	Internal fault. Current measurement is out of range. Contact your local ABB sales representative.

Fault Code	Fault Name In Panel	Description and Recommended Corrective Action
22	SUPPLY PHASE	Ripple voltage in the DC link is too high. Check for and correct: <ul style="list-style-type: none"> • Missing mains phase. • Blown fuse. • Interaction with external input filter. Set parameter 2619 to "ON".
23	ENCODER ERR	Not used (Available only with encoder and parameter Group 50).
23	ENCODER ERR	The drive is not detecting a valid encoder signal. Check for and correct: <ul style="list-style-type: none"> • Encoder presence and proper connection (reverse wired, loose connection, or short circuit). • Voltage logic levels are outside of the specified range. • A working and properly connected Pulse Encoder Interface Module, OTAC-01. • Wrong value entered in parameter 5001 PULSE NR. A wrong value will only be detected if the error is such that the calculated slip is greater than 4 times the rated slip of the motor. • Encoder is not being used, but parameter 5002 ENCODER ENABLE = 1 (ENABLED).
24	OVERSPEED	Motor speed is greater than 120% of the larger (in magnitude) of 2001 MINIMUM SPEED or 2002 MAXIMUM SPEED. Check for and correct: <ul style="list-style-type: none"> • Parameter settings for 2001 and 2002. • Adequacy of motor braking torque. • Applicability of torque control. • Brake chopper and resistor.
25	RESERVED	Not used as of the publication of this manual.
26	DRIVE ID	Internal fault. Configuration Block Drive ID is not valid. Contact your local ABB sales representative.
27	CONFIG FILE	Internal configuration file has an error. Contact your local ABB sales representative.
28	SERIAL 1 ERR	Fieldbus communication has timed out. Check for and correct: <ul style="list-style-type: none"> • Fault setup (3018 COMM FAULT FUNC and 3019 COMM FAULT TIME). • Communication settings (Group 51 or 53 as appropriate). • Poor connections and/or noise on line.
29	EFB CONFIG FILE	Error in reading the configuration file for the embedded fieldbus.
30	FORCE TRIP	Fault trip forced by the fieldbus. See the fieldbus User's Manual.
31	EFB 1	Fault code reserved for the embedded fieldbus (EFB) protocol application. These codes are not used as of the publication of this manual.
32	EFB 2	
33	EFB 3	
34	MOTOR PHASE	
		Fault in the motor circuit. One of the motor phases is lost. Check for and correct: <ul style="list-style-type: none"> • Motor fault. • Motor cable fault. • Thermal relay fault (if used). • Internal fault.

Fault Code	Fault Name In Panel	Description and Recommended Corrective Action
35	OUTPUT WIRING	Possible power wiring error detected. When the drive is not running it monitors for an improper connection between the drive input power and the drive output. Check for and correct: <ul style="list-style-type: none"> • Proper input wiring – line voltage is NOT connected to drive output. • The fault can be erroneously declared if the input power is a delta grounded system and motor cable capacitance is large. This fault can be disabled using parameter 3023 WIRING FAULT.
36	INCOMP SWTYPE	The drive cannot use the software. <ul style="list-style-type: none"> • Internal Fault. • The loaded software is not compatible with the drive. • Call support representative.
37	CB OVERTEMP	Drive control board is overheated. Check for and correct: <ul style="list-style-type: none"> • Excessive ambient temperatures • Fan failure. • Obstructions in the air flow.
38	USER LOAD CURVE	Condition defined by parameter 3701 USER LOAD C MODE has been valid longer than the time defined by 3703 USER LOAD C TIME.
101	SERF CORRUPT	Error internal to the drive. Contact your local ABB sales representative and report the error number.
102	RESERVED	
103	SERF MACRO	
104	RESERVED	
105	RESERVED	
201	DSP T1 OVERLOAD	Error in the system. Contact your local ABB sales representative and report the error number.
202	DSP T2 OVERLOAD	
203	DSP T3 OVERLOAD	
204	DSP STACK ERROR	
205	RESERVED (obsolete)	
206	OMIO ID ERROR	
207	EFB LOAD ERR	
1000	PAR HZRPM LIMITS	Parameter values are inconsistent. Check for any of the following: <ul style="list-style-type: none"> • 2001 MINIMUM SPEED > 2002 MAXIMUM SPEED. • 2007 MINIMUM FREQ > 2008 MAXIMUM FREQ. • 2001 MINIMUM SPEED / 9908 MOTOR NOM SPEED is outside proper range (> 50) • 2002 MAXIMUM SPEED / 9908 MOTOR NOM SPEED is outside proper range (> 50) • 2007 MINIMUM FREQ / 9907 MOTOR NOM FREQ is outside proper range (> 50) • 2008 MAXIMUM FREQ / 9907 MOTOR NOM FREQ is outside proper range (> 50)
1001	PAR PFAREFNG	Parameter values are inconsistent. Check for the following: <ul style="list-style-type: none"> • 2007 MINIMUM FREQ is negative, when 8123 PFA ENABLE is active.

Fault Code	Fault Name In Panel	Description and Recommended Corrective Action
1002	RESERVED (Obsolete)	
1003	PAR AI SCALE	Parameter values are inconsistent. Check for any of the following: <ul style="list-style-type: none"> • 1301 AI 1 MIN > 1302 AI 1 MAX. • 1304 AI 2 MIN > 1305 AI 2 MAX.
1004	PAR AO SCALE	Parameter values are inconsistent. Check for any of the following: <ul style="list-style-type: none"> • 1504 AO 1 MIN > 1505 AO 1 MAX. • 1510 AO 2 MIN > 1511 AO 2 MAX.
1005	PAR PCU 2	Parameter values for power control are inconsistent: Improper motor nominal kVA or motor nominal power. Check for the following: <ul style="list-style-type: none"> • $1.1 \leq (9906 \text{ MOTOR NOM CURR} * 9905 \text{ MOTOR NOM VOLT} * 1.73 / P_N) \leq 3.0$ • Where: $P_N = 1000 * 9909 \text{ MOTOR NOM POWER}$ (if units are kW) or $P_N = 746 * 9909 \text{ MOTOR NOM POWER}$ (if units are HP, e.g. in US)
1006	EXT ROMISSING	Parameter values are inconsistent. Check for the following: <ul style="list-style-type: none"> • Extension relay module not connected and • 1410...1412 RELAY OUTPUTS 4...6 have non-zero values.
1007	PAR FBUSMISSING	Parameter values are inconsistent. Check for and correct: <ul style="list-style-type: none"> • A parameter is set for fieldbus control (e.g. 1001 EXT1 COMMANDS = 10 (COMM)), but 9802 COMM PROT SEL = 0.
1008	PAR PFAWOSCALAR	Parameter values are inconsistent – 9904 MOTOR CTRL MODE must be = 3 (SCALAR: SPEED), when 8123 PFA ENABLE is activated.
1009	PAR PCU1	Parameter values for power control are inconsistent: Improper motor nominal frequency or speed. Check for both of the following: <ul style="list-style-type: none"> • $1 \leq (60 * 9907 \text{ MOTOR NOM FREQ} / 9908 \text{ MOTOR NOM SPEED}) \leq 16$ • $0.8 \leq 9908 \text{ MOTOR NOM SPEED} / (120 * 9907 \text{ MOTOR NOM FREQ} / \text{Motor Poles}) \leq 0.992$
1010	PAR PFA OVERRIDE	Both the override mode and PFA are activated at the same time. These modes are mutually incompatible, because PFA interlocks cannot be observed in the override mode.
1011	PAR OVERRIDE PARS	Override is enabled, but parameters are incompatible. Verify that 1701 is not zero, and (depending on 9904 value) 1702 or 1703 is not zero.
1012	PAR PFA IO 1	IO configuration is not complete – not enough relays are parameterized to PFA. Or, a conflict exists between Group 14, parameter 8117, NR OF AUX MOT, and parameter 8118, AUTOCHNG INTERV.
1013	PAR PFA IO 2	IO configuration is not complete – the actual number of PFA motors (parameter 8127, MOTORS) does not match the PFA motors in Group 14 and parameter 8118 AUTOCHNG INTERV.
1014	PAR PFA IO 3	IO configuration is not complete – the drive is unable to allocate a digital input (interlock) for each PFA motor (parameters 8120 INTERLOCKS and 8127 MOTORS).

Fault history

For reference, the last three fault codes are stored into parameters 0401, 0412, 0413. For the most recent fault (identified by parameter 0401), the drive stores additional data (in parameters 0402...0411) to aid in troubleshooting a problem. For example, parameter 0404 stores the motor speed at the time of the fault.

To clear the fault history (all of the Group 04, Fault History parameters):

1. Using the control panel in Parameters mode, select parameter 0401.
2. Press EDIT.
3. Press UP and Down simultaneously.
4. Press SAVE.

Alarm listing

The following table lists the alarms by code number and describes each.

Alarm Code	Display	Description
2001	OVERCURRENT	Current limiting controller is active. Check for and correct: <ul style="list-style-type: none"> • Excessive motor load. • Insufficient acceleration time (parameters 2202 ACCELER TIME 1 and 2205 ACCELER TIME 2). • Faulty motor, motor cables or connections. • Output disconnect device not interlocked. • Interaction with external input filter.
2002	OVERVOLTAGE	Over voltage controller is active. Check for and correct: <ul style="list-style-type: none"> • Static or transient overvoltages in the input power supply. • Insufficient deceleration time (parameters 2203 DECELER TIME 1 and 2206 DECELER TIME 2). • Interaction with external input filter.
2003	UNDERVOLTAGE	Under voltage controller is active. Check for and correct: <ul style="list-style-type: none"> • Undervoltage on mains.
2004	DIR LOCK	The change in direction being attempted is not allowed. Either: <ul style="list-style-type: none"> • Do not attempt to change the direction of motor rotation, or • Change parameter 1003 DIRECTION to allow direction change (if reverse operation is safe).
2005	I/O COMM	Fieldbus communication has timed out. Check for and correct: <ul style="list-style-type: none"> • Fault setup (3018 COMM FAULT FUNC and 3019 COMM FAULT TIME). • Communication settings (Group 51 or 53 as appropriate). • Poor connections and/or noise on line.
2006	AI1 LOSS	Analog input 1 is lost, or value is less than the minimum setting. Check: <ul style="list-style-type: none"> • Input source and connections • Parameter that sets the minimum (3021) • Parameter that sets the Alarm/Fault operation (3001)
2007	AI2 LOSS	Analog input 2 is lost, or value is less than the minimum setting. Check: <ul style="list-style-type: none"> • Input source and connections • Parameter that sets the minimum (3022) • Parameter that sets the Alarm/Fault operation (3001)

Alarm Code	Display	Description
2008	PANEL LOSS	<p>Panel communication is lost and either:</p> <ul style="list-style-type: none"> • Drive is in local control mode (the control panel displays HAND or OFF), or • Drive is in remote control mode (AUTO) and is parameterized to accept start/stop, direction or reference from the control panel. <p>To correct check:</p> <ul style="list-style-type: none"> • Communication lines and connections • Parameter 3002 PANEL LOSS. • Parameters in Groups 10 START/STOP/DIR and 11: REFERENCE SELECT (if drive operation is AUTO).
2009	DEVICE OVERTEMP	<p>Drive heatsink is hot. This alarm warns that a DEVICE OVERTEMP fault may be near.</p> <p>R1...R4 & R7/R8: 100 °C (212 °F) R5/R6: 110 °C (230 °F)</p> <p>Check for and correct:</p> <ul style="list-style-type: none"> • Fan failure. • Obstructions in the air flow. • Dirt or dust coating on the heat sink. • Excessive ambient temperature. • Excessive motor load.
2010	MOT OVERTEMP	<p>Motor is hot, based on either the drive's estimate or on temperature feedback. This alarm warns that a Motor Underload fault trip may be near. Check:</p> <ul style="list-style-type: none"> • Check for overloaded motor. • Adjust the parameters used for the estimate (3005...3009). • Check the temperature sensors and Group 35 parameters.
2011	UNDERLOAD	<p>Motor load is lower than expected. This alarm warns that a Motor Underload fault trip may be near. Check:</p> <ul style="list-style-type: none"> • Motor and drive ratings match (motor is NOT undersized for the drive) • Settings Group 37: USER LOAD CURVE
2012	MOTOR STALL	<p>Motor is operating in the stall region. This alarm warns that a Motor Stall fault trip may be near.</p>
2013 (note 1)	AUTORESET	<p>This alarm warns that the drive is about to perform an automatic fault reset, which may start the motor.</p> <ul style="list-style-type: none"> • To control automatic reset, use parameter Group 31: AUTOMATIC RESET.
2014 (note 1)	AUTOCHANGE	<p>This alarm warns that the PFA autochange function is active.</p> <ul style="list-style-type: none"> • To control PFA, use parameter Group 81: PFA CONTROL
2015	PFA INTERLOCK	<p>This alarm warns that the PFA interlocks are active, which means that the drive cannot start the following:</p> <ul style="list-style-type: none"> • Any motor (when Autochange is used), • The speed regulated motor (when Autochange is not used).
2016	Reserved	
2017	OFF BUTTON	Note 1.
2018 (note 1)	PID SLEEP	<p>This alarm warns that the PID sleep function is active, which means that the motor could accelerate when the PID sleep function ends.</p> <ul style="list-style-type: none"> • To control PID sleep, use parameters 4022...4026 or 4122...4126.

Alarm Code	Display	Description
2019	ID RUN	Performing ID run.
2020	OVERRIDE	This alarm warns that the Override function is active, which may start the motor.
2021	START ENABLE 1 MISSING	This alarm warns that the Start Enable 1 signal is missing. <ul style="list-style-type: none"> To control Start Enable 1 function, use parameter 1608. To correct, check: <ul style="list-style-type: none"> Digital input configuration. Communication settings.
2022	START ENABLE 2 MISSING	This alarm warns that the Start Enable 2 signal is missing. <ul style="list-style-type: none"> To control Start Enable 2 function, use parameter 1609. To correct, check: <ul style="list-style-type: none"> Digital input configuration. Communication settings.
2023	EMERGENCY STOP	Emergency stop activated.
2024	ENCODER ERROR	The drive is not detecting a valid encoder signal. Check for and correct: <ul style="list-style-type: none"> Encoder presence and proper connection (reverse wired, loose connection, or short circuit). Voltage logic levels are outside of the specified range. A working and properly connected Pulse Encoder Interface Module, OTAC-01. Wrong value entered in parameter 5001 PULSE NR. A wrong value will only be detected if the error is such that the calculated slip is greater than 4 times the rated slip of the motor. Encoder is not being used, but parameter 5002 ENCODER ENABLE = 1 (ENABLED).
2025	FIRST START	Signals that a the drive is performing a First Start evaluation of motor characteristics. This is normal the first time the motor is run after motor parameters are entered or changed. See parameter 9910 (MOTOR ID RUN) for a description of motor models.
2026	RESERVED	Not used.
2027	USER LOAD CURVE	This alarm warns that the condition defined by parameter 3701 USER LOAD C MODE has been valid longer that half of the time difined by 3703 USER LOAD C TIME.
2028	START DELAY	Shown during the Start delay. See parameter 2113 START DELAY.

Note 1. Even when the relay output is configured to indicate alarm conditions (e.g. parameter 1401 RELAY OUTPUT 1 = 5 (ALARM) or 16 (FLT/ALARM)), this alarm is not indicated by a relay output.

Maintenance



Warning! Read *Safety* on page 2 before performing any maintenance on the equipment. Ignoring the safety instructions can cause injury or death.

Maintenance intervals

If installed in an appropriate environment, the drive requires very little maintenance. This table lists the routine maintenance intervals recommended by ABB.

Maintenance	Application	Interval	Instruction
Check/replace R7/R8 enclosure inlet air filter	R7/R8 UL type 12 enclosures	Check every 3 months. Replace as needed.	<i>Frame Sizes R7/R8 – UL type 12 enclosure inlet air filter on page 35.</i>
Check/replace R7/R8 enclosure exhaust air filter.	R7/R8 UL type 12 enclosures	Check every 6 months. Replace as needed.	<i>Frame Sizes R7/R8 – UL type 12 enclosure exhaust filters on page 37.</i>
Check and clean heatsink.	All	Depends on the dustiness of the environment (every 6...12 months)	<i>See Heatsink below.</i>
Replace drive module fan.	All	Every six years	<i>See Drive module fan replacement on page 33.</i>
Replace enclosure fan.	UL type 12 enclosures	Every three years.	<i>See Enclosure fan replacement – UL Type 12 enclosures on page 34.</i>
Change capacitor.	Frame sizes R5, R6 and R8	Every ten years	<i>See Capacitors on page 38.</i>
Replace battery in the Assistant control panel	All	Every ten years	<i>See Control panel on page 38.</i>

Heatsink

The heatsink fins accumulate dust from the cooling air. Since a dusty heatsink is less efficient at cooling the drive, overtemperature faults become more likely. In a "normal" environment (not dusty, not clean) check the heatsink annually, in a dusty environment check more often.

Clean the heatsink as follows (when necessary):

1. Remove power from drive.
2. Remove the cooling fan (see section *Drive module fan replacement* on page 33).
3. Blow clean compressed air (not humid) from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust.

Note: If there is a risk of the dust entering adjoining equipment, perform the cleaning in another room.

4. Replace the cooling fan.
5. Restore power.

Drive module fan replacement

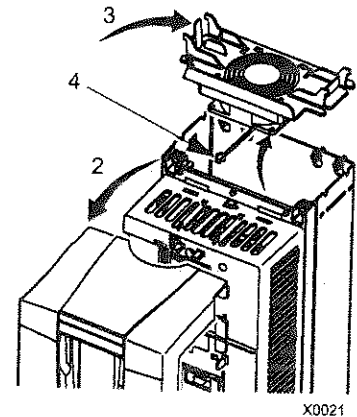
The drive module fan cools the heatsink. Fan failure can be predicted by the increasing noise from fan bearings and the gradual rise in the heatsink temperature in spite of heatsink cleaning. If the drive is operated in a critical part of a process, fan replacement is recommended once these symptoms start appearing. Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

To monitor the running time of the cooling fan, see *Group 29: MAINTENANCE TRIG* instructions.

Frame Sizes R1...R4

To replace the fan:

1. Remove power from drive.
2. Remove drive cover.
3. For Frame Size:
 - R1, R2: Press together the retaining clips on the fan cover sides, and lift.
 - R3, R4: Press in on the lever located on the left side of the fan mount, and rotate the fan up and out.
4. Disconnect the fan cable.
5. Install the fan in reverse order.
6. Restore power.

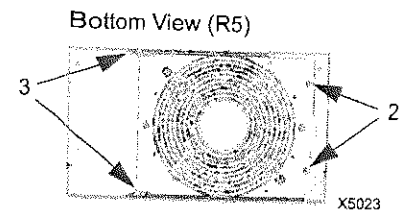


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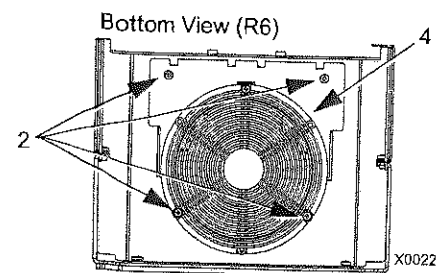
Frame Sizes R5 and R6

To replace the fan:

1. Remove power from drive.
2. Remove the screws attaching the fan.
3. Remove the fan:
 - R5: Swing the fan out on its hinges.
 - R6: Pull the fan out.
4. Disconnect the fan cable.
5. Install the fan in reverse order.
6. Restore power.



X5023



X0022

Frame Sizes R7 and R8

Refer to the installation instructions supplied with the fan kit.

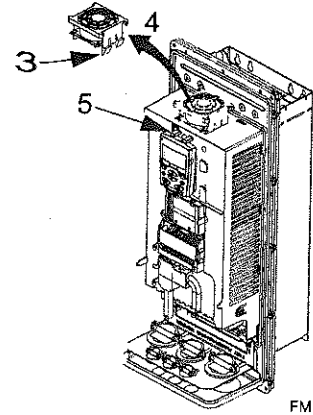
Enclosure fan replacement – UL Type 12 enclosures

UL type 12 enclosures include an additional fan (or fans) to move air through the enclosure.

Frame Sizes R1 to R4

To replace the internal enclosure fan in frame sizes R1 to R4:

1. Remove power from drive.
2. Remove the front cover.
3. The housing that holds the fan in place has barbed retaining clips at each corner. Press all four clips toward the center to release the barbs.
4. When the clips/barbs are free, pull the housing up to remove from the drive.
5. Disconnect the fan cable.
6. Install the fan in reverse order, noting that:
 - The fan air flow is up (refer to arrow on fan).
 - The fan wire harness is toward the front.
 - The notched housing barb is located in the right-rear corner.
 - The fan cable connects just forward of the fan at the top of the drive.



Frame Sizes R5 and R6

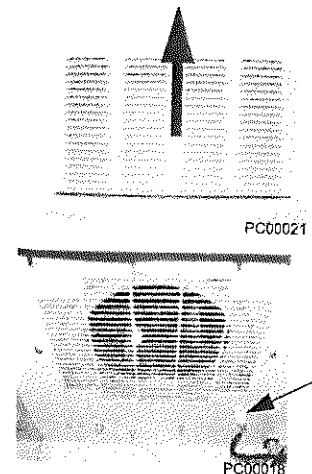
To replace the internal enclosure fan in frame sizes R5 or R6:

- Remove power from drive.
- Remove the front cover.
- Lift the fan out and disconnect the cable.
- Install the fan in reverse order.
- Restore power.

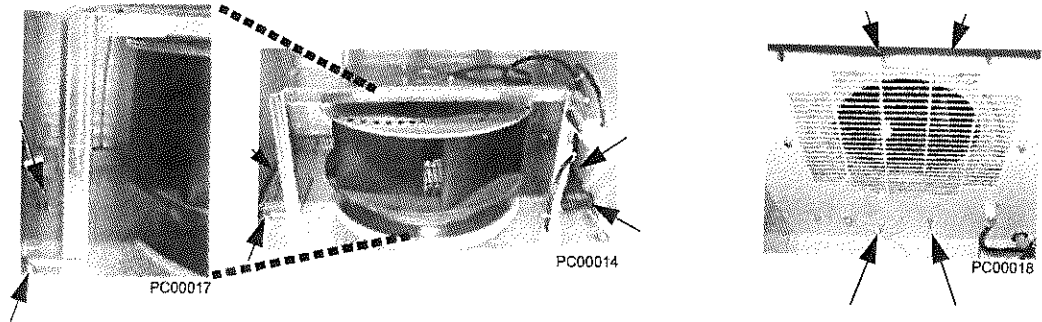
Frame Sizes R7/R8 – UL type 12 enclosures

The enclosure fan is located in the exhaust box on top of the UL type 12 enclosure.

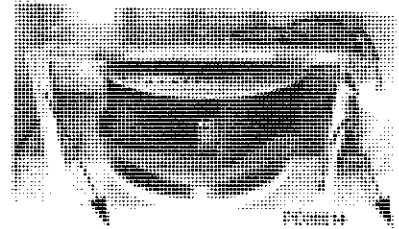
1. Remove the left and right filter frames of the exhaust fan box by lifting them upwards.
2. Disconnect the fan's electrical connector from the cabinet roof (top right inside the cabinet).



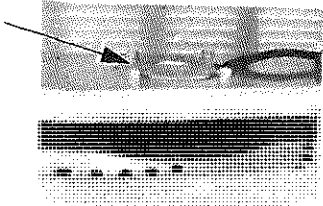
3. Undo the four fastening screws at the corners of the fan frame. The screws are through bolts with nuts on the inside of the cabinet. (Do not drop the hardware into the drive).



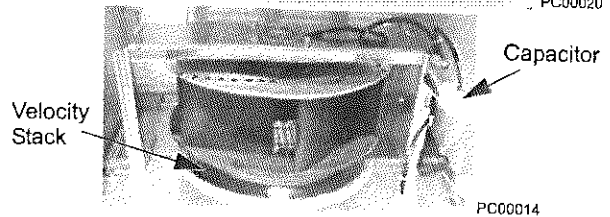
4. Remove the fan and fan frame as one unit.



5. Disconnect the fan wiring and capacitor from the fan frame. Then remove the four screws attaching the fan to the fan frame. Remove the old fan.



6. Install the new fan and capacitor with the replacement part for ABB in the reverse order of the above. Ensure the fan is centered on the velocity stack and rotates freely.



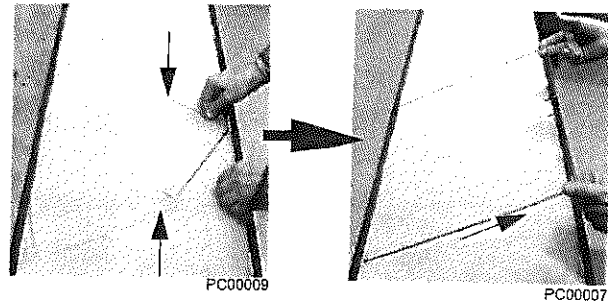
Enclosure air filter replacement – UL Type 12 enclosures

Frame Sizes R7/R8 – UL type 12 enclosure inlet air filter

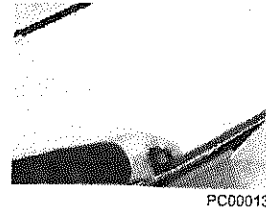
The inlet air filter for the R7/R8 UL type 12 enclosure is located in the enclosure front door.

1. While holding the top of the filter frame, pull up on the bottom of the frame. The filter frame will slide up approximately 3/4 inch and can then safely removed by tilting away from the cabinet and lifting up.

2. Lay the filter frame on a flat work surface. Remove the 3 retaining brackets by squeezing the tabbed corners in towards the middle of each bracket until the bracket clears the filter frame. Save these brackets for replacement. Remove and inspect the filter.

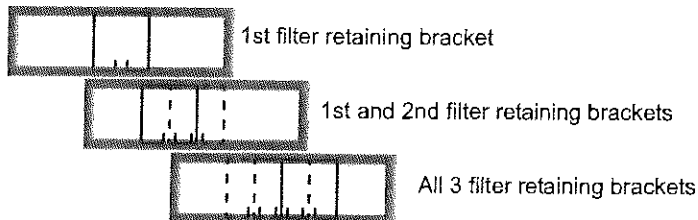
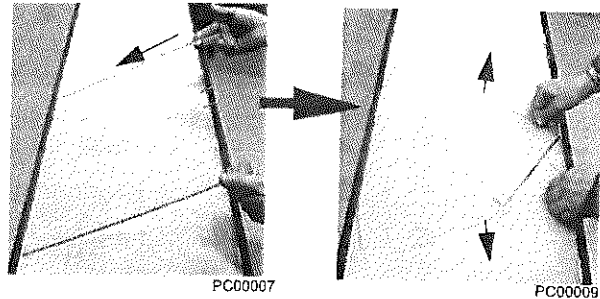


3. Install the replacement filter. Be sure to tuck the filter into the groove around the entire filter frame. This is very important for proper installation.



4. Reinstall the 3 filter restraining brackets. These will prevent the filter from being pulled out of the filter frame.

- Install the center bracket first.
- Install the 2nd bracket overlapping the center bracket by 1/2 to the left.
- Install the 3rd bracket overlapping the center bracket by 1/2 to the right.



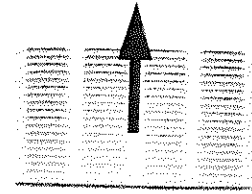
5. Install the filter frame back to the cabinet door. Carefully align the mounting hooks to the slots in the cabinet door. The hooks should be pointing down. Press in at the center of the filter frame with your knee and gently press down with your hands at the top of the frame. The filter frame will slide down approximately 3/4 inch and should be sealed securely to the door around the entire filter frame.

Frame Sizes R7/R8 – UL type 12 enclosure exhaust filters

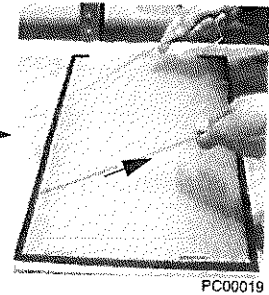
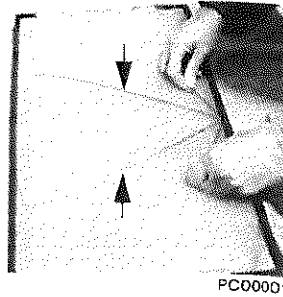
The exhaust filters in the R7/R8 UL type 12 enclosure are located in the exhaust box at the top of the enclosure.

There are 2 filter frames attached to the exhaust box.

1. Remove each filter frame:
 - Lift up on the filter frame until it slides approximately 3/4 inch.
 - Pull away from the exhaust box to remove.
2. For each filter frame, remove the wire retainers that hold the filters in place:
 - Lay the filter frames on a flat work surface.
 - The wire retainers have a square “U” shape. Remove by squeezing the open end of the “U” towards the middle of the “square” until the retainer top (open end of “U”) clears the filter frame.
 - Save the retainers for reinstallation.
3. Remove and inspect the filter.
4. Install clean filters.

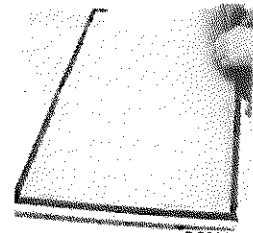


PC00021

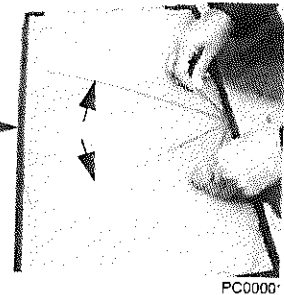
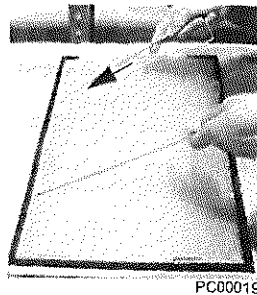


Note: When installing DUSTLOK® filter media, the white side must face to outside of the cabinet, and the orange side faces in.

Be sure to tuck the filter edges into the groove around the entire filter frame. This detail is very important for proper operation.

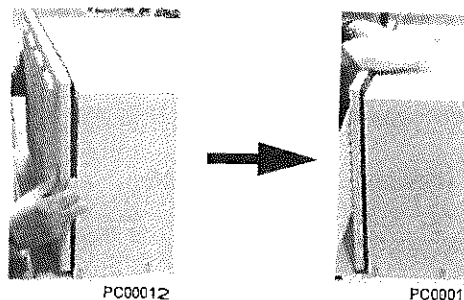


5. Reinstall the filter restrainers.
 - Insert the base of a retainer (bottom of “U” shape) into a filter frame channel.
 - Squeeze the open end of the “U” until it clears the filter frame.
 - Seat the open end of the “U” in the filter frame channel.
 - Release the retainer to its relaxed, square shape.



6. Install each filter frame to the bonnet on top of the cabinet.

- Carefully align the frame's mounting hooks with the slots in the bonnet. (The hooks should be pointing down.)
- Press down at the top of the filter frame. (The filter frame slides down approximately 3/4 inch).
- Check all around the filter frame for a secure seal to the exhaust box.



Capacitors

The drive intermediate circuit employs several electrolytic capacitors. Their life span is from 35,000...90,000 hours depending on drive loading and ambient temperature. Capacitor life can be prolonged by lowering the ambient temperature.

It is not possible to predict a capacitor failure. Capacitor failure is usually followed by a input power fuse failure or a fault trip. Contact ABB if capacitor failure is suspected. Replacements for frame size R5, R6 and R8 are available from ABB. Do not use other than ABB specified spare parts.

Control panel

Cleaning

Use a soft damp cloth to clean the control panel. Avoid harsh cleaners which could scratch the display window.

Battery

A battery is only used in Assistant control panels that have the clock function available and enabled. The battery keeps the clock operating in memory during power interruptions.

The expected life for the battery is greater than ten years. To remove the battery, use a coin to rotate the battery holder on the back of the control panel. Replace the battery with type CR2032.

Note: The battery is NOT required for any control panel or drive function, except the clock.

ACH550 E-Clipse Bypass

Installation – drive

Follow the *Installation* instructions for the drive on page 3. **Failure to observe the warnings and instructions may cause a malfunction or personal hazard.**



WARNING! Before you begin read *Safety* on page 2.

Installation – bypass



WARNING! When the ACH550 with E-Clipse Bypass is connected to the line power, the Motor Terminals T1, T2, and T3 are live even if the motor is not running. Do not make any connections when the ACH550 with E-Clipse Bypass is connected to the line. Disconnect and lock out power to the drive before servicing the drive. Failure to disconnect power may cause serious injury or death.

1. Install wiring – bypass



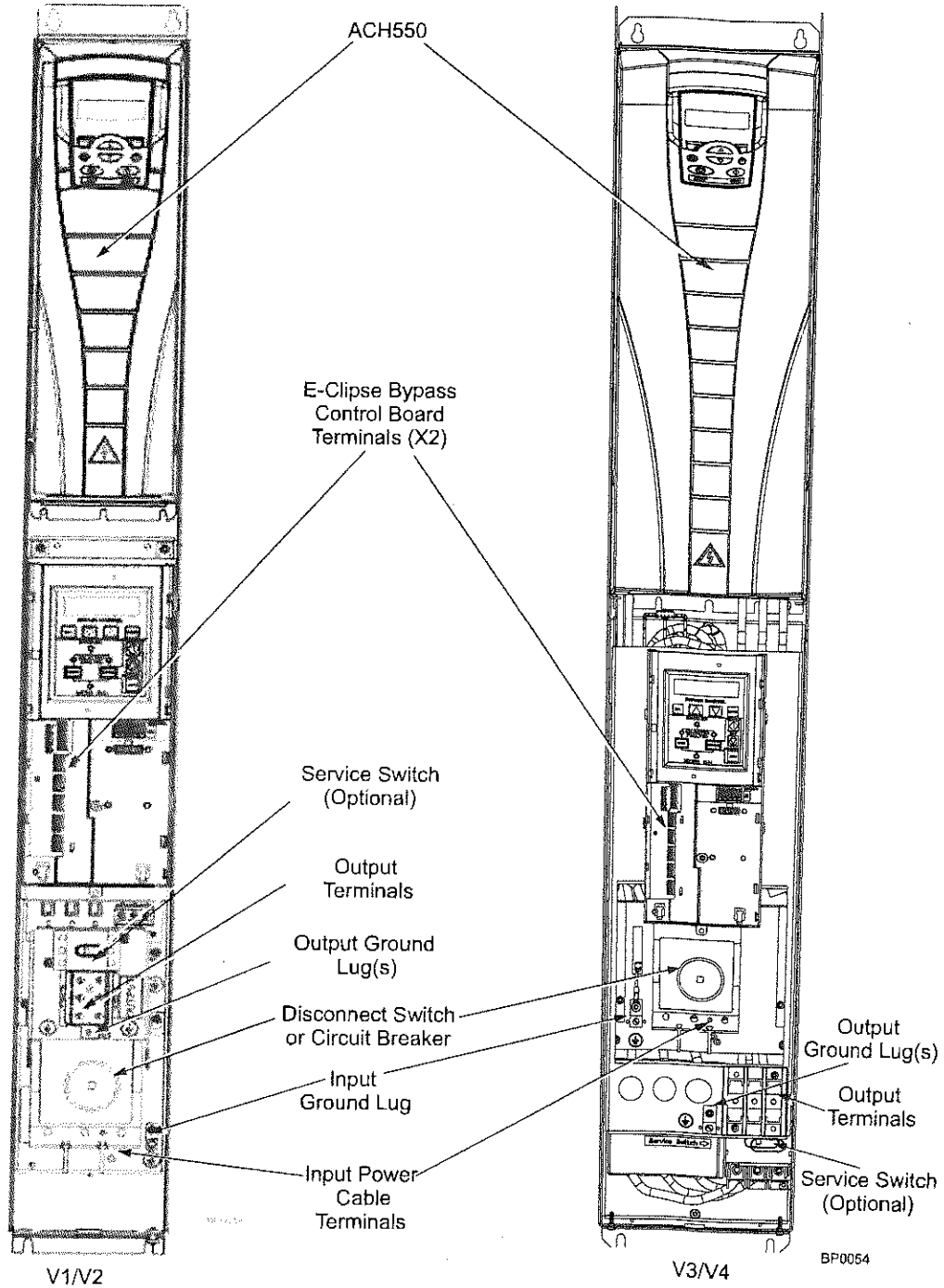
WARNING!

- Do not connect or disconnect input or output power wiring, or control wires, when power is applied.
 - Never connect line voltage to drive output Terminals T1, T2, and T3.
 - Do not make any voltage tolerance tests (Hi Pot or Megger) on any part of the unit. Disconnect motor wires before taking any measurements in the motor or motor wires.
 - Make sure that power factor correction capacitors are not connected between the drive and the motor.
-

Enclosure Designation	Horsepower Range by Voltage Rating		
	208/240V	480V	600V
V1/V2	1 to 7.5 HP	1 to 15 HP	2 to 15 HP
V3/V4	10 to 25 HP	20 to 60 HP	20 to 60 HP
B1	1 to 7.5 HP	1 to 15 HP	2 to 15 HP
B2	10 to 25 HP	20 to 60 HP	20 to 60 HP
B3	30 to 100 HP	75 to 200 HP	75 to 150 HP
B4	N/A	250 to 550 HP	N/A

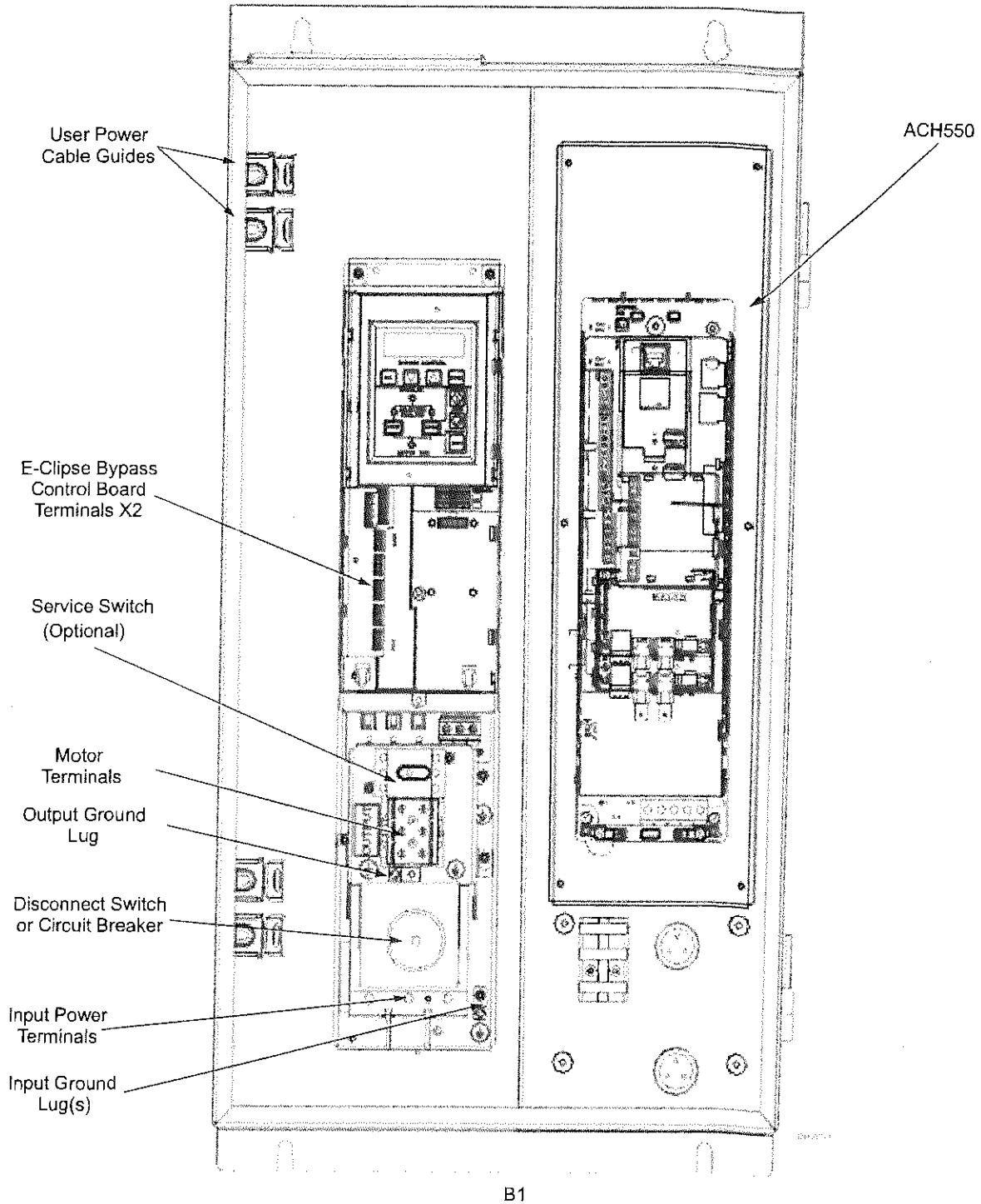
Connection diagrams – Vertical E-Clipse Bypass

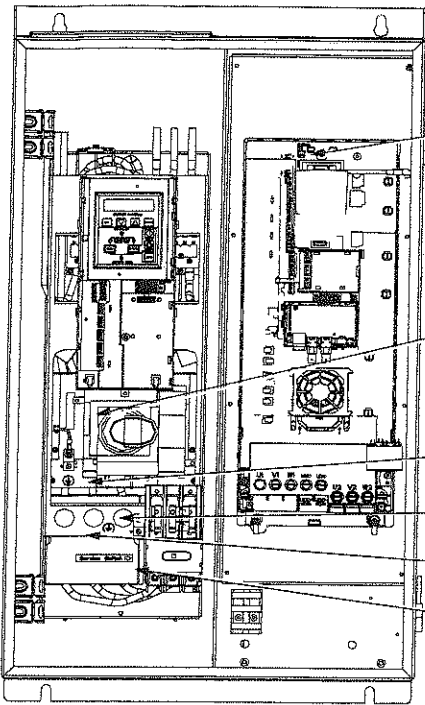
ACH550 Vertical E-Clipse Bypass units are configured for wiring access from the bottom only. The following figure shows the Vertical E-Clipse Bypass wiring connection points.



Connection diagrams – Standard E-Clipse Bypass (wall mounted)

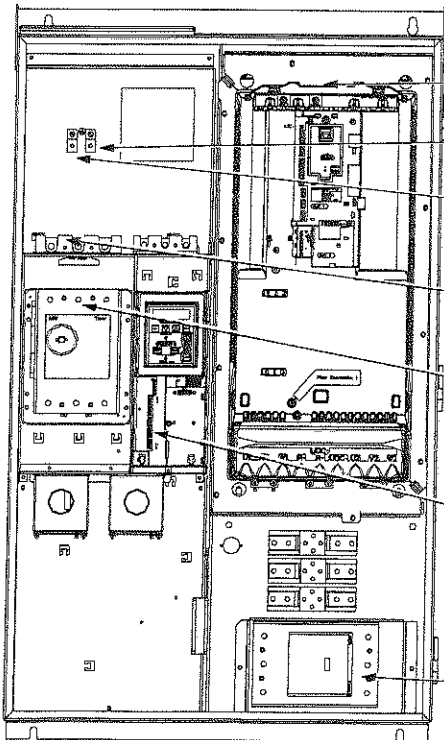
ACH550 Standard E-Clipse Bypass units are configured for wiring access from the top. The following figure shows the Standard E-Clipse Bypass (wall mounted) wiring connection points.





- User Power Cable Guides
- ACH550 Drive
- E-Clipse Bypass Control Board Terminals (X2)
- Disconnect Switch or Circuit Breaker
- Input Ground Lug
- Input Power Terminals
- Motor Terminals
- Output Ground Lug
- Service Switch (optional)

B2

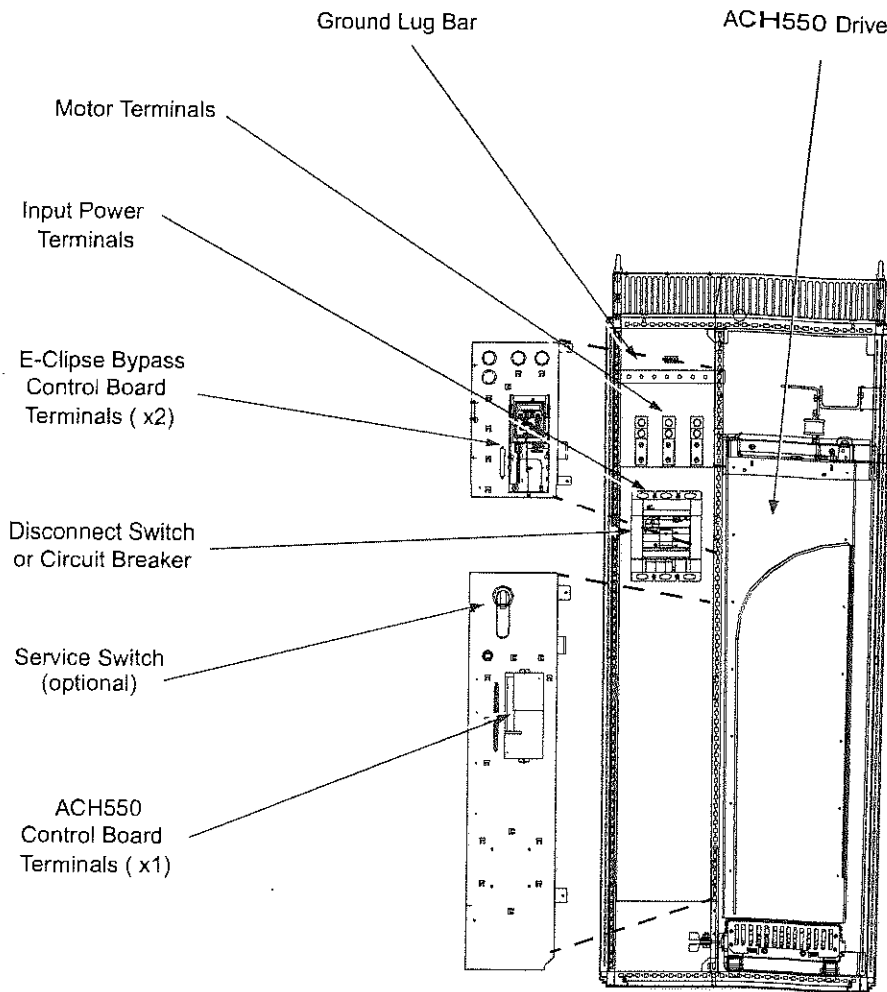


- ACH550 Drive
- Output Ground Lug
- Input Ground Lug
- Motor Terminals
- Input Power Terminals
- E-Clipse Bypass Control Board Terminals (X2)
- Service Switch (optional)

B3

Connection diagrams – Standard E-Cclipse Bypass (R8, floor mounted)

ACH550 Standard E-Cclipse Bypass units are configured for wiring access from the top. The following figure shows the Standard E-Cclipse Bypass (floor mounted) wiring connection points.



B4

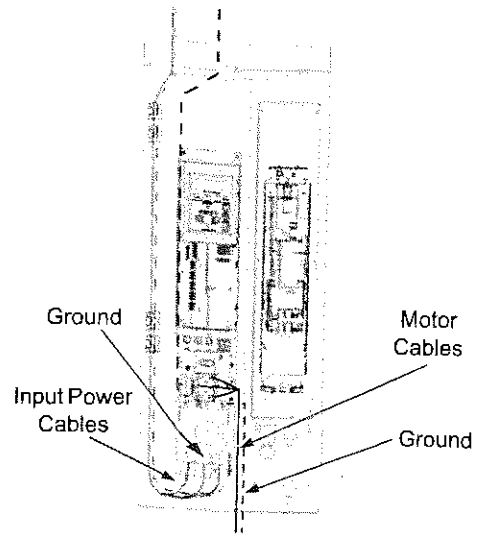
Power connections – Vertical E-Clipse Bypass configurations

Line input connections

Connect the input power to the terminals at the bottom of the disconnect switch or circuit breaker as shown below. Also see *Connection diagrams – Vertical E-Clipse Bypass* on page 40. Connect the equipment grounding conductor to the ground lug near the input power connection point.

Motor connections

Connect the motor cables to the terminals at the bottom of the bypass section as shown in the figure. Also see *Connection diagrams – Vertical E-Clipse Bypass* on page 43. Connect the motor grounding conductor to the ground lug near the motor cable terminal block connection point.



Power connections – Standard E-Clipse Bypass configurations (wall mounted)

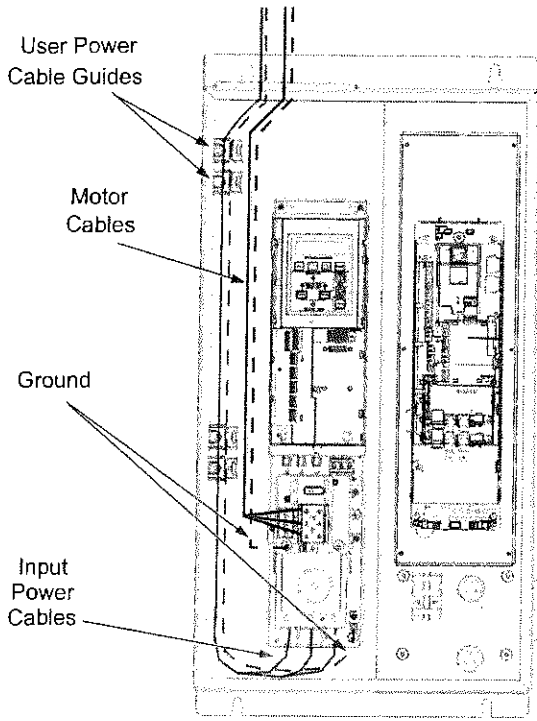
Line input connections

Connect input power to the terminals of the disconnect switch or circuit breaker. Connect the equipment grounding conductor to the ground lug at the top of the enclosure. The figure below shows the connection points for Standard E-Clipse Bypass configurations. Also see *Connection diagrams – Standard E-Clipse Bypass (wall mounted)* on page 41 and *Connection diagrams – Standard E-Clipse Bypass (R8, floor mounted)* on page 43.

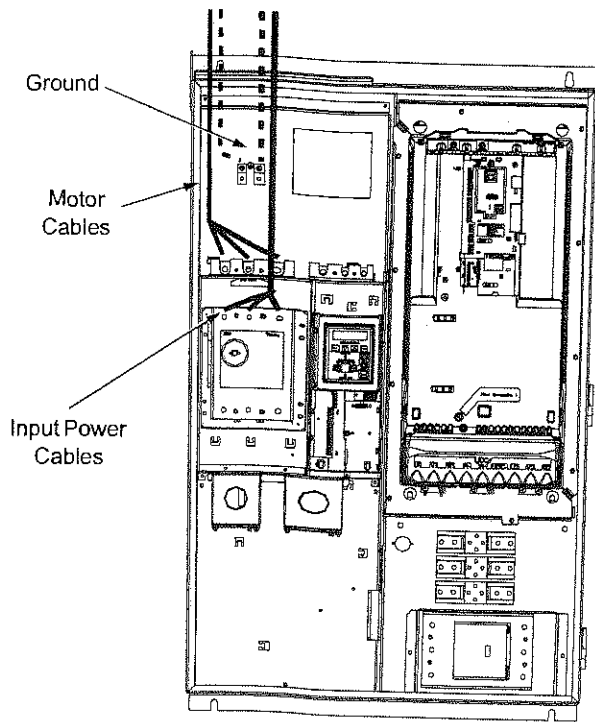
Motor connections

Connect the motor cables to the output terminal block as shown in the figure below. Also see *Connection diagrams – Standard E-Clipse Bypass (wall mounted)* on page 41 and *Connection diagrams – Standard E-Clipse Bypass (R8, floor mounted)* on page 43. The motor grounding conductor can be connected to the ground lug near the terminal block.

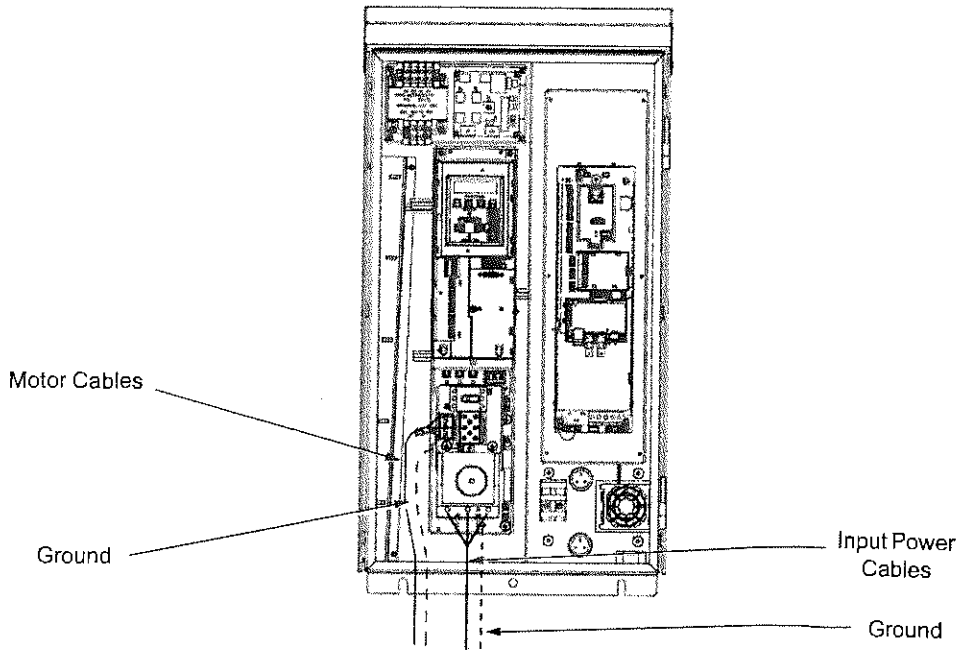
Note: Route cables through the cable guides on the left side of the enclosure. Use separate conduits for input power and motor cables. Follow the guides to separate the cables from each other.



Standard Configuration (B1/B2)



Standard Configuration (B3)



UL Type 3R Configuration (B1/B2)

Note: UL Type 3R, B1/B2 enclosures are designed to be mounted on a wall. Mounting these 3R enclosures on an open rack system requires the use of the supplied 3R enclosure back plates to maintain 3R integrity.



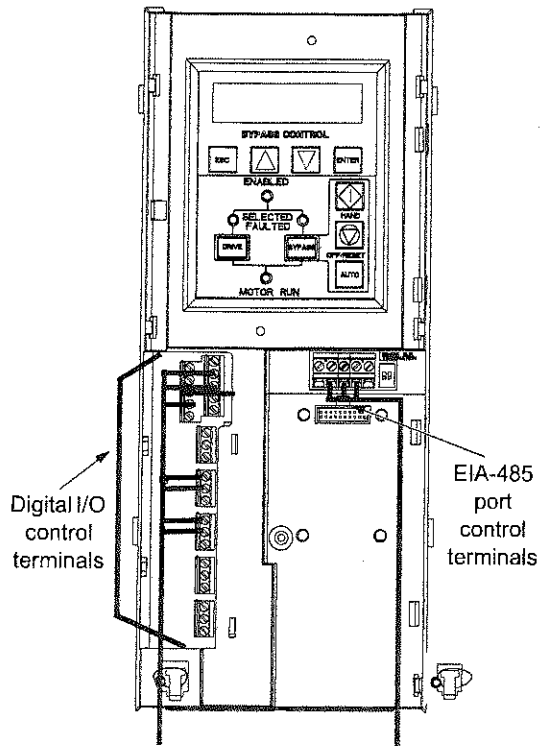
WARNING! Check the motor and motor wiring insulation before connecting the ACH550 to line power. Follow the procedure on page 12. Before proceeding with the insulation resistance measurements, check that the ACH550 is disconnected from incoming line power. Failure to disconnect line power could result in death or serious injury.

Install the control wiring

Connect control wiring to terminal block X1 on the ACH550 control board and to terminal block X2 on the E-Cclipse Bypass control board. For more information on these connections, refer to the following:

- X1 terminal block location and terminal data are defined in the *ACH550-UH User's Manual*.
- X2 terminal block location is illustrated in the figures starting with *Connection diagrams – Vertical E-Cclipse Bypass* on page 40.
- X2 terminal data are provided in *Basic control connections for E-Cclipse HVAC Default* on page 53.
- Basic connections are described in the following paragraphs. Alternate configurations using the E-Cclipse Bypass macro are described in the *ACH550 User's Manual*.
- On Terminal Block X1 inside the ACH550, analog inputs and outputs and additional digital input and relay output connections (AI1, AI2, AO1, AO2, DI1...DI6 and RO1...RO6) are available for use.

Note: The E-Cclipse Bypass control circuitry uses serial communications connections (X1:28...X1:32) inside the ACH550. These connections are not available for any other purpose and must not be reconfigured.



Basic connections

The figure on page 53 shows the basic control connections for use with the E-Clipse Bypass HVAC Default macro. These connections are described in the following paragraphs.

In typical installations, only analog input wires connect to the ACH550 terminal block, with other control connections made on the E-Clipse Bypass control board.

Use wire ties to permanently affix control/communications wiring to the hooked wire race tie points provided, maintaining a minimum 6 mm (1/4") spacing from power wiring.

Drive's power connection terminals

The following tables list power and motor cable terminal sizes for connections to an input circuit breaker or disconnect switch, a motor terminal block and ground lugs. The tables also list torque that should be applied when tightening the terminals.

Vertical enclosure terminals

HP	Identification	Frame Size	Maximum Wire Size Capacities of Power Terminals			
			Circuit Breaker	Disconnect Switch	Motor Termination	Ground Lugs
208...240 Volt						
1	ACH550-VxR-04A6-2	R1	#10 35 in-lbs	#10 7 in-lbs	#6 30 in-lbs	#4 35 in-lbs
1.5	ACH550-VxR-06A6-2	R1				
2	ACH550-VxR-07A5-2	R1				
3	ACH550-VxR-012A-2	R1				
5	ACH550-VxR-017A-2	R1	#8 40 in-lbs	#8 7 in-lbs	#2 50 in-lbs	#2 50 in-lbs
7.5	ACH550-VxR-024A-2	R2				
10	ACH550-VxR-031A-2	R2	#2 50 in-lbs	#4 18 in-lbs	#2/0 120 in-lbs	#2 50 in-lbs
15	ACH550-VxR-046A-2	R3				
20	ACH550-VxR-059A-2	R3				
25	ACH550-VxR-075A-2	R4	#1 50 in-lbs	#1 55 in-lbs		
380...480 Volt						
1/1.5	ACH550-VxR-03A3-4	R1	#10 35 in-lbs	#10 7 in-lbs	#6 30 in-lbs	#4 35 in-lbs
2	ACH550-VxR-04A1-4	R1				
3	ACH550-VxR-06A9-4	R1				
5	ACH550-VxR-08A8-4	R1				
7.5	ACH550-VxR-012A-4	R1	#8 40 in-lbs	#8 7 in-lbs	#2 50 in-lbs	#2 50 in-lbs
10	ACH550-VxR-015A-4	R2				
15	ACH550-VxR-023A-4	R2	#3 50 in-lbs	#4 18 in-lbs	#2/0 120 in-lbs	#2 50 in-lbs
20	ACH550-VxR-031A-4	R3				
25	ACH550-VxR-038A-4	R3				
30	ACH550-VxR-045A-4	R3	#1 50 in-lbs	#1 55 in-lbs	#2/0 120 in-lbs	#2 50 in-lbs
40	ACH550-VxR-059A-4	R4				
50	ACH550-VxR-072A-4	R4				
60	ACH550-VxR-078A-4	R4		#1 70 in-lbs		

HP	Identification	Frame Size	Maximum Wire Size Capacities of Power Terminals			
			Circuit Breaker	Disconnect Switch	Motor Termination	Ground Lugs
500...600 Volt						
2	ACH550-VxR-02A7-6	R2	#8 62 in-lbs	#8 7 in-lbs	#6 30 in-lbs	#4 35 in-lbs
3	ACH550-VxR-03A9-6	R2				
5	ACH550-VxR-06A1-6	R2				
7.5	ACH550-VxR-09A0-6	R2				
10	ACH550-VxR-011A-6	R2				
15	ACH550-VxR-017A-6	R2	#4 62 in-lbs		#2 50 in-lbs	
20	ACH550-VxR-022A-6	R3				
25	ACH550-VxR-027A-6	R3	#1 62 in-lbs	#4 18 in-lbs	#2/0 120 in-lbs	#2 50 in-lbs
30	ACH550-VxR-032A-6	R4				
40	ACH550-VxR-041A-6	R4				
50	ACH550-VxR-052A-6	R4		#1 55 in-lbs		
60	ACH550-VxR-062A-6	R4	#1 70 in-lbs			

Standard enclosure terminals

HP	Type Code ¹	Base Drive Frame Size	Power Wiring Data ²							
			Circuit Breaker UL Type/ NEMA 1 & 12	Circuit Breaker UL Type/ NEMA 3R	Disconnect Switch UL Type/ NEMA 1 & 12	Disconnect Switch UL Type/ NEMA 3R	Motor Terminals UL Type/ NEMA 1 & 2	Motor Terminals UL Type/ NEMA 3R	Ground Lugs UL Type/ NEMA 1 & 2	Ground Lugs UL Type/ NEMA 3R
208...240 Volt										
1	ACH550-BxR-04A6-2	R1	#8 40 in-lbs	#8 40 in-lbs	#8 7 in-lbs	#8 7 in-lbs	#6 30 in-lbs	#6 30 in-lbs	#4 35 in-lbs	#4 35 in-lbs
1.5	ACH550-BxR-06A6-2	R1								
2	ACH550-BxR-07A5-2	R1								
3	ACH550-BxR-012A-2	R1								
5	ACH550-BxR-017A-2	R1								
7.5	ACH550-BxR-024A-2	R2	#1 50 in-lbs	#1 50 in-lbs	#4 18 in-lbs	#4 18 in-lbs	#2/0 120 in-lbs	#2/0 120 in-lbs	#2 50 in-lbs	#2 50 in-lbs
10	ACH550-BxR-031A-2	R2								
15	ACH550-BxR-046A-2	R3								
20	ACH550-BxR-059A-2	R3								
25	ACH550-BxR-075A-2	R4								
30	ACH550-BxR-088A-2	R4	350 MCM 274 in-lbs	350 MCM 274 in-lbs	#1/0 70 in-lbs	#1/0 70 in-lbs	#1 53 in-lbs	#1 53 in-lbs	2 x #3/0 250 in-lbs	#2/0 375 in-lbs
40	ACH550-BxR-114A-2	R4								
50	ACH550-BxR-143A-2	R6								
60	ACH550-BxR-178A-2	R6								
75	ACH550-BxR-221A-2	R6								
100	ACH550-BxR-248A-2	R6	2 x 500 MCM 274 in-lbs	2 x 500 MCM 274 in-lbs	2 x 500 MCM 274 in-lbs	2 x 500 MCM 274 in-lbs	2 x 500 MCM 375 in-lbs	2 x 500 MCM 375 in-lbs	350 MCM 100 in-lbs	

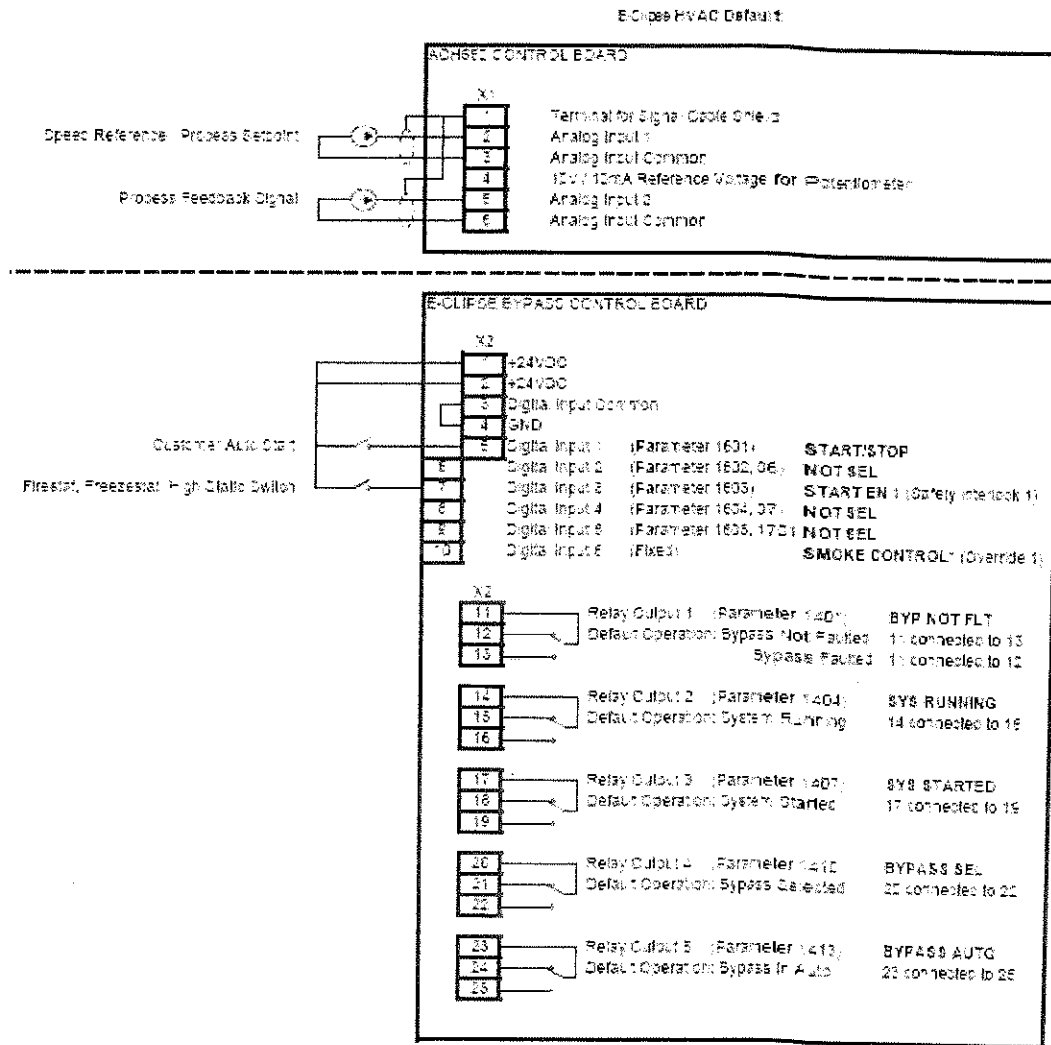
HP	Type Code ¹	Base Drive Frame Size	Power Wiring Data ²								
			Circuit Breaker UL Type/ NEMA 1 & 12	Circuit Breaker UL Type/ NEMA 3R	Disconnect Switch UL Type/ NEMA 1 & 12	Disconnect Switch UL Type/ NEMA 3R	Motor Terminals UL Type/ NEMA 1 & 2	Motor Terminals UL Type/ NEMA 3R	Ground Lugs UL Type/ NEMA 1 & 2	Ground Lugs UL Type/ NEMA 3R	
480 Volt											
1/1.5	ACH550-BxR-03A3-4	R1	#8 40 in-lbs	#8 40 in-lbs	#8 7 in-lbs	#8 7 in-lbs	#6 30 in-lbs	#6 30 in-lbs	#4 35 in-lbs	#4 35 in-lbs	
2	ACH550-BxR-04A1-4	R1									
3	ACH550-BxR-06A9-4	R1									
5	ACH550-BxR-08A8-4	R1									
7.5	ACH550-BxR-012A-4	R1									
10	ACH550-BxR-015A-4	R2									
15	ACH550-BxR-023A-4	R2	#1 50 in-lbs	#1 50 in-lbs	#4 18 in-lbs	#4 18 in-lbs	#2 50 in-lbs	#2 50 in-lbs	#2 50 in-lbs	#2 50 in-lbs	
20	ACH550-BxR-031A-4	R3									
25	ACH550-BxR-038A-4	R3									
30	ACH550-BxR-045A-4	R3			#1 55 in-lbs	#1 55 in-lbs	#2/0 120 in-lbs	#2/0 120 in-lbs			
40	ACH550-BxR-059A-4	R4									
50	ACH550-BxR-072A-4	R4									
60	ACH550-BxR-078A-4	R4	#1 70 in-lbs	#1 70 in-lbs	#1 53 in-lbs	#1 53 in-lbs					
75	ACH550-BxR-097A-4	R4									
100	ACH550-BxR-125A-4	R5					350 MCM 274 in-lbs	350 MCM 274 in-lbs	300 MCM 275 in-lbs	300 MCM 275 in-lbs	250 MCM 300 in-lbs
125	ACH550-BxR-157A-4	R6									
150	ACH550-BxR-180A-4	R6									
200	ACH550-BxR-246A-4	R6	2 x 500 MCM 274 in-lbs	2 x 500 MCM 274 in-lbs	2 x 500 MCM 274 in-lbs	2 x 500 MCM 274 in-lbs	2 x 500 MCM 375 in-lbs	2 x 500 MCM 375 in-lbs	2 x 500 MCM 375 in-lbs	350 MCM 100 in-lbs	
250	ACH550-BxR-316A-4	R8									
300	ACH550-BxR-368A-4	R8		2 x 600 MCM 500 in-lbs							5 Bus bar holes (13/32" bolts)
350	ACH550-BxR-414A-4	R8									
400	ACH550-BxR-486A-4	R8									

HP	Type Code ¹	Base Drive Frame Size	Power Wiring Data ²									
			Circuit Breaker UL Type/ NEMA 1 & 12	Circuit Breaker UL Type/ NEMA 3R	Disconnect Switch UL Type/ NEMA 1 & 12	Disconnect Switch UL Type/ NEMA 3R	Motor Terminals UL Type/ NEMA 1 & 2	Motor Terminals UL Type/ NEMA 3R	Ground Lugs UL Type/ NEMA 1 & 2	Ground Lugs UL Type/ NEMA 3R		
600 Volt												
2	ACH550-BxR-02A7-6	R2	#8 62 in-lbs	#8 62 in-lbs	#8 7 in-lbs	#8 7 in-lbs	#6 30 in-lbs	#6 30 in-lbs	#4 35 in-lbs	#4 35 in-lbs		
3	ACH550-BxR-03A9-6	R2										
5	ACH550-BxR-06A1-6	R2										
7.5	ACH550-BxR-09A0-6	R2										
10	ACH550-BxR-011A-6	R2										
15	ACH550-BxR-017A-6	R2	#1 62 in-lbs	#1 62 in-lbs	#4 18 in-lbs	#4 18 in-lbs	#2 50 in-lbs	#2 50 in-lbs	#2 50 in-lbs	#2 50 in-lbs		
20	ACH550-BxR-022A-6	R3										
25	ACH550-BxR-027A-6	R3										
30	ACH550-BxR-032A-6	R4			#1 55 in-lbs	#1 55 in-lbs	#1 75 in-lbs	#1 75 in-lbs			#2/0 120 in-lbs	#2/0 120 in-lbs
40	ACH550-BxR-041A-6	R4										
50	ACH550-BxR-052A-6	R4										
60	ACH550-BxR-062A-6	R4										
75	ACH550-BxR-077A-6	R6	300 MCM 274 in-lbs	300 MCM 274 in-lbs	#1/0 70 in-lbs	#1/0 70 in-lbs	#1 53 in-lbs	#1 53 in-lbs	3 x #3/0 250 in-lbs	#2/0 375 in-lbs		
100	ACH550-BxR-099A-6	R6										
125	ACH550-BxR-125A-6	R6			300 MCM 275 in-lbs	300 MCM 275 in-lbs	250 MCM 300 in-lbs	250 MCM 300 in-lbs				
150	ACH550-BxR-144A-6	R6										

1. "BxR" represents both BCR and BDR.

2. Torque values shown relate to current production. Check component labels on previously installed units for required tightening torque.

Basic control connections for E-Clipse HVAC Default



Parameters Changed Relative to E-Clipse HVAC Default

Parameter Number	Description	Setting

* Smoke Control (Override1) is a fixed input. Closing Digital Input 6 will place the E-Clipse Bypass in Smoke Control mode which may reassign the function of the other Digital Inputs. Refer to the Smoke Control (Override1) documentation.

2. Check installation – bypass

Control panel settings and checks

Apply power to the E-Clipse Bypass unit. The ACH550 Control Panel should show the operating status of the drive. If the E-Clipse Bypass Control Panel displays a PHASE SEQ (Phase Sequence) fault, remove power, wait at least 5 minutes and then swap any two input phase wires. If the motor is a standard 208 V, 60 Hz motor connected to a 208 V drive or a 460 V, 60 Hz motor connected to a 480 V drive, the default parameter settings should be suitable for the initial tests described below. If the motor's rating is not 208 V or 460 V, 60 Hz, the MOTOR NOM VOLT and MOTOR NOM FREQ parameters will need to be properly set before proceeding. Refer to the *ACH550-UH User's Manual* and set the parameters as required.

Note: The settings for ALL external serial communication between the ACH550 with E-Clipse Bypass and any Building Automation System are configured using the E-Clipse Bypass operator panel. DO NOT attempt to configure the external serial communication connection using the ACH550 operator panel!

The settings for internal communication between the ACH550 and the E-Clipse Bypass are configured at the factory and require no adjustment.

Drive Link recovery procedure

If the ACH550 Drive communication settings are unintentionally changed during setup a "Drive Link Fault", "Drive Link Error" or "Drive Setup" alarm may be displayed. Should this occur, accomplish the following steps in order.

Using the ACH550 Drive Keypad

1. Set Parameter 9802 to "STD MODBUS"
2. Set Parameter 9902 to "E-CLIPSE"
3. Cycle Power

Following the above steps, in order, should restore proper communications between the ACH550 Drive and the E-Clipse Bypass. Should the E-Clipse Keypad continue to display a "Drive Link Fault", "Drive Link Error" or "Drive Setup" alarm, check the following parameter settings to ensure they have been recovered. If necessary, individually set the correct parameter settings as indicated below and cycle power.

The only ACH550 Drive macro that provides the proper configuration settings by default is the E-Clipse Bypass macro. If any other ACH550 Drive macro is used, that macro should be selected after completing the initial tests. When using any other macro the following ACH550 Drive parameter values must be set and power cycled or the E-Clipse Bypass will not function properly:

- Parameter 9802 must be set to "STD MODBUS"
- Parameter 1001 must be set to "Comm"
- Parameter 1002 must be set to "Comm"
- Parameter 1601 must be set to "Comm"

- Parameter 1608 must be set to "Comm"
- Parameter 5303 must be set to "76.8 kb/s"
- Parameter 5304 must be set to "8 EVEN 1"
- Parameter 5305 must be set to "DCU PROFILE"
- Parameter 5310 must be set to "103"
- Parameter 5311 must be set to "104"
- Power must be cycled

Refer to the *ACH550-UH User's Manual* for additional information.

Note: Run motor from drive before attempting bypass operation.

System check: motor connected to ACH550 with E-Clipse Bypass

After performing the control panel checks and setting the ACH550 Drive Start-up Data parameters, check the operation of the ACH550 Drive with E-Clipse Bypass with the motor connected as follows:

1. Disconnect and lock out power to the E-Clipse Bypass unit, wait at least five minutes before disconnecting power.
2. Connect the motor to the output terminals.



CAUTION: If the Bypass Override (Override 2) input contact is closed, the motor will start across the line as soon as power is applied.

If the Safety Interlock and Run Enable input contacts are closed and the Smoke Control (Override 1) input contact is closed, the motor will start across the line as soon as power is applied.

If the Start/Stop, Safety Interlock and Run Enable input contacts are closed and the system is in the Bypass mode and in either Hand or Auto, the motor will start across the line as soon as power is applied.

If the Start/Stop, Safety Interlock and Run Enable input contacts are closed and the system is in the Drive mode with the drive in either Hand or Auto mode, the motor will start on the drive as soon as power is applied.

In order to prevent the motor from starting, the system should be in the Drive mode and the drive should be OFF when the power is disconnected at the end of the previous series of control panel settings and checks.

In order to prevent the motor from running without disconnecting the motor, open the Run Enable and Safety Interlock contacts on bypass control board terminals X2:2, X2:3 and X2:4 before applying power. Set the bypass to Drive mode and the drive to OFF.

3. Apply power to the E-Clipse Bypass unit. The ACH550 Control Panel display should be illuminated. On the bypass control panel, both the display and Enabled LED should be illuminated. If the Enabled LED is not illuminated solid green, check to see that closed contacts or jumpers connect terminal X2:3 to X2:4 and X2:2 to X2:7 on the bypass control board.
4. The Drive Selected LED should be illuminated. If not, press the Drive Select key to switch to Drive mode. Leave the system in the Drive mode when proceeding to the next step.
5. Press the Hand key on the ACH550 Control Panel. Press and hold the UP key until the motor just starts rotating.

Note: If the ACH550 Control Panel displays an OVERCURRENT or EARTH FAULT, disconnect and lock out power to the E-Clipse Bypass unit. Wait at least 5 minutes. Disconnect the motor leads from the E-Clipse Bypass unit and Megger each motor lead to ground to determine if the motor is good. Check the power leads from the Drive / Bypass to the motor for damaged or improper wiring. If the ACH550 Control Panel displays any other drive faults, correct the fault condition before proceeding to the next step.



CAUTION: Check motor rotation direction as soon as the motor begins to move. If motor does not rotate in the correct direction, shut down the drive, disconnect and lock out power to the drive and wait five minutes. Swap any two motor output wires (T1, T2, and T3). Incorrect motor rotation direction may cause equipment damage.

6. Increase the speed to 60 Hz or the highest safe operating speed.
7. Press the OFF key on the drive control panel. The motor should stop.

If the drive does not operate according to these steps, refer to the ACH550-UH User's Manual.

If the drive operates according to these steps, your ACH550 with E-Clipse Bypass is ready to use with preset or modified macro settings.

Note: The settings for ALL external serial communication between the ACH550 with E-Clipse Bypass and any Building Automation System are configured using the E-Clipse Bypass operator panel. DO NOT attempt to configure the external serial communication connection using the ACH550 operator panel!

The settings for internal communication between the ACH550 and the E-Clipse Bypass are configured at the factory and require no adjustment.

Note: Both the ACH550 Drive and the E-Clipse Bypass include preset application macros. The only ACH550 Drive macro that provides the proper configuration settings by default is the *E-Clipse HVAC Default macro* (9902 = 15). If any other ACH550 drive macro or any modified setting of the *E-Clipse HVAC Default macro* is used the following ACH550 Drive parameter values must be set and power cycled or the E-Clipse Bypass will not function properly:

- Parameter 9802 must be set to "STD MODBUS"
- Parameter 1001 must be set to "Comm"
- Parameter 1002 must be set to "Comm"
- Parameter 1601 must be set to "Comm"
- Parameter 1608 must be set to "Comm"
- Parameter 5303 must be set to "76.8 kb/s"
- Parameter 5304 must be set to "8 EVEN 1"
- Parameter 5305 must be set to "DCU PROFILE"
- Parameter 5310 must be set to "103"
- Parameter 5311 must be set to "104"
- Power must be cycled

Refer to the *ACH550-UH User's Manual* for programming instructions.

Note: Run motor from drive before attempting bypass operation.

System check: motor disconnected from the ACH550 with E-Clipse Bypass

If you are familiar with the E-Clipse Bypass operation, you may skip the following section. Otherwise, after performing the system checks and setting the ACH550 Drive Start-up Data parameters, become familiar with the operation of the ACH550 Drive with E-Clipse Bypass without the motor connected as follows:

1. Disconnect and lock out power to the E-Clipse Bypass unit, wait at least five minutes after disconnecting power.
2. Disconnect the motor from the E-Clipse Bypass unit.
3. Apply power to the E-Clipse Bypass unit by turning on the branch circuit disconnect device and the bypass disconnect switch or circuit breaker.
4. The ACH550 Control Panel display should be illuminated. On the E-Clipse Bypass control panel, both the display and *Enabled* LED should be illuminated. If the *Enabled* LED is not illuminated solid green, check to see that closed contacts or jumpers connect terminal X2:3 to X2:4 and X2:2 to X2:7 on the bypass control board.

5. On the E-Clipse Bypass control panel, either the *Drive Selected* or *Bypass Selected* LED should be illuminated. Pressing the *Drive Select* or *Bypass Select* key should switch the bypass back and forth between the *Drive* mode and the *Bypass* mode as indicated by the LEDs above each button. Check that the bypass control panel switches the system between modes. Leave the system in the *Bypass* mode when proceeding to the next step.
6. Check to see that pressing the:
 - *Auto* key on the bypass control panel causes the bottom line on the E-Clipse Bypass display to indicate "*Bypass in Auto*"
 - *Hand* key on the bypass control panel generates a Motor Phase Fault.
 - Under normal conditions (motor connected) pressing the *Hand* key on the bypass control panel causes the bottom line on the E-Clipse Bypass display to indicate "*Hand #A Run*"
 - *OFF* key on the bypass control panel causes the bottom line on the E-Clipse Bypass display to indicate "*Off Stop*"
7. For Steps 8 through 14, ACH550 Drive Parameter 9904 must be set to "Scalar: Freq". After successful completion of Step 13, Parameter 9904 may be set to "Vector: Speed" if very specific application requirements make it necessary to use this type of motor control. Operation using the "Vector: Speed" setting is unnecessary for control of almost all fan and pump applications. Refer to the *ACH550-UH User's Manual* for details on setting parameters.
8. Press the *Drive Select* key on the E-Clipse Bypass control panel. The *Drive Select* LED should be illuminated.
9. Check to see that pressing the:
 - *Auto* key on the bypass control panel causes the E-Clipse Bypass display to indicate "*Bypass in Auto*"
 - *Hand* key on the bypass control panel causes no change to the E-Clipse Bypass display
 - *OFF* key on the bypass control panel causes the E-Clipse Bypass display to indicate "*Bypass in Off*"
10. Press the *HAND* key on the drive control panel. Note that the top line of the control panel display indicates "HAND" and run as a clockwise rotating arrow. The *Drive Run* LED on the E-Clipse Bypass control panel should be illuminated.
11. Press the *UP* arrow on the drive control panel. Note that the speed reference indication in the top line of the drive control panel display increases from "0.0% SP."
12. In the middle line of the drive control panel display, the output current indication should indicate "0.0 A."
13. Press the *DOWN* arrow on the drive control panel until the speed and frequency indications return to "0.0."
14. Press the *OFF* key on the drive control panel. Note that the bottom line of the drive control panel display indicates "Off."

If the ACH550 Drive and E-Clipse Bypass operate according to these steps, and you have familiarized yourself with their operation, disconnect and lock out power to prepare for the next test.



WARNING! Wait at least five minutes after disconnecting power from the drive before you attempt to service the drive. Bus capacitors in the intermediate DC circuit must discharge before servicing the drive. Using a meter rated for 1000 VDC, check for zero volts at:

- Terminals BRK+ to GND and BRK- to GND (frame size R1/R2)
- Terminals UC+ and UC- (frame size R3...R8).

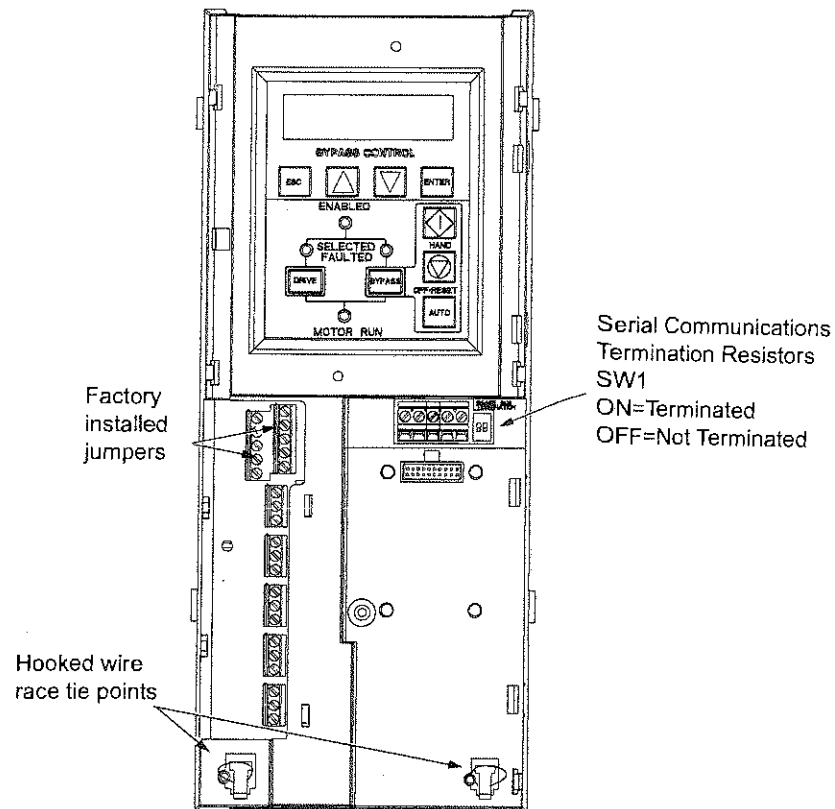
If the drive does not operate according to these steps, refer to the ACH550-UH User's Manual.

3. Check jumpers and switches

The settings described in this section are factory set and, for most situations, do not require adjustment. However, it is a good practice to review these settings to confirm that they are appropriate for the configuration installed.

Jumper and switch locations

The figure below shows the locations of the SW1 DIP switch on the E-Clipse Bypass control board. The function and setting of this switch is explained in the following paragraph.



DIP switch settings

The DIP switch is used to configure the serial communications termination resistors. To reduce noise on the serial communications network, terminate the EIA-485 network using 120 ohm resistors at both ends of the network. Use the DIP switches to connect or disconnect the on-board termination resistors. Both switches must be positioned in the ON or OFF position to correctly configure the termination resistors.

Note: When using embedded protocols, set SW1 in the OFF position.

Circuit breaker settings

On some ACH550 E-Clipse Bypasses, the circuit breaker has adjustable settings for instantaneous current protection. The factory default settings are practical for most applications. Refer to the "ABB SACE Instruction Sheet" (supplied with these units) for additional information on the adjustment of these settings.

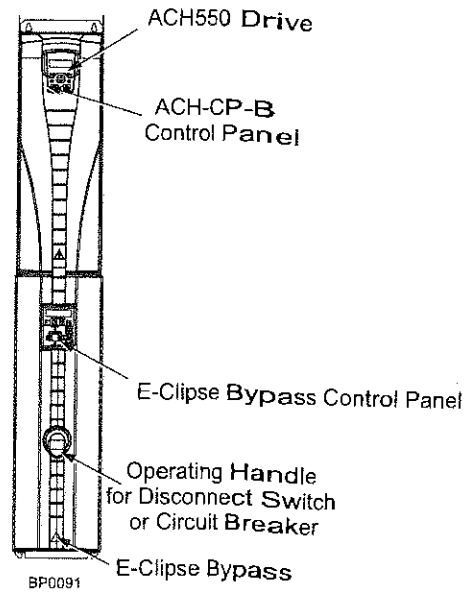
Operation

E-Clipse bypass configurations

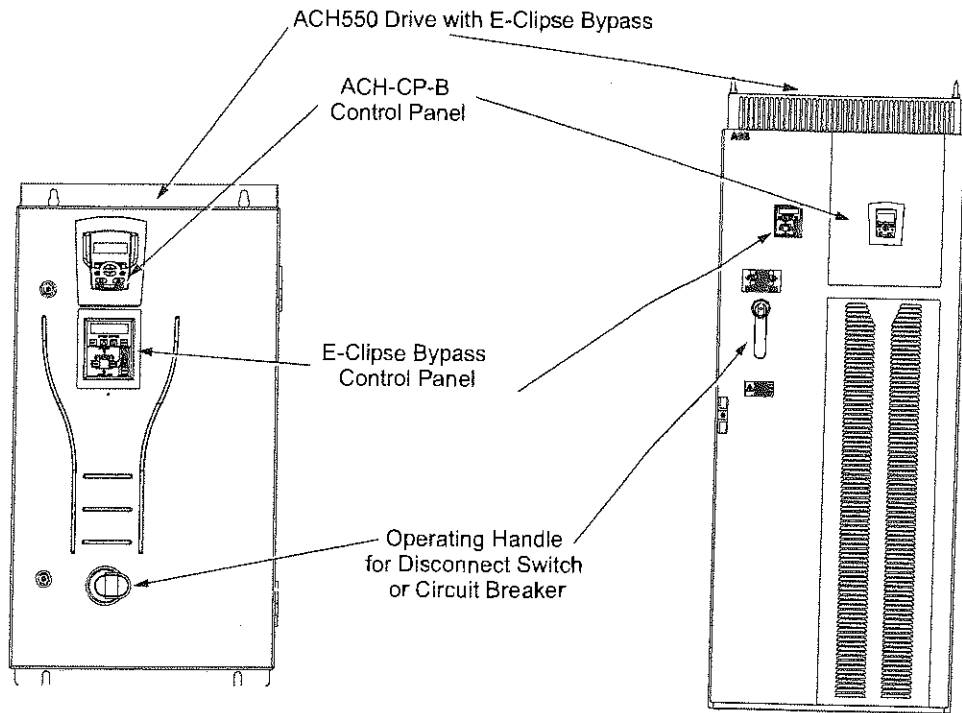
The ACH550 with E-Clipse Bypass is an ACH550 AC adjustable frequency drive in an integrated UL type 1, UL type 12 or UL type 3R package with a bypass motor starter. The ACH550 with E-Clipse Bypass provides:

- Disconnect switch or circuit breaker with door mounted control lever. The lever can be padlocked in the OFF position (padlock not supplied).
- Bypass starter.
- Motor overload protection.
- Local operator panel with indicating lights and multifunction display.
- Provisions for external control connections.
- Embedded communications for major BMS protocols including BACnet, Johnson Controls International N2, Siemens Building Technologies FLN, and Modbus
- Optional fieldbus adapters for connection to additional BMS protocols including LonWorks and Ethernet
- Optional drive service switch (drive input disconnect), the functional equivalent of a three-contactor bypass arrangement.

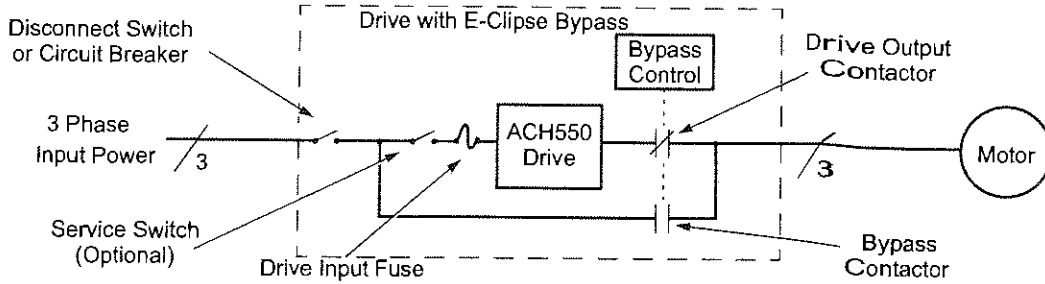
The following shows the front view of the ACH550 E-Clipse Bypass vertical configuration, and identifies the major components.



The following shows the front view of the ACH550 E-Clipse Bypass standard configurations, and identifies the major components.

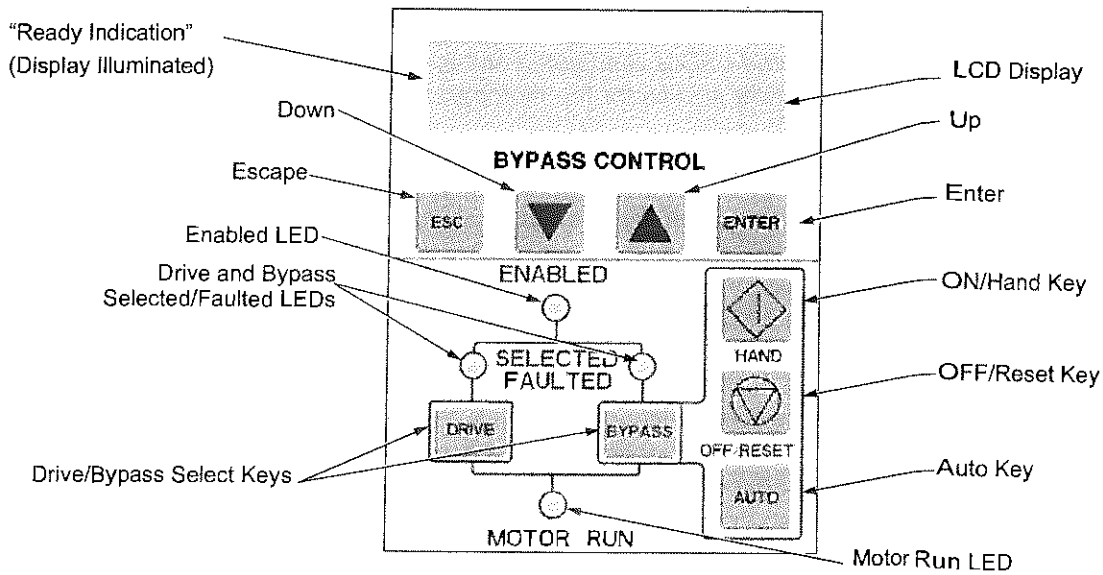


The following is a typical power diagram.



Bypass control

The bypass control panel features:



Ready (Power On) Indication

The *Ready (Power On) indication* is provided by the bypass control panel. The bypass control panel display will be illuminated and text will be displayed when the disconnect switch or circuit breaker is closed and control power is applied to the bypass.

Enabled LED

The *Enabled LED* is illuminated green under the following conditions:

- Both the Safety Interlock(s) and Run Enable contacts are closed.
- The Safety Interlock contact(s) are closed with no Start command present.

The Enabled LED flashes green if the Run Enable contact is open and when the Safety Interlock contact(s) are closed and a Start command is present.

The Enabled LED is illuminated red when the Safety Interlock contact(s) are open.

Motor Run LED

The *Motor Run LED* is illuminated green when the motor is running in either bypass mode or in drive mode. The Motor Run LED flashes green to indicate the system has been placed in an Override condition.

Bypass Faulted LED

The *Bypass Faulted LED* is illuminated or flashes red when the motor or bypass protection functions have shut down the bypass. The specific nature of the fault is indicated on the bypass control display. Refer to the *Diagnostics* section of this manual for more details.

Drive Selected LED

The *Drive Selected LED* is illuminated green when the drive has been selected as the power source for the motor and no drive fault is present.

Bypass Selected LED

The *Bypass Selected LED* is illuminated or flashes green when the bypass has been selected as the power source for the motor and no bypass fault is present.

Drive Faulted LED

The *Drive Faulted LED* is illuminated red when the bypass has lost its communications link with the drive or when the motor or drive protection functions have shut down the drive. The specific nature of the fault is indicated on the drive control panel display. Refer to the *Diagnostics* section on page 66 of the ACH550-UH User's Manual for more details.

Automatic Transfer

The *Automatic Transfer* indication is provided on the bypass control panel. The bypass control display will continuously flash an alarm to indicate the system has automatically transferred to Bypass after a Drive fault. The Bypass Selected LED flashes green when the system has automatically transferred to bypass operation. The bypass event log will also record this event.

Auto Indication

The *Auto Indication* is provided on the bypass control panel default display when the bypass control panel Auto key is pressed. Normally this indicates that the Auto Start contact or serial communications has been selected as the means for starting and stopping the motor in the bypass mode.

Off Indication

The *Off Indication* is provided on the bypass control panel default display when bypass control panel Off key is pressed.

Hand Indication

The *Hand Indication* is provided on the bypass control panel default display when the motor has been started manually in the bypass mode.

Drive Select Key

The *Drive Select Key* selects the drive as the power source for the motor.

Bypass Select Key

The *Bypass Select Key* selects the bypass as the power source for the motor.

Off/Reset Key

The *Off/Reset Key* may be used to manually stop the motor if the motor has been running on bypass power. The Off/Reset key also resets most bypass faults. It may take several minutes before the bypass can be reset after an overload trip. If a bypass fault condition is present the second press of this key places the bypass in the OFF mode.

Auto Key

The *Auto Key* selects the Auto Start contact or serial communications as the means for starting and stopping the motor in the bypass mode.

Hand Key

The *Hand Key* can be used to manually start the motor when the bypass has been selected as the power source for the motor.

Bypass control panel modes








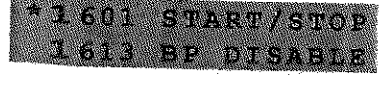








The HVAC Bypass Control Panel has several different modes for configuring, operating and diagnosing the bypass. Select MENU and use the UP/DOWN buttons to select modes. The modes are:

- Default Display mode – Provides (HAND/OFF/AUTO) indication of the bypass operating control mode.
- Bypass Status mode – Provides status indications of the current system operating conditions.
- Start-Up Parameter Mode – Provides a list of parameters or operating conditions that may be configured or viewed during startup.
- Parameter List mode – Used to edit parameter values individually.
- Changed Parameter mode – Displays changed parameters.
- Bypass Fault Display mode – If there is an active bypass fault, the control panel will flash the fault number and fault diagnostic indication in English.
- Bypass Alarm Display mode – If there is an active bypass alarm, the control panel will flash the alarm number and alarm diagnostic indication in English.

Start-up by changing the parameters from the start-up list

























To change the parameters, follow these steps:



1	The Default Display indicates the Bypass Control mode.		DRIVE SELECTED BYPASS IN OFF
2	Press ENTER to enter the Main Menu .	ENTER	*BYPASS STATUS STARTUP PARAMS

3	Select the Startup Params with the Up/Down arrows and press ENTER .	  	
4	Select the appropriate Parameter with the Up/Down arrows and press ENTER .	  	
5	Press the Up/Down arrows to change the Parameter Value .	 	
6	Press ENTER to store the modified value or press ESC to leave the Parameter Edit mode.	 or 	
7	Press ESC to return to the Main Menu , and again to return to the Default Display .		

Start-up by changing the parameters individually from the parameter list

To change the parameters, follow these steps:

1	The Default Display indicates the Bypass Control mode.		
2	Press ENTER to enter the Main Menu .		
3	Select the Parameter List with the Up/Down arrows and press ENTER .	  	
4	Select the appropriate Parameter Group with the Up/Down arrows and press ENTER .	  	
5	Select the appropriate Parameter in a group with the Up/Down arrows and press ENTER .	  	
6	Press the Up/Down arrows to change the Parameter Value .	 	
7	Press ENTER to store the modified value or press ESC to leave the Parameter Edit mode.	 or 	
8	Press ESC to return to the listing of Parameter Groups , and again to return to the Main Menu .	 	

9	Press ESC to return to the Default Display from the Main Menu .		
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Note: In the Parameter Edit mode the current parameter value appears below the parameter name.

Note: To view the default parameter value, press the **Up/Down** arrows simultaneously. Press **Enter** to restore the default parameter value or press **ESC** to leave the **Parameter Edit** mode.

Diagnostics

Fault listing

Fault Code	Fault Name in Panel	Fault	Possible Cause	Corrective Action
3001	COIL CURR FBK	RBCU is sensing abnormal current feedback when neither contactor should be energized	Defective component on RBCU	Change RBCU
3002	BYP CONTACT STUCK	M2 contactor indicates it is not prepared to move on a power up check of the contactor or after contact is commanded to open	Defective Contactor Defective RBCU	Disconnect incoming power from unit Check if contactor armature moves freely. If armature moves freely, then change the RBCU. If armature does not move freely, then change individual contactor (M2) or the complete assembly (RCSA-0x)
3003	DRV CONTACT STUCK	M1 contactor indicates it is not prepared to move on a power up check of the contactor or after contact is commanded to open	Defective Contactor Defective RBCU	Disconnect incoming power from unit Check if contactor armature moves freely. If armature moves freely, then change the RBCU. If armature does not move freely, then change individual contactor (M1) or the complete assembly (RCSA-0x)

Fault Code	Fault Name In Panel	Fault	Possible Cause	Corrective Action
3004	BYPASS COIL OPEN	M2 contactor will not close when commanded to do so	Loose J8 connector on RBCU Loose wires on contactor terminals A1 and/or A2 Bad Output on RBCU Bad Contactor	Verify that J8 connector is firmly seated. With incoming power disconnected, check for tightness of A1 and A2 terminals Swap RBCU Change Contactor/ Assembly
3005	DRIVE COIL OPEN	M1 contactor will not close when commanded to do so	Loose J8 connector on RBCU Loose wires on contactor terminals A1 and/or A2 Bad Output on RBCU Bad Contactor	Verify that J8 connector is firmly seated. With incoming power disconnected, check for tightness of A1 and A2 terminals Swap RBCU Change Contactor/ Assembly
3006	UNDERVOLTAGE	Message only occurs if drive is controlling the motor and the power to the bypass is removed before the drive phases back. Message will appear in the fault log. This message will only appear when drive contactor opens when drive is operating	Loose J7 connector on RBCU unit Loose input wiring Incoming power problems	Check that J7 connector is firmly seated in RBCU Check tightness of incoming connections Check Parameter 0413 to view voltage level at time of trip Check upstream protection
3008	DRIVE AI2 LOSS	Only displayed when in Supervisory mode. Indicates that AI2 on the drive has failed.	Check ACH550 manual for AI2 loss	Check ACH550 manual for AI2 loss
3009	MTR OVERLOAD	Bypass opens on motor overload conditions defined in the drive	Drive Mode: Bad Motor Bad CT's Bad RBCU Bypass mode: Bad motor Bad CT's Bad RBCU Either mode: low input voltage	Check if overload condition exists Drive Mode: Refer to 550 manual for proper troubleshooting techniques Bypass Mode: Check that J2 connector is firmly seated in RBCU Use clamp meter to verify mtr current vs. display in parameter 0101 Check input voltage

Fault Code	Fault Name In Panel	Fault	Possible Cause	Corrective Action
3010	INP PHASE A LOSS	Fault will be generated only when trying to close the bypass contactor and the RBCU does not sense voltage on Phase A	Loose J7 connector Loose wiring on Contactor assembly. Blown upstream fuse	Check J7 connector Check yellow wire on input block Check incoming voltage, phase to ground
3011	INP PHASE B LOSS	Fault will be generated only when trying to close the bypass contactor and the RBCU does not sense voltage on Phase B	Loose J7 connector Loose wiring on Contactor assembly. Blown upstream fuse	Check J7 connector Check black wire on input block Check incoming voltage, phase to ground
3012	INP PHASE C LOSS	Fault will be generated only when trying to close the bypass contactor and the RBCU does not sense voltage on Phase C	Loose J7 connector Loose wiring on Contactor assembly. Blown upstream fuse	Check J7 connector Check red on input block Check incoming voltage, phase to ground
3013	DRIVE 1ST START	Fault generated if attempting to close the bypass contactor without running the bypass in drive mode first.	NA	Run bypass unit in drive mode before attempting bypass mode
3014	COIL POW SUPPLY	Coil power supply has failed to reach rated voltage	Internal failure on RBCU unit Shorted contactor coil	Cycle power on bypass unit. If contactor coil is shorted, fault 3023 or 3024 will be generated. If 3023 or 3024 is generated, replace respective contactor If 3023 or 3024 is not generated on power up, replace RBCU unit.
3016	EARTH FAULT	Declared if attempting to close the bypass contactor when the drive has earth fault declared	Earth fault in motor	Refer to the fault code 16 on page 25.
3017	MTR UNDERLOAD	If motor power(%) level falls below minimum power level establish in parameter 3003 for the time (s) set in parameter 3002 fault will be generated. Parameter 3003 is a percentage of motor power as defined in the drive via parameter 9909. Fault only applies to bypass mode	Broken belt	Check load Reset bypass keypad Check fault code 17 on page 25, for further action

Fault Code	Fault Name In Panel	Fault	Possible Cause	Corrective Action
3018	MAX CYCLE FAULT	Supervisory Mode only. Declared if bypass contactor is closed by supervisory control 16 times within a 1 hour period.	High and low levels of hysteresis band are too tight	Check parameters 3202-3205. Increase time delays on parameters 3204 and 3205
3019	DRIVE LINK FAULT	Supervisory Mode Only. Fault generated if RS-485 link between drive and bypass stops communicating.	Bad cable/connection between drive and bypass. Communication improperly set in drive Parameter 9802. Application Macro improperly set in drive parameter 9902.	Proper seating of cable in drive and RBCU(connector J3) Check drive parameter 9802 (Modbus) and 9902 (E-Clipse) Check drive Group 53 Follow DriveLink recovery procedure
3020	PHASE SEQ	Sequence of 3 phase voltage input is such that bypass operation will result in motor rotation opposite of drive forward operation.	Phase sequence unknown at time of wiring	Swap any two of the three input wires to the bypass unit
3021	PH A CURR FBK	Fault is generated when current in Phase A is detected and the bypass contactor is open	Loose CT connection Bad RBCU Bad CT	Check J2 connector for proper seating Check connector on Current Assembly Replace RBCU Replace RCSA unit
3022	PH C CURR FBK	Fault is generated when current in Phase C is detected and the bypass contactor is open	Loose CT connection Bad RBCU Bad CT	Check J2 connector for proper seating Check connector on Current Assembly Replace RBCU Replace RCSA unit
3023	BYP COIL SHORTED	Coil characteristics are checked only on power up and coil current is greater than allowable values	Shorted contactor coil Shorted/damaged cable Bad RBCU	Replace RBCU Replace RCSA unit
3024	DRV COIL SHORTED	Coil characteristics are checked only on power up and coil current is greater than allowable values	Shorted contactor coil Shorted/damaged cable Bad RBCU	Replace RBCU Replace RCSA unit
3027	INVALID SUB ASM	Contactor assembly as recorded in the RBCU unit does not match drive information communicated via 485 link	RBCU unit from a different size bypass used to replace a defective RBCU. Parameters not matched after Firmware change.	Contact ABB at 1-800-HELP-365 Option 4

Fault Code	Fault Name in Panel	Fault	Possible Cause	Corrective Action
3028	EXT COMM LOSS	Time between fieldbus messages has exceeded timeout interval set with parameter 3005	Incorrect Communication settings in Group 51 & 53. Poor Connections Noise on Communication Line	Check Group 51 & 53 Tighten Connections Check Communication Cable Grounding
3029	EFB CONFIG FILE	Error reading configuration file for embedded fieldbus	Internal Startup error	Cycle Power Replace RBCU
3030	FORCE TRIP	Fault trip forced by external fieldbus	Overriding Control System tripped E-Clipse unit via fieldbus.	Check Overriding Control System
3031 ... 3033	EFB 1...EFB 3	Fault code reserved for embedded fieldbus.	For Bacnet: Device object instances for the drive and or bypass are set greater than 4194302 in paramters 5011 5017 and or 5311 5317 respectively	Check Parameters 5011, 5017 and/or 5311, 5317
3034	MTR PHASE	Detects open motor phase. Detection is done by current transformers in bypass unit.	Internal problem Cable problem Motor problem	Check wiring in E-Clipse Unit Check motor cabling Check Motor Check if 3006 is Disabled
3037	PCB TEMP	RBCU unit has reached 190 degrees Fahrenheit, 88 degrees Celsius	Cabinet cooling has failed Ambient conditions too high Bad RBCU unit	Stop drive and let cool down and restart Add additional cooling Replace RBCU
3038	NO DRIVE DATA	No drive data available (Group 112) .	Bypass not able to extract drive data on initial power up due to: Bad cable/connection between drive and bypass. Communication improperly set in drive Parameter 9802. Application Macro improperly set in drive parameter 9902.	Proper seating of cable in drive and RBCU (connector J3) Check drive parameter 9802 (Modbus) and 9902 (E-Clipse) Check drive Group 53 Follow DriveLink recovery procedure then cycle power to bypass.
3039	FBA PAR CONF	Non embedded fieldbus has detected an error in Group 51 parameters	Incorrect settings in Group 51	Verify Group 51 parameters
3101	SFLASH CORRUPT	Internal checksum error	NA	Cycle power Replace RBCU Upgrade firmware

Fault Code	Fault Name In Panel	Fault	Possible Cause	Corrective Action
3102	PMAP FILE	Parameter file is corrupt		Cycle Power Contact ABB with information that preceeded fault
3201	T1 OVERLOAD	T1 program cycle is overloaded	NA	Contact ABB with information that preceeded fault Cycle Power Replace RBCU
3202	T2 OVERLOAD	T2 program cycle is overloaded	NA	Contact ABB with information that preceeded fault Cycle Power Replace RBCU
3203	T3 OVERLOAD	T3 program cycle is overloaded	NA	Contact ABB with information that preceeded fault Cycle Power Replace RBCU
3204	STACK OVERFLOW	Program cycle is overloaded	NA	Contact ABB with information that preceeded fault Cycle Power Replace RBCU
3205	UNKNOWN CB	Bypass control board type is unknown.	Firmware is not compatible with control board in RBCU.	Firmware 93F and greater compatible with all RBCU hardware. Firmware 93D and earlier can only be loaded in RBCU Rev D and earlier.
3206	UNKNOWN DRIVE	Drive reports rating not found in bypass software	Drive does not match drives configured in bypass RBCU	Replace RBCU or reload with most current firmware
3207	UNKNOWN BYPASS	NA	NA	Replace RBCU or load most current firmware Contact ABB at 1-800-HELP-365 option 4 Replace RBCU or load most current firmware

Fault History

See page 28.

Alarm listing

The following table lists the alarms by code number and describes each.

Alarm Code	Alarm Name in Panel	Alarm	Possible Cause	Corrective Action
4001	INP PHASE A LOSS	Alarm will occur in drive mode. In bypass, alarm will occur if bypass contactor has not closed. Unit will trip on Fault 3010 if the bypass contactor is closed	Loose J8 connector Loose wiring on Contactor assembly. Blown upstream fuse	Check J8 connector Check yellow wire on input block Check incoming voltage, phase to ground
4002	INP PHASE B LOSS	Alarm will occur in drive mode. In bypass, alarm will occur if bypass contactor has not closed. Unit will trip on Fault 3011 if the bypass contactor is closed	Loose J8 connector Loose wiring on Contactor assembly. Blown upstream fuse	Check J8 connector Check black wire on input block Check incoming voltage, phase to ground
4003	INP PHASE C LOSS	Alarm will occur in drive mode. In bypass, alarm will occur if bypass contactor has not closed. Unit will trip on Fault 3012 if the bypass contactor is closed	Loose J8 connector Loose wiring on Contactor assembly. Blown upstream fuse	Check J8 connector Check red wire on input block Check incoming voltage, phase to ground
4004	AUTO TRANSFER	Message is displayed when the drive faults and the bypass switches to bypass mode as configured in Parameter 1608	Drive fault	Check drive
4005	EXT COMM ERR	Time between fieldbus messages has exceeded timeout interval set with parameter 3005	Incorrect Communication settings in Group 51 & 53. Poor Connections Noise on Communication Line	Check Group 51 & 53 Tighten Connections Check Communication Cable Grounding
4006	Selected by PAR 1620: RUN ENABLE DAMPER END SWITCH VALVE OPENING PRE-LUBE CYCLE	Alarm will occur when start order is given and the "RUN Enable" is not present	Run Enable condition is not satisfied. Bad 24v supply Bad digital input	Check 24 Volts on RBCU unit Check for 24 volts on respective DI when condition is satisfied Check Parameter 0103 for status of digital input
4007	PCB TEMP	RBCU unit reached 181 degrees Fahrenheit, 83 degrees Celsius	Cabinet cooling has failed Ambient conditions too high Bad RBCU unit	Stop drive and let cool down and restart Add additional cooling Replace RBCU

Alarm Code	Alarm Name in Panel	Alarm	Possible Cause	Corrective Action
4008	DRIVE SETUP	Alarm generated when configuration of drive is such that bypass can not properly control the drive. Specifically, drive parameters 1001,1002,1601, 1608	Incorrect parameters settings	Set Parameter 1001 to "COMM" Set Parameter 1002 to "COMM" Set Parameter 1601 to "COMM" Set Parameter 1608 to "COMM"
4009	BYPASS RUN DELAY	Alarm is generated when a bypass start command is issued and there is non zero time value in bypass parameter 1614	NA	NA
4010	MTR OVERLOAD	Bypass warning if motor overload conditions exist as defined in the drive	Drive Mode: Bad Motor Bad Ct's Bad RBCU Bypass mode: Bad motor Bad CT's Bad RBCU Either mode: low input voltage	Drive Mode: Refer to 550 manual for proper troubleshooting techniques Bypass Mode: Check that J2 connector is firmly seated in RBCU Check input voltage Does overload condition exist?
4011	MTR UNDERLOAD	Alarm comes at half the time of a mtr underload fault. See fault 3017 for further text	NA	Parameter 3002 is the time Parameter 3003 is the level
4012	BYPASS DISABLED	Alarm will be generated if parameter 1613 is set to "Disable"	NA	NA
4013	DRIVE LINK ERROR	Same as Fault 3019 however will occur when not in supervisory mode	Bad cable between drive and bypass Communication improperly set in drive Parameter 98.02(Modbus) Application Macro in 99.02 set to 15 (text)	Proper seating of cable in drive and RBCU(connector J3) Check drive parameter 98.02 and 99.02 Check drive Group 53 Follow DriveLink recovery procedure
4014	DRIVE TEST	Alarm is generated when bypass parameter 1617 is set to "enable"	NA	NA
4015	START DRIVE 1ST	Message displayed on initial "out of box" power up sequence	NA	Run drive in Hand

Alarm Code	Alarm Name In Panel	Alarm	Possible Cause	Corrective Action
4016	INP VOLTAGE LOW	3-Phase input voltage has not reached a sufficient level to enable editing of parameters via the keypad. This message is generated within a few seconds of power up	NA	Loose J7 connector Low input voltage. Incoming voltage has not reached at least 155 VAC within a few seconds of powerup
4019	OVERRIDE 1	Alarm is generated when Smoke Control is active	NA	Check Parameter 0103 and 0104 for digital input status
4020	OVERRIDE 2	Alarm is generated when Fireman's Override is active	NA	Check Parameter 0103 and 0104 for digital input status
4021	Selected by PAR 1621 START ENABLE 1 VIBRATION SWITCH FIRESTAT FREEZESTAT OVERPRESSURE VIBRATION TRIP SMOKE ALARM SAFETY OPEN LOW SUCTION PRES	Alarm will occur when start order is given and the "RUN Enable" is not present	Run Enable condition is not satisfied. Bad 24v supply Bad digital input 24 V common is not tied to Digital input common on bypass when using external 24 v supply	Check 24 Volts on RBCU unit Check for 24 volts on respective DI when condition is satisfied Check Parameter 0103 For status of digital input
4022	Selected by PAR 1622 START ENABLE 2 VIBRATION SWITCH ... LOW SUCTION PRES	Alarm will occur when start order is given and the "RUN Enable" is not present	Run Enable condition is not satisfied. Bad 24v supply Bad digital input 24 V common is not tied to Digital input common on bypass when using external 24 v supply	Check 24 Volts on RBCU unit Check for 24 volts on respective DI when condition is satisfied Check Parameter 0103 For status of digital input
4023	Selected by PAR 1623 START ENABLE 3 VIBRATION SWITCH ... LOW SUCTION PRES	Alarm will occur when start order is given and the "RUN Enable" is not present	Run Enable condition is not satisfied. Bad 24v supply Bad digital input 24 V common is not tied to Digital input common on bypass when using external 24 v supply	Check 24 Volts on RBCU unit Check for 24 volts on respective DI when condition is satisfied Check Parameter 0103 For status of digital input

Alarm Code	Alarm Name In Panel	Alarm	Possible Cause	Corrective Action
4024	Selected by PAR 1624 START ENABLE 4 VIBRATION SWITCH ... LOW SUCTION PRES	Alarm will occur when start order is given and the "RUN Enable" is not present	Run Enable condition is not satisfied. Bad 24v supply Bad digital input 24 V common is not tied to Digital input common on bypass when using external 24 v supply	Check 24 Volts on RBCU unit Check for 24 volts on respective DI when condition is satisfied Check Parameter 0103 For status of digital input
4025	LOCAL DISABLED	Alarm is displayed if MODE LOCK (16.29) is set to AUTO MODE and the Hand or Off key is pressed		
4026	AUTO DISABLED	This alarm is displayed if MODE LOCK (1629) is set to LOCAL MODE and the Auto key is pressed.		
4027	COMM CONFIG ERR	Alarm is displayed if the drive and bypass MAC addresses are equal or invalid.	E-Clipse parameters 5002(BP MAC ID) & 5302 (DV MAC ID) are set to the same value	Change MAC address to unique values
4028	FBA PAR CONF	Non embedded fieldbus has detected an error in Group 51 parameters		Verify Group 51 parameters
4029	DRIVE FAULTED	The drive is faulted.		Reset drive

Bypass status listing

Bypass Status (16 Characters)	Condition	Description
DRIVE/BYPASS?	DRIVE SELECTED BYPASS SELECTED	Displays which one is selected, drive or bypass
SAFETIES?	OPEN CLOSED	Displays if safeties (=START ENABLE 1 and/or START ENABLE 2) have been applied, or if they are missing
RUN PERMISSIVES?	OPEN CLOSED	Displays if RUN ENABLE is present or not
START REQUEST?	NOT PRESENT PRESENT	Displays if start request has been applied to the system
AUTO TRANSFER?	NOT TRANSFERRED TRANSFERRED	Displays if the system is in Auto Transfer state or not. Does not reflect to PAR 16.08 AUTO XFER value itself
BYP OVERRIDE 1?	NOT ACTIVATED ACTIVATED	Status of Override 1
BYP OVERRIDE 2?	NOT ACTIVATED ACTIVATED	Status of Override 2
DRIVE FAULTED?	NO YES	Displays if drive is faulted or not
BYPASS FAULTED?	NO YES	Displays if bypass is faulted or not
SYSTEM STARTED?	NO YES	Displays if system is started or not
SYSTEM RUNNING?	NO YES	Displays if system is running or not
BYPASS ALARMS?	NO ALARMS ALARM ACTIVE	Displays if there is an active alarm(s) in bypass or not
HAND/OFF/AUTO?	OFF MODE HAND MODE AUTO MODE	Displays operating mode of the bypass - OFF, HAND or AUTO

Error messages

#	Error Message	Description
1	CAN'T EDIT PAR IS READ ONLY	Try to save value (=press the ENTER key in Parameter Edit State) of a read-only parameter. E.g. try to change value PAR 01.02 INPUT VOLT
2	CAN'T EDIT WHEN STARTED	Try to change value of a parameter, which is allowed to be changed only when system is not started. E.g. PAR 16.02 RUN ENABLE
3	CAN'T EDIT UP+DOWN ONLY	Try to change value of a "reset only" parameter other than zero. UP+DOWN buttons must be pressed simultaneously for requesting default value of the PAR on the display (value zero), and after that ENTER pressed for saving it (reset the parameter). E.g. PAR 04.01 LAST FAULT
4	CAN'T EDIT INP VOLTAGE LOW	Input voltage too low. Changing of parameters prohibited since system cannot save values to nv-mem w/ insufficient voltage.
5	CAN'T EDIT PAR IS HIDDEN	Try to save value (=press the ENTER key in Parameter Edit State) of a hidden parameter. Should not be possible. If hidden parameters are turned visible, this message is not given.
6	CAN'T EDIT UNDER LO-LIMIT	Try to save value which is over LO-LIMIT of the parameter. Should not be possible when changing parameters from control panel.
7	CAN'T EDIT UNDER HI-LIMIT	Try to save value which is over HI-LIMIT of the parameter. Should not be possible when changing parameters from control panel.
8	CAN'T EDIT ENUM VAL ONLY	Try to save value which is out of enumerated value list. Should not be possible when changing parameters from control panel.
9	CAN'T EDIT NO DEFAULT	Try to request default value (=press UP and DOWN buttons simultaneously) for a parameter which is defined not to have a default value. Should not be possible when changing parameters from control panel.
10	CAN'T EDIT TRY AGAIN.	Parameter system is busy, e.g. application macro change is in process at the same time when someone is trying to save a value for a parameter. Should not be possible when changing parameters from control panel.

Maintenance

See *Maintenance* for the ACH550-UH on page 31.

ACH550-PCR/PDR

Installation

This information is unique to ACH550 input disconnect configurations (PCR or PDR). The ACH550 with Input Disconnect is an ACH550 AC adjustable frequency drive packaged with an input disconnect switch or circuit breaker. Refer to the *Installation* instructions on page 3, for all other information. **Failure to observe the warnings and instructions may cause a malfunction or personal hazard.**



WARNING! Before you begin read *Safety* on page 2.



WARNING! When the ACH550 with Input Disconnect is connected to the line power, the Motor Terminals T1, T2, and T3 are live even if the motor is not running. Do not make any connections when the ACH550 with Input Disconnect is connected to the line. Disconnect and lock out power to the drive before servicing the drive. Failure to disconnect power may cause serious injury or death.

1. Install wiring

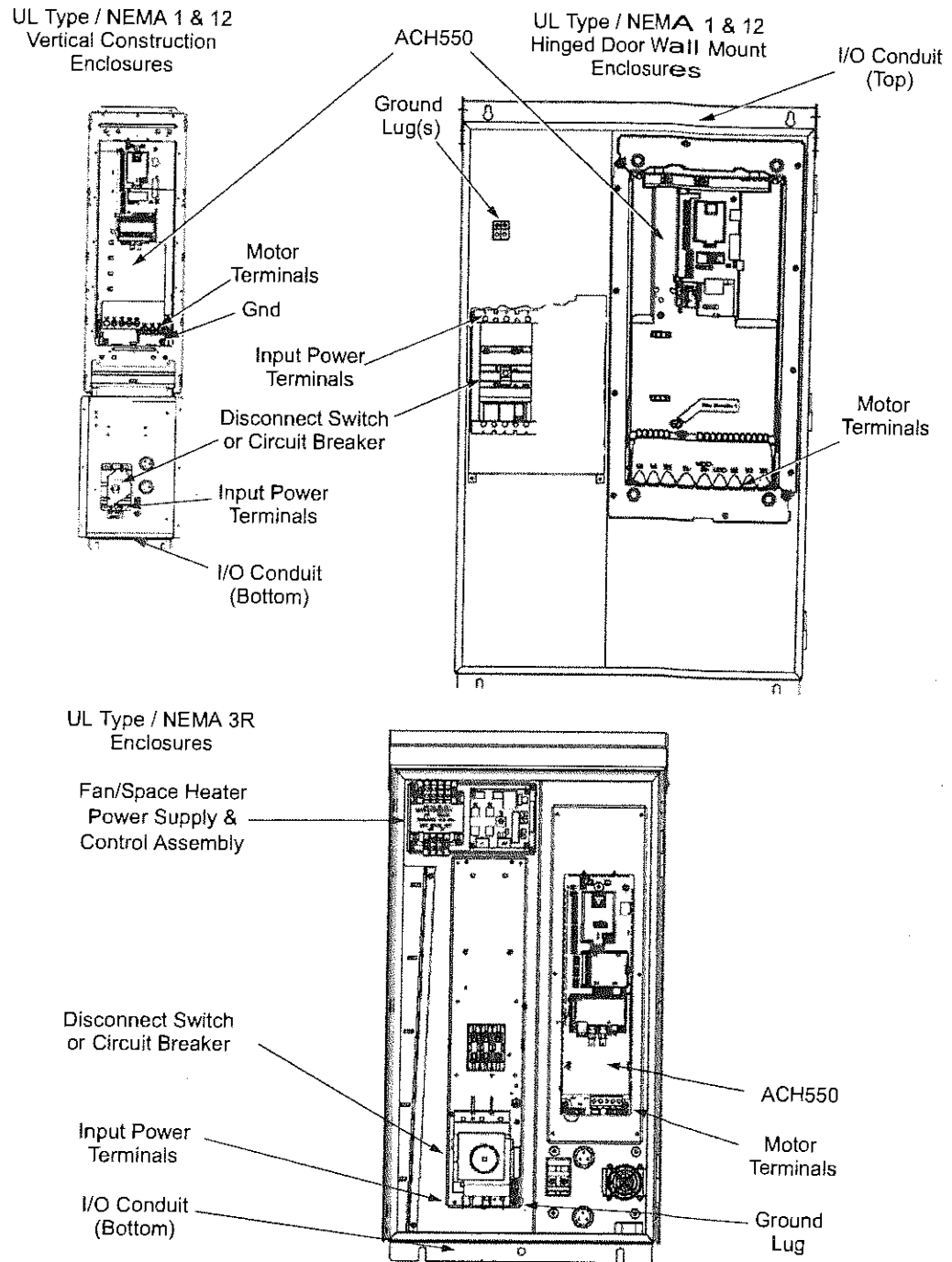


WARNING!

- Metal shavings or debris in the enclosure can damage electrical equipment and create a hazardous condition. Where parts, such as conduit plates require cutting or drilling, first remove the part. If that is not practical, cover nearby electrical components to protect them from all shavings or debris.
 - Do not connect or disconnect input or output power wiring, or control wires, when power is applied.
 - Never connect line voltage to drive output Terminals T1, T2, and T3.
 - Do not make any voltage tolerance tests (Hi Pot or Megger) on any part of the unit. Disconnect motor wires before taking any measurements in the motor or motor wires.
 - Make sure that power factor correction capacitors are not connected between the drive and the motor.
-

Connection diagrams – standard drive with input disconnect (wall mounted)

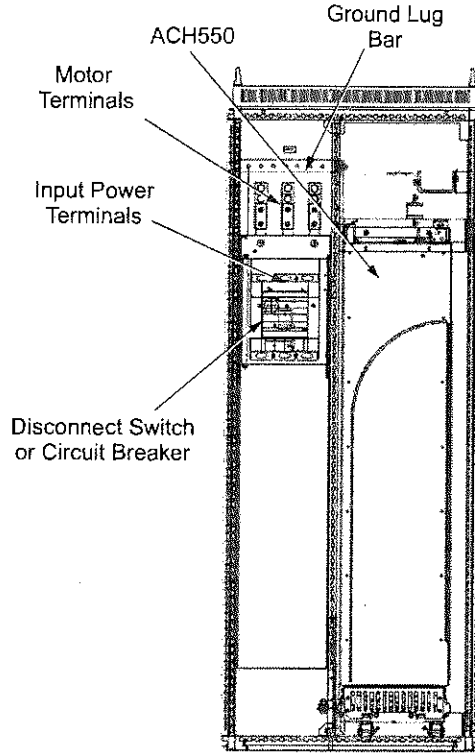
The following figure shows the Standard Drive with Input Disconnect (wall mounted) wiring connection points.



Note: Some UL Type 3R enclosures are designed to be mounted on a wall. Mounting some of these 3R enclosures on an open rack system requires the use of the supplied 3R enclosure back plates to maintain 3R integrity.

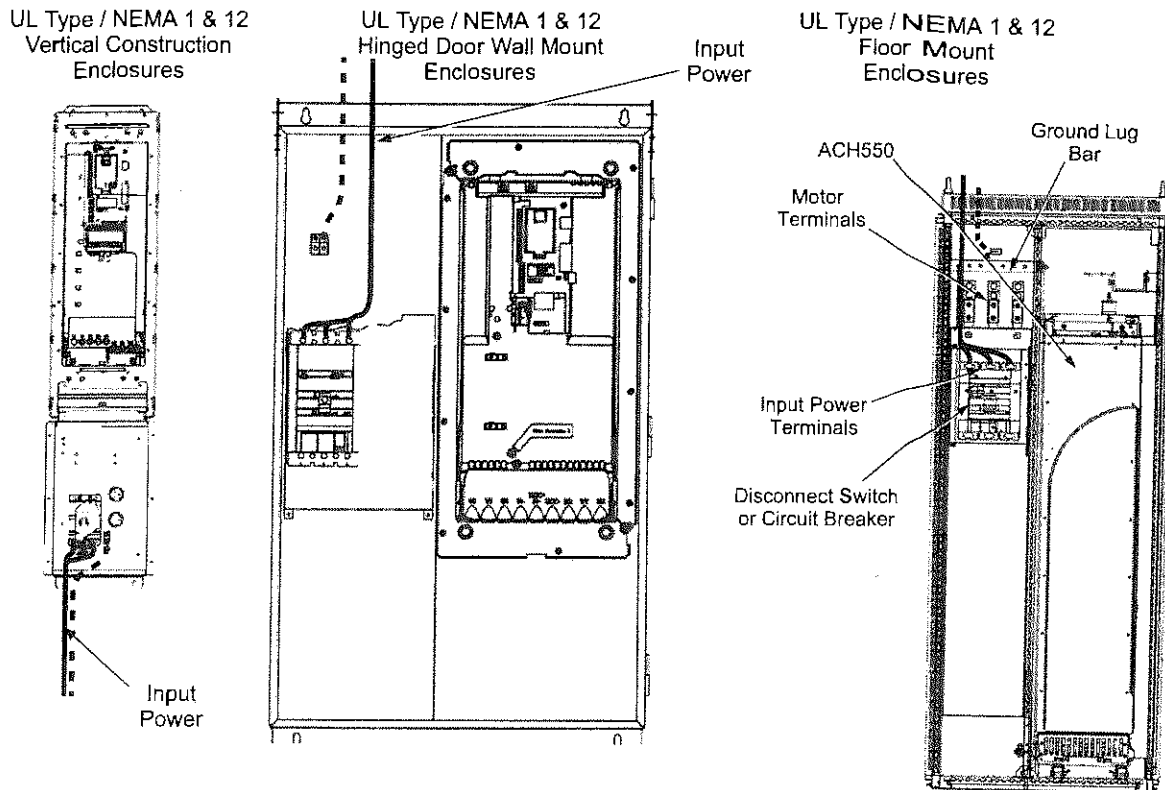
Connection diagrams – standard drive with input disconnect (floor mounted)

Floor mounted UL Type / NEMA 1 & 12 Drive with Input Disconnect units are configured for wiring access from the top and include a removable conduit mounting plate. The following figure shows the wiring connection points.



Line input connections – standard drive with input disconnect configurations

Connect input power to the terminals of the disconnect switch or circuit breaker. Connect the equipment grounding conductor to the ground lug at the top of the enclosure. The figure below shows the connection points for Standard Drive with Input Disconnect configurations.



Dashed line is ground run.

Note: The terminals on disconnect switches for the following rated ACH550-PDR products is 7 in-lbs. Do not use a power driver or over tighten to prevent breaking screw heads or stripping the terminal.

230 VAC	460 VAC	600 VAC
-04A6-2	-03A3-4	-02A7-6
-06A6-2	-04A1-4	-03A9-6
-07A5-2	-06A9-4	-06A1-6
-012A-2	-08A8-4	-09A0-6
-017A-2	-012A-4	-011A-6
-024A-2	-015A-4	-017A-6
-031A-2	-023A-4	

Power connection terminals

The following tables show maximum wire size and required tightening torque for incoming power, grounding and motor terminals.

208/240 Volt		Base Drive Frame Size	Power Wiring Data ²						
HP	Type Code ¹		Circuit Breaker UL Type/ NEMA 1 & 12	Circuit Breaker UL Type / NEMA 3R	Disconnect Switch UL Type/ NEMA 1&12	Disconnect Switch UL Type/ NEMA 3R	Motor Terminals	Ground Lugs UL Type/ NEMA 1&12	Ground Lugs UL Type / NEMA 3R
1	ACH550-PxR-04A6-2	R1	#10 35 in-lbs	#10 35 in-lbs	#10 7 in-lbs	#10 7 in-lbs	Refer to Drive's power connection terminals	#10 35 in-lbs	#10 35 in-lbs
1.5	ACH550-PxR-06A6-2	R1							
2	ACH550-PxR-07A5-2	R1							
3	ACH550-PxR-012A-2	R1							
5	ACH550-PxR-017A-2	R1							
7.5	ACH550-PxR-024A-2	R2	#6 45 in-lbs	#6 45 in-lbs	#8 7 in-lbs	#8 7 in-lbs		#6 35 in-lbs	#6 35 in-lbs
10	ACH550-PxR-031A-2	R2	#3 50 in-lbs	#3 50 in-lbs	#4 18 in-lbs	#4 18 in-lbs		#3 50 in-lbs	#3 50 in-lbs
15	ACH550-PxR-046A-2	R3							
20	ACH550-PxR-059A-2	R3	#1 50 in-lbs	#1 50 in-lbs	#1 55 in-lbs	#1 55 in-lbs		#2 50 in-lbs	#2 50 in-lbs
25	ACH550-PxR-075A-2	R4							
30	ACH550-PxR-088A-2	R4	350 MCM 274 in-lbs	300 MCM 200 in-lbs	#1/0 70 in-lbs	#1/0 70 in-lbs		3 x #3/0 250 in-lbs	#2/0 275 in-lbs
40	ACH550-PxR-114A-2	R4							
50	ACH550-PxR-143A-2	R6			300 MCM 275 in-lbs	300 MCM 200 in-lbs			
60	ACH550-PxR-178A-2	R6							
75	ACH550-PxR-221A-2	R6	2 x 500 MCM 274 in-lbs	2 x 500 MCM 274 in-lbs	2 x 500 MCM 274 in-lbs	2 x 500 MCM 274 in-lbs	350 MCM 100 in-lbs		
100	ACH550-PxR-248A-2	R6							

1. "PxR" represents both PCR and PDR.

2. Torque values shown relate to current production. Check component labels on previously installed units for required tightening torque.

480 Volt			Power Wiring Data ²						
HP	Type Code ¹	Base Drive Frame Size	Circuit Breaker UL Type/ NEMA 1 & 12	Circuit Breaker UL Type/ NEMA 3R	Disconnect Switch UL Type/ NEMA 1&12	Disconnect Switch UL Type/ NEMA 3R	Motor Terminals	Ground Lugs UL Type/ NEMA 1&12	Ground Lugs UL Type/ NEMA 3R
1/1.5	ACH550-PxR-03A3-4	R1	#10 35 in-lbs	#10 35 in-lbs	#10 7 in-lbs	#10 7 in-lbs	Refer to Drive's power connection terminals	#10 35 in-lbs	#10 35 in-lbs
2	ACH550-PxR-04A1-4	R1							
3	ACH550-PxR-06A9-4	R1							
5	ACH550-PxR-08A8-4	R1							
7.5	ACH550-PxR-012A-4	R1	#6 45 in-lbs	#6 45 in-lbs	#8 7 in-lbs	#8 7 in-lbs		#6 35 in-lbs	#6 35 in-lbs
10	ACH550-PxR-015A-4	R2							
15	ACH550-PxR-023A-4	R2	#3 50 in-lbs	#3 50 in-lbs	#4 18 in-lbs	#4 18 in-lbs		#3 50 in-lbs	#3 50 in-lbs
20	ACH550-PxR-031A-4	R3							
25	ACH550-PxR-038A-4	R3							
30	ACH550-PxR-045A-4	R3	#1 50 in-lbs	#1 50 in-lbs	#1 55 in-lbs	#1 55 in-lbs		#1 50 in-lbs	#1 50 in-lbs
40	ACH550-PxR-059A-4	R4							
50	ACH550-PxR-072A-4	R4							
60	ACH550-PxR-078A-4	R4	350 MCM 274 in-lbs	300 MCM 200 in-lbs	#1/0 70 in-lbs	#1/0 70 in-lbs	3 x #3/0 250 in-lbs	#2 50 in-lbs	
75	ACH550-PxR-097A-4	R4							
100	ACH550-PxR-125A-4	R5							
125	ACH550-PxR-157A-4	R6							
150	ACH550-PxR-180A-4	R6	2 x 500 MCM 274 in-lbs	2 x 500 MCM 274 in-lbs	2 x 500 MCM 274 in-lbs	2 x 500 MCM 274 in-lbs	350 MCM 100 in-lbs		
200	ACH550-PxR-246A-4	R6							
250	ACH550-PxR-316A-4	R8	2 x 500 MCM 274 in-lbs		2 x 500 MCM 274 in-lbs		5 Bus Bar Holes (13/32")		
300	ACH550-PxR-368A-4	R8							
350	ACH550-PxR-414A-4	R8							
400	ACH550-PxR-486A-4	R8							
450	ACH550-PxR-526A-4	R8	3 x 400 MCM 375 in-lbs		3 x 400 MCM 375 in-lbs				
500	ACH550-PxR-602A-4	R8							
550	ACH550-PxR-645A-4	R8							

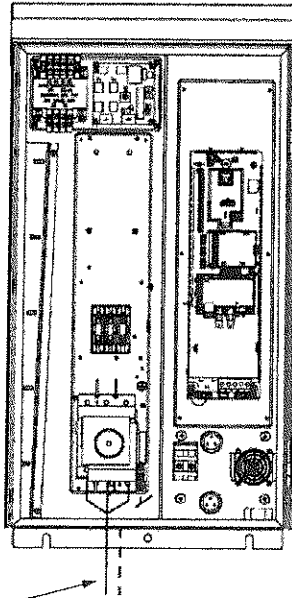
1. "PxR" represents both PCR and PDR.

2. Torque values shown relate to current production. Check component labels on previously installed units for required tightening torque.

600 Volt			Power Wiring Data ²						
HP	Type Code ¹	Frame Size	Circuit Breaker UL Type / NEMA 1 & 12	Circuit Breaker UL Type / NEMA 3R	Disconnect Switch UL Type / NEMA 1&12	Disconnect Switch UL Type / NEMA 3R	Motor Terminals	Ground Lugs UL Type / NEMA 1&12	Ground Lugs UL Type / NEMA 3R
2	ACH550-PxR-02A7-6	R2	#6 62 in-lbs	#6 62 in-lbs	#8 7 in-lbs	#8 7 in-lbs	Refer to Drive's power connection terminals	#6 35 in-lbs	#6 35 in-lbs
3	ACH550-PxR-03A9-6	R2							
5	ACH550-PxR-06A1-6	R2							
7.5	ACH550-PxR-09A0-6	R2							
10	ACH550-PxR-011A-6	R2							
15	ACH550-PxR-017A-6	R2	#3 62 in-lbs	#3 62 in-lbs				#3 50 in-lbs	#3 50 in-lbs
20	ACH550-PxR-022A-6	R3							
25	ACH550-PxR-027A-6	R3	#1 62 in-lbs	#1 62 in-lbs	#4 18 in-lbs	#4 18 in-lbs		#2 50 in-lbs	#2 50 in-lbs
30	ACH550-PxR-032A-6	R4							
40	ACH550-PxR-041A-6	R4							
50	ACH550-PxR-052A-6	R4			#1 62 in-lbs	#1 62 in-lbs	#1 55 in-lbs		
60	ACH550-PxR-062A-6	R4							
75	ACH550-PxR-077A-6	R6	350 MCM 274 in-lbs	300 MCM 275 in-lbs	#1/0 70 in-lbs	#1/0 70 in-lbs	3 x #3/0 250 in-lbs	#2/0 375 in-lbs	
100	ACH550-PxR-099A-6	R6							
125	ACH550-PxR-125A-6	R6							
150	ACH550-PxR-144A-6	R6			300 MCM 275 in-lbs	300 MCM 200 in-lbs			

1. "PxR" represents both PCR and PDR.

2. Torque values shown relate to current production. Check component labels on previously installed units for required tightening torque.

UL Type / NEMA 3R
EnclosuresInput
Power

WARNING! Check the motor and motor wiring insulation before connecting the ACH550 to line power. Follow the procedure on page 12. Before proceeding with the insulation resistance measurements, check that the ACH550 is disconnected from incoming line power. Failure to disconnect line power could result in death or serious injury.

Note: For the remainder of the wiring (motor and control wiring) refer to page 7.

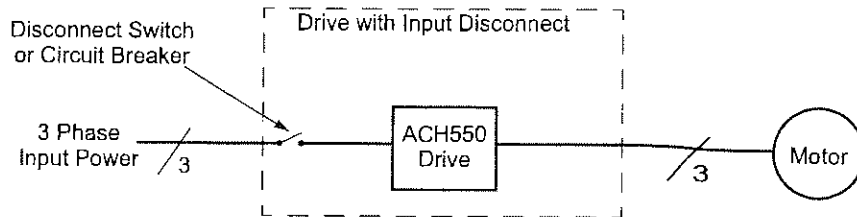
Operation

This information is unique to ACH550 input disconnect configurations (PCR or PDR). Refer to the *Operation* instructions on page 21 for all other information.

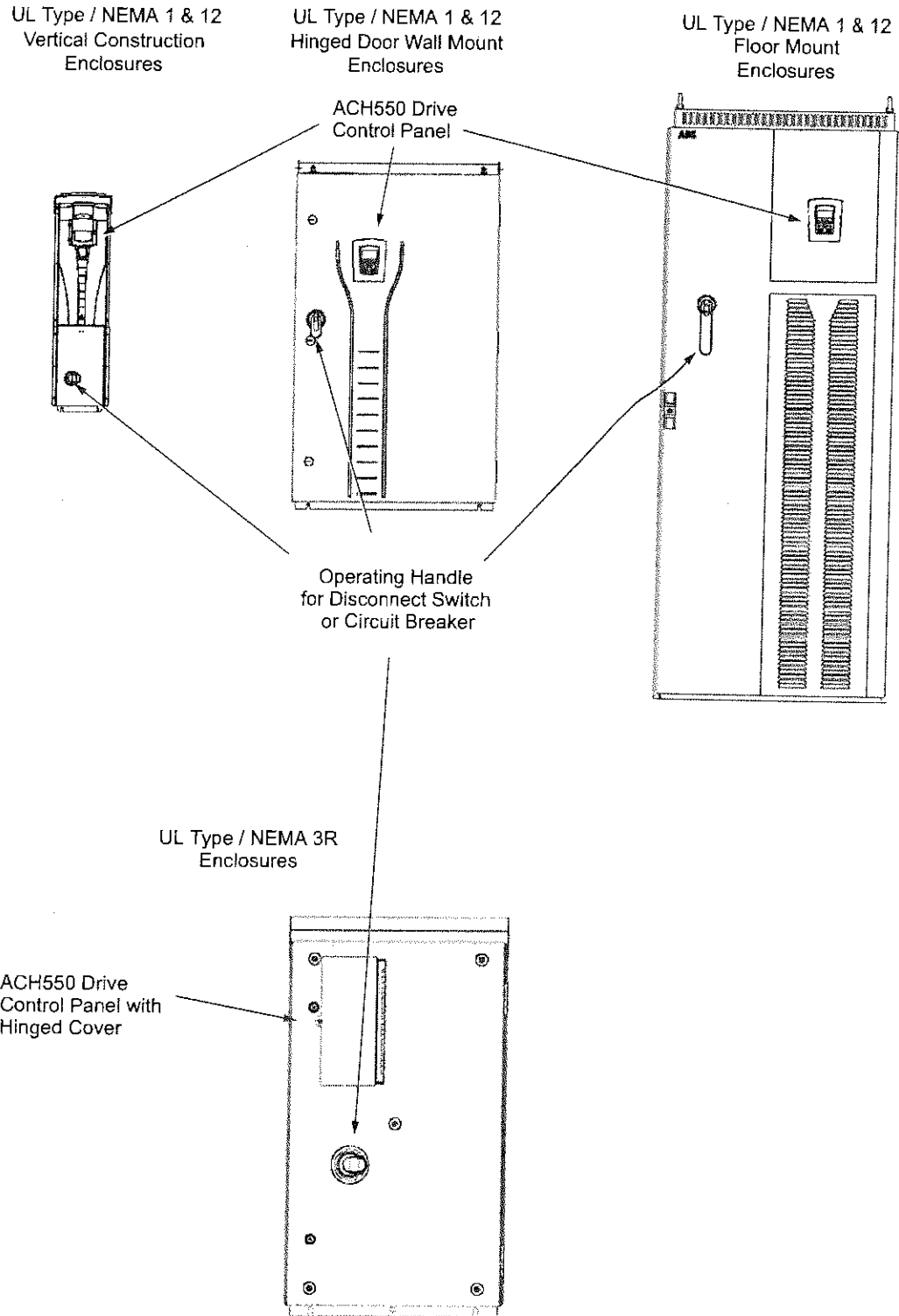
Input disconnect configuration

The ACH550 with Input Disconnect is an ACH550 AC adjustable frequency drive packaged with an input disconnect switch or circuit breaker, and with a door interlocked, external operating handle. The operating handle can be padlocked in the OFF position (padlock not supplied). Enclosure options are UL Type 1, UL Type 12, and UL Type 3R (NEMA 1, NEMA 12, and NEMA 3R).

The following is a typical power diagram.



The following shows the front view of the ACH550 Drive with Input Disconnect standard configurations, and identifies the major components.



Maintenance

Maintenance intervals

If installed in an appropriate environment, the drive **requires** very little maintenance. This table lists the routine maintenance intervals recommended by ABB for ACH550 enclosures in addition to the intervals on page 31.

Maintenance	Configuration	Interval	Instruction
Check/replace hinged door wall mount enclosure inlet air filter	Hinged door wall mount UL Type / NEMA 12 enclosures	Check every 3 months. Replace as needed.	<i>Enclosure air filter replacement – UL Type / NEMA 12 hinged door wall mount enclosures on page 89.</i>
Check/replace floor mount enclosure inlet air filter	Floor mount UL Type / NEMA 12 enclosures	Check every 3 months. Replace as needed.	<i>See Maintenance on page 34 and Enclosure air filter replacement – UL Type / NEMA 12 hinged door wall mount enclosures on page 89.</i>
Check/replace NEMA 3R enclosure air filters	UL Type / NEMA 3R enclosures - PX3R-5 and higher	Check every 3 months. Replace as needed.	See PX3R dimensional information.
Check/replace floor mount enclosure exhaust air filter.	Floor mount UL Type / NEMA 12 enclosures	Check every 6 months. Replace as needed.	<i>See Maintenance on page 35 and Enclosure air filter replacement – UL Type / NEMA 12 hinged door wall mount enclosures on page 89.</i>

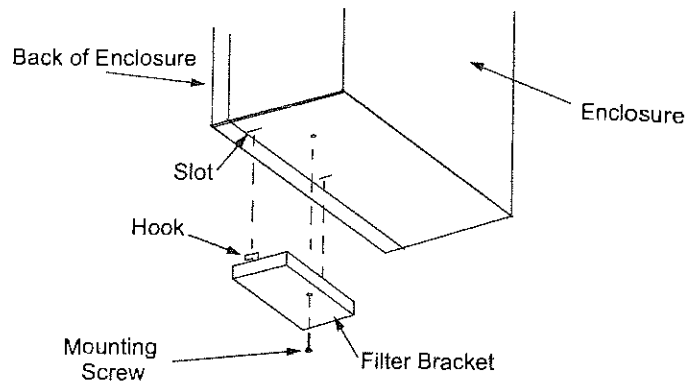
Enclosure air filter replacement – UL Type / NEMA 12 hinged door wall mount enclosures

Filter material

Material	Filter Type
American Air Filter (358-35-06A-12A)	Polykleon White 12.7 mm x 152.4 mm x 304.6 mm stk

This procedure applies to drive with input disconnect configurations in UL Type / NEMA 12 hinged door wall mount enclosures. This filter is located at the bottom of the enclosure. Use the following procedure to check and replace filters.

1. On the enclosure, remove the screw holding the filter bracket in place.
2. Slide the filter bracket forward until the hooks on the bracket clear the slots on the enclosure base. This step allows the filter and bracket to drop free from the enclosure.



3. Lift the filter out of the filter bracket and replace as appropriate.
4. With the filter in the filter bracket, align the hooks on the bracket with the slots in the enclosure base, and press the hooks up into the slots.
5. Slide the filter bracket back, making sure that the hooks catch on the enclosure.
6. Replace the mounting screw. Tighten until the gasket on the bracket is about 50% compressed.

Enclosure air filter replacement – UL Type / NEMA 12 floor mount enclosures

Filter material

Enclosure Type	Inlet (door)	Outlet (roof)
UL Type / NEMA 12	3AUA0000006723 (qty 1)	3AUA0000006722 (qty 2)

Note: When installing the filter media, the white side must face the outside of the cabinet and the colored side must face the inside of the cabinet. Refer to page 34.

Diagnostics

Refer to the *Diagnostics* instructions on page 24.

Complete ACH550 Drive Parameter List

GROUP 01 OPERATING DATA	GROUP 11 REFERENCE SELECT	1706 OVERRIDE DIR	3004 EXTERNAL FAULT 2	3605 STOP DAY 1
101 SPEED & DIR	1101 KEYPAD REF SEL	1707 OVERRIDE REF	3005 MOT THERM PROT	3606 START TIME 2
102 SPEED	1102 EXT1/EXT2 SEL	GROUP 20	3006 MOT THERM TIME	3607 STOP TIME 2
103 OUTPUT FREQ	1103 REF1 SELECT	LIMITS	3007 MOT LOAD CURVE	3608 START DAY 2
104 CURRENT	1104 REF 1 MIN	2001 MINIMUM SPEED	3008 ZERO SPEED LOAD	3609 STOP DAY 2
105 TORQUE	1105 REF 1 MAX	2002 MAXIMUM SPEED	3009 BREAK POINT	3610 START TIME 3
106 POWER	1106 REF2 SELECT	2003 MAX CURRENT	FREQ	3611 STOP TIME 3
107 DC BUS VOLTAGE	1107 REF 2 MIN	2006 UNDERVOLT CTRL	3010 STALL FUNCTION	3612 START DAY 3
109 OUTPUT VOLTAGE	1108 REF 2 MAX	2007 MINIMUM FREQ	3011 STALL	3613 STOP DAY 3
110 DRIVE TEMP	GROUP 12	2008 MAXIMUM FREQ	FREQUENCY	3614 START TIME 4
111 EXTERNAL REF 1	CONSTANT SPEEDS	2013 MIN TORQUE SEL	3012 STALL TIME	3615 STOP TIME 4
112 EXTERNAL REF 2	1201 CONST SPEED SEL	2014 MAX TORQUE SEL	3017 EARTH FAULT	3616 START DAY 4
113 CTRL LOCATION	1202 CONST SPEED 1	2015 MIN TORQUE 1	3018 COMM FAULT	3617 STOP DAY 4
114 RUN TIME (R)	1203 CONST SPEED 2	2016 MIN TORQUE 2	FUNC	3622 BOOST SEL
115 KWH COUNTER (R)	1204 CONST SPEED 3	2017 MAX TORQUE 1	3019 COMM FAULT TIME	3623 BOOST TIME
116 APPL BLK OUTPUT	1205 CONST SPEED 4	2018 MAX TORQUE 2	3021 A1 FAULT LIMIT	3626 TIMER 1 SRC
118 DI 1-3 STATUS	1206 CONST SPEED 5	GROUP 21	3022 A2 FAULT LIMIT	3627 TIMER 2 SRC
119 DI 4-6 STATUS	1207 CONST SPEED 6	START/STOP	3023 WIRING FAULT	3628 TIMER 3 SRC
120 AI 1	1208 CONST SPEED 7	2101 START FUNCTION	3024 CB TEMP FAULT	3629 TIMER 4 SRC
121 AI 2	1209 TIMED MODE SEL	2102 STOP FUNCTION	GROUP 31	GROUP 37
122 RO 1-3 STATUS	GROUP 13	2103 DC MAGN TIME	AUTOMATIC RESET	USER LOAD CURVE
123 RO 4-6 STATUS	ANALOG INPUTS	2104 DC HOLD CTL	3101 NR OF TRIALS	3701 USER LOAD C
124 AO 1	1301 MINIMUM AI1	2105 DC HOLD SPEED	3102 TRIAL TIME	MODE
125 AO 2	1302 MAXIMUM AI1	2106 DC CURR REF	3103 DELAY TIME	3702 USER LOAD C
126 PID 1 OUTPUT	1303 FILTER AI1	2107 DC BRAKE TIME	3104 AR OVERCURRENT	FUNC
127 PID 2 OUTPUT	1304 MINIMUM AI2	2108 START INHIBIT	3105 AR OVERVOLTAGE	3703 USER LOAD C TIME
128 PID 1 SETPNT	1305 MAXIMUM AI2	2109 EM STOP SEL	3106 AR	3704 LOAD FREQ 1
129 PID 2 SETPNT	1306 FILTER AI2	2110 TORQ BOOST	UNDERVOLTAGE	3705 LOAD TORQ LOW 1
130 PID 1 FBK	GROUP 14	2113 START DELAY	3107 AR AI-MIN	3706 LOAD TORQ HIGH 1
131 PID 2 FBK	RELAY OUTPUTS	GROUP 22	3108 AR EXTERNAL FLT	3707 LOAD FREQ 2
132 PID 1 DEVIATION	1401 RELAY OUTPUT 1	ACCEL/DECEL	GROUP 32	3708 LOAD TORQ LOW 2
133 PID 2 DEVIATION	1402 RELAY OUTPUT 2	2201 ACC/DEC 1/2 SEL	SUPERVISION	3709 LOAD TORQ HIGH 2
134 COMM RO WORD	1403 RELAY OUTPUT 3	2202 ACCELER TIME 1	3201 SUPERV 1 PARAM	3710 LOAD FREQ 3
135 COMM VALUE 1	1404 RO 1 ON DELAY	2203 DECELER TIME 1	3202 SUPERV 1 LIM LO	3711 LOAD TORQ LOW 3
136 COMM VALUE 2	1405 RO 1 OFF DELAY	2204 RAMP SHAPE 1	3203 SUPERV 1 LIM HI	3712 LOAD TORQ HIGH 3
137 PROCESS VAR 1	1406 RO 2 ON DELAY	2205 ACCELER TIME 2	3204 SUPERV 2 PARAM	3713 LOAD FREQ 4
138 PROCESS VAR 2	1407 RO 2 OFF DELAY	2206 DECELER TIME 2	3205 SUPERV 2 LIM LO	3714 LOAD TORQ LOW 4
139 PROCESS VAR 3	1408 RO 3 ON DELAY	2207 RAMP SHAPE 2	3206 SUPERV 2 LIM HI	3715 LOAD TORQ HIGH 4
140 RUN TIME	1409 RO 3 OFF DELAY	2208 EM DEC TIME	3207 SUPERV 3 PARAM	3716 LOAD FREQ 5
141 MWH COUNTER	1410 RELAY OUTPUT 4	2209 RAMP INPUT 0	3208 SUPERV 3 LIM LO	3717 LOAD TORQ LOW 5
142 REVOLUTION	1411 RELAY OUTPUT 5	GROUP 23	3209 SUPERV 3 LIM HI	3718 LOAD TORQ HIGH 5
CNTR	1412 RELAY OUTPUT 6	SPEED CONTROL	GROUP 33	GROUP 40
143 DRIVE ON TIME HI	1413 RO 4 ON DELAY	2301 PROP GAIN	INFORMATION	PROCESS PID SET 1
144 DRIVE ON TIME LO	1414 RO 4 OFF DELAY	2302 INTEGRATION TIME	3301 FW VERSION	4001 GAIN
145 MOTOR TEMP	1415 RO 5 ON DELAY	2303 DERIVATION TIME	3302 LP VERSION	4002 INTEGRATION TIME
150 CB TEMP	1416 RO 5 OFF DELAY	2304 ACC	3303 TEST DATE	4003 DERIVATION TIME
153 MOT THERM	1417 RO 6 ON DELAY	COMPENSATION	3304 DRIVE RATING	4004 PID DERIV FILTER
STRESS	1418 RO 6 OFF DELAY	2305 AUTOTUNE RUN	3305 PARTABLE	4005 ERROR VALUE INV
158 PID COMM VALUE 1	GROUP 15	GROUP 25	VERSION	4006 UNITS
159 PID COMM VALUE 2	ANALOG OUTPUTS	CRITICAL SPEEDS	GROUP 34	4007 DSP FORMAT
174 SAVED KWH	1501 AO1 CONTENT	2501 CRIT SPEED SEL	PANEL DISPLAY	4008 0% VALUE
175 SAVED MWH	1502 AO1 CONTENT MIN	2502 CRIT SPEED 1 LO	3401 SIGNAL 1 PARAM	4009 100% VALUE
176 SAVED AMOUNT 1	1503 AO1 CONTENT	2503 CRIT SPEED 1 HI	3402 SIGNAL 1 MIN	4010 SET POINT SEL
177 SAVED AMOUNT 2	MAX	2504 CRIT SPEED 2 LO	3403 SIGNAL 1 MAX	4011 INTERNAL SETPNT
178 SAVED CO2	1504 MINIMUM AO1	2505 CRIT SPEED 2 HI	3404 OUTPUT 1 DSP	4012 SETPOINT MIN
GROUP 03	1505 MAXIMUM AO1	2506 CRIT SPEED 3 LO	FORM	4013 SETPOINT MAX
FB ACTUAL SIGNALS	1506 FILTER AO1	2507 CRIT SPEED 3 HI	3405 OUTPUT 1 UNIT	4014 FBK SEL
301 FB CMD WORD 1	1507 AO2 CONTENT	GROUP 26	3406 OUTPUT 1 MIN	4015 FBK MULTIPLIER
302 FB CMD WORD 2	1508 AO2 CONTENT MIN	MOTOR CONTROL	3407 OUTPUT 1 MAX	4016 ACT1 INPUT
303 FB STS WORD 1	1509 AO2 CONTENT	2601 FLUX OPT ENABLE	3408 SIGNAL 2 PARAM	4017 ACT2 INPUT
304 FB STS WORD 2	MAX	2602 FLUX BRAKING	3409 SIGNAL 2 MIN	4018 ACT1 MINIMUM
305 FAULT WORD 1	1510 MINIMUM AO2	2603 IR COMP VOLT	3410 SIGNAL 2 MAX	4019 ACT1 MAXIMUM
306 FAULT WORD 2	1511 MAXIMUM AO2	2604 IR COMP FREQ	3411 OUTPUT 2 DSP	4020 ACT2 MINIMUM
307 FAULT WORD 3	1512 FILTER AO2	2605 U/F RATIO	FORM	4021 ACT2 MAXIMUM
308 ALARM WORD 1	GROUP 16	2606 SWITCHING FREQ	3412 OUTPUT 2 UNIT	4022 SLEEP SELECTION
309 ALARM WORD 2	SYSTEM CONTROLS	2607 SW FREQ CTRL	3413 OUTPUT 2 MIN	4023 PID SLEEP LEVEL
GROUP 04	1601 RUN ENABLE	2608 SLIP COMP RATIO	3414 OUTPUT 2 MAX	4024 PID SLEEP DELAY
FAULT HISTORY	1602 PARAMETER LOCK	2609 NOISE	3415 SIGNAL 3 PARAM	4025 WAKE-UP DEV
401 LAST FAULT	1603 PASS CODE	SMOOTHING	3416 SIGNAL 3 MIN	4026 WAKE-UP DELAY
402 FAULT TIME 1	1604 FAULT RESET SEL	2619 DC STABILIZER	3417 SIGNAL 3 MAX	4027 PID 1 PARAM SET
403 FAULT TIME 2	1605 USER PAR SET	GROUP 29	3418 OUTPUT 3 DSP	GROUP 41
404 SPEED AT FLT	CHG	MAINTENANCE TRIG	FORM	PROCESS PID SET 2
405 FREQ AT FLT	1606 LOCAL LOCK	2901 COOLING FAN	3419 OUTPUT 3 UNIT	4101 GAIN
406 VOLTAGE AT FLT	1607 PARAM SAVE	TRIG	3420 OUTPUT 3 MIN	4102 INTEGRATION TIME
407 CURRENT AT FLT	1608 START ENABLE 1	2902 COOLING FAN ACT	3421 OUTPUT 3 MAX	4103 DERIVATION TIME
408 TORQUE AT FLT	1609 START ENABLE 2	2903 REVOLUTION TRIG	GROUP 35	4104 PID DERIV FILTER
409 STATUS AT FLT	1610 DISPLAY ALARMS	2904 REVOLUTION ACT	MOTOR TEMP MEAS	4105 ERROR VALUE INV
410 DI 1-3 AT FLT	1611 PARAMETER VIEW	2905 RUN TIME TRIG	3501 SENSOR TYPE	4106 UNITS
411 DI 4-6 AT FLT	GROUP 17	2906 RUN TIME ACT	3502 INPUT SELECTION	4107 UNIT SCALE
412 PREVIOUS FAULT 1	OVERVERRIDE	2907 USER MWH TRIG	3503 ALARM LIMIT	4108 0% VALUE
413 PREVIOUS FAULT 2	1701 OVERRIDE SEL	2908 USER MWH ACT	3504 FAULT LIMIT	4109 100% VALUE
GROUP 10	1702 OVERRIDE FREQ	GROUP 30	GROUP 36	4110 SET POINT SEL
START/STOP/DIR	1703 OVERRIDE SPEED	FAULT FUNCTIONS	TIMED FUNCTIONS	4111 INTERNAL SETPNT
1001 EXT1 COMMANDS	1704 OVERR PASS	3001 AI-MIN FUNCTION	3601 TIMERS ENABLE	4112 SETPOINT MIN
1002 EXT2 COMMANDS	CODE	3002 PANEL COMM ERR	3602 START TIME 1	4113 SETPOINT MAX
1003 DIRECTION	1705 OVERRIDE	3003 EXTERNAL FAULT 1	3603 STOP TIME 1	4114 FBK SEL
			3604 START DAY 1	4115 FBK MULTIPLIER
				4116 ACT1 INPUT



3AUA0000081824 REV B
Effective: 04/15/2012

ABB Inc.
16250 West Glendale Drive
New Berlin, WI 53151
USA
Telephone +1 800 752-0696
Fax +1 262 785-0397
Internet www.abb.us/drives



WARRANTY POLICY

This policy defines the warranties covered by the Low Voltage Drives Sales group and the means by which a customer can obtain additional warranty for a specified product beyond the standard warranty period listed in the ABB General Terms & Conditions. (ABB typically warrants equipment, excluding software, against defects in material and workmanship for a period of twelve (12) months from date of start-up, not to exceed eighteen (18) months from date of shipment from ABB - for specifics consult the latest revision of the document). Extended warranty requirements must be requested through the Sales Quotation Procedure/Must Win Process.

This policy applies to all LV Drive Products purchased from the LV Drives Sales Divisions (i.e. Standard ACS 50, ACS 100, ACS 140, ACS 150, ACS 160, ACS 350, ACS/H 400, ACS/H 550, ACS 600, ACS 800 and DC Drives plus Motors and Accessories included in the scope of supply). Certified start-up and extended warranty coverage is available only for the products listed herein when purchased and installed in the US and Canada, unless otherwise defined and approved through the Sales Quotation Procedure and RFQ Process/Must Win process.

Extended 36 Month Parts/Labor/Travel Warranty

The following lists the general products and the warranties available for each product.

DRIVES PURCHASED AND INSTALLED IN THE US AND CANADA

ACS 50/150/350 drive products carry a standard "parts only" warranty for a period of 12 months from date of start up, not to exceed 24 months from date of shipment from ABB New Berlin. These products are not serviceable in the field and drive modules, control panels or other options are replaced. Associated labor and transportation costs are not covered. Certified start up is not available.

ACS 100/140/160 drive products carry a standard "parts only" warranty for a period of 24 months from date of start up, not to exceed 30 months from date of shipment from ABB New Berlin. These drives are not serviceable in the field and are replaced. Associated labor and transportation costs are not covered. Certified start up is not available.

Standard ACS 400 products carry a standard "parts and on-site labor " warranty, excluding travel time and travel cost, for a period of 24 months from date of start up, not to exceed 30 months from date of shipment from ABB New Berlin. Frame sizes R1 and R2 are not field serviceable and are replaced with new or refurbished product at ABB's option. When start up service is performed by an ABB certified start up technician and registered with ABB Technical Support in New Berlin, the purchaser will receive on-site parts, labor and travel costs as authorized by ABB Technical Support 1-800-HELP-365 during the standard warranty period. Certified start-up must be performed within 24 months from the date of shipment from ABB New Berlin and properly registered within the normal warranty period in order for the on-site parts, labor and travel costs to be covered.



Standard ACH 400, ACS/H 550, ACS 600, ACS 800 and DCS 400/500B products carry a standard "parts and on-site labor" warranty, excluding travel time and travel cost, for a period of 12 months from date of start up, not to exceed 24 months from date of shipment from ABB New Berlin. When start up service is performed by an ABB certified start up technician and registered with ABB Technical Support in New Berlin, the warranty period is extended to 24 months from date of start up, not to exceed 30 months from date of shipment from the ABB New Berlin facility. The extended warranty includes repair, or replacement at ABB's option, when the defective unit is returned to ABB freight prepaid. Alternatively, the purchaser will receive on-site parts and labor, including travel time and travel costs as authorized by ABB Technical Support Department 1-800-HELP-365 during the warranty period. In order for the extended warranty to be valid, the certified start up must be performed within 24 months from date of shipment and properly registered with ABB Technical Support.

Returns to ABB of product or parts are to be made by prepaid freight. Collect return shipments are not accepted. Replacement product or parts from ABB are shipped prepaid from ABB.

Engineered Drives and Multi-Drives (including XXT ratings) are not eligible for certified start-up and related extended warranty.

On-site drive warranty repairs are performed by local ABB certified Designated Service Stations or by ABB service engineers.

PURCHASE OF EXTENDED SALES WARRANTY

Extended warranty can be purchased for certain drives. The extended warranty can add up to 4 years of warranty to the standard warranty as described below, with a total maximum warranty time limit of 5 years after shipment from ABB in New Berlin, WI.

Eligible drives include standard ACS/H 400, ACS/H 550, ACS 600, ACS 800 and Engineered Drives prior to purchase. Drives already in operation are eligible if a registered certified start-up has been performed, subject to a 12-month limitation from date of shipment (see below).

When extended warranty is requested, start up services must be performed by an ABB certified start up technician and registered with ABB Technical Support in New Berlin.

Standard Products

Extended Warranties must be purchased at time of order, or within 12 months from date of shipment from the ABB New Berlin facility. The extended warranty can be obtained in two ways using the Sales Quotation Procedure and Must Wins:

1. If a warranty extension is requested, a Must Win stating the requested warranty period must be submitted to ABB Drives Sales and approved prior to order placement.
2. If a warranty extension is purchased, the following price adders shall apply:
 - For "parts and on-site labor" warranty, 3% of the total net price of the equipment ordered is to be added for each additional year purchased, up to the maximum total warranty time of 5 years from date of shipment.



- For "on-site parts, labor, and travel" warranty, 5% of the total net price of the equipment ordered is to be added for each additional year purchased, up to the maximum total warranty time of 5 years from date of shipment.

Engineered Drives

Extended warranty for drives only in an engineered drives system must be purchased at the time of order and in compliance with the approved request for quote. This extended warranty can be obtained by using the Sales Quotation Procedure (RFQ).

If additional warranty is purchased, the following adder apply:

- For "on-site parts, labor, and travel" warranty, 5% of the total net price of the equipment ordered is to be added for each additional year purchased, up to the maximum total warranty of 5 years from date of shipment from ABB New Berlin.

Extended warranty for non-ABB equipment (e.g. motors, transformers, etc.) in an engineered drive system is available to the extent it is offered by the Manufacturer.

DRIVES PURCHASED IN THE US AND CANADA AND INSTALLED IN COUNTRIES OTHER THAN THE US AND CANADA

Drives purchased by US OEM's for export to countries other than the US and Canada carry the same standard "parts only" or "parts and on-site labor" warranty as drives purchased and installed in the US and Canada as set forth above. Certified start-up and extended warranty coverage is not available.

Warranty remedies are normally executed through the ABB global service network either by repair at a local ABB facility or by providing on-site service. Replacement/repair parts are delivered to the point of repair at no cost to Purchaser, with the exception of cost of import duties. Replacement product (drives) is delivered to Purchaser in the US. Purchaser is responsible for delivery arrangements to third country.

Distance costs (travel time, travel costs) in third country by service personnel, local third country shipping costs in connection with return of product to ABB facility for repairs and import duties into third country are not included in the warranty coverage.

Purchaser is responsible for submitting export registration forms to ABB for exported drives. Registration forms can be found on www.abb-drives.com or can be requested from ABB Technical Support (1-800-HELP 365).

WARRANTY CLAIMS

When a warranty claim is made to ABB Technical Support a Fault/No-Fault purchase order must be issued to ABB. If the failed equipment is not returned within 30 days from the date of shipment of the replacement unit from ABB, or if the failure is found to be of non-warranty nature, the customer will be billed for the costs incurred on the No-fault purchase order.

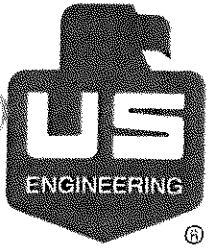
**MOTORS INCLUDED IN SCOPE OF SUPPLY**

ABB NEMA or IEC Inverter Duty Low Voltage AC motors are warranted for 24 months from date of start up, not to exceed 30 months from date of shipment. For additional warranty requirements, please contact ABB LV Drives Sales.

ABB DC motors carry a 12-month, "parts only" warranty from date of start up, not to exceed 18 months from date of shipment, excluding items that are considered normal wear and tear on a DC Machine (i.e. brushes, bearings, etc.). For additional warranty requirements, please contact ABB LV Drives Sales.

If the scope of supply includes motors not manufactured by ABB, including brand labeled motors, such motors are covered by the Manufacturer's standard warranty. The Manufacturer is responsible for warranty administration.

***Additional warranties not covered in this procedure, must be signed off by the Business Manager through the guidelines of the Sales Quotation Procedure (Must Wins).**



Common Motor and VFD
Product Submittal
Information

**BEATTIE
ELEMENTARY
SCHOOL**

3430 MEADOWLARK AVE
FORT COLLINS CO 80526



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
---	--	--

Date: 4/28/2014	Reference Number: 0072
------------------------	-------------------------------

Transmitted To: Chris Mallory US Engineering Co. P.O. Box 905 Loveland, CO 80539	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001 N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
--	---

Qty	Submittal Package No	Description	Due Date	Package Action
1	021 - 230513 - 0	Variable Frequency Drives		Make Corrections Noted

Transmitted For	Delivered Via	Tracking Number
For Your Use and Corrections	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
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Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

<hr style="border: 0; border-top: 1px solid black;"/> Signature	<hr style="border: 0; border-top: 1px solid black;"/> Signed Date
<hr style="border: 0; border-top: 1px solid black;"/> <i>Prolog Manager</i>	<hr style="border: 0; border-top: 1px solid black;"/> Page 1

TRANSMITTAL



Belford Watkins Group
Architects

Date: 4.10.14

Project: Beattie Elementary

To: Rob Price/DJ Anderson

From: Patti Watkins

We are transmitting the following submittals with the comments listed below:

ARCHITECTURE

INTERIORS

PLANNING

NET: No Exception Taken **MCN: Make Corrections Noted** **RX: Rejected**
RR: Revise and Resubmit **SSI: Submit Specified Item**
CMT: See Comment Below

230513 Variable Frequency Drives

Copies	Section	Item	Manufacturer	NET	MCN	RR	RX	SSI	CMT
1	230513	Product Data	ABB		X				1

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures, there from. The Contractor remains responsible for details and accuracy, for conforming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

Notes: 1: VFD'S AND MOTORS (Make Corrections Noted, verify final acceptance with PSD)

1. AE concurs that the note on page 4 of this submittal meets the intent of the specification and provides PSD with the opportunity to maintain full system operation when the drive is down for service. However, this should be confirmed with PSD as their requirements for VFD's are very specific.
2. Motor data only appears to be included for the 2 hp motors. Provide the 7.5 hp motors as well.



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
---	--	--

Date: 3/28/2014	Reference Number: 0029
------------------------	-------------------------------

Transmitted To: Don Watkins Belford Watkins Group P.O. Box 1306 Fort Collins, CO 80521 Tel: 970-212-1243	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001 N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
---	---

Qty	Submittal Package No	Description	Due Date	Package Action
1	021 - 230513 - 0	Variable Frequency Drives	4/11/2014	

Transmitted For	Delivered Via	Tracking Number
Review & Approval	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

<hr style="border: 0; border-top: 1px solid black;"/> Signature	<hr style="border: 0; border-top: 1px solid black;"/> Signed Date
<i>Prolog Manager</i>	Printed on: 3/28/2014 FCI PM Data
	Page 1



4001 N. Valley Drive
Longmont, CO 80504
Phone: 970-535-4867
Fax: 970-535-4867

DATE: 03/28/2014

SPECIFICATION SECTION(S): 230513
SCOPE OF WORK: HVAC - VFD's

PROJECT: Poudre School District – Beattie Elementary School

PROJECT #: 30-13-038

ARCHITECT/DESIGNER: Belford Watkins Group, LLC.
425 West Mulberry Ave., Suite 207
P.O. Box 1306
Fort Collins, CO 80521

PHONE: 970-407-0070

GENERAL CONTRACTOR: FCI CONSTRUCTORS, INC.
4001 N. Valley Drive
Longmont, CO 80504

PHONE: 970-535-4725
FAX: 970-535-4867

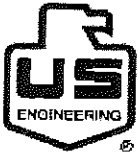
SUBMITTED BY: U.S. Engineering
PO Box 905
Loveland, CO 80539

PHONE: 970-669-1666
FAX:

CONTRACTORS STAMP:

ARCHITECT/ENGINEER STAMP

FCI CONSTRUCTORS, INC.
Review of this submittal is subject to the provisions of the Contract Drawings and Specifications. This action is for general concurrence only.
<input checked="" type="checkbox"/> Reviewed
<input type="checkbox"/> Reviewed with Notations Indicated - Resubmit with Corrections
<input type="checkbox"/> DISAPPROVED RESUBMIT
<input type="checkbox"/> Reviewed with Notations Indicated - Resubmittal not Required.
Submittal Reviewed By: DA Date:03/28/2014
Submittal No: 021 Spec. Section: 230513



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 130539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-006

Date: 3/18/2014

Revision #: _____

Discipline: Temp. Controls

Project: Beattie Elementary

Project #: 1202

Supplier: CFM Company

Spec Sect: 23 05 13

Submitted Items:

Page Number	Paragraph Number	Description	Manufacturer
23 05 13 - 4	2.02	Variable Frequency Drives	ABB
			Lead Time-10 business days

Target Dates:

Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
3/11/14	3/18/14	3/28/14		

GC/Arch/Engineer Stamp Area:

Signed: 
Chris Mallory
U.S. Engineering



CFM COMPANY

AIR CONDITIONING / HEATING / VENTILATING EQUIPMENT

413D North Highway 287 - Ft. Collins, CO 80524

Phone: (970) 493-7293 / Fax: (970) 493-7297

PSD - Beattie Elementary

TAG: VFD's

ABB Variable Frequency Drives

**Specification Section:
230513**

Submittal Date: 3/12/2014

Submitted by: Justin Dunkin

Specification Section 230513, 2.02-C, calls for secondary starter to control motors in case of VFD failure. ABB VFD's with Electronic Bypass (as submitted) have BAS integration for both the drive and the bypass. Due to this feature the bypass can fully control the motors in the case of a drive failure. Drives are also submitted and provided with a drive service switch so that in the case of a drive failure the drive can be safely repaired/replaced while the bypass is still in operation. ABB VFD's with these features as submitted meet the intent of the specification

Submittal Schedule

This schedule includes the products supplied as part of this submittal.

Schedule			Motor Data ¹			Drive Data			
Tagging /						Output			
Item	Qty	Equipment ID	HP	FLA	Voltage	Product ID	HP	Amps	Voltage
1	1	CT-1	10	28	208 VAC	ACH550-VCR-031A-2+F267	10	30.8	208 VAC
2	1	P-3	3	9.6	208 VAC	ACH550-VCR-012A-2+F267	3	11.8	208 VAC
3	1	P-4	5	15.2	208 VAC	ACH550-VCR-017A-2+F267	5	16.7	208 VAC
4	1	RTU-6	10	28	208 VAC	ACH550-VCR-031A-2+F267	10	30.8	208 VAC
5	5	2 HP VFD's	2	6.8	208 VAC	ACH550-VCR-07A5-2+F267	2	7.5	208 VAC
6	5	7.5 HP VFD's	7.5	22	208 VAC	ACH550-VCR-024A-2+F267	7.5	24.2	208 VAC

Notes: 1. AC Motor Data is per National Electrical Code Table 430.250 for typical motors used in most applications and is provided as typical data only. DC motor data is per typical industry standards. Actual motor data may vary.

Clarifications and Exceptions to Specification and Terms

The comments and clarifications that follow are offered in response to the specification items identified below. Please refer to the specification section and paragraph indicated. Any contract executed based on this proposal is done based acceptance of the exceptions noted herein.

Item ID	Title	Clarifications and Exceptions
230513, 2.02-C	Accessories	Specification calls for secondary starter to control motors in case of VFD failure. ABB VFD's with Electronic Bypass (as submitted) have BAS integration for both the drive and the bypass. Due to this feature the bypass can fully control the motors in the case of a drive failure. Drives are also submitted and provided with a drive service switch so that in the case of a drive failure the drive can be safely repaired/replaced while the bypass is still in operation. ABB VFD's with these features as submitted meet the intent of the specification.

Submittal Schedule Details for CT-1

Item	Tag / Equipment ID	Product ID
1	CT-1	ACH550-VCR-031A-2+F267

Item Description
Input Voltage: 208 VAC Rated Output Current: 30.8 AMPS Construction: Vertical E-clipse-Bypass, Circuit Breaker Enclosure: NEMA/UL Type 1 Nominal Horsepower: 10 Frame Size: R2 Input Disconnecting Means: Circuit Breaker Bypass: E-Clipse Bypass Input Impedance: 5% Short Circuit Current Rating: 100 kA Communication Protocols: Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet Other Options: Service Switch Recommended Spare Parts Package :

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	Bussmann Type
60	JJS-60

Wire Size Capacities of Power Terminals				
Circuit Breaker	Disconnect Switch	Terminal Block	Overload Relay	Ground Lug
#2 50 in-lbs	N/A N/A	#2 50 in-lbs	N/A N/A	#2 50 in-lbs

Dimensions and Weights				
Height in / mm	Width in / mm	Depth in / mm	Weight lbs / kg	Dimension Drawing
47.7 / 1211	8.4 / 214	10.9 / 278	70 / 32	3AUA0000016373 Sheet 1

Heat Dissipation & Airflow Requirements			
Power Losses		Airflow	
Watts	BTU/Hr	CFM	CM/Hr
285	373	52	88

Reference Drawings		
Power Wiring	Connection Diagram	Dimension Detail
00VCR024PW-C	VCVDR014CC-A	3AUA0000016373 Sheet 1

Submittal Schedule Details for P-3

Item	Tag / Equipment ID	Product ID
2	P-3	ACH550-VCR-012A-2+F267

Item Description
Input Voltage: 208 VAC Rated Output Current: 11.8 AMPS Construction: Vertical E-clipse-Bypass, Circuit Breaker Enclosure: NEMA/UL Type 1 Nominal Horsepower: 3 Frame Size: R1 Input Disconnecting Means: Circuit Breaker Bypass: E-Clipse Bypass Input Impedance: 5% Short Circuit Current Rating: 100 kA Communication Protocols: Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet Other Options: Service Switch Recommended Spare Parts Package :

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	Bussmann Type
15	KTK-R-15

Wire Size Capacities of Power Terminals				
Circuit Breaker	Disconnect Switch	Terminal Block	Overload Relay	Ground Lug
#10 35 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs

Dimensions and Weights				
Height in / mm	Width in / mm	Depth in / mm	Weight lbs / kg	Dimension Drawing
40.2 / 1021	5.4 / 136	10.1 / 256	32 / 15	3AUA0000016371 Sheet 1

Heat Dissipation & Airflow Requirements			
Power Losses		Airflow	
Watts	BTU/Hr	CFM	CM/Hr
116	404	26	44

Reference Drawings		
Power Wiring	Connection Diagram	Dimension Detail
00VCR012PW-C	VCVDR014CC-A	3AUA0000016371 Sheet 1

Submittal Schedule Details for P-4

Item	Tag / Equipment ID	Product ID
3	P-4	ACH550-VCR-017A-2+F267

Item Description
Input Voltage: 208 VAC Rated Output Current: 16.7 AMPS Construction: Vertical E-clipse-Bypass, Circuit Breaker Enclosure: NEMA/UL Type 1 Nominal Horsepower: 5 Frame Size: R1 Input Disconnecting Means: Circuit Breaker Bypass: E-clipse Bypass Input Impedance: 5% Short Circuit Current Rating: 100 kA Communication Protocols: Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet Other Options: Service Switch Recommended Spare Parts Package :

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	Bussmann Type
30	KTK-R-30

Wire Size Capacities of Power Terminals				
Circuit Breaker	Disconnect Switch	Terminal Block	Overload Relay	Ground Lug
#10 35 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs

Dimensions and Weights				
Height in / mm	Width in / mm	Depth in / mm	Weight lbs / kg	Dimension Drawing
40.2 / 1021	5.4 / 136	10.1 / 256	32 / 15	3AUA0000016371 Sheet 1

Heat Dissipation & Airflow Requirements				
Power Losses			Airflow	
Watts	BTU/Hr	CFM	CM/Hr	
161	551	26	44	

Reference Drawings		
Power Wiring	Connection Diagram	Dimension Detail
00VCR012PW-C	VCVDR014CC-A	3AUA0000016371 Sheet 1

Submittal Schedule Details for RTU-6

Item	Tag / Equipment ID	Product ID
4	RTU-6	ACH550-VCR-031A-2+F267

Item Description
<p>Input Voltage: 208 VAC Rated Output Current: 30.8 AMPS Construction: Vertical E-clipse-Bypass, Circuit Breaker Enclosure: NEMA/UL Type 1 Nominal Horsepower: 10 Frame Size: R2 Input Disconnecting Means: Circuit Breaker Bypass: E-Clipse Bypass Input Impedance: 5% Short Circuit Current Rating: 100 kA Communication Protocols: Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet Other Options: Service Switch Recommended Spare Parts Package :</p>

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	Bussmann Type
60	JJS-60

Wire Size Capacities of Power Terminals				
Circuit Breaker	Disconnect Switch	Terminal Block	Overload Relay	Ground Lug
#2 50 in-lbs	N/A N/A	#2 50 in-lbs	N/A N/A	#2 50 in-lbs

Dimensions and Weights				
Height in / mm	Width in / mm	Depth in / mm	Weight lbs / kg	Dimension Drawing
47.7 / 1211	8.4 / 214	10.9 / 278	70 / 32	3AUA0000016373 Sheet 1

Heat Dissipation & Airflow Requirements			
Power Losses		Airflow	
Watts	BTU/Hr	CFM	CM/Hr
285	373	52	88

Reference Drawings		
Power Wiring	Connection Diagram	Dimension Detail
00VCR024PW-C	VCVDR014CC-A	3AUA0000016373 Sheet 1

Submittal Schedule Details for 2 HP VFD's

Item	Tag / Equipment ID	Product ID
5	2 HP VFD's	ACH550-VCR-07A5-2+F267

Item Description
<p>Input Voltage: 208 VAC Rated Output Current: 7.5 AMPS Construction: Vertical E-clipse-Bypass, Circuit Breaker Enclosure: NEMA/UL Type 1 Nominal Horsepower: 2 Frame Size: R1 Input Disconnecting Means: Circuit Breaker Bypass: E-Clipse Bypass Input Impedance: 5% Short Circuit Current Rating: 100 kA Communication Protocols: Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet Other Options: Service Switch Recommended Spare Parts Package :</p>

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	Bussmann Type
15	KTK-R-15

Wire Size Capacities of Power Terminals				
Circuit Breaker	Disconnect Switch	Terminal Block	Overload Relay	Ground Lug
#10 35 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs

Dimensions and Weights				
Height in / mm	Width in / mm	Depth in / mm	Weight lbs / kg	Dimension Drawing
40.2 / 1021	5.4 / 136	10.1 / 256	32 / 15	3AUA0000016371 Sheet 1

Heat Dissipation & Airflow Requirements			
Power Losses		Airflow	
Watts	BTU/Hr	CFM	CM/Hr
81	276	26	44

Reference Drawings		
Power Wiring	Connection Diagram	Dimension Detail
00VCR012PW-C	VCVDR014CC-A	3AUA0000016371 Sheet 1

Submittal Schedule Details for 7.5 HP VFD's

Item	Tag / Equipment ID	Product ID
6	7.5 HP VFD's	ACH550-VCR-024A-2+F267

Item Description
Input Voltage: 208 VAC Rated Output Current: 24.2 AMPS Construction: Vertical E-clipse-Bypass, Circuit Breaker Enclosure: NEMA/UL Type 1 Nominal Horsepower: 7.5 Frame Size: R2 Input Disconnecting Means: Circuit Breaker Bypass: E-Clipse Bypass Input Impedance: 5% Short Circuit Current Rating: 100 kA Communication Protocols: Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet Other Options: Service Switch Recommended Spare Parts Package :

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	Bussmann Type
30	KTK-R-30

Wire Size Capacities of Power Terminals				
Circuit Breaker	Disconnect Switch	Terminal Block	Overload Relay	Ground Lug
#8 40 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs

Dimensions and Weights				
Height in / mm	Width in / mm	Depth in / mm	Weight lbs / kg	Dimension Drawing
44.1 / 1120	5.4 / 136	10.3 / 262	40 / 18	3AUA0000016372 Sheet 1

Heat Dissipation & Airflow Requirements			
Power Losses		Airflow	
Watts	BTU/Hr	CFM	CM/Hr
227	776	52	88

Reference Drawings		
Power Wiring	Connection Diagram	Dimension Detail
00VCR012PW-C	VCVDR014CC-A	3AUA0000016372 Sheet 1

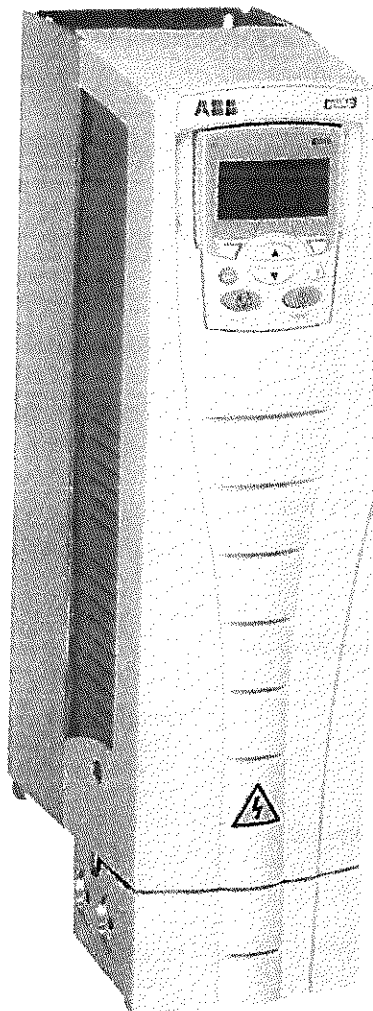
ACH550 Product Overview

Description

The ACH550 series is a microprocessor based Pulse Width Modulated (PWM) adjustable speed AC drive. The ACH550 drive takes advantage of sophisticated microprocessor control and advanced IGBT power switching technology to deliver high-performance control of AC motors for a wide range of HVAC applications.

With drives ranging from 1 to 550 HP, the ACH550 series features a universal full graphic interface that "speaks" to the operator in plain English phrases, greatly simplifying set-up, operation, and fault diagnosis. The ACH550 is also programmable in fourteen other languages.

Each ACH550 drive comes equipped with an extensive library of pre-programmed HVAC application macros which, at a touch of a button, allow rapid configuration of inputs, outputs, and performance parameters for specific HVAC applications to maximize convenience and minimize start-up time. The ACH550 series can handle the most demanding commercial applications in an efficient, dependable, and economic manner.



ACH550 Standard Features

UL, cUL labeled and CE marked, BTL listed
EMI/RFI Filter (1st Environment, Restricted Distribution)
Seismic Certificate of Compliance in accordance with
IBC 2000 referencing ASCE 7-98 and ICC AC156
IBC 2003 referencing ASCE 7-02 and ICC AC156
IBC 2006 referencing ASCE 7-05 and ICC AC156
IBC 2009 referencing ASCE 7-05 and ICC AC156

Start-Up Assistants
Maintenance Assistants
Diagnostic Assistants
Real Time Clock
Includes Day, Date and Time
Operator Panel Parameter Backup (read/write)
Full Graphic and Multilingual Display
for Operator Control, Parameter Set-Up and Operating
Data Display:
Output Frequency (Hz) / Motor Speed (RPM)
Motor Current
Calculated Energy Savings (\$, kWh/MWh, CO²)
Calculated % Motor Torque
Calculated Motor Power (kW)
DC Bus Voltage
Output Voltage
Heatsink Temperature
Elapsed Time Meter (reset-able)
KWh (reset-able)
Input / Output Terminal Monitor
PID Actual Value (Feedback) & Error
Fault Text
Warning Text
Three (3) Scalable Process Variable Displays
User Definable Engineering Units

Two (2) Programmable Analog Inputs
Six (6) Programmable Digital Inputs
Two (2) Programmable Analog Outputs
Up to six (6) Programmable Relay Outputs (Three (3) Standard)
Adjustable Filters on Analog Inputs and Outputs
Mathematical Functions on Analog Reference Signals
All Control Inputs Isolated from Ground and Power
Four (4) Resident Serial Communication Protocols
BACnet (MS/TP)
Johnson Controls N2
Siemens Building Technologies FLN (P1)
Modbus RTU

Input Speed Signals
Current 0 (4) to 20 mA
Voltage 0 (2) to 10 VDC
Increase/Decrease Reference Contacts (Floating Point)
Serial Communications

Start/Stop
2 Wire (Dry Contact Closure)
3 Wire (Momentary Contact)
Application of Input Power
Application of Reference Signal (PID Sleep/Wake-Up)
Serial Communications

Start Functions
Ramp
Flying Start
Pre-magnetization (DC Brake) on Start
Automatic Torque Boost
Automatic Torque Boost with Flying Start
Auto Restart (Reset) – Customer Selectable and Adjustable

Stop Functions
Ramp or Coast to Stop
Emergency Stop
DC Braking / Hold at Stop
Flux Braking

Accel/Decel
Two (2) sets of Independently Ramps
Linear or Adjustable 'S' Curve Accel/Decel Ramps

HVAC Specific Application **Macros**
Separate Safeties (2) and Run Permissive Inputs
Damper Control
Override Input (Fire Mode)
Timer Functions
Four (4) Daily Start/Stop Time Periods
Four (4) Weekly Start/Stop Time Periods
Four Timers for Collecting Time Periods and Overrides
Seven (7) Preset Speeds
Supervision Functions
Adjustable Current Limit
Electronic Reverse
Automatic Extended Power Loss Ride Through (Selectable)
Programmable Maximum Frequency to 500 Hz
PID Control
Two (2) Integral Independent Programmable PID Setpoint Controllers (Process and External)
External Selection between Two (2) Sets of Process PID Controller Parameters
PID Sleep/Wake-Up

Motor Control Features
Scalar (V/Hz) and Vector Modes of Motor Control
V/Hz Shapes
Linear
Squared
Energy Optimization
IR Compensation
Slip Compensation
Three (3) Critical Frequency Lockout Bands

Preprogrammed Protection Circuits
Overcurrent
Short Circuit
Ground Fault
Overvoltage
Undervoltage
Input Phase Loss
Output Device (IGBT) Overtemperature
Adjustable Current Limit Regulator
UL508C approved Electronic Motor Overload (I²T)

Programmable Fault Functions for Protection Include
Loss of Analog Input
Panel Loss
External Fault
Motor Thermal Protection
Stall
Underload
Motor Phase Loss
Ground Fault

Input Impedance
5% Equivalent Impedance with Internal Reactor(s)
Patented Swinging Choke Design for Superior Harmonic Mitigation (R1...R6 Frames)
3% Equivalent Impedance (R8 Frame)

OPTIONAL FEATURES

3 Relay Extension Module (OREL-01)
115/230 V Digital Input Interface Card (OHDI-01)
Fieldbus Adapter Modules
LonWorks
BACnet IP to MS/TP Router
Profibus
DeviceNet
Ethernet
ControlNet
DriveWindow Light Start-up, Operation, Programming and Diagnostic Tool
Fan Replacement Kit

ACH550 Specifications

Input Connection

Input Voltage (U ₁)	208/220/230/240 VAC 3-phase +/-10% 208/220/230/240 VAC 1-phase +/-10% 380/400/415/440/460/480 VAC 3-phase +/-10%
Frequency	48 - 63 Hz
Line Limitations	Max +/-3% of nominal phase to phase input voltage
Fundamental Power Factor (cos φ)	0.98 at nominal load
Connection	U ₁ , V ₁ , W ₁ (U ₁ , V ₁ , 1-phase)

Output (Motor) Connection

Output Voltage	0 to U ₁ , 3-phase symmetrical, U ₂ at the field weakening point
Output Frequency	-500 to 500 Hz
Frequency Resolution	0.01 Hz
Continuous Output Current	
Variable Torque	1.0 * I _{2N} (Nominal rated output current, Variable Torque)
Short Term Overload Capacity	
Variable Torque	1.1 * I _{2N} , (1 min/10 min)
Peak Overload Capacity	
Variable Torque	1.35 * I _{2N} , (2 sec/1 min)
Base Motor Frequency Range	10 to 500 Hz
Switching Frequency	1, 4, 8 or 12 kHz
Acceleration Time	0.1 to 1800 s
Deceleration Time	0.1 to 1800 s
Efficiency	0.98 at nominal power level
Short Circuit Withstand Rating	100,000 AIC (UL) w/o fuses
Connection	U ₂ , V ₂ , W ₂

Enclosure

Style	UL (NEMA) Type 1, Type 12, or Type 3R
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Agency Approval

Listing and Compliance	UL, cUL, CE
------------------------	-------------

Ambient Conditions, Operation

Air Temperature	-15 ^o to 40 ^o C (5 ^o to 104 ^o F), above 40 ^o C the maximum output current is de-rated 1% for every additional 1 ^o C (up to 50 ^o C (122 ^o F) maximum limit.
Relative Humidity	5 to 95%, no condensation allowed, maximum relative humidity is 60% in the presence of corrosive gasses
Contamination Levels	
IEC	60721-3-1, 60721-3-2 and 60721-3-3
Chemical Gasses	3C1 and 3C2
Solid Particles	3S2
Installation Site Altitude	0 to 1000 m (3300 ft) above sea level. At sites over 1000 m (3300 ft) above sea level, the maximum power is de-rated 1% for every additional 100 m (330 ft). If the installation site is higher than 2000 m (6600 ft) above sea level, please contact your local ABB distributor or representative for further information
Vibration	Max 3.0 mm (0.12 in) 2 to 9 Hz, Max 10 m/s ² (33 ft/s ²) 9 to 200 Hz sinusoidal Seismic Certified referencing IBC 2000, 2003, 2006 and 2009

Ambient Conditions, Storage (in Protective Shipping Package)

Air Temperature	-40 ^o to 70 ^o C (-40 ^o to 158 ^o F)
Relative Humidity	Less than 95%, no condensation allowed
Vibration	In accordance with ISTA 1A and 1B specifications
Shock (IEC 60086-2-29)	Max 100 m/s ² (330 ft/s ²) 11 ms

Ambient Conditions, Transportation (in Protective Shipping Package)

Air Temperature	-40 ^o to 70 ^o C (-40 ^o to 158 ^o F)
Relative Humidity	Less than 95%, no condensation allowed
Atmospheric Pressure	60 to 106 kPa (8.7 to 15.4 PSI)
Vibration	Max 3.5 mm (0.14 in) 2 to 9 Hz, Max 15 m/s ² (49 ft/s ²) 9 to 200 Hz sinusoidal
Shock (IEC 60086-2-29)	Max 100 m/s ² (330 ft/s ²) 11 ms
Free Fall	R1: 76 cm (30 in) R2: 61 cm (24 in) R3: 46 cm (18 in) R4: 31 cm (12 in) R5 & 6: 25 cm (10 in)

Cooling Information

Cooling Method	Integral fan(s)
Power Loss	Approximately 3% of rated power

ACH550 Specifications (continued)

Analog Inputs

Quantity.....	Two (2) programmable
Voltage Reference:.....	0 (2) to 10 V, 312kOhm, single ended
Current Reference:.....	0 (4) to 20 mA, 100Ohm, single ended
Potentiometer:.....	10 VDC, 10 mA (1K to 10KOhms)
Input Updating Time.....	8 ms
Terminal Block Size.....	2.3mm ² / 14AWG

Reference Power Supply

Reference Voltage.....	+10 VDC, 1% at 25°C (77°F)
Maximum Load.....	10 mA
Applicable Potentiometer.....	1 kOhm to 10 kOhm
Terminal Block Size.....	2.3mm ² / 14AWG

Analog Outputs

Quantity.....	Two (2) programmable current outputs
Signal Level.....	0 (4) to 20 mA
Accuracy.....	+/- 1% full scale range at 25°C (77°F)
Maximum Load Impedance.....	500 Ohms
Output Updating Time.....	2 ms
Terminal Block Size.....	2.3mm ² / 14AWG

Digital Inputs

Quantity.....	Six (6) programmable digital inputs
Isolation.....	Isolated as one group
Signal Level.....	24 VDC, (10V Logic 0)
Input Current.....	15 mA at 24 VDC
Input Updating Time.....	4 ms
Terminal Block Size.....	2.3mm ² / 14AWG

Internal Power Supply

Primary Use.....	Internal supply for digital inputs
Voltage:.....	+24 VDC, max 250 mA
Maximum Current:.....	250 mA
Protection:.....	Short circuit protected

Relay Outputs

Quantity.....	Three (3) programmable relay (Form C) outputs
Switching Capacity:.....	8 A at 24 VDC or 250 VAC, 0.4 A at 120 VDC
Max Continuous Current:.....	2A RMS
Contact Material:.....	Silver Cadmium Oxide (AgCdO)
Isolation Test Voltage.....	4 kVAC, 1 minute
Output Updating Time.....	12 ms
Terminal Block Size.....	2.3mm ² / 14AWG

Protections

Single Phase.....	Protected (input & output)
Overcurrent Trip Limit:.....	3.5 x I _{2N} instantaneous
Adjustable Current Regulation Limit:.....	1.1 x I _{2N} (RMS) max.
Overvoltage Trip Limit:.....	1.30 x U _N
Undervoltage Trip Limit:.....	0.65 x U _N
Overtemperature (Heatsink):.....	+115°C (+239°F)
Auxiliary Voltage:.....	Short Circuit Protected
Ground Fault:.....	Protected
Short Circuit:.....	Protected
Microprocessor fault:.....	Protected
Motor Stall Protection:.....	Protected
Motor Overtemperature Protection (I _{2t}):.....	Protected
Input Power Loss of Phase:.....	Protected
Loss of Reference:.....	Protected
Short Circuit Current Rating:.....	100,000 RMS symmetrical Amperes
input Line Impedance:.....	Swinging choke 5% equivalent R1-R6, 3% equivalent R8

U₁ = Input Voltage

U₂ = Output Voltage

P_N = Power – Normal Duty (HP)

U_N = Nominal Motor Voltage

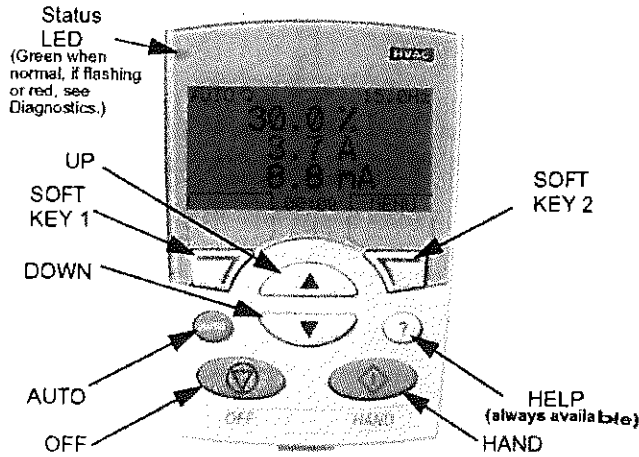
f_N = Nominal Motor Frequency

I_{2N} = Nominal Motor Current – Normal Duty

Specifications are subject to change without notice. Please consult the factory when specifications are critical.

ACH550 Control Panel

The ACH550 Control Panel is a multifunction control panel with full graphic LCD display and multiple language capability. The control panel can be connected to and detached from the ACH550 at any time. The panel can be used to upload and copy parameters to other ACH550 drives.



Run Indication and Shaft Direction located in upper left corner of display.

Control Panel Display	Significance
Rotating arrow (clockwise or counterclockwise)	Drive is running and at set point Shaft direction is forward or reverse
Rotating arrow blinking	Drive is operating but not at setpoint
Stationary arrow	Drive is stopped

LED Indicators

The green LED indicates that the power is on and the drive is operating normally. The red LED indicates a fault. A blinking green LED indicates an alarm condition. A blinking red LED indicates a fault that requires power to be cycled off and on to reset the drive.

Fault Indications

The ACH550 Control Panel can display over 20 alarm and fault messages. The last fault and previous faults (1 to 9) are retained in memory. The last fault and previous faults (1 & 2) also record important diagnostic information to assist in troubleshooting. Most faults can be reset by pressing the RESET key (Soft Key 1).

Parameters

Application specific parameters are immediately accessible through a selection of start-up "Assistants". A complete list of parameters is also available grouped by function in approximately 33 menu groups. One of the basic menu functions can be used to display the complete list of changed parameters.

Real Time Clock

The Operator Control Panel includes a real time clock which provides Day, Date and Time information, displayed in a choice of formats. The real time clock has a 10 year battery back up and provides time and date stamping of drive faults and other events. The clock is also used by the ACH550s internal timer functions, providing an integral time clock for start/stop control as well as other control operations.

Control Modes

When the HAND key is pressed, the drive starts and pressing the UP/DOWN keys can modify the reference frequency. The HAND (keypad) control mode is indicated.

When the OFF key is pressed, the drive stops and the OFF control mode is indicated.

When the AUTO key is pressed, the AUTO control mode is indicated. The drive can be started and stopped using whichever remote start/stop command has been configured, a contact closure applied to the start/stop input, a serial communication command or a process feedback signal. In AUTO mode the drive speed is typically controlled by the external speed reference input or by the PID controller.

If the HAND key is pressed while the drive is running in the AUTO control mode, the drive continues to run without changing speed, but ceases to respond to external input or PID speed reference changes. (Bumpless transfer) Pressing the UP/DOWN keys can modify the reference frequency.

If the AUTO key is pressed while the drive is running in the HAND control mode and an external start command is present, the drive continues to run and follows the acceleration or deceleration control ramp to the speed set by the external input or PID speed reference. (Bumpless transfer)

Cable Connections

Terminal	Description	Note
U1, V1, W1	3~ power supply input	Use of 1~ supply requires 50% derate of output current and is applicable for 208 to 240 VAC operation only.
PE / GND	Protective Ground	Follow local rules for cable size.
U2, V2, W2	Power output to motor	
Uc+, Uc-	DC bus	
X1 1 to 18	Control Wiring	Low voltage control – Use shielded cable
X1 19 to 27	Control Wiring	Low voltage or 115VAC
X1 28 to 32	Serial Communications	Use shielded cable

Follow local codes for cable size. To avoid electromagnetic interference, use separate metallic conduits for input power wiring, motor wiring, control and communications wiring. Keep these four classes of wiring separated in situations where the wiring is not enclosed in metallic conduit. Also, keep 115VAC control wiring separated from low voltage control wiring and power wiring.

Use shielded cable for control wiring.

Ampacity is based on the use of 60 °C rated power cable up to 100 Amps (75 °C over 100 Amps).

Refer to the included tables for current ratings, fuse recommendations and maximum wire size capacities and tightening torques for the terminals. The ACH550 is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 480 V maximum. The ACH550 has an electronic motor protection feature that complies with the requirements of the National Electric Code (NEC). When this feature is selected and properly adjusted. Additional overload protection is not required unless more than one motor is connected to the drive or unless additional protection is required by applicable safety regulations.

For CE installation requirements, see ABB publication CE-US-02 "CE Council Directives and Variable Speed Drives." Contact your local ABB representative for specific IEC installation instructions.

ACH550 Control Terminals - Main I/O Terminal X1

X1	Identification	Description
1	SCR	Terminal for signal cable screen. (Connected internally to chassis ground.)
2	AI 1	Analog input channel 1, programmable. Default ² = External reference Resolution 0.1 % accuracy ±1 %. 0 (4) - 20 mA (R _i = 312 kΩ) (J1:AI1 ON) 0 (2) - 10 V (R _i = 100 Ω) (J1:AI1 OFF)
3	AGND	Analog input common. (Connected internally to chassis ground through 1 MΩ)
4	10 V	10 V/10 mA reference voltage output for analog input potentiometer, accuracy ±2 %. (1 kΩ ≤ R ≤ 10 kΩ)
5	AI 2	Analog input channel 2, programmable. Default ² = PID Feedback Resolution 0.1 % accuracy ±1 %. 0 (4) - 20 mA (R _i = 312 kΩ) (J1:AI2 ON) 0 (2) - 10 V (R _i = 100 Ω) (J1:AI2 OFF)
6	AGND	Analog input common. (Connected internally to chassis ground through 1 MΩ)
7	AO1	Analog output channel 1, programmable. Default ² = Output frequency 0 (4) - 20 mA (load < 500 Ω), accuracy ±3% full scale.
8	AO2	Analog output channel 2, programmable. Default ² = Output current 0 (4) - 20 mA (load < 500 Ω), accuracy ±3% full scale.
9	AGND	Analog output common. Connected internally to chassis ground through 1 MΩ
10	24 V	Auxiliary voltage output 24 V DC / 250 mA (Reference to AGND). Short circuit protected.
11	GND	Common for digital input (DI) return signals.
12	DCOM	Digital input circuit common for all digital inputs (DIs). Connected internally as floating.
DI Configuration ¹		To activate a digital input, there must be ≥ +10 V (or ≤ -10 V) between that input and DCOM. The 24 V may be provided by the ACH550 (X1:10) or by an external 12-24 V source of either polarity.
13	DI 1	Digital input 1, programmable. Default ² = Start/Stop (AUTO mode) Activation starts the drive
14	DI 2	Digital input 2, programmable. Default ² = Not configured.
15	DI 3	Digital input 3, programmable. Default ² = Constant (Preset) speed. Activation selects constant speed 1
16	DI 4	Digital input 4, programmable. Default ² = Start enable 1 (safety interlock) Deactivation stops the drive.
17	DI 5	Digital input 5, programmable. Default ² = Not configured.
18	DI 6	Digital input 5, programmable. Default ² = Not configured.
19	RO1C	Common
20	RO1A	Normally Closed (NC)
21	RO1B	Normally Open (NO)
22	RO2C	Common
23	RO2A	Normally Closed (NC)
24	RO2B	Normally Open (NO)
25	RO3C	Common
26	RO3A	Normally Closed (NC)
27	RO3B	Normally Open (NO)
28	Screen	Terminal for signal cable screen. (Connected internally to chassis ground.)
29	B	RS-485 Serial Communications Positive input connection
30	A	RS-485 Serial Communications Negative input connection
31	AGND	Analog input common. (Connected internally to chassis ground through 1 MΩ.)
32	Screen	Terminal for signal cable screen. (Connected internally to chassis ground.)

- Notes:
1. Digital input impedance 1.5 kΩ. Maximum voltage for digital inputs is 30 V. Use multi-strand wire, size range: 20-16 AWG (0.5-1.5 mm²)
 2. Default values depend on the macro used. Values specified are for the HVAC default macro.
 3. For fail-safe reasons, the Fault (-1) Relay signals a "Fault", when the ACH550 is powered down.

ACH550 with ABB E-Clipse bypass – Overview

ABB E-Clipse bypass Standard Features

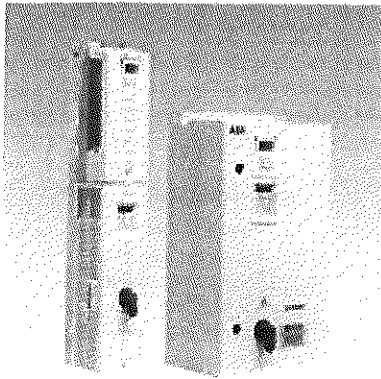
- Door Interlocked Disconnect or Circuit Breaker
- English Language Back-Lit LCD Display
- Operator Control Panel
- LED Status Pilot Lights
- Smoke Control
- Override Mode
- Serial Communications
- 5 Programmable Relay Outputs (Form C)
- 100% Functionality with Drive Removed
- Programmable Auto Transfer to Bypass
- Plain English Safety Annunciation
- UL & cUL Listed
- Seismic Zone 4 Certified (IBC 2006)
- UL Type 1, Type 12 or Type 3R Enclosure
- Programmable Class 10, 20, or 30 OL
- Automatic Restart
- 24 Month Parts and Labor Warranty (with Certified Start-up)
- Two Contactor **Bypass**
- System Status **Display**
- Bypass **Diagnostics** Display
- Drive Exclusive **Fast-Acting** Fuses
- Electronic Motor **Overload** Protection
- Damper Control – VFD and Bypass Modes
- 6 Digital Inputs (**5** programmable)
- Single Phase **Protection** in VFD & Bypass Mode
- Bullet Proof **Contactor** Protection
- Serial **Communications** Pass Through I/O
- Proof-of-Flow **Indication & Action**
- Conformal Coated **Circuit** Boards
- +30%; -35% **Input** Voltage Tolerance
- Run Permissive **Circuit**
- Supervisory **Control**
- UL Listed **I²T** Electronic Overload
- UL Listed and **tested** 100,000 Ampere SCCR (VCR and **BCR** Units)

The ACH550 with ABB E-Clipse bypass is an ACH550 HVAC Drive in an integrated UL Type 1, UL Type 12 or NEMA 3R enclosure with a bypass motor starter. The ACH550 with ABB E-Clipse bypass provides an input disconnect switch or circuit breaker with door mounted and interlocked operator (padlockable in the OFF position), a bypass starter, electronic motor overload protection, a local programming and operator keypad with indicating lights, provisions for external control connections, and serial communications capability. Certain configurations (+F267) also provide a drive service switch.

UL Type 1 (NEMA 1) and UL Type 12 (NEMA 12) E-Clipse units are available from 1 to 100 HP at 208/240V, 1 to 400 HP at 480V, and 2 to 150 HP at 600V. UL Type 1 and UL Type 12 units are wall mounted from 1 to 200 HP and floor mounted from 250 to 550 HP. The operator keypad is mounted on the door of the enclosure.

For outdoor applications, UL Type 3R (NEMA 3R) E-Clipse unit are available from 1 to 100 HP at 208/240V, 1 to 200 HP at 480V and 2 to 150 HP at 600V. Construction is sheet steel with a tough powder coat paint finish for corrosion resistance. A thermostatically controlled space heater and thermostatic control of the force ventilated cooling system are standard. The operator keypads are mounted on the enclosure door and covered by a hinged panel.

The ACH550 with ABB E-Clipse bypass includes two contactors. One contactor is the bypass contactor, used to connect the motor directly to the incoming power line in the event that the ACH550 is out of service. The other contactor is the ACH550 output contactor that disconnects the ACH550 from the motor when the motor is operating in the Bypass mode. The drive output contactor and the bypass contactor are electrically interlocked to prevent "back feeding".



The ACH550 with ABB E-Clipse bypass is a microprocessor-controlled "intelligent" system which features programmable Class 20 or 30 overload curves, programmable underload (broken belt) and overload trip or indication. Also included as standard features are single-phase protection in bypass mode, programmable manual or automatic transfer to bypass, fireman's override, smoke control, damper control, no contactor chatter on brown-out power conditions and serial communications. Should a drive problem occur, fast acting fuses exclusive to the ACH550 drive path disconnect the drive from the line prior to clearing upstream branch circuit protection, maintaining bypass capability.

Damper Control Circuit (Run Permissive)

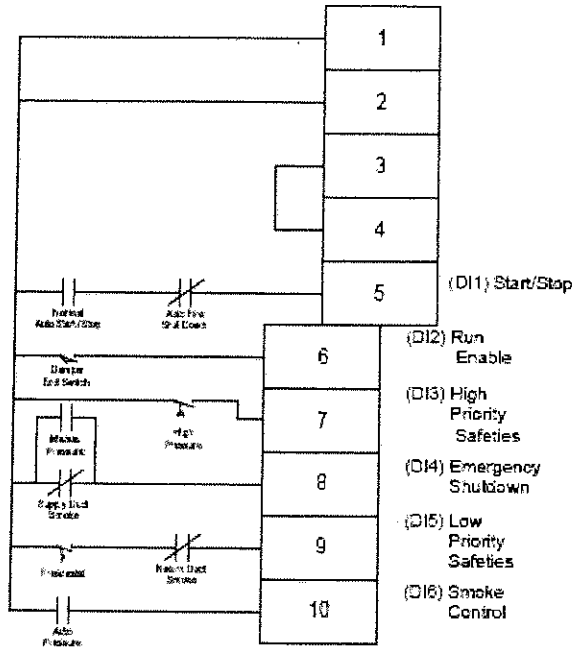
The damper control circuit closes a dry contact upon a start command to open a damper such as an outdoor air damper, fire damper, isolation damper, etc. before the motor is allowed to operate in drive mode or bypass mode regardless of the source of the run command. When the damper is fully open, a normally open dry contact from the damper end-switch closes and allows the motor to operate. Up to four dedicated inputs are provided for safety interlocks such as firestats, smoke detectors, etc.

The safety interlock inputs may also be linked to plain English keypad diagnostic indications to be displayed on the LCD. The unit may be set-up to display any of the following diagnostics upon opening of a digital input: Vibration Switch; Firestat; Freezestat; Over Pressure; Vibration Trip; Smoke Alarm; Safety Open; Low Suction; Start Enable; Run Enable; Damper End Switch; Valve Open Proof; or Pre-Lube Cycle. When any of these contacts open, the motor stops (in drive or bypass mode) and the damper is commanded to close. Although it is not a recommend sequence of operation, this run permissive circuit may also be controlled via serial communications.

Smoke Control and Override Modes

The ACH550 with ABB E-Clipse bypass has two Override modes of operation for critical control situations. The Smoke Control Override accepts a normally open dry contact that forces the motor to run in bypass and ignores all keypad inputs. In Smoke Control Override mode, the system acknowledges high priority digital inputs such as overpressure safeties and damper end-switch run permissive proofs, and disregards other, low priority digital inputs. See the attached sample wiring diagram for further details. Smoke Control Override (Override 1) response is not field programmable. The unit will go into smoke Override mode whenever DI6 is closed.

X2 E-Clipse Bypass Controller Input



Normal Operation:

- Close Start/Stop (X2:5)
- Fan starts, assuming that X2: 6, 7, 8, and 9 are all closed

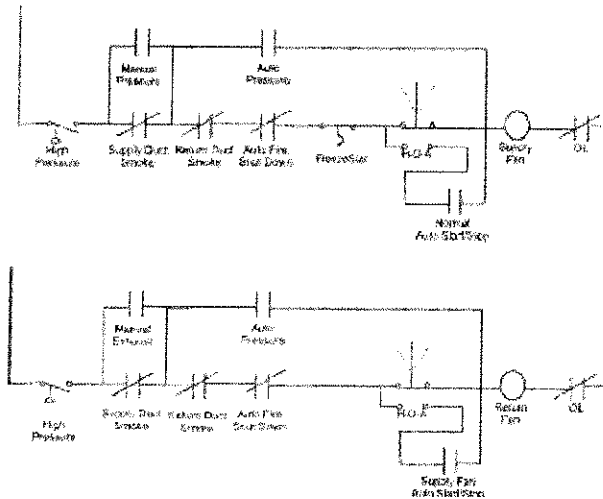
Emergency Shutdown:

- Open auto fire shutdown, unit stops

Smoke Control Mode:

- Close contact on X2: 10
- Fan starts regardless of position of internal HOA switch and inputs X2:5 and X2:9
- Inputs X2:8, 7 and 8 followed
- Internal overloads followed

Typical Starter Wiring for a Smoke Control listed System Today:



Notes:

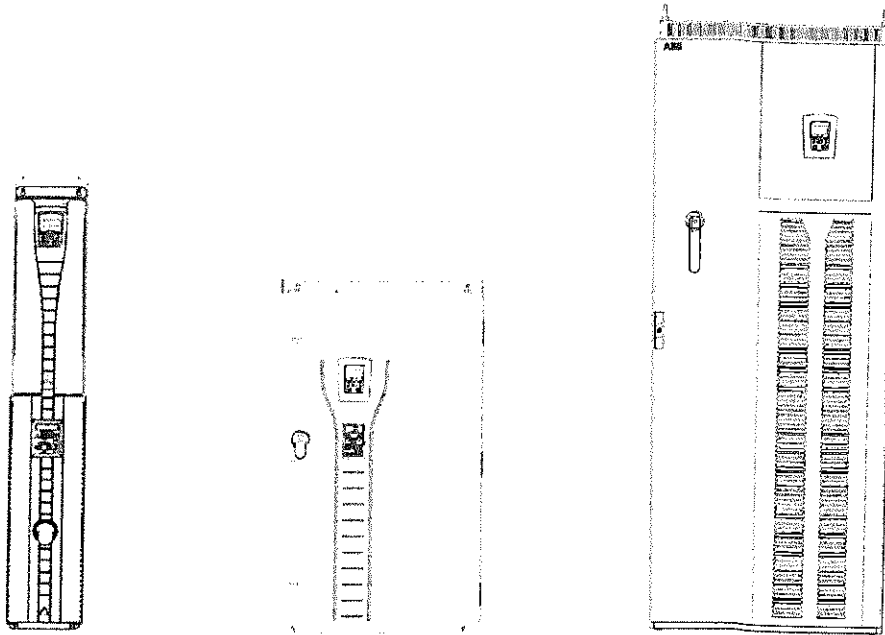
1. Pressure outputs, duct smoke detectors and auto shutdown are 2-pole.
2. Manual control also activates "auto control" relays.

The second mode, Override 2, is fully programmable. Override 2 default programming is designed for "Run to Destruction" operation. However, the end user can program the unit to acknowledge some external inputs while ignoring others, ignore all external inputs or acknowledge all external inputs. This mode is fully programmable to allow the user to program the response of the unit to match his local AHJ.

Serial communications

All ABB E-Clipse bypass units have the following Embedded Fieldbus (EFB) protocols included as standard: Modbus RTU; Johnson Controls N2; Siemens Building Technologies FLN (P1); and BACnet (MS/TP).

The ACH550 with ABB E-Clipse bypass has the ability to monitor VFD/Bypass mode of operation, the status of the bypass H-O-A switch, bypass fault and override status over serial communication. In addition, the user can monitor and / or control over 45 points of bypass information via the communications protocols. Serial communication capabilities include - bypass run-stop control; the ability to force the unit to bypass; and the ability to control all relay outputs. The DDC system can monitor bypass feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC system is also capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information is transmitted over the serial communications bus. Remote system (drive or bypass) fault reset is possible.



Vertical & Standard ABB E-Clipse bypass Exterior Views

ABB E-Clipse bypass Operator Control

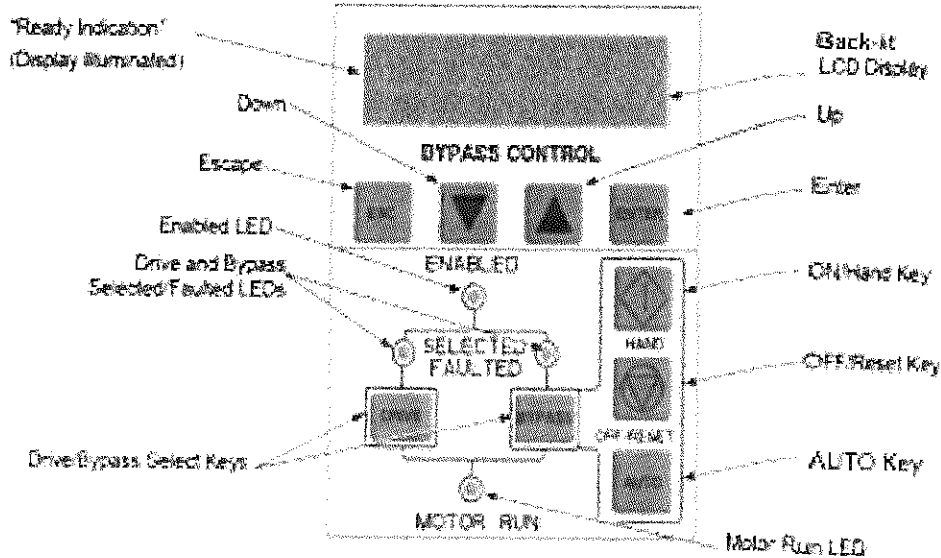
ACH550 Control Panel

The ACH550 Control Panel is a keypad with an LCD unit that provides status indication and operator controls for the ACH550 drive. In normal operation with the ABB E-Clipse bypass, the ACH550 should be placed in the *Auto* mode of operation by pressing the *Auto* key on the ACH550 Control Panel. Refer to the *ACH550 User's Manual* for additional information on the ACH550 Control Panel and other aspects of ACH550 operation.

Bypass Control Keypad

The ABB E-Clipse bypass has a separate keypad with an LCD unit that provides status indication and programming of the system. This keypad is also used for selecting the *Drive* or *Bypass* mode of operation and manually starting and stopping the motor in the *Bypass* mode. The bypass keypad has LED indicating lights that indicate the status of both the bypass and the drive as well as an LCD display that provides programming, status and warning/fault indications.

The illustration below shows the bypass control keypad and identifies the keys and LED indicating lights.



The functions of the various keys and LEDs are described in the following table.

Enabled LED	<p>The <i>Enabled</i> LED is illuminated green under the following conditions:</p> <ul style="list-style-type: none"> • Both the Safety Interlock(s) and Run Enable contacts are closed. • The Safety Interlock(s) contact are closed with no Start command present. <p>The <i>Enable</i> LED flashes green if the Run Enable contact is open and when the Safety Interlock contact(s) are closed and a Start command is present.</p> <p>The Enable LED is illuminated red when the Safety Interlock contact(s) are open.</p>
Drive Selected LED	The <i>Drive Selected</i> LED is illuminated green when the drive has been selected as the power source for the motor and no drive fault is present.
Bypass Selected LED	The <i>Bypass Selected</i> LED is illuminated green when the bypass has been selected as the power source for the motor and no bypass fault is present.
Motor Run LED	The <i>Motor Run</i> LED is illuminated green whenever the system is running. The <i>Motor Run</i> LED flashes green to indicate the system has been placed in an Override operating mode.
Drive Faulted LED	The <i>Drive Fault</i> LED is illuminated red when the bypass has lost its' communications link with the drive or when the motor or drive protection functions have shut down the drive.
Bypass Faulted LED	The <i>Bypass Faulted</i> LED is illuminated or flashes red when the motor or bypass protective functions have shut down the bypass.
Drive Key	The <i>Drive</i> Key selects the drive as the power source for the motor.
Bypass Key	The <i>Bypass</i> Key selects the bypass as the power source for the motor.
Auto Key	The <i>Auto</i> key selects the <i>Auto Start</i> contact or serial communications as the means for starting and stopping the motor in the bypass mode.
Off/Reset Key	The <i>Off/Reset</i> key may be used to manually stop the motor if the motor is running on bypass power. The <i>Off/Reset</i> Key also resets most bypass faults. It may take several minutes before the bypass can be reset after an overload trip. If a bypass fault condition is present, the second push of the <i>Off/Reset</i> key puts the bypass in the Off mode.
Hand Key	The <i>Hand</i> key can be used to manually start the motor when the bypass has been selected as the power source for the motor.
UP Key	Used to navigate through system programming steps.
Down Key	Used to navigate through system programming steps.

Control Modes

Drive mode

Under normal conditions the system is in the *Drive* mode. The ACH550 drive provides power to the motor and controls its speed. The source of the drive's start/stop and speed commands is determined by the *Auto* or *Hand* mode selection of the drive's keypad. Commands come from the control terminals or serial communications when the *Auto* mode has been selected or from the drive keypad when the *Hand* mode has been selected. The user can normally switch to the *Drive* mode by pressing the *Drive* key on the bypass keypad.

Bypass mode

In the *Bypass* mode, the motor is powered by AC line power through the bypass contactor. The source of the bypass start/stop commands is determined by the *Auto* or *Hand* mode selection of the bypass keypad. Commands come from the control terminals or serial communications when the *Auto* mode has been selected or from the bypass keypad when the *Hand* mode has been selected. The user can normally switch to the *Bypass* mode by pressing the *Bypass* key on the bypass keypad.

Smoke Control mode

In the *Smoke Control (Override 1)* mode, the motor is powered by AC line power through the bypass contactor. The source of the Smoke Control command is DI 6 and is unaffected by external stop commands. The VFD Keypad and the Bypass Keypad will not accept user commands when the system is in Smoke Control mode (the keypad user inputs are disabled). The user can switch to the *Smoke Control* mode by closing the *Smoke Control* input contact (DI 6). When the *Smoke Control* input contact is closed, the system is forced to bypass and runs the motor. The Motor Run LED flashes green when the system is in override. While in *Smoke Control*, the system only responds to certain inputs. Normally when the *Smoke Control* input contact is switched from closed to open, the system returns to the operating mode that existed prior to entering *Smoke Control* and can once again be controlled using the *Drive* and *Bypass* keys. The exception to this is when the *Bypass Override (Override 2)* input contact is closed, in which case the system switches to *Bypass Override* operation.

Bypass Override mode

In the *Bypass Override (Override 2)* mode, the motor is powered by AC line power through the bypass contactor. The source of the start command is internal and unaffected by external stop commands. The VFD Keypad and the Bypass Keypad will not accept user commands when the system is in Bypass Override mode (the keypad user inputs are disabled). The user can switch to the *Bypass Override* mode by closing the *Bypass Override* input contact (DI 5-if programmed). When the *Bypass Override* input contact is closed, the system is forced to bypass and does not respond to the *Drive* and *Bypass* keys. The Motor Run LED flashes green when the system is in override. While in *Bypass Override* the system responds to bypass overloads and programmed faults. The system may be custom programmed to acknowledge or disregard certain faults, safeties and enables. The unit is default programmed to ignore all external safeties and run enables. See Group 17 for programmability of the digital input and fault functions. Normally when the *Bypass Override* input contact is switched from closed to open, the system switches to the *Drive* mode and can be controlled using the *Drive* and *Bypass* keys. The exception to this is when the *Smoke Control (Override 1)* input contact is closed, in which case the system remains in *Smoke Control* operation.

Hand mode

When the system is in the *Bypass* mode, the operator can manually start the motor by pressing the *Hand* key. The motor will run and the *Hand* LED will be illuminated green. In order to run the motor, the *Safety Interlock* and *Run Enable* contacts must be closed (green *Enable* LED) and any bypass fault must be reset.

Auto mode

In the *Auto* mode the bypass start/stop command comes from the *Start/Stop* input terminal on the bypass control board or from serial communications – if programmed. The *Auto* mode is selected by pressing the

Auto key on the bypass keypad. The *Auto* LED is illuminated green when the **bypass** is in the *Auto* mode. If the system is in the *Bypass* mode, the motor will run across the line **if** the *Auto* mode is selected, the *Start/Stop*, *Safety Interlock* and *Run Enable* contacts are closed and any **bypass** fault is reset.

Off Mode

If the motor is running in the *Bypass* mode, the operator can manually stop the motor by pressing the *OFF* key. The *Motor Running* LED will go out. The motor can be restarted by pressing the *Hand* key or the bypass can be returned to the *Auto* mode by pressing the *Auto* key. If the **system** is in the *Drive* mode, pressing the *OFF* key will take the bypass out of the *Auto* mode, but will **not** affect motor operation from the drive. If the system is switched to the *Bypass* mode, a motor that is **running** will stop.

Programmable Relay Contact Outputs

The ABB E-Clipse bypass has five programmable relay outputs as standard. **The** default programming descriptions for these relay outputs is described below.

Bypass Not Faulted

The *Bypass Not Faulted* relay is energized during normal operation. The *Bypass Not Faulted* relay is de-energized when a bypass fault has occurred.

System Running

The *System Running* relay is energized when the ABB E-Clipse bypass System is running. The *System Running* relay provides an output when the motor is running whether powered by the ACH550 drive or the bypass.

System Started

The *System Started* relay is energized when the ABB E-Clipse bypass system is started. Three conditions must be met in order for the relay to energize. 1) a *Start* command must be present, 2) the *Safety Interlock* input contact must be closed and 3) there can be no fault present in the system. The *Start* command can come from the bypass control board terminal block, the ACH550 keypad, the bypass keypad, or serial communications depending on the operational mode selected. The *System Started* relay is ideal for use in damper actuator circuits, opening the dampers only under those conditions where the system is preparing to run the motor. The *System Started* relay will de-energize, closing the dampers if the safeties open, the system faults, or when a *Stop* command is issued.

Bypass Selected

Relay output four is factory default programmed for Bypass Selected. The relay will be energized anytime the user has placed the system in Bypass mode.

Bypass Auto

Relay Output five is factory default programmed for *Bypass Auto*. The relay will be energized anytime the user has placed the bypass in the Auto mode.

The complete list of programmable relay output functions follows:

0 = NOT SEL	10 = DRV NOT FLT	20 = BYP UNDERLD
1 = SYS READY	11 = DRIVE ALARM	21 = PCB OVERTMP
2 = SYS RUNNING	12 = OVERRIDE	22 = SYS UNDERLD
3 = SYS STARTED	13 = BYPASS HAND	23 = SYSTEM FLT
4 = BYPASS SEL	14 = BYPASS OFF	24 = SYS FLT/ALM
5 = BYPASS RUN	15 = BYPASS AUTO	25 = SYS EXT CTL
6 = BYPASS FLT	16 = COM CTRL	26 = SYS OVERLD
7 = BYP NOT FLT	17 = SYS ALARM	27 = CONTACT FLT
8 = BYPASS ALRM	18 = BYPASS FLT/ALM	
9 = DRIVE FAULT	19 = BYP OVERLD	

Cable Connections

The following illustrations show the ACH550 with ABB E-Clipse bypass cable connection points for the various enclosure styles. The illustrations indicate the location of input and output power connections as well as equipment and motor grounding connection points.

ACH550 drives are configured for wiring access from the bottom only on Vertical ABB E-Clipse bypass units and from the top only on Standard ABB E-Clipse bypass units. At least three separate metallic conduits are required, one for input power, one for output power to the motor and one for control signals.

All ABB E-Clipse bypass units provided with a circuit breaker input - VCR and BCR configurations have a panel short circuit current rating of 100,000 RMS symmetrical Amperes. Units provided with a disconnect input - VDR and BDR configurations require separate external low peak fuses (supplied by others) to obtain the 100,000 KAIC SCCR.

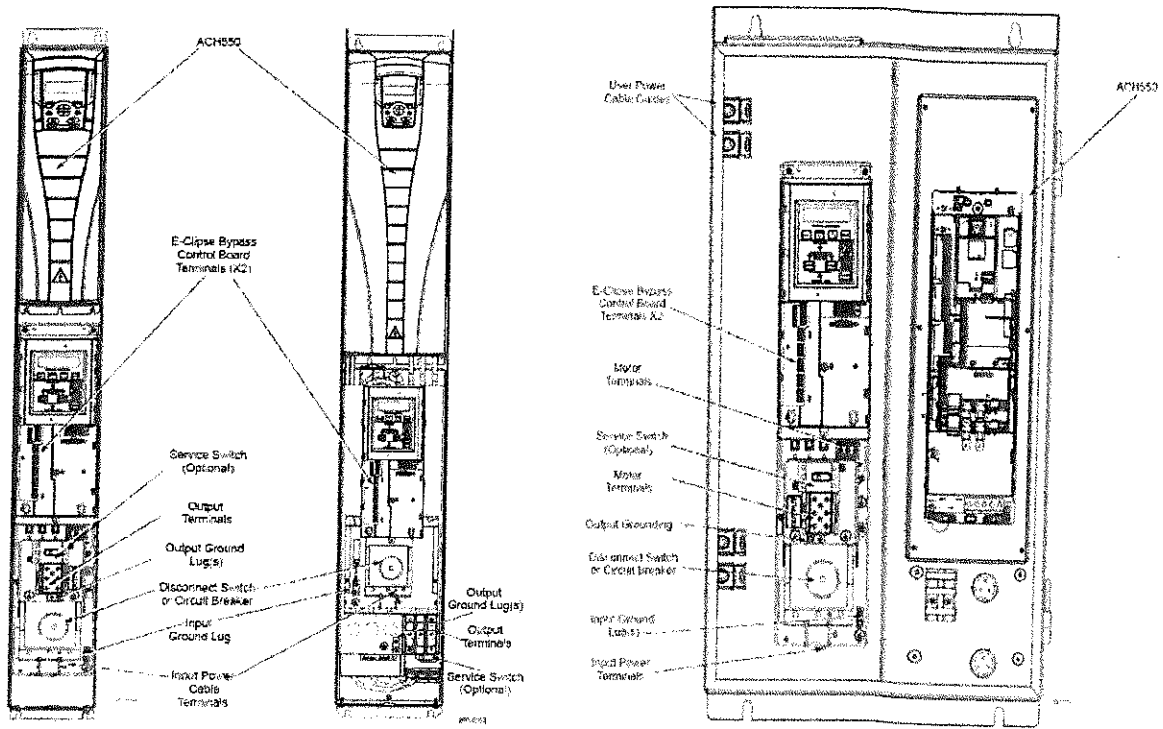
Terminal Sizes

Power and motor cable terminal sizes are shown in the *Submittal Schedule Details* and in the *Wire Size Capacities of Power Terminals* Table. The information provided is for connections to an input circuit breaker or disconnect switch, a motor terminal block, overload relay and ground lugs. The table also lists torque that should be applied when tightening the connections.

Protections

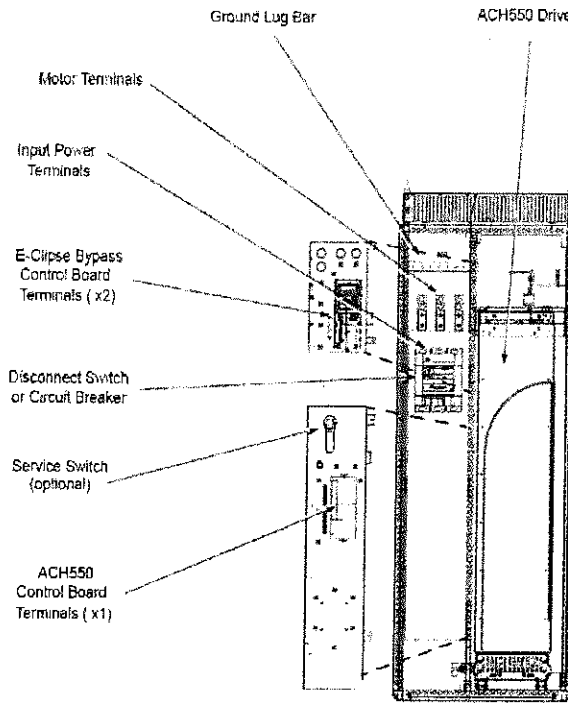
All ABB E-Clipse bypass units include the following protective features: single phase input and output; motor open phase; motor overload (UL Listed); stuck contactor; contactor coil open; undervoltage; motor underload (proof-of-flow / broken belt); serial communications loss; and overtemperature. All printed circuit boards are conformally coated as standard.

Internal Layout Drawings



Vertical ABB E-Clipse Bypass
(UL Type 1 / 12)

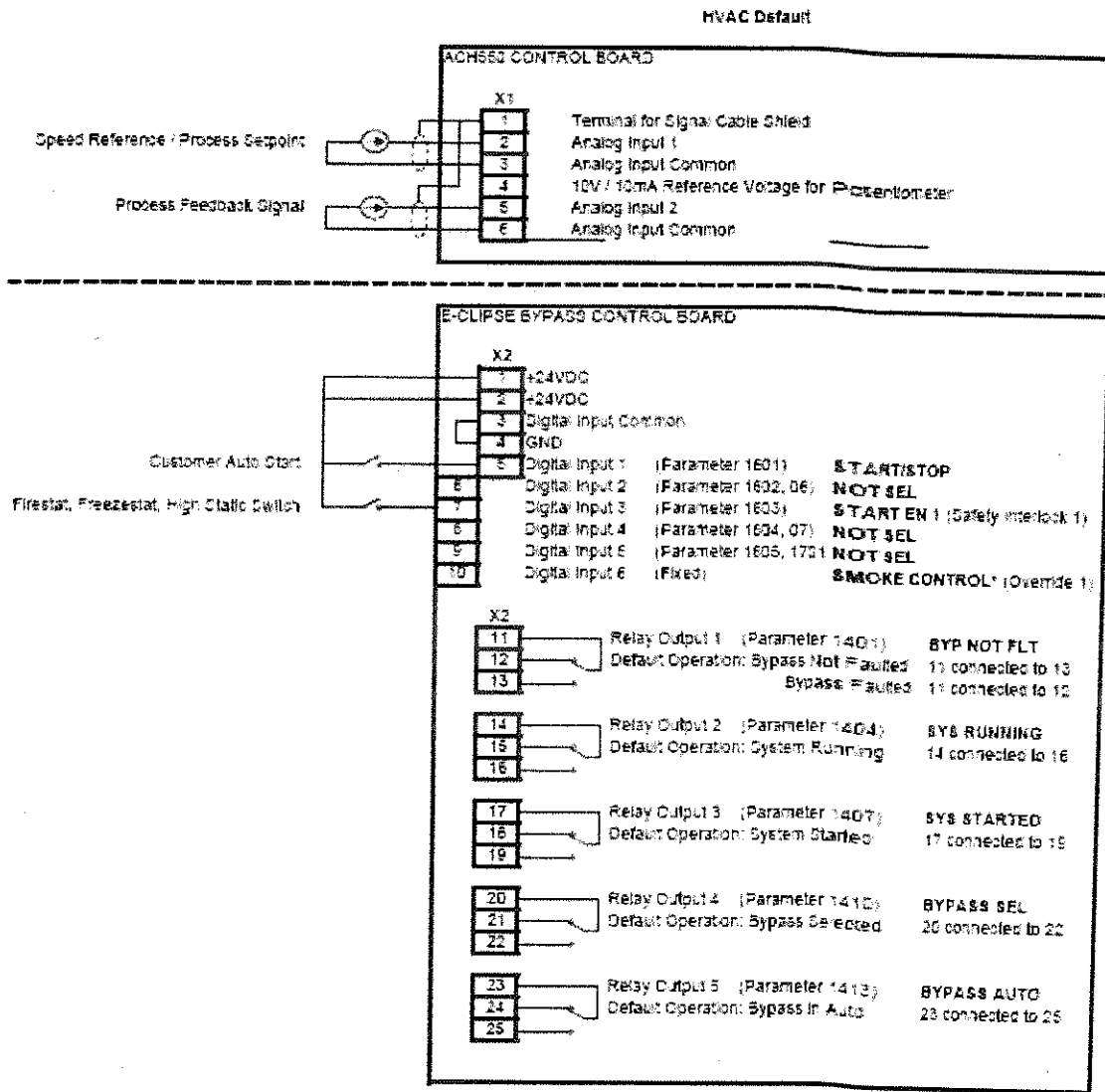
Standard Wall Mount ABB E-Clipse Bypass



Standard Floor Mount ABB E-Clipse Bypass

Control Terminals

The control wiring includes connections to an analog speed command signal **and** a start/stop relay contact for controlling the motor in the AUTO mode. There may also be connections to external run enable interlock contacts and a connection from the Motor Run contact to an external status indication circuit. For a detailed description of the control circuit functions and alternate Control Connection diagrams, refer to the *ACH550 with ABB E-Clipse bypass Users Manual*.



Basic Control Connections for Damper Actuator Control

Engineering Data and Ratings Tables

Fuses

Drive input fuses are recommended to disconnect the drive from power in the event that a component fails in the drive's power circuitry. Recommended drive input fuse specifications are listed in the *Submittal Schedule Details* and in the *Fuse Ratings Table*. Fuse rating information is provided for customer reference.

Item	Catalog Number	Drive Input Fuse Ratings	
		Amps (600V)	Bussmann Type
1	ACH550-VCR-031A-2+F267	60	JJS-60
2	ACH550-VCR-012A-2+F267	15	KTK-R-15
3	ACH550-VCR-017A-2+F267	30	KTK-R-30
4	ACH550-VCR-031A-2+F267	60	JJS-60
5	ACH550-VCR-07A5-2+F267	15	KTK-R-15
6	ACH550-VCR-024A-2+F267	30	KTK-R-30

Terminal Sizes / Cable Connection Requirements

Power and motor cable terminal sizes and connection requirements are shown in the *Submittal Schedule Details* and in the *Terminal Sizes / Cable Connection Requirements Table*. The information provided below is for connections to input power and motor cables. These connections may be made to an input circuit breaker or disconnect switch, a motor terminal block, overload relay, and/or directly to bus bars and ground lugs. The table also lists torque that should be applied when tightening terminals and spacing requirements where multiple mounting holes are provided in the bus bar.

Item	Catalog Number	Circuit Breaker	Disconnect Switch	Terminal Block	Overload Relay	Ground Lug
1	ACH550-VCR-031A-2+F267	#2 50 in-lbs	N/A N/A	#2 50 in-lbs	N/A N/A	#2 50 in-lbs
2	ACH550-VCR-012A-2+F267	#10 35 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs
3	ACH550-VCR-017A-2+F267	#10 35 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs
4	ACH550-VCR-031A-2+F267	#2 50 in-lbs	N/A N/A	#2 50 in-lbs	N/A N/A	#2 50 in-lbs
5	ACH550-VCR-07A5-2+F267	#10 35 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs
6	ACH550-VCR-024A-2+F267	#8 40 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs

Heat Dissipation Requirements

The cooling air entering the drive must be clean and free from corrosive materials. The *Submittal Schedule Details* and the *Heat Dissipation Requirements table* below give the heat dissipated into the hot air exhausted from the drives. If the drives are installed in a confined space, the heat must be removed from the area by ventilation or air conditioning equipment.

Item	Catalog Number	Power Losses		Airflow	
		Watts	BTU/Hr	CFM	CM/Hr
1	ACH550-VCR-031A-2+F267	285	373	52	88
2	ACH550-VCR-012A-2+F267	116	404	26	44

Item	Catalog Number	Power Losses		Airflow	
		Watts	BTU/Hr	CFM	CM/Hr
3	ACH550-VCR-017A-2+F267	161	551	26	44
4	ACH550-VCR-031A-2+F267	285	373	52	88
5	ACH550-VCR-07A5-2+F267	81	276	26	44
6	ACH550-VCR-024A-2+F267	227	776	52	88

Dimensions and Weights

Dimensions and weights of the drives provided are given in the *Submittal Schedule Details* and in the *Dimensions and Weights* Table. The table also lists the applicable dimension drawings that include additional detail. Dimension drawings may be provided in the back of this submittal.

Item	Catalog Number	Height mm / in	Width mm / in	Depth mm / in	Weight kg / lbs	Dimension Drawing
1	ACH550-VCR-031A-2+F267	1211 / 47.7	214 / 8.4	278 / 10.9	32 / 70	3AUA0000016373 Sheet 1
2	ACH550-VCR-012A-2+F267	1021 / 40.2	136 / 5.4	256 / 10.1	15 / 32	3AUA0000016371 Sheet 1
3	ACH550-VCR-017A-2+F267	1021 / 40.2	136 / 5.4	256 / 10.1	15 / 32	3AUA0000016371 Sheet 1
4	ACH550-VCR-031A-2+F267	1211 / 47.7	214 / 8.4	278 / 10.9	32 / 70	3AUA0000016373 Sheet 1
5	ACH550-VCR-07A5-2+F267	1021 / 40.2	136 / 5.4	256 / 10.1	15 / 32	3AUA0000016371 Sheet 1
6	ACH550-VCR-024A-2+F267	1120 / 44.1	136 / 5.4	262 / 10.3	18 / 40	3AUA0000016372 Sheet 1

Schematics and Wire Diagrams

Detailed wiring diagrams and schematics may be included for the products covered in this submittal. Please reference the following ABB part numbers for the drawings included with this submittal:

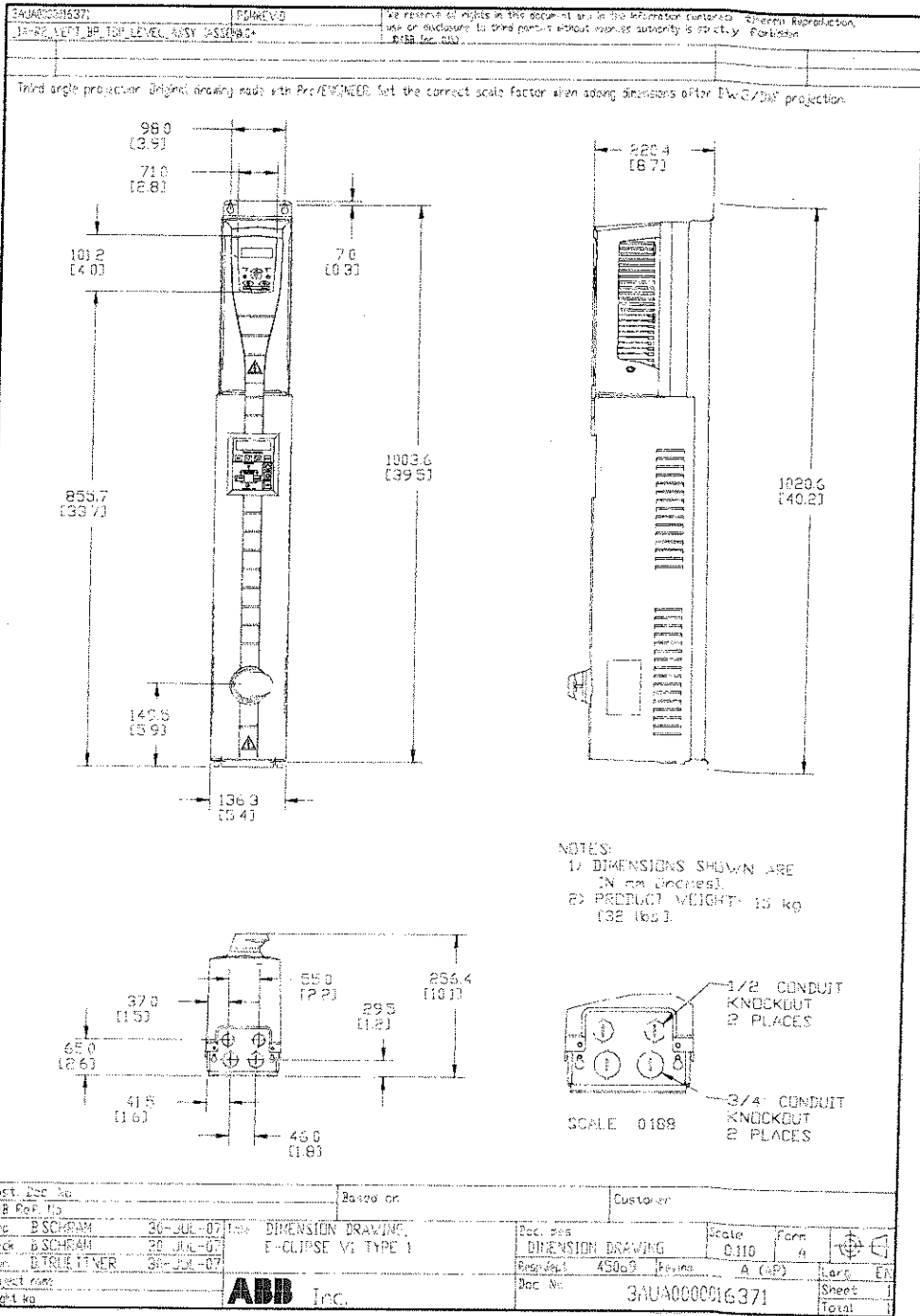
Item	Catalog Number	Power Wiring	Connection Diagram	Dimension Detail
1	ACH550-VCR-031A-2+F267	00VCR024PW-C	VCVDR014CC-A	3AUA0000016373 Sheet 1
2	ACH550-VCR-012A-2+F267	00VCR012PW-C	VCVDR014CC-A	3AUA0000016371 Sheet 1
3	ACH550-VCR-017A-2+F267	00VCR012PW-C	VCVDR014CC-A	3AUA0000016371 Sheet 1
4	ACH550-VCR-031A-2+F267	00VCR024PW-C	VCVDR014CC-A	3AUA0000016373 Sheet 1
5	ACH550-VCR-07A5-2+F267	00VCR012PW-C	VCVDR014CC-A	3AUA0000016371 Sheet 1
6	ACH550-VCR-024A-2+F267	00VCR012PW-C	VCVDR014CC-A	3AUA0000016372 Sheet 1

Product short Circuit Current Rating

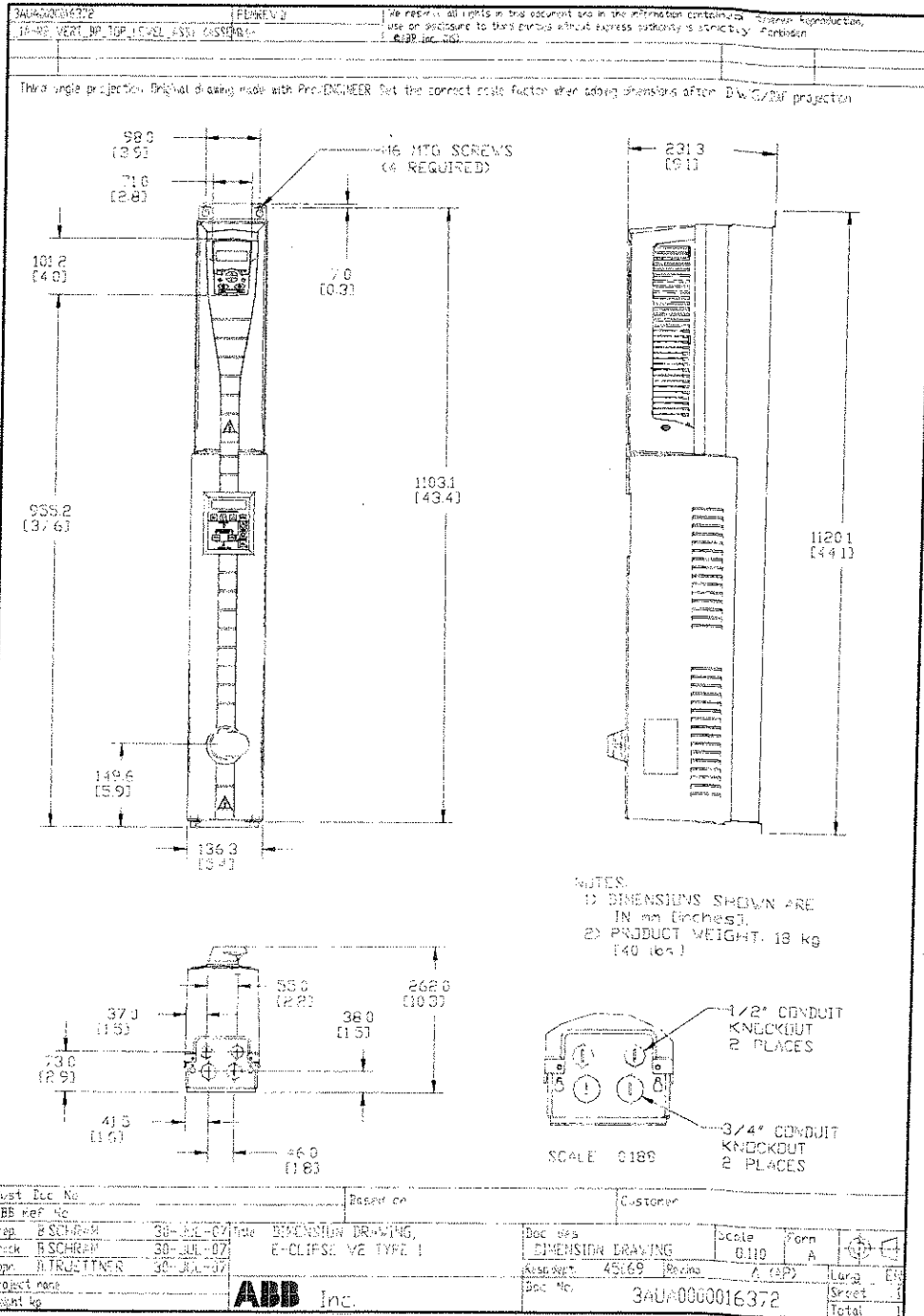
Short circuit ratings shown below are as show on the device rating label.

Item	Catalog Number	Short Circuit Current Rating
1	ACH550-VCR-031A-2+F267	100 kA
2	ACH550-VCR-012A-2+F267	100 kA
3	ACH550-VCR-017A-2+F267	100 kA
4	ACH550-VCR-031A-2+F267	100 kA
5	ACH550-VCR-07A5-2+F267	100 kA
6	ACH550-VCR-024A-2+F267	100 kA

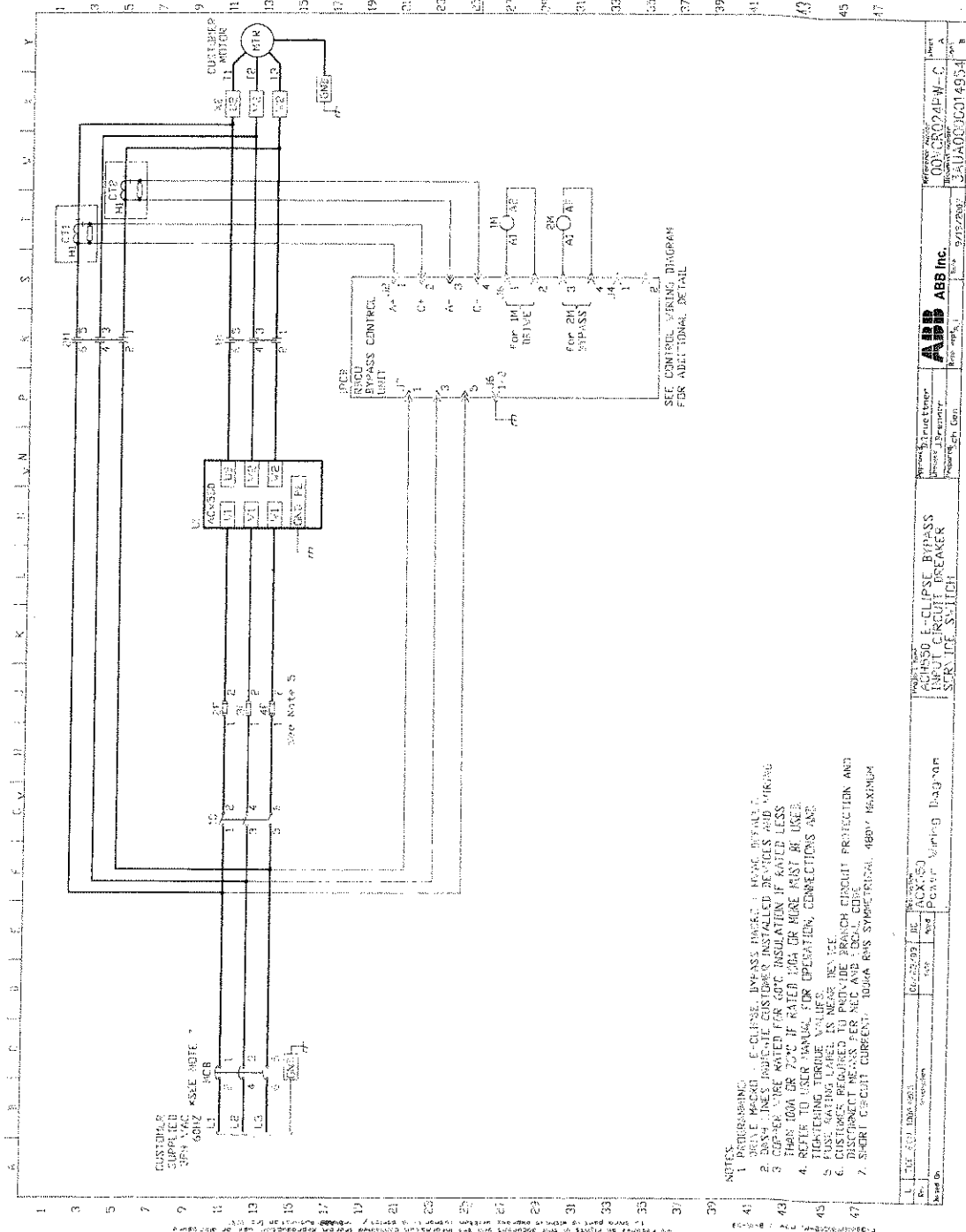
Dimension Drawing for P-3, P-4, 2 HP VFD's



Dimension Drawing for 7.5 HP VFD's



Power Drawing for CT-1, RTU-6



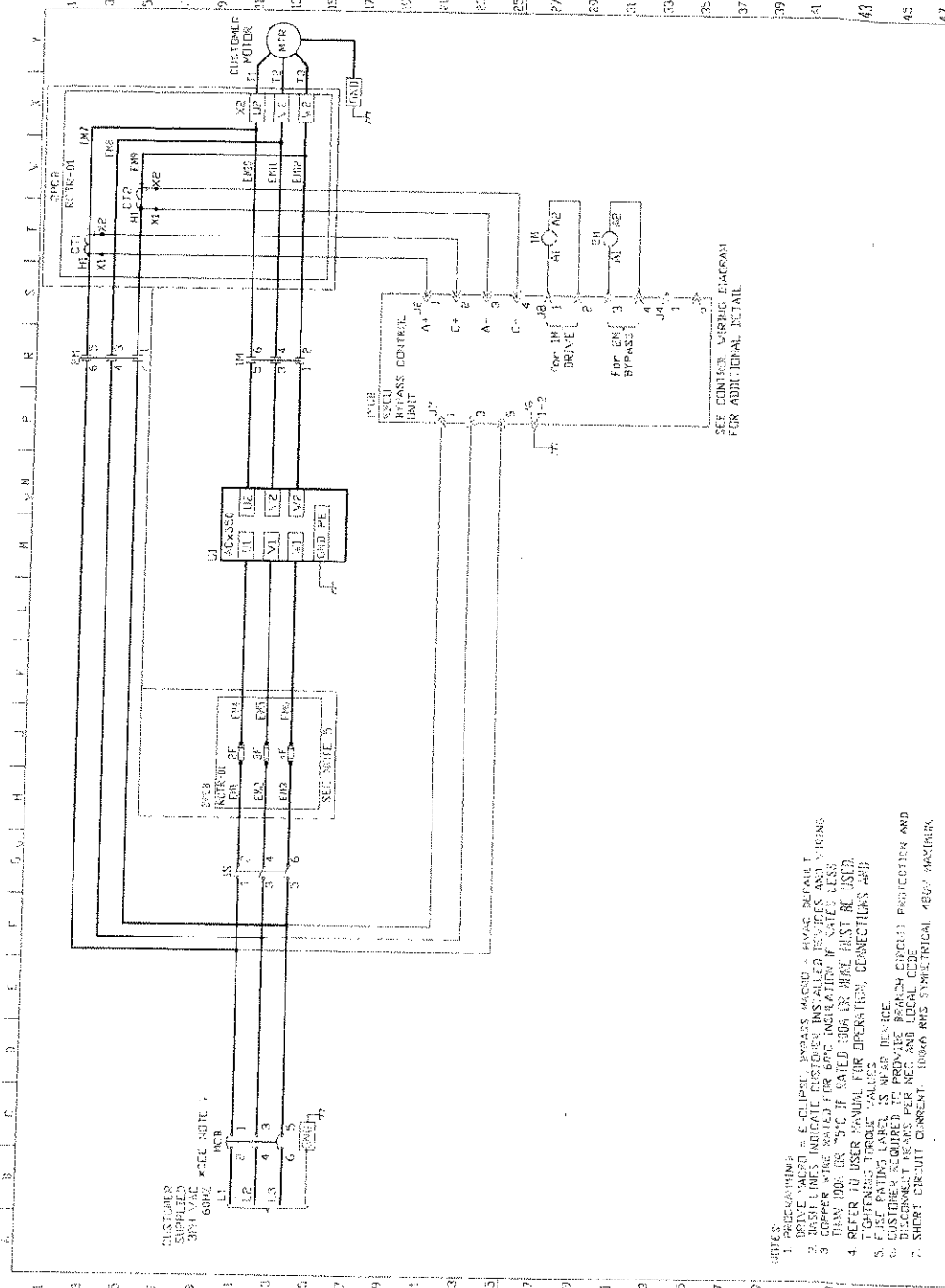
CUSTOMER SUPPLIER
3PH 3W3C
60HZ
RCCB

10 11 12 13
14 15 16 17
18 19 20 21
22 23 24 25
26 27 28 29
30 31 32 33
34 35 36 37
38 39 40 41
42 43 44 45
46 47

- NOTES
1. REWIRING: E-CLIPSE BYPASS INPUT CIRCUIT BREAKER
 2. 3PH 3W3C CUSTOMER SUPPLIER INSTALLED DEVICES AND WIRING
 3. CABLE TYPE RATED FOR 60°C INSULATION IF RATED LESS THAN 100A OR 70°C IF RATED 100A OR MORE MUST BE USED
 4. REFER TO USER MANUAL FOR OPERATION, CONNECTIONS AND
 5. MUST OBTAIN APPROVED VALUES FROM USER
 6. CUSTOMER REQUIRED TO PROVIDE PENALTY PROTECTION AND
 7. SHORT CIRCUIT CURRENT 100KA RMS SYMMETRICAL 480V MAXIMUM

Model	ABB	ABB Inc.	341A0036014934
Part No.	ABB	ABB Inc.	341A0036014934
Revision	001	ABB Inc.	341A0036014934
Manufacturer	ABB	ABB Inc.	341A0036014934
Product	ABB	ABB Inc.	341A0036014934
Material	ABB	ABB Inc.	341A0036014934
Quantity	ABB	ABB Inc.	341A0036014934
Unit Price	ABB	ABB Inc.	341A0036014934
Total Price	ABB	ABB Inc.	341A0036014934
Tax	ABB	ABB Inc.	341A0036014934
Shipping	ABB	ABB Inc.	341A0036014934
Notes	ABB	ABB Inc.	341A0036014934

Power Drawing for P-3, P-4, 2 HP VFD's, 7.5 HP VFD's



CUSTOMER SUPPLIED SEE NOTE 1
 600V AC VFD RACK
 480V AC MOTOR

- NOTES:
1. PRECAUTIONS
 2. DRIVE VOLTAGE = 480V AC BYPASS BREAKER & HVAC BEHIND IT
 3. DRIVE VOLTAGE INDICATE CUSTOMER INSTALLED BEHIND AND WIRING
 4. DRIVE VOLTAGE INDICATE CUSTOMER INSTALLED BEHIND AND WIRING
 5. DRIVE VOLTAGE INDICATE CUSTOMER INSTALLED BEHIND AND WIRING
 6. CUSTOMER REQUIRED TO PROVIDE BEHIND BEHIND PROTECTION AND DISCONNECT BEHIND PER NEC AND LOCAL CODE
 7. SHORT CIRCUIT CURRENT 1800A RMS SYMMETRICAL 480V 60/60HZ

REV	LEN	DATE	BY	CHKD	DESCRIPTION
1					600V AC BYPASS BREAKER
2					480V AC VFD RACK
3					480V AC MOTOR
4					480V AC BYPASS BREAKER
5					480V AC VFD RACK
6					480V AC MOTOR
7					480V AC BYPASS BREAKER
8					480V AC VFD RACK
9					480V AC MOTOR
10					480V AC BYPASS BREAKER
11					480V AC VFD RACK
12					480V AC MOTOR
13					480V AC BYPASS BREAKER
14					480V AC VFD RACK
15					480V AC MOTOR
16					480V AC BYPASS BREAKER
17					480V AC VFD RACK
18					480V AC MOTOR
19					480V AC BYPASS BREAKER
20					480V AC VFD RACK
21					480V AC MOTOR
22					480V AC BYPASS BREAKER
23					480V AC VFD RACK
24					480V AC MOTOR
25					480V AC BYPASS BREAKER
26					480V AC VFD RACK
27					480V AC MOTOR
28					480V AC BYPASS BREAKER
29					480V AC VFD RACK
30					480V AC MOTOR
31					480V AC BYPASS BREAKER
32					480V AC VFD RACK
33					480V AC MOTOR
34					480V AC BYPASS BREAKER
35					480V AC VFD RACK
36					480V AC MOTOR
37					480V AC BYPASS BREAKER
38					480V AC VFD RACK
39					480V AC MOTOR
40					480V AC BYPASS BREAKER
41					480V AC VFD RACK
42					480V AC MOTOR
43					480V AC BYPASS BREAKER
44					480V AC VFD RACK
45					480V AC MOTOR
46					480V AC BYPASS BREAKER
47					480V AC VFD RACK



CFM COMPANY

AIR CONDITIONING / HEATING / VENTILATING EQUIPMENT

413D North Highway 287 - Ft. Collins, CO 80524

Phone: (970) 493-7293 / Fax: (970) 493-7297

PSD - Beattie Elementary

TAG: Motors

Premium Efficient VFD Rated Motors

Specification Section:

230513

Submittal Date: 3/12/2014

Submitted by: Justin Dunkin

EFFECTIVE:
22-MAR-11

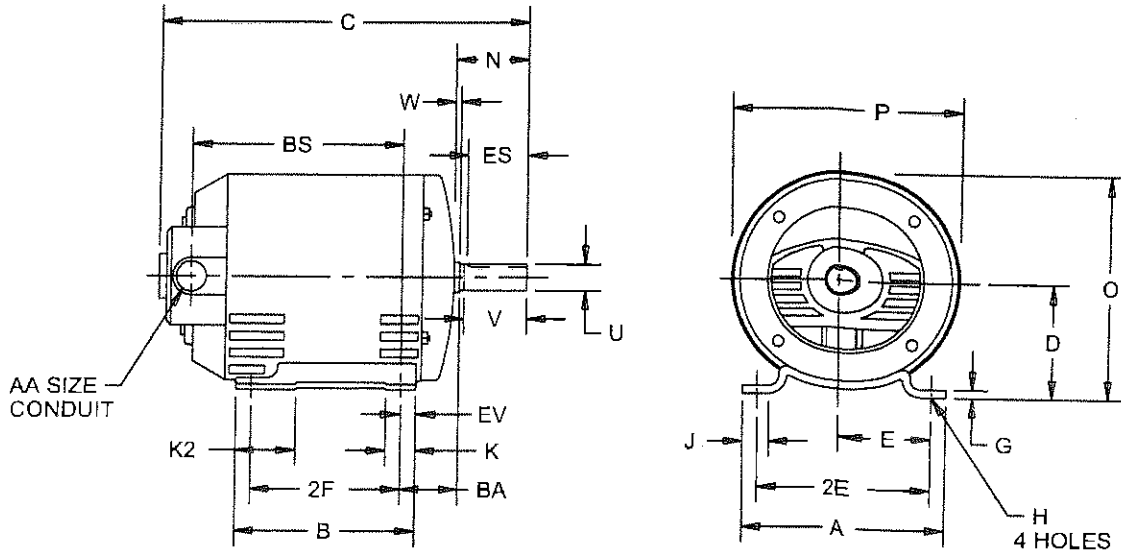
SUPERSEDES:
17-MAY-07

HORIZONTAL MOTORS
OPEN DRIP PROOF (6.50" FRAME)
FRAME: 143T, 145T
BASIC TYPE: D

PRINT:
07-1904

SHEET:
1 OF 1

2 HP Motors



ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS

UNITS	A	B	C	D -.06	E	2E ±.03	G	H +.05	J	K	K2	N
IN	6.50	6.00	12.84	3.50	2.75	5.50	.13	.34	1.00	.88	1.88	2.31
MM	165	152	326	89	70	140	3	9	25	22	48	59

UNITS	O	P ²	U -.0005	V MIN	W	AA	BA	BS	ES MIN	EV	SQ KEY
IN	6.72	6.44	.8750	2.06	.06	3/4 NPT	2.25	6.88	1.41	.50	.188
MM	171	164	22.225	52	2		57	175	36	13	4.78

FRAME	UNITS	2F ±.03
143T	IN	4.00
	MM	102
145T	IN	5.00
	MM	127

1. ALL ROUGH DIMENSIONS MAY VARY BY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS.
2. LARGEST MOTOR WIDTH.
3. TOLERANCES SHOWN ARE IN INCHES ONLY.

07-1904/D

Nidec Motor Corporation
St. Louis, Missouri

INFORMATION DISCLOSED ON THIS DOCUMENT IS CONSIDERED PROPRIETARY AND SHALL NOT BE REPRODUCED OR DISCLOSED WITHOUT WRITTEN CONSENT OF NIDEC MOTOR CORPORATION



ISSUED BY
S. KUBER
APPROVED BY
R. KING

1-HP_DP_NMCA (MAR-2011) SOLIDEDGE

NAMEPLATE DATA

CATALOG NUMBER		D2P2D		NAMEPLATE PART #:		422702-002	
MODEL	DS66	FR	145T	TYPE	DE	ENCL	ODP
SHAFT END BRG		6205-2Z-J/C3 - QTY 1		OPP END BRG		6203-2Z-J/C3 - QTY 1	
PH	3	MAX AMB	40 C	ID#			
INSUL CLASS	F	Asm. Pos.	F1		DUTY	CONT	
HP	2	RPM	1745	HP	2	RPM	1420
VOLTS	460	230	208	VOLTS	380	190	
FL AMPS	2.8	5.6	5.9	FL AMPS	3.3	6.6	
SF AMPS	3.1	6.2		SF AMPS	3.7	7.4	
SF	1.15	DESIGN	B	CODE	L		
NEMA NOM EFFICIENCY	86.5	NOM PF	77.4	KiloWatt	1.492		
GUARANTEED EFFICIENCY	84.0	MAX KVAR	1.2	HZ	60		
				SF	1.15	DESIGN	B
				NEMA NOM EFFICIENCY	82.5	NOM PF	83.2
				GUARANTEED EFFICIENCY	80.0	MAX KVAR	1
						HZ	50

HAZARDOUS LOCATION DATA (IF APPLICABLE):

DIVISION		CLASS I		GROUP I	
TEMP CODE		CLASS II		GROUP II	

VFD DATA (IF APPLICABLE):

VOLTS		
AMPS		
TORQUE 1		
VFD LOAD TYPE 1		
VFD HERTZ RANGE 1		
VFD SPEED RANGE 1		
SERVICE FACTOR		
NO. POLES	4	
VECTOR MAX RPM		
Radians / Seconds	1	
TORQUE 2		
VFD LOAD TYPE 2		
VFD HERTZ RANGE 2		
VFD SPEED RANGE 2		
FL SLIP		
MAGNETIZING AMPS	1.7	
Encoder PPR		
Encoder Volts		

TEAO DATA (IF APPLICABLE):

HP (AIR OVER)		HP (AIR OVER M/S)		RPM (AIR OVER)		RPM (AIR OVER M/S)	
FPM AIR VELOCITY		FPM AIR VELOCITY M/S		FPM AIR VELOCITY SEC			

ADDITIONAL NAMEPLATE DATA:

Decal / Plate	WD-344136	Customer PN	
Notes		Non Rev Ratchet	
Max Temp Rise	80C RISE/RES@1.00SF	OPP/Upper Oil Cap	GREASE
Thermal (WDG)		SHAFT/Lower Oil Cap	GREASE
Altitude			
Regulatory Notes		Regulatory Compliance	CC 030A
CCS		Marine Duty	
Balance		Arctic Duty	
3/4 Load Eff.	86.7	Inrush Limit	
Motor Weight (LBS)	35	Direction of Rotation	
Sound Level		Special Note 1	
Vertical Thrust (LBS)		Special Note 2	
Thrust Percentage		Special Note 3	
Bearing Life		Special Note 4	
Starting Method		Special Note 5	
Number of Starts		Special Note 6	
200/208V 60Hz Max Amps	6.6	SH Max. Temp.	
190V 50 hz Max Amps	7.4	SH Voltage	
380V 50 Hz Max Amps	3.7	SH Watts	
NEMA Inertia		Load Inertia	
Sumpheater Voltage		Sumpheater Wattage	
Special Accessory Note 1		Special Accessory Note 16	
Special Accessory Note 2		Special Accessory Note 17	
Special Accessory Note 3		Special Accessory Note 18	
Special Accessory Note 4		Special Accessory Note 19	
Special Accessory Note 5		Special Accessory Note 20	
Special Accessory Note 6		Special Accessory Note 21	
Special Accessory Note 7		Special Accessory Note 22	
Special Accessory Note 8		Special Accessory Note 23	
Special Accessory Note 9		Special Accessory Note 24	
Special Accessory Note 10		Special Accessory Note 25	
Special Accessory Note 11		Special Accessory Note 26	
Special Accessory Note 12		Special Accessory Note 27	
Special Accessory Note 13		Special Accessory Note 28	
Special Accessory Note 14		Special Accessory Note 29	
Special Accessory Note 15		Special Accessory Note 30	

NIDEC MOTOR CORPORATION
ST. LOUIS, MO



TYPICAL NAMEPLATE DATA
ACTUAL MOTOR NAMEPLATE LAYOUT MAY VARY
SOME FIELDS MAY BE OMITTED

Nidec trademarks followed by the ® symbol are registered with the U.S. Patent and Trademark Office.

MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
DS66	D2P2D	3	DE	145T

ORDER NO.	22123	LINE NO.
-----------	-------	----------

MPI:	150950	150951	150952	150953	150954
HP:	2	2	2	2	2
POLES:	4	4	4	4	4
VOLTS:	460	230	208	380	190
HZ:	60	60	60	50	50
SERVICE FACTOR:	1.15	1.15	1.15	1.15	1.15
EFFICIENCY (%):					
S.F.	86.3	86.3	84.7	81.7	81.7
FULL	86.5	86.5	85.5	82.5	82.5
3/4	86.7	86.7	86.9	85.6	85.6
1/2	84.6	84.6	85.8	85.2	85.2
1/4	76.5	76.5	79.3	79.2	79.2
POWER FACTOR (%):					
S.F.	80.7	80.7	85.1	85.8	85.8
FULL	77.4	77.4	82.7	83.2	83.2
3/4	68.9	68.9	76	76	76
1/2	55.2	55.2	63.6	63	63
1/4	34.7	34.7	41.6	40.6	40.6
NO LOAD	7.3	7.3	7.8	7.4	7.4
LOCKED ROTOR	68.8	68.8	67.7	73.8	73.8
AMPS:					
S.F.	3.1	6.2	6.6	3.7	7.4
FULL	2.8	5.6	5.9	3.3	6.6
3/4	2.4	4.7	4.7	2.6	5.2
1/2	2	4	3.8	2.1	4.2
1/4	1.8	3.5	3.1	1.8	3.5
NO LOAD	1.7	3.4	2.9	1.7	3.4
LOCKED ROTOR	24.1	48	43	21.4	43
NEMA CODE LETTER	L	L	J	H	H
NEMA DESIGN LETTER	B	B	B	B	B
FULL LOAD RPM	1745	1745	1725	1420	1420
NEMA NOMINAL EFFICIENCY (%)	86.5	86.5	85.5	82.5	82.5
GUARANTEED EFFICIENCY (%)	84	84	82.5	80	80
MAX KVAR	1.2	1.2	0.9	1	1
AMBIENT (°C)	40	40	40	40	40
ALTITUDE (FASL)	3300	3300	3300	3300	3300
SAFE STALL TIME-HOT (SEC)	10	10	13	13	13
SOUND PRESSURE (DBA @ 1M)	55	55	55	51	51
TORQUES:					
BREAKDOWN(% F.L.)	478	478	384	357	357
LOCKED ROTOR(% F.L.)	396	396	313	310	310
FULL LOAD(LB-FT)	6	6	6.1	7.4	7.4

NEMA Nominal and Guaranteed Efficiencies are up to 3,300 feet above sea level and 25 ° C ambient

The Above Data Is Typical. Sinewave Power Unless Noted Otherwise

NIDEC MOTOR CORPORATION
ST. LOUIS, MO

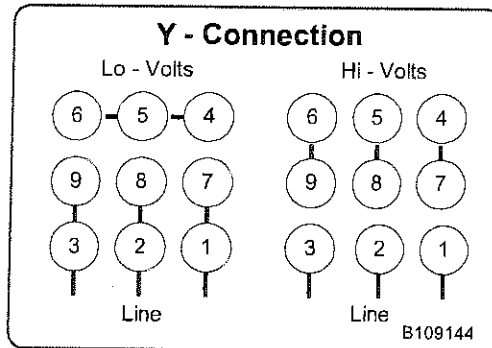
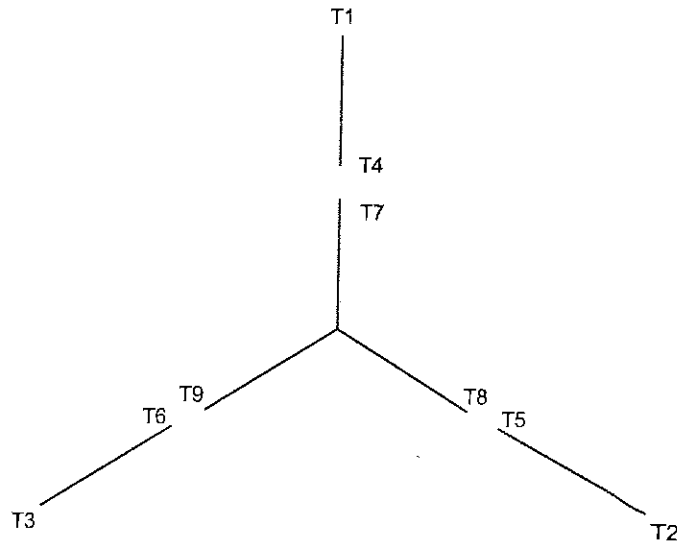


Nidec trademarks followed by the ® symbol are registered with the U.S. Patent and Trademark Office.



B109144

Motor Wiring Diagram 9 Lead, Dual Voltage (WYE Conn.)



To reverse direction of rotation interchange connections L1 and L2.

Each lead may have one or more cables comprising that lead.
In such case each cable will be marked with the appropriate lead number.

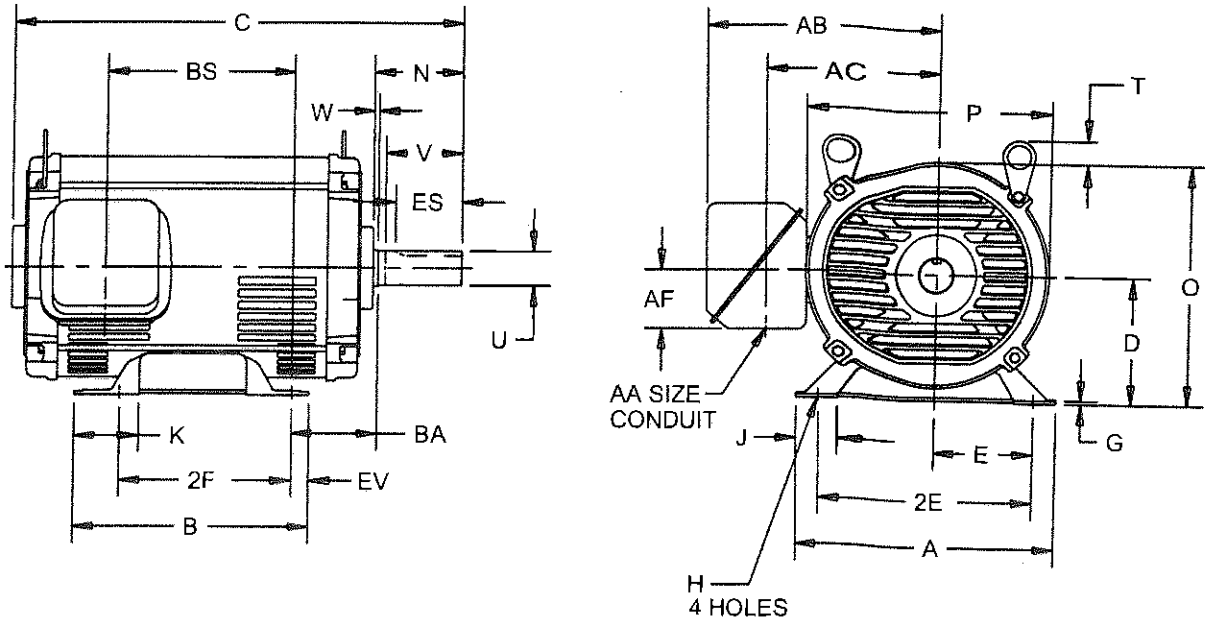
EFFECTIVE:
26-NOV-12

SUPERSEDES:
11-MAY-11

HORIZONTAL MOTORS
OPEN DRIP PROOF
FRAME: 210T
BASIC TYPE: D

PRINT:
07-2204
SHEET:
1 OF 1

7.5 HP Motors



ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS

UNITS	A	D -.06	E	2E ±.03	G	H +.05	J	K	N	O	P ²	T
IN	9.50	5.25	4.25	8.50	.19	.41	1.16	1.03	3.50	9.96	9.42	1.25
MM	241	133	108	216	5	10	29	26	89	253	239	32

UNITS	U -.0005	V MIN	W	AA	AB	AC	AF	BA	ES MIN	EV	SQ KEY
IN	1.3750	3.25	.13	1.00	7.60	6.40	2.13	3.50	2.41	.50	.313
MM	34.925	83	3		193	163	54	89	61	13	7.95

FRAME	UNITS	B	C	2F ±.03	BS
213T	IN	6.50	15.96	5.50	6.67
	MM	165	405	140	169
215T	IN	8.00	17.46	7.00	8.17
	MM	203	443	178	208

- 1: ALL ROUGH DIMENSIONS MAY VARY BY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS.
- 2: LARGEST MOTOR WIDTH.
- 3: TOLERANCES ARE IN INCHES ONLY.

- 4: CONDUIT OPENINGS MAY BE LOCATED IN STEPS OF 90° REGARDLESS OF LOCATION. STANDARD AS SHOWN WITH CONDUIT OPENING DOWN.
- 5: FRAME REFERENCE: 10.53/213//12.03/215

2204/D

Nidec Motor Corporation
St. Louis, Missouri

INFORMATION DISCLOSED ON THIS DOCUMENT IS CONSIDERED PROPRIETARY AND SHALL NOT BE REPRODUCED OR DISCLOSED WITHOUT WRITTEN CONSENT OF NIDEC MOTOR CORPORATION



ISSUED BY
R. KING
APPROVED BY
J. HAGENE

(MAR-2011) SOLIDEDGE

IHP_DP

MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
R341	D7P2D	3	DE	213T

ORDER NO.	3096	LINE NO.

	128016	128017	128018	128019	128020
MPI:					
HP:	7.5	7.5	7.5	7.5	7.5
POLES:	4	4	4	4	4
VOLTS:	460	230	208	380	190
HZ:	60	60	60	50	50
SERVICE FACTOR:	1.15	1.15	1.15	1.15	1.15
EFFICIENCY (%):					
S.F.	91	91	89.5	87.5	87.5
FULL	91	91	90.2	88.5	88.5
3/4	92.2	92.2	91.8	91.1	91.1
1/2	91.6	91.6	92	91.8	91.8
1/4	87.5	87.5	88.9	89.3	89.3
POWER FACTOR (%):					
S.F.	84.5	84.5	85.6	85.7	85.7
FULL	83.3	83.3	85.3	85.3	85.3
3/4	79.4	79.4	83.4	82.9	82.9
1/2	70.7	70.7	77.7	76.1	76.1
1/4	49.4	49.4	59.5	56.4	56.4
NOLOAD	6	6	6.8	5.7	5.7
LOCKED ROTOR	44.9	44.9	44	47.3	47.3
AMPS:					
S.F.	10.5	21	23.3	13	26.1
FULL	9.3	18.5	20.2	11.3	22.5
3/4	7.2	14.4	15.2	8.4	16.9
1/2	5.4	10.8	10.9	6.1	12.2
1/4	4.1	8.1	7.3	4.2	8.4
NOLOAD	3.5	7.1	5.8	3.5	6.9
LOCKED ROTOR	60	120	105	56	113
NEMA CODE LETTER	H	H	F	F	F
NEMA DESIGN LETTER	B	B	B	#	#
FULL LOAD RPM	1765	1765	1755	1450	1450
NEMA NOMINAL EFFICIENCY (%)	91	91	90.2	88.5	88.5
GUARANTEED EFFICIENCY (%)	89.5	89.5	88.5	86.5	86.5
MAX KVAR	2.4	2.4	1.8	2	1.9
AMBIENT (°C)	40	40	40	40	40
ALTITUDE (FASL)	3300	3300	3300	3300	3300
SAFE STALL TIME-HOT (SEC)	25	25	30	29	29
SOUND PRESSURE (DBA @ 1M)	58	58	58	54	54
TORQUES:					
BREAKDOWN(% F.L.)	294	294	231	231	231
LOCKED ROTOR(% F.L.)	225	225	176	174	174
FULL LOAD(LB-FT)	22.3	22.3	22.4	27.1	27.1

NEMA Nominal and Guaranteed Efficiencies are up to 3,300 feet above sea level and 25 ° C ambient

The Above Data Is Typical, Sinewave Power Unless Noted Otherwise

NIDEC MOTOR CORPORATION
ST. LOUIS, MO

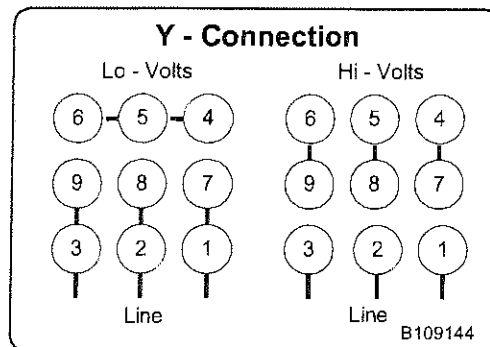
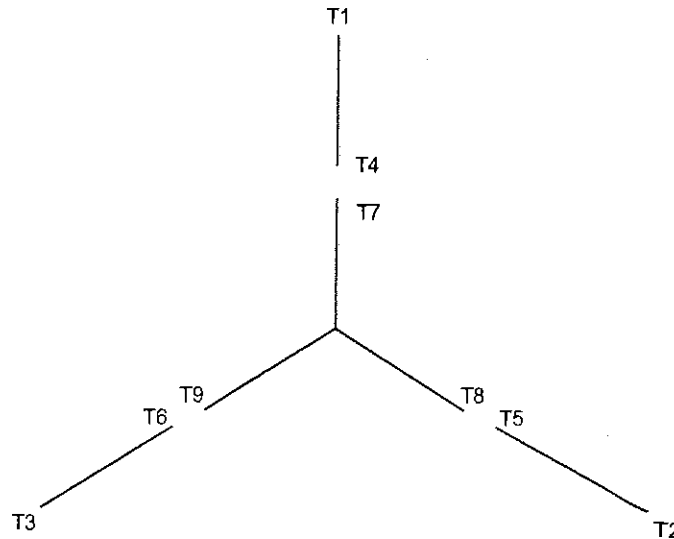


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B109144

Motor Wiring Diagram 9 Lead, Dual Voltage (WYE Conn.)



To reverse direction of rotation interchange connections L1 and L2.

Each lead may have one or more cables comprising that lead.
In such case each cable will be marked with the appropriate lead number.

Suitability of Integral Horsepower (IHP)* Motors on Variable Frequency Drives

Variable Frequency Drives (VFD)

All Nidec Motor Corporation inverter duty motors have 40°C ambient, 1.0 SF on Inverter Power, 3300 ft. max altitude, 460 voltage or less line power, up to 10:1 speed range on Variable Torque and Class F Insulation.

Nidec Motor Corporation's INVERTER GRADE[®] insulated motors exceeded NEMA[®] MG-1 Part 30 & 31 before the standards were established.

We are a leader in the development of electric motors to withstand pulse width modulated (PWM) drives evolution from power transistors to higher switching frequency insulated gate bipolar transistors (IGBTs).

Today, as the need for medium duty motor inverter applications grows, Nidec Motor Corporation provides products to meet these demands.

Through continued research and development, Nidec Motor Corporation has included the insulation wire from its INVERTER GRADE[®] motors in all Premium Efficient motors, enhancing their potential inverter compatibility.

Inverter compatibility with motors is complex. As a result, many variables must be considered when determining the suitability of certain types of motors. These variables include:

- Torque requirements (Constant or Variable)
- Speed Range
- Line/System Voltage
- Cable Length between VFD & Motor
- Drive Switching (Carrier) Frequency Motor Construction
- VFD dv/dt
- High Temperatures High Humidity

Wider speed ranges, higher voltages, higher switching frequencies and increased cable lengths all add to the severity of the application and therefore the potential for premature motor failure. Nidec Motor Corporation has differentiated its products into families for your ease of selection for various inverter applications.

Warranty Guidelines

The information within this section refers to the motor and drive application guidelines and limitations for warranty.

Hazardous Location Motors

Use of a variable frequency drive with the motors in this catalog, intended for use in hazardous locations, is only approved for Division 1, Class I, Group D hazardous location motors with a T2B temperature code, with a limitation of 2:1 constant torque or 10:1 variable torque output. No other stock hazardous location motors are inherently suitable for operation with a variable frequency drive. If other requirements are needed, including non-listed Division 2, please contact your Nidec Motor Corporation territory manager to conduct an engineering inquiry.

575 Volt Motors

575 volt motors can be applied on inverters when output filters are used.

Applying INVERTER GRADE[®] Insulated Motors on Variable Frequency Drives (2, 4, 6 pole)

The products within this catalog labeled "Inverter Duty" or "Vector Duty" are considered INVERTER GRADE[®] insulated motors. INVERTER GRADE[®] motors exceed the NEMA[®] MG-1 Part 31 standard.

Nidec Motor Corporation provides a three-year limited warranty on all NEMA[®] frame INVERTER GRADE[®] insulated motors and allows long cable runs between the motor and the VFD (limited to 400 feet typical without output filters). Cable distance can be further limited by hot and humid environments and VFD manufacturers cable limits. These motors may be appropriate for certain severe inverter application or when the factors relating to the end use application are undefined (such as spares).

Nidec Motor Corporation's U.S. Motors[®] brand is available in the following INVERTER GRADE[®] insulated motors:

- Inverter Duty NEMA[®] frame motors good for 10:1 Variable Torque & 5:1 Constant Torque, including Vertical Type RUSI
- Inverter Duty motors rated for 10:1 Constant Torque
- ACCU-Torq[®] and Vector Duty Motors with full torque to 0 Speed
- 841 Plus[®] NEMA[®] Frame Motors

Applying motors that do not have INVERTER GRADE[®] insulation on Variable Frequency Drives (2, 4, 6 pole)

Meet NEMA[®] MG-1, Section IV, Part 31.4.4.2. They can be used with adjustable frequency drives under the following parameters: On NEMA[®] frame motors, 10:1 speed rating on variable torque loads & 4:1 speed range on constant torque loads. On TITAN[®] frame motors, 10:1 speed rating on variable torque loads. On TITAN[®] frame motors, inquiry required for suitability on constant torque loads. Cable distances are for reference only and can be further limited by hot and humid environments. Refer to specific VFD manufacturers cable limits.

Cable Distances			
Maximum Cable Distance VFD to Motor			
Switching Frequency	460 Volt	230 Volt	380 Volt
3 KHz	127 ft	400 ft	218 ft
6 KHz	90 ft	307 ft	154 ft
9 KHz	73 ft	251 ft	126 ft
12 KHz	64 ft	217 ft	109 ft
15 KHz	57 ft	194 ft	98 ft
20 KHz	49 ft	168 ft	85 ft

Applying Standard & Energy Efficient Motors on Variable Frequency Drives is not recommended. VFD related failures on standard and energy efficient motors 444 frame and above will not be covered under warranty.

*This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL[®] & CSA[†] listings where indicated.

† All marks shown within this document are properties of their respective owners.



Motor / Inverter Compatibility

Thermal Overloads and Single Phase Motors

Motors with thermal overloads installed may not operate properly on a VFD. The current carrying thermal overload is designed for sine wave power. Operation on a VFD may cause nuisance tripping or potentially not protect the motor as would be expected on line power. Thermo-stats or thermistors installed in the motor and connected properly to the VFD may provide suitable thermal overload protection when operating on a VFD. (Consult Codes)

Single phase motors and other fractional horsepower ratings are not designed to be operated on a VFD. Within Nidec Motor Corporation standard products, all motors NEMA® 48 frame (5.5" diameter) and smaller are not suitable for VFD applications. Three phase 56 and 143/145 frame applications should be noted on the catalog price page; or if in doubt ask a Nidec Motor Corporation technical representative for recommendations on compatibility with a VFD.

Slow Speed Motors

Motors with a base design of slower than six poles require special consideration regarding VFD sizing and minimizing harmonic distortion created at the motor terminals due to cable installation characteristics. Additional external PWM waveform filters and shielded motor cables designed for PWM power may be required to provide acceptable motor life. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%).

690V Applications

Motors that will be applied to 690VAC PWM VFDs require the use of an external filter to limit peak voltage spikes and the use of an INVERTER GRADE® motor. Where available, an alternative to using an output filter is to upgrade to a 2300V insulation system.

Low Voltage TITAN® Motors

When using 449 frame and larger motors on PWM type VFDs consider the use of an external filter and shielded motor cables designed for PWM power to minimize harmonic distortion and peak voltages at the motor terminals. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%).

Bearing Currents related to PWM waveform

Due to the uniqueness of this condition occurring in the field, protection of the motor bearings from shaft currents caused by common mode voltages is not a standard feature on sine wave or Inverter Duty motor products, unless explicitly noted. Some installations may be prone to a voltage discharge condition through the motor bearings called fluting.

Fluting damage is related to characteristics of the PWM waveform, VFD programming and characteristics and installation.

Bearing fluting as a result of VFD waveform characteristics may be prevented by the installation of a shaft grounding device such as a brush or ring and/or correction of the installation characteristics causing the shaft voltage condition. Insulated bearing(s) may be required. VFD filters may be needed if bearing fluting is to be avoided.

Multiple Motors on a Single VFD

Special considerations are required when multiple motors are powered from a single VFD unit. Most VFD manufacturers can provide guidelines for proper motor thermal considerations and starting/stopping of motors. Cable runs from the VFD and each motor can create conditions that will cause extra stress on the motor winding. Filters may be required at the motor to provide maximum motor life.

Grounding and Cable Installation Guidelines

Proper output winding and grounding practices can be instrumental in minimizing motor related failures caused by PWM waveform characteristics and installation factors. VFD manufacturers typically provide detailed guidelines on the proper grounding of the motor to the VFD and output cable routing. Cabling manufacturers provide recommended cable types for PWM installations and critical information concerning output wiring impedance and capacitance to ground.

Vertical Motors on VFDs

Vertical motors operated on VFD power present unique conditions that may require consideration by the user or installation engineer:

- Non-reversing-ratchet operation can interfere at low speeds (up to 300 RPM) causing locked rotor and drive tripping.
- Unexpected / unacceptable system vibration and or noise levels caused by the torque pulsation characteristics of the PWM waveform, a system critical frequency falling inside the variable speed range of the process or the added harmonic content of the PWM waveform exciting a system component
- Application related problems related to the controlled acceleration/ deceleration and torque of the motor on VFD power and the building of system pressure/ load.
- The impact the reduction of pump speed has on the down thrust reflected to the pump motor and any minimum thrust requirements of the motor bearings
- Water hammer during shutdown damaging the non-reversing ratchet

Humidity and Non-operational Conditions

The possible build-up of condensation inside the motor due to storage in an uncontrolled environment or non-operational periods in an installation, can lead to an increased rate of premature winding or bearing failures when combined with the stresses associated with PWM waveform characteristics. Moisture and condensation in and on the motor winding over time can provide tracking paths to ground, lower the Megohm resistance of the motor winding to ground, and lower the Corona Inception Voltage level of the winding.

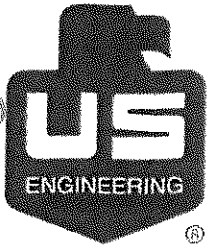
Proper storage and maintenance guidelines are important to minimize the potential of premature failures. Space heaters or trickle voltage heating methods are the preferred methods for drying out a winding that has low megaohm readings. Damage caused by these factors are not covered by the limited warranty provided unless appropriate heating methods are properly utilized during non-operational periods and prior to motor start-up.

NEMA® Application Guide for AC Adjustable Speed Drive Systems: <http://www.nema.org/stds/acadjustable.cfm#download>

*This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL® & CSA® listings where indicated.

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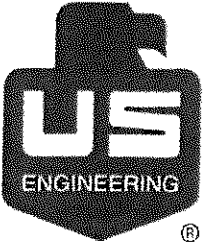




Tab-2
Specification Section: 23 21 13
Hydronic Pumps:
P-3 (Bell & Gossett)
P-4 (Bell & Gossett)

**BEATTIE
ELEMENTARY
SCHOOL**

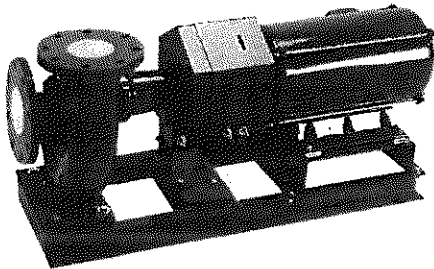
1000 MEADOW LARK AVE
FORT COLLINS CO 80516



Hydronic Pumps O&M and
Warranty Information:
P-3 (Bell & Gossett)

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SCHOOL**

1000 MEADOWVIEW AVE
FORT COLLINS CO 80526



Series 1510 Based Mounted Centrifugal Pump Kits

IMPORTANT

The Series 1510 pump kits are to be assembled by qualified personnel only. Any questions regarding the assembly procedure should be referred to the Bell & Gossett Service Manager.

Impeller cap screws and washers are furnished with the kit. All other fasteners and shims must be furnished by assembler. (Refer to Fastener Chart for proper sizing of cap screws, nuts and washers.)

1. Mount volute to base, adding a minimum of .025" in shims between volute and base. Use 4 cap screws, 4 lock washers, 4 flat washers and risers when applicable.
2. Assemble volute cover plate to small bearing assembly (1" shaft) with 4 cap screws. On large bearing assembly (1 1/4" shaft), use 8 cap screws.
3. Press seal insert in volute cover plate. Push pump shaft forward from rear of bearing assembly to take up end play. Moisten the inner diameter of seal assembly with soapy water, maintaining forward pressure on the shaft, and press seal firmly in place. Carbon seal face must be tight against ceramic insert. Apply small end of tapered spring on seal.
4. Make certain that impeller has been properly cut to size for required GPM and feet of head and balanced. Slide impeller onto bearing assembly shaft until it bottoms against the shaft shoulder. Fasten impeller using one cap screw, one internal lock washer and one large impeller washer. Make certain that cap screw is tightened to 18-20 foot pounds on small bearing assembly (1" shaft) and 40-44 foot pounds on the large bearing assembly (1 1/4" shaft).
5. Mount bearing assembly, impeller, volute gasket and cover plate to volute.
6. Add foot support to base and bearing frame using 4 cap screws, 4 lock washers, 4 flat washers and 4 nuts. In some instances, the nuts will be welded direct to the base cross member.
7. Mount saddle to base with 4 cap screws, 4 lock washers, 8 flat washers and 4 nuts.

8. Mount motor to saddle using 4 cap screws, 4 lock washers, 8 flat washers and 4 nuts.
9. Apply pump coupler half to pump shaft and motor coupler half to motor shaft. Tighten one coupler half in its final position and add coupler sleeve. If using a two piece sleeve, hang the wire ring loosely in the groove next to the teeth. Slide the loose flange tightly up against the sleeve and back off 1/8" for axial clearance. Tighten the loose flange to the shaft.

Check vertical and horizontal misalignment by using a straight edge scale or piece of bar stock with the center notched to provide clearance for the raised portion of the coupler sleeve. For 3500 rpm operation, it will be necessary to check the angular misalignment by using a dial indicator or micrometer calipers. Measure the gap at intervals around the periphery of the coupling to determine minimum and maximum gap. The difference between these two values should be as close to zero as possible.

If the angular alignment was adjusted, it will be necessary to recheck the vertical and horizontal misalignment again.

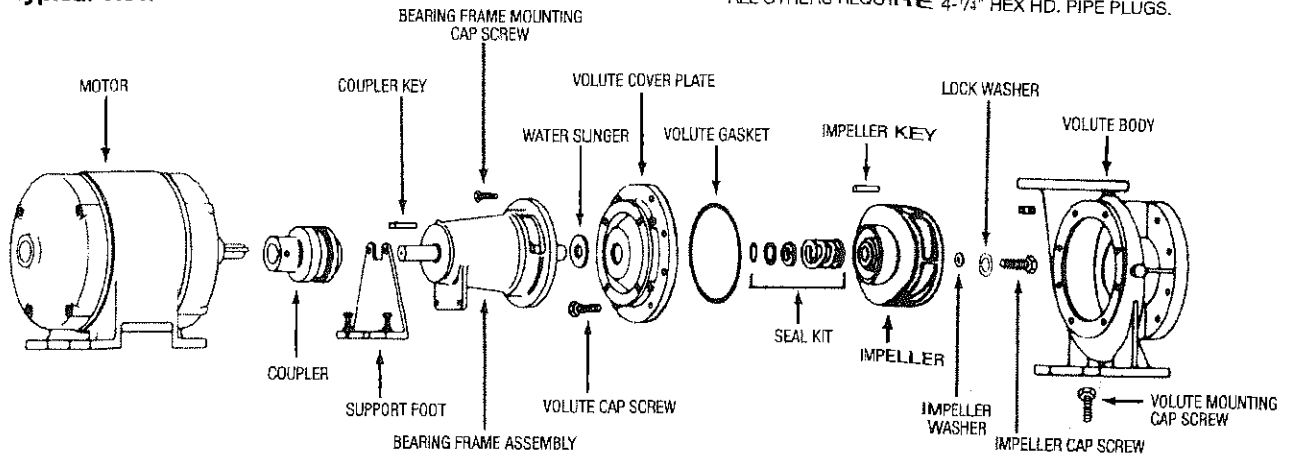
If using a two piece sleeve, force the wire ring into its groove in the center of the sleeve. The use of a blunt screw driver may be necessary.

10. Apply coupler guard using 4 cap screws, 4 lock washers and 4 nuts.
11. Recheck all exposed nuts and cap screws for tightness.
12. Complete all name plate data and affix to base.
13. Complete and return Pump Kit Data Card to the Customer Service Dept., Bell & Gossett, 8200 N. Austin Ave., Morton Grove, IL 60053.
14. Affix installation and service instructions (P81673).
15. Make certain complete unit is properly lubricated.

EXPLODED VIEW

Typical View

NOTE: 1 1/4" and 1 1/2" VOLUTES REQUIRE 4-7/8" HEX HD. PIPE PLUGS. ALL OTHERS REQUIRE 4-7/4" HEX HD. PIPE PLUGS.



FASTENER CHART

VOLUTE TO BASE	
PUMP SIZE	FASTENERS
1 1/4 AC thru 3 AC Fr #143T thru 215T 4 AC thru 4 BC FR #143T thru 256T	4-7/16 x 1 3/4 Cap Screw 4-7/16 Washer 4-7/16 Lock Washer
1 1/4 AC thru 3 AC Fr #254T thru 256T	4-7/16 x 3 Cap Screw 4-7/16 Washer 4-7/16 Lock Washer
3E thru 5E and 5BC thru 4GB All Frames	4-1/2 x 2 Cap Screw 4-1/2 Nut 4-1/2 Washer 4-1/2 Lock Washer
5G, 6G and 6E All Frames	4-5/8 x 2 1/2 Cap Screw 4-5/8 Nut 4-5/8 Washer 4-5/8 Lock Washer
COVER PLATE TO VOLUTE	
A Size Pumps	} Cap Screws
B Size Pumps	
G and E Size Pumps	
	8-3/8 x 7/8 12-7/16 x 1 16-1/2 x 1 1/4
BEARING FRAME TO COVER PLATE	
Small Frame	} Cap Screws
Large Frame	
	4-3/8 x 1 8-3/8 x 1 1/4
SUPPORT FOOT	
All Sizes	4-7/16 x 1 Cap Screw
SADDLE TO BASE	
1 1/4 AB thru 4 BC Fr #143T-256T	4-3/8 x 1 Cap Screw 4-3/8 Nut 8-3/8 Washer 4-3/8 Lock Washer
3E thru 5E and 5BC thru 4GB All Frames	4-1/2 x 1 1/2 Cap Screw 4-1/2 Nut 8-1/2 Washer 4-1/2 Lock Washer
5G, 6G and 6E All Frames	4-5/8 x 1 1/2 Cap Screw 4-5/8 Nut 8-5/8 Washer 4-5/8 Lock Washer

MOTOR TO SADDLE	
FRAME SIZE	FASTENERS
56 143T, 145T	4-5/16 x 1 1/4 Cap Screw 4-5/16 Nut 8-5/16 Washer 4-5/16 Lock Washer
182T, 184T	4-3/8 x 1 1/2 Cap Screw 4-3/8 Nut 8-3/8 Washer 4-3/8 Lock Washer
213T, 215T	4-3/8 x 2 Cap Screw 4-3/8 Nut 8-3/8 Washer 4-3/8 Lock Washer
254T, 256T 284T, 286T	4-7/16 x 2 Cap Screw 4-7/16 Nut 8-7/16 Washer 4-7/16 Lock Washer
324T, 326T 364T, 365T	4-1/2 x 2 1/4 Cap Screw 4-1/2 Nut 8-1/2 Washer 4-1/2 Lock Washer
404TS	4-5/8 x 2 3/4 Cap Screw 4-5/8 Nut 8-5/8 Washer 4-5/8 Lock Washer



Xylem Inc.
8200 N. Austin Avenue
Morton Grove, Illinois 60053
Phone: (847) 966-3700
Fax: (847) 965-8379
www.xyleminc.com/brands/belgosssett

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TERMS AND CONDITIONS OF SALE

FLOWTRONEX PSI LLC, a Division of Xylem Inc.
(DBA Flowtronex, Water Equipment Technologies, A-C Fire Pump,
Bell & Gossett, and/or Goulds Water Technology)

1. Agreement, Integration and Conflict of Terms. These terms and conditions, together with any special conditions expressly incorporated thereto in the quotation or sales form, are to govern any sale by Flowtronex PSI LLC. (d/b/a Flowtronex, Water Equipment Technology, A/C Firepumps, Bell & Gossett, and/or Goulds), a division of Xylem Inc. ("Seller"). This writing is an offer or counteroffer by Seller to sell the goods and/or services set forth on the quotation or sales form subject to these terms and conditions and is expressly made conditional on Buyer's assent to these terms and conditions. Acceptance by Buyer is expressly limited to these terms and conditions. Any additional or different terms and conditions contained in Buyer's purchase order or other communication shall not be effective or binding upon Seller unless specifically agreed to in writing by Seller; Seller hereby objects to any such conditions, and the failure of Seller to object to specific provisions contained in any purchase order or other communication from Buyer shall not be construed as a waiver of these terms and conditions nor an acceptance of any such provisions. Neither Seller's commencement of performance nor delivery shall be deemed or construed as acceptance of Buyer's additional or different terms and conditions.

Buyer agrees that these terms and conditions, together with any accompanying quotation and any special conditions or limited process guarantees or documents referred to or included within the quotation and expressly made a part of this agreement, (e.g., drawings, illustrations, specifications, or diagrams), is the complete and final agreement between the parties ("Agreement"). This Agreement supersedes all prior negotiations, representations, or agreements, either written or oral, between the parties and, further, can only be altered, modified or amended with the express written consent of Seller.

2. Quotation, Withdrawal, Expiration. Quotes are valid for thirty (30) calendar days from the date of issuance. Seller reserves the right to cancel or withdraw the quotation at any time with or without notice or cause prior to acceptance by Buyer. There is no Agreement if any conditions specified within the quotation or sales form are not completed by Buyer to Seller's satisfaction within thirty (30) calendar days of Seller's acknowledgement in writing of an order. Seller nevertheless reserves its right to accept any contractual documents received from Buyer after this 30-day period.

3. Prices. Prices apply to the specific quantities stated on the quotation or sales form. Unless otherwise agreed to in writing by Seller, all prices are F.O.B. Seller's plant, and do not include transportation costs or charges relating to transportation, which costs and charges shall be solely the responsibility of Buyer. Prices include standard packing according to Seller's specifications. All costs and taxes for special packing requested by Buyer, including packing for exports, shall be paid by Buyer as an additional charge. Prices are subject to change without notice.

4. Taxes. The price for the goods does not include any applicable sales, use, excise, GST, VAT, or similar tax. Buyer shall have the responsibility for the payment of such taxes if applicable.

5. Payment Terms. Seller reserves the right to require payment in advance or C.O.D. and otherwise modify credit terms should Buyer's credit standing not meet Seller's acceptance. Unless different payment terms are expressly set forth in the quotation or sales form or order acknowledgment or Sales Policy Manual, goods will be invoiced upon shipment. Payment in full is due within thirty (30) days from the invoice date. In the event payment is not made when due, Buyer agrees to pay Seller a service or finance charge of the lesser of (i) one and one-half percent (1.5%) per month (18% per annum), or (ii) the highest rate permitted by applicable law, on the unpaid balance of the invoice from and after the invoice due date. Buyer is responsible for all costs and expenses associated with any checks returned due to insufficient

TERMS AND CONDITIONS OF SALE

FLOWTRONEX PSI LLC

funds. All credit sales are subject to prior approval of Seller's credit department. Export shipments will require payment prior to shipment or an appropriate Letter of Credit. If, during the performance of the contract with Buyer, the financial responsibility or condition of Buyer is such that Seller in good faith deems itself insecure, or if Buyer becomes insolvent, or if a material change in the ownership of Buyer occurs, or if Buyer fails to make any payments in accordance with the terms of its contract with Seller, then, in any such event, Seller is not obligated to continue performance under the contract and may stop goods in transit and defer or decline to make delivery of goods, except upon receipt of satisfactory security or cash payments in advance, or Seller may terminate the order upon written notice to Buyer without further obligation to Buyer whatsoever. If Buyer fails to make payments or fails to furnish security satisfactory to Seller, then Seller shall also have the right to enforce payment to the full contract price of the work completed and in process. Upon default by Buyer in payment when due, Buyer shall immediately pay to Seller the entire unpaid amounts for any and all shipments made to Buyer irrespective of the terms of said shipment and whether said shipments are made pursuant to this Agreement or any other contract of sale between Seller and Buyer, and Seller may withhold all subsequent shipments until the full amount is settled. Acceptance by Seller of less than full payment shall not be a waiver of any of its rights hereunder.

Buyer shall not assign or transfer this Agreement or any interest in it, or monies payable under it, without the written consent of Seller and any assignment made without such consent shall be null and void.

6. Delivery, Risk of Loss. Delivery dates are estimates, and time is not of the essence. All shipments will be made F.O.B. Seller's plant unless otherwise specified. Seller shall not be responsible to Buyer for any loss, whether direct, indirect, incidental or consequential in nature, including without limitation loss of profits, arising out of or relating to any failure of the goods to be delivered by the specified delivery date. In the absence of specific instructions, Seller will select the carrier. Upon delivery to the common carrier, title and the risk of loss for the material shall pass to Buyer. Buyer shall reimburse Seller for the additional cost of its performance resulting from inaccurate or lack of delivery instructions, or by any act or omission on Buyer's part. Any such additional cost may include, but is not limited to, storage, insurance, protection, re-inspection and delivery expenses. Buyer further agrees that any payment due on delivery shall be made on delivery into storage as though goods had been delivered in accordance with the order.

7. Warranty. For goods sold by Seller to Buyer that are used by Buyer for personal, family or household purposes, Seller warrants the goods to Buyer on the terms of Seller's limited warranty available on Seller's website. For goods sold by Seller to Buyer for any other purpose, Seller warrants that the goods sold to Buyer hereunder (with the exception of membranes, seals, gaskets, elastomer materials, coatings and other "wear parts" or consumables all of which are not warranted except as otherwise provided in the quotation or sales form) will be (i) be built in accordance with the specifications referred to in the quotation or sales form, if such specifications are expressly made a part of this Agreement, and (ii) free from defects in material and workmanship for a period of one (1) year from the date of installation or eighteen (18) months from the date of shipment (which date of shipment shall not be greater than thirty (30) days after receipt of notice that the goods are ready to ship), whichever shall occur first (the "Warranty").

Seller shall, at its option and at no cost to Buyer, either repair or replace any product which fails to conform with the Warranty; provided, however, that under either option, Seller shall not be obligated to remove the defective product or install the replaced or repaired product and Buyer shall be responsible for all other costs, including, but not limited to, service costs, shipping fees and expenses. Seller shall have complete discretion as to the method or means of repair or replacement. Buyer's failure to comply with Seller's repair or replacement directions shall constitute a waiver of its rights and render all warranties void. Any parts repaired or replaced under the Warranty are warranted only for the balance of the warranty period on the parts that were repaired or replaced. The Warranty is conditioned on Buyer giving written notice to Seller of any defects in material or workmanship

of warranted goods within ten (10) days of the date when any defects are first manifest.

Seller shall have no warranty obligations to Buyer with respect to any product or parts of a product that: (a) have been repaired by third parties other than Seller or without Seller's written approval; (b) have been subject to misuse, misapplication, neglect, alteration, accident, or physical damage; (c) have been used in a manner contrary to Seller's instructions for installation, operation and maintenance; (d) have been damaged from ordinary wear and tear, corrosion, or chemical attack; (e) have been damaged due to abnormal conditions, vibration, failure to properly prime, or operation without flow; (f) have been damaged due to a defective power supply or improper electrical protection; or (g) have been damaged resulting from the use of accessory equipment not sold by Seller or not approved by Seller in connection with products supplied by Seller hereunder. In any case of products not manufactured by Seller, there is no warranty from Seller; however, Seller will extend to Buyer any warranty received from Seller's supplier of such products.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ANY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES, GUARANTEES, CONDITIONS OR TERMS OF WHATEVER NATURE RELATING TO THE GOODS PROVIDED HEREUNDER, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY EXPRESSLY DISCLAIMED AND EXCLUDED. BUYER'S EXCLUSIVE REMEDY AND SELLER'S AGGREGATE LIABILITY FOR BREACH OF ANY OF THE FOREGOING WARRANTIES ARE LIMITED TO REPAIRING OR REPLACING THE PRODUCT AND SHALL IN ALL CASES BE LIMITED TO THE AMOUNT PAID BY THE BUYER HEREUNDER. IN NO EVENT IS SELLER LIABLE FOR ANY OTHER FORM OF DAMAGES, WHETHER DIRECT, INDIRECT, LIQUIDATED, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR SPECIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY OR LOSS OF REPUTATION.

8. Inspection. Buyer shall have the right to inspect the goods upon their receipt. When delivery is to Buyer's site or to a project site ("Site"), Buyer shall notify Seller in writing of any nonconformity of the goods with this Agreement within three (3) days from receipt by Buyer. For all other deliveries, Buyer shall notify Seller in writing of any nonconformity with this Agreement within fourteen (14) days from receipt by Buyer. Failure to give such applicable notice shall constitute a waiver of Buyer's right to inspect and/or reject the goods for nonconformity and shall be equivalent to an irrevocable acceptance of the goods by Buyer. Claims for loss of or damage to goods in transit must be made to the carrier, and not to Seller.

9. Seller's Limitation of Liability. IN NO EVENT SHALL SELLER'S LIABILITY UNDER THIS AGREEMENT EXCEED THE AMOUNT PAID BY BUYER UNDER THIS AGREEMENT. SELLER SHALL HAVE NO LIABILITY FOR LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY, LOSS OF REPUTATION, INDIRECT, CONSEQUENTIAL, INCIDENTAL, PUNITIVE OR EXEMPLARY DAMAGES.

10. Force Majeure. Seller may cancel or suspend this Agreement and Seller shall have no liability for any failure to deliver or perform, or for any delay in delivering or performing any obligations, due to acts or omissions of Buyer and/or its contractors, or due to circumstances beyond its reasonable control, including but not limited to acts of God, fire, flood or other natural disasters, war and civil disturbance, riot, acts of governments, terrorism, disease, currency restrictions, labor shortages or disputes, unavailability of materials, fuel, power, energy or transportation facilities, failures of suppliers or subcontractors to effect deliveries, in which case the time for performance shall be extended in an amount equal to the excused period, provided that Seller shall have, as soon as reasonably practicable after it has actual knowledge of the beginning of any excusable delay, notified Buyer of such delay, of the

reason therefor and of the probable duration and consequence thereof. Seller shall use its best efforts to eliminate the cause of the delay, interruption or cessation and to resume performance of its obligations hereunder with the least possible delay.

11. Cancellation. Except as otherwise provided in this Agreement, no order may be cancelled unless requested in writing by either party and accepted in writing by the other. In the event of a cancellation by Buyer, Buyer shall, within thirty (30) days of such cancellation, pay Seller a cancellation fee, which shall include all costs and expenses incurred by Seller prior to the receipt of the request for cancellation including, but not limited to, all commitments to its suppliers, subcontractors and others, all labor and overhead expended by Seller, plus a reasonable charge for profit.

Notwithstanding anything to the contrary herein, in the event of the commencement by or against Buyer of any voluntary or involuntary proceedings in bankruptcy or insolvency, or in the event Buyer shall be adjusted bankrupt, make a general assignment for the benefit of its creditors, or if a receiver shall be appointed on account of Buyer's insolvency, or if Buyer fails to make payment when due under this Agreement, or in the event Buyer does not correct or, if immediate correction is not possible, commence and diligently continue action to correct any default of Buyer to comply with any of the provisions or requirements of this Agreement within ten (10) calendar days after being notified in writing of such default by Seller, Seller may, by written notice to Buyer, without prejudice to any other rights or remedies which Seller may have, terminate its further performance of this Agreement. In the event of such termination, Seller shall be entitled to receive payment as if Buyer has cancelled the Agreement as per the preceding paragraph. Seller may nevertheless elect to complete its performance of this Agreement by any means it chooses. Buyer agrees to be responsible for any additional costs incurred by Seller in so doing.

Upon termination of this Agreement, the rights, obligations and liabilities of the parties which shall have arisen or been incurred under this Agreement prior to its termination shall survive such termination.

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13. Proprietary Information, Injunction. Seller's designs, illustrations, drawings, specifications, technical data, catalogues, "know-how", economic or other business or manufacturing information (collectively "Proprietary Information") disclosed to Buyer shall be deemed proprietary and confidential to Seller. Buyer agrees not to disclose, use, or reproduce any Proprietary Information without first having obtained Seller's express written consent. Buyer's agreement to refrain from disclosing, using or reproducing Proprietary Information shall survive completion of the work under this Agreement. Buyer acknowledges that its improper disclosure of Proprietary Information to any third party will result in Seller's suffering irreparable harm. Seller may seek injunctive or equitable relief to prevent Buyer's unauthorized disclosure.

14. Installation and Start-up. Unless otherwise agreed to in writing by Seller, installation shall be the sole responsibility of Buyer. Where start-up service is required with respect to the goods purchased

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17. Minimum Order. Seller reserves the right to refuse to process any order that does not meet quantity requirements that Seller may establish for any given product or group of products.

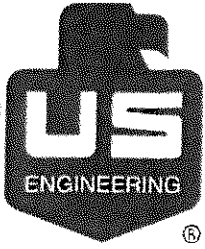
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Hydronic Pumps O&M and
Warranty Information:
P-4 (Bell & Gossett)

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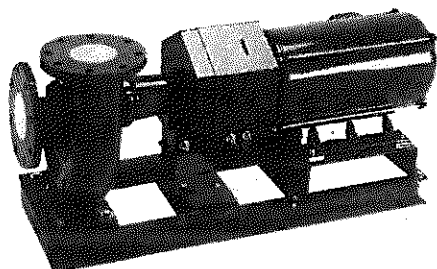
1000 MEADOWLARK AVE
FORT COLLINS, CO 80526



Bell & Gossett
a xylem brand

INSTRUCTION MANUAL

P81555D



Series 1510 Based Mounted Centrifugal Pump Kits

IMPORTANT

The Series 1510 pump kits are to be assembled by qualified personnel only. Any questions regarding the assembly procedure should be referred to the Bell & Gossett Service Manager.

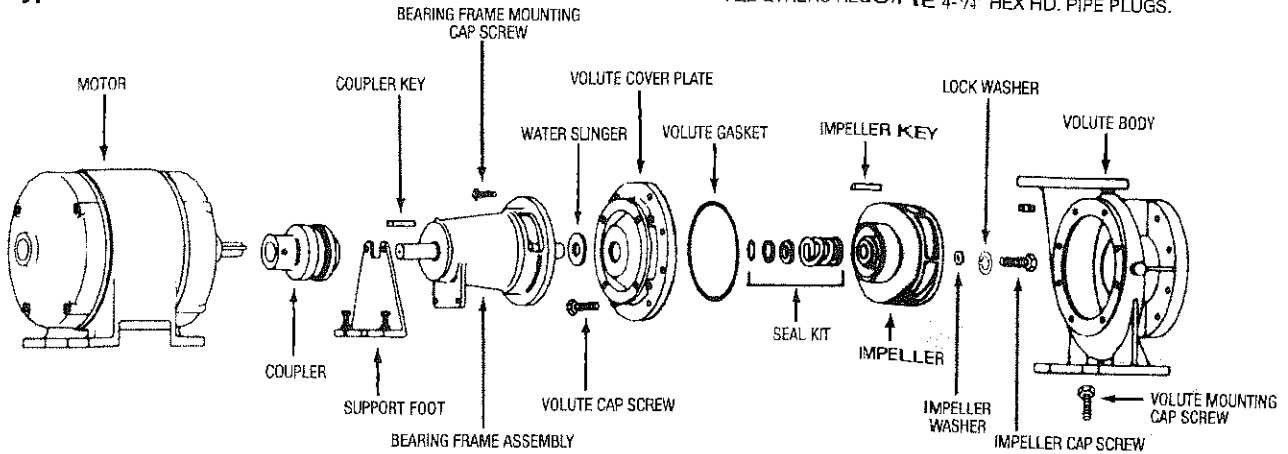
Impeller cap screws and washers are furnished with the kit. All other fasteners and shims must be furnished by assembler. (Refer to Fastener Chart for proper sizing of cap screws, nuts and washers.)

1. Mount volute to base, adding a minimum of .025" in shims between volute and base. Use 4 cap screws, 4 lock washers, 4 flat washers and risers when applicable.
2. Assemble volute cover plate to small bearing assembly (1" shaft) with 4 cap screws. On large bearing assembly (1 1/4" shaft), use 8 cap screws.
3. Press seal insert in volute cover plate. Push pump shaft forward from rear of bearing assembly to take up end play. Moisten the inner diameter of seal assembly with soapy water, maintaining forward pressure on the shaft, and press seal firmly in place. Carbon seal face must be tight against ceramic insert. Apply small end of tapered spring on seal.
4. Make certain that impeller has been properly cut to size for required GPM and feet of head and balanced. Slide impeller onto bearing assembly shaft until it bottoms against the shaft shoulder. Fasten impeller using one cap screw, one internal lock washer and one large impeller washer. Make certain that cap screw is tightened to 18-20 foot pounds on small bearing assembly (1" shaft) and 40-44 foot pounds on the large bearing assembly (1 1/4" shaft).
5. Mount bearing assembly, impeller, volute gasket and cover plate to volute.
6. Add foot support to base and bearing frame using 4 cap screws, 4 lock washers, 4 flat washers and 4 nuts. In some instances, the nuts will be welded direct to the base cross member.
7. Mount saddle to base with 4 cap screws, 4 lock washers, 8 flat washers and 4 nuts.
8. Mount motor to saddle using 4 cap screws, 4 lock washers, 8 flat washers and 4 nuts.
9. Apply pump coupler half to pump shaft and motor coupler half to motor shaft. Tighten one coupler half in its final position and add coupler sleeve. If using a two piece sleeve, hang the wire ring loosely in the groove next to the teeth. Slide the loose flange tightly up against the sleeve and back off 1/8" for axial clearance. Tighten the loose flange to the shaft.
Check vertical and horizontal misalignment by using a straight edge scale or piece of bar stock with the center notched to provide clearance for the raised portion of the coupler sleeve. For 3500 rpm operation, it will be necessary to check the angular misalignment by using a dial indicator or micrometer calipers. Measure the gap at intervals around the periphery of the coupling to determine minimum and maximum gap. The difference between these two values should be as close to zero as possible.
If the angular alignment was adjusted, it will be necessary to recheck the vertical and horizontal misalignment again.
If using a two piece sleeve, force the wire ring into its groove in the center of the sleeve. The use of a blunt screw driver may be necessary.
10. Apply coupler guard using 4 cap screws, 4 lock washers and 4 nuts.
11. Recheck all exposed nuts and cap screws for tightness.
12. Complete all name plate data and affix to base.
13. Complete and return Pump Kit Data Card to the Customer Service Dept., Bell & Gossett, 8200 N. Austin Ave., Morton Grove, IL 60053.
14. Affix installation and service instructions (P81673).
15. Make certain complete unit is properly lubricated.

EXPLODED VIEW

Typical View

NOTE: 1 1/4" and 1 1/2" VOLUTES REQUIRE 4-7/8" HEX HD. PIPE PLUGS.
ALL OTHERS REQUIRE 4-3/4" HEX HD. PIPE PLUGS.



FASTENER CHART

VOLUTE TO BASE	
PUMP SIZE	FASTENERS
1 1/4 AC thru 3 AC Fr #143T thru 215T 4 AC thru 4 BC FR #143T thru 256T	4-7/16 x 1 3/4 Cap Screw 4-7/16 Washer 4-7/16 Lock Washer
1 1/4 AC thru 3 AC Fr #254T thru 256T	4-7/16 x 3 Cap Screw 4-7/16 Washer 4-7/16 Lock Washer
3E thru 5E and 5BC thru 4GB All Frames	4-1/2 x 2 Cap Screw 4-1/2 Nut 4-1/2 Washer 4-1/2 Lock Washer
5G, 6G and 6E All Frames	4-5/8 x 2 1/2 Cap Screw 4-5/8 Nut 4-5/8 Washer 4-5/8 Lock Washer
COVER PLATE TO VOLUTE	
A Size Pumps B Size Pumps G and E Size Pumps	8-3/8 x 7/8 } 12-7/16 x 1 } Cap Screws 16-1/2 x 1 1/4 }
BEARING FRAME TO COVER PLATE	
Small Frame Large Frame	4-3/8 x 1 } 8-3/8 x 1 1/4 } Cap Screws
SUPPORT FOOT	
All Sizes	4-7/16 x 1 Cap Screw
SADDLE TO BASE	
1 1/4 AB thru 4 BC Fr #143T-256T	4-3/8 x 1 Cap Screw 4-3/8 Nut 8-3/8 Washer 4-3/8 Lock Washer
3E thru 5E and 5BC thru 4GB All Frames	4-1/2 x 1 1/2 Cap Screw 4-1/2 Nut 8-1/2 Washer 4-1/2 Lock Washer
5G, 6G and 6E All Frames	4-5/8 x 1 1/2 Cap Screw 4-5/8 Nut 8-5/8 Washer 4-5/8 Lock Washer

MOTOR TO SADDLE	
FRAME SIZE	FASTENERS
56 143T, 145T	4-5/16 x 1 1/4 Cap Screw 4-5/16 Nut 8-5/16 Washer 4-5/16 Lock Washer
182T, 184T	4-3/8 x 1 1/2 Cap Screw 4-3/8 Nut 8-3/8 Washer 4-3/8 Lock Washer
213T, 215T	4-3/8 x 2 Cap Screw 4-3/8 Nut 8-3/8 Washer 4-3/8 Lock Washer
254T, 256T 284T, 286T	4-7/16 x 2 Cap Screw 4-7/16 Nut 8-7/16 Washer 4-7/16 Lock Washer
324T, 326T 364T, 365T	4-1/2 x 2 1/4 Cap Screw 4-1/2 Nut 8-1/2 Washer 4-1/2 Lock Washer
404TS	4-5/8 x 2 3/4 Cap Screw 4-5/8 Nut 8-5/8 Washer 4-5/8 Lock Washer



Xylem Inc.
8200 N. Austin Avenue
Morton Grove, Illinois 60053
Phone: (847) 966-3700
Fax: (847) 965-8379
www.xylem.com/brands/bellgossett

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TERMS AND CONDITIONS OF SALE

FLOWTRONEX PSI LLC, a Division of Xylem Inc.
(DBA Flowtronex, Water Equipment Technologies, A-C Fire Pump, Bell & Gossett, and/or Goulds Water Technology)

1. Agreement, Integration and Conflict of Terms. These terms and conditions, together with any special conditions expressly incorporated thereto in the quotation or sales form, are to govern any sale by Flowtronex PSI LLC. (d/b/a Flowtronex, Water Equipment Technology, A/C Firepumps, Bell & Gossett, and/or Goulds), a division of Xylem Inc. ("Seller"). This writing is an offer or counteroffer by Seller to sell the goods and/or services set forth on the quotation or sales form subject to these terms and conditions and is expressly made conditional on Buyer's assent to these terms and conditions. Acceptance by Buyer is expressly limited to these terms and conditions. Any additional or different terms and conditions contained in Buyer's purchase order or other communication shall not be effective or binding upon Seller unless specifically agreed to in writing by Seller; Seller hereby objects to any such conditions, and the failure of Seller to object to specific provisions contained in any purchase order or other communication from Buyer shall not be construed as a waiver of these terms and conditions nor an acceptance of any such provisions. Neither Seller's commencement of performance nor delivery shall be deemed or construed as acceptance of Buyer's additional or different terms and conditions.

Buyer agrees that these terms and conditions, together with any accompanying quotation and any special conditions or limited process guarantees or documents referred to or included within the quotation and expressly made a part of this agreement, (e.g., drawings, illustrations, specifications, or diagrams), is the complete and final agreement between the parties ("Agreement"). This Agreement supersedes all prior negotiations, representations, or agreements, either written or oral, between the parties and, further, can only be altered, modified or amended with the express written consent of Seller.

2. Quotation, Withdrawal, Expiration. Quotes are valid for thirty (30) calendar days from the date of issuance. Seller reserves the right to cancel or withdraw the quotation at any time with or without notice or cause prior to acceptance by Buyer. There is no Agreement if any conditions specified within the quotation or sales form are not completed by Buyer to Seller's satisfaction within thirty (30) calendar days of Seller's acknowledgement in writing of an order. Seller nevertheless reserves its right to accept any contractual documents received from Buyer after this 30-day period.

3. Prices. Prices apply to the specific quantities stated on the quotation or sales form. Unless otherwise agreed to in writing by Seller, all prices are F.O.B. Seller's plant, and do not include transportation costs or charges relating to transportation, which costs and charges shall be solely the responsibility of Buyer. Prices include standard packing according to Seller's specifications. All costs and taxes for special packing requested by Buyer, including packing for exports, shall be paid by Buyer as an additional charge. Prices are subject to change without notice.

4. Taxes. The price for the goods does not include any applicable sales, use, excise, GST, VAT, or similar tax. Buyer shall have the responsibility for the payment of such taxes if applicable.

5. Payment Terms. Seller reserves the right to require payment in advance or C.O.D. and otherwise modify credit terms should Buyer's credit standing not meet Seller's acceptance. Unless different payment terms are expressly set forth in the quotation or sales form or order acknowledgment or Sales Policy Manual, goods will be invoiced upon shipment. Payment in full is due within thirty (30) days from the invoice date. In the event payment is not made when due, Buyer agrees to pay Seller a service or finance charge of the lesser of (i) one and one-half percent (1.5%) per month (18% per annum), or (ii) the highest rate permitted by applicable law, on the unpaid balance of the invoice from and after the invoice due date. Buyer is responsible for all costs and expenses associated with any checks returned due to insufficient

TERMS AND CONDITIONS OF SALE
FLOWTRONEX PSI LLC

funds. All credit sales are subject to prior approval of Seller's credit department. Export shipments will require payment prior to shipment or an appropriate Letter of Credit. If, during the performance of the contract with Buyer, the financial responsibility or condition of Buyer is such that Seller in good faith deems itself insecure, or if Buyer becomes insolvent, or if a material change in the ownership of Buyer occurs, or if Buyer fails to make any payments in accordance with the terms of its contract with Seller, then, in any such event, Seller is not obligated to continue performance under the contract and may stop goods in transit and defer or decline to make delivery of goods, except upon receipt of satisfactory security or cash payments in advance, or Seller may terminate the order upon written notice to Buyer without further obligation to Buyer whatsoever. If Buyer fails to make payments or fails to furnish security satisfactory to Seller, then Seller shall also have the right to enforce payment to the full contract price of the work completed and in process. Upon default by Buyer in payment when due, Buyer shall immediately pay to Seller the entire unpaid amounts for any and all shipments made to Buyer irrespective of the terms of said shipment and whether said shipments are made pursuant to this Agreement or any other contract of sale between Seller and Buyer, and Seller may withhold all subsequent shipments until the full amount is settled. Acceptance by Seller of less than full payment shall not be a waiver of any of its rights hereunder.

Buyer shall not assign or transfer this Agreement or any interest in it, or monies payable under it, without the written consent of Seller and any assignment made without such consent shall be null and void.

6. Delivery, Risk of Loss. Delivery dates are estimates, and time is not of the essence. All shipments will be made F.O.B. Seller's plant unless otherwise specified. Seller shall not be responsible to Buyer for any loss, whether direct, indirect, incidental or consequential in nature, including without limitation loss of profits, arising out of or relating to any failure of the goods to be delivered by the specified delivery date. In the absence of specific instructions, Seller will select the carrier. Upon delivery to the common carrier, title and the risk of loss for the material shall pass to Buyer. Buyer shall reimburse Seller for the additional cost of its performance resulting from inaccurate or lack of delivery instructions, or by any act or omission on Buyer's part. Any such additional cost may include, but is not limited to, storage, insurance, protection, re-inspection and delivery expenses. Buyer further agrees that any payment due on delivery shall be made on delivery into storage as though goods had been delivered in accordance with the order.

7. Warranty. For goods sold by Seller to Buyer that are used by Buyer for personal, family or household purposes, Seller warrants the goods to Buyer on the terms of Seller's limited warranty available on Seller's website. For goods sold by Seller to Buyer for any other purpose, Seller warrants that the goods sold to Buyer hereunder (with the exception of membranes, seals, gaskets, elastomer materials, coatings and other "wear parts" or consumables all of which are not warranted except as otherwise provided in the quotation or sales form) will be (i) be built in accordance with the specifications referred to in the quotation or sales form, if such specifications are expressly made a part of this Agreement, and (ii) free from defects in material and workmanship for a period of one (1) year from the date of installation or eighteen (18) months from the date of shipment (which date of shipment shall not be greater than thirty (30) days after receipt of notice that the goods are ready to ship), whichever shall occur first (the "Warranty").

Seller shall, at its option and at no cost to Buyer, either repair or replace any product which fails to conform with the Warranty; provided, however, that under either option, Seller shall not be obligated to remove the defective product or install the replaced or repaired product and Buyer shall be responsible for all other costs, including, but not limited to, service costs, shipping fees and expenses. Seller shall have complete discretion as to the method or means of repair or replacement. Buyer's failure to comply with Seller's repair or replacement directions shall constitute a waiver of its rights and render all warranties void. Any parts repaired or replaced under the Warranty are warranted only for the balance of the warranty period on the parts that were repaired or replaced. The Warranty is conditioned on Buyer giving written notice to Seller of any defects in material or workmanship

of warranted goods within ten (10) days of the date when any defects are first manifest.

Seller shall have no warranty obligations to Buyer with respect to any product or parts of a product that: (a) have been repaired by third parties other than Seller or without Seller's written approval; (b) have been subject to misuse, misapplication, neglect, alteration, accident, or physical damage; (c) have been used in a manner contrary to Seller's instructions for installation, operation and maintenance; (d) have been damaged from ordinary wear and tear, corrosion, or chemical attack; (e) have been damaged due to abnormal conditions, vibration, failure to properly prime, or operation without flow; (f) have been damaged due to a defective power supply or improper electrical protection; or (g) have been damaged resulting from the use of accessory equipment not sold by Seller or not approved by Seller in connection with products supplied by Seller hereunder. In any case of products not manufactured by Seller, there is no warranty from Seller; however, Seller will extend to Buyer any warranty received from Seller's supplier of such products.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ANY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES, GUARANTEES, CONDITIONS OR TERMS OF WHATEVER NATURE RELATING TO THE GOODS PROVIDED HEREUNDER, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY EXPRESSLY DISCLAIMED AND EXCLUDED. BUYER'S EXCLUSIVE REMEDY AND SELLER'S AGGREGATE LIABILITY FOR BREACH OF ANY OF THE FOREGOING WARRANTIES ARE LIMITED TO REPAIRING OR REPLACING THE PRODUCT AND SHALL IN ALL CASES BE LIMITED TO THE AMOUNT PAID BY THE BUYER HEREUNDER. IN NO EVENT IS SELLER LIABLE FOR ANY OTHER FORM OF DAMAGES, WHETHER DIRECT, INDIRECT, LIQUIDATED, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR SPECIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY OR LOSS OF REPUTATION.

8. Inspection. Buyer shall have the right to inspect the goods upon their receipt. When delivery is to Buyer's site or to a project site ("Site"), Buyer shall notify Seller in writing of any nonconformity of the goods with this Agreement within three (3) days from receipt by Buyer. For all other deliveries, Buyer shall notify Seller in writing of any nonconformity with this Agreement within fourteen (14) days from receipt by Buyer. Failure to give such applicable notice shall constitute a waiver of Buyer's right to inspect and/or reject the goods for nonconformity and shall be equivalent to an irrevocable acceptance of the goods by Buyer. Claims for loss of or damage to goods in transit must be made to the carrier, and not to Seller.

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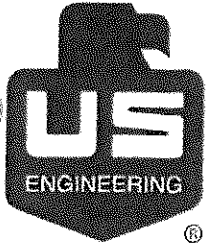
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Hydronic Pumps Product
Submittal Information:
Bell & Gossett P-3
Bell & Gossett P-4

**BEATTIE
ELEMENTARY
SCHOOL**

3900 MEADOWLARK AVE
FORT COLLINS CO 80526



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary
3000 Meadowlark Avenue
Fort Collins, CO 80526

Project # 30-13-038
Tel: Fax:

FCI Constructors, Inc. - Longmont

Date: 4/11/2014

Reference Number: 0052

Transmitted To: Chris Mallory
US Engineering Co.
P.O. Box 905
Loveland, CO 80539

Transmitted By: DJ Anderson
FCI Constructors, Inc. - Longmont
4001 N. Valley Drive
Longmont, CO 80504
Tel: 970-535-4725
Fax: 970-535-4867

Qty	Submittal Package No	Description	Due Date	Package Action
1	016 - 232123 - 0	Hydronic Pumps		Make Corrections Noted

Transmitted For	Delivered Via	Tracking Number
For Your Use and Corrections	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
001		Hydronic Pumps - Product Data	232123		
002		Hydronic Pumps - Shop Drawings	232123		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

Notes: 1. HYDRONIC PUMPS, SUCTION DIFFUSERS AND FLEXIBLE CONNECTORS
(Make Corrections Noted)
1. Provide factory startup service per specification requirements.
2. Provide Type Z suction diffuser for Pj3 and Type X for Pj4. Submittal indicates that Type Z should be used for tower systems.

Signature

Signed Date

Prolog Manager

Printed on: 4/11/2014 FCI PM Data

TRANSMITTAL

Belford Watkins Group
Architects



Date: 4.10.14

Project: Beattie Elementary

To: Rob Price/DJ Anderson

From: Patti Watkins

We are transmitting the following submittals with the comments listed below:

ARCHITECTURE

INTERIORS

PLANNING

NET: No Exception Taken

MCN: Make Corrections Noted

RX: Rejected

RR: Revise and Resubmit

SSI: Submit Specified Item

CMT: See Comment Below

232123 Hydronic Pumps

Copies	Section	Item	Manufacturer	NET	MCN	RR	RX	SSI	CMT
1	237433	Product Data, shop drawings	Daikin		x				1

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures, there from. The Contractor remains responsible for details and accuracy, for conforming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

Notes: 1. HYDRONIC PUMPS, SUCTION DIFFUSERS AND FLEXIBLE CONNECTORS

(Make Corrections Noted)

1. Provide factory startup service per specification requirements.
2. Provide Type Z suction diffuser for P-3 and Type X for P-4. Submittal indicates that Type Z should be used for tower systems.



4001 N. Valley Drive
 Longmont, CO 80504
 Phone: 970-535-4867
 Fax: 970-535-4867

DATE: 03/28/2014

SPECIFICATION SECTION(S): 232123
 SCOPE OF WORK: HVAC - Hydronic Pumps

PROJECT: Poudre School District – Beattie Elementary School

PROJECT #: 30-13-038

ARCHITECT/DESIGNER: Belford Watkins Group, LLC.
 425 West Mulberry Ave., Suite 207
 P.O. Box 1306
 Fort Collins, CO 80521

 PHONE: 970-407-0070

GENERAL CONTRACTOR: FCI CONSTRUCTORS, INC.
 4001 N. Valley Drive
 Longmont, CO 80504

 PHONE: 970-535-4725
 FAX: 970-535-4867

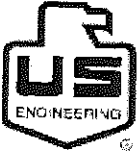
SUBMITTED BY: U.S. Engineering
 PO Box 905
 Loveland, CO 80539

 PHONE: 970-669-1666
 FAX:

CONTRACTORS STAMP:

ARCHITECT/ENGINEER STAMP

FCI CONSTRUCTORS, INC.	
Review of this submittal is subject to the provisions of the Contract Drawings and Specifications. This action is for general concurrence only.	
<input checked="" type="checkbox"/>	Reviewed
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmit with Corrections
<input type="checkbox"/>	DISAPPROVED RESUBMIT
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmittal not Required.
Submittal Reviewed By: DA	Date: 03/28/2014
Submittal No: 016	Spec. Section: 232123



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 80539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-013

Date: 3/18/2014

Revision #: _____

Discipline: Piping

Project : Beattie Elementary

Project #: 1202

Supplier : Wholesale Specialties

Spec Sect: 23 21 23

Submitted Items:

Page Number	Paragraph Number	Description	Manufacturer
23 21 23-2	2	Hydronic Pumps	
		P-3	Bell & Gossett
		P-4	Bell & Gossett
		Suction Diffusers	Bell & Gossett
		Flexes	Metraflex
			Lead Time-30 Business Days

Target Dates:

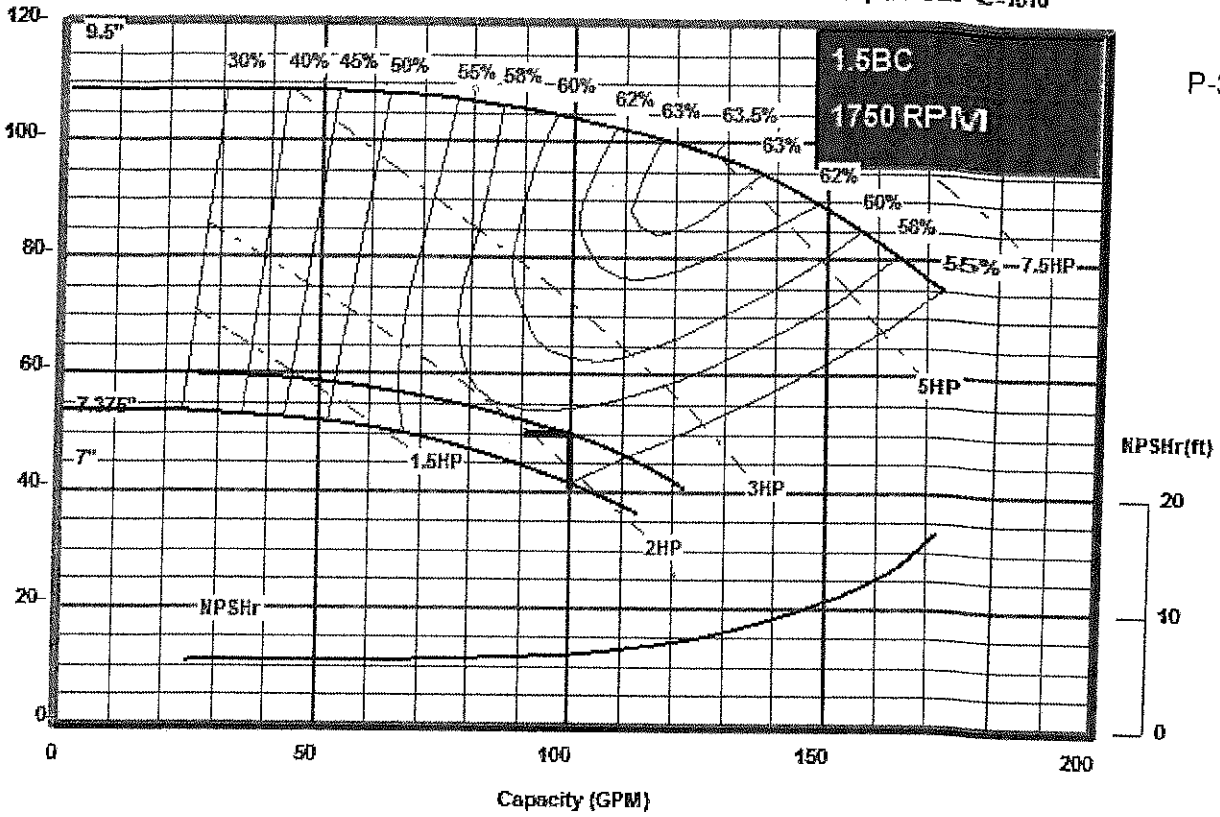
Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
3/11/14	3/18/14	3/28/14		

GC/Arch/Engineer Stamp Area:

U.S. Engineering

Signed:

Name



Suction Size = 2"
 Discharge Size = 1.5"

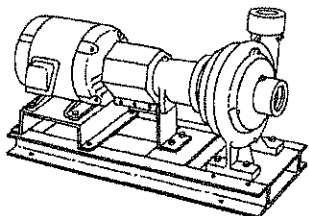
Min Imp Dia = 7"
 Max Imp Dia = 9.5"
 Cut Dia = 7.375"

Design Capacity = 100.0 GPM
 Design Head = 50.0 Feet
 Motor Size = 3 HP





JOB: Beattie Elementary	REPRESENTATIVE: MCNEVIN CO
UNIT TAG: P-3 ENGINEER: AE Associates CONTRACTOR: U.S. Engineering	ORDER NO. SUBMITTED BY: Wholesale Specialties APPROVED BY:
	DATE: DATE: DATE:



1.5BC

Series e-1510

Centrifugal Pumps - Base Mounted

SPECIFICATIONS

FLOW	100 (GPM)	HEAD	50 (FT)
HP	3	RPM	1800
VOLTS	208-230/460		
CYCLE	60	PHASE	3
ENCLOSURE	Baldor ODP Nema Premium Efficient		
APPROX. WEIGHT	140		
SPECIALS	_____		

MATERIALS OF CONSTRUCTION

- Stainless Steel Fitted

FEATURES

- i-ALERT™ Condition Monitor
- ANSI/OSHA Coupling Guard
- Center Drop Out Spacer Coupling
- Fabricated Heavy Duty Baseplate

MAXIMUM WORKING PRESSURE

- 175 psi (12 bar) W.P.

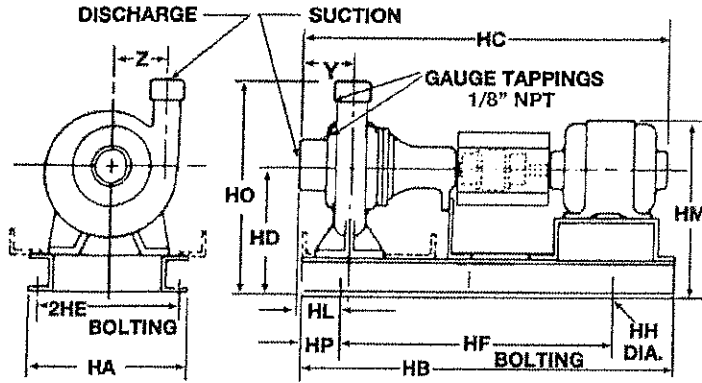
TYPE OF SEAL

- Standard Seal (Buna-Carbon/Ceramic)
- F Standard Seal w/ Flush Lin (Buna-Carbon/Ceramic)
- S Stuffing Box Construction Mechanical Single Seal (EPR-Tungsten Carbide/Carb)
- PF Stuffing Box Construction (Graphite Impregnated Teflon)

Note: Equipped with NEOPRENE coupling

Series e-1510 1.5BC Centrifugal Pump Submittal

B-880.16A



NOZZLE SIZES	
Discharge	1-1/2" N.P.T.
Suction	2" N.P.T.

DIMENSIONS - inches (mm)

STANDARD SEAL

MOTOR FRAME	HA	HB	HC MAX	HD	2HE	HF ₁	HF ₂	HH	HL	HM MAX	HO	HP	Y	Z
	"S" FRAME													
143T	14-5/8 (371)	31 (787)	28-3/8 (721)	10-3/4 (273)	12-7/8 (327)	25 (635)	-	3/4 (19)	1-11/16 (43)	14-1/2 (368)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
145T	14-5/8 (371)	31 (787)	29-3/8 (746)	10-3/4 (273)	12-7/8 (327)	25 (635)	-	3/4 (19)	1-11/16 (43)	14-1/2 (368)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
182T	14-5/8 (371)	31 (787)	32-1/8 (816)	10-3/4 (273)	12-7/8 (327)	25 (635)	-	3/4 (19)	1-11/16 (43)	16 (406)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
184T	14-5/8 (371)	31 (787)	32-7/8 (835)	10-3/4 (273)	12-7/8 (327)	25 (635)	-	3/4 (19)	1-11/16 (43)	16 (406)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
213T 1750 RPM	14-5/8 (371)	34-5/8 (879)	36-7/8 (937)	10-3/4 (273)	12-7/8 (327)	28-5/8 (727)	-	3/4 (19)	1-11/16 (43)	16-5/8 (422)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
215T 1750 RPM	14-5/8 (371)	34-5/8 (879)	36-7/8 (937)	10-3/4 (273)	12-7/8 (327)	28-5/8 (727)	-	3/4 (19)	1-11/16 (43)	16-5/8 (422)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)

"L" FRAME

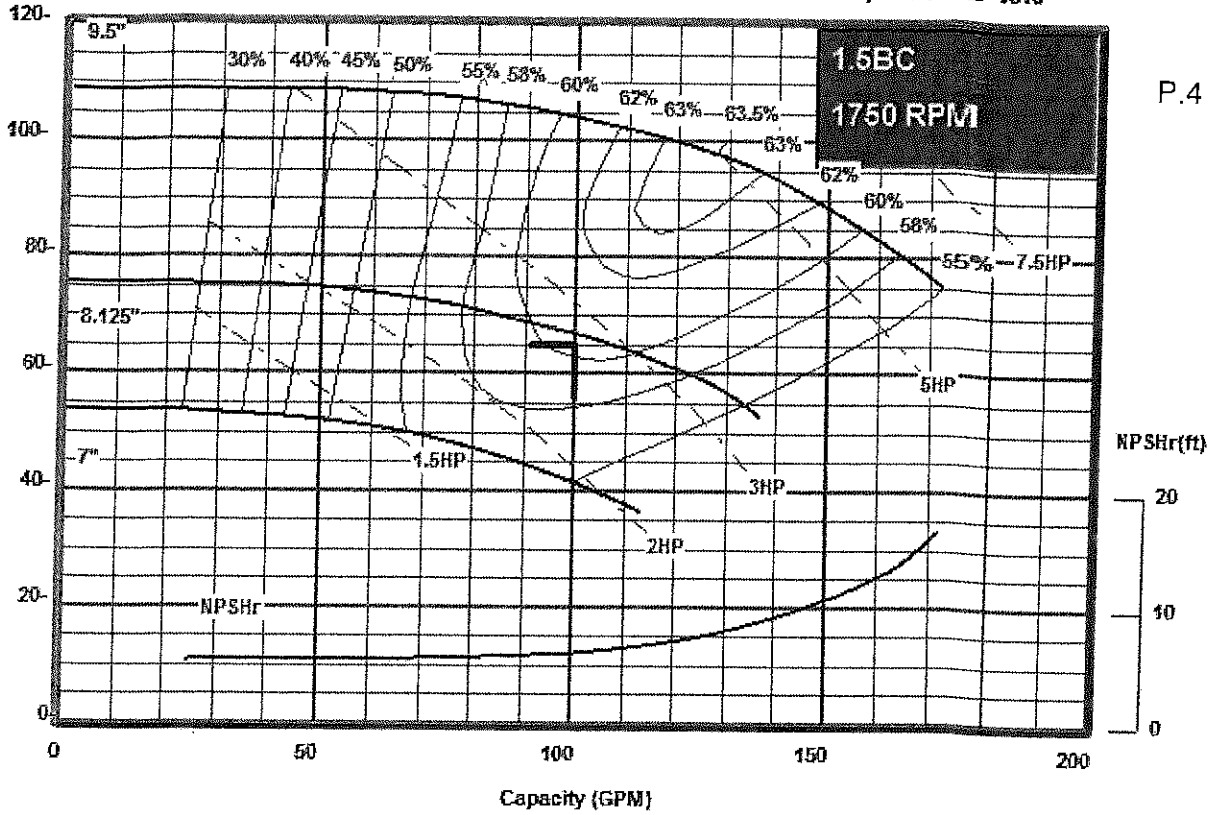
213T 3500 RPM	14-5/8 (371)	39-3/8 (1000)	41-1/4 (1048)	10-3/4 (273)	12-7/8 (327)	33-3/8 (848)	-	3/4 (19)	1-11/16 (43)	16-5/8 (422)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
215T 3500 RPM	14-5/8 (371)	39-3/8 (1000)	41-1/4 (1048)	10-3/4 (273)	12-7/8 (327)	33-3/8 (848)	-	3/4 (19)	1-11/16 (43)	16-5/8 (422)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
254T	16 (406)	46-1/2 (1181)	45 (1143)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	18-7/8 (479)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
256T	16 (406)	46-1/2 (1181)	45 (1143)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	18-7/8 (479)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
284TS	16 (406)	46-1/2 (1181)	46-3/4 (1187)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	18-7/8 (479)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
286TS	16 (406)	46-1/2 (1181)	46-1/8 (1172)	13 (330)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	21 (533)	19-1/2 (495)	5 (127)	3-1/8 (79)	5-3/4 (146)
324TS	16 (406)	46-1/2 (1181)	47-5/8 (1210)	13 (330)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	21 (533)	19-1/2 (495)	5 (127)	3-1/8 (79)	5-3/4 (146)
326TS	16 (406)	46-1/2 (1181)	49-5/8 (1260)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	21-1/8 (537)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)

STUFFING BOX

MOTOR FRAME	HA	HB	HC MAX	HD	2HE	HF ₁	HF ₂	HH	HL	HM MAX	HO	HP	Y	Z
	"S" FRAME													
143T	14-5/8 (371)	34-5/8 (879)	32 (813)	10-3/4 (273)	12-7/8 (327)	28-5/8 (727)	-	3/4 (19)	1-11/16 (43)	14-1/2 (368)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
145T	14-5/8 (371)	34-5/8 (879)	33 (838)	10-3/4 (273)	12-7/8 (327)	28-5/8 (727)	-	3/4 (19)	1-11/16 (43)	14-1/2 (368)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
182T	14-5/8 (371)	34-5/8 (879)	35-3/4 (908)	10-3/4 (273)	12-7/8 (327)	28-5/8 (727)	-	3/4 (19)	1-11/16 (43)	16 (406)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
184T	14-5/8 (371)	34-5/8 (879)	36-1/2 (927)	10-3/4 (273)	12-7/8 (327)	28-5/8 (727)	-	3/4 (19)	1-11/16 (43)	16 (406)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
213T 1750 RPM	14-5/8 (371)	39-3/8 (1000)	40-1/2 (1029)	10-3/4 (273)	12-7/8 (327)	33-3/8 (848)	-	3/4 (19)	1-11/16 (43)	16-5/8 (422)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
215T 1750 RPM	14-5/8 (371)	39-3/8 (1000)	40-1/2 (1029)	10-3/4 (273)	12-7/8 (327)	33-3/8 (848)	-	3/4 (19)	1-11/16 (43)	16-5/8 (422)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)

"L" FRAME

213T 3500 RPM	16 (406)	46-1/2 (1181)	43-3/4 (111)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	17-7/8 (454)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
215T 3500 RPM	16 (406)	46-1/2 (1181)	43-3/4 (111)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	17-7/8 (454)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
254T	16 (406)	46-1/2 (1181)	43-3/4 (111)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	17-7/8 (454)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
256T	16 (406)	51-3/4 (1314)	47-1/2 (1207)	12 (305)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	2-13/16 (71)	18-7/8 (479)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
284TS	16 (406)	51-3/4 (1314)	49-1/4 (1251)	12 (305)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	2-13/16 (71)	18-7/8 (479)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
286TS	16 (406)	51-3/4 (1314)	48-1/2 (1232)	13 (330)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	2-13/16 (71)	21 (533)	19-1/2 (495)	5 (127)	3-1/8 (79)	5-3/4 (146)
324TS	16 (406)	51-3/4 (1314)	50 (1270)	13 (330)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	2-13/16 (71)	21 (533)	19-1/2 (495)	5 (127)	3-1/8 (79)	5-3/4 (146)



Suction Size = 2"
Discharge Size = 1.5"

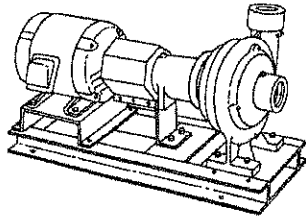
Min Imp Dia = 7"
Max Imp Dia = 9.5"
Cut Dia = 8.125"

Design Capacity = 100.0 GPM
Design Head = 65.0 Feet
Motor Size = 5 HP





JOB: Beattie Elementary	REPRESENTATIVE: MCNEVIN CO
UNIT TAG: P-4 ENGINEER: AE Associates CONTRACTOR: U.S. Engineering	ORDER NO. SUBMITTED BY: Wholesale Specialties APPROVED BY:
	DATE: DATE: DATE:



1.5BC Series e-1510 Centrifugal Pumps - Base Mounted

SPECIFICATIONS

FLOW 100 (GPM) HEAD 65 (FT)
 HP 5 RPM 1800
 VOLTS 208-230/460
 CYCLE 60 PHASE 3
 ENCLOSURE Baldor ODP Nema Premium Efficient
 APPROX. WEIGHT 219
 SPECIALS _____

MATERIALS OF CONSTRUCTION

Stainless Steel Fitted

FEATURES

- I-ALERT™ Condition Monitor
- ANSI/OSHA Coupling Guard
- Center Drop Out Spacer Coupling
- Fabricated Heavy Duty Baseplate

MAXIMUM WORKING PRESSURE

175 psi (12 bar) W.P.

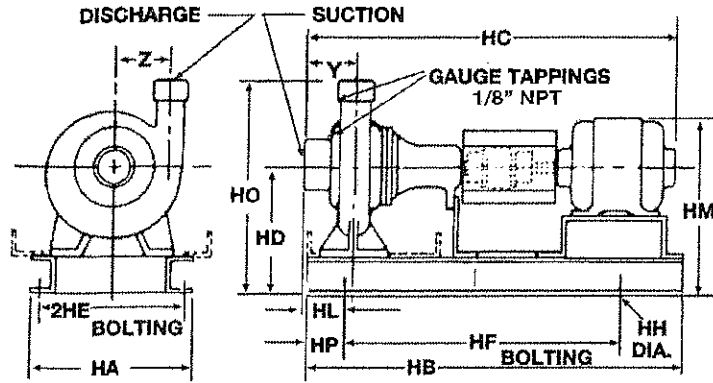
TYPE OF SEAL

- Standard Seal (Buna-Carbon/Ceramic)
- F Standard Seal w/ Flush Lin (Buna-Carbon/Ceramic)
- S Stuffing Box Construction Mechanical Single Seal (EPR-Tungsten Carbide/Carb)
- PF Stuffing Box Construction (Graphite Impregnated Teflon)

Note: Equipped with NEOPRENE coupling

Series e-1510 1.5BC Centrifugal Pump Submittal

B-880.16A



NOZZLE SIZES	
Discharge	1-1/2" N.P.T.
Suction	2" N.P.T.

DIMENSIONS - inches (mm)

STANDARD SEAL

MOTOR FRAME	HA	HB	HC MAX	HD	2HE	HF ₁	HF ₂	HH	HL	HM MAX	HO	HP	Y	Z
"S" FRAME														
143T	14-5/8 (371)	31 (787)	28-3/8 (721)	10-3/4 (273)	12-7/8 (327)	25 (635)	-	3/4 (19)	1-11/16 (43)	14-1/2 (366)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
145T	14-5/8 (371)	31 (787)	29-3/8 (746)	10-3/4 (273)	12-7/8 (327)	25 (635)	-	3/4 (19)	1-11/16 (43)	14-1/2 (366)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
182T	14-5/8 (371)	31 (787)	32-1/8 (816)	10-3/4 (273)	12-7/8 (327)	25 (635)	-	3/4 (19)	1-11/16 (43)	16 (406)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
184T	14-5/8 (371)	31 (787)	32-7/8 (835)	10-3/4 (273)	12-7/8 (327)	25 (635)	-	3/4 (19)	1-11/16 (43)	16 (406)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
213T 1750 RPM	14-5/8 (371)	34-5/8 (879)	36-7/8 (937)	10-3/4 (273)	12-7/8 (327)	28-5/8 (727)	-	3/4 (19)	1-11/16 (43)	16-5/8 (422)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
215T 1750 RPM	14-5/8 (371)	34-5/8 (879)	36-7/8 (937)	10-3/4 (273)	12-7/8 (327)	28-5/8 (727)	-	3/4 (19)	1-11/16 (43)	16-5/8 (422)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)

MOTOR FRAME	HA	HB	HC MAX	HD	2HE	HF ₁	HF ₂	HH	HL	HM MAX	HO	HP	Y	Z
"L" FRAME														
213T 3500 RPM	14-5/8 (371)	39-3/8 (1000)	41-1/4 (1048)	10-3/4 (273)	12-7/8 (327)	33-3/8 (848)	-	3/4 (19)	1-11/16 (43)	16-5/8 (422)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
215T 3500 RPM	14-5/8 (371)	39-3/8 (1000)	41-1/4 (1048)	10-3/4 (273)	12-7/8 (327)	33-3/8 (848)	-	3/4 (19)	1-11/16 (43)	16-5/8 (422)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
254T	16 (406)	46-1/2 (1181)	45 (1143)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	18-7/8 (479)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
256T	16 (406)	46-1/2 (1181)	45 (1143)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	18-7/8 (479)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
284TS	16 (406)	46-1/2 (1181)	46-3/4 (1187)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	18-7/8 (479)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
286TS	16 (406)	46-1/2 (1181)	46-1/8 (1172)	13 (330)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	21 (533)	19-1/2 (495)	5 (127)	3-1/8 (79)	5-3/4 (146)
324TS	16 (406)	46-1/2 (1181)	47-5/8 (1210)	13 (330)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	21 (533)	19-1/2 (495)	5 (127)	3-1/8 (79)	5-3/4 (146)
326TS	16 (406)	46-1/2 (1181)	49-5/8 (1260)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	21-1/8 (537)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)

STUFFING BOX

MOTOR FRAME	HA	HB	HC MAX	HD	2HE	HF ₁	HF ₂	HH	HL	HM MAX	HO	HP	Y	Z
"S" FRAME														
143T	14-5/8 (371)	34-5/8 (879)	32 (813)	10-3/4 (273)	12-7/8 (327)	28-5/8 (727)	-	3/4 (19)	1-11/16 (43)	14-1/2 (366)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
145T	14-5/8 (371)	34-5/8 (879)	33 (836)	10-3/4 (273)	12-7/8 (327)	28-5/8 (727)	-	3/4 (19)	1-11/16 (43)	14-1/2 (366)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
182T	14-5/8 (371)	34-5/8 (879)	35-3/4 (908)	10-3/4 (273)	12-7/8 (327)	28-5/8 (727)	-	3/4 (19)	1-11/16 (43)	16 (406)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
184T	14-5/8 (371)	34-5/8 (879)	36-1/2 (927)	10-3/4 (273)	12-7/8 (327)	28-5/8 (727)	-	3/4 (19)	1-11/16 (43)	16 (406)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
213T 1750 RPM	14-5/8 (371)	39-3/8 (1000)	40-1/2 (1029)	10-3/4 (273)	12-7/8 (327)	33-3/8 (848)	-	3/4 (19)	1-11/16 (43)	16-5/8 (422)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)
215T 1750 RPM	14-5/8 (371)	39-3/8 (1000)	40-1/2 (1029)	10-3/4 (273)	12-7/8 (327)	33-3/8 (848)	-	3/4 (19)	1-11/16 (43)	16-5/8 (422)	17-1/4 (438)	3 (76)	3-1/8 (79)	5-3/4 (146)

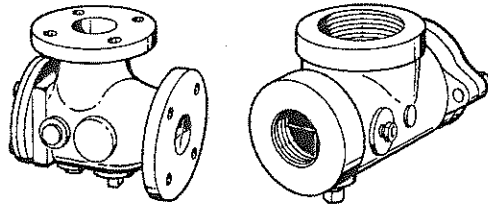
MOTOR FRAME	HA	HB	HC MAX	HD	2HE	HF ₁	HF ₂	HH	HL	HM MAX	HO	HP	Y	Z
"L" FRAME														
213T 3500 RPM	16 (406)	46-1/2 (1181)	43-3/4 (111)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	17-7/8 (454)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
215T 3500 RPM	16 (406)	46-1/2 (1181)	43-3/4 (111)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	17-7/8 (454)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
254T	16 (406)	46-1/2 (1181)	43-3/4 (1111)	12 (305)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	2-13/16 (71)	17-7/8 (454)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
256T	16 (406)	51-3/4 (1314)	47-1/2 (1207)	12 (305)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	2-13/16 (71)	18-7/8 (479)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
284TS	16 (406)	51-3/4 (1314)	49-1/4 (1251)	12 (305)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	2-13/16 (71)	18-7/8 (479)	18-1/2 (470)	5 (127)	3-1/8 (79)	5-3/4 (146)
286TS	16 (406)	51-3/4 (1314)	48-1/2 (1232)	13 (330)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	2-13/16 (71)	21 (533)	19-1/2 (495)	5 (127)	3-1/8 (79)	5-3/4 (146)
324TS	16 (406)	51-3/4 (1314)	50 (1270)	13 (330)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	2-13/16 (71)	21 (533)	19-1/2 (495)	5 (127)	3-1/8 (79)	5-3/4 (146)



SUBMITTAL

B-825H

JOB: Beattie Elementary		REPRESENTATIVE: MCNEVIN CO	
UNIT TAG:	ORDER NO.:	DATE: 3/10/2014	
ENGINEER: AE Associates	SUBMITTED BY: Wholesale Specialties	DATE:	
CONTRACTOR: U.S. Engineering	APPROVED BY:	DATE:	



B&G Suction Diffuser

Centrifugal Pump Accessories

DESCRIPTION

The Bell & Gossett Suction Diffuser with disposable start-up strainer is designed for direct application to the pump suction and provides ideal flow conditions for the pump providing NPSH requirements are met. The integral orifice cylinder has a free area equal to five times the cross section of the pump suction opening and serves as a strainer protecting the pump.

OPERATING DATA

Operating Temperature: 250°F (121°C)
 Working Pressure: 175 psi (1,207 kPa)

MATERIALS OF CONSTRUCTION

Type	Body	Inlet Vanes	Orifice Cylinder	Start-Up Strainer
X	Cast Iron	Steel		16 Mesh Bronze
Z	Cast Iron	Stainless Steel		16 Mesh Bronze

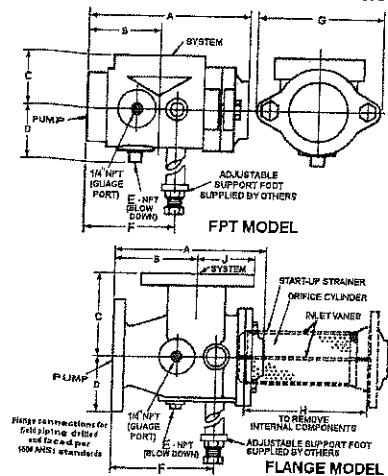
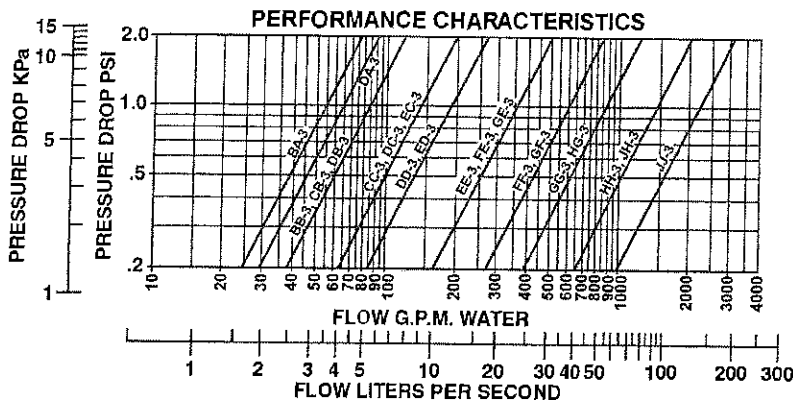
NOTES: Type X-For Closed Systems.
 Type Z-For Domestic Water and Tower Systems.

SCHEDULE

MODEL NUMBER	DIMENSIONS INCHES (mm)				TAGGING INFORMATION	X QUANTITY	Z QUANTITY
	SYSTEM SIDE		PUMP SIDE				
BA-3X/BA-3Z	2 (50.8)	FPT	1-1/2 (38.1)	FPT			
BB-3X/BB-3Z	2 (50.8)	FPT	2 (50.8)	FPT			
CB-3X/CB-3Z	2-1/2 (63.5)	FPT	2 (50.8)	FPT			
CC-3X/CC-3Z	2-1/2 (63.5)	FLG	2-1/2 (63.5)	FLG			
DA-3X/DA-3Z	3 (76.2)	FPT	1-1/2 (38.1)	FPT			
DB-3X/DB-3Z	3 (76.2)	FPT	2 (50.8)	FPT	P-3 & 4	2	
DC-3X/DC-3Z	3 (76.2)	FLG	2-1/2 (63.5)	FLG			
DD-3X/DD-3Z	3 (76.2)	FLG	3 (76.2)	FLG			
EC-3X/EC-3Z	4 (101.6)	FLG	2-1/2 (63.5)	FLG			
ED-3X/ED-3Z	4 (101.6)	FLG	3 (76.2)	FLG			
EE-3X/EE-3Z	4 (101.6)	FLG	4 (101.6)	FLG			
FE-3X/FE-3Z	5 (127)	FLG	4 (101.6)	FLG			
FF-3X/FF-3Z	5 (127)	FLG	5 (127)	FLG			
GE-3X/GE-3Z	6 (152.4)	FLG	4 (101.6)	FLG			
GF-3X/GF-3Z	6 (152.4)	FLG	5 (127)	FLG			
GG-3X/GG-3Z	6 (152.4)	FLG	6 (152.4)	FLG			
HG-3X/HG-3Z	8 (203.2)	FLG	6 (152.4)	FLG			

SUCTION DIFFUSER

B-825H



TYPICAL SPECIFICATIONS

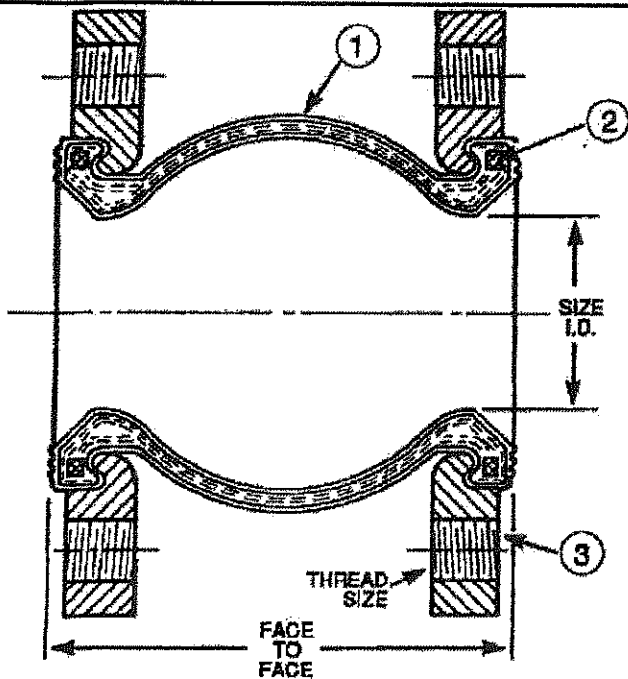
Provide at each pump a Suction Diffuser for mechanical coupling systems of the sized noted on drawings. Units shall consist of angle type body, grooved system connection, flanged pump connection, stainless steel inlet vanes and combination Diffuser-Strainer-Orifice Cylinder with 3/16 diameter openings for pump protection. The orifice cylinder shall be equipped with a disposable fine mesh strainer which shall be removed after system start-up.

Orifice cylinder shall be designed to withstand pressure differential equal to pump shut-off head (maximum _____ PSI) and shall have a free area equal to five times cross section area of pump suction opening. Vane length shall be no less than 2-1/2 times the pump connection diameter. Unit shall be provided with adjustable support foot to carry the weight of suction piping. Each Suction Diffuser to be Xylem Bell & Gossett Model No. SDG-

DIMENSIONS - INCHES (mm)

Model No.	System Side	Pump Side	A	B	C	D	E	F	G	H	J	Orifice Cylinder Free Area in ² (cm ²)	Approx. Shpg. Wt. Lbs. (Kg)
BA-3	2 (50.8) T	1-1/2 (38.1) T	6-13/16 (173)	3 (76)	2-1/4 (57)	2-3/8 (60)	3/4 (19)	3-13/16 (97)	5-1/4 (133)	8 (203)	N/A	11 (71)	13 (6)
BB-3	2 (50.8) T	2 (50.8) T	8-3/8 (213)	3-7/8 (98)	2-3/4 (70)	2-3/4 (70)	3/4 (19)	3-7/8 (98)	5-3/4 (146)	9 (229)	N/A	20-1/2 (132)	14 (6)
CB-3	2-1/2 (63.5) T	2 (63.5) T	8-3/8 (213)	3-7/8 (98)	2-3/4 (70)	2-3/4 (70)	3/4 (19)	3-7/8 (98)	5-3/4 (146)	9 (229)	N/A	20-1/2 (132)	16 (7)
CC-3	2-1/2 (63.5) F	2-1/2 (63.5) F	9 (229)	4-3/4 (121)	4-3/4 (121)	3-1/2 (89)	3/4 (19)	5-5/8 (143)	N/A	11 (279)	3-1/2 (89)	26 (168)	36 (16)
DA-3	3 (76.2) T	1-1/2 (38.1) T	8-3/8 (213)	3-7/8 (98)	2-3/4 (70)	2-3/4 (70)	3/4 (19)	3-7/8 (98)	5-3/4 (146)	9 (229)	N/A	20-1/2 (132)	17 (8)
DB-3	3 (76.2) T	2 (50.8) T	8-3/8 (213)	3-7/8 (98)	2-3/4 (70)	2-3/4 (70)	3/4 (19)	3-7/8 (98)	5-3/4 (146)	9 (229)	N/A	20-1/2 (132)	17 (8)
DC-3	3 (76.2) F	2-1/2 (63.5) F	9 (229)	5 (127)	5 (127)	3-1/2 (89)	3/4 (19)	5-5/8 (143)	N/A	11 (279)	3-3/4 (95)	26 (168)	44 (20)
DD-3	3 (76.2) F	3 (76.2) F	10 (254)	5-1/2 (140)	5-1/2 (140)	3-3/4 (95)	3/4 (19)	6-7/8 (175)	N/A	12 (305)	3-3/4 (95)	37-1/2 (242)	48 (22)
EC-3	4 (101.6) F	2-1/2 (63.5) F	9 (229)	6-1/2 (165)	6-1/2 (165)	3-1/2 (95)	3/4 (19)	5-5/8 (143)	N/A	11 (279)	4-1/2 (114)	26 (168)	42 (19)
ED-3	4 (101.6) F	3 (76.2) F	10 (254)	6-1/2 (165)	6-1/2 (165)	3-3/4 (95)	3/4 (19)	6-7/8 (175)	N/A	13 (330)	4-1/2 (114)	37-1/2 (242)	55 (25)
EE-3	4 (101.6) F	4 (101.6) F	12-5/8 (321)	6-1/2 (165)	6-1/2 (165)	4-1/2 (114)	3/4 (19)	7-5/8 (194)	N/A	14 (356)	4-1/2 (114)	65 (419)	72 (33)
FE-3	5 (127) F	4 (101.6) F	12-5/8 (321)	7-1/2 (191)	7-1/2 (191)	4-1/2 (114)	3/4 (19)	7-5/8 (194)	N/A	15 (381)	5 (127)	65 (419)	84 (38)
FF-3	5 (127) F	5 (127) F	14-1/4 (362)	7-1/2 (191)	7-1/2 (191)	5 (127)	3/4 (19)	9 (229)	N/A	15 (381)	5 (127)	90 (581)	100 (45)
GE-3	6 (152.4) F	4 (101.6) F	12-5/8 (321)	8 (203)	8 (203)	4-1/2 (114)	3/4 (19)	7-5/8 (194)	N/A	15 (381)	5-1/2 (140)	65 (419)	90 (41)
GF-3	6 (152.4) F	5 (127) F	14-1/4 (362)	8 (203)	8 (203)	5 (127)	3/4 (19)	9 (229)	N/A	15 (381)	5-1/2 (140)	90 (581)	105 (48)
GG-3	8 (152.4) F	6 (152.4) F	16-3/8 (416)	8 (203)	8 (203)	5-1/2 (140)	3/4 (19)	10-1/8 (257)	N/A	17 (432)	5-1/2 (140)	127 (819)	134 (61)
HG-3	8 (203.2) F	6 (152.4) F	16-3/8 (416)	9 (229)	9 (229)	5-1/2 (140)	3/4 (19)	10-1/8 (257)	N/A	18 (457)	6-3/4 (171)	127 (819)	150 (68)
HH-3	8 (203.2) F	8 (203.2) F	20-1/2 (521)	9 (229)	9 (229)	6-3/4 (171)	3/4 (19)	11 (279)	N/A	21 (533)	6-3/4 (171)	218 (1406)	250 (113)
JH-3	10 (254) F	8 (203.2) F	20-1/2 (521)	10 (254)	11 (279)	6-3/4 (171)	3/4 (19)	11 (279)	N/A	21 (533)	8 (203)	218 (1406)	290 (132)
JJ-3	10 (254) F	10 (254) F	25-1/4 (641)	11 (279)	11 (279)	8 (203)	3/4 (19)	13-1/2 (343)	N/A	25 (635)	8 (203)	338 (2180)	415 (188)

(T) Threaded - FPT (F) Flanged *Dimensions include orifice cylinder + 2-1/2 (64) inch clearance.



ITEM	PART NAME	MATERIAL
1	STANDARD BODY	EPDM
2	WIRE	STEEL
3	FLANGE	PLATE STEEL

MAXIMUM WORKING TEMPERATURE 230°F

*Maximum Operating Conditions

Temperature (°F)	Maximum Pressure (PSI)	
	12" & Smaller	14" to 24"
170°	225	125
180°	200	115
190°	175	105
200°	150	95
210°	125	40
220°	100	35
230°	75	25

*EPDM is the standard elastomer for the interior and exterior covering. Contact factory for other elastomers. Not for steam applications.

OPTIONAL MATERIALS AVAILABLE
Go to www.metroflex.com

This flexible joint should be installed to the length shown on the drawing. Piping and equipment connected by this flexible joint must be anchored and guided. If not, control units must be used to prevent movement past design limits. Not intended for torsion.

TO BE FURNISHED WITH CONTROL UNITS: YES NO

Qty.	SIZE I.D. (in)	F/F (in)	Pressure (PSI)	MOVEMENT CAPABILITY AND FORCES										No. Holes	Thread Size
				AXIAL				DEFLECTION							
				Comp. (in)	Approx Force (Lbs)	Elong. (in)	Approx Force (Lbs)	Lateral (in)	Approx. Force (Lbs)	Angular (Degrees)	Weight (Lbs)				
1	3 3/4	225	1/4	N/A	3/32	N/A	1/4	N/A	15	5	4	1/2-12NC			
1 1/4	3 3/4	225	1/4	N/A	3/32	N/A	1/4	N/A	15	6	4	1/2-12NC			
1 1/2	3 3/4	225	1/4	N/A	3/32	N/A	1/4	N/A	15	7	4	1/2-12NC			
2	4 1/8	225	3/8	55	1/4	73	3/8	55	15	8	4	5/8-11NC			
2	4 1/2	225	1/2	102	1/4	68	3/8	97	15	13	4	5/8-11NC			
3	5 1/8	225	1/2	136	1/4	115	3/8	108	15	14	4	5/8-11NC			
4	5 3/8	225	3/4	145	3/8	242	1/2	275	15	18	8	5/8-11NC			
5	6 3/4	225	3/4	172	3/8	196	1/2	308	15	23	8	3/4-NC			
6	7 1/8	225	3/4	293	3/8	563	1/2	484	15	28	8	3/4-NC			
8	8 1/8	225	1	372	1/2	587	7/8	688	15	40	8	3/4-NC			
10	9 3/8	225	1	398	1/2	455	7/8	781	15	68	12	7/8-NC			
12	10 1/4	225	1	390	1/2	356	7/8	842	15	94	12	7/8-NC			
14	10 1/2	125	1	N/A	5/8	N/A	7/8	N/A	15	105	12	1-1/8 HOLE			
16	10 1/2	125	1	N/A	5/8	N/A	7/8	N/A	15	120	16	1-1/8 HOLE			
18	10 1/2	125	1	N/A	5/8	N/A	7/8	N/A	15	125	16	1-1/4 HOLE			
20	10 1/2	125	1	N/A	5/8	N/A	7/8	N/A	15	145	20	1-1/4 HOLE			
24	10 1/2	125	1	N/A	5/8	N/A	7/8	N/A	15	265	20	1-3/8 HOLE			

REV.	DATE	DESCRIPTION
3	07/30/2012	VACUUM COLUMN TAKEN OUT OF CHART

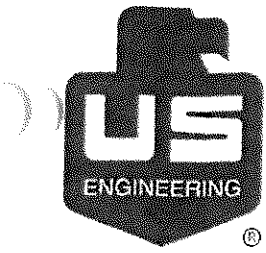
CUSTOMER: **U.S. Engineering**
 PROJECT: **Beattie Elementary**
 ENGINEER: **AE Associates**
 ARCHITECT: _____
 PRO. OR P.O. NO. _____

Metroflex
for pipes in motion

2323 W. HUBBARD ST.
CHICAGO, IL 60612
TEL: 312-738-3800
FAX: 312-738-0415
WWW.METRAFLEX.COM

DESCRIPTION: **METRASPHERE STYLE "O" SPHERICAL EXPANSION JOINT**

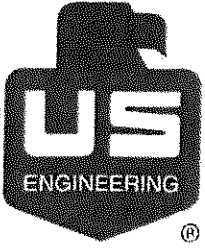
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 APPROVED: **MIR** DATE: **07/31/2012**
 SCALE: **NONE** DRAWING NUMBER: **MSO-REV3**



Tab-3
Specification Section: 23 25 00
HVAC Water Treatment
Dolphin Unit (Dolphin)

**BEATTIE
ELEMENTARY
SCHOOL**

3100 MEADOWLARK AVE
FORT COLLINS CO 80526



Dolphin O&M and
Warranty Information:
Dolphin Unit

**BEATTIE
ELEMENTARY
SCHOOL**

3430 MEADOWLARK AVE
FORT COLLINS CO 80526

5001 S Zuni St.
Littleton CO, 80120
303.975.2100 tel
303.936.2755 fax

LONG

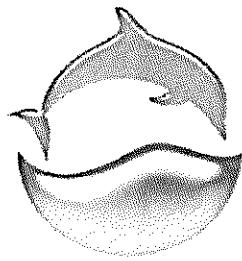
BUILDING ENVIRONMENTS

*Technology for
Better Buildings*

OPERATION AND MAINTENANCE MANUAL

PROJECT	PSD Beattie Elementary School
ITEM	Dolphin WaterCare O&M
ENGINEER	
CONTRACTOR	US Engineering Company
TAG	Dolphin Series Model G3030-PVC 3
MANUFACTURER	Dolphin
SUBMITTED BY	LONG Building Environments --

DATE: June 26, 2014



DOLPHIN WATERCARE™

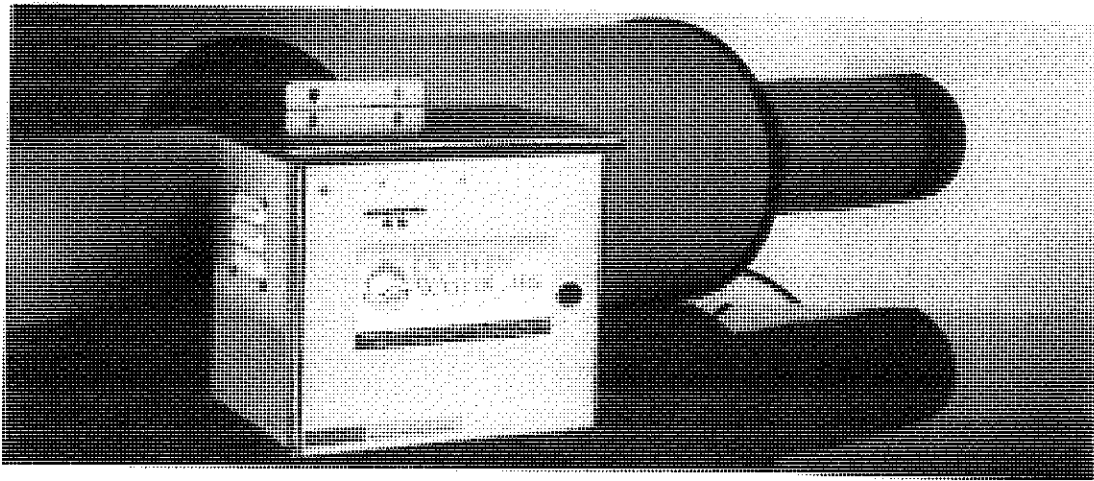
TREATING WATER RESPONSIBLY

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TECHNICAL MANUAL

• INSTALLATION, OPERATION, AND MAINTENANCE •

DOLPHIN SERIES 3000



Superior Performance • Chemical-Free • Energy Savings • Minimal Maintenance • Water Savings

DESIGNED, DEVELOPED, MANUFACTURED, AND MARKETED BY:

CLEARWATER SYSTEMS CORPORATION

145 DENNISON ROAD

P.O. BOX 463

ESSEX, CT 06426

PHONE: 860-767-0850 • FAX: 860-762-8972

Email: service@dolphinwatercare.com • Internet: www.dolphinwatercare.com

The Dolphin System™ is covered by the following patents: U.S. Patents 6,063,267 and 6,641,739, Canadian Patent 2335496, and Japanese Patent 3595505.
Other patents applications pending.

List of Ongoing Appendixes or Addenda

New information may be issued in the form of an appendix or as an addendum to your manual. Please store such items with your acknowledgment of receiving them in the following table.

Appendix/Addendum Designation and Title	Issue Date	Date Received	Acknowledged By

This document supports the following Clearwater System Corporation products.

- Dolphin System 3000
- Dolphin System 3000-G
- Dolphin System 3000-REF

This device is registered with the U.S. EPA as a Pesticide, Device or Active Ingredient Producing Establishment
EPA Est. 73323-CT-0001

This product conforms to the requirements of CFR 47(FCC) PART 18, 2006 for radiated emissions.



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1.0 INTRODUCTION

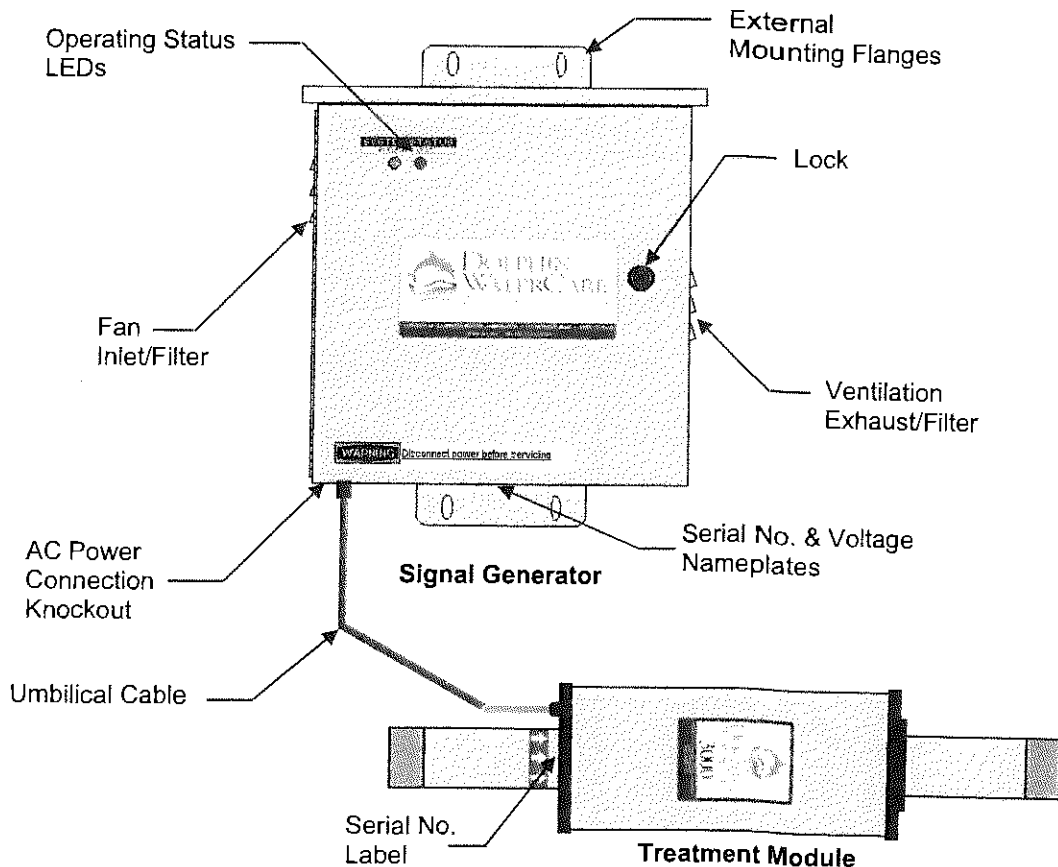
The Dolphin Series 3000 (or Dolphin System™) equipment has been designed for superior performance, ease of installation, minimal maintenance, longevity, and low-cost operation. Please take a few minutes to read the basic instructions and warnings in this manual before attempting any installation of or adjustment to the Dolphin System. If you have any questions about any aspect of installing or attending to the system, please contact our service center through any of the means listed on the cover of this manual.

1.1 The Dolphin Series 3000

The Dolphin System consists of two main components.

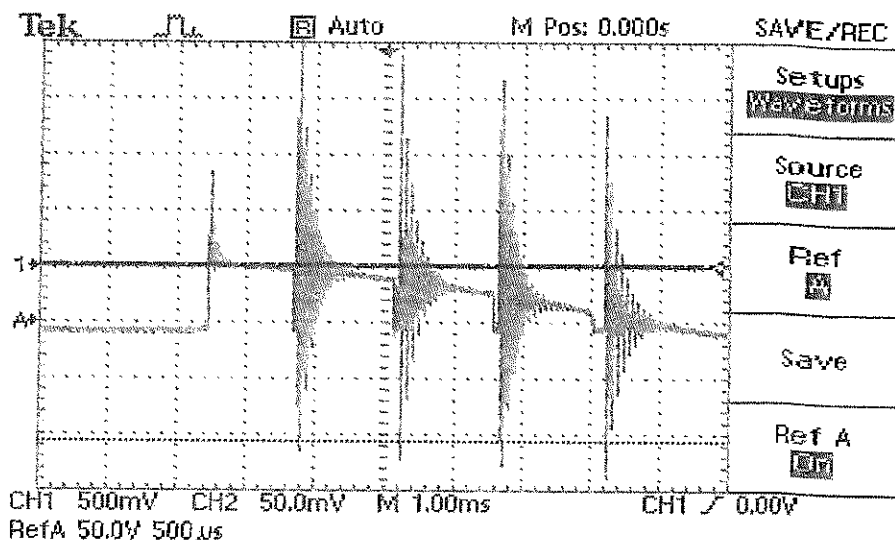
- The **Signal Generator** houses the power and control components in a NEMA 3R and IEC IP24 rated enclosure. Any serviceable items (fuses, fan filters) are located in the enclosure.
- The **Treatment Module** is connected to the Signal Generator via an umbilical cable. There are no customer serviceable parts in the Treatment Module.

Figure 1. Overview: The Dolphin Series 3000 System



2.0 PRINCIPLES OF OPERATION

The Dolphin imparts pulsed, high frequency electric fields into flowing water. The characteristic waveform is shown below.

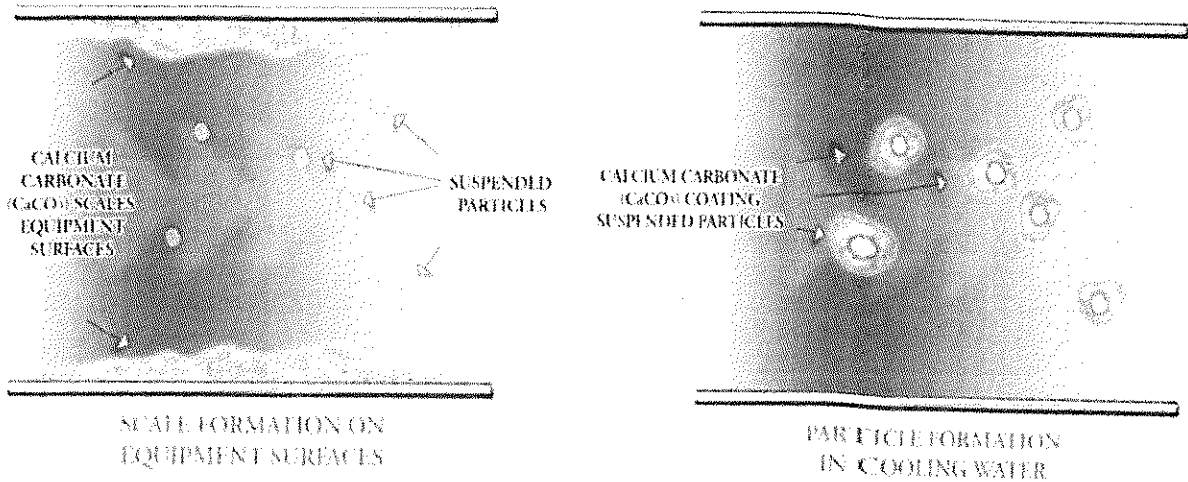


2.1 Scale Prevention

When evaporation or steam production occurs in a cooling tower or boiler, the water exits as water vapor and leaves the dissolved minerals behind, causing increased concentration. Upon sufficient concentration, the dissolved minerals such as calcium carbonate (i.e., limestone) become solid in a process known as precipitation. The Dolphin System changes the form of precipitated solids from "hard lime scale" to a harmless powder.

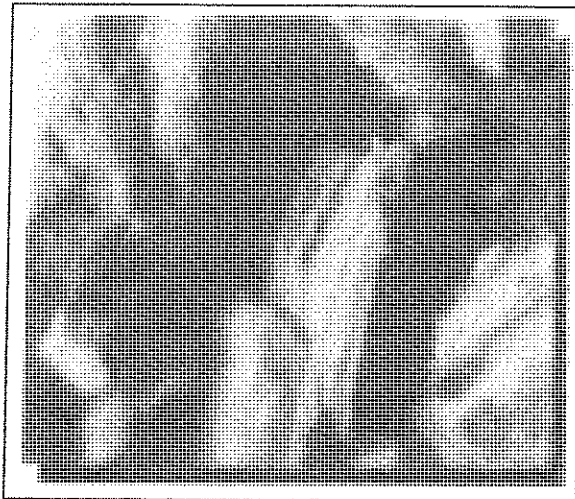
The Dolphin System accomplishes this change by "activating" naturally occurring, small-suspended particles in the water. These tiny suspended particles exist in large quantities in all city water or well water that is used as cooling tower or boiler make-up water. Under Dolphin System treatment, the suspended particles (suspended meaning that they neither sink nor float because of their small size) act as seeds for precipitation of dissolved minerals. The Dolphin System activates the suspended particles by removing the static electric charge on their surface.

A powder of calcium carbonate (limestone) grows by coating or adhering to the suspended seed particles. The powder formation relieves the ever-growing pressure to form solids that occur from the increasing mineral concentration, before scale has a chance to form on equipment surfaces. Without Dolphin System treatment, the pressure to form solids is relieved by the formation of scale on equipment surfaces. The process is much like seeding a cloud to produce rain when weather conditions are building up water concentration in the atmosphere.

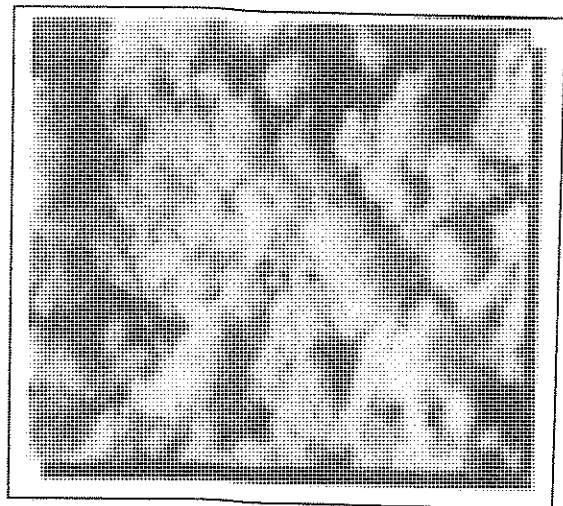


In removing the surface charge on suspended particles, the Dolphin System makes those particles the preferred sites for precipitation to occur. Thus, the minerals coat or adhere to the suspended particles rather than equipment surfaces. These coated particles or powder can be easily removed from a cooling tower basin by manual means, filtration, or centrifugal separation. The quantity of powder is typically about 15% of normal blown-in dirt in a cooling tower. In a boiler, the powder exits through normal bottom blowdown.

Photomicrographs of the two mineral formations are shown in the following magnifications:



Typical Surface Scale 60x
Chemical Treatment



Bulk Solution Precipitate 60x
Pulsed-Power Treatment

2.2 Bacterial Control

The Dolphin System has two methods of controlling microbial populations in cooling systems: encapsulation and electroporation.

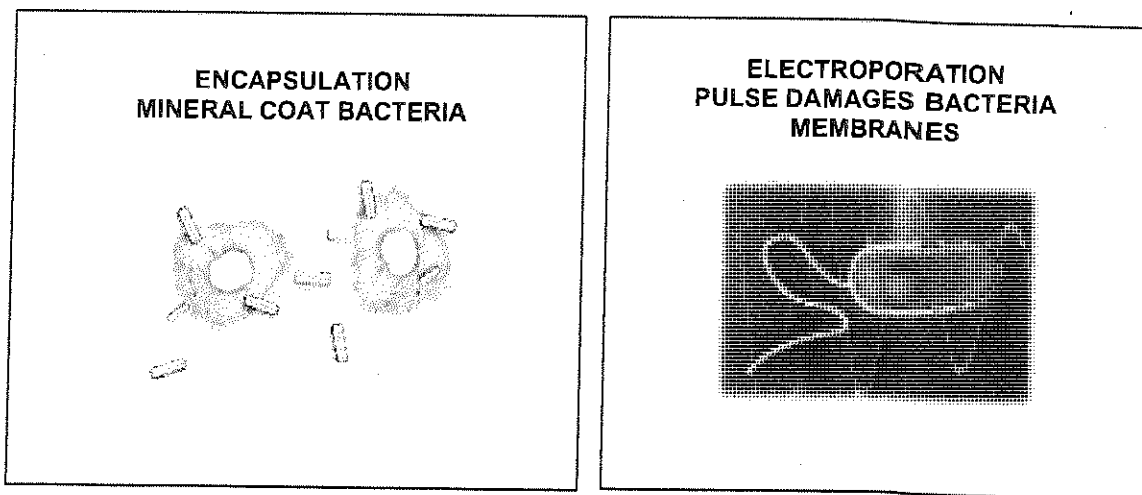
A. Encapsulation

The limestone-type powder previously described incorporates most of the free-floating (i.e., planktonic) bacteria. Without Dolphin System treatment, the bacteria are repelled by the suspended particles due to the fact that nearly all tiny particles have similar negative static electric charges on their surfaces. Once Dolphin System powder is growing, the repulsion to bacteria is eliminated; therefore, the bacteria are attracted to powder by other natural forces (i.e., van der Waals forces) and become entrapped in the powder particle. The powder, in effect, sweeps the water clean of planktonic bacteria and renders them incapable of reproducing.

B. Electroporation

The high frequency, pulsing action of the Dolphin System's electric fields damages the membranes of planktonic bacteria by creating small "pores" in their outer membrane. The condition weakens the bacteria and inhibits their capability to reproduce.

The combined effect of these two separate methods, encapsulation and electroporation, results in exceptionally low total bacterial counts (TBC) in cooling tower water.



Microbial life is encapsulated into the forming powder, preventing it from reproducing. Microbes have a 24-48 hour life span. Any microbes not captured in the forming powder are "zapped" by the secondary pulse, forcing them to spend their life span repairing cell wall damage rather than reproducing.

C. Biofilm or Slime

Normally bacteria form a biofilm or slime layer on equipment surfaces. A biofilm consists of

a slimy bacterial secretion that forms a protective canopy to protect the bacteria beneath it from chemical biocides. It is very slimy to the touch, four times more insulating to heat transfer than mineral scale, and is the primary cause of microbial influenced corrosion. The bacteria that live in a biofilm adhering to an equipment surface are called sessile bacteria and represent 99% of the total bacteria in a system. The Dolphin System eliminates the slime layer through the process of nutrient limitation. All the living organisms in a cooling tower depend on each other for their food supply. Thus, when the nutrients from the planktonic bacteria are diluted by the two methods described in subsections A and B of section 2.2, the biofilm cannot be sustained and will not be created (or it will disintegrate if one already exists prior to Dolphin System installation or operation).

2.3 Corrosion Control

The most serious corrosion concerns in a cooling tower or boiler come from chemical additives. Removing chemicals, avoiding the use of softened water, and using the chemical-free Dolphin System eliminates those concerns. Other serious concerns come from localized corrosive attack caused by biofilm or mineral scale. Under Dolphin System treatment, these conditions are absent and therefore these types of corrosion are eliminated.

A. Localized Corrosion

Of all the forms of corrosion, localized corrosion is of most concern because it can cause rapid deterioration and leaks in a system. Localized corrosion can only be detected visually (except in the case of eddy current testing of chiller tubes to detect the localized attack caused by chemicals or biofilm). Localized corrosion can be eliminated virtually by Dolphin System treatment. If you have questions or concerns on any type of localized corrosion, call your Clearwater Service Representative for guidance. Types of localized corrosion that could be present in cooling towers or boilers include: microbial influenced corrosion, pitting, and under-deposit corrosion of several varieties.

B. Uniform Corrosion

Uniform corrosion is characterized by the slow dissolving of entire metal surfaces. It is of minimal concern because it rarely limits equipment life due to the corrosion resistance of the metals used for equipment construction. Corrosion coupons, which use the weight loss of a metal sample to measure uniform corrosion rates, are a reliable method of corrosion monitoring. Galvanized sheet steel and stainless steel show no uniform corrosion in Dolphin-treated systems. Copper and plain carbon steel experience minimal uniform corrosion within industry accepted norms in Dolphin-treated systems.

In a cooling tower, the method the Dolphin System employs to ensure low uniform corrosion rates is to take advantage of the natural corrosion-inhibiting powers of calcium carbonate. The Dolphin System manages cooling tower water so that calcium carbonate powder is always forming. Calcium carbonate in that state (called saturation) acts as a powerful cathodic corrosion inhibitor. As such, it greatly slows the corrosion process by blocking the reception of electrons that are thrown off by the corrosion process. With no place for the electrons to go, the corrosion process is physically and very effectively controlled.

In a boiler, the Dolphin System operates with water chemistry that creates an adherent protective surface called magnetite.

3.0 Cooling Tower Operations

3.1 Cleaning, "Passivation," and Galvanized Conditioning

A. Cleaning

New pipe and cooling system installations should be cleaned to remove oils, dirt, mill-scale, and construction debris. This cleaning requires that the system be flushed, cleaned using chemical cleaners, and flushed again.

B. "Passivation" of Iron Piping (Chemical Corrosion Inhibition)

If a cooling system is to be filled but not used at a significant load for a few weeks, the system should be treated with a corrosion inhibitor at sufficient concentration to allow film formation (this is a higher concentration than film maintenance). This treatment usually involves circulating appropriate corrosion inhibitors for at least 24 hours. After this chemical treatment, the corrosion inhibitors may remain in the system while operating under Dolphin System control. As the system is operated, the chemical additives will be purged in the blowdown. At the same time the calcium carbonate (which is naturally in the make-up water) will concentrate to provide corrosion protection without additional chemicals. If the tower is to be commissioned and not used for a while, it is important that the corrosion-inhibiting chemicals remain in the tower to minimize general corrosion until the tower water is concentrated to the saturation of calcium carbonate. It is also advisable to circulate the water at least once per week to allow the corrosion inhibitors to do their job.

C. Conditioning Galvanized Towers to Prevent White Rust

In addition to the cleaning previously specified, immersion surfaces of new galvanized (zinc-coated) towers should be **conditioned** by maintaining the pH of the system between 7.5 and 8.3 for 6 to 8 weeks. This protective conditioned surface will appear as a dull gray finish, replacing the shiny metallic appearance of new-galvanized sheets. Once the conditioning is established, it is permanent unless damaged by aggressive environments (pH less than 6.5) or mechanical bruising, in which case conditioning must be repeated. Failure to condition immersed areas on galvanized steel may produce a white "waxy" residue called "**white rust**". If unchecked, the white rust will penetrate through the zinc coating and allow corrosive attack of the underlying steel. Damage under the white rust tends to be rather shallow; therefore, unless white rust is extensive, it affects only the appearance of the tower rather than significantly shortening the equipment life.

The preferred method for maintaining the pH range for the conditioning period is by dilution of tower water with makeup water through blowdown control. Based on make-up water analysis, Clearwater will provide a conductivity setting for the blowdown controller that will maintain the pH between 7.7 and 8.1. Periodic testing of pH by a Clearwater sales/service representative will verify that the pH is within this range. During the conditioning period, water usage for blowdown will likely be higher than normal; however, the cost of natural conditioning through blowdown control will be more economical than conditioning with chemicals.

If make-up water is above 8.3, it is usually due to lime softening. If so, a few days of operation will reduce the pH to below 8.3. At that time, the water chemistry can be re-evaluated by Clearwater and a new conductivity setting will be provided to follow the above procedure. Other unusual water conditions may require chemically assisted conditioning

under the guidance of your Clearwater service representative.

3.2 Tower Startup

There are several cautionary steps to follow or verify before starting the cooling system under Dolphin System operation:

- The system must be clean and clear of debris, construction materials, oils, and solvents.
- The system may be cleaned using a pressure wash or a phosphate-based chemical flush. If a chemical cleaner is used, it should be buffered to maintain the pH between 6.5 and 8.0. **Do not use phosphate on galvanized towers or components.**
- Galvanized surfaces should be inspected for scratches, dents, or regions where the coating appears physically damaged. Any physical damage to the zinc coating must be repaired before conditioning. The Cooling Technology Institute (CTI) and the Association of Water Technologies (AWT) recommend the use of zinc-rich paints to repair damaged galvanized surfaces.
- Galvanized surfaces should be inspected for any evidence of corrosion prior to operation of the system. Any regions of corrosion should be repaired prior to conditioning.
- Once the period of conditioning has been successfully completed, the protective layer is permanently formed. Contact the Clearwater Systems Corporation service representative to assist you in developing post-conditioning settings for standard tower operation.

3.3 Transition to Dolphin System Treatment

In retrofit applications, the transition to Dolphin System treatment is typically made under one of the following three scenarios.

A. System Totally Drained

The preferred method of transition between chemical control and Dolphin System control is to drain the system totally, clean the system with pressure wash or chemical flush, and recharge it with fresh chemical-free water ready for Dolphin System control.

B. System Not Drained

When the system cannot be drained conveniently (e.g., in a high rise building), treatment with the Dolphin System may be started with the chemicals present; however, the following steps should be taken:

- Stop all new chemical additions.
- Operate with the blowdown substantially opened or continuously opened for a scheduled period of time (as suggested by Clearwater Systems, based on the volume of the system). This activity will have the effect of changing the chemical-containing water gradually over a few days of operation without disruption.

C. Dolphin Installation on One Cooling Cell or Chiller Circuit at a Time

When continuous operation or other reasons dictate that one cell or chiller must be shut down for Dolphin System installation while the others run, the waters are usually commingled after restart and thus contain chemicals. In such cases, until all cells or chiller circuits have been converted to Dolphin System control, operate the system under the chemical water treatment. When the installation is complete and all the required

Dolphin units are in operation, follow the method in subsection B (System Not Drained) for transition to chemical-free water.

3.4 Algae

Algae are plants which, like all plants, require sunlight and nutrients to grow. In cooling towers algae are aesthetically undesirable and may promote other microbial growth. However, unless the algae interfere with the thermal performance of the tower by blocking fill or plugging nozzles, it is of itself relatively benign. Clearwater defines a biologically active system as one with an active slime layer and high planktonic bacteria count. Such a system is at risk for poor thermal performance, microbial influenced corrosion, and pathogens.

Algae growth, combined with high total bacteria count, can be a warning sign of a biologically active system. Algae growth combined with low Total Bacteria Count (TBC) is NOT a warning sign for a biologically active system. Consistently low total bacteria counts are a sign of a biologically INACTIVE system regardless of the presence or absence of algae.

Algae growth may be particularly noticeable during the spring and summer. As previously noted, algae requires sunlight to grow; therefore, open cooling systems and systems that receive direct sunlight are more prone to algae growth. Blown-in dirt and nutrients also promote algae growth.

The Dolphin System provides excellent microbial control and good algae control under most situations. However, a combination of one or more of the following factors may result in some opportunistic and relatively benign algae growth:

- Exposure of the basin to direct sunlight.
- Limited water circulation in areas of the basin (e.g., an outside trough on cross-flow towers).
- Settled dirt and precipitates.
- Intermittent circulation of the water through the system.
- Areas of intermittent wetting (splash areas).

If the amount of algae is undesirable, the following actions can be performed to minimize a persistent algae bloom:

- Block exposure of sunlight to the algae-prone regions. Care must be used to prevent interference of airflow and thermal performance of the tower. When feasible, this procedure is the best solution.
- Improve the water flow in quiescent areas of the tower.
- For intermittently operated systems, circulate the water periodically without a load through the Dolphin unit.
- The use of filtration systems to relieve the system of blown-in and precipitated solids can reduce the area for algae to thrive. Effective filtration will not remove existing algae but should prevent future blooms.
- Slug-fed chemical algaecide does not interfere with Dolphin System water treatment; therefore, algaecide addition is permitted. However, algaecide treatment may be only marginally effective in areas where climate and blow-in make the tower particularly prone to algae blooms.

- If there is no slime, if the heterotrophic plate counts are in control, and if the algae are not interfering with tower performance, ignore the algae until it is removed by routine periodic tower cleaning.

3.5 Monitoring

The following three measurements are key to maintaining a well-run cooling tower:

- pH
- Conductivity
- Total Bacteria Count

These three parameters should be measured and recorded once per month on large cooling systems of 600 tons of cooling or greater, and once per quarter on smaller systems. Occasionally, Total Dissolved Solids (TDS) is used as an alternative measurement of conductivity. Under Dolphin System treatment TDS is less accurate and should not be used. Your Clearwater service representative can provide continuing monitoring service or provide guidance for self-monitoring your system.

The pH in a cooling tower under Dolphin System treatment will naturally rise and level off between 8.0 and 9.0, depending on local conditions. Conductivity in cooling tower water should approximately match the setting on your conductivity controller that operates the system blowdown.

4.0 SERVICE AND WARRANTY

4.1 Service

Clearwater Systems Corporation has made quality an uncompromising standard in its design and production of the Dolphin Series 3000 water treatment system. The Dolphin System is designed and built in a modern U.S. facility with only premium materials being used in its construction. The electronics are totally solid state and should provide years of trouble-free operation. However, as with any electronic device, problems can occur. In the unlikely event that Dolphin System service is required, it is very important that it be provided only by factory-trained and authorized technicians who are familiar with this unique technology and have access to factory-authorized parts. **Any attempts to repair Dolphin System equipment by unauthorized individuals or with unauthorized parts can void your warranty.** We strongly advise you to contact your local Clearwater Systems representative or one of our Clearwater Systems technical sales engineers.

4.2 Limited Warranty

Clearwater Systems Corporation warrants that the products it manufactures will be free from defects in materials and workmanship. The warranty term is one year beginning on the date of installation, as described herein. However, entering a service contract with a Clearwater-certified service provider may extend the warranty term. The warranty will remain in effect while the equipment is monitored under a valid service contract for a maximum of five years from date of installation.

This warranty shall not apply and does not cover damage due to external causes, including accident, abuse tampering, misuse, electrical overload, servicing not authorized by Clearwater Systems Corporation, usage not in accordance with product instructions, faulty installation, unauthorized product modification, failure to perform required preventive maintenance, and problems caused by the use of parts and components not supplied by Clearwater.

During the one-year period beginning on the date of installation, Clearwater Systems Corporation will repair or replace products covered under this limited warranty that, at Clearwater's option, either are returned to Clearwater's facility or repaired on-site by authorized Clearwater personnel or agents. To request warranty service, the purchaser must call Clearwater's customer technical support agent within the warranty period. If warranty service is required and repair is to be accomplished at a Clearwater facility, Clearwater will issue a Return Material Authorization Number. The purchaser must ship the products back to Clearwater in their original or equivalent packaging, prepay shipping charges, and insure the shipment or accept the risk of loss or damage during shipment. Clearwater will ship the repaired or replacement products to the purchaser freight prepaid if the purchaser uses an address in the continental United States. Shipments to other locations will be made freight collect.

Clearwater owns all parts removed from repaired products. If Clearwater repairs or replaces a product, the warranty term is not extended.

NOTE

CLEARWATER SYSTEMS CORPORATION MAKES NO EXPRESSED WARRANTIES BEYOND THOSE STATED IN THIS WARRANTY STATEMENT. CLEARWATER DISCLAIMS ALL OTHER WARRANTIES AND CONDITIONS, EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. CLEARWATER'S RESPONSIBILITY FOR MALFUNCTIONS AND DEFECTS IN THE PRODUCT IS LIMITED TO REPAIR AND REPLACEMENT, AS SET FORTH IN THIS WARRANTY STATEMENT. THESE WARRANTIES GIVE THE PURCHASER SPECIFIC LEGAL RIGHTS, AND THE PURCHASER MAY ALSO HAVE OTHER RIGHTS, WHICH MAY VARY FROM STATE TO STATE (OR JURISDICTION).

CLEARWATER SYSTEMS DOES NOT ACCEPT: (1) LIABILITY FOR THE PRODUCTS OR THEIR PERFORMANCE BEYOND THE REMEDIES SET FORTH IN THIS WARRANTY STATEMENT, OR (2) LIABILITY FOR ANY SPECIAL, INDIRECT, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY KIND OR CHARACTER, INCLUDING, WITHOUT LIMITATION, LOSS OF REVENUE OR PROFITS, FAILURE TO REALIZE SAVINGS OR OTHER BENEFITS, OR CLAIMS AGAINST PURCHASER BY ANY THIRD PARTY, EVEN IF CLEARWATER SYSTEMS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

4.3 Legionella Statement

Legionella bacteria are ubiquitous (present in virtually all raw water). The risk of human infection is related to many factors such as temperature, mist formation, likelihood of breathing the mist, and individual immune system characteristics, among others.

- **Dolphin Microbial Control.** The Dolphin System controls the population of any species of bacteria present in cooling tower water by inhibiting bacterial reproduction. The Dolphin System is not a disinfection device and does not selectively or uniformly kill bacteria. Low populations of bacteria, both planktonic (suspended in the water) and sessile (part of a slime layer), provide for a cleaner, less biologically active tower, and therefore may have a beneficial impact on Legionella infection prevention.

- **Legionella Infection Prevention.** Recommended practice for prevention of Legionella infection should include:
 1. Follow all guidelines and regulations for cooling system design and operation that are applicable to your local government regulation entity, business or industry protocol, and company policy.
 2. Follow cooling system manufacturer guidelines for cooling system cleaning and maintenance.
 3. Maintain the best possible drift elimination to minimize human exposure to drift.
 4. A clean, biologically inactive tower minimizes the risk of "Legionella Amplification," a process whereby Legionella activity is greatly increased by interaction with other organisms in the cooling tower water. Therefore, the following actions are recommended for a clean, biologically inactive tower:
 - Blown-in dust carrying nutrients and organic materials can encourage biological activity. These materials should be removed either frequently or continuously.
 - Total Bacteria Count (TBC) (planktonic bacteria), as measured by a Heterotrophic Plate Count Standard Methods 9215B using a pour plate agar (tryptone glucose yeast) and performed by a certified laboratory, is the best measure of biological activity. A low TBC, achievable with the Dolphin System, is indicative of a clean, biologically inactive cooling tower. Sampling and analysis for TBC should be frequently performed.
 - Absence of a tactile slime layer (low counts of sessile bacteria), achievable with the Dolphin System, is indicative of a clean, biologically inactive tower. Visual and tactile (touch) monitoring for slime layer should be frequently performed.
 5. If Legionella risk becomes unacceptable because of suspicion of human infection or any other reason, follow applicable approved guidelines for Legionella sampling, Legionella testing, and cooling system disinfection.

- **Legionella Disclaimer.** Clearwater Systems Corporation cannot, through the use of its product (the Dolphin System) or any other means, eliminate the presence of Legionella in water systems or control the potential risk factors for human infection. Therefore, Clearwater Systems disclaims any responsibility for damages resulting from the presence of Legionella bacteria in a water system.

4.4 Safety Instructions and Warnings

WARNING—To reduce the risk of fire or injury

1. READ AND FOLLOW ALL INSTALLATION INSTRUCTIONS.
2. Install as per manufacturer installation's procedure.
3. Install unit in accordance with Clearwater's specified clearance around the unit, and with proper orientation (top, bottom).
4. Install in accordance with local electrical code.
5. Install in accordance with local plumbing code.

IMPORTANT SAFETY INSTRUCTIONS

WARNING – To reduce the risk of severe injury or death.

1. READ AND FOLLOW ALL INSTRUCTIONS.
2. DISCONNECT POWER PRIOR TO SERVICING.
3. SAVE THESE INSTRUCTIONS.

5.0 DOLPHIN SERIES 3000 MAJOR COMPONENT DESCRIPTIONS

As depicted on page 1 of this manual in Figure 1, the Dolphin System consists of two main units: the Signal Generator and the Treatment Module.

5.1 The Signal Generator

Depicted in Figure 2, the Signal Generator contains the transformer, fuses, status LEDs, Digital Dolphin printed circuit board, umbilical cable connector, AC power connection at terminal block, ventilation ports, and a ventilation fan. The Signal Generator is a stainless steel NEMA 3R rated enclosure that provides protection against rain and sleet in an outdoor installation. Tables 1 to 1E list the physical specifications for the various Signal Generators.

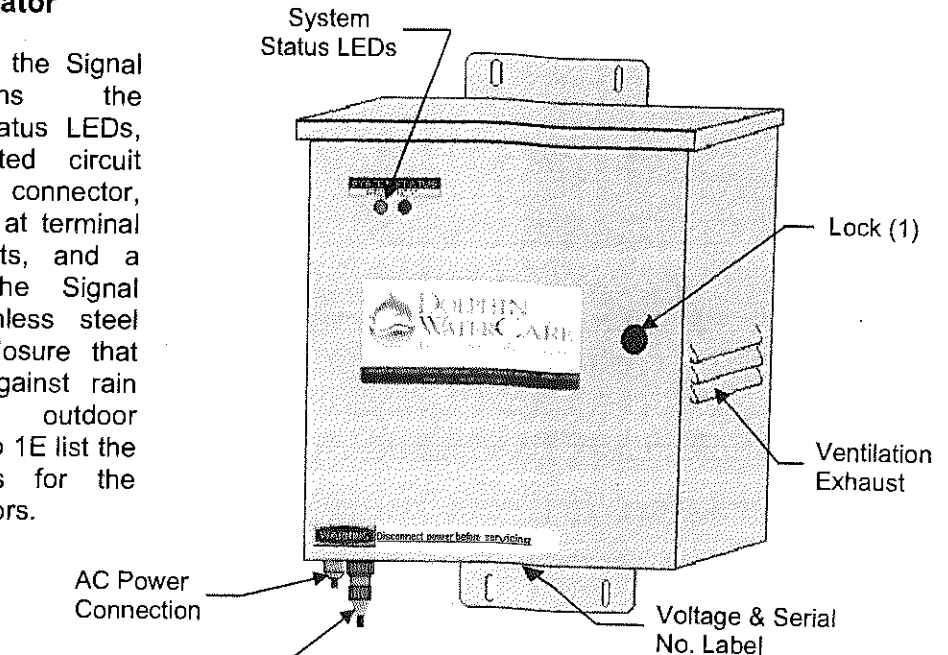


Figure 2.
Dolphin Series 3000
1" - 6" Signal Generator

Table 1. Signal Generator Small Panel Specifications 1" - 6" 115V/60Hz

Model	Nom. Pipe Size	Voltage	VA	Fuse Size	Signal Generator NEMA 3R Enclosure	Umbilical Cable	Net Weight	
							Treatment Module	Signal Generator
3010-SST	1"	115/1/60	140	MDL-2	10"X10"X8"	10 ft	13 lb	32 lb
3010-PVC	1"	115/1/60	140	MDL-2	10"X10"X8"	10 ft	11 lb	32 lb
3020-SST	2"	115/1/60	225	MDL-3	10"X10"X8"	10 ft	28 lb	32 lb
3020-PVC	2"	115/1/60	225	MDL-3	10"X10"X8"	10 ft	24 lb	32 lb
3030-SST	3"	115/1/60	405	MDL-5	10"X10"X8"	10 ft	50 lb	32 lb
3030-PVC	3"	115/1/60	405	MDL-5	10"X10"X8"	10 ft	35 lb	32 lb
3040-PVC	4"	115/1/60	490	MDL-7	10"X10"X8"	10 ft	43 lb	32 lb
3060-PVC	6"	115/1/60	480	MDL-7	10"X10"X8"	10 ft	110 lb	32 lb

- All Signal Generators are configured for AC power hardwiring in the field.
- Dimensions and specifications are for reference only and are subject to change without notice.
- **Special order** - Umbilical Cables up to a maximum of **26** feet in length can be provided at time of order.
- **Optional Umbilical Extension Cable** - Umbilical extension cables with male/female connectors are available for field installation. *Total umbilical cable length including extension cable must not exceed 26 feet.*

Table 1A. Signal Generator Small Panel Specifications 1" - 6" 230V/60Hz

Model	Nom. Pipe Size	Voltage	VA	Fuse Size	Signal Generator NEMA 3R Enclosure	Umbilical Cable	Net Weight	
							Treatment Module	Signal Generator
3010-SST	1"	230/1/60	140	MDL-1	10"X10X8"	10 ft	13 lb	32 lb
3010-PVC	1"	230/1/60	140	MDL-1	10"X10"X8"	10 ft	11 lb	32 lb
3020-SST	2"	230/1/60	230	MDL-1 1/2	10"X10"X8"	10 ft	28 lb	32 lb
3020-PVC	2"	230/1/60	230	MDL-1 1/2	10"X10"X8"	10 ft	24 lb	32 lb
3030-SST	3"	230/1/60	405	MDL-2 1/2	10"X10"X8"	10 ft	50 lb	32 lb
3030-PVC	3"	230/1/60	405	MDL-2 1/2	10"X10"X8"	10 ft	35 lb	32 lb
3040-PVC	4"	230/1/60	505	MDL-3	10"X10"X8"	10 ft	43 lb	32 lb
3060-PVC	6"	230/1/60	510	MDL-3	10"X10"X 8"	10 ft	110 lb	32 lb

Table 1B. Signal Generator Small Panel Specifications 1" - 6" 230V/50Hz

Model	Nom. Pipe Size	Voltage	VA	Fuse Size	Signal Generator NEMA 3R Enclosure (mm)	Umbilical Cable (m)	Net Weight	
							Treatment Module	Signal Generator
3010-SST	1"	230/1/50	150	MDL-1	10"X10"X8" (254X254X203)	10 ft (3 m)	13 lb (6 kg)	32 lb (15 kg)
3010-PVC	1"	230/1/50	150	MDL-1	10"X10"X8" (254X254X203)	10 ft (3 m)	11 lb (5 kg)	32 lb (15 kg)
3020-SST	2"	230/1/50	245	MDL-1 1/2	10"X10"X8" (254X254X203)	10 ft (3 m)	28 lb (13 kg)	32 lb (15 kg)
3020-PVC	2"	230/1/50	245	MDL-1 1/2	10"X10"X8" (254X254X203)	10 ft (3 m)	24 lb (11 kg)	32 lb (15 kg)
3030-SST	3"	230/1/50	420	MDL- 2 1/2	10"X10"X8" (254X254X203)	10 ft (3 m)	50 lb (23 kg)	32 lb (15 kg)
3030-PVC	3"	230/1/50	420	MDL-2 1/2	10"X10"X8" (254X254X203)	10 ft (3 m)	35 lb (16 kg)	32 lb (15 kg)
3040-PVC	4"	230/1/50	505	MDL-3	10"X10"X8" (254X254X203)	10 ft (3 m)	43 lb (20 k)	32 lb (15 kg)
3060-PVC	6"	230/1/50	535	MDL-3	10"X10"X8" (254X254X203)	10 ft (3 m)	110 lb (50 kg)	32 lb (15 kg)

- All Signal Generators are configured for AC power hardwiring in the field.
- Dimensions and specifications are for reference only and are subject to change without notice.
- **Special order** - Umbilical Cables up to a maximum of 26 feet in length can be provided at time of order.
- **Optional Umbilical Extension Cable** - Umbilical extension cables with male/female connectors are available for field installation. Total umbilical cable length including extension cable must not exceed 26 feet.

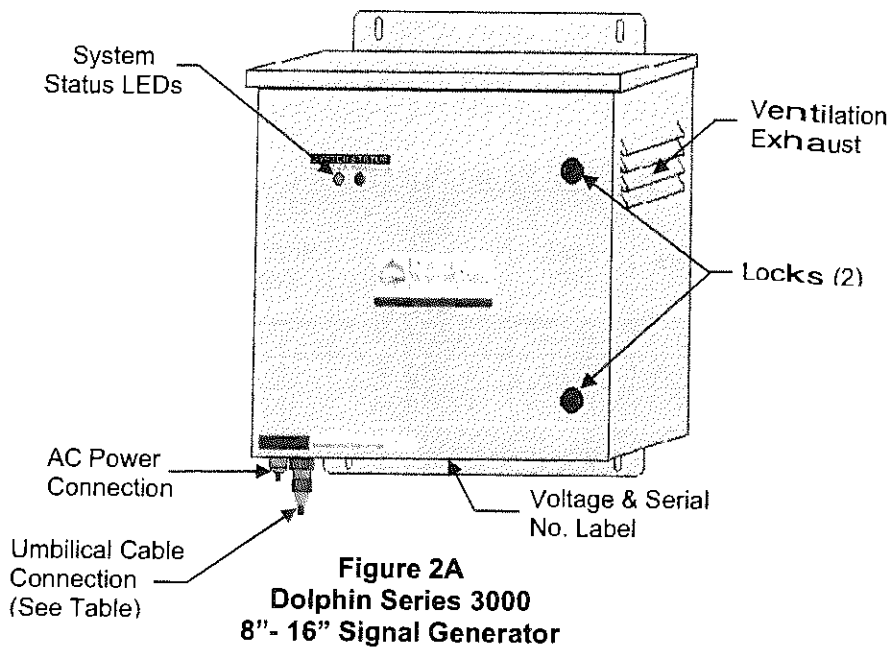


Table 1C. Signal Generator Large Panel Specifications 8"- 16" 230V/60Hz

Model	Nom. Pipe Size	Voltage	VA	Fuse Size		Signal Generator NEMA 3R Enclosure	Umbilical Cable	Net Weight	
				Primary	Secondary			Treatment Module	Signal Generator
3080-PVC	8"	230/1/60	1665	FLM15A	LPJ-25SP	16"X16"X10"	26 ft	140 lb	84 lb
3100-PVC	10"	230/1/60	1730	FLM15A	LPJ-25SP	16"X16"X10"	26 ft	175 lb	84 lb
3120-PVC	12"	230/1/60	1600	FLM15A	LPJ-25SP	16"X16"X10"	26 ft	206 lb	84 lb
3160-PVC	16"	230/1/60	1690	FLM15A	LPJ-25SP	16"X16"X10"	26 ft	250 lb	84 lb

Table 1D. Signal Generator Large Panel Specifications 8"- 16" 230V/50Hz

Model	Nom. Pipe Size	Voltage	VA	Fuse Size		Signal Generator NEMA 3R Enclosure (mm)	Umbilical Cable (m)	Net Weight	
				Primary	Secondary			Treatment Module	Signal Generator
3080-PVC	8"	230/1/50	2195	FLM15A	LPJ-25SP	16"X16"X10" (406x406x254)	26 ft (8 m)	140 lb (64 kg)	84 lb (38 kg)
3100-PVC	10"	230/1/50	2280	FLM15A	LPJ-25SP	16"X16"X10" (406x406x254)	26 ft (8 m)	175 lb (79 kg)	84 lb (38 kg)
3120-PVC	12"	230/1/50	2110	FLM15A	LPJ-25SP	16"X16"X10" (406X406X254)	26 ft (8 m)	206 lb (93 kg)	84 lb (38 kg)
3160-PVC	16"	230/1/50	2230	FLM15A	LPJ-25SP	16"X16"X10" (406X406X254)	26 ft (8 m)	250 lb (113 kg)	84 lb (38 kg)

- All Signal Generators are configured for AC power hardwiring in the field.
- Dimensions and specifications are for reference only and are subject to change without notice.
- **Special order** - Umbilical Cable lengths shorter than 26 feet can be provided at time of order.
- **Optional Umbilical Extension Cable - Not available on 8"- 16" Treatment Modules**

Table 1E. Signal Generator Specifications 8"- 16" 480V/60Hz

Model	Nom. Pipe Size	Voltage	VA	Fuse Size		Signal Generator NEMA 3R Enclosure	Umbilical Cable	Net Weight	
				Primary	Secondary			Treatment Module	Signal Generator
3080-PVC	8"	480/1/60	1740	LP-CC-5A	LPJ-25SP	16"X16"X10"	26 ft	140 lb	84 lb
3100-PVC	10"	480/1/60	1810	LP-CC-5A	LPJ-25SP	16"X16"X10"	26 ft	175 lb	84 lb
3120-PVC	12"	480/1/60	1680	LP-CC-5A	LPJ-25SP	16"X16"X10"	26 ft	206 lb	84 lb
3160-PVC	16"	480/1/60	1770	LP-CC-5A	LPJ-25SP	16"X16"X10"	26 ft	250 lb	84 lb

- All Signal Generators are configured for AC power hardwiring in the field.
- Dimensions and specifications are for reference only and are subject to change without notice.
- **Special order** - Umbilical Cable lengths shorter than 26 feet can be provided at time of order.
- **Optional Umbilical Extension Cable - Not available on 8"- 16" Treatment Modules**

5.2 The Treatment Module

Depicted in Figure 3 on page 17, the Treatment Module consists of an unobstructed PVC or stainless steel flow-through pipe, coil assembly, internal thermal protection switch with automatic reset, umbilical cable, and locking plug connector. Table 2 lists the specifications for the various Treatment Modules. The 1" and 2" stainless steel units are supplied with NPT-threaded ends and the 3" stainless steel unit is supplied with flanges. All PVC Treatment Modules are provided without standard end fittings unless otherwise specified. **Optional** end fittings available from Clearwater include, 150 (psi) Van Stone style flanges, Straub Couplings, and Fernco Couplings.

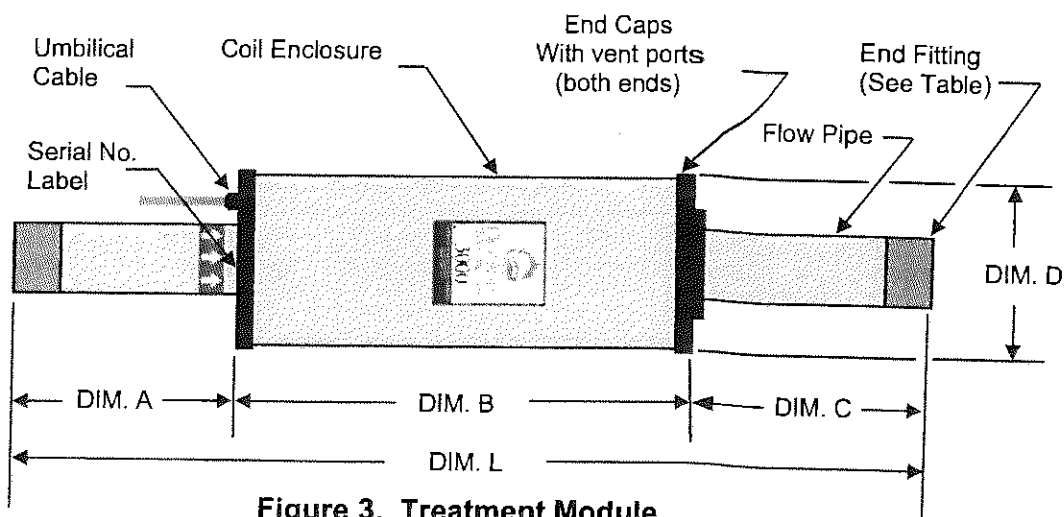


Figure 3. Treatment Module

Table 2. Treatment Module Specifications

Model	Nominal Pipe Size	Pipe Material	Dim. A (mm)	Dim. B (mm)	Dim. C (mm)	Dia. D (mm)	Dim. L (mm)	Umbilical Cable (m)	Pipe Fitting
3010-SST	1"	T316 SS, Sched. 40	2.5" (64)	14.5" (368)	2.8" (71)	4.9" (125)	19.75" (502)	10 ft (3 m)	1" NPT
3010-PVC	1"	PVC, Sched. 80	2.5" (64)	14.5" (368)	2.8" (71)	4.9" (125)	19.75" (502)	10 ft (3 m)	As Specified
3020-SST	2"	T316 SS, Sched. 40	9.0" (229)	19.2" (488)	11.3" (287)	6.0" (152)	39.5" (1003)	10 ft (3m)	2" NPT
3020-PVC	2"	PVC, Sched. 80	9.0" (229)	19.2" (488)	11.3" (287)	6.0" (152)	39.5" (1003)	10 ft (3 m)	As Specified
3030-SST	3"	T316 SS, Sched. 10	9.0" (229)	19.2" (488)	11.3" (287)	9.0" (229)	39.5" (1003)	10 ft (3 m)	Flanged
3030-PVC	3"	PVC, Sched. 80	9.0" (229)	19.2" (488)	11.3" (287)	9.0" (229)	39.5" (1003)	10 ft (3 m)	As Specified
3040-PVC	4"	PVC, Sched. 80	9.0" (229)	19.2" (488)	11.3" (287)	9.0" (229)	39.5" (1003)	10 ft (3 m)	As Specified
3060-PVC	6"	PVC, Sched. 80	17.0" (432)	23.2" (589)	19.3" (490)	13.1" (333)	59.5" (1511)	10 ft (3 m)	As Specified
3080-PVC	8"	PVC, Sched. 80	14.0" (356)	28.2" (716)	17.3" (439)	16.5" (419)	59.5" (1511)	26 ft (8 m)	As Specified
3100-PVC	10"	PVC, Sched. 80	14.0" (356)	28.2" (716)	17.3" (439)	16.5" (419)	59.5" (1511)	26 ft (8 m)	As Specified
3120-PVC	12"	PVC, Sched. 80	14.0" (356)	28.2" (716)	17.3" (439)	16.5" (419)	59.5" (1511)	26 ft (8 m)	As Specified
3160-PVC	16"	PVC, Sched. 80	15.25" (387)	29.3" (743)	15.0" (381)	24.8" (630)	59.5" (1511)	26 ft (8 m)	As Specified

- All PVC models furnished with plain pipe ends suitable for appropriate field installed plumbing connection.
- **Special order** - Umbilical Cables lengths up to a maximum of 26 feet can be provided at time of order.
- **Optional Umbilical Extension Cable** - Umbilical extension cables with male/female connectors are available for field installation. Extension Cables are not available for 8"- 16" Treatment Modules.
- NPT = National Pipe Taper (threaded)
- As Specified = PVC Van Stone Flanges, Straub Couplings and Flex-Seal Couplings.
- Dimensions and specifications are for reference only and are subject to change without notice.

5.3 Operating Temperatures and Pressures for the Dolphin System

For all units, the recommended ambient operating air temperatures are 0°F to 123°F (-17°C to 50°C) at 0 to 95% humidity.

Table 3. Maximum Fluid Operating Pressure For Treatment Module

PVC Pipe Max. pressure at 73° F (23° C)		
Pipe Dia.	US (psi)	Metric (bar)
1"	630 psi	43.4
2"	400 psi	27.6
3"	370 psi	25.5
4"	320 psi	22.1
6"	280 psi	19.3
8"	250 psi	17.2
10"	230 psi	15.9
12"	230 psi	15.9
16"	220 psi	15.2

Rated pressures based on nominal pipe diameter and material.
Consideration must also be given to rated capacity of flange (if applicable).

NOTE

The maximum fluid operating temperature for a Dolphin stainless steel Treatment Module is 250°F (121°C)

Table 4. Temperature De-Rating Factor for PVC Pipe

Temperature Degrees F	Temperature Degree C	Pressure De-rating Factor for PVC
73	22.8	1.00
80	26.7	0.88
90	32.2	0.75
100	37.8	0.62
110	43.3	0.51
120	48.9	0.40
130	54.4	0.31
140	60.0	0.22

6.0 INSTALLATION INSTRUCTIONS

6.1 Proper Lifting of the Treatment Module

Prior to installation, please note the following handling and lifting precautions regarding the Treatment Module.

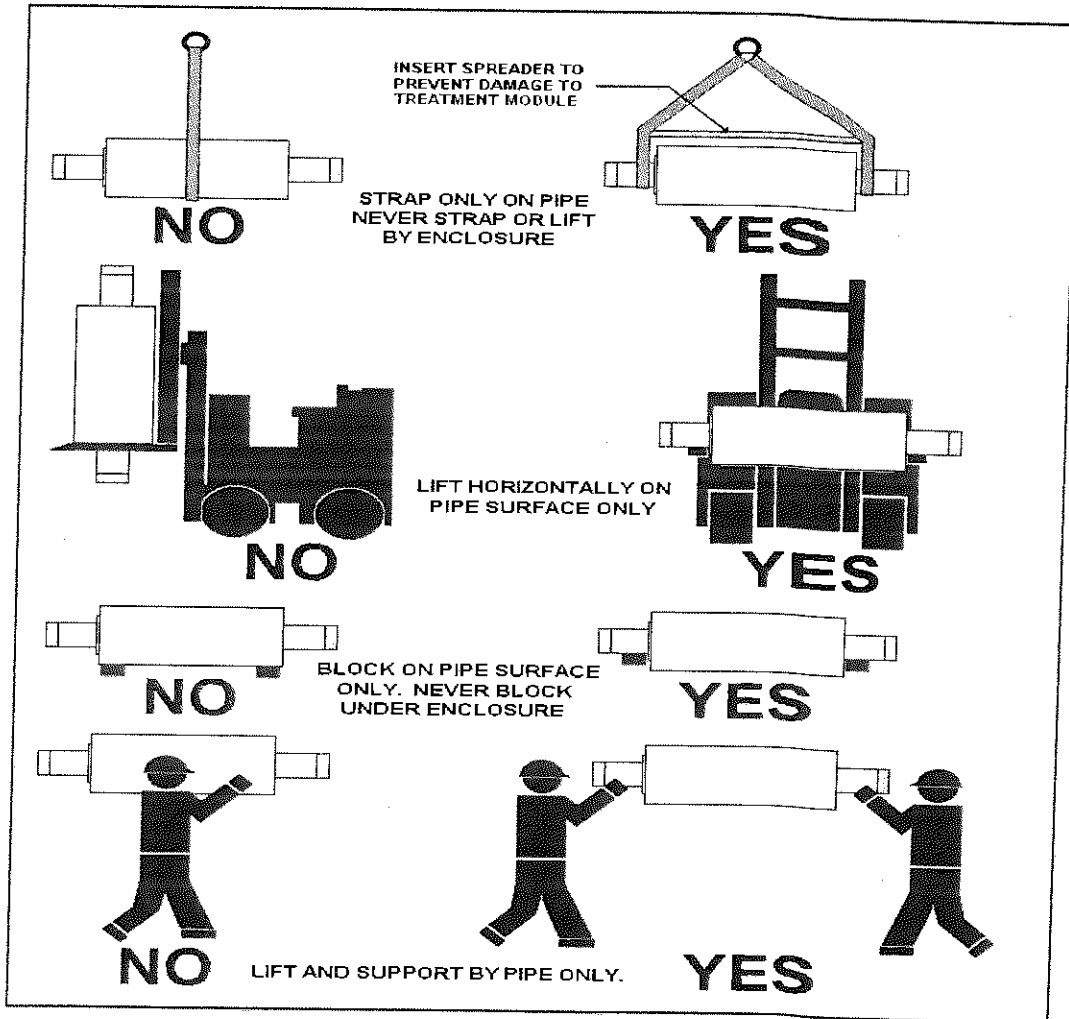


Figure 4. Proper Lifting of Treatment Module

WARNING

TO AVOID POSSIBLE DAMAGE TO THE TREATMENT MODULE, NEVER ATTEMPT TO LIFT OR SECURE THE TREATMENT MODULE BY THE COIL ENCLOSURE. ALL LIFTING, SUPPORTING, AND FASTENING HANGERS MUST BE SECURED TO THE FLOW PIPE ONLY.

WARNING

TO AVOID POSSIBLE DAMAGE TO THE TREATMENT MODULE, NEVER ATTEMPT TO TIGHTEN THE TREATMENT MODULE TO THE THREADED FITTING BY GRIPPING AND ROTATING THE COIL COVER. ALL ROTATIONAL FORCE USED TO TIGHTEN INSTALLATION FITTINGS MUST BE APPLIED DIRECTLY TO ONLY THE FLOW-THROUGH PIPE OR FITTINGS.

WARNING

THE DOLPHIN SYSTEM MUST BE DE-ENERGIZED PRIOR TO PERFORMING ANY MAINTENANCE, CLEANING, OR DRAINING OF THE SYSTEM THAT WOULD RESULT IN WATER LEVELS BEING REDUCED TO THE POINT WHERE A DRY PIPE CONDITION WOULD OCCUR IN THE DOLPHIN SYSTEM TREATMENT MODULE.

6.2 Installation Location of the Treatment Module on an Evaporative Condenser Tower

A typical evaporative condenser cooling tower requires one Dolphin System. Figure 5 shows the preferred location for the Dolphin Treatment Module: in the tower riser (shown with an option vertical rain hood installed).

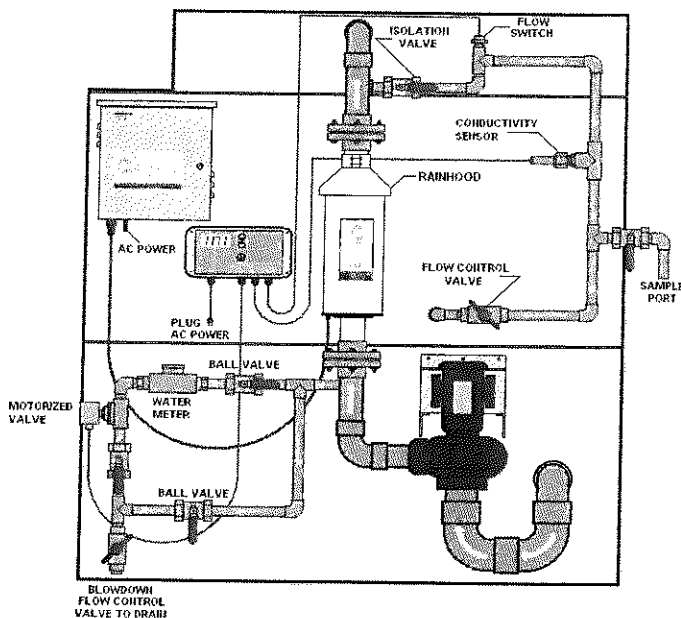


Figure 5. Typical Evaporative Condenser Tower

6.3 Installation Location of the Treatment Module on a Cooling Tower

Typically, a modern stand-alone cooling tower requires one Dolphin System. Figure 6 shows two alternate preferred locations for the Dolphin System in such a cooling tower (shown with full centrifugal separation).

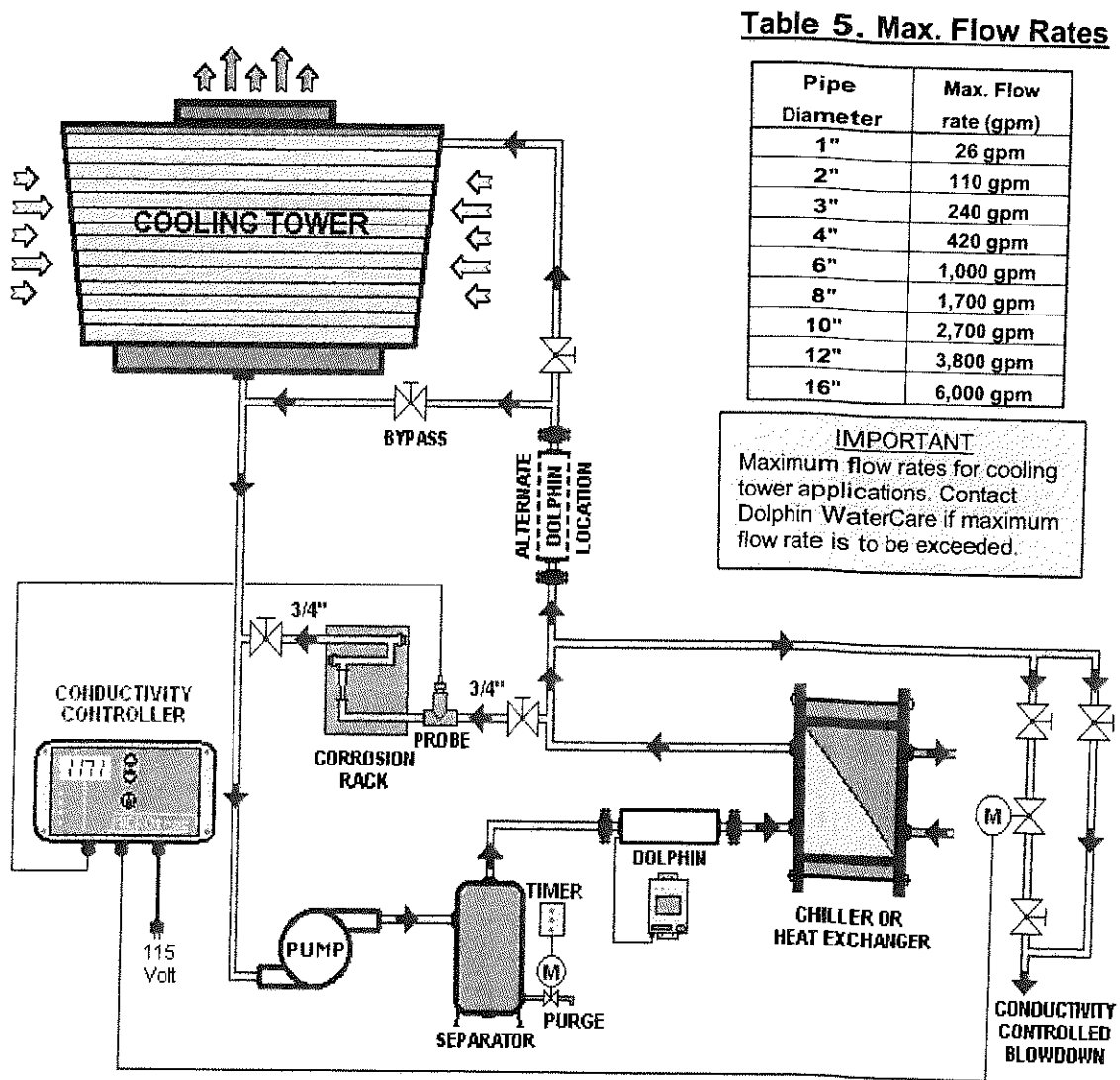


Figure 6. Typical Evaporative Cooling Tower Installation

For large, complex, and integrated cooling systems, Clearwater Systems will evaluate customer drawings or sketches and determine the optimal number, size, and location of Dolphin Systems.

6.4 Installation Guidelines

1. The location always to be avoided for the Dolphin System placement is the suction side of the recirculation pumps (return from the tower).
2. The Treatment Module must be located at least three (3) feet away from motors, pumps, and high voltage energy sources.
3. The Treatment Module should be installed so that the water flow is in the direction indicated by the white arrows on the green label.
4. Outdoor installation of the Treatment Module must have rain protection from an optional vertical or horizontal rain hood as described in Section 10.
5. The Dolphin System should be wired so that the Treatment Module is de-energized when it contains no water. This can be accomplished in three ways:
 - Locate the Treatment Module so that it will always have water in it, even when the system is shut down (below drain down water level).
 - Wire Dolphin System power into the recirculating pump circuit.
 - Use the remote connection option RM1/RM2 on the Dolphin transformer terminal strip (see page 28).

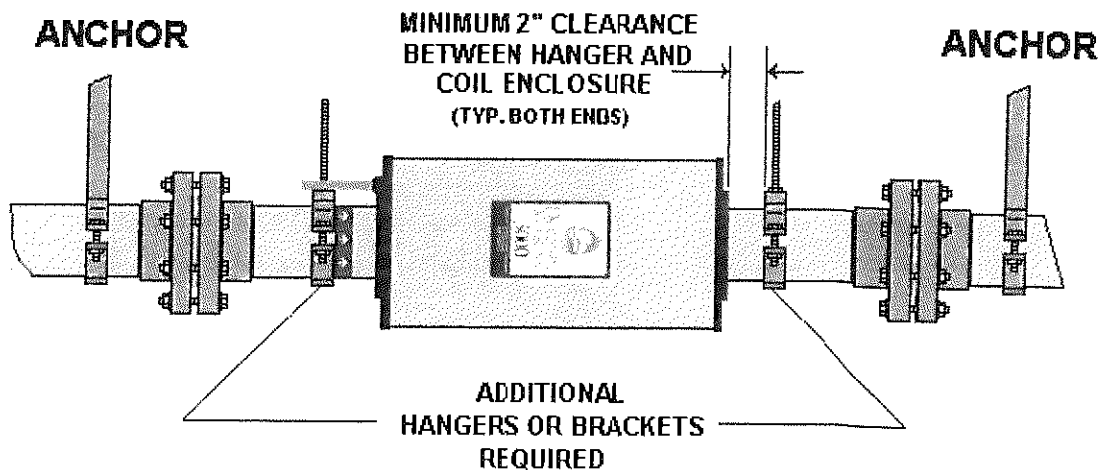


Figure 7. Support of Dolphin Treatment Module for Pipe Sizes 6" or Larger

IMPORTANT INSTALLATION NOTE

When installing a PVC Dolphin Treatment Module in either steel or PVC pipe, adequate bracing must be provided in the form of hangers or brackets to support the additional weight of the Dolphin Treatment Module and related pipe and fixtures. Clearwater Systems Corporation strongly recommends that additional hangers or brackets be installed in accordance with local building or plumbing codes, with the addition of two additional hangers or brackets directly supporting the Treatment Module.

CAUTION

WHEN INSTALLING A PVC DOLPHIN TREATMENT MODULE ON STEEL PIPING, THE STEEL PIPING MUST BE FIRMLY ANCHORED AND BRACED TO PREVENT THE PVC COIL-PIPE ASSEMBLY FROM BEARING ANY WEIGHT OF THE STEEL PIPING AND TO PREVENT ANY TORSION MOVEMENT, WATER HAMMER, OR OTHER STRESSES BEING APPLIED TO THE PVC TREATMENT MODULE.

6.5 Installation of the Signal Generator

The Signal Generator can be mounted easily on any flat surface using the external flanges mounted on the backside (See Figure 1). All Dolphin units are configured for **single phase AC power** hardwiring in the field.

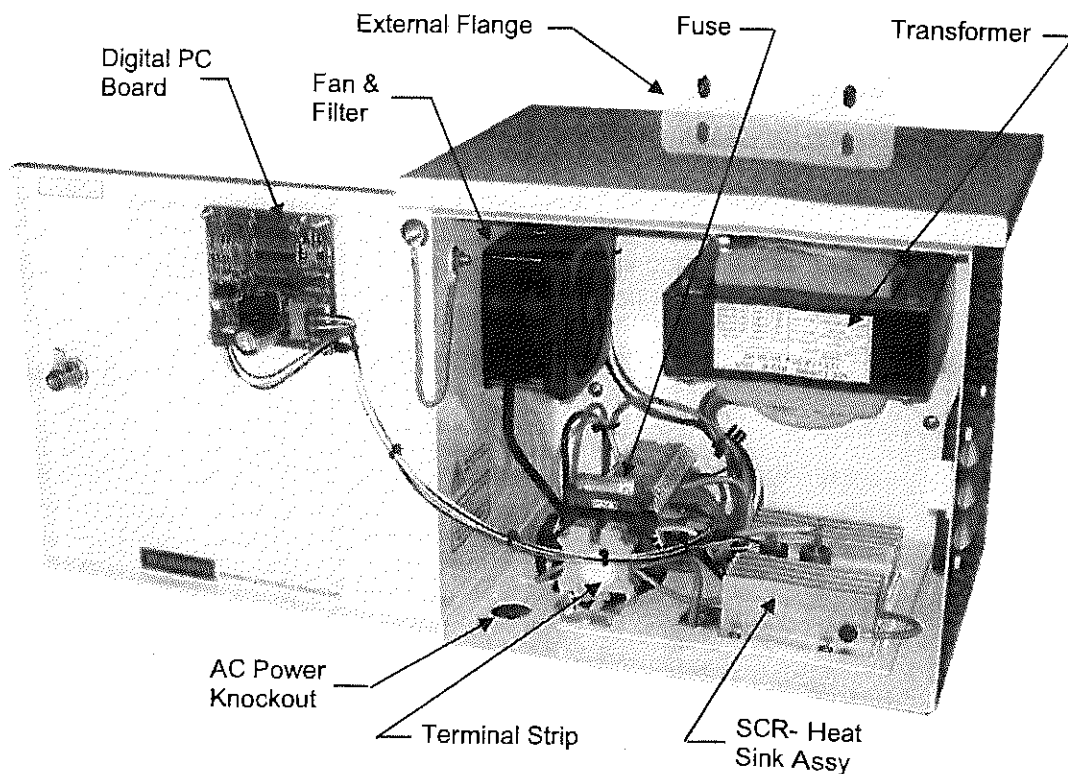


Figure 8. 1"- 6" Signal Generator Small Panel 1"- 6" Call-Out

Installation Advice. The Signal Generator Panel should be mounted at eye level in an accessible area that allows for easy observation of power and signal status LEDs during normal daily operations. Ensure that all unit ventilation ports are clear of obstructions. Check that the Signal Generator mounting location is within the maximum Umbilical Cable length supplied with the unit. Never under any circumstance exceed the maximum Umbilical Cable length specified for each size Dolphin WaterCare System. Make sure that serial number on bottom of Signal Generator enclosure matches the serial on End Cap of Treatment Module.

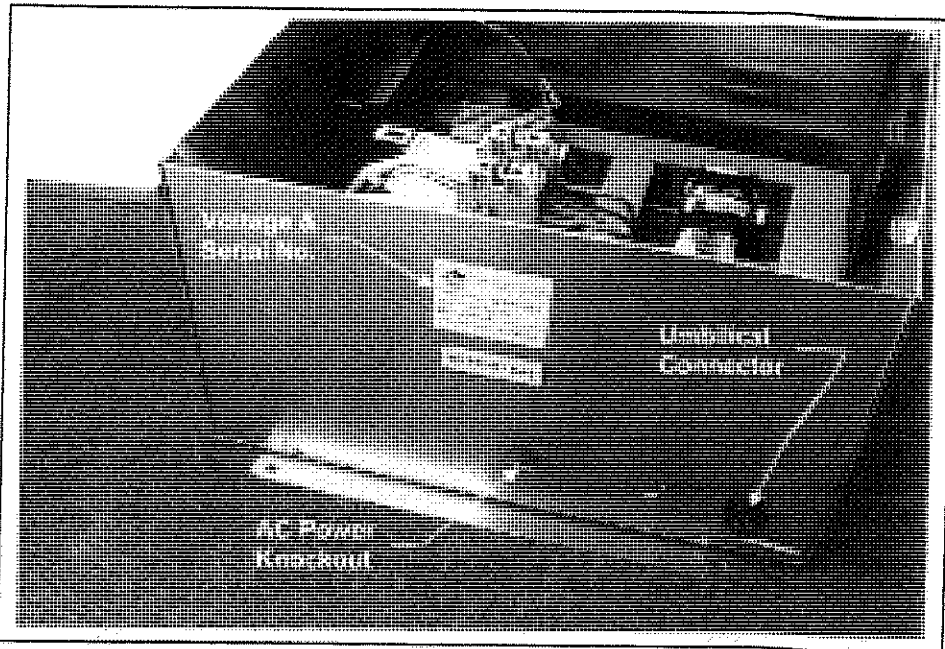


Figure 8A. Signal Generator (Bottom View) AC Power and Serial Number Label

IMPORTANT INSTALLATION NOTE

Prior to installing Dolphin System always confirm that the voltage requirement of the Signal Generator matches that of the facility by checking the Voltage/Serial No. Label located on the bottom of the Signal Generator. The serial number on this label must also match the serial number on the End Cap of the Treatment Module.

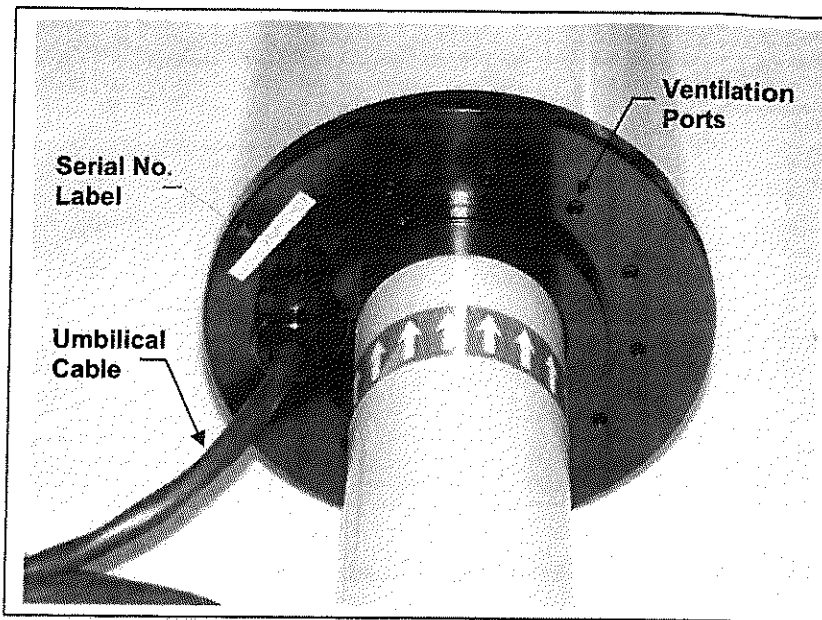


Figure 8B. Treatment Module Serial Number Label

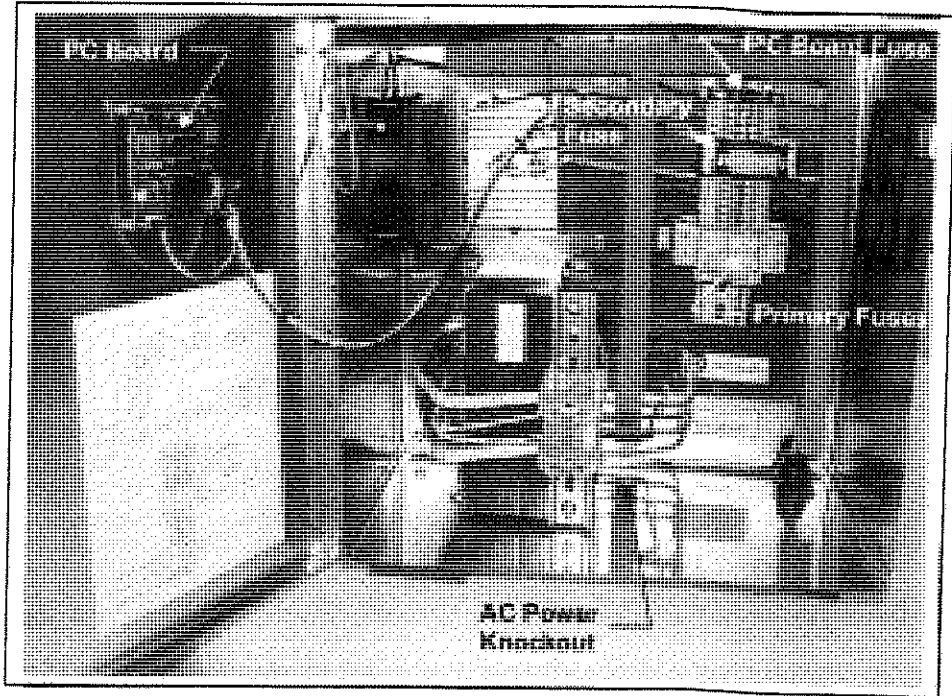


Figure 8C. 8"- 16" Signal Generator (Front View) 230V Large Panel Call-Out

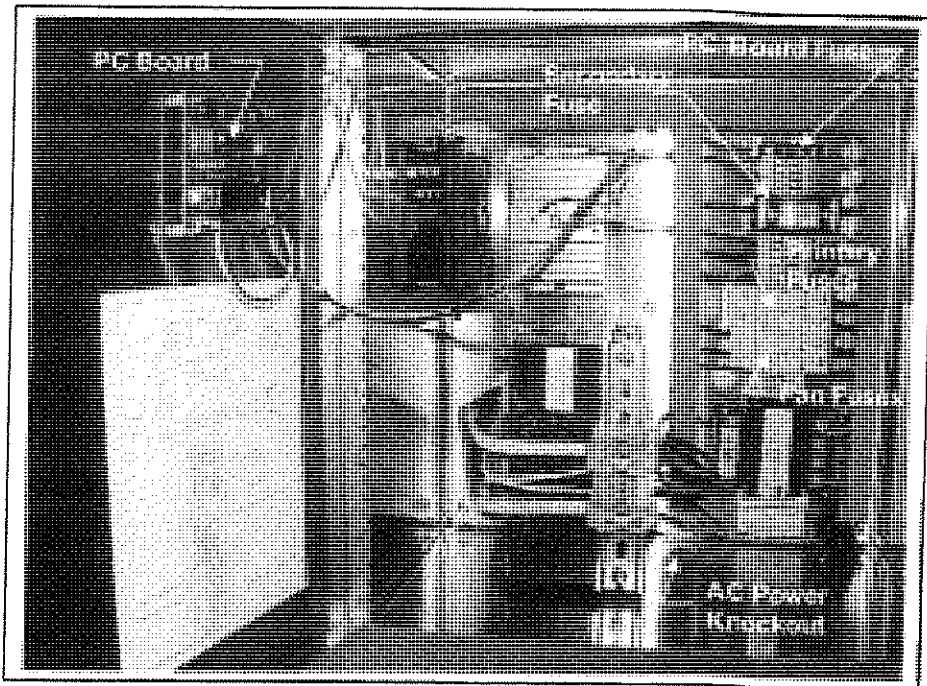


Figure 8D. 8"- 16" Signal Generator (Front View) 480V Large Panel Call-Out

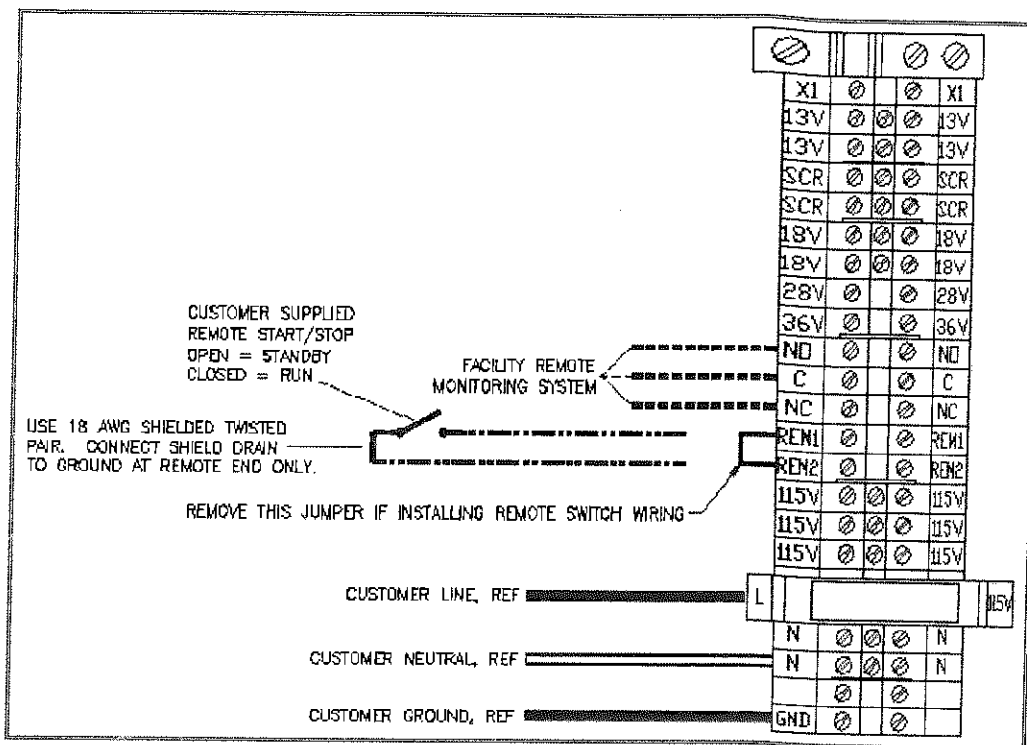


Figure 9. AC Power Wiring Diagram 1'' to 6'' - 115 Volt

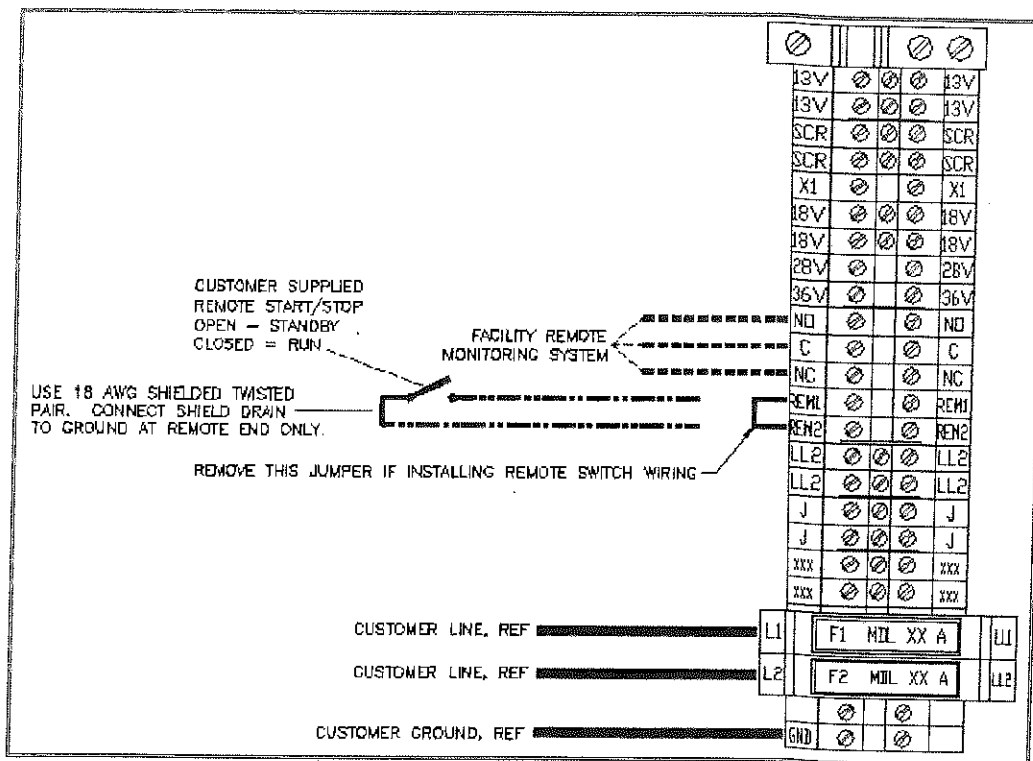


Figure 9A. AC Power Wiring Diagram 1'' to 6'' - 230 Volt

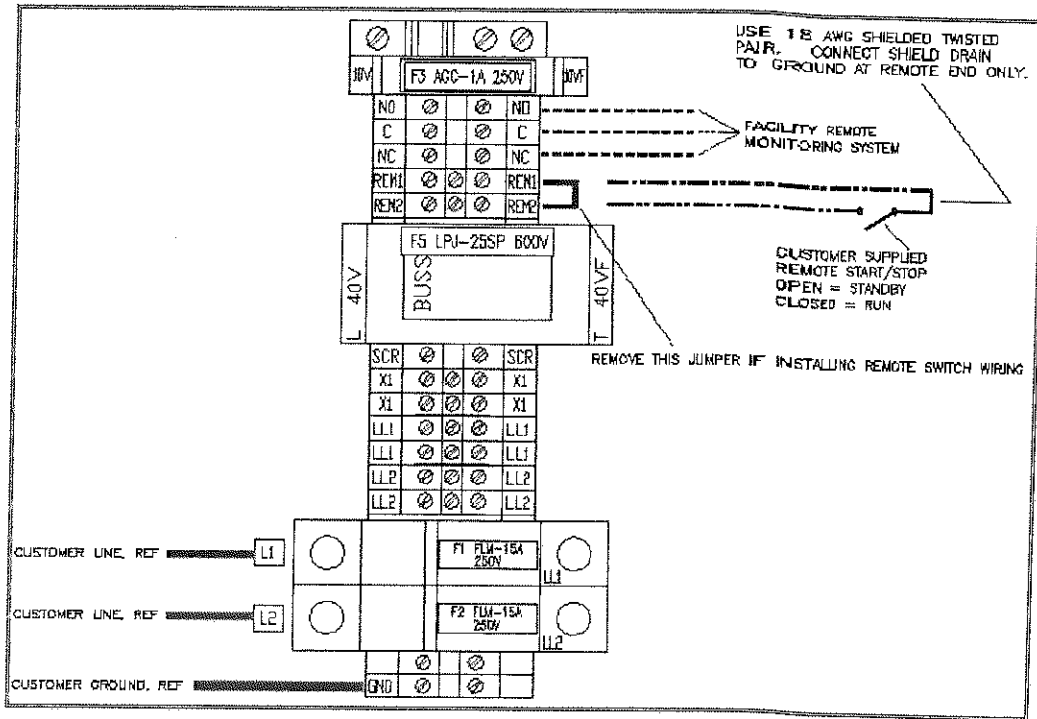


Figure 9B. AC Power Wiring Diagram 8'' to 16'' – 230 Volt

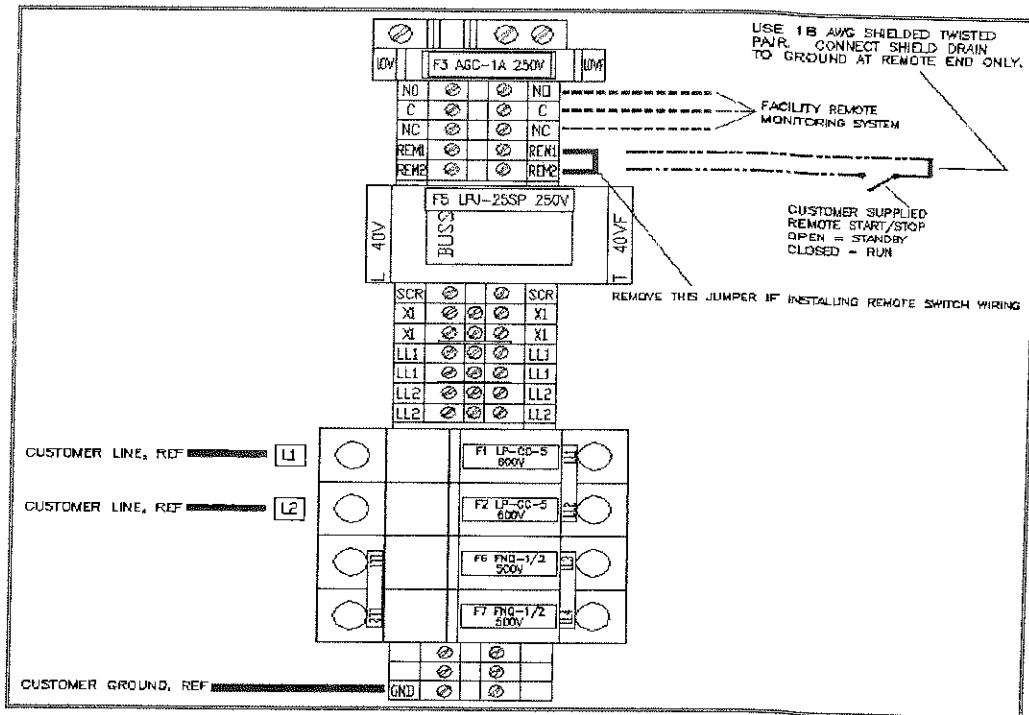


Figure 9C. AC Power Wiring Diagram 8'' to 16'' – 480 Volt

6.6 System Status Relay

The Dolphin 3000 Series has a system status relay contact for connection to a facilities Building Management System (BMS). The connection contacts are located on the Dolphin System's terminal strip located in the Signal Generator Panel as shown in the illustration below.

The system status relay is a dry form C contact (NC/COM/NO). The contacts are rated for up to 0.6 Amps at 125 VAC or 2 Amps at 30 VDC.

The contacts are labeled as to their status when the board is not powered. Thus the NO (Normally Open) contact is closed when the board is operating properly and will open whenever the signal is interrupted.

NO	Normally Open
C	Common
NC	Normally Closed

NOTE: When used in conjunction with Remote Start/Stop, System Status can not be used as an alarm connection.

6.7 Remote Start/Stop

The Dolphin 3000 Series incorporates a remote start/stop feature that can be interlocked with the condenser water pump or Building Management System. The Dolphin Treatment Module would only be energized when the condenser water pump is operational.

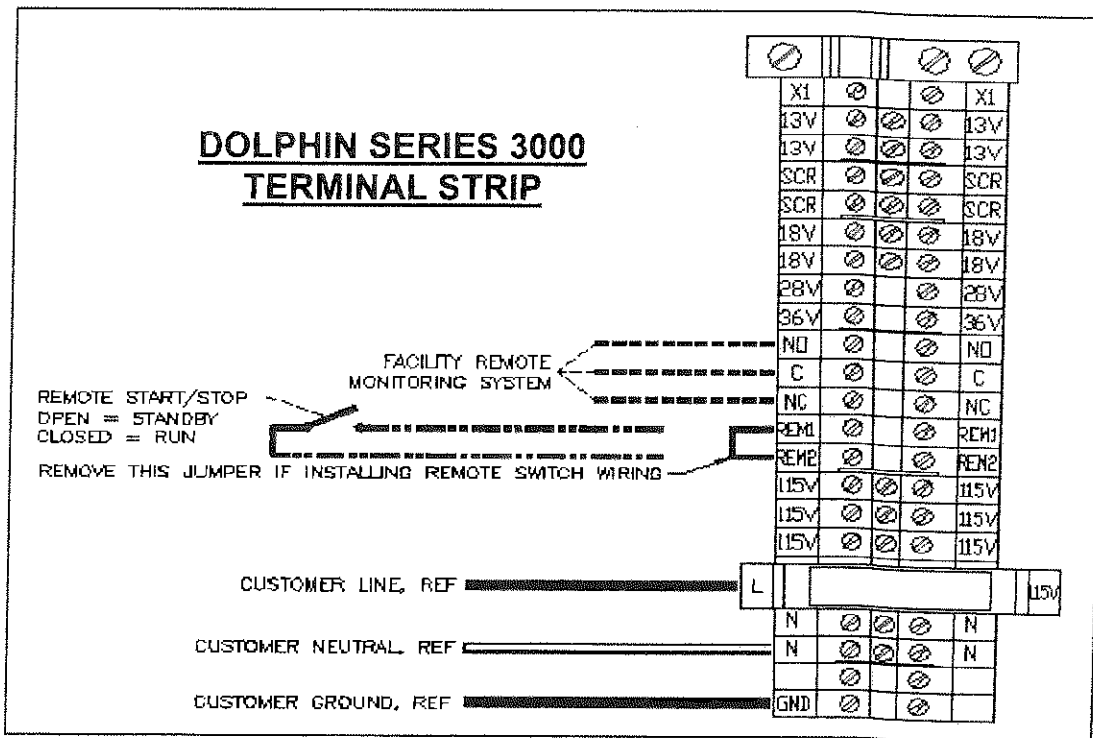


Figure 10. Dolphin Building Management Connections

7.0 TESTING AND TROUBLESHOOTING

Before calling for service, please review the following troubleshooting chart for potential operating problems and related solutions. If a problem persists or is intermittent, please call your local Clearwater representative or Clearwater Systems directly.

Table 6. Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE	SOLUTION
The Dolphin System will not turn on.	Faulty AC wiring connection to Dolphin Signal Generator or circuit breaker. Wrong voltage. A tripped circuit breaker. Fuse located in the Signal Generator is loose, missing, or blown.	Inspect AC wiring circuit. Confirm that the AC power voltage matches the voltage requirements of the Dolphin System. Check AC power supply circuit breaker; reset if necessary. Check the fuses on the Signal Generator; replace if necessary.
Both System Status LEDs fail to light.	See causes above.	See solutions above.
Red Fault LED is lit.	Umbilical Cable is not firmly plugged into Signal Generator. Overheating of Signal Generator SCR thermal switch (fan not operating) Fan not operating. Umbilical Cable connector has wrong pin configuration. Treatment Module Thermal Switch has opened Maximum operating temperature of the water flowing through the Treatment Module has been exceeded. The Thermal Safety Switch has opened. Printed Circuit Board Fault.	Reinsert the Umbilical Cable plug into the connector located on the bottom of the Signal Generator. Make certain that the plug locks in position. Clean fan inlets and ventilation filters. Check for operating fan on larger units Call for service. Check the serial numbers on the Signal Generator and the Treatment Module to make sure they match. Clean Ventilation Ports in Treatment Module End Caps. Reduce the operating temperature of water flowing through the Treatment Module. The Thermal Safety Switch will automatically reset. Call for service.
Blinking Green LED.	You are in standby mode when connected to a remote start-stop. Missing jumper between REM 1 and REM 2.	Test remote start-stop. Install jumper.
Blown Fuse.	Defective or weak fuse. Power surge. Dolphin System has exceeded its electrical design parameters. Lightning strikes on related equipment. Line voltage is incorrect. Water has entered the electronics. Shorted wire or cable. Short circuit in transformer or coils.	Replace the fuse with the same type and rating and attempt restart of the Dolphin System. Check line for proper voltage, ground, load, and neutral. Contact your local Clearwater representative or Clearwater Systems directly.
All other flashing LED sequences	Dolphin System malfunction or fault.	Call Clearwater Systems directly.

8.0 ROUTINE MAINTENANCE

WARNING **ELECTRICAL SHOCK HAZARD**

POWER TO THE DOLPHIN SYSTEM MUST BE DISCONNECTED OR TURNED OFF PRIOR TO OPENING THE SIGNAL GENERATOR DOOR, PERFORMING ANY MAINTENANCE, OR CLEANING THE CABLES AND CONNECTORS OF THE TREATMENT MODULE.

The Dolphin System requires no routine maintenance other than occasional inspections of the Umbilical Cable and cleaning of the filters located in the Signal Generator fan inlet and ventilation exhaust vents and the small ventilation ports on the Treatment Module end caps.

NOTE: Check the cooling vents and fan (if fan-equipped) periodically to help ensure proper airflow. Remove all foreign matter that might inhibit proper airflow through the Dolphin System. Clean the Signal Generator filters and the Treatment Module ventilation openings.

WARNING

THE DOLPHIN SYSTEM MUST BE TURNED OFF OR UNPLUGGED PRIOR TO PERFORMING ANY MAINTENANCE, CLEANING, OR DRAINING OF THE SYSTEM THAT WOULD RESULT IN WATER LEVELS BEING REDUCED TO THE POINT WHERE A DRY PIPE CONDITION WOULD OCCUR IN THE TREATMENT MODULE.

8.1 Inspection

• **Inspection Procedures.** Inspection procedures for the Dolphin System pertain mainly to inspecting cables and connectors, the Treatment Module, and the Signal Generator.

1. Inspect the AC Power supply for visible damage that might affect Dolphin System safety and operation. This visible inspection should ensure that no wires have been cut or are exposed.
2. Inspect the Umbilical Cable for visible damage that might affect the safety and operation of the Dolphin System. This visible inspection should ensure that no wires have been cut or are exposed.
3. Inspect the Umbilical Cable connectors at both the Signal Generator and Treatment Module Umbilical Cable for corroded or damaged pins.
4. Inspect the Treatment Module ventilation ports to verify that they are clear.
5. Inspect the Signal Generator to ensure that it is firmly secured.
6. Inspect the Signal Generator fan filters and ventilation exhaust/filter to verify that they are clear.

8.2 Cleaning

The Dolphin System should be virtually maintenance free. In a dusty environment, the ventilation filters of the Signal Generator and the ventilation ports on the Treatment Module may need to be periodically cleaned. If for any reason the outward surface of the Signal Generator requires cleaning, clean the outside surface with a damp clean cloth. Wipe clean with a soft cloth. Let it air dry.

9.0 PREPARATION FOR SHIPMENT

• **Reshipping Procedures.** In the unlikely event that you need to return the Dolphin System for repairs, the following reshipping procedures apply as guidelines for best commercial practices.

1. Wrap the Signal Generator and Treatment Module in barrier material, or equivalent, and secure with premium quality duct tape or equivalent.
2. Pad projections, sharp edges, or other features of the units that may damage the package, with cellulose cushioning material or equivalent.
3. Use a sturdy cardboard, wooden, or composite box capable of handling the weight of the Dolphin System.
4. Secure all seams with high quality packaging tape.
5. Address package to:

**Clearwater Systems Corporation
900 Industrial Park Road, Suite #1
Deep River, CT 06417
Attn: RMA Coordinator**

6. **IMPORTANT** - Be sure to include your return mailing address and Material Return Authorization (RMA) number on the shipping label.

10.0 OUTSIDE INSTALLATION

Optional equipment for outside installation of the Dolphin System may include the following items.

1. Factory installed vertical rain hoods for the Dolphin System Treatment Module (as shown below in the cut-out graphic on the left, with an overview below on the right).
2. Horizontal rain hoods for the Dolphin System Treatment Module are custom built to meet specific project requirements and are field installed. A typical horizontal rain hood is depicted in Figure 12 on page 34.
3. Dolphin Series 3000 Signal Generators are supplied in NEMA 3R and IEC IP24 rated enclosures. Therefore, no rain hoods are necessary for Signal Generator enclosure when being installed outdoors.

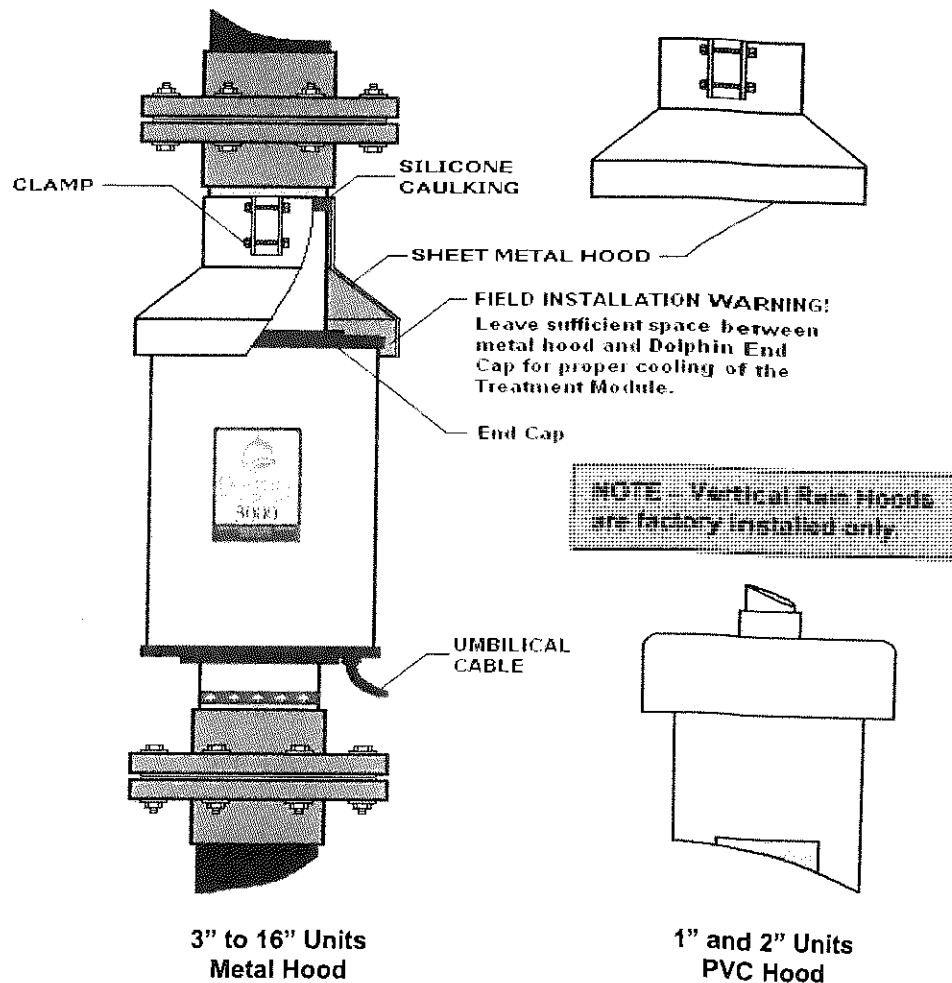


Figure 11. Outside – Vertical Installation with Rain Hoods

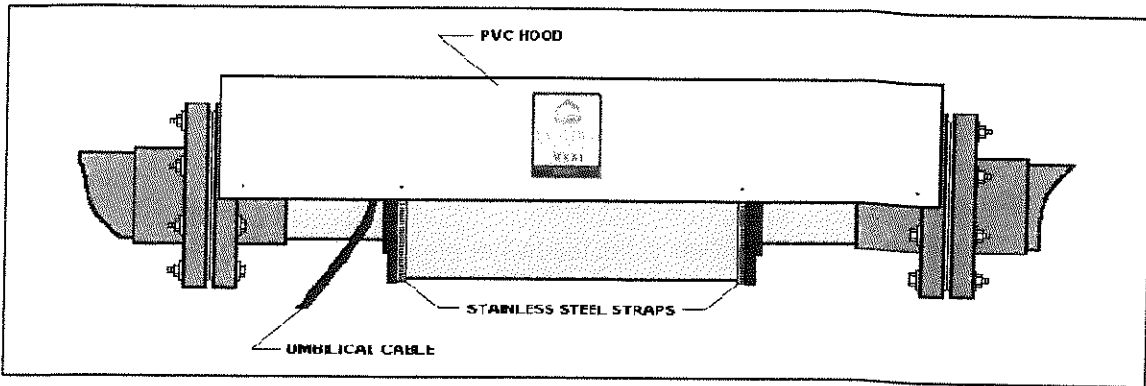


Figure 12. Outside – Horizontal Installation with Rain Hood

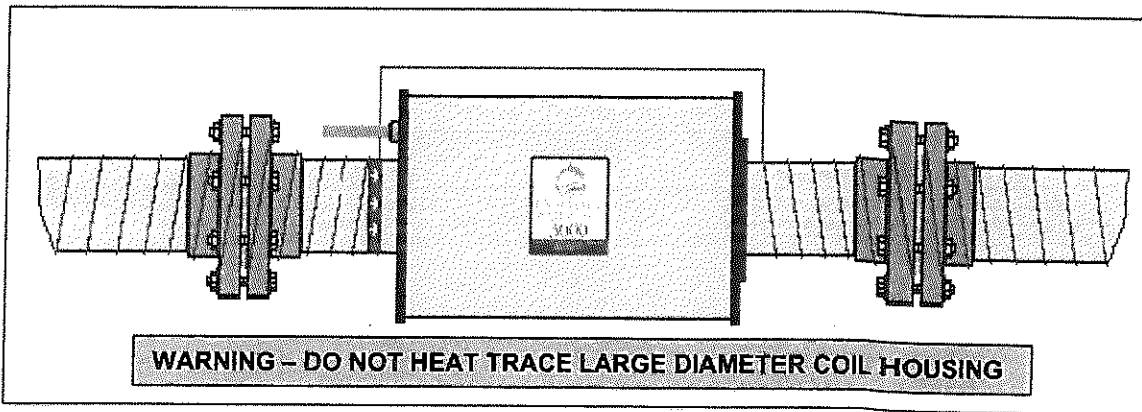


Figure 13. Heat Tracing of Treatment Module

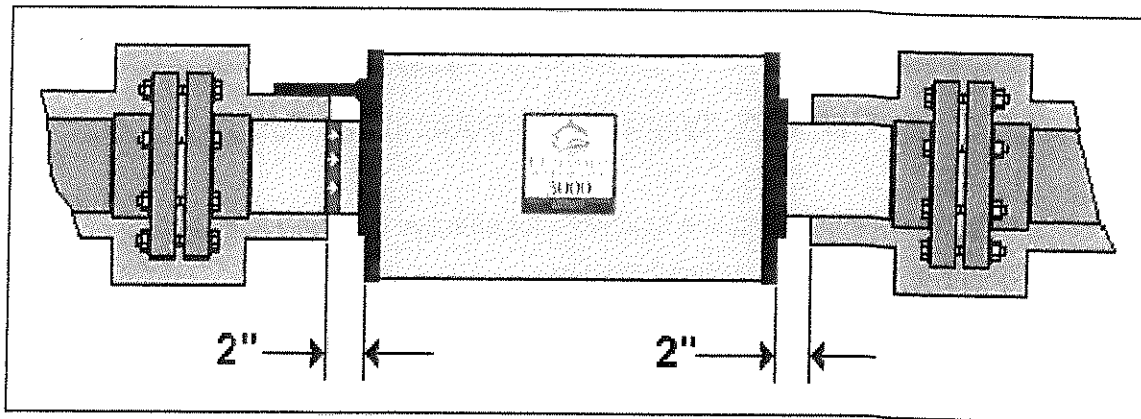


Figure 14. Insulation of Treatment Module

Pipe insulation must be kept at least two (2) inches from vents located in both Treatment Module end caps to allow for proper dissipation of heat generated within the Treatment Module.

11.0 Steam Boiler Application of the Dolphin System

11.1 Dolphin System Steam Boiler Installation and Operation

Two stainless steel Dolphins are typically installed on a boiler as follows and shown in Figure 15:

- Between the discharge side of the feedwater pump and the boiler,
- On the make-up water.

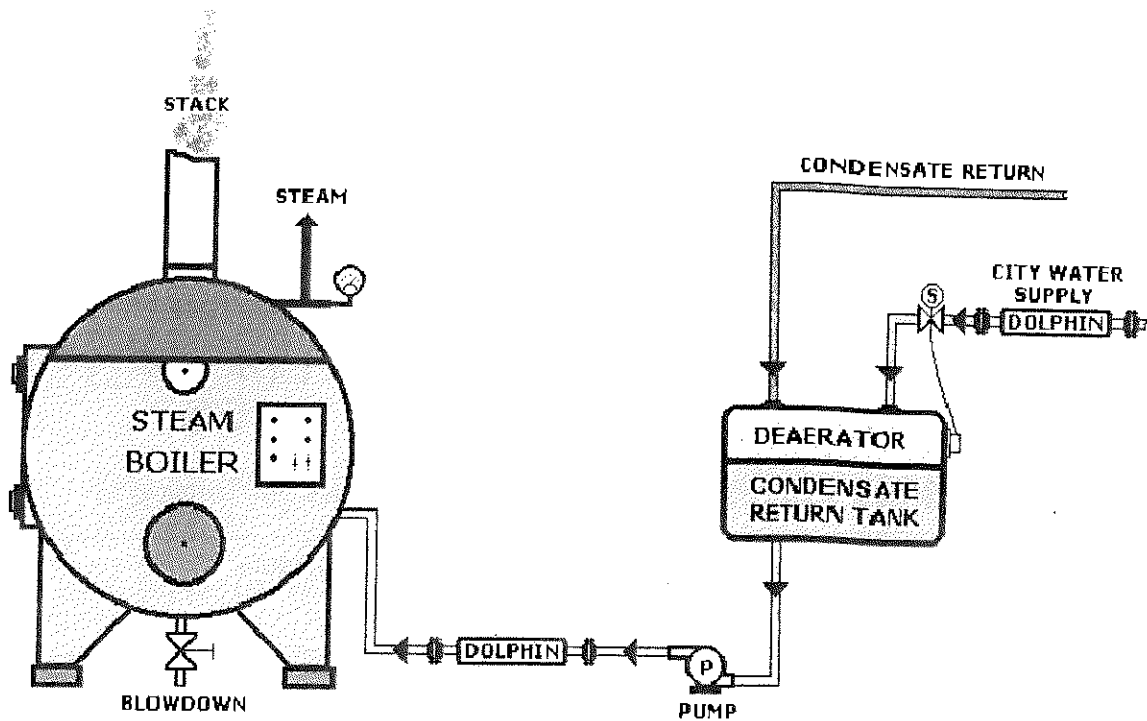


Figure 15. Typical Steam Boiler Installation

Boilers should have the following characteristics for effective Dolphin treatment:

- A conductivity actuated surface blowdown,
- A manual bottom blowdown,
- A de-aerator or hot well maintaining at least 190-220° F.
- A minimum of 80% condensate return.

11.2 Dolphin Steam Boiler Installation Guidelines

1. On boilers with economizers the Dolphin System will be installed prior to economizer to avoid excessive temperature conditions (less than 250° F/121° C).

2. The location of the boiler-feed Dolphin System to be avoided is the suction side of the boiler feedwater pumps.
3. The Dolphin Treatment Module must be located at least three feet away from motors, pumps, and high voltage energy sources.
4. The Dolphin Treatment Module should be installed such the water flow is in the direction of the white arrows on the green direction of flow label.

APPENDIX A: MAINTENANCE SCHEDULES

Table A-1. Dolphin-Equipped Cooling Tower Maintenance Schedule

Action	Person Responsible	Date Performed	Recommended Frequency
Dolphin Equipment			
Check LED indicators to ensure that the system is on and operating properly.			Daily
Check Treatment Module ventilation ports and clean, if required.			Monthly
Check Signal Generator fan, fan inlet filters, ventilation exhaust/filter. Remove all dirt and debris and clean as required.			Monthly
Visually inspect all wetted tower components for mineral deposit, algae, corrosion, discoloration of water, or odors associated with biological contamination.			Weekly
Blowdown System			
Check water in system for proper pH and conductivity specified by Clearwater Systems Corp.			Weekly
Perform blowdowns of system to maintain proper pH and conductivity.			As Required if Performed Manually
Check automatic blowdown system to make sure it is operative.			Monthly
Clean all sensors and probes associated with the automatic blowdown system.			Monthly
Check bleed-valve to make sure it is operative.			Monthly
Calibrate automatic blowdown system: pH probe or conductivity probe.			Monthly
Good General Practices			
Flush basin and dispersion pan of debris.			Quarterly
Clean entire system.			Annually
Inspect and clean protective finish of the tower. Paint if necessary with appropriate rust-inhibiting paint per manufacturer's instructions.			Annually
After extended shutdown periods, clean all debris from the system, including: tower, pan, system piping, heat exchanger, and remote sump holding tanks. Drain systems and refill with fresh clean water.			Extended Shut Downs

Table A-2. Dolphin-Equipped Boiler Maintenance Schedule

Action	Person Responsible	Date Performed	Recommended Frequency
Dolphin Equipment			
Check LED indicators to ensure that the system is on and operating properly.			Daily
Check the Treatment Module ventilation ports and clean, as required.			Monthly
Check Signal Generator fan, fan filters, ventilation exhaust/filter. Remove all dirt and debris and clean as required.			Monthly
Blowdown System			
Check water in the system for proper pH and conductivity or TDS (total dissolved solids).			Weekly
Perform blowdowns of the system to maintain proper pH and conductivity.			As Required if Manual
If so equipped, check automatic blowdown system to make sure it is operative.			Weekly
If so equipped, clean all sensors and probes associated with the automatic blowdown system.			Monthly
Calibrate automatic blowdown system: pH probe or conductivity probe.			Monthly

If you have any questions, please contact

DOLPHIN WATERCARE

A division of Clearwater Systems Corporation

145 Dennison Road

P.O. Box 463

Essex, CT 06426

Phone: 860-767-0850 • Fax 860-767-8972

Email: service@dolphinwatercare.com

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**APPENDIX B:
DOLPHIN WATERCARE CHEMISTRY LOGS**

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Appendix C: Glossary of Terms

Table C-1
GLOSSARY OF TERMS

ASTM: American Society for Testing Materials. Standard procedures for sampling and evaluation purposes.

blowdown: the removal of concentrated water for the purpose of controlling the total dissolved solids concentration in the recirculating water.

Calcite: a naturally occurring form of calcium carbonate (CaCO_3), which produces a very hard scale when introduced to heat-transfer surfaces. In crystalline form, calcite can also include limestone, chalk, and marble.

CFU/ml: colony-forming units per milliliter; used to measure total bacterial count (TBC).

Calcium carbonate: a compound (CaCO_3) found in nature as calcite and aragonite; commonly found in water, plant ashes, bones, and shells. Calcium carbonate is used in making lime and Portland cement.

condensate return tank: a collection tank for process steam that has been condensed to water and is to be returned to the system.

conductivity: the transfer of thermal or electrical energy along a potential gradient. This principle is used to determine the quantity of dissolved solids in a water sample. Measured in units of micro-Siemens per centimeter ($\mu\text{S}/\text{cm}$) or the equivalent micro-mho per centimeter ($\mu\text{mho}/\text{cm}$).

cooling tower: a structure used to cool water by exposing it to ambient air. Typically, water enters the top of the tower and flows over a series of cascading plates or screens while air is drawn through the structure with fans.

cycles of concentration (COC): parameter used to measure the efficiency of blowdown. COC is defined as the ratio of the volume of make-up water to the volume of water removed by blowdown and drift. Since all soluble minerals in the make-up water will be in the blowdown water, an accurate way to measure COC is by the ratio of such a mineral in the blowdown to the same mineral in the make-up. Conductivity ratios are often used as a quick-and-easy method to measure blowdown efficiency. This method is NOT appropriate with the Dolphin System, since a bulk-solution precipitate forms, relieving the mineral concentration (and lowering conductivity) from the tower water. Determining the ratio of soluble ions such as chloride and sulfate is a better method for determining COC.

de-ionized water: water that is free of positively or negatively charge atoms.

de-aeration tank: A heated and vented tank for boiler feedwater that removes dissolved gasses (particularly CO_2 and oxygen) before they enter the boiler.

drift: cooling tower water that is carried out with the airflow. This water contains all of the chemicals and minerals in the tower water and is the major vector for Legionella transmission.

feedwater: the water that enters a boiler during operation. It includes make-up water and condensate from the condensate return tank.

hard water: water that contains scale-forming impurities. The magnitude of water hardness is dependent on the concentration of dissolved calcium and/or magnesium compounds.

HPC: Heterotrophic Plate Count. An EPA-approved method (SMEWW 9215B) for measuring Total Bacteria Count (TBC).

GLOSSARY OF TERMS (continued)

IEC IP24: International Electrotechnical Commission Ingress Protection enclosure designation 24 which is intended to provide a degree of protection against access to hazardous parts and wet weather.

ion: an atom or group of atoms that carries a positive or negative charge as the result of having lost (positive charge) or gained (negative charge) one or more electrons.

Legionella: waterborne bacteria that can cause a type of pneumonia by infection if inhaled into the lungs.

magnetite: iron oxide (Fe_3O_4), also known as magnetic oxide; created by the reaction of pure water and iron under some specific conditions.

make-up water: water that must be added to the system to replace water which has evaporated, gone to drain, lost, etc.

MIC: microbial-influenced corrosion.

microbe: a microorganism or germ.

NEMA 3R: National Electrical Manufacturers Association enclosure designation 3R, which is intended for outdoor use primarily to provide a degree of protection against rain, sleet, and damage from external ice formation.

NPT-threaded: National Pipe Taper, part of the American National Standard for Pipe Threads; designates a thread diameter taper of 1/16" per inch of thread length. NPS designates National Pipe Straight (no taper).

pH: a scale whose values range from 0 to 14, with 7 representing neutral, numbers less than 7 increasing acidity, and numbers greater than 7 increasing alkalinity. Derived from the negative logarithm of the effective hydrogen ion activity in gram equivalents per liter.

PID: Precipitation Induction Device. A broad classification of water-treatment methods under which the Dolphin System is included.

ppm: parts per million, used as a volumetric measurement of very small quantities. The common unit of milligrams per liter (mg/l) is equivalent to ppm.

PPS: pulsed-powered system; the technology behind the Dolphin System.

precipitate: a solid substance separated from a solution or suspension by chemical or physical change.

PVC: polyvinyl chloride; used for plastic pipe.

rain hoods: protective covers used to minimize the exposure of the Dolphin System to weather elements.

scale: solid deposits on heat transfer surfaces caused by impurities in hard water.

TBC: total bacteria count, typically measured in colony forming units per milliliter (CFU/ml).

TDS: total dissolved solids, typically measured in parts per million (ppm).

transformer: an electromagnetic device that converts variations of voltage and current in a primary circuit into variations of voltage and current in a secondary circuit.

Notes



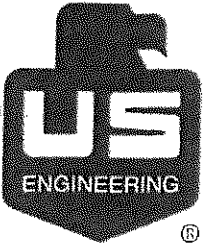
DOLPHIN WATERCARE

TREATING WATER RESPONSIBLY

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Clearwater Systems Corporation
145 Dennison Road • P.O. Box 463
Essex, CT 06426

Phone: 860-767-0850 • Fax: 860-767-8972 • www.dolphinwatercare.com • service@dolphinwatercare.com



HVAC Water Treatment
Product Submittal
Information:
Dolphin Unit

**BEATTIE
ELEMENTARY
SCHOOL**

3000 MEADOWLARK AVE
FORT COLLINS, CO 80526

TRANSMITTAL



Belford Watkins Group
Architects

Date: 4.18.14

Project: Beattie Elementary

To: Rob Price/DJ Anderson

From: Patti Watkins

We are transmitting the following submittals with the comments listed below:

ARCHITECTURE

INTERIORS

PLANNING

NET: No Exception Taken MCN: Make Corrections Noted RX: Rejected
RR: Revise and Resubmit SSI: Submit Specified Item
CMT: See Comment Below

232500 HVAC Water Treatment

Copies	Section	Item	Manufacturer	NET	MCN	RR	RX	SSI	CMT
1	232500	Product Data			x				1

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures, there from. The Contractor remains responsible for details and accuracy, for conforming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

Notes: HVAC WATER TREATMENT (Make Corrections Noted)

1. Sheet M-0.3 requires model G3030-SST, not G3030-PVC. Provide stainless steel model, not PVC.
2. Include optional corrosion rack on open loop system.
3. Corrosion coupon rack is not required on closed loop system.



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
---	---	--

Date: 4/8/2014	Reference Number: 0038
-----------------------	-------------------------------

Transmitted To: Don Watkins Belford Watkins Group P.O. Box 1306 Fort Collins, CO 80521 Tel: 970-212-1243	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001 N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
---	---

Qty	Submittal Package No	Description	Due Date	Package Action
1	030 - 232500 - 0	HVAC Water Treatment	4/22/2014	

Transmitted For	Delivered Via	Tracking Number
Review & Approval	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
001		HVAC Water Treatment - Product Data	232500		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks



4001 N. Valley Drive
 Longmont, CO 80504
 Phone: 970-535-4867
 Fax: 970-535-4867

DATE: 4/8/2014

SPECIFICATION SECTION(S): 232500
 SCOPE OF WORK: HVAC - Water Treatment

PROJECT: Poudre School District – Beattie Elementary School

PROJECT #: 30-13-038

ARCHITECT/DESIGNER: Belford Watkins Group, LLC.
 425 West Mulberry Ave., Suite 207
 P.O. Box 1306
 Fort Collins, CO 80521

 PHONE: 970-407-0070

GENERAL CONTRACTOR: FCI CONSTRUCTORS, INC.
 4001 N. Valley Drive
 Longmont, CO 80504

 PHONE: 970-535-4725
 FAX: 970-535-4867

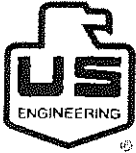
SUBMITTED BY: U.S. Engineering
 PO Box 905
 Loveland, CO 80539

 PHONE: 970-669-1666
 FAX:

CONTRACTORS STAMP:

ARCHITECT/ENGINEER STAMP

FCI CONSTRUCTORS, INC.	
Review of this submittal is subject to the provisions of the Contract Drawings and Specifications. This action is for general concurrence only.	
<input checked="" type="checkbox"/>	Reviewed
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmit with Corrections
<input type="checkbox"/>	DISAPPROVED RESUBMIT
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmittal not Required.
Submittal Reviewed By: DA	Date: 4/8/2014
Submittal No: 030	Spec. Section: 232500



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 80539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-014

Date: 4/2/2014

Revision #: _____

Discipline: Piping

Project: Beattie Elementary

Project #: 1202

Supplier: Long & Summit Labs

Spec Sect: 23 25 00

Submitted Items:

Page Number	Paragraph Number	Description	Manufacturer
232500-3	2.2	Water Treatment System	Dolphin
232500-3	2.2	Chemicals-MSDS Sheets	
M-0.2	Schedule	Glycol Feeder	

Target Dates:

Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
4/3/14	4/10/14	5/8/14	5/15/14	6/12/14

GC/Arch/Engineer Stamp Area:

U.S. Engineering

Signed:

Chris Mallory

Equipment Type:

Chemical Free Water Treatment Systems

Equipment Tag:

None

Equipment Manufacturer:

Dolphin

Model:

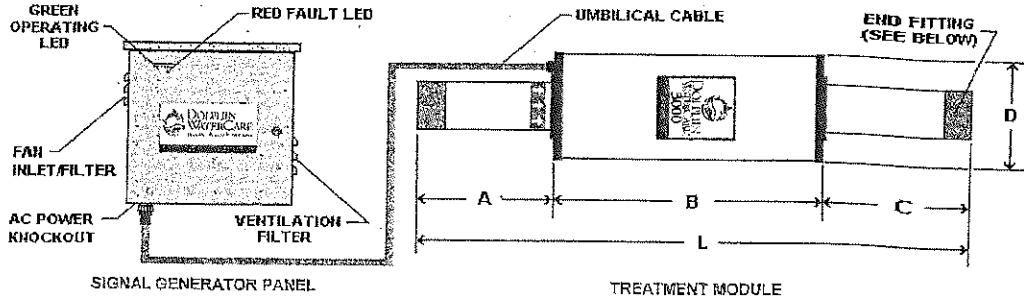
G3030-PVC 3"

- Includes:
 - Dolphin System Treatment Module (*Schedule 80 PVC*)
 - Dolphin System Signal Generator
 - 115/60/1 power
 - Walchem WECT 400 Conductivity Controller
 - 3/4" Belimo Motorized Blowdown Valve with NEMA 4 Actuator
 - Start-up and first year water treatment service

Note: *External wiring, control wiring, installation are by others*



Unit Specifications



3" DOLPHIN SYSTEM

Model Number	U.S. Pipe Size	Pipe Schedule	Cable Length	Std. Pipe End Fitting	AC Power	Max. VA	Internal Fuse
G3030-PVC	3"	80 PVC	10'	Optional	115/1/60	405	MDL -5

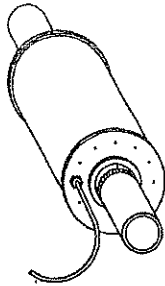
Signal Generator Enclosure Nema 3-R Dimensions	Dimensions in inches				
	A	B	C	D	L
10" X 10" X 8"	9.0	19.2	11.3	9.0	39.5

311 Center Point Drive | Middletown, CT | 06457

Phone: 860-767-0850 | Fax: 860-767-8972

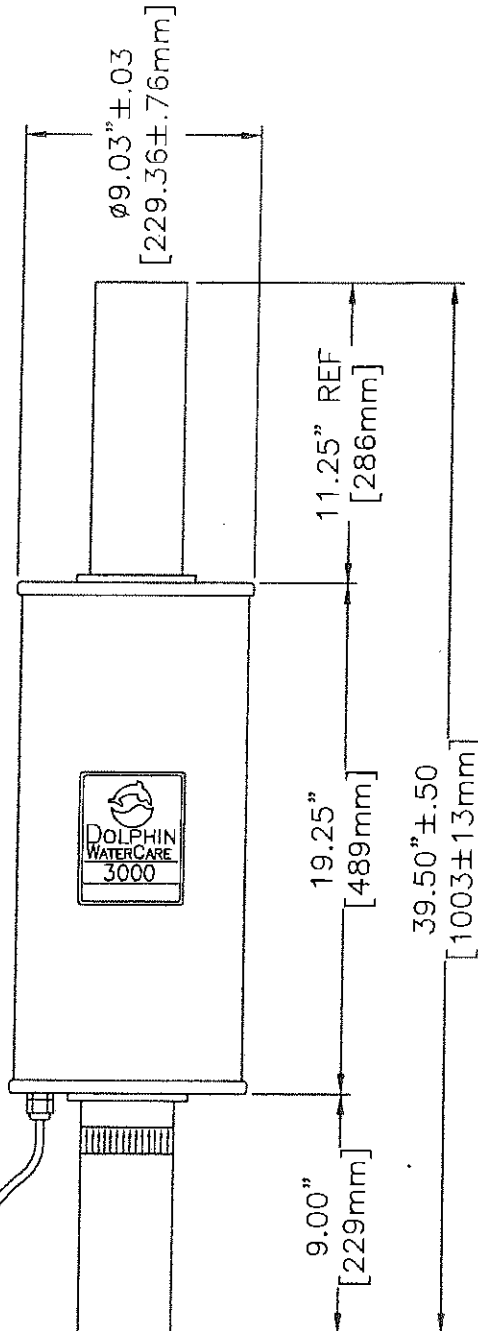
www.dolphinwatercare.com

A DIVISION OF CLEARWATER SYSTEMS CORPORATION



UMBILICAL - FOR LENGTH
SEE ACCESSORIES/OPTIONS

3" NOMINAL
PIPE SIZE
REF: $\phi 3.500$
[89mm]



3" NOMINAL PVC

MAX GPM
240

MAX PSI
SEE PRESSURE
RATING CHART

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WHATEVER MUST HAVE WRITTEN AUTHORIZATION FROM CLEARWATER SYSTEMS CORPORATION.

Title: DOLPHIN SYSTEM 3000
TREATMENT MODULE

DOLPHIN WATERCARE®

CLEARWATER SYSTEMS CORP., MIDDLETOWN, CT 06457

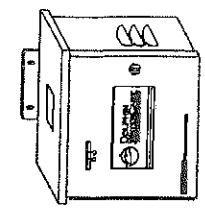
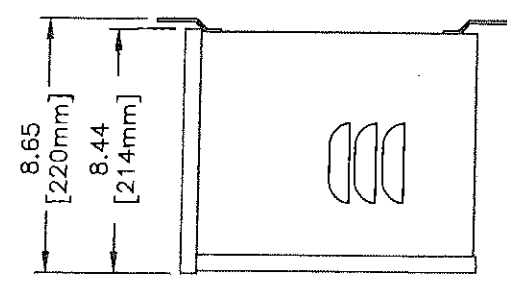
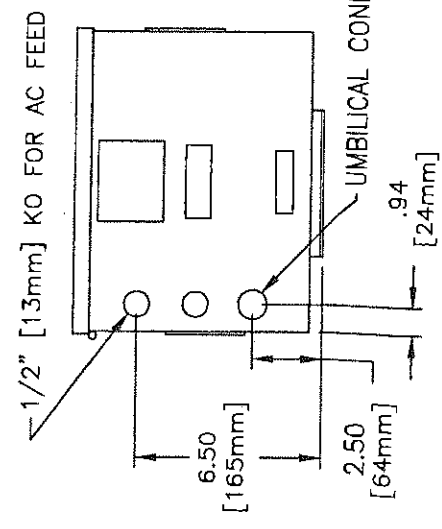
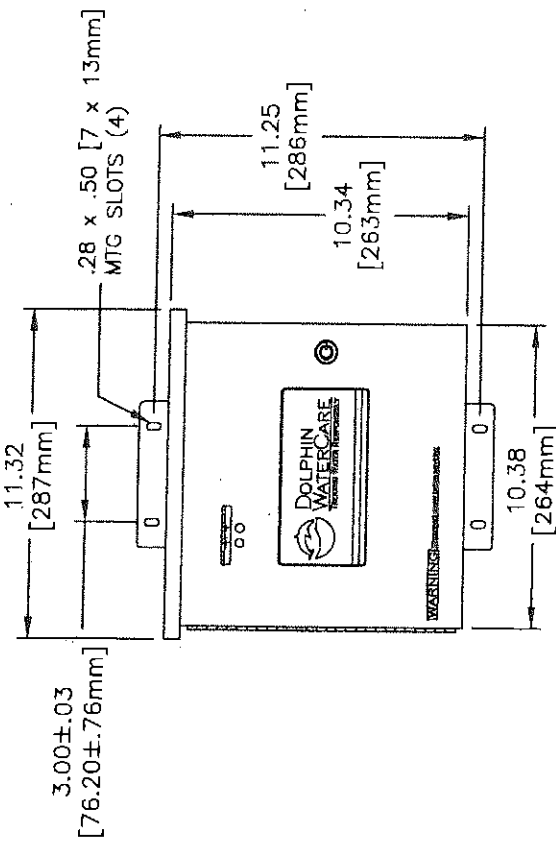
DATE: 8-20-07 DRAWN BY: ALK APPROVED BY: MKW

SCALE
NONE

DRAWING NO.
CPG3030-PNR

SHEET
1 OF 1

REV.
A



FOR NOM. PIPE SIZES 1", 2", 3", 4", 6"

NOMINAL PIPE SIZE	STANDARD AC VOLTAGE	FUSE	VA
1"	115V60Hz 1Ph	MDL-2	140
2"	115V60Hz 1Ph	MDL-3	225
3"	115V60Hz 1Ph	MDL-5	405
4"	115V60Hz 1Ph	MDL-7	490
6"	115V60Hz 1Ph	MDL-7	480

115V / 60 HZ

Title: **DOLPHIN SYSTEM™ 3000
SIGNAL GENERATOR**

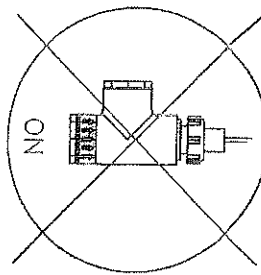
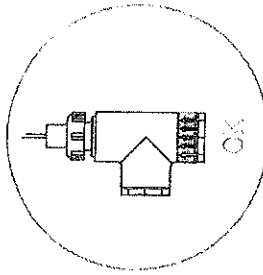
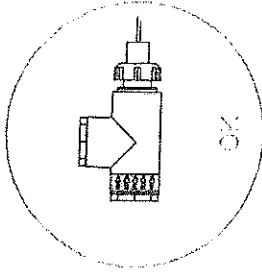
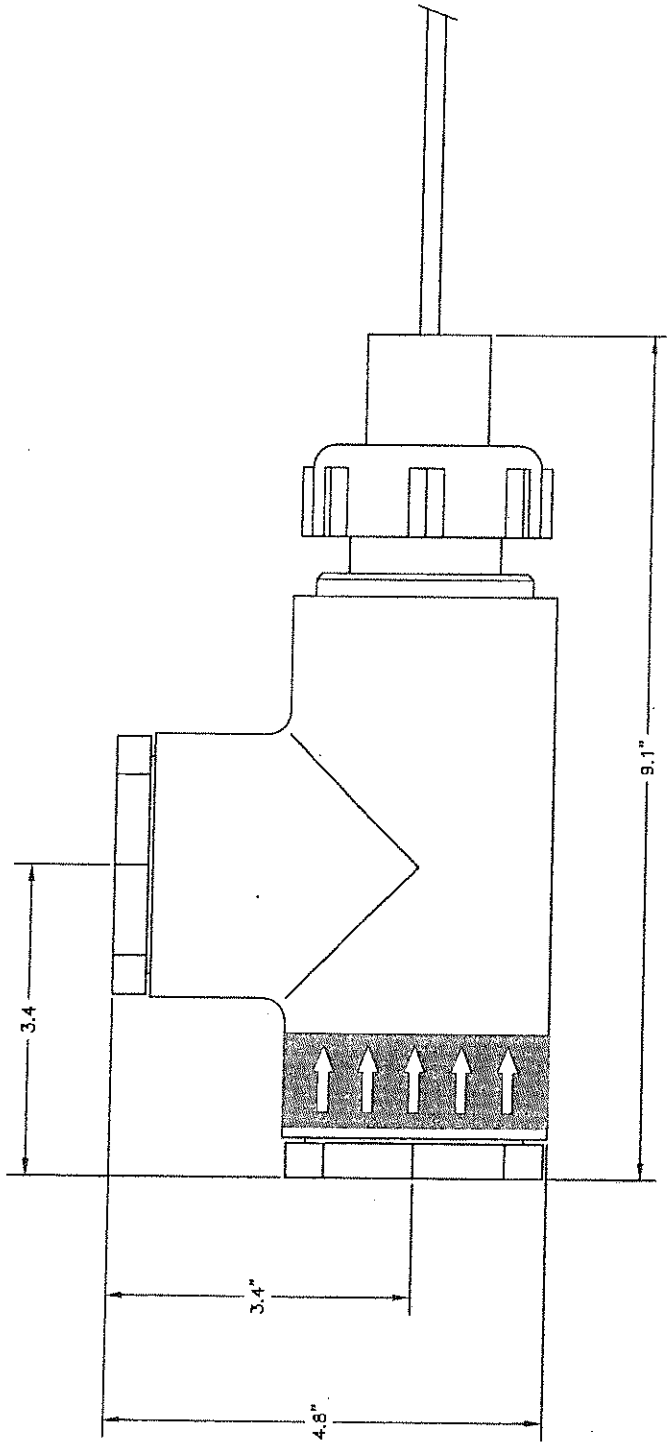
DOLPHIN WATERCARE™

DIV. OF CLEARWATER SYSTEMS CORP., 145 DENNISON ROAD, ESSEX, CT 06426

DATE: 8-20-07 | DRAWN BY: ALK | APPROVED BY: MPP
 SCALE: NONE | DRAWING NO. CPG3001-SG1 | SHEET 1 OF 1
 REV. NEW

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TEE AND PROBE FOR WALCHEM WECT400

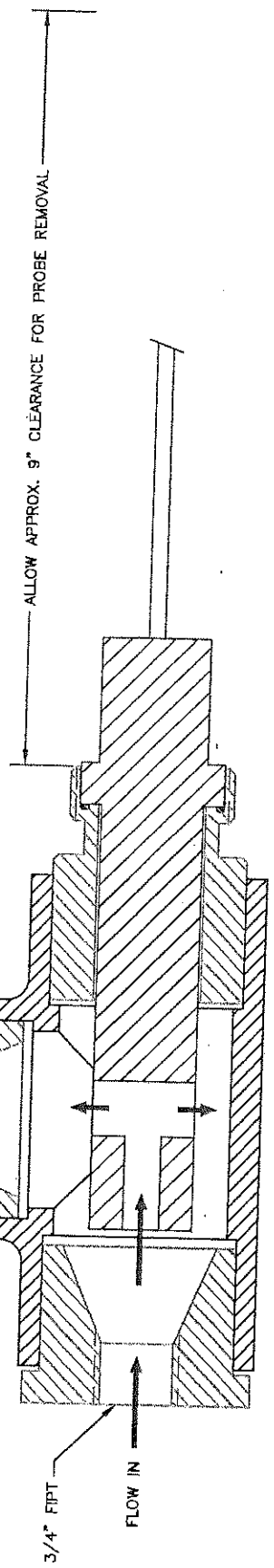


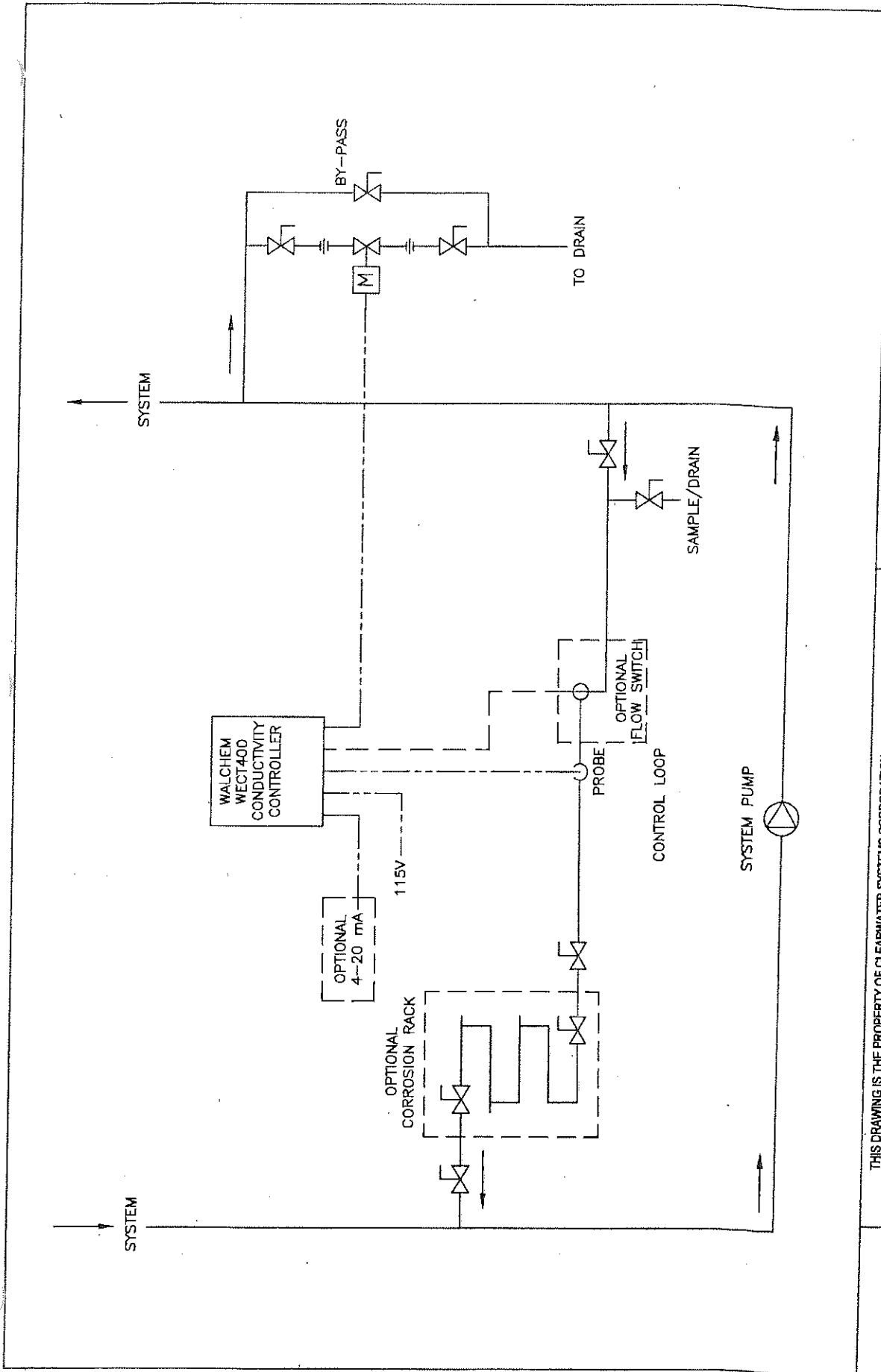
NOTE - TEE CAN BE MOUNTED IN ANY POSITION EXCEPT 'CAP DOWN'

3/4" FIPT

FLOW OUT

(RETAINER CAP NOT SHOWN)





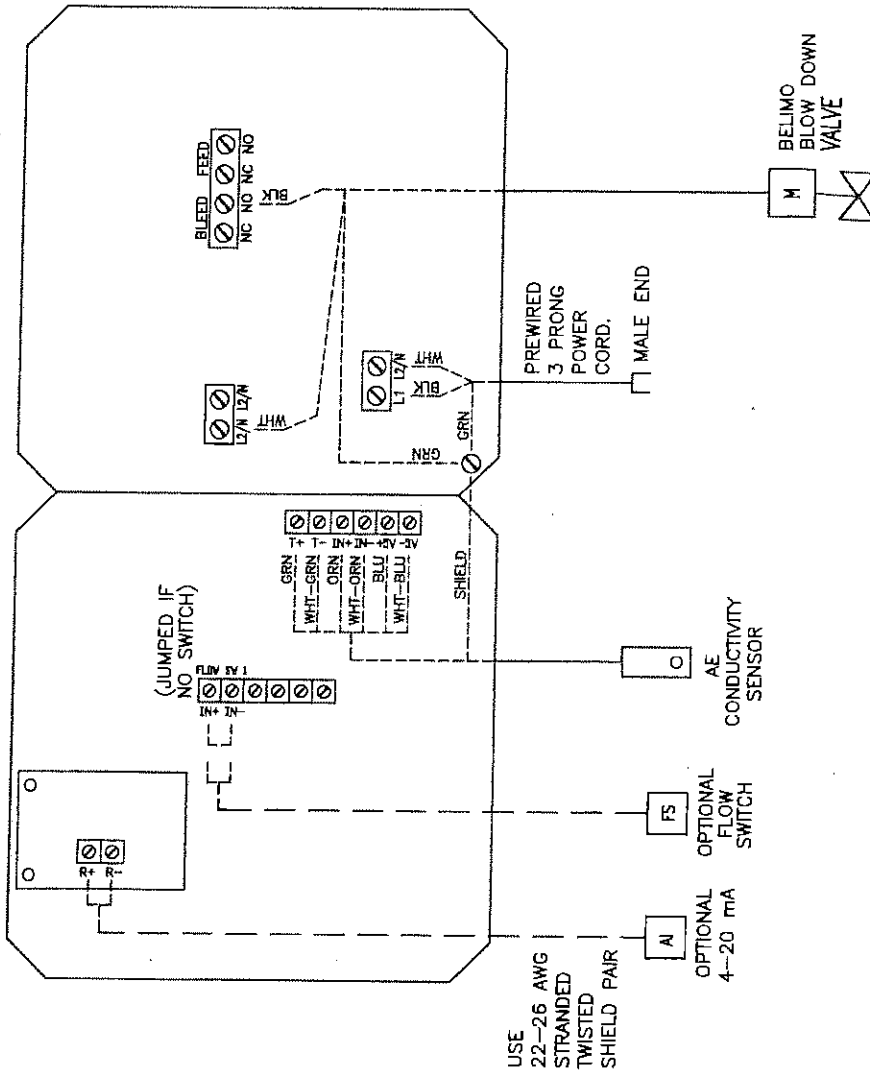
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Title: **DOLPHIN SYSTEM™ 3000**
SYSTEM DIAGRAM - WECT400

DOLPHIN WATERCARE™
 CLEARWATER SYSTEMS CORP. 311 CENTERPOINT DR. MIDDLETOWN CT 06457
 DATE: 10-13-11 DRAWN BY: ALK APPROVED BY:

SCALE NONE	DRAWING NO. CPD3000-AWC	SHEET 1 OF 1	REV. A
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AIC (WALCHEM WECT400 CONTROLLER)



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Title: DOLPHIN SYSTEM™ 3000
CONTROL WIRING DIAGRAM - WECT400

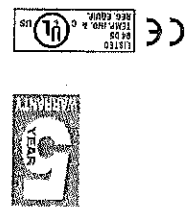
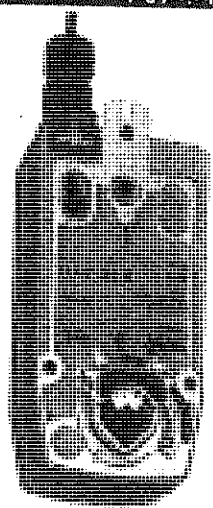
DOLPHIN WATERCARE™

CLEARWATER SYSTEMS CORP. 311 CENTERPOINT DR. MIDDLETOWN, CT 06457
DATE: 10-13-11 DRAWN BY: ALK APPROVED BY:

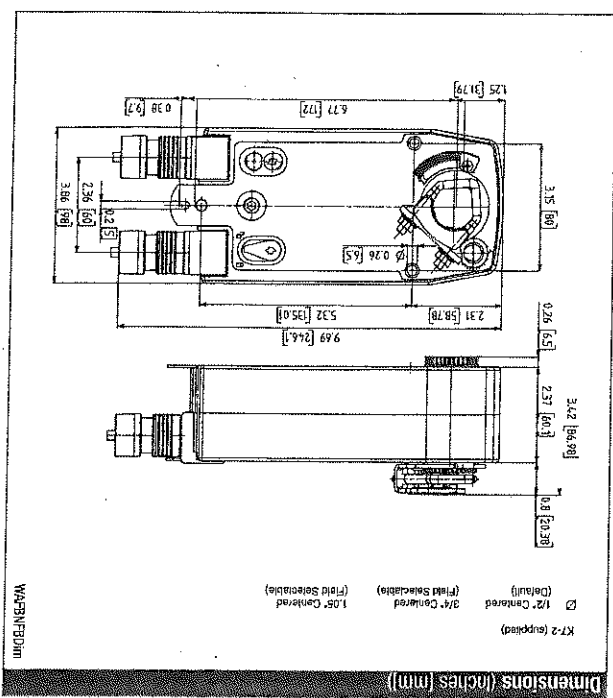
SCALE NONE DRAWING NO. CPW3000-AWC

SHEET 1 OF 1 REV. B

Technical Data	
Power supply	24...240 VAC -20% / +10%, 50/60 Hz
Power consumption	running 6 W holding 2.5 W
Transformer sizing	6 VA @ 24 VAC (class 2 power source) 6.5 VA @ 120 VAC 9.5 VA @ 240 VAC
Electrical connection	3 ft, 18 GA appliance cable, 1/2" conduit 5 models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors NFXUP... NFBUP... NFXUP... 16 foot cord standard
Control	On/off electronic throughout 0 to 95° rotation 90 in-lb (10 Nm) minimum spring reversible with CW/CCW mounting 95° (adjustable with mechanical end stop, 35° to 95°) motor 20 seconds @ 4°F to 122°F [-20°C to 50°C]; < 75 seconds
Running time	Position indication visual indicator, 0° to 95° (0° is full spring return position) 5 mm hex crank (3/16" Allen), supplied max. 95% RH non-condensing -22°F to 122°F [-30°C to 60°C] -40°F to 176°F [-40°C to 80°C] Storage temperature Housing material Nema 2, IP54, Enclosure Type 2 Agency listings † ULus acc. to UL60730-1A-2-14, CAN/CSA E60730-1-02, CE acc. to 2004/108/EC & 2006/95/EC Noise level <50dB(A) motor @ 7.5 seconds ≤52dB(A) spring return maintenance free ISO 9001 Quality standard Weight 4.15 lbs (1.9 kg), 4 lbs (2.0 kg) with switches † Rated Impulse Voltage 4kV, Type of action 1A (1 AAB for S version), Control Position Degree 3. Auxiliary switches 2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°



Application
For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.
The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.
Operation
The NFB and NFX series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.
The NFB and NFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.
The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.
The NFBUP-S and NFXUP-S versions are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°. The NFBUP, NFXUP-S, NFXUP and NFXUP-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

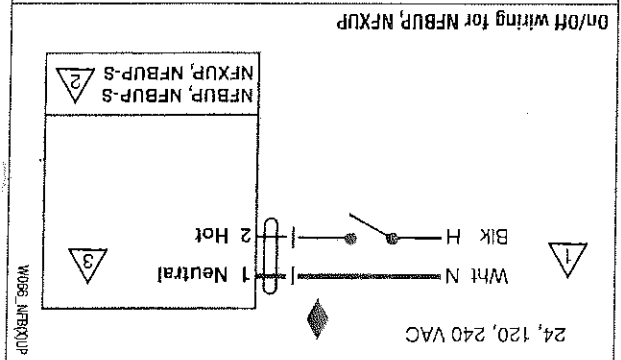
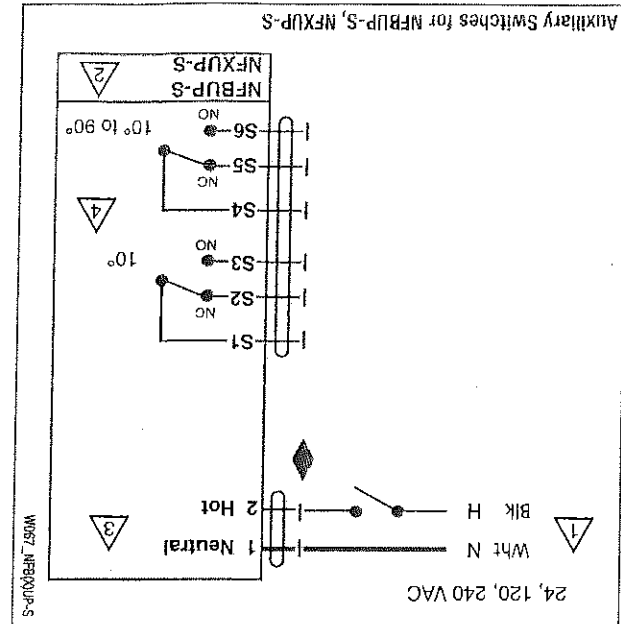


MA0024 - 05/10 - Subject to change. © Belimo Aircontrols (USA), Inc.



On/Off, Spring Return, 24 to 240 VAC
NFBUP, NFXUP-S, NFXUP, NFXUP-S

Torque min. 90 in-lb, for control of air dampers



WARNING Live Electrical Components!
 During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

APPLICATION NOTES
 Meets cULus requirements without the need of an electrical ground connection.
 For end position indication, interlock control, fan startup, etc., NFBUP-S end NFXUP-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, UL. Approved, UL. Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.

INSTALLATION NOTES
 No ground connection is required.
 Provide overload protection and disconnect as required.
 Actuators may be connected in parallel.
 Power consumption and input impedance must be observed.

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Typical Specification	
Shaft extension	M4-8-25
Damper position indicator	IND-MFB
Universal clamp for up to 1.05" dia jackshafts	K7-2
Crank arm	KH-AFB
Conduit fitting	TF-CC US
8mm and 10 mm wrench	Tool-06
Universal mounting bracket	ZG-100
Universal mounting bracket	ZG-101
Mounting bracket for Barber Colman® MA 3, 4, Honeywell®	ZG-118
Mod III or IV or Johnson® Series 100 replacement or new crank arm type installation	ZG-AFB
Crank arm adapter kit	ZG-AFB118
Crank arm adapter kit	ZS-100
Weather shield (metal)	ZS-150
Weather shield (polycarbonate)	ZS-260
Explosion-proof housing	ZS-300
NEMA 4X housing	

Note: When using NFBUP, NFXUP, NFBUP-S, NFXUP-S actuators, only use accessories listed on this page.
 For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

On/Off, Spring Return, 24 to 240 VAC
 NFBUP, NFXUP, NFBUP-S, NFXUP-S

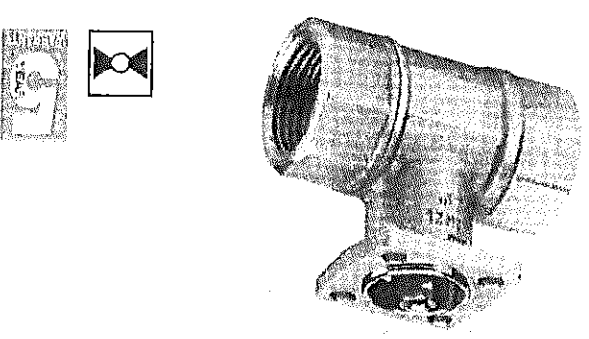
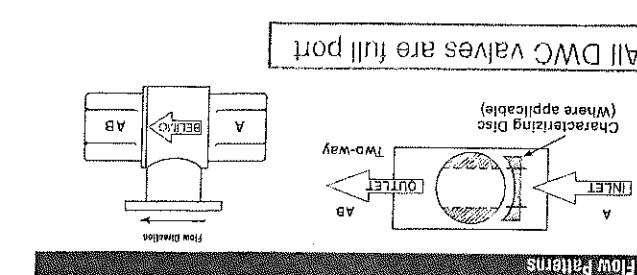


B2 Series, 2-Way, Characterized Control Valve

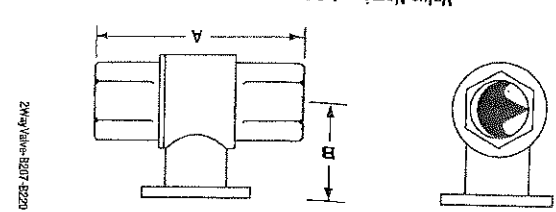
Application
 This valve is typically used in air handling units on heating or cooling coils, and fan coil unit heating or cooling coils. Some other common applications include Unit Ventilators, VAV box re-heat coils and bypass loops. This valve is suitable for use in a hydraulic system with variable flow.

Valve Nominal Size	Type	Actuator
1/2"	2-Way NPT	Spring
3/8"	Non-Spring	
1/2"	Non-Spring	

Model	DN [mm]	Inches	Cv
B207	15	3/8"	0.10
B209	15	3/8"	0.8
B210	15	3/8"	1.2
B211	15	3/8"	1.9
B212	15	3/8"	3
B213	15	3/8"	4.2
B214	15	3/8"	7.4
B215	15	3/8"	10
B216	15	3/8"	11
B217	20	3/4"	4.2
B218	20	3/4"	7.4
B219	20	3/4"	10
B220	20	3/4"	14
B221	20	3/4"	24
B222	25	1"	24
B223	25	1"	7.4
B224	25	1"	10
B225	25	1"	30
B226	32	1 1/4"	19
B227	32	1 1/4"	28
B228	32	1 1/4"	37
B229	32	1 1/4"	49
B230	40	1 1/2"	29
B231	40	1 1/2"	37
B232	40	1 1/2"	49
B233	50	2"	57
B234	50	2"	65
B235	50	2"	77
B236	50	2"	85
B237	50	2"	100
B238	50	2"	130
B239	50	2"	240
B240	60	2 1/2"	30
B241	60	2 1/2"	37
B242	60	2 1/2"	49
B243	60	2 1/2"	57
B244	60	2 1/2"	65
B245	60	2 1/2"	77
B246	60	2 1/2"	85
B247	60	2 1/2"	100
B248	60	2 1/2"	130
B249	60	2 1/2"	240
B250	70	3"	30
B251	70	3"	37
B252	70	3"	49
B253	70	3"	57
B254	70	3"	65
B255	70	3"	77
B256	70	3"	85
B257	70	3"	100
B258	70	3"	130
B259	70	3"	240
B260	80	3 1/4"	30
B261	80	3 1/4"	37
B262	80	3 1/4"	49
B263	80	3 1/4"	57
B264	80	3 1/4"	65
B265	80	3 1/4"	77
B266	80	3 1/4"	85
B267	80	3 1/4"	100
B268	80	3 1/4"	130
B269	80	3 1/4"	240

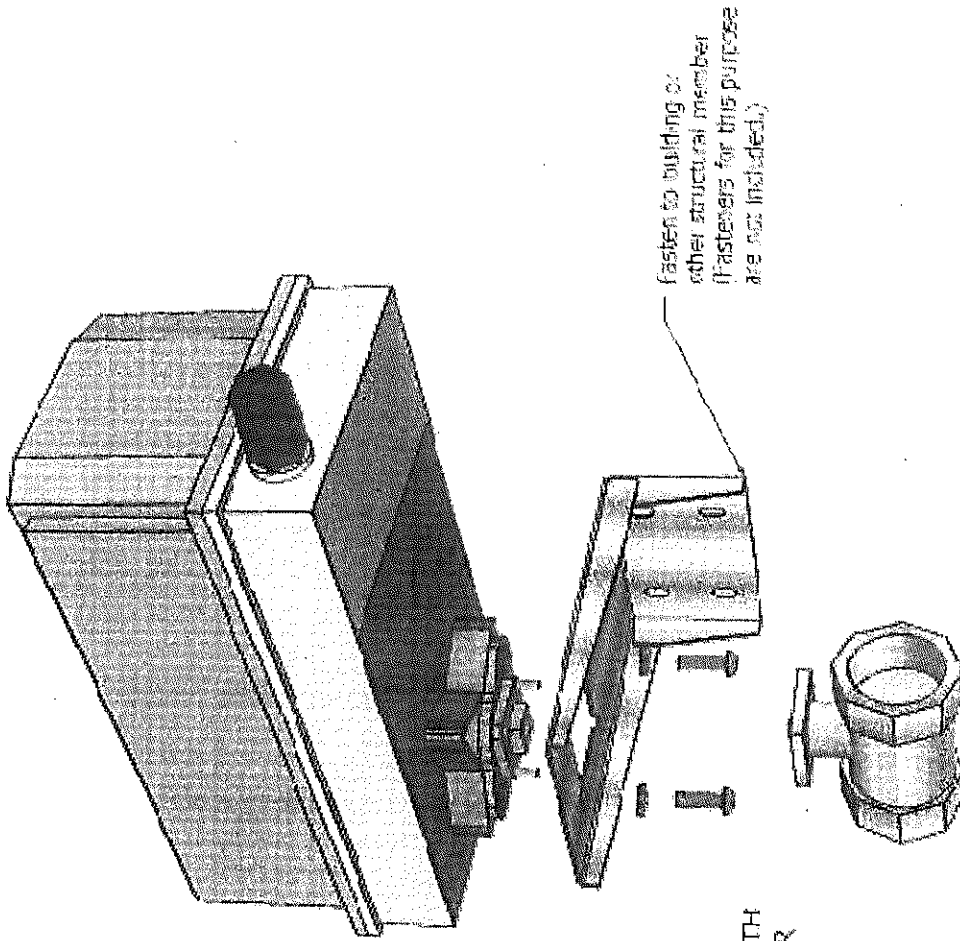


Technical Data	
Service	chilled or hot water, 50% glycol
Flow characteristic	A-port equal percentage
Controllable Flow Range	75%
Sizes	1/2", 3/8", 1", 1 1/4", 1 1/2", 2", 2 1/2", 3"
Type of end fitting	NPT female ends
Materials:	Body: forged brass, nickel plated Ball: stainless steel Stem: stainless steel Seats: PTFE Characterizing disc: Tarzel® Packing: 2 EPDM O-rings, lubricated
Body pressure rating	1/2" - 1 1/4" (B230) 30 psi 1 1/4" (B231) - 3" (B250) 400 psi
Close off pressure	100 psi
Maximum differential pressure (ΔP)	50 psi for typical applications
Leakage	0% for A to AB
External leakage	according to EN 12266-1:2003
Cv rating	Tarzel® is a registered trademark of Dupont A-port; see product chart for values



Valve Body	Inches	DN [mm]	Dimensions (inches [mm])
B207-B216	1/2"	15	1.39" [35.2]
B217-B221	3/4"	20	1.78" [45.2]
B222-B225	1"	25	1.87" [47.4]
B226-B230	1 1/4"	32	1.87" [47.4]
B231-B233	1 1/2"	40	1.87" [47.4]
B234-B240	2"	50	2.04" [51.9]
B241-B250	2 1/2"	60	2.27" [57.7]
B251-B254	3"	70	2.73" [69.5]
B255-B265	3 1/4"	80	2.73" [69.5]
B266-B269	3 1/2"	80	2.73" [69.5]

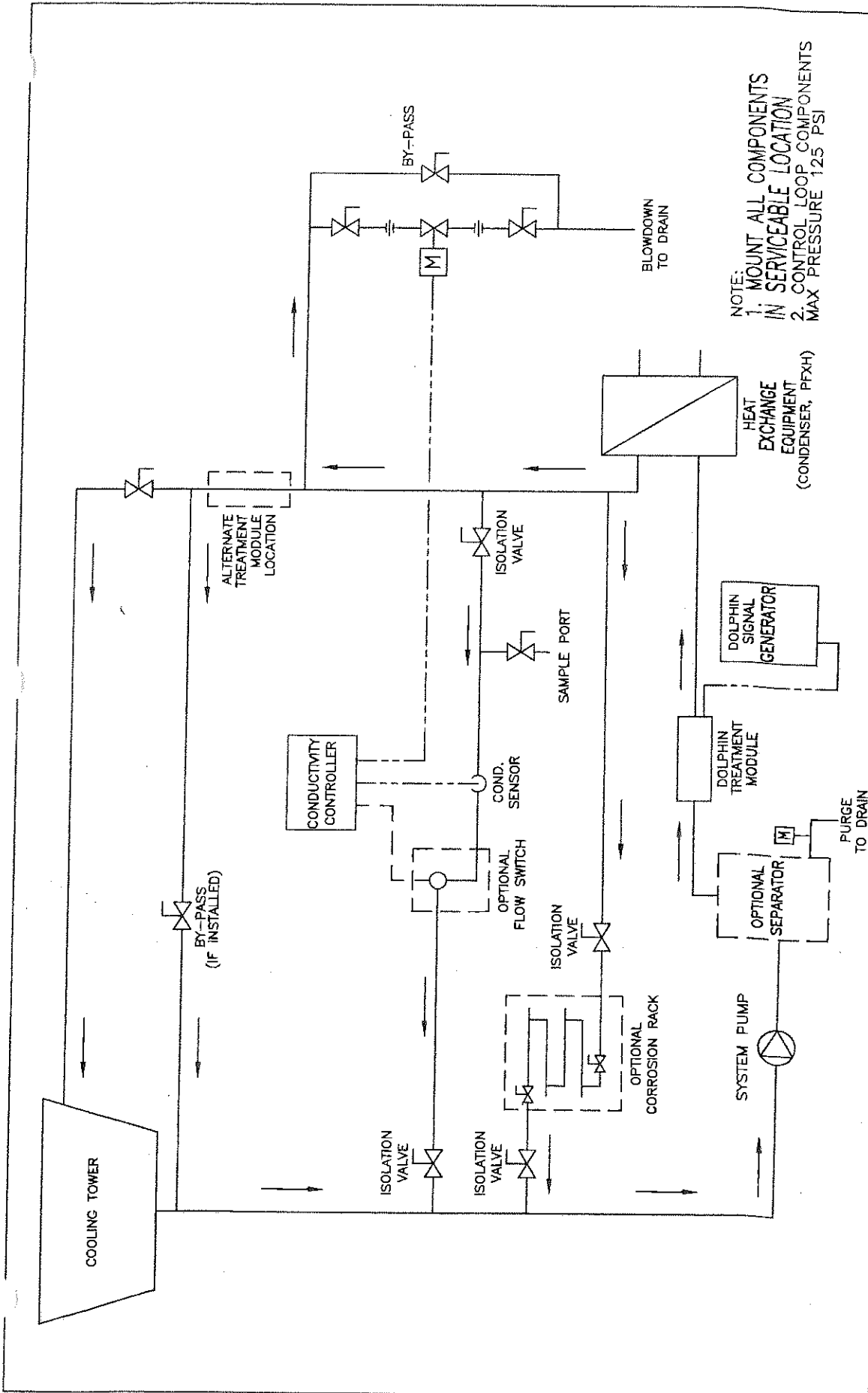
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fasten to building or
other structural member
(fasteners for this purpose
are not included.)

USE OF THE SUPPLIED
SUPPORT BRACKET WITH
THE NEMA 4 ACTUATOR
IS REQUIRED.

CLEARWATER SYSTEMS CORP.
CPA3000-MA REV: NEW



NOTE:
 1. MOUNT ALL COMPONENTS
 IN SERVICEABLE LOCATION
 2. CONTROL LOOP COMPONENTS
 MAX PRESSURE 125 PSI

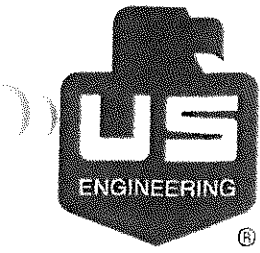
Title: DOLPHYN SYSTEM 3000 OPEN COOLING TOWER SYSTEM DIAGRAM.	
DOLPHYN WATERCARE®	
CLEARWATER SYSTEMS CORP, MIDDLETOWN, CT 06457	
DATE: 2-12-13	DRAWN BY: ALK
SCALE: NONE	APPROVED BY: MKW
DRAWING NO. CPD3000-OCT	SHEET 1 OF 1
	REV. NEW

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 WHATSOEVER MUST HAVE WRITTEN AUTHORIZATION FROM CLEARWATER SYSTEMS CORPORATION.

**THIS DRAWING APPLIES TO:
 OPEN COOLING TOWERS**

**IMPORTANT - DOLPHYN MUST BE
 INSTALLED ON DISCHARGE SIDE OF PUMP**

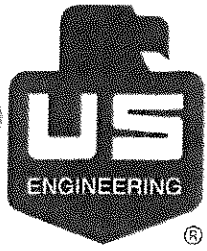
SEE INSTALLATION MANUAL FOR ADDITIONAL INFORMATION



Tab-4
Specification Section: 23 25 00
HVAC Water Treatment:
Bypass Feeder (Neptune)
Glycol Feeder (Advantage
Controls)
Chemical MSDS

**BEATTIE
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SCHOOL**

3000 MEADOW LARK AVE
FORT COLLINS CO 80526



Bypass Feeder
(Neptune) O&M and
Warranty Information

**BEATTIE
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3000 MEADOWLARK AVE
FORT COLLINS, CO 80526



OPERATIONS AND MAINTENANCE MANUAL

US ENGINEERING

BEATTIE ELEMENTARY SCHOOL

Water Treatment Equipment

Bypass filter feeders (CHW)
Glycol feeder GF501A1A1AC



P.O. Box 247 • Lansdale, PA 19446-0247
 Tel: 215-699-8700 • Fax: 215-699-0370
 Toll-Free Tel: 1-888-3NEPTUNE (1-888-363-7886)
 Toll-Free Fax: 1-800-255-4017
 Web Site: <http://www.neptune1.com>
 E-mail: pump@neptune1.com

Important Note:

These instructions describe Neptune Models VTF and DBF By-Pass Feeders with or without a filter bag plus Model DBFC By-Pass Feeders with Cartridge Filter and Models FTF and FTF-DB Filter Feeders which use a bag inside the basket filter.

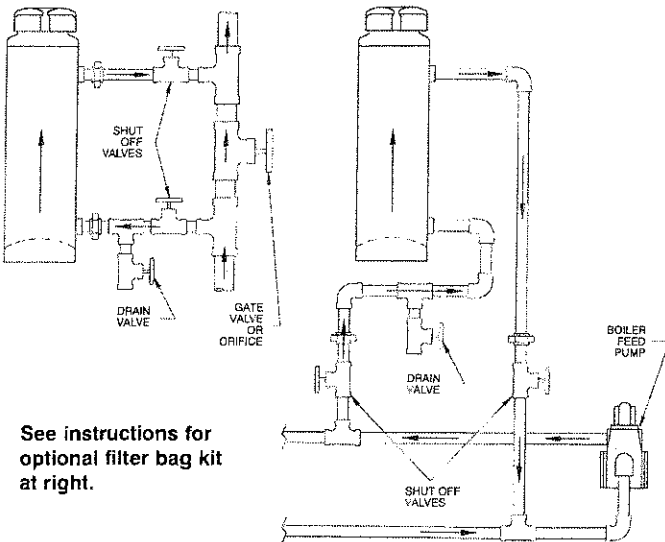
Note carefully the flow arrow shown for each type of feeder. The flow in the standard by-pass feeder must be "upward" if a filter bag kit is to be used. The flow on the by-pass feeder with a cartridge filter is "downward." The filter feeder with bag and basket filter requires "downward" flow.

INSTALLATION & OPERATION INSTRUCTIONS – ALL MODELS

1. Pipe feeder to cause pressure drop across inlet and outlet resulting in flow through feeder.
2. Provide isolation and drain valves for servicing and draining.
3. Use with hot or cold water only. DO NOT USE FOR STEAM (300 psi @ 200°F max.).
4. Be certain gasket is positioned in grooves under cap before replacing cap. (Replace gasket if cap does not seal by hand pressure.) Cap should seal with hand tightening pressure only. Do not strike cap with any tool to seal or unseal.
5. Open valves slowly when returning service.
6. **CAUTION! DO NOT OPEN UNDER PRESSURE** – close isolation valves and bleed off pressure before opening.
7. **CAUTION! CONTENTS MAY BE HOT.**
8. CONSULT YOUR CHEMICAL SUPPLIER FOR THE PROPER USE OF THIS TANK WITH THE CHEMICAL.
9. DO NOT COMBINE CHEMICALS IN THIS DISPENSING DEVICE – without specific instructions from your chemical supplier. READ AND FOLLOW LABEL DIRECTIONS FOR THE CHEMICAL IN USE.

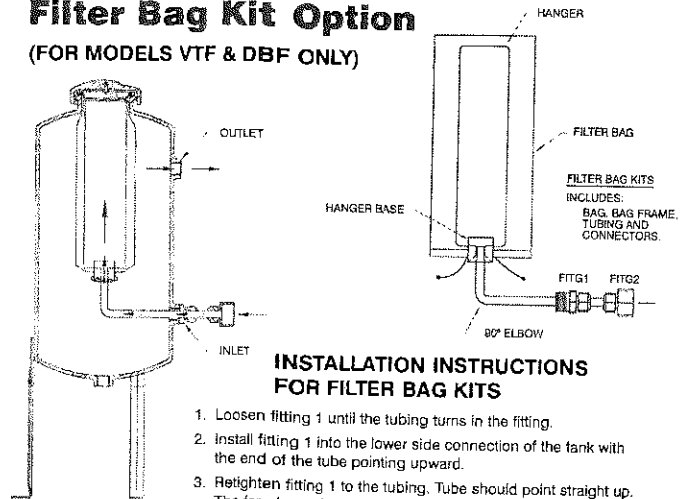
**Standard By-Pass Feeder
 MODELS VTF & DBF**

Refer to installation and operation instructions above.



See instructions for optional filter bag kit at right.

**Filter Bag Kit Option
 (FOR MODELS VTF & DBF ONLY)**

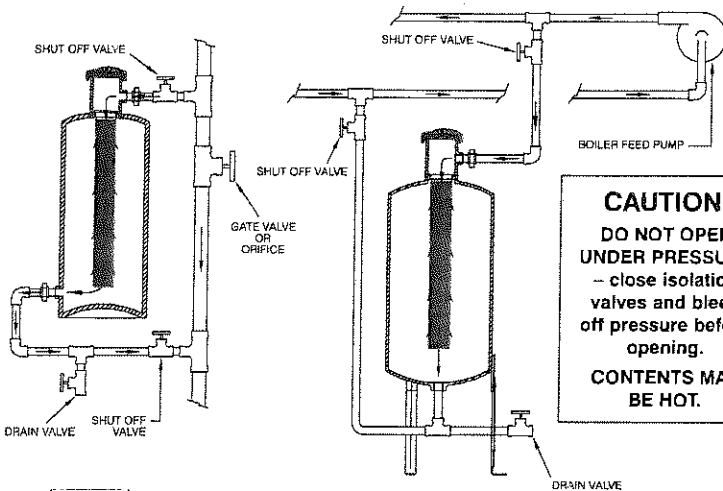


**INSTALLATION INSTRUCTIONS
 FOR FILTER BAG KITS**

1. Loosen fitting 1 until the tubing turns in the fitting.
2. Install fitting 1 into the lower side connection of the tank with the end of the tube pointing upward.
3. Retighten fitting 1 to the tubing. Tube should point straight up. The ferrule on the tubing is preset for the tank diameter.
4. Place bag over the hanger wire. Pull the drawstring closed and tie tightly so the bag gathers around the hanger base with the opening of the hanger base protruding from the bag.
5. Insert the bag and hanger base into the tank with the opening of the hanger base pointing downward. The hanger base should engage the tube which is pointing upward and the tubing should fit into the hanger base until the tubing rests against the edges of the wire which protrude into the center of the hanger base.
6. The cap will keep downward force on the wire, keeping the assembly in place.

Filter Feeder MODELS FTF & FTF-DB

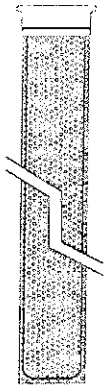
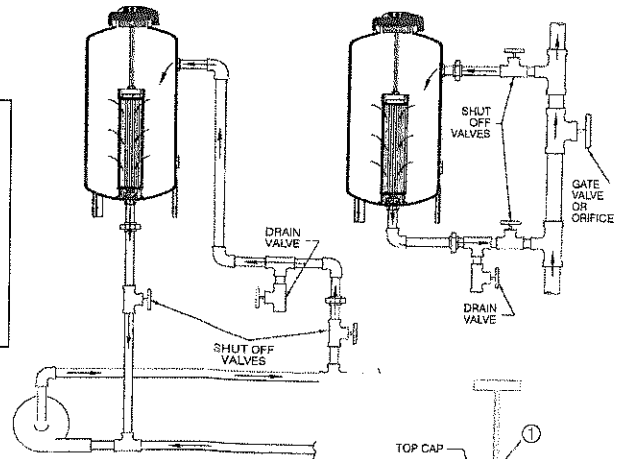
Refer to installation and operation instructions on other side.



CAUTION!
DO NOT OPEN
UNDER PRESSURE
— close isolation
valves and bleed
off pressure before
opening.
CONTENTS MAY
BE HOT.

By-Pass Feeder with Cartridge Filter MODEL DBFC

Refer to installation and operation instructions on other side. Maximum flow 6 GPM.



FILTER FEEDER ASSEMBLY INSTRUCTIONS

Neptune Filter Feeders may be used as a By-Pass Feeder with or without the basket. The basket may be used for handling granular chemical products. A filter bag may be placed in the basket allowing the feeder to also be used as a filter.

The filter bag is placed *inside* the basket. Bags are available in 1, 5, 20 and 50 micron ratings. The bag slides into the basket and the ring rests on the top rim of the basket.

The basket is then placed into the feeder and will hang from the support lip.

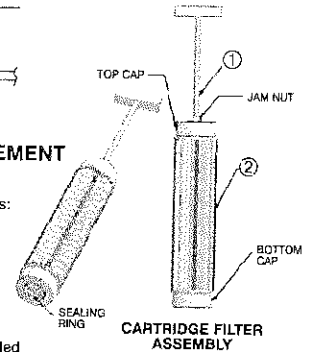
Reverse the procedure and insert a clean bag as needed.

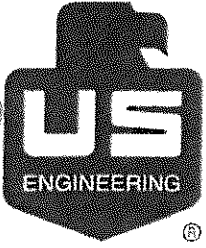
CARTRIDGE REMOVAL/REPLACEMENT INSTRUCTIONS

The cartridge filter assembly consists of two parts:

1. Handle Assembly
2. Filter Cartridge

Remove the cartridge filter assembly from the vessel by holding the handle (1) and pulling out straight. Loosen the jam nut just enough so that the threaded rod can be turned. (This will ensure the correct length of the handle-cartridge assembly to fit inside the vessel.) Unscrew threaded rod to separate bottom cap. Remove old cartridge (2) and discard. Slide a new cartridge (2) onto the top cap. Slide in the bottom cap. Screw in the threaded rod into the bottom cap until jam nut touches the top cap. Make sure that the ridge on the face of top and bottom caps line up with the grooves on the ends of the filter cartridge. Snug the jam nut to secure cartridge. Check the sealing ring inside the end of the bottom cap and replace if necessary. Slide the cartridge filter assembly back into the vessel, taking care that the bottom cap is piloted onto the stub in the bottom of the tank. Make certain assembly is fully seated. Replace the cap.





Glycol Feeder
(Advantage Controls)
O&M and Warranty
Information

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ELEMENTARY
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3000 MEADWAY PARK AVE
FORT COLLINS CO 80526



OPERATIONS AND MAINTENANCE MANUAL

US ENGINEERING

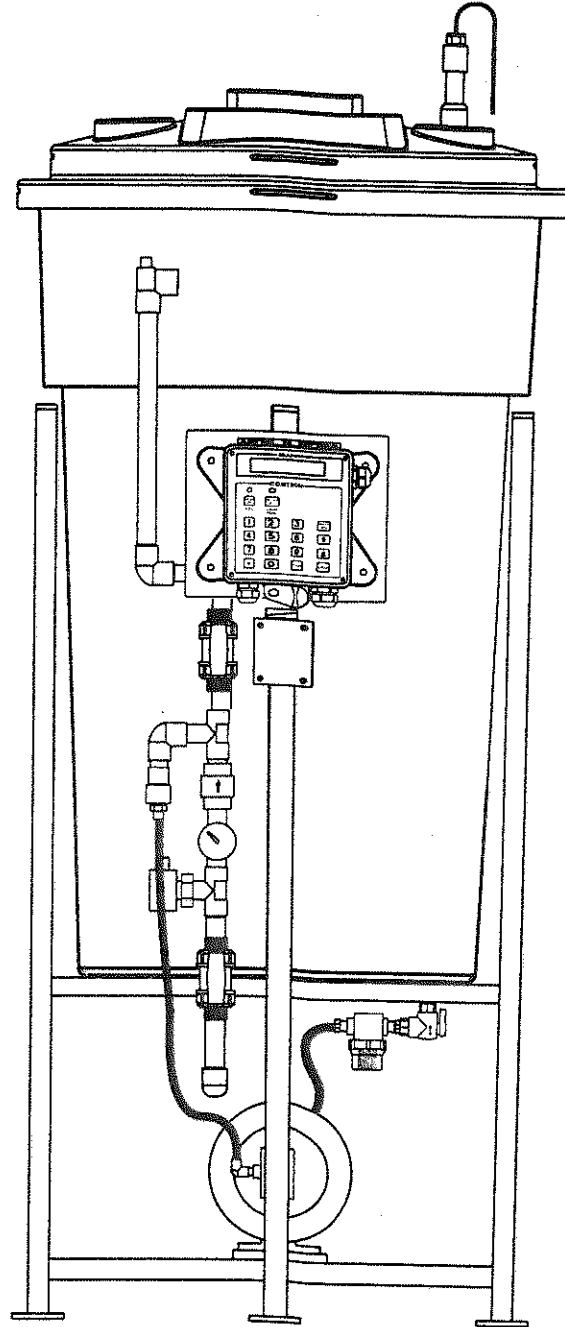
BEATTIE ELEMENTARY SCHOOL

Water Treatment Equipment

Bypass filter feeders (CHW)
Glycol feeder GF501A1A1AC

Model GF Digital Glycol Feeder

*Installation
Maintenance
Repair
Manual*



Advantage Controls
P.O. Box 1472
Muskogee, OK 74402
Phone: 800-743-7431
Fax: 888-686-6212
www.advantagecontrols.com

4/2014

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I. Introduction

The Advantage Controls Glycol Feed Systems are design to regulate pressure in closed loop Hydronic Heating and Cooling applications.

Advantage Controls micro-processor base controller reads a solid state pressure transducer, displays system pressure, and uses a 16 character keyboard for the entry of control parameters. The micro-processor has built in real-time clock and EEPROM back-up for all user settings, in case of power interruptions. Setting for all functions are made using the keyboard, readings are displayed on a back lit 16 character alphanumeric display.

Advantage Controls Glycol Feeders are stand alone pre-wired, pre-plumbed systems designed for ease of installation. Our systems are mounted on a powder coated steel frame with anchor points.

Advantage Controls Model Designation allows for a wide variety of configurations, operation and function of each Glycol Feed Systems this is dependent on your specific model number. Please check your model number against the selection guide for better understanding of your system.

Please read this instruction manual to become familiar with your system.

II. Model Numbering and General Specifications

BUILD A MODEL

GF - - - - -

TANK SELECTION

- 0 = No tank
- 1 = 55 gallon poly
- 2 = 100 gallon poly
- 3 = 30 gallon poly
- 7 = 150 gallon poly

STAND SELECTION

- A = Powder Coated steel stand
- B = Powder Coated steel stand w/ mixer bracket
- C = Tank top mount (no tank included)
- D = Portable stand with built in rollers

PUMP SELECTION

*Dual pump sys. require 2 pump selections (i.e., -11)

- 0 = No pump
- 1 = 1.5 gpm at 100 PSI; 1/3 hp
- 2 = 3.75 gpm at 100 PSI; 1/2 hp
- 3 = 6.1 gpm at 60 PSI; 1/3 hp
- 4 = 10 gpm at 60 PSI; 1/2 hp
- 5 = 30 gpd at 100 PSI; solenoid driven

PUMP CONFIGURATION

- A = Standard configuration
- B = Alternating pumps for single loops
(requires 2 pump selections)
- C = Pump plumbed for transfer duty into tank

LOOP SELECTION

*Dual loop sys. require 2 loop selections (i.e., -11)

- 0 = No loop
- 1 = Sch 80 PVC loop; 100 PSI max; 100°F max
- 2 = Copper/brass loop; 100 PSI max; 180°F max
- 3 = Carbon steel loop; 100 PSI max

CONTROL SELECTION

- A = **Digital controller** w/ 0-100 PSI pressure transducer for 30 gal & + sizes
- D = Pressure transducer, level wand and pump starter relay for use with separately ordered MegaTron or SS with 4-20mA input ability

OPTIONS

- 1 = 240V
- 2 = 4-20mA output of pressure on digital controller
- 3 = Solenoid valve for pressure relief on digital units
- 4 = 30-50 PSI pressure switch for analog units
- 5 = Position backcheck to use tank for expansion
- H = 1/4" PVC pipe instead of pump suction tubing
- M = Mixer controls (order mixer separate)
- Y = ETL approval (only on units with controller option D)

Most units include poly tank and stand, low level switch with audible alarm (100db) with silence switch, dry contact alarm, pressure relief valve and plumbing assembly with pressure gauge.

Digital models display the actual loop pressure and allow for user settable control points from a pressure sensor rated for 5-100 psi (0.3-6.9 bar). 16 character LCD, backlit display. EPROM memory.

III. Installation

Electrical Wiring

The standard digital glycol feeder controller has an internal regulated power supply that will operate in the range of approximately 100 to 250 VAC on the incoming wiring. Output relay(s) are protected with a replaceable fuse. Each relay's output voltage will equal incoming line voltage. The Standard prewired units are supplied with a 8 foot, 16 AWG, 3 wire grounded, 120 VAC USA power cord for incoming power.

NOTE: Liquid tight fittings and labeled signal lead cables are provided for all signal (low voltage) connections, low drum level and pressure transducer.

WARNINGS:



- 1. The controller should be connected to its own isolated circuit breaker, and for best results, the ground should be a true earth ground, not shared. Wiring must be done according to all applicable local codes.**
- 2. Power (line voltage) must be disconnected while making any connections. If power is supplied to the unit, line voltage will be present on the relay cards.**
- 3. Low voltage signal wires (transducer, level, alarm, etc.) should never be run in conduit with high voltage wires.**

Mounting Instructions

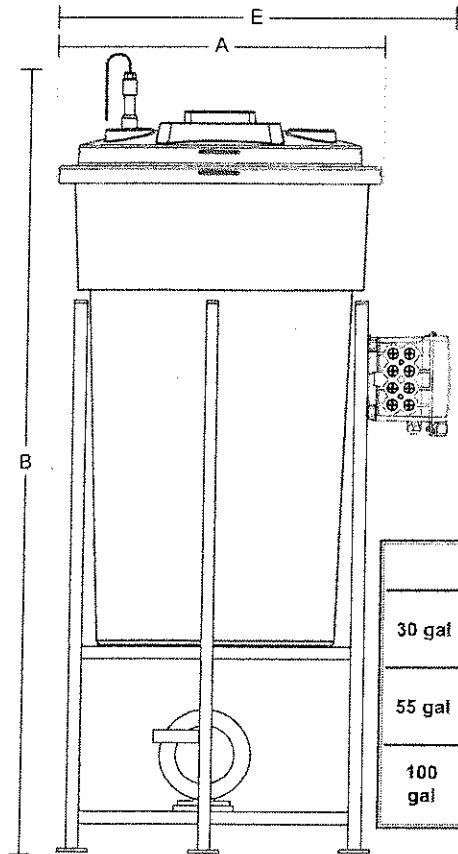
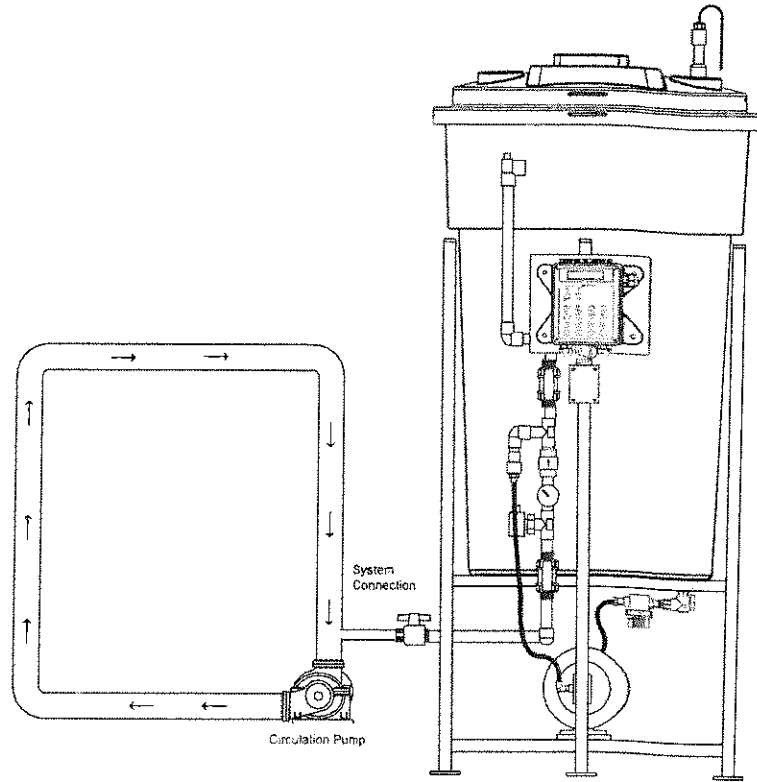
Select a mounting location that provides the operator easy access to the unit and a clear view of the controller. The location should be convenient to grounded electrical connections and system plumbing connections. Mount the glycol feeder stand to a level concrete pad using the ½" mounting holes in the base of the stand. Concrete pad construction and anchoring bolts must comply with local building codes. The required sample line plumbing should be connected to the return header of the Hydronic system

WARNING:



Avoid locations that expose the controller to direct sunlight, vapors, vibration, liquid spills or extreme temperatures; less than 0°F (-17.8°C) or greater than 120°F (50°C). EMI(electromagnetic interference) from radio transmissions and electric motors can also cause damage or interference and should be avoided.

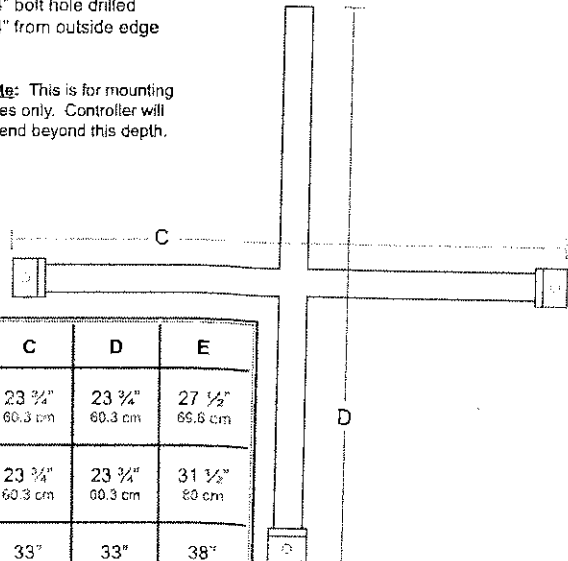
Typical Installation and Measurements



GLYCOL STAND FOOT PRINT

1/4" bolt hole drilled
3/4" from outside edge

Note: This is for mounting
holes only. Controller will
extend beyond this depth.

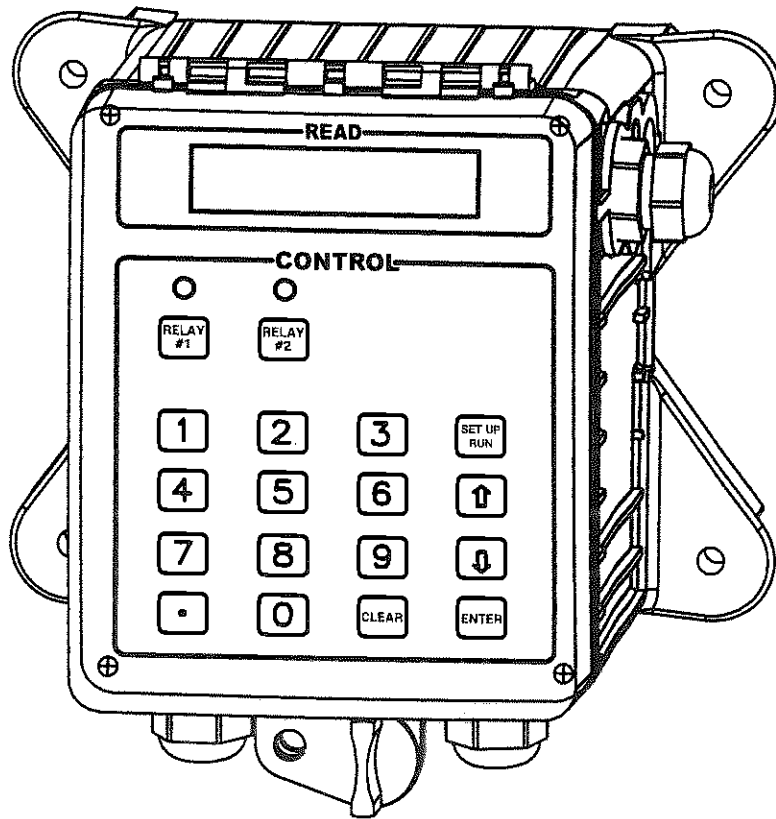


	A	B	C	D	E
30 gal	23 3/4" 60.3 cm	49" 124.4 cm	23 3/4" 60.3 cm	23 3/4" 60.3 cm	27 1/2" 69.6 cm
55 gal	27 1/2" 69.8 cm	64" 162.5 cm	23 3/4" 60.3 cm	23 3/4" 60.3 cm	31 1/2" 80 cm
100 gal	31 1/4" 79.3 cm	66" 167.6 cm	33" 83.8 cm	33" 83.8 cm	38" 96.5 cm

Side View Shown

Start Up and Test Procedure / Recommendations

1. Before filling tank, be sure that the tank and the filter bowl are free of packing material and or construction debris.
2. Check plumbing as it may have become loose from vibrations during shipping.
3. Fill Tank
4. Open isolation valve to system.
5. If there are no leaks verify that the pressure gauge agrees with system pressure. This value may vary do to connection to Hydronic systems placement.
6. Before applying power to the controller, remove fuse from lower relay enclosure. (There will be two (2) fuses on duel pump system) Reasoning behind this is, factory settings may not agree with your system and this gives time for you to set your parameters before applying power to the pump or pumps.
7. Apply power to your system. Plug it in.
8. Once you are familiar with the controller from either reading the instruction manual or trial and error. Proceed with setting perimeters that are correct for your hydronic system.



Digital Front Panel Drawing

IV. Digital Front Panel Description

READ: 1x16 (1/4") Alpha Numeric Display.

CONTROL: Relay 1, Relay 2 - HOA switches for control relays.



SET UP/RUN key - System initializes into RUN mode. Press this switch to toggle the controller from SET UP mode to RUN mode.



UP/DOWN arrows - Used to change the display from one line to the next. All menus are circular, so when all items in a menu have been displayed, the display will return to the originally displayed item.



ENTER key - Used to access a menu and to log a changed value into the program.



CLEAR key - Used to clear numerical values from items being changed in the SET UP mode.



DECIMAL key - Used at certain places to change a function or displayed items. For example, when temperature is being displayed, pressing the DECIMAL key will change the reading from Fahrenheit to Celsius or visa versa.



NUMERICAL keys - Used to enter new values in the SET UP mode.

V. Digital System Operation Overview

MicroTron controllers have two modes of operation, RUN and SET UP. Both the RUN and SET UP menus are circular. Pressing the DOWN key in either menu will display the next line of information on the display. After the last item in a menu has been displayed, pressing the DOWN key will return the display to the top line of that menu.

RUN MODE - This mode is for normal operation. The control relays will only be automatically activated in this mode. In the RUN mode the display will read system values. If an alarm is present the display flashes with the alarm status.

The RUN menu will display values such as pressure, day, time, date and other values depending upon the features present on the unit. The unit will automatically return to the RUN mode if no keys are pressed for three minutes.

SET UP MODE - This mode is used to make adjustments to settings and readings on the controller. To access the SET UP mode from the RUN screen, press the SETUP/RUN key. Use the up or down arrow to scroll through the various SET UP menus. When you want to enter a specific SET UP menu, press the ENTER key. Once you have entered a SET UP sub menu you will be able to step through that menu's options with the down arrow key.

Relays may be forced on while in the SET UP mode. Press the desired relay test key to force it on. Press it a second time to turn it off. Once the unit returns to the RUN mode, relays will activate automatically.

Description of SET UP Menu Screens

The SET UP menu is the main menu circle of set up sub-menus used to customize your unit to the particular parameters needed for your installation. Listed on the following pages is a description and menu map of each SET UP menu.

NOTES:

1. Depending upon your model number, your unit may not use all of the SET UP options listed.
2. After you press ENTER or CLEAR to change a numerical value in the SET UP menu, use the number keys to define the new value. Press ENTER again to enter the new value.
3. When entering new numeric values, all available digits (characters) must be entered. The number of available digits depends upon the scale of operation. Position of cursor indicates number of digits to be entered.

For example, when entering a run time value for a timer in the minute and seconds scale (10:30 would equal 10 minutes and 30 seconds). You would need to key in a number of 0030 to make it 0 (zero) minutes and 30 seconds.

CALIBRATION

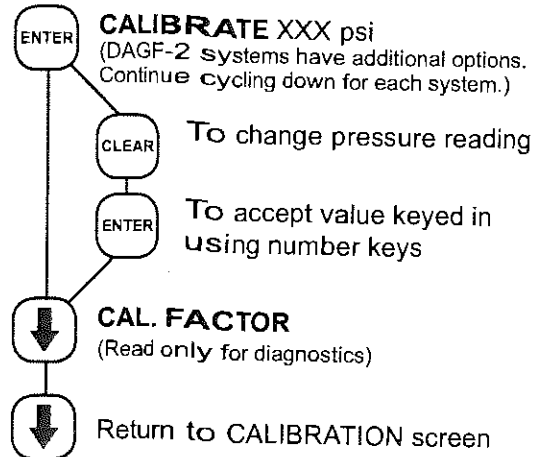
This menu is used to change the display system pressure. After the unit is properly installed and when power is supplied to the controller, the display will read PRESSURE XX psi. This will be the system pressure of the closed loop. A dual system controller will display P1 XX psi, and P2 XX psi, with P1 representing closed loop system 1 pressure and P2 representing closed loop system 2 pressure.

Press the Setup/Run key, and the display will read CALIBRATION, press CLEAR. The display will read calibration, followed by the current system pressure. To change this reading, press ENTER, and key in the correct psi reading. (note: you must enter three digits, as in 52 psi would be entered as 052. Press ENTER to accept the calibrated pressure entry.

CAL. FACTOR - This is a relative number used in diagnostics.

Normal Cal. Factor on valve is between 900-1500.
Extreme values - above 1500 or below 800.

-- CALIBRATION --



PRESSURE SET (1 & 2)

This menu is used to set the on and off pressures for the pump (or pumps in the case of a dual system). From the Run mode, press the Setup/Run key. Press the down arrow until the display reads PRESSURE SET (or P1 set for a dual controller). Press ENTER. The display will read CUT-IN XX psi. Press CLEAR, and use the numerical keypad to key in the psi value at which you want the pump to activate (note: you must enter 3 digits as above). Press ENTER to accept the new value.

Use the down arrow to scroll to CUT-OUT XX psi. Press ENTER. Press CLEAR, and key in the psi value at which you want the pump to shut off. Press ENTER to accept the new value.

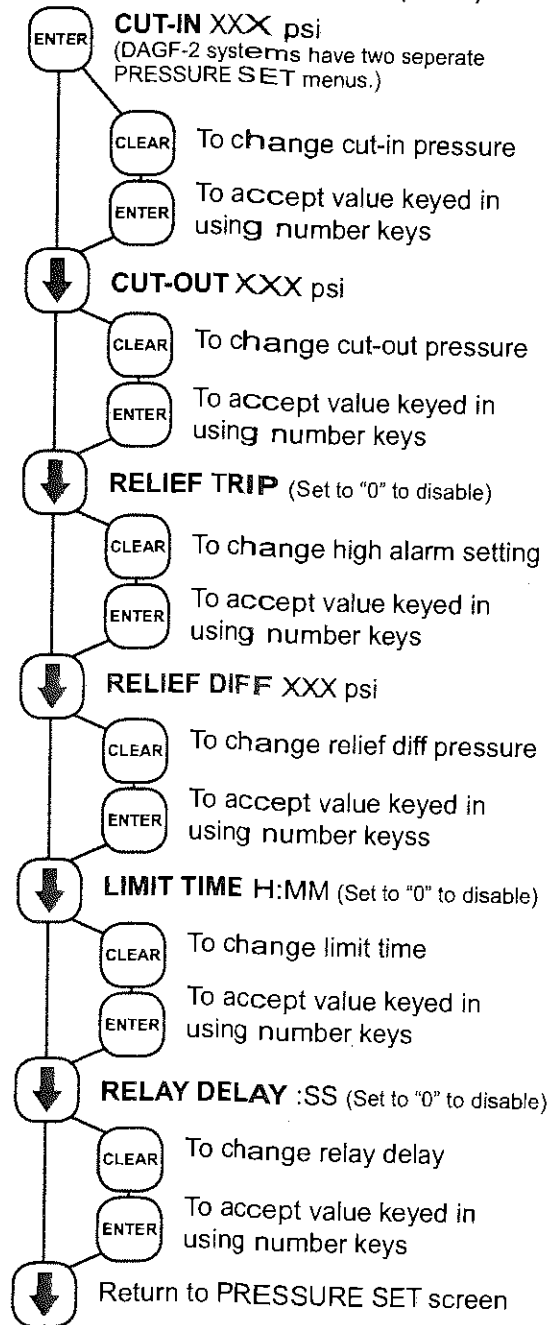
Note: Cut-out pressure must be at least 5 PSI greater than Cut-in pressure.

Press the down arrow, the display will read RELIEF TRIP XX psi. If this is set to something other than 000, the unit will activate a second relay within the controller when the relief trip point is exceeded (over pressure). To set, press CLEAR, then use the number keys to key in the desired trip point value. Press ENTER to accept the new value.

RELIEF TRIPS: 55 psi for High Pressure
30 psi for Low Pressure

Press the down arrow, the display will read LIMIT TIME X:XX. If this is set at anything other than 0:00, the pump will only be allowed to run for the amount of time set. This is to prevent possible damage to the pump in the event of malfunction. To change the limit time, press CLEAR, then use the number keys to key in the desired limit time value. Press ENTER to accept the new value. Press the down arrow, the display will read RELAY DELAY XX. This function is for slowing the response of system pressure reading, delaying the relay action where your system pressure is somewhat erratic.

-- PRESSURE SET (1 & 2) --



DUAL PUMP OPERATION FOR ONE PLUMBING LOOP (OPTION B)

MicroTron digital glycol feeders with option B include a redundant glycol feed pump. By default, pump #1 will be the active pump. To select pump #2 as the active pump, perform the following steps:

1. Using the front panel keypad, press the HOA key labeled RELAY #1 or the HOA key labeled RELAY #3. The display will read OUTPUT: PUMP 1 (or OUTPUT: PUMP 2 if pump #2 had been previously selected).
2. Press the ENTER key to toggle the activation mode between pump #1 and pump #2.
3. Press the SETUP RUN key to accept the pump selection and return to the normal operating mode.

CLOCK SET

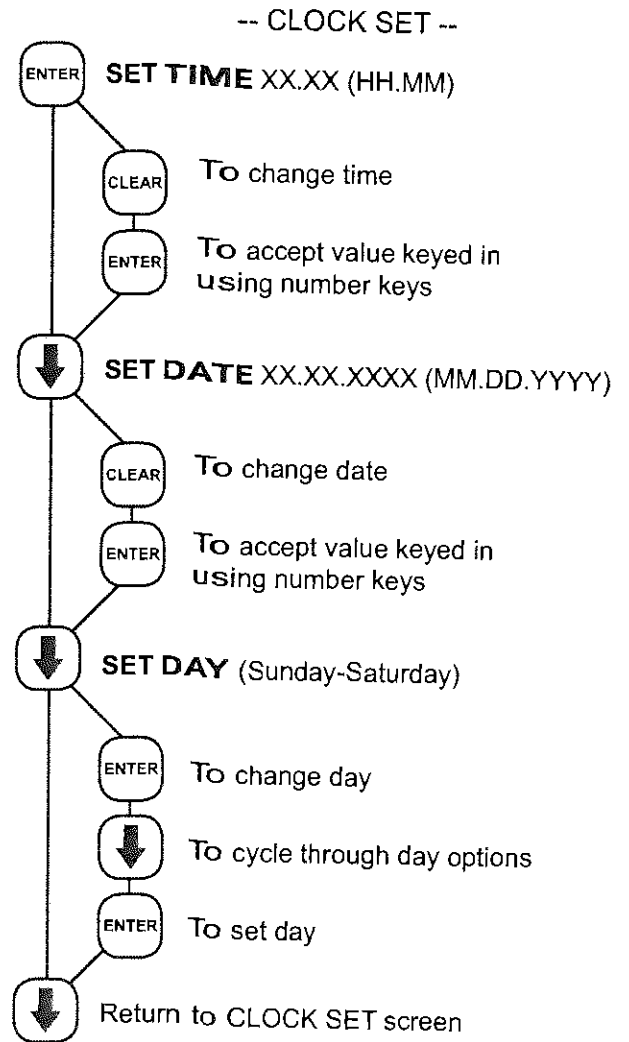
This menu is for adjusting the time, date and day of the week.

After entering a new value, hit the ENTER key to accept the value and advance.

The clock time is based on a 24 hour clock. So, a time of 1:00 pm would be shown as 13.00.

NOTES:

If unit doesn't have a biocide timer, there will not be a SET DAY selection.



SYSTEM SET

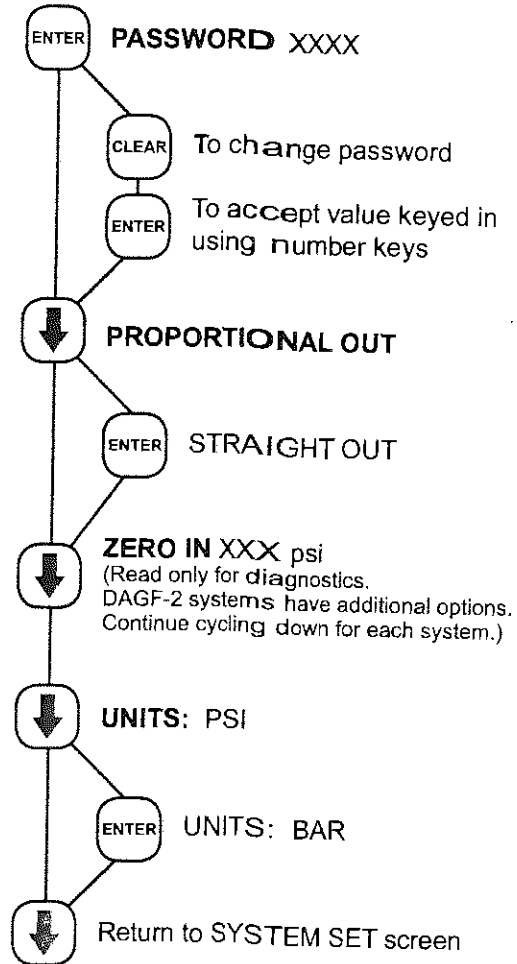
This menu is used to configure the controller to specific operational needs. All of the items in this menu may not apply depending on the controller model but will always be present.

NOTE: Do not use this menu to make calibration adjustments. Use the Calibration screen. Some features disabled and does not apply on this model.

PASSWORD - If a value of 0000 is entered, a password is not required. If a password is entered, it must be used to operate the controller. If the first digit is zero, relays may be activated without a password.

ZERO IN - CAUTION! This this function is used only when there is zero or no pressure at the sensor (Pressure Transducer). If ENTER BUTTON is pushed when there is pressure at the sensor the accuracy of the controller will be greatly effected. Refer to troubleshooting section at end of manual.

-- SYSTEM SET --



DIAGNOSTICS

This menu is used to select, enter and test the following items.

MODEL NUMBER - Read only screen.

FIRMWARE VERSION NUMBER - Read only screen.
Have both available for service

TEST DISPLAY - Press ENTER and all pixels will flash. Make a visual check to see that all pixels are lit.

TEST KEYPAD - Press ENTER, then press each individual key to test its function. NOTE: Pressing the SET UP/RUN key returns display to the main menu. Pressing ENTER again returns to TEST KEYPAD.

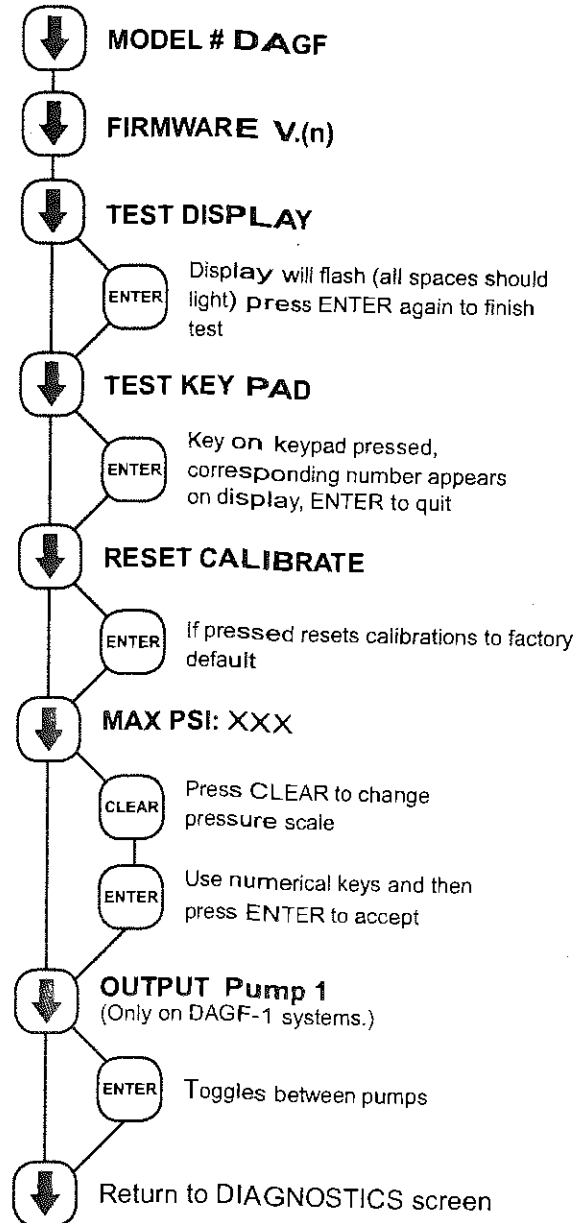
RESET CALIBRATE - CAUTION! Pressing ENTER Button here will reset calibration data to factory defaults. You will need to reset or verify all setting after doing this.

MAX PSI: XXX - This allows you to set the maximum psi. The max setting should correspond to the max pressure rating of the transducer. On the standard model, this is 100 psi. This setting allows the controller to be used with pressure transducers with "other" output ranges. Press CLEAR to change the pressure scale. Use numerical keys and then press ENTER to accept.

OUTPUT Pump 1 (DAGF-1 models only)

This is used in conjunction with feeders with Option B, dual pump system. This allows the operator to switch from pump one to pump two when option E is specified.

-- DIAGNOSTICS --



LEVEL SET

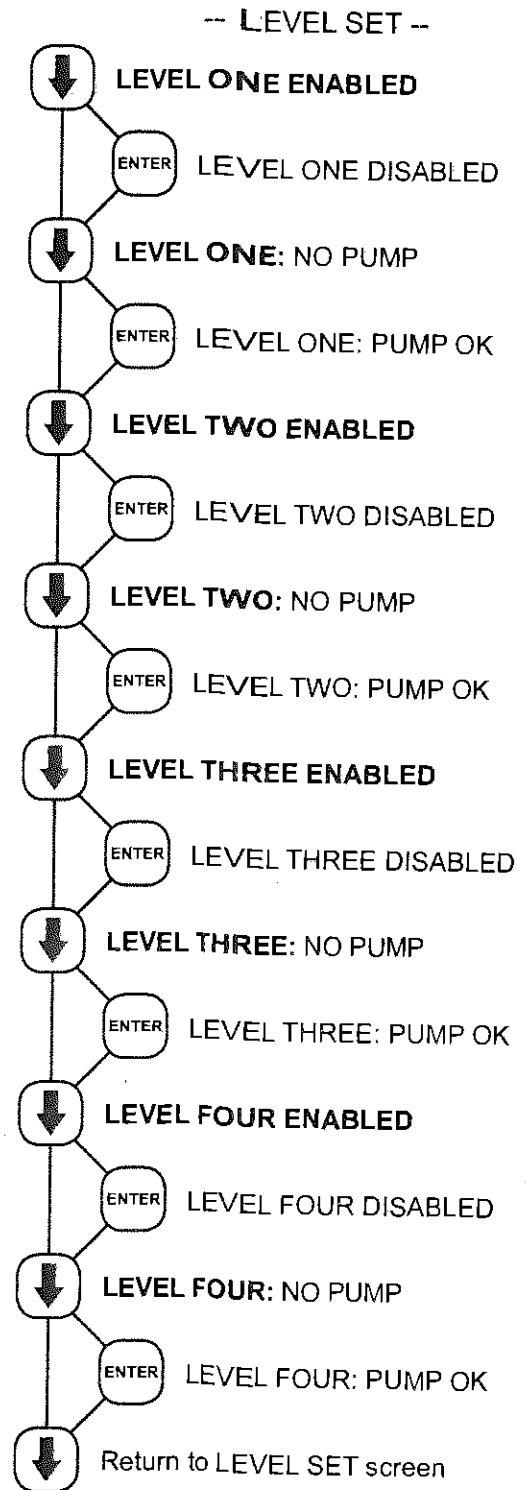
LEVEL ENABLE - Enable and Disable options allow for the activation or deactivation of the control logic that governs the input of the level wand(s). Up to four level wands can be used simultaneously.

LEVEL: PUMP - Each level wand, in the Enabled state, can be used to control the high voltage relay output(s) of the controller.

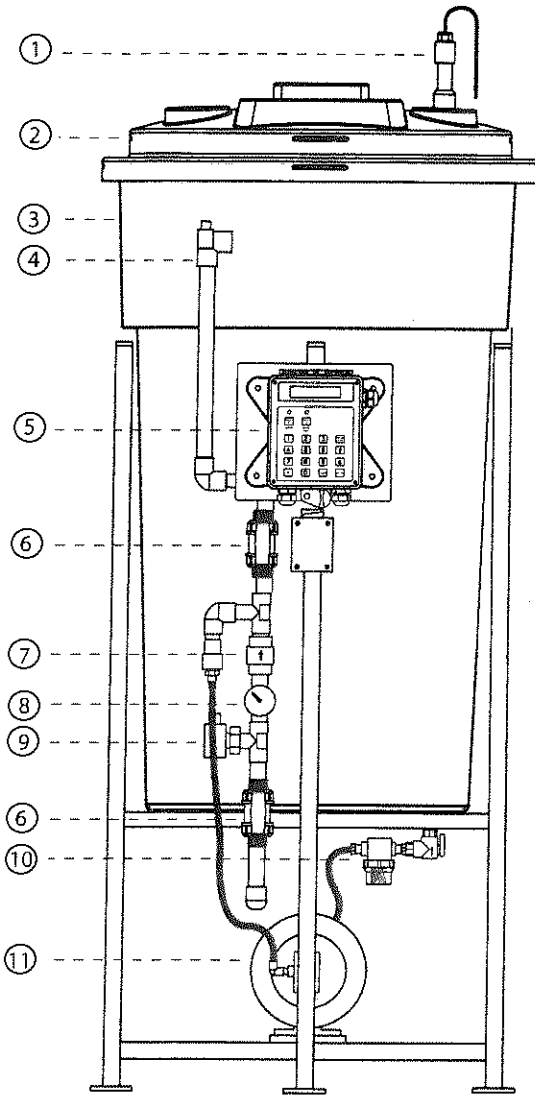
When the "No Pump" option is selected, by pressing ENTER on the keypad, the high voltage relay output(s) will deactivate upon the level wand being triggered.

When the "Pump OK" option is selected, by pressing ENTER on the keypad, the high voltage relay output(s) will not deactivate upon the level wand being triggered but an alarm message will appear on the display of the controller that reads: Possible Dry Pump.

Note: Levels 2, 3 and 4 are a built in function of the MicroTron control platform. Not used on glycol feeder models.



VI. Parts List



Parts List

1. Level wand for 30 gl = **ALL-S30**; 55 gl = **ALL-S42**
2. Tank lid for 30 gl = **LID-30-C1D**; 55 gl = **LID-55-C1D**
3. Tank for 30gl = **AGF-APCT-30**; for 55 gl = **AGF-APCT-55**
4. Pressure relief valve = **AGF-PRV**
5. Controller (for selection A) = **DALL-GF-V**
6. Isolation valve = **BV-3/4** for PVC; **GV-3/4** for copper
7. Back check = **CKV-3/4PP** for PVC; **CKV-3/4B** for copper
8. Pressure gauge = **AGF-PG**
9. Pressure transducer = **AGF-PTD**
10. Suction shut-off and strainer assembly = **AGF-SUCTION**
11. Pump = **991F41** (for selection 1); **992MJ07** (for selection 2)

Note: This list covers most of our popular models. For models not covered, consult factory.

No. 530

Calibrated Pressure Relief Valve

Features

- A calibrated adjustment feature for setting the valve to the relief pressure required.
- All Bronze construction
- All stainless steel springs

Specifications

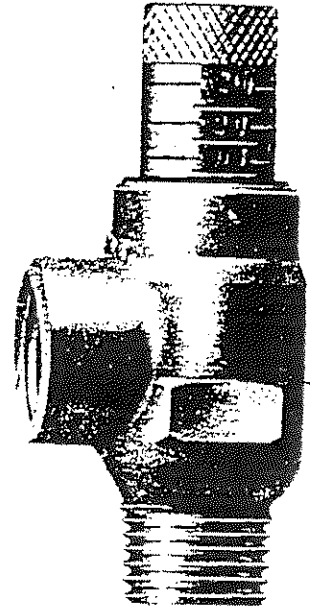
- Sizes 1/2" and 3/4" (15 and 20 MM)
- Inlet (bottom) is male threaded, NPT
- Outlet (side) is female threaded, NPT.

Design

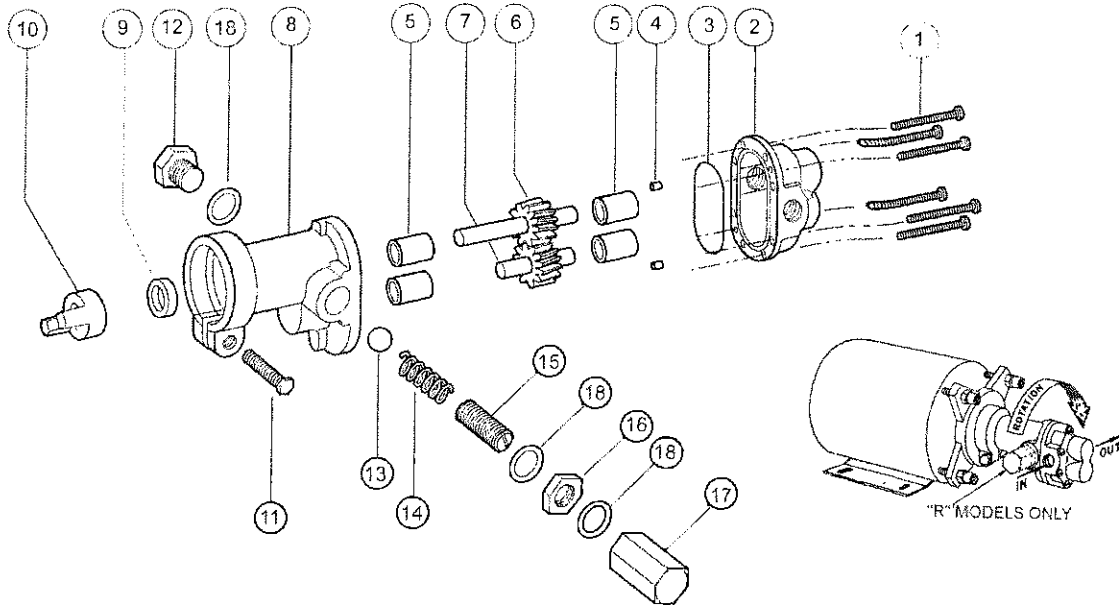
- Wats No. 530 is spring operated bronze relief valve designed to be used as protection against excessive pressure of water, oil or air.
- This device is designed for emergency safety relief and shall not be used as an operation control.
- Buna-N disc on machined body seat.

Application

- Ideally suited as a by-pass thermal expansion relief valve.
- There are a wide variety of applications where the valve is used as a protective device. One such application would be on various pipelines.



Parts List



	1	2	3*	4	5*	6*	7*	8	9#	10	11	12	13	14	15	16	17	18
	Screw	Body	O-Ring	Dowel Pin	Bearing	Drive Gear Assy	Idle Gear Assy	Cover	Lip Seal	Coupling	Screw	Plug Nut	Ball	Spring	Adj. Screw	Locknut	Bypass Nut	Fiber Washer
Pump No.	6 Req'd	1 Req'd	1 Req'd	2 Req'd	4 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	3 Req'd
N991	7733	9300NB5N	9797-033	8885	5024	32149	32110	9303NN2N	5007	5604	5595	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N991R	7733	9300NB5N	9797-033	8885	5024	32149	32110	9303NN2B	5007	5604	5595	1838	5803	1840	5237	5240	5239	6533

#Seal #5007 is Standard Buna N, #7580 is Viton(R)**-Teflon (R)**

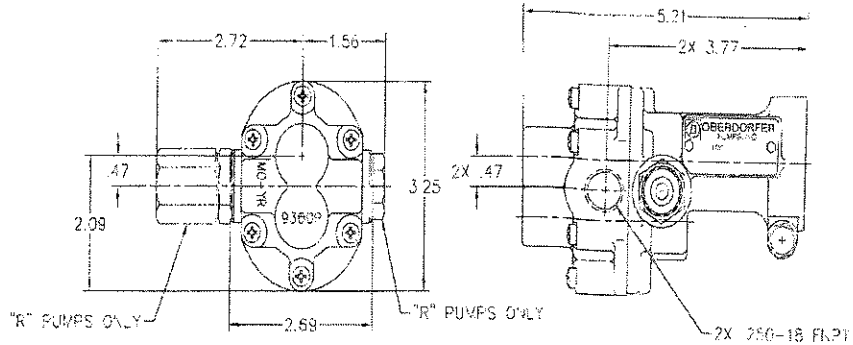
*Repair Kit contains items 3, 5, 6, 7 & 9. Repair Kit for N991(R) is #10640.

VARIATIONS

Pump No.	g ^{1/2}	
	Lip Seal	Repair Kit #
N991S5	7580	11318
N991RS5	7580	11318

Adapter Kit	Kit Number	Description
M	10562	48 Frame
N	10816	56 Frame
P	11722	S56 Frame
Q	11331	56C Frame (to 1/4 HP)
F	11332	IEC71
---	---	Adapterless- Modified 48

DIMENSIONS



*Viton® or equivalent FKM will be used.
 Viton® is a registered trademark of DuPont Dow Elastomers.
 *Teflon® or equivalent PTFE will be used. Teflon® is a registered trademark of DuPont.

Specifications are subject to change without notice.

VIII. Troubleshooting & Maintenance

The Advantage Glycol Feeder is designed for many years of trouble free operation. Should a problem occur, refer to the following chart to help identify the problem. If replacement is required, follow the procedures listed in the Warranty and Factory Service portion of this manual.

NO POWER TO UNIT. POWER PRESENT AT RECEPTICAL

This happens if the power cord is tripped over or gets caught and pulled by accident.

1. First disconnect plug from live receptacle.
2. Next you will need Phillips #2 driver to remove face plate
3. Face plates are snug fitting and it may require a small standard driver in the slot at the side of the panel to get it moving.
4. Once the panel is free, let it hang down out of view of the enclosure opening.
5. Locate the connector inside of the enclosure for power this is a GREEN three (3) terminal with screw downs.
6. Reconnect to RELAY / POWER BOARD (Drawing on page 20)
7. Before replacing the panel, do a quick visual of all connections and wiring to ensure no other damage has occurred.
8. Replace panel and secure.
9. Plug in power cord and proceed with Start-up.
10. Your power issue was not corrected.
Record Model /Serial Numbers and Call Customer Service 1 (800) 743-7431.

PUMP WILL NOT RUN. BLOWS FUSE WHEN ENERGIZED

This usually is caused by having some debris in the gears of the pump.

1. Before removing the pump head loosen the six head screw a half turn.
2. Replace blown fuse and energize pump.
3. If this corrects issue, de-energize pump, tighten six screw, proceed with Star-Up.
4. If this doesn't solve issue the pump head should be removed and inspected for particles. Because of tolerance in the gears it doesn't take a big particle to freeze the motor.
5. Before removing the head be sure to close the suction line valve.
6. It is not necessary to remove tubing.
7. Remove the six (6) head screws.
8. Be aware of the seal ring as you remove the head.
9. With your fingers turn the gears to insure that the motor is not seized.
10. If the gears turn freely you may power the pump for a short period to prove rotation.
11. If the gears do not turn freely, but they do turn, try powering the pump for short period.
12. If there is rotation. Replace the Pump Head, being careful to align gasket.
13. If the pump motor is frozen, it is best to replace the entire pump.

PUMP DOES NOT RUN WHEN INDICATOR IS ILLUMINATED

1. Check fuse and that the fuse holder cap is secure
2. Check pump wiring.
3. Check level of fluid / depth of level wand.
4. Does power down and up fix issue?
 - If Yes, there is a limit time set in the PRESSURE SET Menu.
 - If No, the most likely cause is a loose wire inside of control enclosure. (See NO POWER TO UNIT. POWER PRESENT AT RECEPTICAL 1 thru 10 above)

PUMP DOES NOT SHUT OFF WHEN TANK IS EMPTY

1. First verify that in LEVEL SET Menu that level one(1) is active.
2. Level is not Active, press enter to change to active. This should end issue.
3. Level is Active. Disconnect level wand connection. Alarm should sound and pump stop.

- If Yes, inspect end of level wand for debris or damage, replace if needed. (The float at bottom of the wand should have free movement, up and down.
- If No, inspect wire for damage. If no damage visible inspect internal wiring. (See NO POWER TO UNIT, POWER PRESENT AT RECEPTICAL 1 thru 10 above)

4. If no resolution is found, record Serial / Model numbers and call customer service

LOW LEVEL ALARM STAYS ON

1. Disconnect level wand connection and short across connectors with screw driver. (this is low voltage and not dangerous)
2. This turns off the alarm. There is a problem with the wand itself.
3. Inspect the float end of the level wand.
4. If the float is free moving replace wand.
5. Shorting the connector does not turn off alarm. Inspect internal wiring. (See NO POWER TO UNIT, POWER PRESENT AT RECEPTICAL 1 thru 10 above)
6. Still no resolution record Model / Serial numbers and call customer service.

READING ZERO WILL NOT CALIBRATE

1. Isolate glycol feeder from system pressure by closing isolation valve.
2. Release pressure at the sensor by either valve or loosening union.
3. With pressure at zero press ENTER.
4. Controller will than display CALIBRATE.
5. Open Isolation Valve to reestablish pressure to Sensor.
6. Press enter and key in correct pressure.
7. Press enter key and the correct value should display after brief moment.

Maintenance

Being a self-contained unit with a sealed fractional horsepower motor vary little maintenance is required.

1. Depending on your environment will gauge how often the bowl strainer will need cleaning.
2. The Tank should be inspected occasionally for trash and or debris.
3. Occasional running of Your pump or pumps will insure their longest life.

IX. Manufacturer's Product Warranty

Advantage Controls warrants units of its manufacture to be free of defects in material or workmanship. Liability under this policy extends for 24 months from date of installation. Liability is limited to repair or replacement of any failed equipment or part proven defective in material or workmanship upon manufacturer's examination. Removal and installation costs are not included under this warranty. Manufacturer's liability shall never exceed the selling price of equipment or part in question. Advantage disclaims all liability for damage caused by its products by improper installation, maintenance, use or attempts to operate products beyond their intended functionality, intentionally or otherwise, or any unauthorized repair. Advantage is not responsible for damages, injuries or expense incurred through the use of its products.

The above warranty is in lieu of other warranties, either expressed or implied. No agent of ours is authorized to provide any warranty other than the above.

30 Day Billing Memo Policy

Advantage Controls maintains a unique factory exchange program to ensure uninterrupted service with minimum downtime. If your unit malfunctions, call 1-800-743-7431, and provide our technician with Model and Serial Number information. If we are unable to diagnose and solve your problem over the phone, a fully warranted replacement unit will be shipped, usually within 48 hours, on a 30 Day Billing Memo.

This service requires a purchase order and the replacement unit is billed to your regular account for payment.

The replacement unit will be billed at current list price for that model less any applicable resale discount. Upon return of your old unit, credit will be issued to your account if the unit is in warranty. If the unit is out of warranty or the damage not covered, a partial credit will be applied based upon a prorated replacement price schedule dependent on the age of the unit. Any exchange covers only the controller or pump. Electrodes, liquid end components and other external accessories are not included.

Reference Chart % Propylene Glycol

Weight % Propylene Glycol	Volume % Propylene Glycol	Freeze Point°F	Refractive Index N _D 77°F	Degree Brix	Boiling Point °F @760MM Hg
20	19.4	19.9	1.3565	15.4	213°F
21	20.4	19.0	1.3575	16.0	
22	21.4	18.0	1.3586	16.7	
23	22.4	17.0	1.3598	17.4	
24	23.4	16.0	1.3611	18.4	
25	24.4	15.0	1.3621	18.8	214°F
26	25.3	14.0	1.3632	19.6	
27	26.4	13.0	1.3643	20.2	
28	27.4	12.0	1.3654	20.8	
29	28.4	11.0	1.3664	21.4	
30	29.4	9.1	1.3674	22.0	216°F
31	30.4	8.0	1.3685	22.7	
32	31.4	7.0	1.3700	23.6	
33	32.4	6.0	1.3714	24.4	
34	33.5	4.0	1.3729	25.3	
35	34.4	3.0	1.3742	26.1	217°F
36	35.5	1.0	1.3755	26.9	
37	36.5	0	1.3765	27.5	
38	37.5	-2.0	1.3775	28.0	
39	38.5	-4.0	1.3785	28.5	
40	39.6	-5.0	1.3796	29.1	219°F
41	40.6	-7.0	1.3806	29.6	
42	41.6	-9.0	1.3816	30.2	
43	42.6	-11.0	1.3826	30.7	
44	43.7	-13.00	1.3837	31.3	
45	44.7	-15.0	1.3847	31.8	220°F
46	45.7	-17.0	1.3857	32.4	
47	46.8	-19.0	1.3868	33.0	
48	47.8	-22.0	1.3878	33.5	
49	48.9	-25.0	1.3889	34.1	
50	49.9	-29.0	1.3899	34.7	222°F
51	50.9	-31.0	1.3911	35.5	
52	51.9	-33.0	1.3922	35.9	
53	53.0	-37.0	1.3936	36.6	
54	54.0	-40.00	1.3947	37.2	
55	55.0	-43.6	1.3961	38.0	
56	56.0	-46.0	1.3968	38.4	
57	57.0	-50.0	1.3891	39.1	
58	58.0	-53.0	1.3911	39.6	
59	59.0	-57.0	1.4002	40.3	
60	60.0	-60.0	1.4012	40.7	225°F

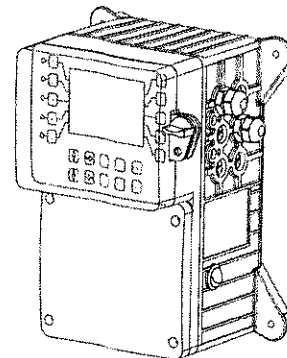
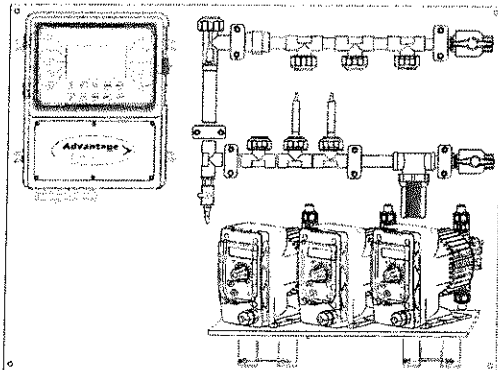
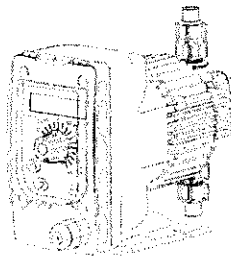
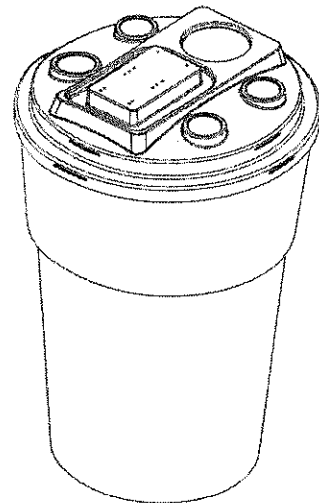
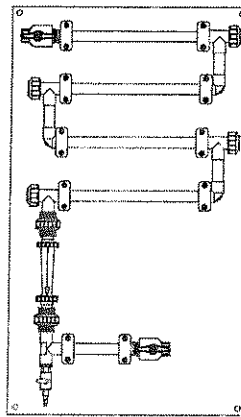
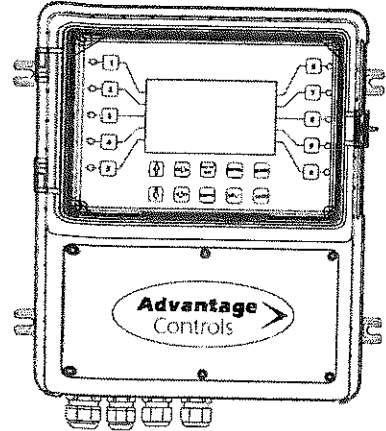
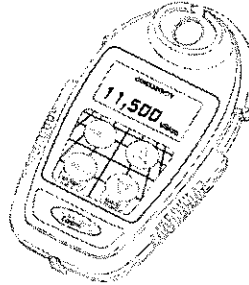
Reference Chart % Ethylene Glycol

Weight % Ethylene Glycol	Volume % Ethylene Glycol	Freeze Point°F	Refractive Index N _D 77°F	Degree Brix	Boiling Point °F @760MM Hg
20	18.1	17.0	1.3525	13.0	216°F
21	19.2	16.5	1.3536	13.7	
22	20.1	16.0	1.3546	14.3	
23	21.0	14.0	1.3555	14.8	
24	22.0	13.0	1.3565	15.4	
25	22.9	12.0	1.3575	16.0	218°F
26	23.9	11.0	1.3585	16.6	
27	24.8	10.0	1.3590	17.0	
28	25.8	9.0	1.3606	17.7	
29	26.7	8.0	1.3615	18.5	
30	27.7	7.0	1.3625	19.0	220°F
31	28.7	5.0	1.3636	22.8	
32	29.6	4.0	1.3645	23.4	
33	30.6	2.0	1.3645	20.9	
34	31.6	1.0	1.3666	21.5	
35	32.6	0.0	1.3677	22.2	221°F
36	33.5	-1.0	1.3686	22.8	
37	34.5	-3.0	1.3696	23.4	
38	35.5	-4.0	1.3707	24.0	
39	36.5	-5.0	1.3718	24.6	
40	37.5	-8.0	1.3728	28.2	224°F
41	38.5	-9.0	1.3729	29.1	
42	39.5	-11.0	1.3750	26.5	
43	40.5	-13.0	1.3760	27.2	
44	41.5	-15.0	1.3770	27.7	
45	42.5	-17.0	1.3780	28.2	225°F
46	44.0	-20.0	1.3796	29.1	
47	45.0	-22.0	1.3806	29.6	
48	46.0	-24.0	1.3818	30.2	
49	47.1	-26.0	1.3828	30.8	
50	48.0	-28.0	1.3837	31.3	227°F
51	49.1	-31.0	1.3848	31.9	
52	50.1	-35.0	1.3858	32.5	
53	51.2	-36.0	1.3869	33.1	
54	52.2	-38.0	1.3880	33.6	
55	53.2	-43.0	1.3889	34.1	227°F
56	54.3	-45.0	1.3968	38.4	
57	55.3	-50.0	1.3909	35.2	
58	56.3	-52.0	1.3919	35.7	
59	57.4	-54.0	1.3930	36.4	
60	68.4	-58.4	1.3939	36.8	230°F

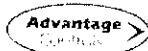
Get the Advantage in Water Treatment Equipment

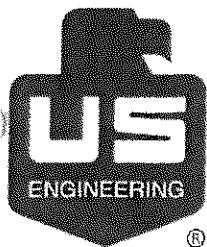
Advantage Controls can give you the *Advantage* in products, knowledge and support on all of your water treatment equipment needs.

- Cooling Tower Controllers
- Boiler Blow Down Controllers
- Blow Down Valve Packages
- Solenoid Valves
- Water Meters
- Chemical Metering Pumps
- Corrosion Coupon Racks
- Chemical Solution Tanks
- Solid Feed Systems
- Feed Timers
- Filter Equipment
- Glycol Feed Systems
- Pre Fabricated Systems



Get the Advantage

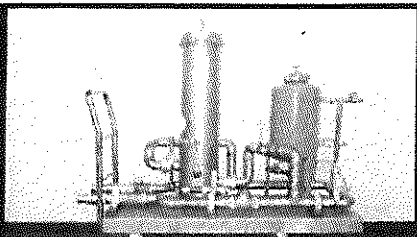




Chemical MSDS For
HVAC Water
Treatment

**BEATTIE
ELEMENTARY
SCHOOL**

1000 MEADOWLARK AVE
FORT COLLINS CO 80526



The Right Chemistry

Multi-Purpose Cleaner

C-311

CHARACTERISTICS:

C-311 is designed as a multipurpose cleaner used to clean new and existing piping systems, for boiler boil-out and in cleaning new and operational cooling tower systems. C-311 will penetrate, lift and disperse oil, grease, biofilm, and loose corrosion debris and mill residues. C-311 is a granular powdered formulation containing sodium hydroxide, trisodium phosphate, sodium metasilicate, chelating agents and a unique blend of petroleum distillates, surfactants and wetting agents. C-311 will lift and disperse various organic and inorganic foulants in such a way that they remain uniformly suspended in the water for complete removal through system draining, on-line purge flushing, filtration or a combination of these removal procedures. C-311 is especially effective in cooling tower systems for the remediation of microbiological films, algae build-up and to immediately stop the under deposit corrosion produced by iron and sulfate reducing bacteria.

C-311 may be safely used with all metals normally used in piping systems, i.e. steel, copper, copper alloys, stainless steel, solder, etc. C-311 is not suitable for use with aluminum or for extended contact with galvanized steel. C-311 may, however, be used in cooling towers containing galvanized steel components if total exposure time, including flushing, is limited to 24 hours. New cooling towers cleaned with C-311 have been found to have significantly less white rust occurrence than towers not initially cleaned. The cleaning period and time that is required for complete flushing of closed recirculating water systems should not extend beyond 120 hours. If C-311 is not completely removed within this time period, elastomers, copper and copper alloys, soldered joints, and mechanical pump seals may be damaged.

BENEFITS:

- * Extremely efficient cleaner
- * Conforms to FDA and GRAS guidelines
- * USDA approved for boiler boil-out and new pipe cleaning
- * Totally removes oil, grease and organic films
- * Penetrates and disperses bio-growth to stop underlying activity
- * Safe with system components, elastomers and pump seals
- * Excellent for remediation of acidic glycol initiated corrosion

TYPICAL PROPERTIES:

Physical Form	Light amber granular solid
Solubility in Water	Rapid and complete
pH of 1% Solution	14
Chemical Properties	Highly Alkaline, Slightly hygroscopic Odor Aromatic
Flash Point	None

CLEANING PIPING SYSTEMS:

The dosage of C-311 is 60 lbs. per 1000 gallons of system volume. Determine the volume of water in the system and then calculate the total amount of C-311 required. Dissolve the necessary C-311 in water prior to adding to the system using a pump/tank/agitator assembly (available from H-O-H Chemicals) or a pot feeder for small systems. If the dosage is correct, the total ("M") alkalinity of the system water will be approximately 5000 ppm.

The cleaning solution should be circulated for at least 24 hours, heating to 160° to 180° F., if possible. Heat should not be applied to chiller systems where Freon is present without first removing the refrigerant. If the water cannot be heated, extend the circulation time to 48 hours, but never more than 72 hours. When cleaning is complete the cleaner should be removed as quickly as possible. The system may be completely drained and thoroughly flushed with fresh water or, alternately, adding fresh water and removing system water at the same rate may be used to purge the system. Flushing is considered complete when the total ("M") alkalinity of the system water is within 50 ppm of the alkalinity of the fresh water. Flushing should be completed within 120 hours after the introduction of C-311.

During the cleaning period, it is highly desirable to use side stream filtration to remove fine particulate matter. The filtration rate in GPM should be sufficient to filter the total system volume in roughly 3 to 4 hours. The filtering media (30 or 50 micron cartridges) should be replaced as necessary.

STEAM BOILER BOIL-OUT:

Steam Boilers: Determine the working volume of the boiler and calculate the C-311 requirement on the basis of 60 pounds per 1000 gallons. Dissolve C-311 in water and, if possible, add the solution proportionately to boiler as it is being filled. If not, pour the solution through a vent or manhole. Fire the boiler gradually and close all vents when steam appears. Build pressure to 50% of normal working pressure. The boil-out should continue for a minimum of 48 hours. During the entire boiling-out period, blow the boiler from all openings at least once every 8 hours, blowing first from the surface blow and progressing to lower points on the boiler. Replenish blow-down losses with C-311 treated water to maintain desired cleaning strength and, upon completion, flush all boiler surfaces with high pressure water. Inspect boiler for cleanliness.

COOLING TOWER SYSTEM CLEANING:

Determine the total capacity of the system to be cleaned and calculate the amount of C-311 required based on a dosage rate of 75 lbs. C-311 per 1000 gallons of system volume. Before adding C-311, first clean the tower sump of as much sediment and debris as possible. This will insure the rapid contact of C-311 with any remaining adherent material that could not be easily removed from the cooling tower. If desired, the basin water or the entire system may be slug dosed with sodium hypochlorite to minimize bioactivity while the sludge is being removed. Discontinue bleed-off and all chemical introductions before adding C-311.

C-311 may be added directly to the cooling tower basin provided that highly turbulent flow is present. The C-311 may be slowly sifted into the flowing water at a pace sufficient to avoid accumulation at the bottom of the sump. Alternately, if the discharge of cooling tower water can be approached safely, C-311 may be slowly added to the water flowing into the system recirculating water piping leaving the cooling tower. A third option is to employ a pump/tank/agitator assembly (available from H-O-H Chemicals) with the discharge directed into the cooling tower sump.

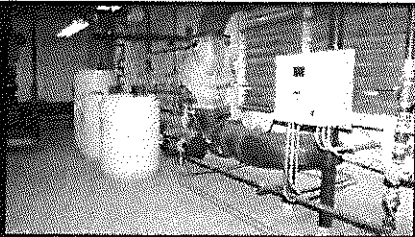
About 15 minutes after completing the addition of the C-311 determine both the "P" and the "M" alkalinity of the tower water. Based on this data, the hydroxide ("OH") alkalinity of the water may be determined by multiplying the "P" alkalinity by two and then subtracting the "M" alkalinity, i.e. $2(P) - M = OH$. The initial "OH" should be roughly 2000 ppm, but this will quickly fall as the cleaner reacts with organic matter and with atmospheric carbon dioxide. The cleaning should be considered complete after four (4) hours or one hour after the "OH" alkalinity has fallen to zero. At this point bleed-off should be reestablished at its maximum rate with flow being maintained continuously until flushing is complete. Flushing is considered complete when the "M" alkalinity of the tower water has fallen to no more than 50 ppm over the "M" alkalinity of the tower make-up water.

STORAGE AND HANDLING:

C-311 contains a high fraction of sodium hydroxide (Lye). Concentrated solutions of pure C-311 will cause serious skin burns and rapid damage of eye tissue. Safety equipment including face shield, rubber gloves and rubber apron must be worn when handling C-311. C-311 is mildly hygroscopic and should be used promptly after opening the shipping container. C-311 may harden once the shipping container is opened depending on the amount of moisture absorbed from the atmosphere and the subsequent length of storage. Store in a cool dry location away from sources of radiant heat and out of direct sunlight.

MATERIALS OF CONSTRUCTION:

C-311 (powder) may be allowed to contact steel, stainless steel, copper or plastics. Pure C-311 powder should not be allowed contact aluminum, brass, soldered connections, galvanized metal, painted surfaces, asphalt or rubber roofing materials, fabrics, carpeting or any decorative surfaces. When dissolving C-311 use polyethylene utensils, tanks and tubing. Alternately, rubber hose, PVC, polypropylene Tygon and vinyl are also acceptable.



The Right Chemistry

Multi-Purpose Cleaner C-311

SAFETY AND ENVIRONMENTAL INFORMATION:

C-311 is a highly alkaline product that will damage the skin and eyes. Wear rubber gloves, rubber apron, chemical safety goggles or full-face shield while handling this product. In the event of skin contact, flush with water and wash thoroughly with a mild soap and water. If redness or burning occurs, get prompt medical attention. In case of eye contact, flush eyes with large amounts of fresh water for 15 minutes and get immediate medical attention. **DO NOT TAKE INTERNALLY.** Anyone responsible for the procurement, use or disposal of C-311 should familiarize themselves with the appropriate safety and handling information outlined in the H-O-H Chemicals Material Safety Data Sheet. In the event of an emergency with C-311, contact H-O-H Chemicals during business hours at 847/358 7400 or Chemtrec anytime day or night at 800/424-9300.

Water containing the recommended dosage of C-311 is mildly caustic with a pH of approximately 12.5. Check local discharge ordinances prior to discharging to a sanitary sewer or plant out-fall.

SHIPPING:

C-311 cleaner is shipped in 50-pound net plastic pails or 125 pound net plastic lined fiber drums. C-311 is considered to be a hazardous substance for the purposes of shipping by DOT. C-311 is classified as a corrosive, packaging group II.

ADDITIONAL INFORMATION:

To place an order or obtain technical information,

847/358 7400
www.hohchemicals.com

* C-311 MSDS

MATERIAL SAFETY DATA SHEET

QUICK REFERENCE:

C-311



H - O - H Water Technology, Inc.
 500 South Vermont Street
 Palatine, Illinois 60067

EMERGENCY PHONE No's

847 - 358 - 7400 (H - O - H BUSINESS Hrs.)
 800 - 424 - 9300 (CHEMTREC - 24 Hrs.)

HMIS:

4 = EXTREME
 3 = SEVERE
 2 = MODERATE
 1 = SLIGHT
 0 = INSIGNIFICANT



D.O.T.:

HAZARD LABELING



IN FIBER KEGS

PRODUCT IDENTIFICATION	PRODUCT NAME	CHEMICAL FAMILY	DATE	Rev. No.	SUPERSEDES	EPA - TPQ	BY
	C-311	CAUSTIC CLEANER	7-5-08	13	7-11-06	NA	

HAZARDOUS COMPONENTS	CHEMICAL NAME	COMMON NAME	CAS No.	PERCENT	OSHA PEL	ACGIH-TLV	OTHER
	SODIUM HYDROXIDE	LYE, CAUSTIC SODA	1310-73-2	44	2 mg/m ³	2 mg/m ³	OSHA Cel. 2 mg / m ³

COMMENT
1. NEVER ADD WATER TO THIS PRODUCT. IN MAKING SOLUTIONS, FOR CLEANING, ALWAYS ADD PRODUCT SLOWLY TO WATER WITH VIGOROUS MIXING OR AGITATION. 2. THE PERMISSIBLE FEDERAL EXPOSURE STANDARD FOR PURE SODIUM HYDROXIDE IN AIR IS 2 mg/m ³ . NO CRITERIA HAS BEEN SET FOR WATER. 3. GRANULES OF THIS PRODUCT TEND TO STICK TO PROTECTIVE CLOTHING AND GLOVES. WHEN REMOVING SUCH PROTECTIVE EQUIPMENT, BE CAREFUL NOT TO COME INTO CONTACT WITH RESIDUAL PRODUCT. ALWAYS WASH PROTECTIVE EQUIPMENT THOROUGHLY AFTER EACH USE.

PHYSICAL DATA	BOILING POINT (Degrees Fahrenheit)	NA	SOLUBILITY (In water)	SOLUBLE	EVAPORATION RATE (water = 1.0)	NA
	VAPOR PRESSURE (In millimeters of Mercury)	NA	SPECIFIC GRAVITY (water = 1.0)	NA	pH	12.6
	VAPOR DENSITY (air = 1.0)	NA	PERCENT (%) VOLATILE (by volume)	NA		
	APPEARANCE and ODOR	LIGHT YELLOW COLORED GRANULAR SOLID WITH MILD ORGANIC ODOR.				

FIRE AND EXPLOSION	FLASH POINT (Degrees Fahrenheit)	METHOD	FLAMMABLE LIMITS	LOWER EXPLOSIVE LIMIT	UPPER EXPLOSIVE LIMIT
	NONE	NA		NOT APPLICABLE	NOT APPLICABLE
	EXTINGUISHING MEDIA	SPECIAL FIRE FIGHTING PROCEDURES	UNUSUAL FIRE AND EXPLOSION HAZARDS		
	WATER THIS PRODUCT WILL NOT BURN OR DIRECTLY PROMOTE FIRE.	PROTECT OR REMOVE FIBRE KEGS THIS PRODUCT IS PACKAGED IN FIBRE KEGS THAT MAY BE DAMAGED IN A FIRE. IF THIS PRODUCT IS RELEASED FROM A DAMAGED SHIPPING CONTAINER, REACTIONS MAY OCCUR WITH METALS, CERTAIN BUILDING MATERIALS, OR VARIOUS STORED MATERIALS. SODIUM HYDROXIDE REACTS STRONGLY WITH ALUMINUM PRODUCING FLAMMABLE HYDROGEN GAS. DO NOT ALLOW DRY SPILLED MATERIAL TO CONTACT ANY OTHER CHEMICAL.	SECONDARY REACTIONS UNDER NORMAL CONDITIONS THIS PRODUCT WILL NOT SUPPORT COMBUSTION OR ACCELERATE A FIRE. IF CONTACT WITH BUILDING MATERIALS, OTHER CHEMICALS, OR LIVE ELECTRICAL SERVICES OCCURS DURING A FIRE, UNPREDICTABLE HEAT, HAZARDOUS GASES, OR ELECTRICAL ARCS MAY BE PRODUCED.		

REACTIVITY DATA	STABILITY	CONDITIONS TO AVOID
	STABLE <input checked="" type="checkbox"/> UNSTABLE <input type="checkbox"/>	NOT APPLICABLE
	INCOMPATIBILITY (Materials to Avoid)	METALS (SUCH AS ALUMINUM, TIN, AND ZINC), ACIDS, BROMINE AND CHLORINE RELEASE AGENTS.
	HAZARDOUS DECOMPOSITION PRODUCTS	NONE.
HAZARDOUS POLYMERIZATION MAY WILL OCCUR <input type="checkbox"/> WON'T OCCUR <input checked="" type="checkbox"/>	CONDITIONS TO AVOID	NOT APPLICABLE

SPECIAL PRECAUTIONS	STORAGE AND HANDLING	OTHER
	1. PROTECT CONTAINERS AGAINST PHYSICAL DAMAGE. 2. STORE IN A COOL, DARK, WELL-VENTILATED LOCATION AWAY FROM DIRECT SUNLIGHT AND OTHER SOURCES OF RADIANT HEAT. 3. KEEP CONTAINERS TIGHTLY CLOSED WHEN NOT IN USE. NEVER MOVE AN OPEN OR LOOSELY CLOSED CHEMICAL CONTAINER. 4. WEAR HAND AND FOOT PROTECTION WHEN MOVING HEAVY CONTAINERS. 5. STORE AT 60° F. OR HIGHER.	1. NOT TO BE TAKEN INTERNALLY. 2. NOT TO BE USED FOR OTHER THAN SPECIFIED PURPOSE. 3. KEEP AWAY FROM CHILDREN. 4. NEVER MIX THIS MATERIAL WITH ANY OTHER CHEMICAL UNLESS AT THE SPECIFIC DIRECTION OF H - O - H PERSONNEL. 5. TRIPLE RINSE EMPTY CONTAINERS BEFORE OFFERING FOR DISPOSAL OR SALVAGE. NEVER REUSE EMPTY CONTAINERS.

HEALTH HAZARD DATA	THRESHOLD LIMIT VALUE	4.5 mg/m ³ (AIR) 15 MINUTE CEILING (NIOSH) RELATIVE TO PURE SODIUM HYDROXIDE.	C-311
	ACUTE HEALTH HAZARDS		
TISSUE BURNS		NONE	
STRONGLY CORROSIVE TO ALL BODY TISSUES WITH WHICH IT COMES IN CONTACT.		BURNS CAN BE SLOW TO HEAL, BUT NO CHRONIC HEALTH HAZARDS ARE INVOLVED. FREQUENT EXPOSURE TO LEVELS MODERATELY IN EXCESS OF THE TLV MAY PRODUCE SYMPTOMS, BUT IF EXPOSURE IS ELIMINATED, SYMPTOMS SHOULD DISAPPEAR.	

EFFECTS OF EXPOSURE	SKIN AND EYES / TARGET ORGAN	INHALATION / TARGET ORGAN	INGESTION / TARGET ORGAN
	BURNS	NON - VOLATILE / NON - DUSTING	
CAUSES HIGHLY PAINFUL INSTANTANEOUS IRRITATION OF EYES AND EYELIDS. MAY CAUSE ULCERATION OR PERFORATION OF EYES OR EYELIDS, LOSS OF EYES OR EYESIGHT.		IF A LIQUID MIST OR SPRAY OF CONCENTRATED PRODUCT IS DRAWN INTO THE BREATHING TRACT, SEVERE IRRITATION OF RESPIRATORY TRACT, PULMONARY EDEMA, MAY OCCUR.	CAUSES ULCERATION, BLEEDING, AND SCARRING OF THE DIGESTIVE TRACT. SHOCK, CONVULSIONS, COMA, AND DEATH MAY RESULT DEPENDING ON THE AMOUNT INGESTED.
CAUSES ULCERATION OF SKIN WITH SLIPPERY, SOAPY FEELING. IRREPARABLE DAMAGE POSSIBLE.		NASAL, MUCOUS, AND BRONCHIAL TISSUE MAY BE BURNED AND/OR PERMANENTLY DAMAGED.	COFFEE - GROUND - LIKE MATERIAL PRODUCED WITH VOMITING INDICATES DIGESTIVE BLEEDING.
CONDITIONS AGGRAVATED	DERMATITIS, BLISTERS, BURNS, OR ANY PRE-EXISTING SKIN IRRITATION IF CONTACT OCCURS.	IN NORMAL USE, NO EFFECT SHOULD BE NOTED SINCE NO VOLATILE COMPONENT IS PRESENT.	IN NORMAL USE, INGESTION SHOULD NOT OCCUR. INGESTION WILL PRODUCE IMMEDIATE TRAUMA.

EMERGENCY PROCEDURES	SKIN AND EYES	INHALATION	INGESTION
	EYES	NON - VOLATILE	DO NOT INDUCE VOMITING
FLUSH EYES WITH WATER FOR AT LEAST 15 MINUTES HOLDING EYELIDS OPEN. GET IMMEDIATE MEDICAL ATTENTION.		IF LIQUID CONCENTRATE, SPRAY, OR MIST IS INHALED, REMOVE SUBJECT TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. GIVE OXYGEN BY PROPERLY TRAINED PERSONNEL IF BREATHING IS DIFFICULT. KEEP SUBJECT WARM AND AT REST. OBTAIN EMERGENCY MEDICAL ATTENTION. DO NOT LEAVE PERSON UNATTENDED. ENCOURAGE NOSE BLOWING, COUGHING, AND SPITTING - OUT.	IF CONSCIOUS, DILUTE INGESTED MATERIAL WITH 2 OR MORE GLASSES OF WATER OR MILK. OBTAIN EMERGENCY MEDICAL ATTENTION. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.
SKIN FLUSH WITH WATER FOR 15 MINUTES. TREAT FOR BURNS. OBTAIN MEDICAL ADVICE. REMOVE EXPOSED CLOTHING AND WASH WELL BEFORE REUSE. CONTINUE TO WASH WITH LUKE - WARM WATER UNTIL THE FEELING OF STICKINESS OR SOAPINESS DISAPPEARS, UP TO AN HOUR MAY BE NEEDED.			INDUCED VOMITING IS NOT RECOMMENDED DUE TO POSSIBLE BRONCHIAL OR PULMONARY INGESTION. EMERGENCY MEDICAL ATTENTION IS REQUIRED TO REMOVE ANY INGESTED CAUSTIC AND MINIMIZE INTERNAL BURNS AND TISSUE DAMAGE.

CARCINOGEN LISTING	NATIONAL TOXICOLOGY PROGRAM (NTP)	IARC MONOGRAPHS	OSHA REGULATED
	NO	NO	YES (SODIUM HYDROXIDE)

SPILL OR LEAK PROCEDURES	SPILLS AND RELEASES	WASTE DISPOSAL METHODS
	COLLECT ANY SPILLED MATERIAL AND RETURN TO SHIPPING CONTAINER IF NOT CONTAMINATED. IF CONCENTRATED SOLUTIONS ARE SPILLED, NOTIFY THE APPROPRIATE POLLUTION CONTROL (ESDA) AUTHORITIES IF LEAKAGE ENTERS A SEWER OR IN ANY OTHER WAY IS ESCAPING FROM THE PREMISES. COLLECT SPILLED SOLUTION INTO SUITABLE CONTAINERS FOR RECLAIM OR DISPOSAL. NEUTRALIZE WITH DILUTE SOLUTIONS OF SULFURIC, HYDROCHLORIC, OR SULFAMIC ACIDS OR SODIUM BISULFATE. WHEN NEUTRALIZING WITH DILUTE ACID, BE CAREFUL FOR HEAT GENERATION AND POSSIBLE OVER NEUTRALIZATION LEADING TO ACIDIC CONDITIONS.	CONSULT FEDERAL, STATE, AND LOCAL REGULATIONS PERTAINING TO WASTE DISPOSAL.

CONTROL MEASURES	EYE PROTECTION	TIGHT - FITTING CHEMICAL GOGGLES AND FACE SHIELD.		
	RESPIRATORY PROTECTION	NOT REQUIRED FOR ORDINARY USE. DURING EMERGENCY CONDITIONS OR IF A SERIOUS SPILL OCCURS, AN AIR PURIFYING RESPIRATOR DESIGNED TO ABSORB ALKALINE VAPORS (AMMONIA, AMINES, ETC.) AND CHLORINE SHOULD BE USED.		
	OTHER PROTECTIVE EQUIPMENT	IMPERMEABLE CLOTHING. SAFETY SHOWERS AND EYEWASH FOUNTAINS SHOULD BE INSTALLED IN STORAGE AND HANDLING AREAS.		
	LOCAL EXHAUST	YES	SPECIAL VENTILATION	NOT REQUIRED FOR NORMAL USE.
	MECHANICAL VENTILATION	NOT REQUIRED FOR NORMAL USE.	OTHER VENTILATION	NOT REQUIRED FOR NORMAL USE.
	PROTECTIVE GLOVES	NON - SLIP ELBOW LENGTH VINYL OR RUBBER GLOVES.	PROTECTIVE CLOTHING	RUBBER OR VINYL APRON.

REFERENCES	1. <i>Threshold Limit Values For Chemical Substances And Physical Agents In The Work Environment</i> : ACGIH, 1989.
	2. <i>OSHA Safety and Health Standards</i> : 29CFR 1900 to 1910, July 1, 1988
	3. <i>Fifth Annual Report on Carcinogens</i> ; U. S. Dept. of Health and Human Services, National Toxicology Program, 1989 (Summary).
	4. M. Sittig, <i>Handbook of Toxic & Hazardous Chemicals</i> , (Noyes Publications, Park Ridge, N. J., 1981).
	5. <i>Community Right - To - Know Manual</i> , (Thompson Publishing Group, Washington, D. C., 1990).
	6. <i>Right - To - Know / Chemical Manual</i> (ILLINOIS MANUFACTURES ASSOCIATION; Rooks, Pills, and Poust, 1990).
	7. <i>Toxic and Hazardous Industrial Chemicals Safety Manual</i> (THE INTERNATIONAL TECHNICAL INFORMATION INSTITUTE, 1975).
	8. M. J. Lefevre, S. A. Conibear, <i>First Aid Manual for Chemical Accidents</i> , 2nd ed. (Van Nostrand Reinhold, New York, 1989).
	9. <i>Hazardous Materials Guide; Shipping, Materials Handling and Transportation</i> (J. J. KELLER & ASSOCIATES, Inc., Neenah, Wisconsin, Dec. 1990)
	10. <i>Hazard Communication Guide; Federal & State Right to Know Standards</i> (J. J. KELLER & ASSOCIATES, Inc., Neenah, Wisconsin, Dec. 1990)

REPORTABLE QUANTITY	IF MORE THAN THE INDICATED QUANTITY IS DISCHARGED TO DRAINAGE (Sewer/surface water), AIR, OR SOIL, IMMEDIATELY REPORT AS INDICATED.		
	CERCLA OR EPA (Extremely Hazardous) NATIONAL RESPONSE CENTER (800 - 424 - 8802)	STATE EMERGENCY RELEASE NOTIFICATION ILLINOIS (Only) 800 - 782 - 7860 (Consult for others)	LOCAL EMERGENCY RESPONSE AUTHORITY Record Telephone No. of Local Response Authority
WRITTEN REPORT MUST FOLLOW	2,275 lbs. (Sodium Hydroxide)	CONTACT	CONTACT

Material Safety Data Sheet

L-825

SUMMIT LABORATORIES, INC.
3955 Forest Street
Denver, CO 80207

Phone: (303) 293-9862
Chemical Emergencies Only:
Chem-Tel 1-800-255-3924

SECTION 1 - Product Identification

Tradename: L-825
Description: Corrosion and Scale Inhibitor
Product Type: Closed Loop Treatment

Hazardous Ingredients:

<u>Ingredients</u>	<u>CAS Number</u>	<u>%</u>	<u>Exposure Criteria</u>
Sodium Nitrite	7632-00-0	<20.0	NA
Potassium Hydroxide	1310-58-3	< 1.0	2MG/M3
Tolytriazole, Sodium Salt	64665-57-2	< 1.6	NA

SECTION 2 - Physical Data

Appearance:	Pale yellow liquid	Vapor density:	Equivalent to water
Odor:	Slight	Vapor pressure:	NE
Boiling point:	100-103C (Water)	Solubility in water:	Complete
Freeze point:	NE	pH:	11.0-12.0
Decomposition temperature:	490 C (914 F)	Specific gravity:	1.14
Evaporation rate:	Equivalent to water	Pounds per gallon:	9.5
Percent volatile:	>70% Water		

SECTION 3 - Fire and Explosion Hazard Data

Flash point:	NA – water solution	°F
Flammable limits in air % by vol.	Upper: NA	Lower: NA
Extinguishing media:	Water fog, carbon dioxide, foam, dry chemical	
Special fire fighting procedures:	None	
Unusual fire and explosion hazard:	None	
Auto ignition temperature	NE	°F

SECTION 4 - Reactivity Data

Stability:	Stable
Incompatibility:	Acids, ammonium salts, amines, activated carbon, cyanides, and reducing agents
Hazardous decomposition products:	Oxygen and toxic nitrogen gases
Hazardous polymerization:	Will not occur

SECTION 5 - Health Hazard Data

Emergency and first aid procedures:

Eyes: Immediately flush with water at least 15 minutes and seek medical attention.

Skin: Wash with soapy water. See a physician if irritation occurs. Wash contaminated clothing.

Inhalation: Remove to fresh air.

Ingestion:

SECTION 6 - Spill or Leak Procedures**Spill Procedures:**

Large Spill: Dam area to prevent spill from spreading. Pump into appropriate container.
 Small Spill: Flush liquid to sewer with copious amounts of water.

Waste Disposal Methods:

Dispose in accordance with Federal, State and Local regulations.

SECTION 7 - Special Protection Information

Ventilation: Good general mechanical ventilation recommended.
Protective gloves: Impervious gloves.
Eye protection: Splash-proof chemical goggles.
Respiratory protection: None required for normal conditions.
Other protective equipment: Gauntlets and apron.

SECTION 8 - Special Precautions**Handling Precautions:**

Do not get in eyes, on skin or on clothing. Do not inhale mists. Use only with adequate ventilation.

Fire Hazard:

Although this product is not flammable in its aqueous state, it will burn in the presence of a strong ignition source after the water is removed.

Shipping and Storing Precautions:

Keep container tightly closed when not in use and during transport.

Personal Hygiene:

Wash thoroughly after handling.

SECTION 9 - Regulatory Information

EMERGENCY RESPONSE GUIDE #	140
DOT Proper shipping name	Oxidizing liquid, corrosive, n.o.s., 5.1, III (Contains Sodium Nitrite, Potassium Hydroxide)
DOT Number	UN3098
HMIS	Health - 2, Flammability - 0, Reactivity - 0, Protection - D
RCRA Status	is not considered Hazardous waste RCRA (40 CFR 261.33)
CERCLA Status	Has no estimated RQ as blended product.
SARA Title III - CERCLA list:	This product does not contain a "CERCLA" listed hazardous substance for emergency release notification under Sec. 304 (40 CFR 302).
SARA Title III - EHS list:	This product does not contain an "extremely hazardous substance" (EHS) for emergency planning under Sec. 301-303 (40 CFR 300 and 355) and for emergency release notification under Sec. 304.
SARA TITLE III - TOXIC CHEMICALS list	This product does not contain a compound that requires routine annual "Toxic chemical release reporting" under Sec 313 (40 CFR 372)
TSCA Inventory status:	Listed

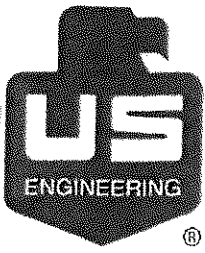
NE = Not Established

NA = Not Applicable

This Material Safety Data Sheet (MSDS) has been prepared in compliance with the federal OSHA Hazard Communication Standard 29 CFR 191.1200

The information and recommendations made herein are based upon data believed to be correct. However, no guarantee or warranty of any kind expressed or implied is made with respect to the contained herein.

Revised 05/20/2008



HVAC Water Treatment
Product Submittal
Information:
Bypass Feeder (Neptune)
Glycol Feeder (Advantage
Controls)
Chemical MSDS

**BEATTIE
ELEMENTARY
SCHOOL**

1100 MEDICINE LARK AVE
FORT COLLINS CO 80526



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary
3000 Meadowlark Avenue
Fort Collins, CO 80526

Project # 30-13-038
Tel: Fax:

FCI Constructors, Inc. - Longmont

Date: 4/18/2014

Reference Number: 0066

Transmitted To: Chris Mallory
US Engineering Co.
P.O. Box 905
Loveland, CO 80539

Transmitted By: DJ Anderson
FCI Constructors, Inc. - Longmont
4001 N. Valley Drive
Longmont, CO 80504
Tel: 970-535-4725
Fax: 970-535-4867

Qty	Submittal Package No	Description	Due Date	Package Action
1	030 - 232500 - 0	HVAC Water Treatment		Make Corrections Noted

Transmitted For	Delivered Via	Tracking Number
For Your Use and Corrections	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
001		HVAC Water Treatment - Product Data	232500		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

- Notes: HVAC WATER TREATMENT (Make Corrections Noted)
1. Sheet Mj0.3 requires model G3030jSST, not G3030jPVC. Provide stainless steel model, not PVC.
 2. Include optional corrosion rack on open loop system.
 3. Corrosion coupon rack is not required on closed loop system.

_____ Signature	_____ Signed Date
<i>Prolog Manager</i>	Page 1

TRANSMITTAL



Belford Watkins Group
Architects

Date: 4.18.14

Project: Beattie Elementary

To: Rob Price/DJ Anderson

From: Patti Watkins

We are transmitting the following submittals with the comments listed below:

ARCHITECTURE

INTERIORS

PLANNING

NET: No Exception Taken **MCN: Make Corrections Noted** **RX: Rejected**
RR: Revise and Resubmit **SSI: Submit Specified Item**
CMT: See Comment Below

232500 HVAC Water Treatment

Copies	Section	Item	Manufacturer	NET	MCN	RR	RX	SSI	CMT
1	232500	Product Data			x				1

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures, there from. The Contractor remains responsible for details and accuracy, for conforming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

Notes: HVAC WATER TREATMENT (Make Corrections Noted)

1. Sheet M-0.3 requires model G3030-SST, not G3030-PVC. Provide stainless steel model, not PVC.
2. Include optional corrosion rack on open loop system.
3. Corrosion coupon rack is not required on closed loop system.



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary
3000 Meadowlark Avenue
Fort Collins, CO 80526

Project # 30-13-038
Tel: Fax:

FCI Constructors, Inc. - Longmont

Date: 4/8/2014

Reference Number: 0038

Transmitted To: Don Watkins
Belford Watkins Group
P.O. Box 1306
Fort Collins, CO 80521
Tel: 970-212-1243

Transmitted By: DJ Anderson
FCI Constructors, Inc. - Longmont
4001 N. Valley Drive
Longmont, CO 80504
Tel: 970-535-4725
Fax: 970-535-4867

Qty	Submittal Package No	Description	Due Date	Package Action
1	030 - 232500 - 0	HVAC Water Treatment	4/22/2014	

Transmitted For	Delivered Via	Tracking Number
Review & Approval	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
001		HVAC Water Treatment - Product Data	232500		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

Signature

Signed Date



4001 N. Valley Drive
 Longmont, CO 80504
 Phone: 970-535-4867
 Fax: 970-535-4867

DATE: 4/8/2014

SPECIFICATION SECTION(S): 232500
 SCOPE OF WORK: HVAC - Water Treatment

PROJECT: Poudre School District – Beattie Elementary School

PROJECT #: 30-13-038

ARCHITECT/DESIGNER: Belford Watkins Group, LLC.
 425 West Mulberry Ave., Suite 207
 P.O. Box 1306
 Fort Collins, CO 80521

 PHONE: 970-407-0070

GENERAL CONTRACTOR: FCI CONSTRUCTORS, INC.
 4001 N. Valley Drive
 Longmont, CO 80504

 PHONE: 970-535-4725
 FAX: 970-535-4867

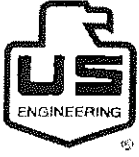
SUBMITTED BY: U.S. Engineering
 PO Box 905
 Loveland, CO 80539

 PHONE: 970-669-1666
 FAX:

CONTRACTORS STAMP:

ARCHITECT/ENGINEER STAMP

FCI CONSTRUCTORS, INC.	
Review of this submittal is subject to the provisions of the Contract Drawings and Specifications. This action is for general concurrence only.	
<input checked="" type="checkbox"/>	Reviewed
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmit with Corrections
<input type="checkbox"/>	DISAPPROVED RESUBMIT
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmittal not Required.
Submittal Reviewed By: DA	Date: 4/8/2014
Submittal No: 030	Spec. Section: 232500



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 80539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-014

Date: 4/2/2014

Revision #: _____

Discipline: Piping

Project : Beattie Elementary

Project #: 1202

Supplier : Long & Summit Labs

Spec Sect: 23 25 00

Submitted Items:

Page Number	Paragraph Number	Description	Manufacturer
232500-3	2.2	Water Treatment System	Dolphin
232500-3	2.2	Chemicals-MSDS Sheets	
M-0.2	Schedule	Glycol Feeder	

Target Dates:

Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
4/3/14	4/10/14	5/8/14	5/15/14	6/12/14

GC/Arch/Engineer Stamp Area:

U.S. Engineering

Signed:

Chris Mallory



SUBMITTAL
US ENGINEERING

BEATTIE ELEMENTARY SCHOOL

Water Treatment Equipment

Bypass filter feeders (CHW)
Glycol feeder GF501A1A1AC
Cleaning of CHW (closed loop) mains
Corrosion coupon rack (CHW)

BUILD A MODEL

GF - 1 A 11 A 22 E

TANK SELECTION

- 0 = No tank
- 1 = 55 gal (208L) poly
- 2 = 100 gal (378L) poly
- 3 = 30 gal (113L) poly
- 4 = 50 gal (189L) carbon steel
- 5 = 5 gal (18L) no stand, 30 gpd pump only
- 7 = 150 gallon poly (567L)
- 8 = 200 gallon poly (757L)

STAND SELECTION

- A = Painted steel stand
- B = Painted steel stand w/ mixer bracket
- C = Tank top mount (no tank included)
- D = Portable stand with built in rollers
- E = No stand (for 5 gal tanks)

PUMP SELECTION

*Dual pump sys. require 2 pump selections (i.e., -11)

- 0 = No pump
- 1 = 1.5 gpm at 100 PSI; 1/3 hp
- 2 = 3.3 gpm at 100 PSI; 1/2 hp
- 3 = 6.1 gpm at 60 PSI; 1/3 hp
- 4 = 9.9 gpm at 60 PSI; 1/2 hp
- 5 = 30 gpd at 100 PSI; solenoid driven

PUMP CONFIGURATION

- A = Standard configuration
- B = Alternating pumps for single loops (requires 2 pump selections)
- C = Pump plumbed for transfer duty into tank

LOOP SELECTION

*Dual loop sys. require 2 loop selections (i.e., -11)

- 0 = No loop
- 1 = Sch 80 PVC loop; 100 PSI max; 100°F max
- 2 = Copper loop; 100 PSI max; 180°F max
- 3 = Carbon steel loop; 100 PSI max

CONTROL SELECTION

- A = Digital controller w/ 0-100 PSI 4-20mA output sensor
- C = Analog 5-20 PSI switch for 5 gal tank w/ 30 GPD pump
- D = Pressure transducer, level wand and pump starter relay for use with separately ordered MegaTron or SS with 4-20mA input ability
- E = Manual pump control; no pressure switch or level wand
- F = Digital controller for dual loops with two sensors

OPTIONS

- 1 = 240V
- 2 = 4-20mA output of pressure on digital controller
- 3 = Solenoid valve for pressure relief on digital units
- 4 = 30-50 PSI pressure switch for analog units
- 5 = Position back check to use tank for expansion
- 6 = High alarm on digital units
- H = 0-200 PSI pressure transducer and gauge on plumbing
- M = Mixer controls (order mixer separate)
- S = ON/OFF switch
- Y = ETL approval (only on units with controller option D)

Specifications

Electrical

- Input 120 VAC, 60 Hz
- Alarm Dry Contact
- Motor: 1/3 HP Pump: 1.5 GPM

Plumbing

- Standard Schedule 80 PVC
- Optional Copper or Carbon steel

Enclosure

Heavy Duty NEMA 4X style, high impact thermoplastic with padlockable gasketed Lexan viewing door

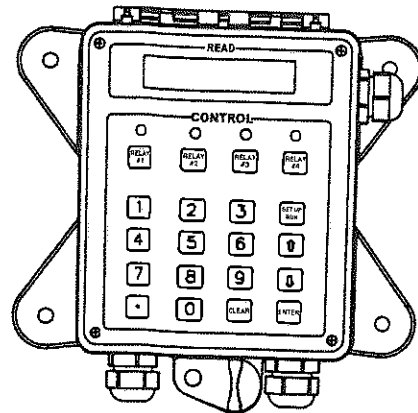
Pressure Gauge 0-100 psi (0-6.9 bar)

Dimensions

- W 39.5" (100.33 cm)
- H 5'3" (160.02 cm)
- D 23.5" (59.69 cm)

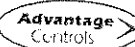
Shipping Weight

330 lbs (149.69 kg) approx.
for model GF-1A1A1A



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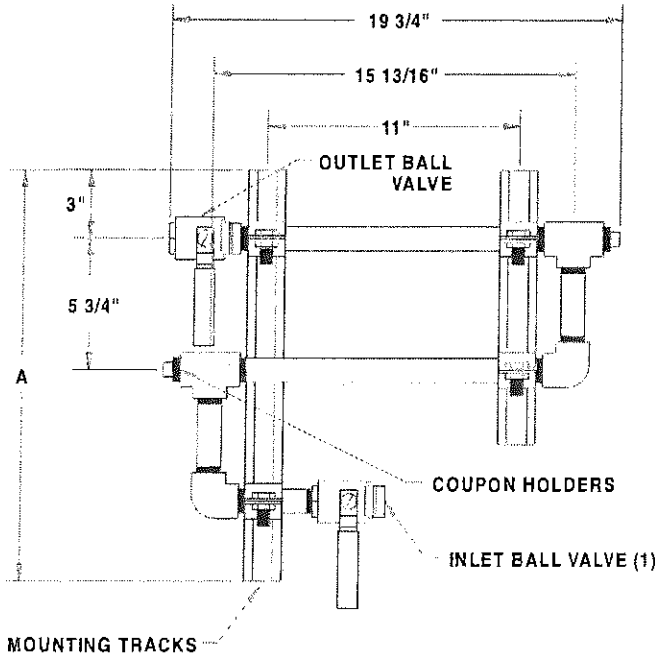
J.L. WINGERT CO.

P.O. Box 6207 • Garden Grove, CA 92846-6207 / 11800 Monarch Street • Garden Grove, CA 92841-2113
 Phone (714) 379-5519 • Fax (714) 379-5549 ■ Email: customerservice@jllwingert.com
 Northern California Region • Phone (510) 487-5310 ■ Southwest Region • Phone (602) 470-1015
www.jllwingert.com

MANUFACTURING: Mixers, Bypass Feeders, Filter Feeders, Bromine Feeders, Sample Coolers, Sludge Traps, Separators, Separator Systems, Tank Stands,
 Tank Package Systems, Glycol Feed Systems, Coupon Racks, Control Stations, NEMA Enclosures, Custom Packaged Systems and Specialty Welding

Specification Sheet #162011 Rev. "C" (3/03)

"CSCR" / "SSCR" COUPON RACKS



SPECIFICATIONS:

Carbon steel and stainless steel coupon racks are constructed from Sch 40 pipe with teflon ball valve seats. CSCR and SSCR coupon racks are secured with two 1 5/8" unistrut mounting tracks. All connections are FNPT.

REPLACEMENT PARTS:

KEY	PART NUMBER	DESCRIPTION
1	1625-007-BR	3/4" brass full port ball valve
	1625-007-SS	3/4" 316 SS full port ball valve
2	1630-04	3/4" carbon steel coupon holder
	1630-05	3/4" SS coupon holder
3	1630-06	SS sample screw

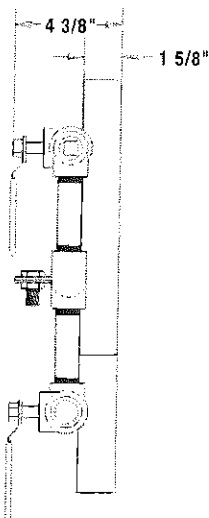
DIMENSIONS:

MODEL NUMBER	A
CR-1-007	12"
CR-2-007	18"
CR-3-007	24"
CR-4-007	30"
CR-5-007	36"
CR-6-007	42"

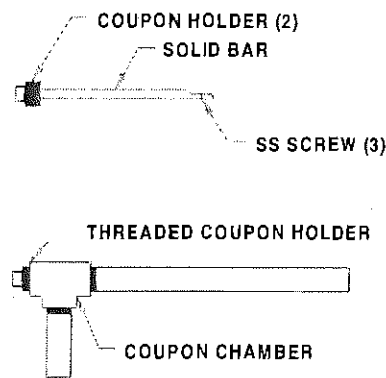
NOTE: "-" insert materials code
 CS=carbon steel, SS=stainless steel

TEMPERATURES & PRESSURES:

TEMPERATURES	PRESSURES
200° F / 93° C	200 PSI / 13.8 BAR

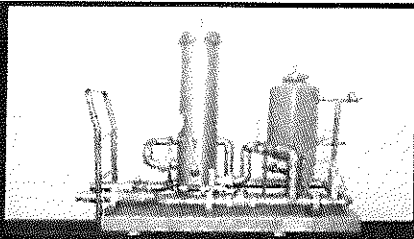


SIDE VIEW



COUPON DETAIL

Note: All dimensions are +/- 1/8". All weights are approximate. All dimensions are subject to change without notice.



The Right Chemistry

Multi-Purpose Cleaner

C-311

CHARACTERISTICS:

C-311 is designed as a multipurpose cleaner used to clean new and existing piping systems, for boiler boil-out and in cleaning new and operational cooling tower systems. C-311 will penetrate, lift and disperse oil, grease, biofilm, and loose corrosion debris and mill residues. C-311 is a granular powdered formulation containing sodium hydroxide, trisodium phosphate, sodium metasilicate, chelating agents and a unique blend of petroleum distillates, surfactants and wetting agents. C-311 will lift and disperse various organic and inorganic foulants in such a way that they remain uniformly suspended in the water for complete removal through system draining, on-line purge flushing, filtration or a combination of these removal procedures. C-311 is especially effective in cooling tower systems for the remediation of microbiological films, algae build-up and to immediately stop the under deposit corrosion produced by iron and sulfate reducing bacteria.

C-311 may be safely used with all metals normally used in piping systems, i.e. steel, copper, copper alloys, stainless steel, solder, etc. C-311 is not suitable for use with aluminum or for extended contact with galvanized steel. C-311 may, however, be used in cooling towers containing galvanized steel components if total exposure time, including flushing, is limited to 24 hours. New cooling towers cleaned with C-311 have been found to have significantly less white rust occurrence than towers not initially cleaned. The cleaning period end time that is required for complete flushing of closed recirculating water systems should not extend beyond 120 hours. If C-311 is not completely removed within this time period, elastomers, copper and copper alloys, soldered joints, and mechanical pump seals may be damaged.

BENEFITS:

- * Extremely efficient cleaner
- * Conforms to FDA and GRAS guidelines
- * USDA approved for boiler boil-out and new pipe cleaning
- * Totally removes oil, grease and organic films
- * Penetrates and disperses bio-growth to stop underlying activity
- * Safe with system components, elastomers and pump seals
- * Excellent for remediation of acidic glycol initiated corrosion

TYPICAL PROPERTIES:

Physical Form	Light amber granular solid
Solubility in Water	Rapid and complete
pH of 1% Solution	14
Chemical Properties	Highly Alkaline, Slightly hygroscopic Odor Aromatic
Flash Point	None

CLEANING PIPING SYSTEMS:

The dosage of C-311 is 60 lbs. per 1000 gallons of system volume. Determine the volume of water in the system and then calculate the total amount of C-311 required. Dissolve the necessary C-311 in water prior to adding to the system using a pump/tank/agitator assembly (available from H-O-H Chemicals) or a pot feeder for small systems. If the dosage is correct, the total ("M") alkalinity of the system water will be approximately 5000 ppm.

The cleaning solution should be circulated for at least 24 hours, heating to 160° to 180° F., if possible. Heat should not be applied to chiller systems where Freon is present without first removing the refrigerant. If the water cannot be heated, extend the circulation time to 48 hours, but never more than 72 hours. When cleaning is complete the cleaner should be removed as quickly as possible. The system may be completely drained and thoroughly flushed with fresh water or, alternately, adding fresh water and removing system water at the same rate may be used to purge the system. Flushing is considered complete when the total ("M") alkalinity of the system water is within 50 ppm of the alkalinity of the fresh water. Flushing should be completed within 120 hours after the introduction of C-311.

During the cleaning period, it is highly desirable to use side stream filtration to remove fine particulate matter. The filtration rate in GPM should be sufficient to filter the total system volume in roughly 3 to 4 hours. The filtering media (30 or 50 micron cartridges) should be replaced as necessary.

STEAM BOILER BOIL-OUT:

Steam Boilers: Determine the working volume of the boiler and calculate the C-311 requirement on the basis of 60 pounds per 1000 gallons. Dissolve C-311 in water and, if possible, add the solution proportionately to boiler as it is being filled. If not, pour the solution through a vent or manhole. Fire the boiler gradually and close all vents when steam appears. Build pressure to 50% of normal working pressure. The boil-out should continue for a minimum of 48 hours. During the entire boiling-out period, blow the boiler from all openings at least once every 8 hours, blowing first from the surface blow and progressing to lower points on the boiler. Replenish blow-down losses with C-311 treated water to maintain desired cleaning strength and, upon completion, flush all boiler surfaces with high pressure water. Inspect boiler for cleanliness.

COOLING TOWER SYSTEM CLEANING:

Determine the total capacity of the system to be cleaned and calculate the amount of C-311 required based on a dosage rate of 75 lbs. C-311 per 1000 gallons of system volume. Before adding C-311, first clean the tower sump of as much sediment and debris as possible. This will insure the rapid contact of C-311 with any remaining adherent material that could not be easily removed from the cooling tower. If desired, the basin water or the entire system may be slug dosed with sodium hypochlorite to minimize bioactivity while the sludge is being removed. Discontinue bleed-off and all chemical introductions before adding C-311.

C-311 may be added directly to the cooling tower basin provided that highly turbulent flow is present. The C-311 may be slowly sifted into the flowing water at a pace sufficient to avoid accumulation at the bottom of the sump. Alternately, if the discharge of cooling tower water can be approached safely, C-311 may be slowly added to the water flowing into the system recirculating water piping leaving the cooling tower. A third option is to employ a pump/tank/agitator assembly (available from H-O-H Chemicals) with the discharge directed into the cooling tower sump.

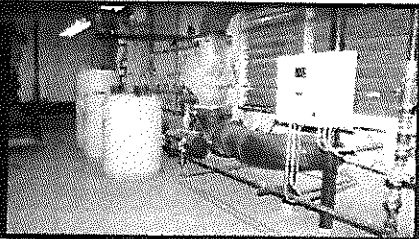
About 15 minutes after completing the addition of the C-311 determine both the "P" and the "M" alkalinity of the tower water. Based on this data, the hydroxide ("OH") alkalinity of the water may be determined by multiplying the "P" alkalinity by two and then subtracting the "M" alkalinity, i.e. $2(P) - M = OH$. The initial "OH" should be roughly 2000 ppm, but this will quickly fall as the cleaner reacts with organic matter and with atmospheric carbon dioxide. The cleaning should be considered complete after four (4) hours or one hour after the "OH" alkalinity has fallen to zero. At this point bleed-off should be reestablished at its maximum rate with flow being maintained continuously until flushing is complete. Flushing is considered complete when the "M" alkalinity of the tower water has fallen to no more than 50 ppm over the "M" alkalinity of the tower make-up water.

STORAGE AND HANDLING:

C-311 contains a high fraction of sodium hydroxide (Lye). Concentrated solutions of pure C-311 will cause serious skin burns and rapid damage of eye tissue. Safety equipment including face shield, rubber gloves and rubber apron must be worn when handling C-311. C-311 is mildly hygroscopic and should be used promptly after opening the shipping container. C-311 may harden once the shipping container is opened depending on the amount of moisture absorbed from the atmosphere and the subsequent length of storage. Store in a cool dry location away from sources of radiant heat and out of direct sunlight.

MATERIALS OF CONSTRUCTION:

C-311 (powder) may be allowed to contact steel, stainless steel, copper or plastics. Pure C-311 powder should not be allowed contact aluminum, brass, soldered connections, galvanized metal, painted surfaces, asphalt or rubber roofing materials, fabrics, carpeting or any decorative surfaces. When dissolving C-311 use polyethylene utensils, tanks and tubing. Alternately, rubber hose, PVC, polypropylene Tygon and vinyl are also acceptable.



The Right Chemistry

Multi-Purpose Cleaner

C-311

SAFETY AND ENVIRONMENTAL INFORMATION:

C-311 is a highly alkaline product that will damage the skin and eyes. Wear rubber gloves, rubber apron, chemical safety goggles or full-face shield while handling this product. In the event of skin contact, flush with water and wash thoroughly with a mild soap and water. If redness or burning occurs, get prompt medical attention. In case of eye contact, flush eyes with large amounts of fresh water for 15 minutes and get immediate medical attention. **DO NOT TAKE INTERNALLY.** Anyone responsible for the procurement, use or disposal of C-311 should familiarize themselves with the appropriate safety and handling information outlined in the H-O-H Chemicals Material Safety Data Sheet. In the event of an emergency with C-311, contact H-O-H Chemicals during business hours at 847/358 7400 or Chemtrec anytime day or night at 800/424-9300.

Water containing the recommended dosage of C-311 is mildly caustic with a pH of approximately 12.5. Check local discharge ordinances prior to discharging to a sanitary sewer or plant out-fall.

SHIPPING:

C-311 cleaner is shipped in 50-pound net plastic pails or 125 pound net plastic lined fiber drums. C-311 is considered to be a hazardous substance for the purposes of shipping by DOT. C-311 is classified as a corrosive, packaging group II.

ADDITIONAL INFORMATION:

To place an order or obtain technical information.

847/358 7400
www.hohchemicals.com

* C-311 MSDS

MATERIAL SAFETY DATA SHEET

QUICK REFERENCE:

C-311



H - O - H Water Technology, Inc.
 500 South Vermont Street
 Palatine, Illinois 60067

EMERGENCY PHONE No's
 847 - 358 - 7400 (H - O - H BUSINESS Hrs.)
 800 - 424 - 9300 (CHEMTREC - 24 Hrs.)

HMIS:

4 = EXTREME
 3 = SEVERE
 2 = MODERATE
 1 = SLIGHT
 0 = INSIGNIFICANT



DOT:

HAZARD LABELING



IN FIBER KEGS

PRODUCT IDENTIFICATION	PRODUCT NAME	CHEMICAL FAMILY	DATE	Rev. No.	SUPERSEDES	EPA - TPQ	BY
	C - 3 1 1	CAUSTIC CLEANER	7 - 5 - 08	13	7 - 11 - 06	NA	

HAZARDOUS COMPONENTS	CHEMICAL NAME	COMMON NAME	CAS No.	PERCENT	OSHA PEL	ACGIH-TLV	OTHER
	SODIUM HYDROXIDE	LYE, CAUSTIC SODA	1310 - 73 - 2	44	2 mg/m ³	2 mg/m ³	OSHA Cel. 2 mg / m ³

COMMENT

- NEVER ADD WATER TO THIS PRODUCT. IN MAKING SOLUTIONS, FOR CLEANING. ALWAYS ADD PRODUCT SLOWLY TO WATER WITH VIGOROUS MIXING OR AGITATION.
- THE PERMISSIBLE FEDERAL EXPOSURE STANDARD FOR PURE SODIUM HYDROXIDE IN AIR IS 2 mg/m³. NO CRITERIA HAS BEEN SET FOR WATER.
- GRANULES OF THIS PRODUCT TEND TO STICK TO PROTECTIVE CLOTHING AND GLOVES. WHEN REMOVING SUCH PROTECTIVE EQUIPMENT, BE CAREFUL NOT TO COME INTO CONTACT WITH RESIDUAL PRODUCT. ALWAYS WASH PROTECTIVE EQUIPMENT THOROUGHLY AFTER EACH USE.

PHYSICAL DATA	BOILING POINT (Degrees Fahrenheit)	NA	SOLUBILITY (in water)	SOLUBLE	EVAPORATION RATE (water = 1.0)	NA
	VAPOR PRESSURE (in millimeters of Mercury)	NA	SPECIFIC GRAVITY (water = 1.0)	NA	pH	12.6
	VAPOR DENSITY (air = 1.0)	NA	PERCENT(%) VOLATILE (by volume)	NA		
	APPEARANCE and ODOR	LIGHT YELLOW COLORED GRANULAR SOLID WITH MILD ORGANIC ODOR.				

FIRE AND EXPLOSION	FLASH POINT (Degrees Fahrenheit)	METHOD	FLAMMABLE LIMITS	LOWER EXPLOSIVE LIMIT	UPPER EXPLOSIVE LIMIT
	NONE	NA		NOT APPLICABLE	NOT APPLICABLE
	EXTINGUISHING MEDIA	SPECIAL FIRE FIGHTING PROCEDURES		UNUSUAL FIRE AND EXPLOSION HAZARDS	
	WATER	PROTECT OR REMOVE FIBRE KEGS		SECONDARY REACTIONS	
	THIS PRODUCT WILL NOT BURN OR DIRECTLY PROMOTE FIRE.	THIS PRODUCT IS PACKAGED IN FIBRE KEGS THAT MAY BE DAMAGED IN A FIRE. IF THIS PRODUCT IS RELEASED FROM A DAMAGED SHIPPING CONTAINER, REACTIONS MAY OCCUR WITH METALS, CERTAIN BUILDING MATERIALS, OR VARIOUS STORED MATERIALS. SODIUM HYDROXIDE REACTS STRONGLY WITH ALUMINUM PRODUCING FLAMMABLE HYDROGEN GAS. DO NOT ALLOW DRY SPILLED MATERIAL TO CONTACT ANY OTHER CHEMICAL.		UNDER NORMAL CONDITIONS THIS PRODUCT WILL NOT SUPPORT COMBUSTION OR ACCELERATE A FIRE. IF CONTACT WITH BUILDING MATERIALS, OTHER CHEMICALS, OR LIVE ELECTRICAL SERVICES OCCURS DURING A FIRE, UNPREDICTABLE HEAT, HAZARDOUS GASES, OR ELECTRICAL ARCS MAY BE PRODUCED.	

REACTIVITY DATA	STABILITY	CONDITIONS TO AVOID	NOT APPLICABLE
	STABLE <input checked="" type="checkbox"/> UNSTABLE <input type="checkbox"/>		
	INCOMPATIBILITY (Materials to Avoid)	METALS (SUCH AS ALUMINUM, TIN, AND ZINC), ACIDS, BROMINE AND CHLORINE RELEASE AGENTS.	
	HAZARDOUS DECOMPOSITION PRODUCTS	NONE.	
HAZARDOUS POLYMERIZATION MAY WILL OCCUR <input type="checkbox"/> WON'T OCCUR <input checked="" type="checkbox"/>	CONDITIONS TO AVOID	NOT APPLICABLE	

SPECIAL PRECAUTIONS	STORAGE AND HANDLING	OTHER
	<ol style="list-style-type: none"> PROTECT CONTAINERS AGAINST PHYSICAL DAMAGE. STORE IN A COOL, DARK, WELL-VENTILATED LOCATION AWAY FROM DIRECT SUNLIGHT AND OTHER SOURCES OF RADIANT HEAT. KEEP CONTAINERS TIGHTLY CLOSED WHEN NOT IN USE. NEVER MOVE AN OPEN OR LOOSELY CLOSED CHEMICAL CONTAINER. WEAR HAND AND FOOT PROTECTION WHEN MOVING HEAVY CONTAINERS. STORE AT 60° F. OR HIGHER. 	<ol style="list-style-type: none"> NOT TO BE TAKEN INTERNALLY. NOT TO BE USED FOR OTHER THAN SPECIFIED PURPOSE. KEEP AWAY FROM CHILDREN. NEVER MIX THIS MATERIAL WITH ANY OTHER CHEMICAL UNLESS AT THE SPECIFIC DIRECTION OF H - O - H PERSONNEL. TRIPLE RINSE EMPTY CONTAINERS BEFORE OFFERING FOR DISPOSAL OR SALVAGE. NEVER REUSE EMPTY CONTAINERS.

HEALTH HAZARD DATA	THRESHOLD LIMIT VALUE	4.5 mg/m ³ (AIR) 15 MINUTE CEILING (NIOSH) RELATIVE TO PURE SODIUM HYDROXIDE.	C-311
	ACUTE HEALTH HAZARDS	CHRONIC HEALTH HAZARDS	
	TISSUE BURNS	NONE	
	STRONGLY CORROSIVE TO ALL BODY TISSUES WITH WHICH IT COMES IN CONTACT.	BURNS CAN BE SLOW TO HEAL, BUT NO CHRONIC HEALTH HAZARDS ARE INVOLVED. FREQUENT EXPOSURE TO LEVELS MODERATELY IN EXCESS OF THE TLV MAY PRODUCE SYMPTOMS, BUT IF EXPOSURE IS ELIMINATED, SYMPTOMS SHOULD DISAPPEAR.	

EFFECTS OF EXPOSURE	SKIN AND EYES / TARGET ORGAN	INHALATION / TARGET ORGAN	INGESTION / TARGET ORGAN
	BURNS	NON - VOLATILE / NON - DUSTING	
	CAUSES HIGHLY PAINFUL INSTANTANEOUS IRRITATION OF EYES AND EYELIDS. MAY CAUSE ULCERATION OR PERFORATION OF EYES OR EYELIDS, LOSS OF EYES OR EYESIGHT. CAUSES ULCERATION OF SKIN WITH SLIPPERY, SOAPY FEELING. IRREPARABLE DAMAGE POSSIBLE.	IF A LIQUID MIST OR SPRAY OF CONCENTRATED PRODUCT IS DRAWN INTO THE BREATHING TRACT, SEVERE IRRITATION OF RESPIRATORY TRACT, PULMONARY EDEMA, MAY OCCUR. NASAL, MUCOUS, AND BRONCHIAL TISSUE MAY BE BURNED AND/OR PERMANENTLY DAMAGED.	CAUSES ULCERATION, BLEEDING, AND SCARRING OF THE DIGESTIVE TRACT. SHOCK, CONVULSIONS, COMA, AND DEATH MAY RESULT DEPENDING ON THE AMOUNT INGESTED. COFFEE - GROUND - LIKE MATERIAL PRODUCED WITH VOMITING INDICATES DIGESTIVE BLEEDING.
CONDITIONS AGGRAVATED	DERMATITIS, BLISTERS, BURNS, OR ANY PRE-EXISTING SKIN IRRITATION IF CONTACT OCCURS.	IN NORMAL USE, NO EFFECT SHOULD BE NOTED SINCE NO VOLATILE COMPONENT IS PRESENT.	IN NORMAL USE, INGESTION SHOULD NOT OCCUR. INGESTION WILL PRODUCE IMMEDIATE TRAUMA.

EMERGENCY PROCEDURES	SKIN AND EYES	INHALATION	INGESTION
	EYES	NON - VOLATILE	DO NOT INDUCE VOMITING
	FLUSH EYES WITH WATER FOR AT LEAST 15 MINUTES HOLDING EYELIDS OPEN. GET IMMEDIATE MEDICAL ATTENTION. SKIN FLUSH WITH WATER FOR 15 MINUTES. TREAT FOR BURNS. OBTAIN MEDICAL ADVICE. REMOVE EXPOSED CLOTHING AND WASH WELL BEFORE REUSE. CONTINUE TO WASH WITH LUKE - WARM WATER UNTIL THE FEELING OF STICKINESS OR SOAPINESS DISAPPEARS, UP TO AN HOUR MAY BE NEEDED.	IF LIQUID CONCENTRATE, SPRAY, OR MIST IS INHALED, REMOVE SUBJECT TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. GIVE OXYGEN BY PROPERLY TRAINED PERSONNEL IF BREATHING IS DIFFICULT. KEEP SUBJECT WARM AND AT REST. OBTAIN EMERGENCY MEDICAL ATTENTION. DO NOT LEAVE PERSON UNATTENDED. ENCOURAGE NOSE BLOWING, COUGHING, AND SPITTING - OUT.	IF CONSCIOUS, DILUTE INGESTED MATERIAL WITH 2 OR MORE GLASSES OF WATER OR MILK. OBTAIN EMERGENCY MEDICAL ATTENTION. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. INDUCED VOMITING IS NOT RECOMMENDED DUE TO POSSIBLE BRONCHIAL OR PULMONARY INGESTION. EMERGENCY MEDICAL ATTENTION IS REQUIRED TO REMOVE ANY INGESTED CAUSTIC AND MINIMIZE INTERNAL BURNS AND TISSUE DAMAGE.

CARCINOGEN LISTING	NATIONAL TOXICOLOGY PROGRAM (NTP)	IARC MONOGRAPHS	OSHA REGULATED
	NO	NO	YES (SODIUM HYDROXIDE)

SPILL OR LEAK PROCEDURES	SPILLS AND RELEASES	WASTE DISPOSAL METHODS
	COLLECT ANY SPILLED MATERIAL AND RETURN TO SHIPPING CONTAINER IF NOT CONTAMINATED. IF CONCENTRATED SOLUTIONS ARE SPILLED, NOTIFY THE APPROPRIATE POLLUTION CONTROL (ESDA) AUTHORITIES IF LEAKAGE ENTERS A SEWER OR IN ANY OTHER WAY IS ESCAPING FROM THE PREMISES. COLLECT SPILLED SOLUTION INTO SUITABLE CONTAINERS FOR RECLAIM OR DISPOSAL. NEUTRALIZE WITH DILUTE SOLUTIONS OF SULFURIC, HYDROCHLORIC, OR SULFAMIC ACIDS OR SODIUM BISULFATE. WHEN NEUTRALIZING WITH DILUTE ACID, BE CAREFUL FOR HEAT GENERATION AND POSSIBLE OVER NEUTRALIZATION LEADING TO ACIDIC CONDITIONS.	CONSULT FEDERAL, STATE, AND LOCAL REGULATIONS PERTAINING TO WASTE DISPOSAL.

CONTROL MEASURES	EYE PROTECTION	TIGHT - FITTING CHEMICAL GOGGLES AND FACE SHIELD.		
	RESPIRATORY PROTECTION	NOT REQUIRED FOR ORDINARY USE. DURING EMERGENCY CONDITIONS OR IF A SERIOUS SPILL OCCURS, AN AIR PURIFYING RESPIRATOR DESIGNED TO ABSORB ALKALINE VAPORS (AMMONIA, AMINES, ETC.) AND CHLORINE SHOULD BE USED.		
	OTHER PROTECTIVE EQUIPMENT	IMPERMEABLE CLOTHING. SAFETY SHOWERS AND EYEWASH FOUNTAINS SHOULD BE INSTALLED IN STORAGE AND HANDLING AREAS.		
	LOCAL EXHAUST	YES	SPECIAL VENTILATION	NOT REQUIRED FOR NORMAL USE.
	MECHANICAL VENTILATION	NOT REQUIRED FOR NORMAL USE.	OTHER VENTILATION	NOT REQUIRED FOR NORMAL USE.
	PROTECTIVE GLOVES	NON - SLIP ELBOW LENGTH VINYL OR RUBBER GLOVES.	PROTECTIVE CLOTHING	RUBBER OR VINYL APRON.

REFERENCES	1. <i>Threshold Limit Values For Chemical Substances And Physical Agents In The Work Environment</i> ; ACGIH, 1989.
	2. OSHA Safety and Health Standards: 29CFR 1900 to 1910, July 1, 1988
	3. <i>Fifth Annual Report on Carcinogens</i> ; U. S. Dept. of Health and Human Services, National Toxicology Program, 1989 (Summary).
	4. M. Sittig, <i>Handbook of Toxic & Hazardous Chemicals</i> , (Noyes Publications, Park Ridge, N. J., 1981).
	5. <i>Community Right - To - Know Manual</i> , (Thompson Publishing Group, Washington, D. C., 1990).
	6. <i>Right - To - Know / Chemical Manual</i> (ILLINOIS MANUFACTURES ASSOCIATION; Rooks, Pitts, and Pousi, 1990).
	7. <i>Toxic and Hazardous Industrial Chemicals Safety Manual</i> (THE INTERNATIONAL TECHNICAL INFORMATION INSTITUTE, 1975).
	8. M. J. Lefevre, S. A. Conibear, <i>First Aid Manual for Chemical Accidents</i> , 2nd ed. (Van Nostrand Reinhold, New York, 1989).
	9. <i>Hazardous Materials Guide; Shipping, Materials Handling and Transportation</i> (J. J. KELLER & ASSOCIATES, Inc., Neenah, Wisconsin, Dec. 1990)
	10. <i>Hazard Communication Guide; Federal & State Right to Know Standards</i> (J. J. KELLER & ASSOCIATES, Inc., Neenah, Wisconsin, Dec. 1990)

REPORTABLE QUANTITY	IF MORE THAN THE INDICATED QUANTITY IS DISCHARGED TO DRAINAGE (Sewer / surface water), AIR, OR SOIL, IMMEDIATELY REPORT AS INDICATED.		
	CERCLA OR EPA (Extremely Hazardous) NATIONAL RESPONSE CENTER (800 - 424 - 8802)	STATE EMERGENCY RELEASE NOTIFICATION ILLINOIS (Only) 800 - 782 - 7860 (Consult for others)	LOCAL EMERGENCY RESPONSE AUTHORITY Record Telephone No. of Local Response Authority
WRITTEN REPORT MUST FOLLOW	2.275 lbs. (Sodium Hydroxide)	CONTACT	CONTACT

Material Safety Data Sheet

L-825

SUMMIT LABORATORIES, INC.
3955 Forest Street
Denver, CO 80207

Phone: (303) 293-9862
Chemical Emergencies Only:
Chem-Tel 1-800-255-3924

SECTION 1 - Product Identification

Tradename: L-825
Description: Corrosion and Scale Inhibitor
Product Type: Closed Loop Treatment

Hazardous Ingredients:

<u>Ingredients</u>	<u>CAS Number</u>	<u>%</u>	<u>Exposure Criteria</u>
Sodium Nitrite	7632-00-0	<20.0	NA
Potassium Hydroxide	1310-58-3	< 1.0	2MG/M3
Tolytriazole, Sodium Salt	64665-57-2	< 1.6	NA

SECTION 2 - Physical Data

Appearance:	Pale yellow liquid	Vapor density:	Equivalent to water
Odor:	Slight	Vapor pressure:	NE
Boiling point:	100-103C (Water)	Solubility in water:	Complete
Freeze point:	NE	pH:	11.0-12.0
Decomposition temperature:	490 C (914 F)	Specific gravity:	1.14
Evaporation rate:	Equivalent to water	Pounds per gallon:	9.5
Percent volatile:	>70% Water		

SECTION 3 - Fire and Explosion Hazard Data

Flash point:	NA - water solution	°F
Flammable limits in air % by vol.	Upper: NA	Lower: NA
Extinguishing media:	Water fog, carbon dioxide, foam, dry chemical	
Special fire fighting procedures:	None	
Unusual fire and explosion hazard:	None	
Auto ignition temperature	NE	°F

SECTION 4 - Reactivity Data

Stability:	Stable
Incompatibility:	Acids, ammonium salts, amines, activated carbon, cyanides, and reducing agents
Hazardous decomposition products:	Oxygen and toxic nitrogen gases
Hazardous polymerization:	Will not occur

SECTION 5 - Health Hazard Data

Emergency and first aid procedures:

Eyes: Immediately flush with water at least 15 minutes and seek medical attention.
Skin: Wash with soapy water. See a physician if irritation occurs. Wash contaminated clothing.
Inhalation: Remove to fresh air.
Ingestion:

SECTION 6 - Spill or Leak Procedures**Spill Procedures:**

Large Spill: Dam area to prevent spill from spreading. Pump into appropriate container.
 Small Spill: Flush liquid to sewer with copious amounts of water.

Waste Disposal Methods:

Dispose in accordance with Federal, State and Local regulations.

SECTION 7 - Special Protection Information

Ventilation: Good general mechanical ventilation recommended.
Protective gloves: Impervious gloves.
Eye protection: Splash-proof chemical goggles.
Respiratory protection: None required for normal conditions.
Other protective equipment: Gauntlets and apron.

SECTION 8 - Special Precautions**Handling Precautions:**

Do not get in eyes, on skin or on clothing. Do not inhale mists. Use only with adequate ventilation.

Fire Hazard:

Although this product is not flammable in its aqueous state, it will burn in the presence of a strong ignition source after the water is removed.

Shipping and Storing Precautions:

Keep container tightly closed when not in use and during transport.

Personal Hygiene:

Wash thoroughly after handling.

SECTION 9 - Regulatory Information

EMERGENCY RESPONSE GUIDE #	140
DOT Proper shipping name	Oxidizing liquid, corrosive, n.o.s., 5.1, III (Contains Sodium Nitrite, Potassium Hydroxide)
DOT Number	UN3098
HMIS	Health - 2, Flammability - 0, Reactivity - 0, Protection - D
RCRA Status	Is not considered Hazardous waste RCRA (40 CFR 261.33)
CERCLA Status	Has no estimated RQ as blended product.
SARA Title III - CERCLA list:	This product does not contain a "CERCLA" listed hazardous substance for emergency release notification under Sec. 304 (40 CFR 302).
SARA Title III - EHS list:	This product does not contain an "extremely hazardous substance" (EHS) for emergency planning under Sec. 301-303 (40 CFR 300 and 355) and for emergency release notification under Sec. 304.
SARA TITLE III - TOXIC CHEMICALS list	This product does not contain a compound that requires routine annual "Toxic chemical release reporting" under Sec 313 (40 CFR 372)
TSCA Inventory status:	Listed

NE = Not Established

NA = Not Applicable

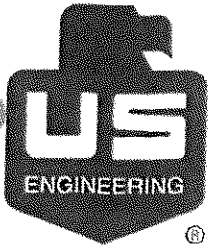
This Material Safety Data Sheet (MSDS) has been prepared in compliance with the federal OSHA Hazard Communication Standard 29 CFR 191.1200

The information and recommendations made herein are based upon data believed to be correct. However, no guarantee or warranty of any kind expressed or implied is made with respect to the contained herein.

Revised 05/20/2008

SUMMIT LABORATORIES, INC. 3955 Forest Street, Denver, CO 80207 (303) 293-9862

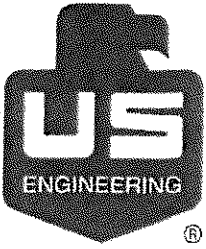




Tab-5
Specification Section: 23 36 00
Air Terminal Units:
VAV 6-1 thru 6-8 (Titus)

**BEATTIE
ELEMENTARY
SCHOOL**

3000 MEADOWLARK AVE
POST COLLINS CO 80520



Air Terminal Units
(Titus) O&M and
Warranty Information:
VAV 6-1 thru 6-8

**BEATTIE
ELEMENTARY
SCHOOL**

3100 MEADOWLARK AVE
FORT COLLINS, CO 80526



Air Purification Company

1861 West 64th Lane, Denver, Colorado 80221

Phone: 303.428.2800 • Fax: 303.428.2700

Project: Beattie Elementary School

Location: Fort Collins, CO

Engineer: AE Associates

Contractor: US Engineering

Date: May – 2014

Product: Air Terminal Units

Subject: Operations and Maintenance Manuals



Air Purification Company

1861 West 64th Lane, Denver, Colorado 80221

Phone: 303.428.2800 • Fax: 303.428.2700

Air Terminal Units

SINGLE DUCT AIR TERMINAL UNITS – TITUS, Model DESV

- ½" EcoShield Liner • Standard Access Door • 120/24v Transformer
- Metal Control Enclosure

- 1 – Size 10 with 1 Row Hot Water Coil **(06-01)**
- 1 – Size 12 with 2 Row Hot Water Coil **(06-02)**
- 1 – Size 12 with 2 Row Hot Water Coil **(06-03)**
- 1 – Size 10 with 2 Row Hot Water Coil **(06-04)**
- 1 – Size 12 with 2 Row Hot Water Coil **(06-05)**
- 1 – Size 12 with 2 Row Hot Water Coil **(06-06)**
- 1 – Size 12 with 2 Row Hot Water Coil **(06-07)**
- 1 – Size 10 with 2 Row Hot Water Coil **(06-08)**

Single Duct VAV Terminals

Receiving Inspection

After unpacking the terminal, check it for shipping damage. If any shipping damage is found, report it immediately to the delivering carrier. Store units in a clean, dry location prior to installation.

Caution: Do not use the flow sensor, connecting tubing, or damper shaft linkage as a handle to lift or move assembly. Damage to the flow sensor or controls may result.

Supporting the Assembly

Many basic single duct terminals are light enough to be supported by the duct work itself. Where heavier accessory modules, such as DDC controls, coils, attenuators, or multiple outlets are included, the terminal should be supported directly. Straps screwed directly into the side of the terminal, threaded rod through the optional hanger brackets (see Figure 1), or the method prescribed for the rectangular duct on the job specifications may be used.

Important: If equipped with pneumatic controls, the terminal must be mounted right side up. It must be level within + or - 10 degrees of horizontal, both parallel to the air flow and at the right angle of air flow. The control side of the terminal is labeled with an arrow indicating UP. The first letter of the model number (P) indicates pneumatic controls. Most electronic units (A-analog controls and D-digital controls) can be installed in any orientation. Check with the local TITUS representative for verification.

Duct Connections

Slip each inlet duct over the inlet collar of the terminal. Fasten and seal the connection by the method prescribed by the job specification.

The diameter of the inlet duct "D" in inches must be equal to the listed size of the terminal; e.g. a duct that actually measures 8 inches must be fitted to a size 8 terminal. The inlet collar of the terminal is made 1/8 inch smaller than listed size in order to fit inside the duct (see Figure 1).

Note: Do not insert duct work inside the inlet collar of the assembly. Inlet duct should be installed in accordance with SMACNA guidelines.

The outlet end of the terminal is designed for use with slip and drive duct connections. A rectangular duct the size of the terminal outlet should be attached.

If single-point electronic velocity sensor is used, 3 to 5 inlet duct diameters of straight duct should be provided at the terminal inlet; for specific guidelines, consult the manufacturer's installation material. Sensor(s) may be attached to the inside of control enclosure for protection during shipping. Sensor must be inserted in inlet duct of terminal before operation. Remove any protective plastic devices from tip of sensor before installation.

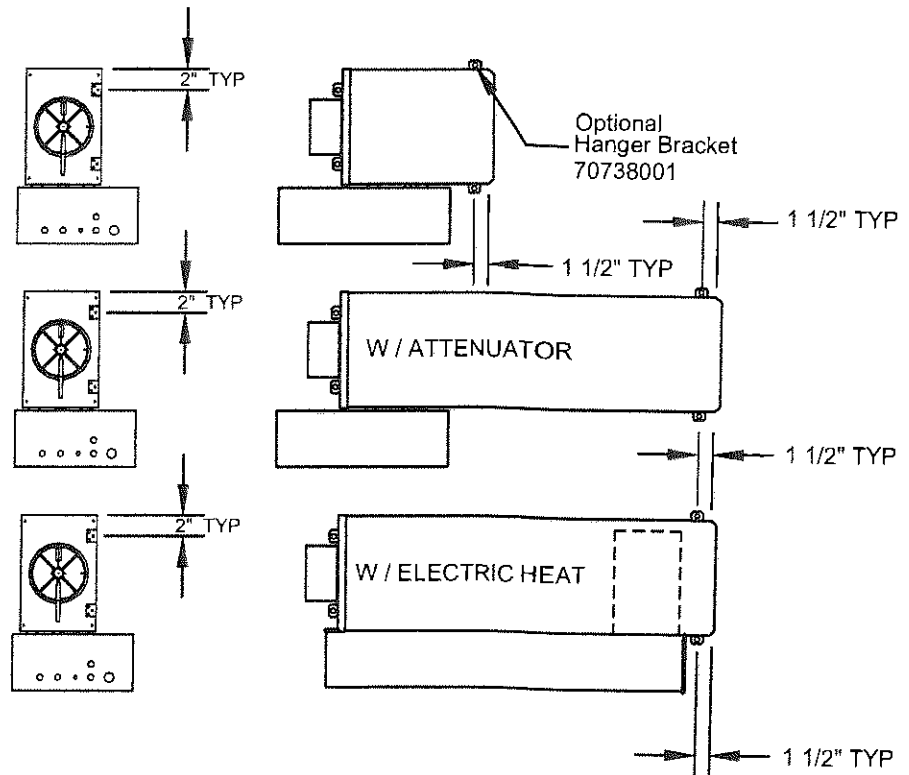


Figure 1. Single Duct Recommended Hanger Bracket Locations

Field Wiring

All field wiring must comply with the local codes and with the National Electrical Code (ANSI/NFPA 70-1981). Electrical, control and piping diagrams are shown on the exterior labeling or on the diagram on the inside of control enclosure cover. All electric heaters if provided by TITUS are balanced by kW per stage. The installing electrician should rotate these heater stages by phase in order to help balance the building electric load.

Control Start-up, Operation

Detailed information regarding power, accessory and communications connections, start-up and operating procedures for the controls provided by TITUS are available from your local TITUS representative. For specific information on controls by other manufacturers, contact that manufacturer's local branch or dealer.

Important: Units with digital controllers may incorporate specific communication addresses based on Building Management Systems Architecture, and original engineering drawings. Installing the terminal in a different location than noted on unit label may result in excessive start-up labor.

Calibration Instructions

For Pneumatic Controls, see PNEU-IOM: Operations Manual for Pneumatic Controls.

For Analog Controls: Titus TA1, see ANA-IOM: Analog Controller Calibration.

For Digital Controls: see control manufacturer's manual

Replacement Parts

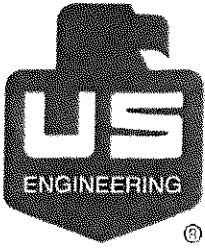
Description	Part Number
Primary Damper Assembly	
Size 4-5-6"	31171301
Size 7"	31171302
Size 8"	31171303
Size 9"	31171304
Size 10"	31171305
Size 12"	31171306
Size 14"	31171307
Size 16"	31171308
Damper Shaft Extension	
Short Stub all sizes	70300301
Long Ext. Sz. 4-6, 14, 16	70300302
Long Ext. Sz. 7-12	70300303
Shaft Bearing - All	70324901
Control Tube	
Red Stripe 1/4" O.D.	61510035
Green Stripe 1/4" O.D.	61510234
Red Stripe 3/8" O.D.	61510279
Green Stripe 3/8" O.D.	61510280
Yellow Stripe 1/4" O.D.	61510260
White Stripe 1/4" O.D.	61510261
Blue Stripe 1/4" O.D.	61510262
Tees for sensor taps	
Plastic 1/4"	42150011
Plastic 3/8"	42150020
Plugs for tees	
1/4"	42160081
3/8"	10015601
AeroCross™ Multipoint Velocity Sensors	
Size 4"	3151520001
Size 5"	3151520001
Size 6"	3151520002
Size 7"	3151520003
Size 8"	3151520004
Size 9"	3151520005
Size 10"	3151520006
Size 12"	3151520007
Size 14"	3151520008
Size 16"	3151520009
Size 24" x 16"	3151520009



LIMITED WARRANTY: Titus Products warrants to Buyer, or any person receiving product during the duration of this warranty, for a period of twelve (12) months from the date of shipment from originating factory that the goods at time of shipment will be free from defects of material and workmanship for normal use and service. This warranty does not extend to goods subjected to misuse, neglect, accident or improper installation, or to maintenance of products which have been altered or repaired by anyone except Seller, Buyer, or any person receiving such a product during the duration of the warranty, shall contact the local Titus Representative or Titus Products - (990 Security Row, Richardson, TX 75081) as soon as any defect becomes known. Titus sole obligation under the foregoing warranty shall be limited to: at its option, repair or replace (and reship to Buyer with transportation charges paid to any place in the United States) defective goods provided, however, that if Titus is unable to correct a defective component part or product after a reasonable number of attempts, the Buyer shall be entitled to elect a refund at original Buyer's purchase price. CHARGES ACCRUED AGAINST SELLER'S ACCOUNT WITHOUT PRIOR APPROVAL OF SELLER WILL NOT BE PAID BY SELLER. If after notifying Titus of defect, Buyer returns goods to Titus for repair and Titus determines that it has not breached the foregoing warranty, the Buyer will be assessed Titus regular reconditioning charges. Titus SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES ARISING FROM DEFECTIVE EQUIPMENT. THIS EXPRESS WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES, GUARANTEES OR REPRESENTATIONS, EXPRESS OR IMPLIED, BY OPERATION OF LAW OR OTHERWISE.



990 Security Row, Richardson, TX 75081
Phone: (972) 669-1030 Fax: (972) 918-8880
www.titus-hvac.com



Air Terminal Units Product
Submittal Information:
VAV 6-1 thru 6-8

**BEATTIE
ELEMENTARY
SCHOOL**

3100 MEADOW LARK AVE
FORT COLLINS, CO 80526



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary
3000 Meadowlark Avenue
Fort Collins, CO 80526

Project # 30-13-038
Tel: Fax:

FCI Constructors, Inc. - Longmont

Date: 4/11/2014

Reference Number: 0045

Transmitted To: Chris Mallory
US Engineering Co.
P.O. Box 905
Loveland, CO 80539

Transmitted By: DJ Anderson
FCI Constructors, Inc. - Longmont
4001N. Valley Drive
Longmont, CO 80504
Tel: 970-535-4725
Fax: 970-535-4867

Qty	Submittal Package No	Description	Due Date	Package Action
1	014 - 233600 - 0	Air Terminal Units		Make Corrections Noted

Transmitted For	Delivered Via	Tracking Number
For Your Use and Corrections	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
001		Air Terminal Units - Product Data	233600		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

- Notes: 1. AIR TERMINAL UNITS (Make Corrections Noted)
- Contractor shall coordinate right or left hand coil configuration based on ceiling space.
 - Outlet dimensions are different than scheduled, coordinate with space in existing ceiling plenum.
 - Ensure that the bottom access door provides access to the upstream side of the heating coil.

Signature

Signed Date

TRANSMITTAL

Belford Watkins Group
Architects



Date: 4.10.14

Project: Beattie Elementary

To: Rob Price/DJ Anderson

From: Patti Watkins

We are transmitting the following submittals with the comments listed below:

ARCHITECTURE

INTERIORS

PLANNING

NET: No Exception Taken MCN: Make Corrections Noted RX: Rejected
RR: Revise and Resubmit SSI: Submit Specified Item
CMT: See Comment Below

237433 Make Up Air Unit

Copies	Section	Item	Manufacturer	NET	MCN	RR	RX	SSI	CMT
1	237433	Product Data	Titus DESV		x				1

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures, there from. The Contractor remains responsible for details and accuracy, for conforming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

Notes: 1. AIR TERMINAL UNITS (Make Corrections Noted)

1. Contractor shall coordinate right or left hand coil configuration based on ceiling space.
2. Outlet dimensions are different than scheduled, coordinate with space in existing ceiling plenum.
3. Ensure that the bottom access door provides access to the upstream side of the heating coil.



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
---	---	--

Date: 3/28/2014	Reference Number: 0022
------------------------	-------------------------------

Transmitted To: Don Watkins Belford Watkins Group P.O. Box 1306 Fort Collins, CO 80521 Tel: 970-212-1243	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001 N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
---	---

Qty	Submittal Package No	Description	Due Date	Package Action
1	014 - 233600 - 0	Air Terminal Units	4/11/2014	

Transmitted For	Delivered Via	Tracking Number
Review & Approval	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
	001	Air Terminal Units - Product Data	233600		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

_____ Signature	_____ Signed Date
---------------------------	-----------------------------



4001 N. Valley Drive
 Longmont, CO 80504
 Phone: 970-535-4867
 Fax: 970-535-4867

DATE: 03/28/2014

SPECIFICATION SECTION(S): 233600
 SCOPE OF WORK: HVAC - Air Terminal Units

PROJECT: Poudre School District – Beattie Elementary School

PROJECT #: 30-13-038

ARCHITECT/DESIGNER: Belford Watkins Group, LLC.
 425 West Mulberry Ave., Suite 207
 P.O. Box 1306
 Fort Collins, CO 80521

 PHONE: 970-407-0070

GENERAL CONTRACTOR: FCI CONSTRUCTORS, INC.
 4001 N. Valley Drive
 Longmont, CO 80504

 PHONE: 970-535-4725
 FAX: 970-535-4867

SUBMITTED BY: U.S. Engineering
 PO Box 905
 Loveland, CO 80539

 PHONE: 970-669-1666
 FAX:

CONTRACTORS STAMP:

ARCHITECT/ENGINEER STAMP

FCI CONSTRUCTORS, INC.	
Review of this submittal is subject to the provisions of the Contract Drawings and Specifications. This action is for general concurrence only.	
<input checked="" type="checkbox"/>	Reviewed
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmit with Corrections
<input type="checkbox"/>	DISAPPROVED RESUBMIT
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmittal not Required.
Submittal Reviewed By: DA	Date: 03/28/2014
Submittal No: 014	Spec. Section: 233600



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 80539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-017

Date: 3/18/2014

Revision #: _____

Discipline: Tinner

Project: Beattie Elementary

Project #: 1202

Supplier: Air Purification

Spec Sect: 23 36 00

Submitted Items:

Page Number	Paragraph Number	Description	Manufacturer
23 36 00-1	2	Air Terminal Units	
		6-1,6-2,6-3,6-4,6-5,6-6,6-7,6-8	Titus Model DESV
			Lead Time-35 Business Days

Target Dates:

Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
3/11/14	3/18/14	3/28/14		

GC/Arch/Engineer Stamp Area:

U.S. Engineering

Signed:

Chris Mallory



Air Purification Company
1861 West 64th Lane, Denver, Colorado 80221
Phone: 303.428.2800 • Fax: 303.428.2700

Project: Beattie Elementary School

Location: Fort Collins, CO

Engineer: AE Associates

Contractor: US Engineering

Date: 3/10/14

Product: Air Terminal Units

Submitted for Approval By:

John Eha

John Eha



Air Purification Company

1861 West 64th Lane, Denver, Colorado 80221

Phone: 303.428.2800 • Fax: 303.428.2700

Air Terminal Units

SINGLE DUCT AIR TERMINAL UNITS – TITUS, Model DESV

- ½" EcoShield Liner
- Standard Access Door
- 120/24v Transformer
- Metal Control Enclosure

- 1 – Size 10 with 1 Row Hot Water Coil **(06-01)**
- 1 – Size 12 with 2 Row Hot Water Coil **(06-02)**
- 1 – Size 12 with 2 Row Hot Water Coil **(06-03)**
- 1 – Size 10 with 2 Row Hot Water Coil **(06-04)**
- 1 – Size 12 with 2 Row Hot Water Coil **(06-05)**
- 1 – Size 12 with 2 Row Hot Water Coil **(06-06)**
- 1 – Size 12 with 2 Row Hot Water Coil **(06-07)**
- 1 – Size 10 with 2 Row Hot Water Coil **(06-08)**

Note: Air Terminal Units will be ordered as Right Hand Configuration with Right Hand Coil Connections unless Contractor specifies otherwise prior to release.

Single Duct Terminal Unit Schedule

JOB NAME

Tag	Model	Size		CFM		Static Pressure		NC Levels		Hot Water Heat Coil										Unit Config		
		Unit	Outlet	Max	Min	Inlet	Down	Min	Rad	Dis	CFM	MBH	EAT	EWT	LAT	APd	GPM	LWT	WPD		Rows	FPI
06-01	DESV	10	14x13	850	65	1	0.25	0.15	24	19	425	14.7	55	180	93.3	0.14	3	169.7	1.18	1-RH	10	RH
06-02	DESV	12	16x15	1475	440	1	0.25	0.46	23	21	740	27.3	55	180	95.8	0.45	1.3	136.2	0.32	2-RH	10	RH
06-03	DESV	12	16x15	1310	430	1	0.25	0.38	22	20	660	26.1	55	180	98.9	0.37	1.3	138	0.32	2-RH	10	RH
06-04	DESV	10	14x13	1290	420	1	0.25	0.61	25	23	640	24.9	55	180	98	0.6	1.7	148.6	0.43	2-RH	10	RH
06-05	DESV	12	16x15	1585	440	1	0.25	0.51	24	22	795	32.3	55	180	100	0.51	1.9	143.4	0.63	2-RH	10	RH
06-06	DESV	12	16x15	1290	200	1	0.25	0.37	22	20	645	29.7	55	180	106	0.36	1.9	147	0.66	2-RH	10	RH
06-07	DESV	12	16x15	1235	440	1	0.25	0.34	22	20	620	29.1	55	180	107.1	0.33	1.9	147.5	0.65	2-RH	10	RH
06-08	DESV	10	14x13	1175	430	1	0.25	0.53	24	22	590	26.6	55	180	105	0.52	2.5	157.6	0.97	2-RH	10	RH

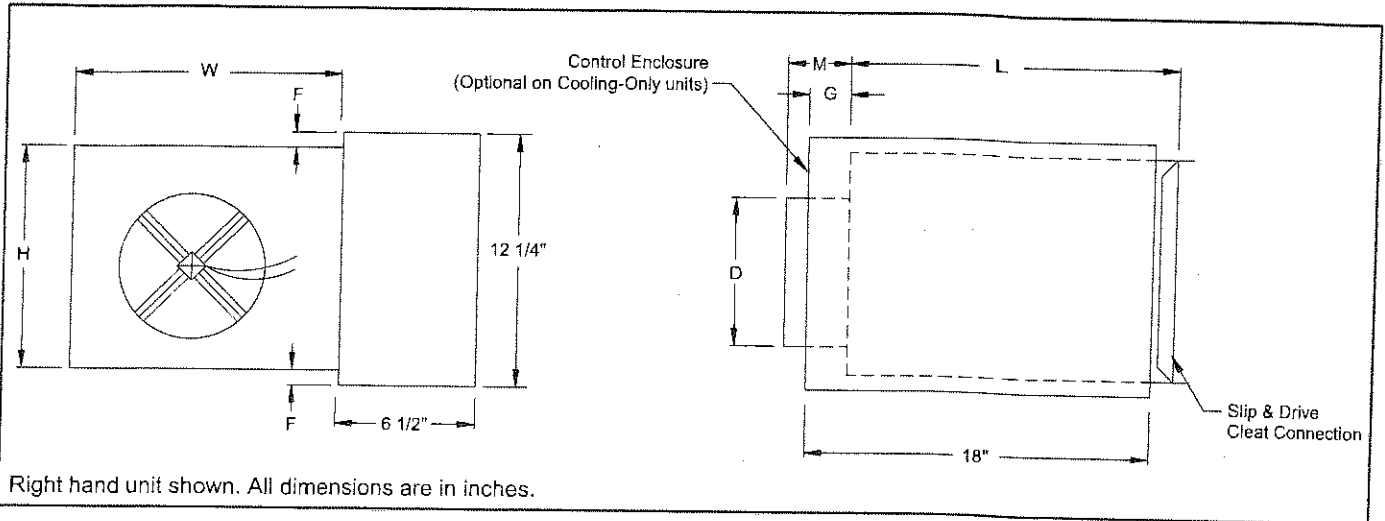
- Notes:
1. Selections are based on Titus as Manufacturer.
 2. All performance based on tests conducted in accordance with ASHRAE 130-2008 and AHRI 880.
 3. All NC levels determined using AHRI 885-2008 Appendix E.
 4. All airflow, pressure losses and heating performance values have been corrected for altitude.
 5. Units of measure: dimensions (in), airflow (cfm), water flow (gpm), air pressure (in wg), water head
 6. Water pressure drop (WPD) units is in ft. water.

The results of this program are only an aid to the designer, and are not a substitute for professional design services. Titus accepts no liability for the adequacy of any resulting design or installation. All data subject to change without notice.

Architect, please confirm the differences between the this Schedule and what is listed on M-0.2 is acceptable.

DESV

Single Duct Terminal Unit
Direct Digital Control, Pressure Independent



Inlet Size	CFM Range	D	F	G	H	L	M	W
4	0-225	3 7/8	2 1/8	7 3/8	8	15 1/2	5 3/8	12
5	0-350	4 7/8	2 1/8	7 3/8	8	15 1/2	5 3/8	12
6	0-500	5 7/8	2 1/8	7 3/8	8	15 1/2	3 3/8	12
7	0-650	6 7/8	1 1/8	7 3/8	10	15 1/2	3 3/8	12
8	0-900	7 7/8	1 1/8	7 3/8	10	15 1/2	3 3/8	12
9	0-1050	8 7/8	-	5 3/8	12 1/2	15 1/2	3 3/8	14
10	0-1400	9 7/8	-	5 3/8	12 1/2	15 1/2	3 3/8	14
12	0-2000	11 7/8	-	5 3/8	15	15 1/2	3 3/8	16
14	0-3000	13 7/8	-	3 3/8	17 1/2	15 1/2	3 3/8	20
16	0-4000	15 7/8	-	3 3/8	18	15 1/2	3 3/8	24
24 x 16	0-8000	23 7/8 x 15 7/8	1 1/8	5 3/8	18	15	3 3/8	38



Accessories (Optional)

Check if provided.

- | | | | |
|--|--|---|---|
| <input checked="" type="checkbox"/> 24 V Control Transformer | <input type="checkbox"/> 1/2" Fibre Free Liner | <input type="checkbox"/> SteriLoc Liner | <input type="checkbox"/> Disconnect Switch |
| <input type="checkbox"/> Dust Tight Enclosure Seal | <input type="checkbox"/> 1" Fiberglass Liner | <input type="checkbox"/> UltraLoc Liner | <input type="checkbox"/> Hanger Brackets |
| <input type="checkbox"/> Fibre Free Liner | <input type="checkbox"/> 1" EcoShield Liner | <input type="checkbox"/> 1/2" EcoShield Liner (Foil Face) | <input type="checkbox"/> Removable Air Flow Sensor |
| <input checked="" type="checkbox"/> 1/2" EcoShield Liner | <input type="checkbox"/> 1" Fibre Free Liner | <input type="checkbox"/> 1" EcoShield Liner (Foil Face) | <input checked="" type="checkbox"/> Bottom Access Door |
| | | | <input checked="" type="checkbox"/> Metal Control Enclosure |

General Description

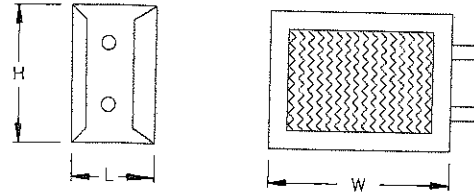
- Heavy gauge steel housing. Mechanically sealed and gasketed, leak resistant construction. Less than 2% of nominal cfm at 1.5" sp wg.
- Dual density internal insulation, treated to resist air erosion. Meets requirements of NFPA 90A and UL 181.
- Rectangular discharge opening is designed for slip and drive cleat duct connection.
- Multipoint center averaging inlet velocity sensor.
- Digital control packages can be factory mounted by Titus.
- Choice of right hand or left hand control location.
- Model DESV can be installed horizontally, vertically, or at any angle. Operation is not affected by position.
- Gauge tees for cfm measurement.

Accessories (Optional)

Hot Water Coil Section

- 1/2" copper tubes
- Aluminum ripple fins, 10 per inch
- Connections: Single circuit, 1/2" O.D. male solder. Multi-circuit, 7/8" O.D., male solder.
- Coil is installed at discharge of unit.
- On units with attenuators, coil are installed at the discharge of attenuator.

- 1 Row
- 2 Row
- 3 Row
- 4 Row



Electric Coil Section

Optional SCR Controlled Electric Heater

Optional Lynergy Controlled Electric Heater

Standard Features

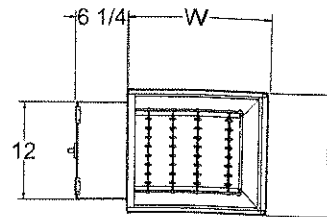
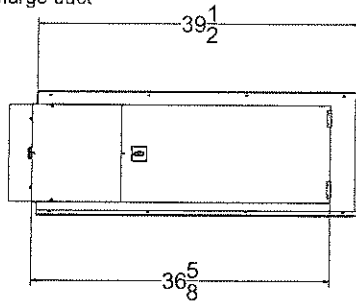
- Single side access to low voltage, high voltage, and electric heater controls.
- Automatic reset thermal cutouts, one per element
- Manual reset secondary protection.
- Positive pressure flow switch
- Magnetic contactor for each step.
- Slip and drive cleat discharge duct connection.

Options

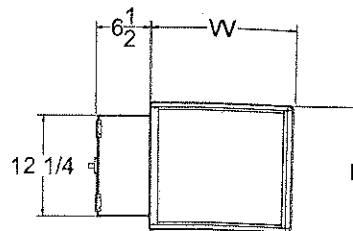
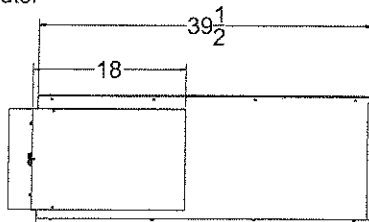
- Fuse Block
- Disconnect switch, door interlock type
- Dust tight construction
- Mercury contactors

Supply Voltage

- 208V, 1 ph, 60Hz
- 240V, 1 ph, 60Hz
- 277V, 1 ph, 60Hz
- 208V, 3 ph, 60Hz
- 480V, 3 ph, 60Hz (4 wire wye standard)



Integral Sound Attenuator



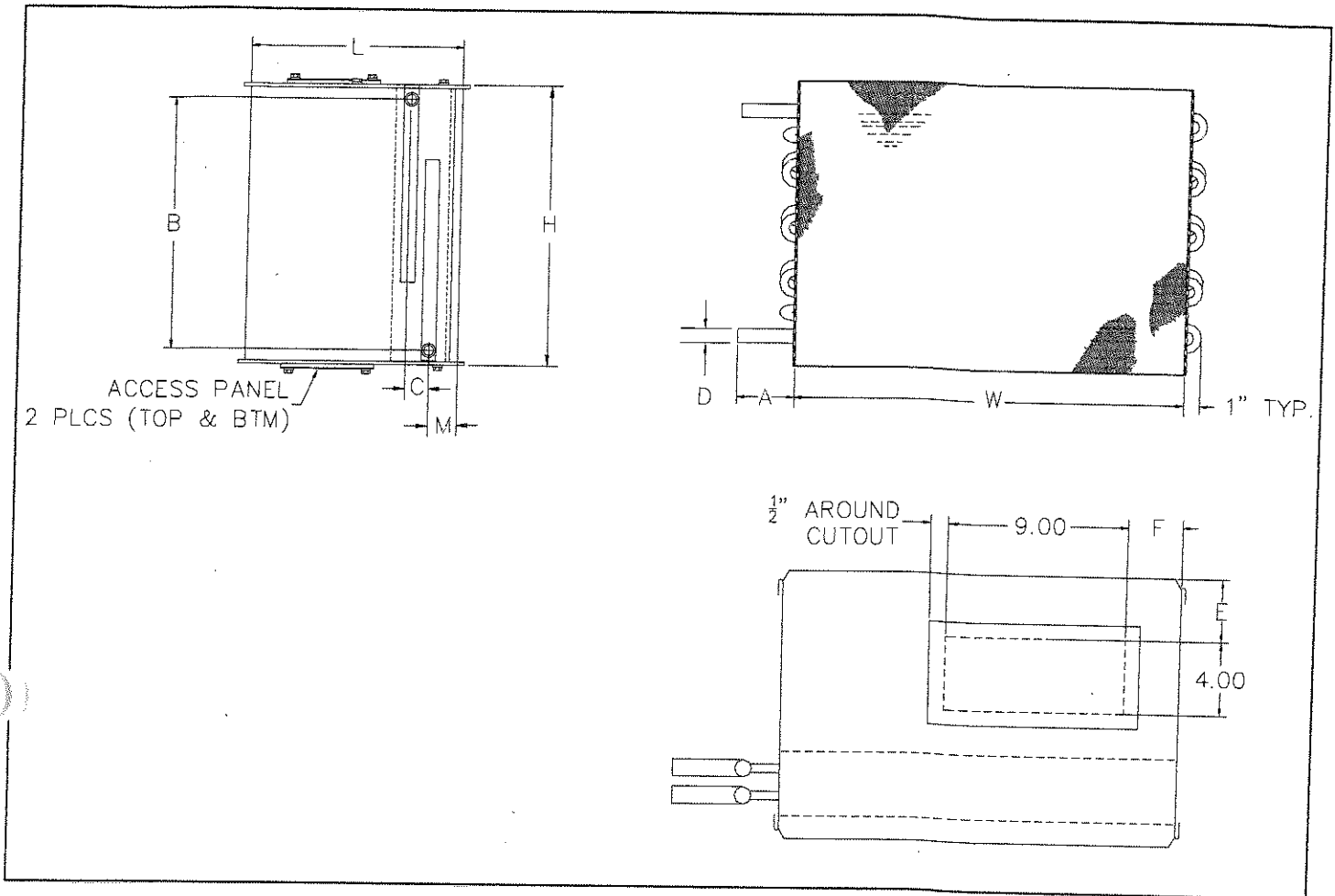
Inlet Size	H	W	Water Coil	
			L (1-2 Row)	L (3-4 Row)
4	8	12	5	7 1/4
5	8	12	5	7 1/4
6	8	12	5	7 1/4
7	10	12	5	7 1/4
8	10	12	5	7 1/4
9	12 1/2	14	5	7 1/4
10	12 1/2	14	5	7 1/4
12	15	16	5	7 1/4
14	17 1/2	20	7 1/2	9 3/4
16	18	24	7 1/2	9 3/4
24 x 16	18	38	5	7 1/4

The total length of the DESV unit is the summation of the unit length (with or without attenuator) and the length of the optional water coil.

This submittal is meant to demonstrate general dimensions of this product. The drawings are not meant to detail every aspect of the product. Drawings are not to scale. Titus reserves the right to make changes without written notice.

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ESV Hot Water Reheat w /Access Door



Unit Size	1 Row										2 Row						
	H	W	M	A	B	C	D	E	F	L	A	B	C	D	E	F	L
4,5,6	8	12	1 3/4	3	6 1/4	0	1/2	2 1/4	1 1/2	10	4 1/4	6 7/8	0	7/8	2 1/4	1 1/2	10 1/2
7,8	10	12	1 3/4	3	8 3/4	0	1/2	2 1/4	1 1/2	10	4 1/4	9	1 1/8	7/8	2 1/4	1 1/2	10 1/2
9,10	12 1/2	14	1 3/4	4 1/4	10 7/8	1 1/4	7/8	2 1/4	2 1/2	10	4 1/4	11 1/2	1 1/8	7/8	2 1/4	2 1/2	10 1/2
12	15	16	1 3/4	4 1/4	13 3/8	1 1/4	7/8	2 1/4	3 1/2	10	4 1/4	14	1 1/8	7/8	2 1/4	3 1/2	10 1/2
14	17 1/2	20	1 3/4	4 1/4	15 7/8	1 1/4	7/8	2 1/4	4	10	4 1/4	16 1/2	1 1/8	7/8	2 1/4	4	10 1/2
16	18	24	1 3/4	4 1/4	15 7/8	1 1/4	7/8	2 1/4	6	10	4 1/4	16 1/2	1 1/8	7/8	2 1/4	6	10 1/2
24 x 16	18	38	1 3/4	4 1/4	15 7/8	1 1/4	7/8	2 1/4	13	10	4 1/4	16 1/2	1 1/8	7/8	2 1/4	13	10 1/2

General Description

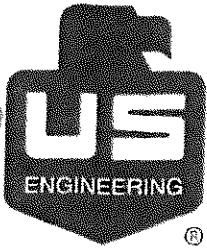
- Coil connections have single circuit 1/2 inch O.D. copper tubes, 0.016 thick wall male solder.
- Multi-Circuit connections have 7/8 inch O.D. copper tubes, 0.016 thick wall male solder.
- Aluminum plate fins, 10 per inch.
- Casing is 20 Gauge galvanized steel.
- Copper male solder connections.
- Connection is slip and drive to duct work down stream of terminal.
- Leak tested to 300 PSIG.
- Maximum working pressure, 240 PSIG
- Maximum 200 degree F water

Unit Size	1 Row		2 Row	
	Water Weight (lbs)	Water Volume (gal)	Water Weight (lbs)	Water Volume (gal)
4,5,6	0.59	0.07	1.26	0.15
7,8	0.77	0.09	1.82	0.22
9,10	1.17	0.14	2.32	0.28
12	1.87	0.22	3.45	0.41
14	2.29	0.27	4.08	0.49
16	2.67	0.32	4.75	0.57
24 x 16	4.20	0.50	7.50	0.90

Note: For additional rows, add difference between the 1 and 2 rows coil capacity.
8.34 LBS / gallon of water

This submittal is meant to demonstrate general dimensions of this product. The drawings are not meant to detail every aspect of the product. Drawings are not to scale. Titus reserves the right to make changes without written notice.

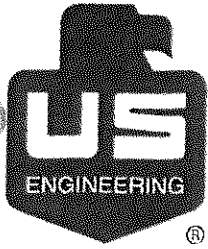
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Tab-6
Specification Section: 23 38 13
Commercial Kitchen Hoods:
EH-1 (Captive Aire)
EH-2 (Captive Aire)

**BEATTIE
ELEMENTARY
SCHOOL**

1000 MEADOWLARK AVE
FORT COLLINS CO 80526

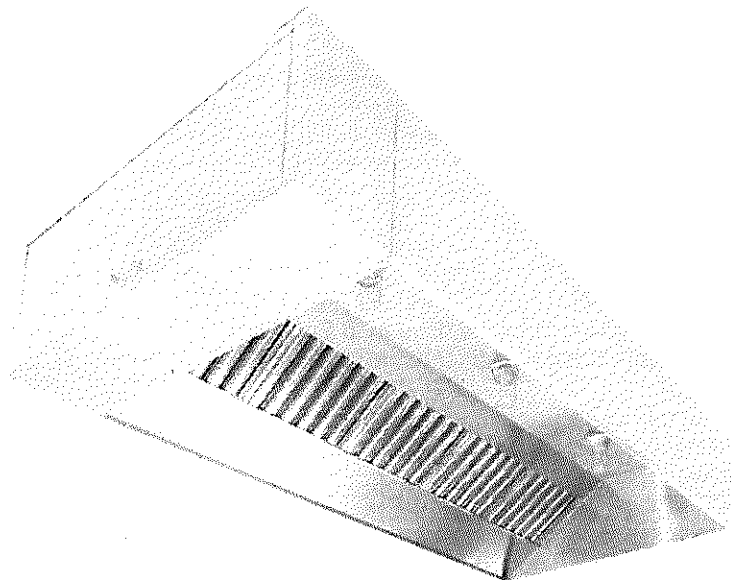


Commercial Kitchen
Hoods (Captive Aire)
O&M and Warranty
Information:
EH-1
EH-2

**BEATTIE
ELEMENTARY
SCHOOL**

3000 MEADOWLARK AVE
FORT COLLINS, CO 80526

Commercial Kitchen Hoods Installation, Operation, and Maintenance Manual



RECEIVING AND INSPECTION

Upon receiving unit, check for any interior and exterior damage, and if found, report it immediately to the carrier. Also check that all accessory items are accounted for and are damage free.

WARNING!!

Installation of this unit should only be performed by a qualified professional who has read and understands these instructions and is familiar with proper safety precautions. Read this manual thoroughly before installing or servicing this equipment.

Save these instructions. This document is the property of the owner of this equipment and is required for future maintenance. Leave this document with the owner when installation or service is complete.

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WARRANTY

This equipment is warranted to be free from defects in materials and workmanship, under normal use and service, for a period of 12 months from date of shipment. This warranty shall not apply if:

1. The equipment is not installed by a qualified installer per the MANUFACTURER'S installation instructions shipped with the product,
2. The equipment is not installed in accordance with federal, state and local codes and regulations,
3. The equipment is misused or neglected,
4. The equipment is not operated within its published capacity,
5. The invoice is not paid within the terms of the sales agreement.

The MANUFACTURER shall not be liable for incidental and consequential losses and damages potentially attributable to malfunctioning equipment. Should any part of the equipment prove to be defective in material or workmanship within the 12-month warranty period, upon examination by the MANUFACTURER, such part will be repaired or replaced by MANUFACTURER at no charge. The BUYER shall pay all labor costs incurred in connection with such repair or replacement. Equipment shall not be returned without MANUFACTURER'S prior authorization and all returned equipment shall be shipped by the BUYER, freight prepaid to a destination determined by the MANUFACTURER.

LISTINGS

This hood is ETL-listed to standard UL710 when installed in accordance with these installation instructions and National Fire Protection Association Standard "NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations."

INSTALLATION

It is imperative that this unit is installed and operated with the designed airflow, filters and construction in accordance with this manual. If there are any questions about any items, please call the service department at 1-866-784-6900 for warranty and technical support issues.

WARNING: IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTAINANCE CAN CAUSE PROPERTY DAMAGE, INJURY OR DEATH. READ THE INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS THOROUGHLY BEFORE INSTALLING OR SERVICING THIS EQUIPMENT.

Site Preparation

1. Provide clearance around installation site to safely rig and lift equipment into its final position. Consider general service and installation space when locating unit.
2. Locate unit close to the space it will serve to reduce long, twisted duct runs.
3. Thoroughly review the plans and specifications of the project.
4. Determine the exact location in which the cooking hood will be installed and verify that there are no interferences which will prevent proper installation.
5. Verify that all overhead beams and angles are structurally strong enough to support the weight of the hood and hanging system. It is often necessary to strengthen existing structural beams, as they are not designed to carry the weight of a stainless steel hood. Refer to the project submittal drawing for hood weight(s). It may also be necessary to create a support structure suspended from the ceiling joists to better align with the desired hood location.
6. Determine if adequate room is available to install the hood and all ductwork with proper clearances from combustible material. IMC, NFPA96 and local authorities having jurisdiction call for a minimum clearance (typically 18 inches for type 1, grease rated hoods) between the cooking hood(s), exhaust ducts, and building materials which are combustible. However, IMC and NFPA96 outline acceptable clearance reduction methods; **most authorities accept the clearance reduction methods approved in the manufacturer's ETL listing for Type 1, grease rated hoods. See Figure 1.** It is important to check with the local authority having jurisdiction to determine that the installation method is satisfactory to meet their requirements prior to installing the equipment.

FOLLOW SMACNA GUIDES AND RECOMMENDATIONS FOR THE HANGING AND INSTALLATION OF HOODS.

Clearance Reduction Methods

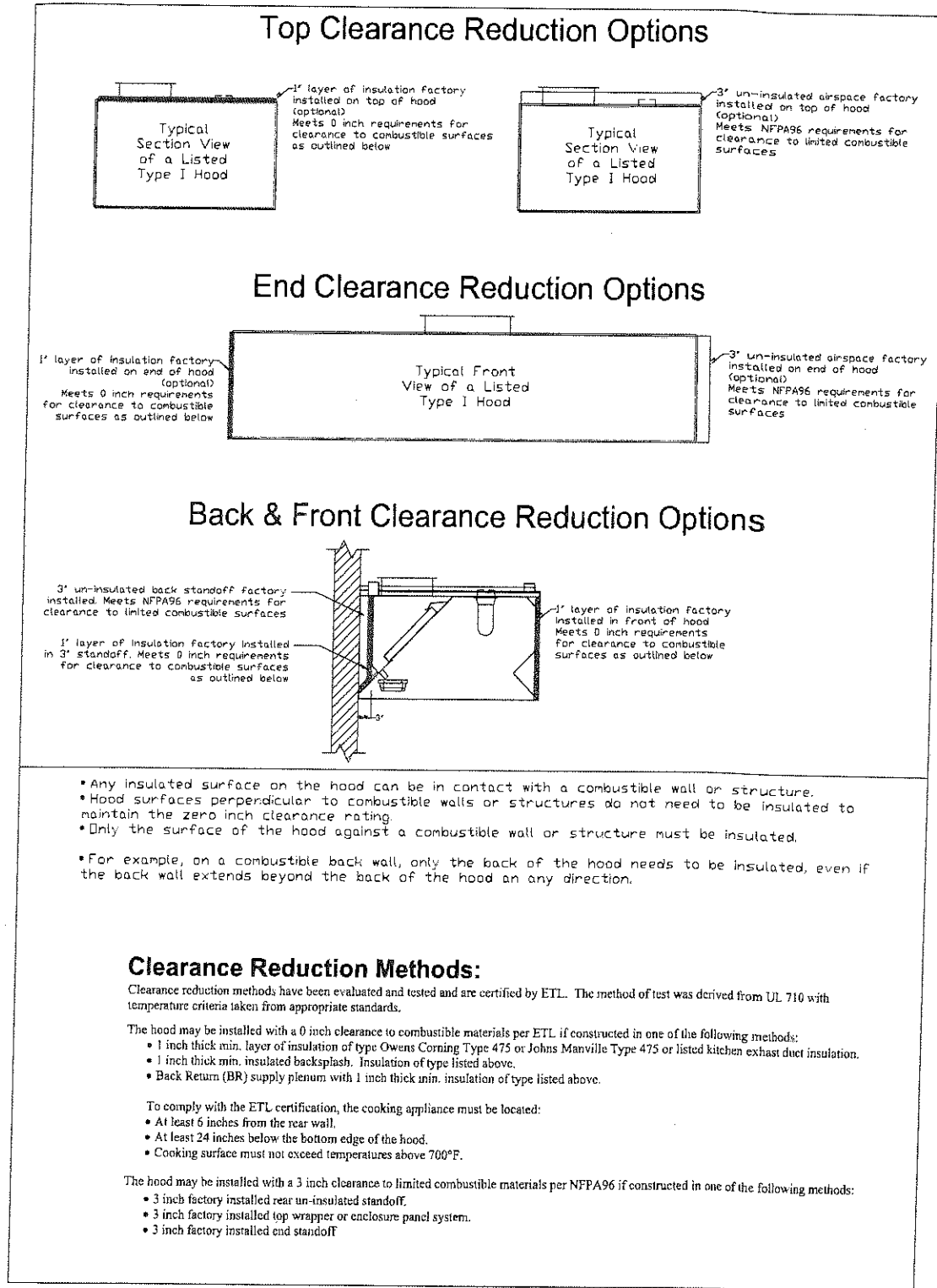


Figure 1

Installation of a Single Hood (Wall or Island)

The following is a step-by-step procedure for installation of the ventilation hood.

1. Uncrate the hood, being very careful not to dent or scratch the outer surface. **NOTE: Report any damage to the delivering freight carrier and file a claim if appropriate.** Refer to the installation drawing for typical details of the ventilation system prior to hanging the hood. Check the nameplate on the equipment to make certain it meets the specifications provided by the architect and/or engineer. **If discrepancies exist, notify the manufacturer immediately.**

The nameplate will also give information regarding the following:

- Clearance from cooking surface to front lower edge of the hood
- Minimum exhaust air flow
- Maximum supply air flow (if applicable)
- Minimum front overhang from cooking surface
- Minimum side overhang from cooking surface
- Maximum cooking surface temperature
- Replacing fusible links for exhaust and supply damper (if applicable)
- Replacing filters

2. Determine the height at which the hood will be hung:

Canopy hoods are typically hung so that the front lower edge of the hood is within 6'6" - 7'0" AFF. However, the hood should be hung so that the proper clearance from the cooking surface to the front lower edge of the hood is maintained. See nameplate for clearance from cooking surface to front lower edge of hood. Exact hood hanging height should be verified with local authorities having jurisdiction.

Note: If there are wrappers (enclosure panels) with the order, measure down from the ceiling the height of the wrappers. That will be the top hanging height of the hood as long as the following criteria are met:

- The front lower edge of the hood is within 6'6" to 7'0" AFF,
- The front lower edge of the hood is within the clearance requirement from the cooking surfaces, and
- If the hanging height based on wrappers does not fall in this range, contact your local office.

Backshelf hoods are typically hung at the maximum height allowed from the cooking surfaces. See nameplate for clearance from cooking surface to front lower edge of hood. Exact hood hanging should be verified with local authorities having jurisdiction.

Note: If there are wrappers with the order, measure down from the ceiling the height of the wrappers. That will be the top hanging height of the hood as long as the front lower edge of the hood is within the clearance requirement from the cooking surfaces. If the hanging height based on wrappers does not fall in this range, contact your local office.

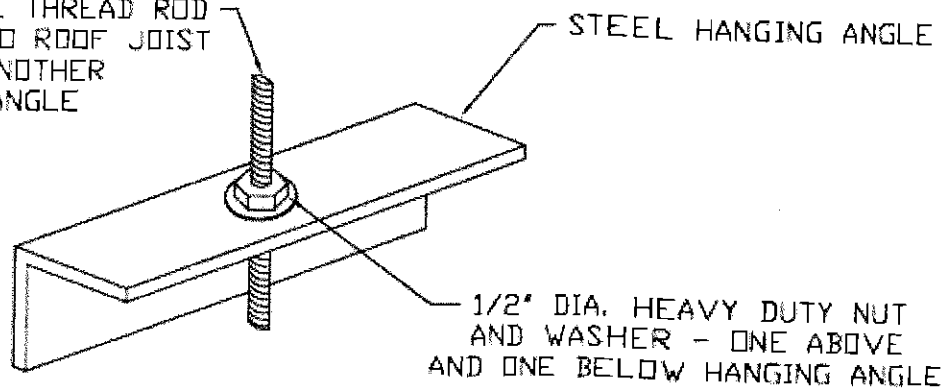
3. If the hood has a back return, install it now. See the *Installation of Hood Accessories* section.
4. If the hood has a bolt-together standoff, install it now. See the *Installation of Hood Accessories* section.
5. If the hood has duct thermostats, install them now per the thermostat installation drawing.
6. Position hood on the floor in its approximate final position with the supply and exhaust risers on the hood located directly beneath the corresponding openings in the roof, if possible. It is advisable to finalize the location using a plumb-bob or laser. **Protect the hood when it is on the jacks to avoid dents, scratches, and other damage to the hood.**
7. Proceed to weld exhaust duct to hood while on the floor, if possible.

8. Use 1/2" threaded rod to hang hoods. Drill 9/16" holes in the structural support system or use Unistrut® to line up with the welded-on angle mounting brackets on the hood. There are several types of mounting brackets depending upon the hood type; each, however, has a predrilled hole. See Figure 2 for details. **The structural integrity of the structural support system is the responsibility of the contractor and the structural engineer.** There are also center hanging angles on hoods 12 feet in length and longer. **Center hanging angles must be used to support the hood weight and prevent filter fit and grease drainage problems.** Some backshelf hoods do not have hanging angles and must be anchored to back wall using the standing flange provided. Structural lagbolts must be used every 12 inches on center maximum and must be secured to studs behind wall.
9. The spacing on the hole for the modified support should line up with the mounting bracket on top of the hood. The top hanger should be 1/2" closer to the back wall than the mounting bracket on the hood to pull the hood against the wall. **See Figure 3.** Some hoods are designed for island installations where a wall is not present.
10. With the hood well protected against possible scratching, raise the hood into position using high lifts or equipment jacks at each end to keep the hood level. When the hood is elevated to the proper height, install 1/2" threaded rod between each mounting bracket on the hood and the modified support. Secure rods with heavy duty nuts and appropriately sized fender washers above and below the hanging angle.
11. Make final adjustments as needed to ensure the hood is hung level. Maintain tension on all rods to ensure the hood weight is evenly distributed. If it is necessary to stand or work on top of the hood, use pieces of plywood to evenly distribute weight on the hood so no damage occurs.
12. Brace hood to ceiling joists and wall(s), as applicable, so that the hood does not move. Secure hood to wall in a manner acceptable to the authority having jurisdiction.
13. If the hood has Back and/or Side Perforated Supply Plenums (i.e. PSPs), install them now. See the *Installation of Hood Accessories* section.
14. If an AC-PSP is to be installed with the hood, install it now. See the *Installation of Hood Accessories* section.
15. Install the exhaust ductwork. The entire exhaust duct system must be continuously welded, liquid tight unless it is Listed Factory Built Grease Duct. The duct must be welded to the hood exhaust collar and the roof curb cap must be welded to the exhaust duct. See *Guidelines for Ductwork Installation - By Others.*
16. Install the supply ductwork. See *Guidelines for Ductwork Installation - By Others.*
17. If the hood is equipped with a control unit, an installation wiring diagram will be provided inside of the control unit. The jobsite electrician is responsible for making the appropriate field connections. This includes all lights and duct/hood mounted thermostats.
18. If the hood is equipped with a factory prepiped fire suppression system, a certified fire system installer is responsible for completing the field hookup, testing, and certifying the system in accordance with the manufacturer's specifications and the local fire codes. If the hood is not prepiped, a certified fire system installer is responsible for installing, testing and certifying the system in accordance with the manufacturer's specifications and the local fire codes.
19. If the hood is equipped with wrappers (enclosure panels), end panels, and/or backsplash panels, install them now. See the *Installation of Hood Accessories* section.
20. Caulk the lower edge of the hood where it meets the wall. This does not apply to hoods installed in island configurations.
21. Install light bulbs, light globes, and grease filters in the hood.
22. Install grease cups in the brackets/slots provided.
23. Use a stainless steel polish to clean the hood of dust or dirt acquired in transit.
24. It is recommended that the protective plastic sheeting remain on the installed hood until construction is complete, so as to avoid any damage to the equipment.

WARNING: NEVER PUNCTURE THE HOOD GREASE CONTAINMENT AREA TO HANG HOOD OR TO HANG ITEMS FROM HOOD. PUNCTURING THE GREASE CONTAINMENT AREA WILL VOID WARRANTY AND LISTING ON HOOD.

Basic Hanging Angle

1/2" DIA. ALL THREAD ROD
CONNECTED TO ROOF JOIST
THROUGH ANOTHER
HANGING ANGLE

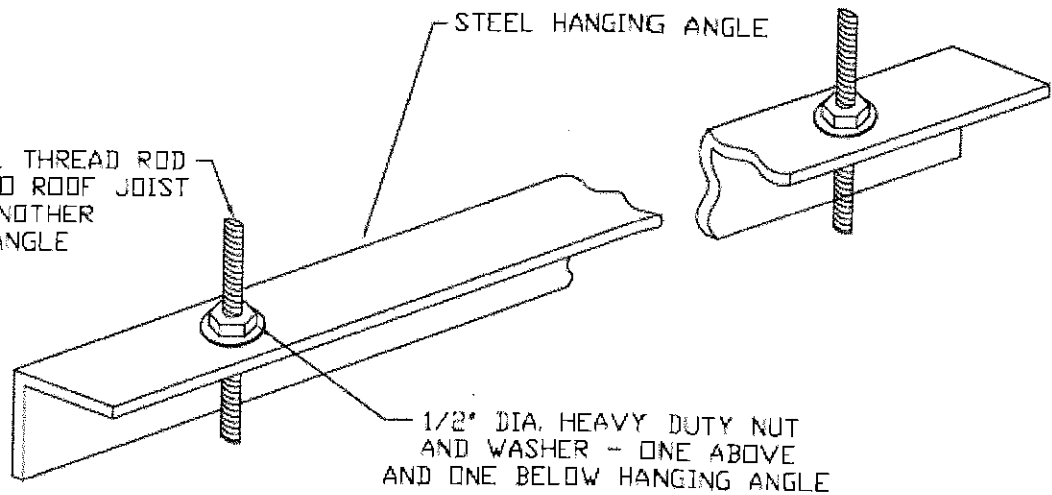


ROD, NUTS, AND WASHERS TO BE SUPPLIED BY INSTALLING CONTRACTOR
HANGING ANGLE IS PRE-PUNCHED AT FACTORY

Figure 2A

Full Length Hanging Angle

1/2" DIA. ALL THREAD ROD
CONNECTED TO ROOF JOIST
THROUGH ANOTHER
HANGING ANGLE

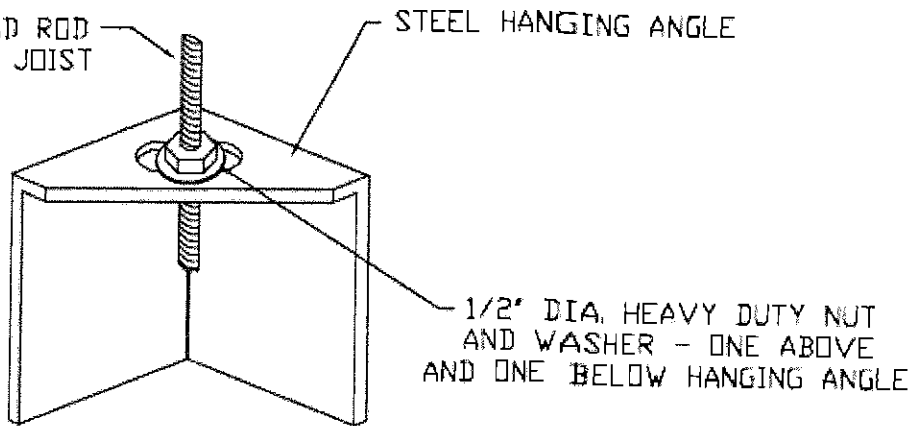


ROD, NUTS, AND WASHERS TO BE SUPPLIED BY INSTALLING CONTRACTOR
HANGING ANGLE IS PRE-PUNCHED AT EACH END AT FACTORY

Figure 2B

Corner Hanging Angle

1/2" DIA. ALL THREAD ROD
CONNECTED TO ROOF JOIST
THROUGH ANOTHER
HANGING ANGLE

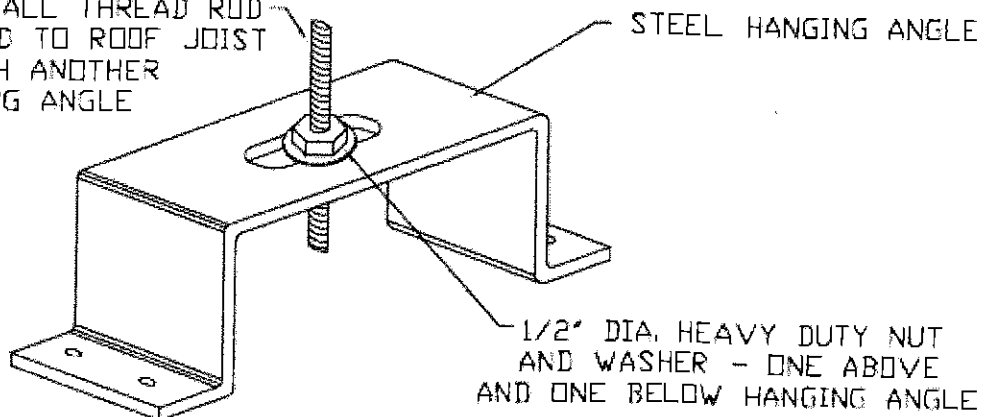


ROD, NUTS, AND WASHERS TO BE SUPPLIED BY INSTALLING CONTRACTOR
HANGING ANGLE IS PRE-PUNCHED AT FACTORY

Figure 2C

PSP Hanging Angle

1/2" DIA. ALL THREAD ROD
CONNECTED TO ROOF JOIST
THROUGH ANOTHER
HANGING ANGLE



ROD, NUTS, AND WASHERS TO BE SUPPLIED BY INSTALLING CONTRACTOR
HANGING ANGLE IS PRE-PUNCHED AT FACTORY

Figure 2D

Side View of Typical Hood

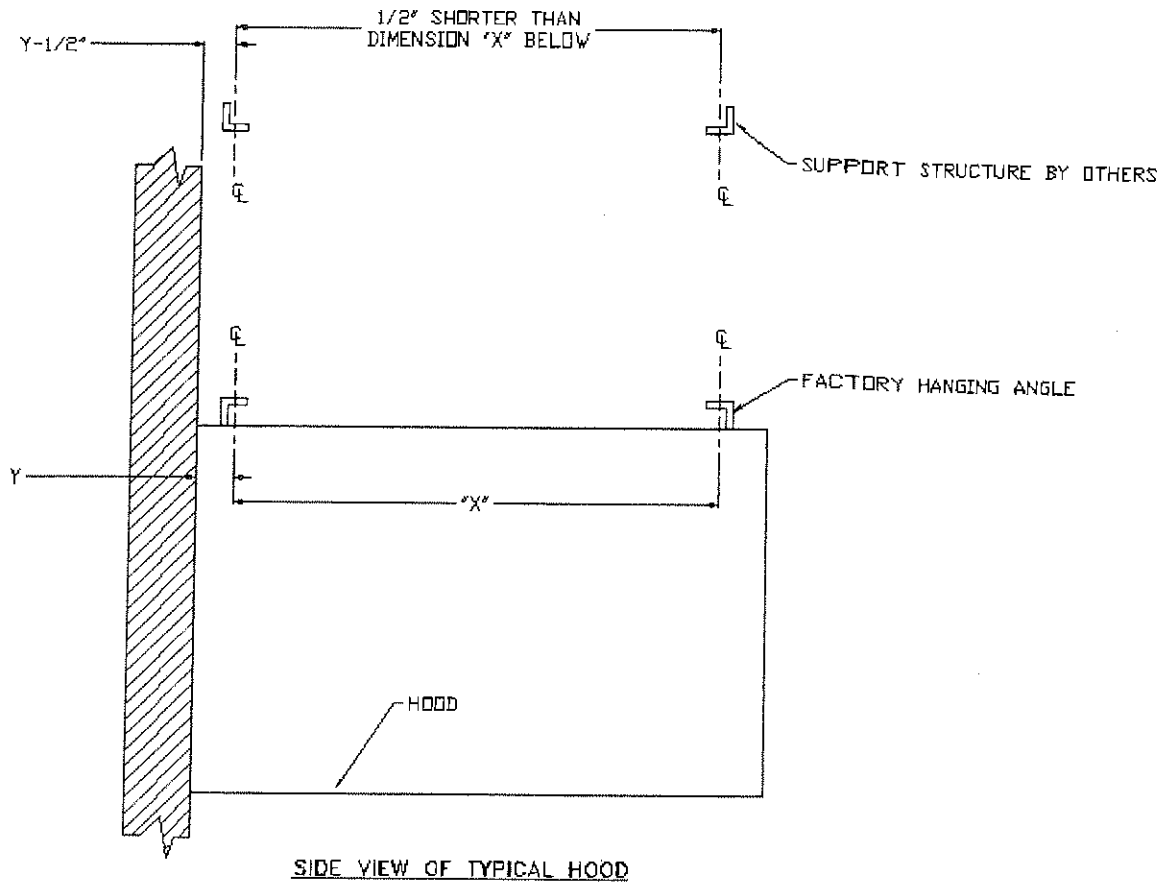


Figure 3

End-to-End Hoods

The following is a step-by-step procedure for installation of end-to-end ventilation hoods. Refer to Figures 4 and 5.

1. Follow steps 1 through 10 of the *Installation of a Single Hood* section for each hood.
2. Adjust tension on hanging rods to position hoods so they fit flush with each other as shown in **Figure 4**.
3. Bolt the top of the hoods together. **See Figure 5**.
4. Once all of the hoods are hung, follow steps 11 through 19 of the *Installation of a Single Hood* section.
5. NOTE: Hoods having more than a 1/8" gap between them must be repositioned so that gap between hoods is $\leq 1/8"$. Run a bead $\geq 1/8"$ of silicone sealant along the lower horizontal seam of the two hoods. Slip the U-channel trim, if applicable, over the seam as shown in **Figure 4**. Tape can be used to hold the U-channel in place until the silicone cures. **U-channel is not required on hoods with Flanged ends**.
6. Run a bead of the same silicone sealant along the front vertical seam between the two hoods. Slip the T-strip trim between the hoods if applicable. **See Figure 5**. **T Strip is not required on hoods with flanged ends and fully welded, ground, and polished corners**.

7. Proceed with steps 20 through 23 of the *Installation of a Single Hood section*.

Hanging Detail for Multiple Hood Models Hung End-to-End (Hemmed Ends)

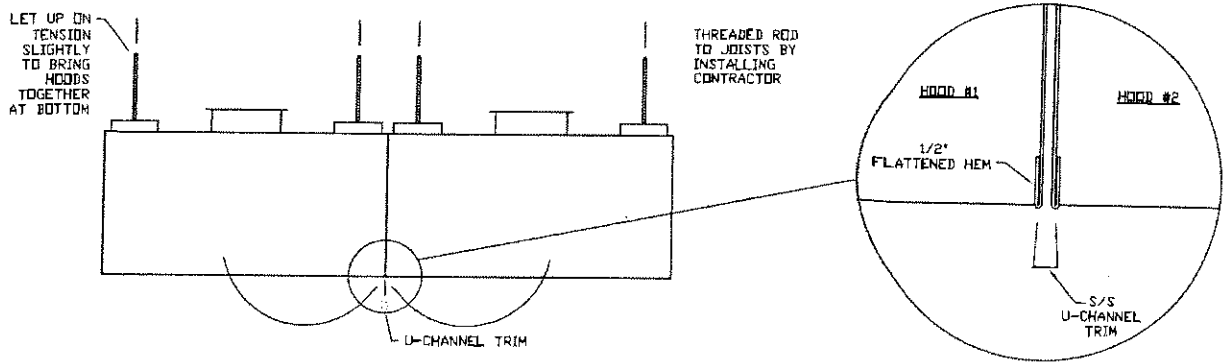


Figure 4A

Hanging Detail for Multiple Hood Models Hung End-to-End (Flanged Ends)

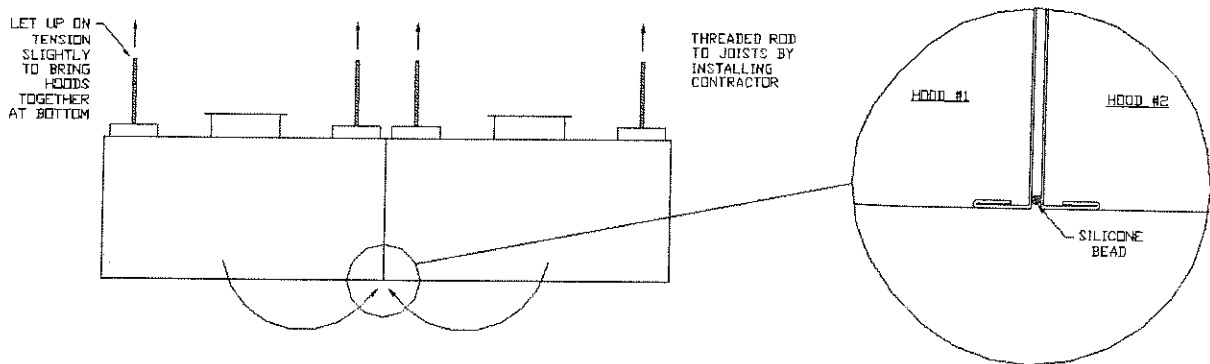


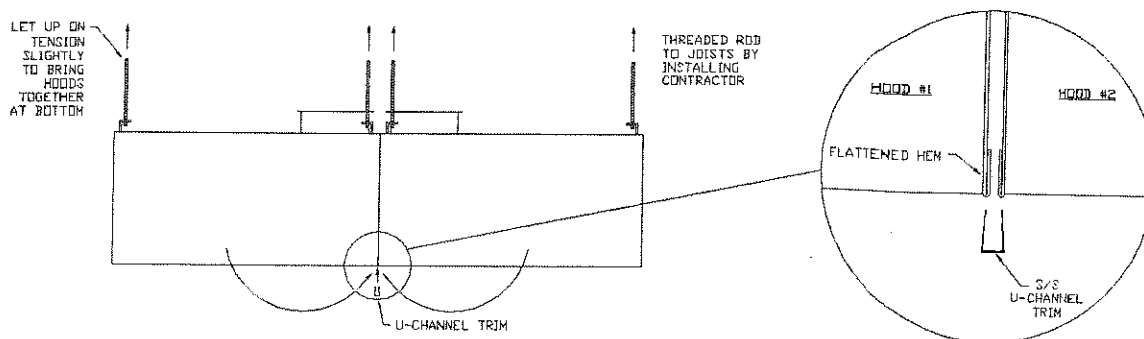
Figure 4B

Back-to-Back Hoods

The following is a step-by-step procedure for installation of back-to-back ventilation hoods. Refer to Figures 5 and 6.

1. Follow steps 1 through 10 of the *Installation of a Single Hood* section for each hood.
2. Adjust tension on hanging rods to position hoods so they fit flush with each other as shown in Figure 6.
3. Bolt the top of the hoods together by sliding a threaded rod through the connection bracket slots and fastening it into position by using heavy duty nuts and washers. See Figure 5.
4. Once all of the hoods are hung, follow steps 11 through 19 of the *Installation of a Single Hood* section.
5. Run a bead $\geq 1/8$ " of silicone sealant on the lower horizontal seam between the two hoods. Slip the U-channel over the seam as shown in Figure 6. Tape can be used to hold the U-channel in place until the silicone cures.
6. Run a bead of the same silicone sealant along the side vertical seam between the two hoods. Slip the T-strip trim between the hoods. See Figure 5. T Strip is not required on hoods with flanged ends and fully welded, ground, and polished corners.
7. Proceed with steps 20 through 23 of the *Installation of a Single Hood* section.

Hanging Detail for Hoods Hung Back-to-Back



HANGING DETAIL FOR HOODS HUNG BACK-TO-BACK

Figure 6

Guidelines for Ductwork Installation

Ductwork is furnished by supplier only if specified by the customer. The following information is provided as a guideline only. Ductwork should be installed in accordance with the local codes and restrictions. It is the responsibility of the installer to check local codes prior to installing the ductwork.

1. All ductwork must be installed in the most direct manner possible.
2. Exhaust duct must be made of 16 gauge carbon steel, 18 gauge stainless steel or must be listed for use with commercial kitchen hoods and follow the manufacturer's listing.
3. Per NFPA 96, all exhaust duct seams and joints must have a continuous liquid tight external weld; exception would be Listed Factory Built Grease Duct.
4. Exhaust risers on the hood have been sized to achieve a velocity of 500-2200 FPM, per NFPA 96, based upon the CFM required for the hood. Maintain the area of each riser when connecting duct offsets or transitions.
5. Branches should enter at gradual expansions and at a preferred angle of 30 degrees or 45 degrees if necessary.
6. When a "pantleg duct" is required to bring two ducts into one exhaust fan, observe the following in order to obtain desired performance:
 - a. Use ONLY radius back and radius throat elbows. 2 to 2.5 diameter center line radius is recommended.
 - b. Maintain the distance between the center lines of exhaust ducts at a maximum of 12' apart.
 - c. The main duct going to the exhaust fan must be the sum of the area of the separate legs.
7. Supply air risers are sized around a maximum of 600 FPM. Maintain this area when installing ducts.
8. Do not use "flexible" type duct for supply duct. Only rigid type duct installed in accordance with SMACNA Low Pressure requirements will be acceptable.
9. Access Doors should be provided at the sides or at the top of the duct, as well as changes of direction. Please refer to your AHJ if questions on requirements for horizontal and vertical duct run.
10. **IMPORTANT:** When a fusible link is installed in the make-up air damper at the hood collar, an access door must be cut into the supply duct by the installer.
11. Duct sensor may ship loose on hoods with field cut risers. When double wall duct or ductwork with a diameter smaller than 10" is used, loose duct sensors should be installed in the top of the plenum near the riser in the path of the exhaust airflow.

Installation of Hood Accessories

Back Return Installation

1. Locate the assembly and unpack the product from the crate, being very careful not to dent or scratch the outer surface. **NOTE: Report any damage to the delivering freight carrier and file a claim if appropriate.**
2. If the supply risers are to be field cut, cut the risers in as desired. **NOTE: For factory cut supply risers, the manufacturer installs a 2" vertical flange around the opening.** This flange is intended to slip inside a supply boot that is provided by the installer.
3. Locate the wall and ceiling joists which will support the assembly.
4. Use 1/2" threaded rod to hang the back return. Install the threaded rod and angle or Unistrut® that will be used to hang the assembly from the ceiling joists. Drill 9/16" holes as needed in the angle for the threaded rod. Be sure to line up with the welded-on angle mounting brackets on the back return.
5. The back return is typically hung so its top edge is the same height as the top edge of the hood. **See Figure 7.** Refer to Step 2 in the *Installation of a Single Hood* instructions to determine the hood and back return hanging heights.
6. Slowly raise the back return until hanging rods can be attached to the hanging angles. It is advisable to do this before the back return reaches its final height. **NOTE: Please use caution as weight is not proportionally dispersed.** Install the threaded rod into the back return hanging angles and use heavy duty nuts to secure the connection.
7. Make sure the back return is level. Secure to wall in a manner acceptable to the AHJ.
8. If there are multiple back return sections, install the remaining sections now. Use caulk and the T-strip trim between adjacent back return sections. **See Figure 8.**
9. Peel the protective plastic coating on the back return down below where the bottom edge of the hood will rest against it, so it does not remain behind the hood.
10. Caulk the seams between the wall and the back return assembly after the hood and all other accessories have been installed.

Section View of Typical Hood with Back Return

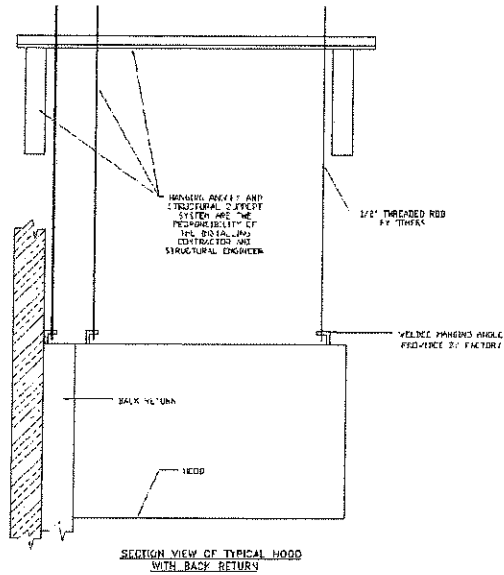


Figure 7

Back Return – Multiple Sections

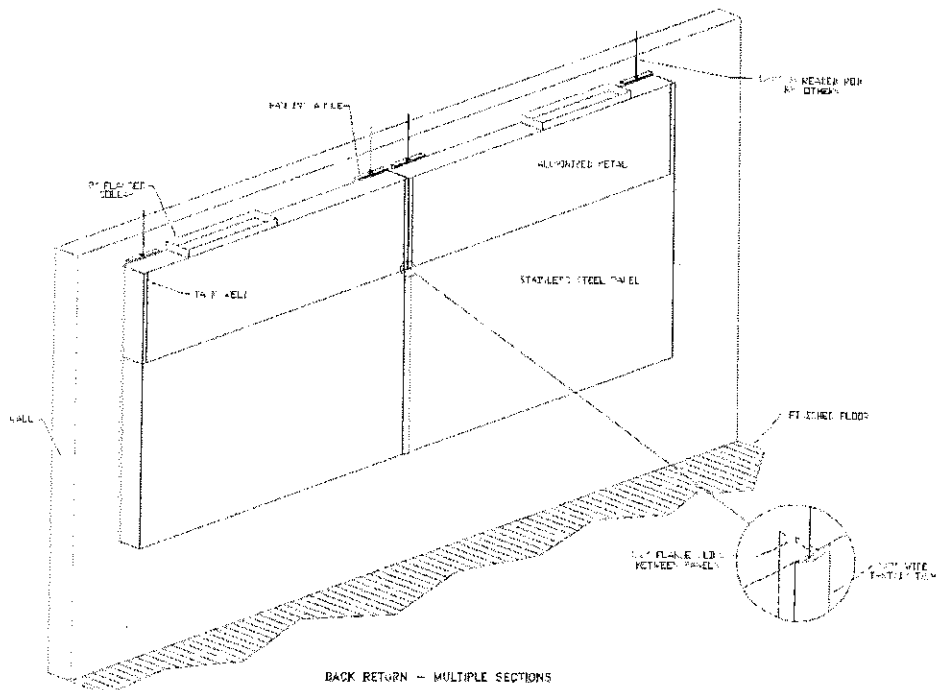
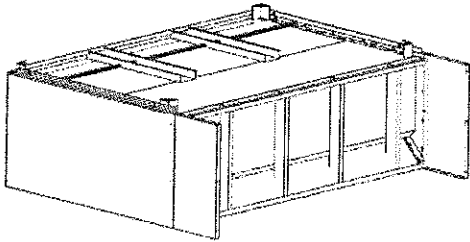


Figure 8

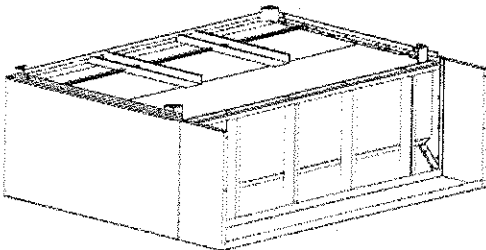
Bolt-Together Standoff Installation

1. Unpack the standoff panels from the shipping container, being very careful not to dent or scratch the panels. **NOTE: Report any damage to the delivering freight carrier and file a claim if appropriate.**
2. Mount the end caps for the back standoff to the hood securely with self-tapping sheet metal screws. Clamp the back standoff and the hood together before screwing so they do not shift. **See Figure 9.**
3. Place the back standoff filler piece into place flush with the rear bottom edge of the hood and secure with self-tapping sheet metal screws.
4. Continue with hood installation instructions.
5. After the hood installation is complete, secure the bolt-together standoff to the wall or other hoods as applicable in a manner acceptable to the authority having jurisdiction.

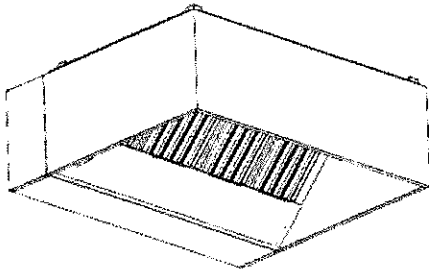
Bolt Together Standoff Installation



Mount the end caps for the back standoff to the hood using self-tapping sheet metal screws provided. Screw through the end cap flanges into the flanges on the hood.



Place the back standoff horizontal filler piece into place. Mount the filler piece using self-tapping sheet metal screws provided. Screw through the filler piece flanges into the studs on the back side of the hood. Do not penetrate into the capture area. Once complete, no screws should be visible from the outside of the hood.



Attach the back standoffs to the wall using screws appropriate for the wall. Screw through the flanges of the standoff into the wall. If standoff mounts against another hood, use the procedure from steps 1 and 2 for the second hood.

Figure 9

Back and Side PSP (Perforated Supply Plenum) Installation

1. Locate the assembly and unpack it from the crate, being very careful not to dent or scratch the outer surface. **NOTE: Report any damage to the delivering freight carrier and file a claim if appropriate.**
2. Upon completion of the hood install, install the back PSP first. Then **if applicable**, install the side PSPs.
3. If the supply risers are to be field cut, cut the risers in as desired.
4. Locate the ceiling joists which will support the assembly. If using Unistrut®, then securely attach to the ceiling joist.
5. Use 1/2" threaded rod to hang the PSP. Install the threaded rod and angle that will be used to hang the assembly from the ceiling joists. Drill 9/16" holes in the angle if not using Unistrut®. Be sure to line up with the angle mounting brackets on the PSP.
6. Peel the protective plastic coating on the hood down below where the bottom edge of the PSP will rest against the hood, so it does not remain behind the PSP.
7. Move the PSP into position as indicated by the project submittal drawings; lining up the top edge of the PSP with the top edge of the hood. Remove the protective coating from the back of the PSP. **See Figure 10.**
8. Install the threaded rod into the PSP hanging angles and use heavy duty nuts to secure the connection. Adjust tension on hanging rods to position PSP so it fits flush with the hood. **NOTE: Do not apply too much tension; otherwise, a gap between the PSP and Hood will be created at the bottom.**
9. Install additional PSPs, if applicable, in the same manner.
10. Where applicable, use sheet metal screws to secure the PSP attaching bracket on top of side PSPs to front PSP. **See Figure 11.**
11. Caulk the seams between the hood(s) and each PSP assembly, as well as between adjacent PSP assemblies (if applicable) after the hood(s) and hood accessories have been installed. An isometric view of the hood assembly for a model PSPFBSS is shown in **Figure 12.**

PSP Installation on Model PSPFBSS

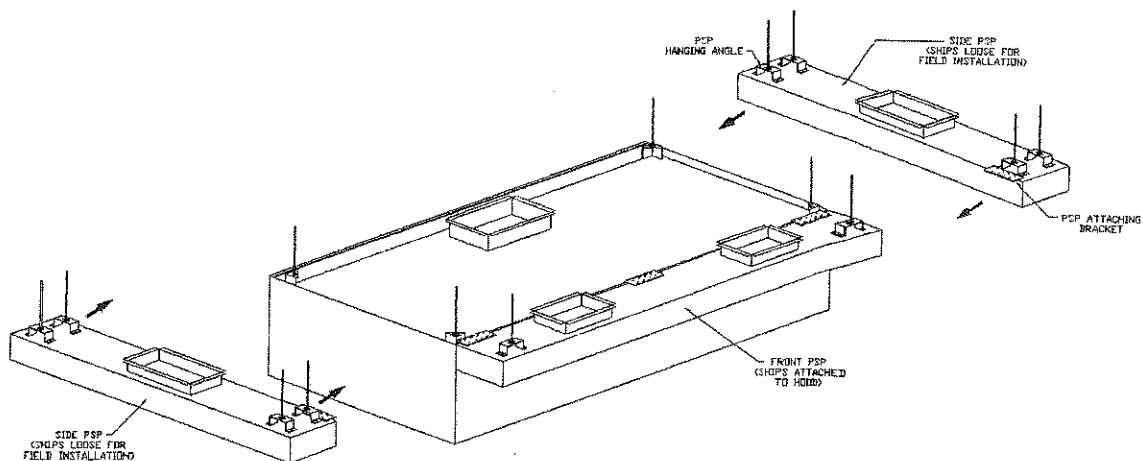


Figure 10

Attachment of Side PSP

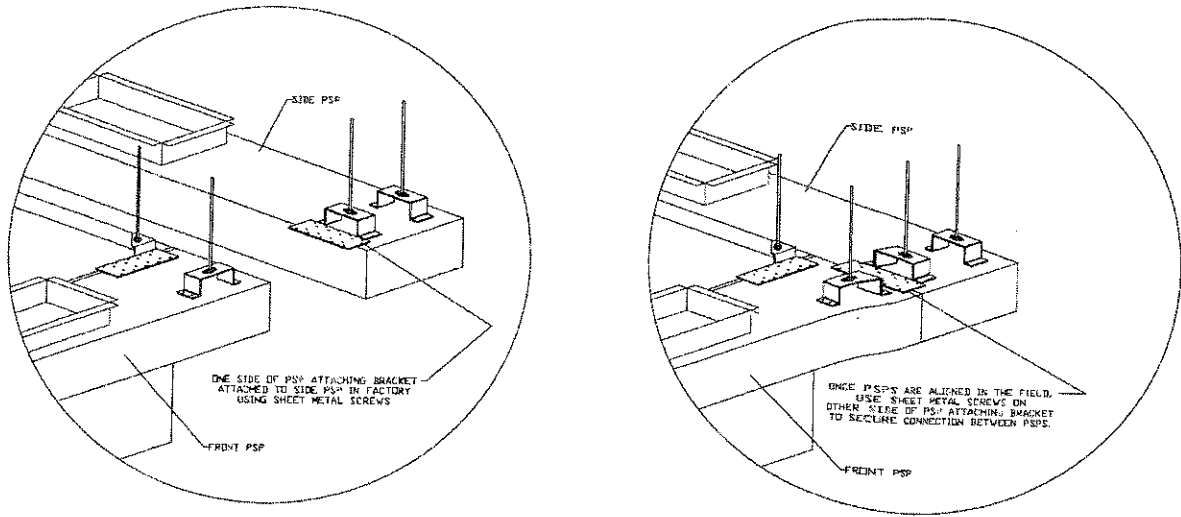


Figure 11

PSP with a FBSS Configuration

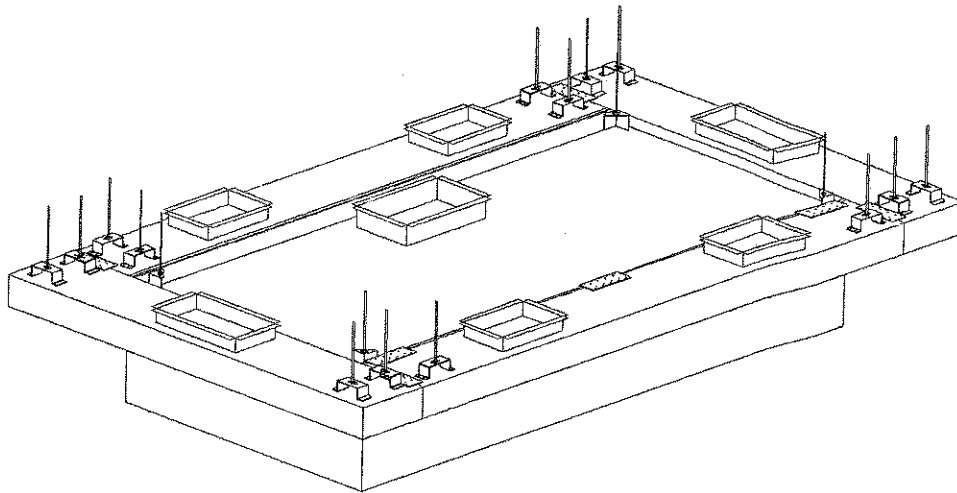


Figure 12

AC-PSP Installation

1. Locate the assembly and unpack it from the crate, being very careful not to dent or scratch the outer surface. **NOTE: Report any damage to the delivering freight carrier and file a claim if appropriate.**
2. If the supply risers are to be field cut, cut the risers in as desired.
3. Locate the ceiling joists which will support the assembly. If using Unistrut®, then securely attach to the ceiling joist.

4. Use 1/2" threaded rod to hang the AC-PSP. Install the threaded rod **and** angle that will be used to hang the assembly from the ceiling joists. Drill 9/16" holes as needed in the angle for the threaded rod. Be sure to line up with the welded-on angle mounting brackets on the AC-PSP.
5. Peel the protective plastic coating on the hood down below where the bottom edge of the AC-PSP will rest against the hood so it does not remain behind the AC-PSP.
6. Move the AC-PSP into position as indicated by the project submittal **drawings**; lining up the top edge of the AC-PSP with the top edge of the hood. Remove the protective plastic coating from the back of the AC-PSP. **See Figure 13a and 13b.**
7. Install the threaded rod into the AC-PSP hanging angles and use heavy-duty nuts to secure the connection. Adjust tension on hanging rods to position AC-PSP so it fits flush with the hood.
8. Caulk the seams between the hood(s) and the AC-PSP assembly, as well as between adjacent AC-PSP assemblies (if applicable) after the hood(s) and hood accessories have been installed.

AC-PSP Installation

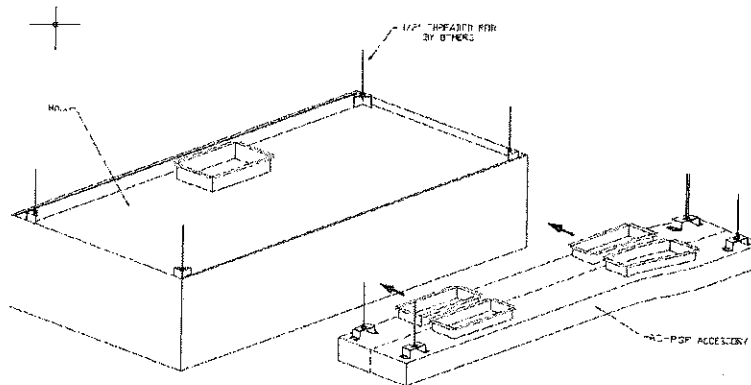


Figure 13A

AC-PSP Installation

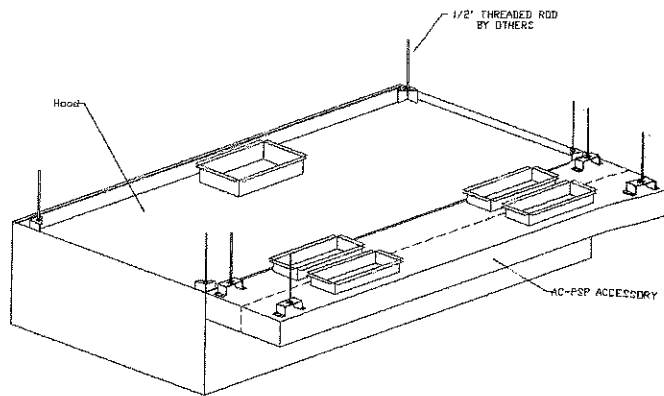


Figure 13B

Wrapper (Enclosure Panel) Installation

1. Unpack the wrapper panels from the shipping container, being very careful not to dent or scratch the panels. **NOTE: Report any damage to the delivering freight carrier and file a claim if appropriate.**
2. Locate one of the side wrapper panels and position it on the hood so that the 1/2" flange on the bottom of the panel slips underneath the side channel on top of the hood. **See Figure 14A: Wrapper Detail.** **NOTE: A notch will have to be cut on the wrapper flange using shears (tin snips) where interference occurs, where applicable. See Figure 14B: Top Hood Seam Detail.**
3. Press fit panel into place until wrapper face is flush with hood face. Screw or pop-rivet wrapper to the side channel and wall. **See Figure 14C: Wrapper Detail and Rear Wall Attachment.**
4. Locate front wrapper panel. Position its lower 1/2" flange under front channel on hood and slide panel into position, so that the end of front panel is behind the 90 degree bend of the side panel. **See Figure 14D: Front Corner Assembly.** Once in place, press fit the lower flange of the front panel into the front channel in order to have wrapper face flush with the front of the hood. Screw or pop-rivet bottom of front panel to the front channel.
5. Drill appropriate holes and rivet front to side wrapper panel. **See Figure 14D: Front Corner Assembly.**
6. If multiple panels are used, a stainless trim piece will be provided to attach multiple panels together (i.e. hood is side to side, hood is back to back to another, or the wrapper length exceeds 16 feet). Attach the panels by slipping them behind the stainless trim and fastening with screws or rivets. **See Figure 15.** **NOTE: Trim will have to be cut to fit. In most instances, trim should extend from bottom of hood to top of wrapper panel.**
7. Locate the other side panel. Repeat steps 2 and 3. Attach to front wrapper panel as instructed in step 4. **NOTE: In most instances where hood is located against a side wall, fasten the front wrapper panel to the wall. See Figure 14E: Side Wall Attachment.**
8. Caulk all gaps and seams after the hood(s) and hood accessories have been installed.

Wrapper Detail

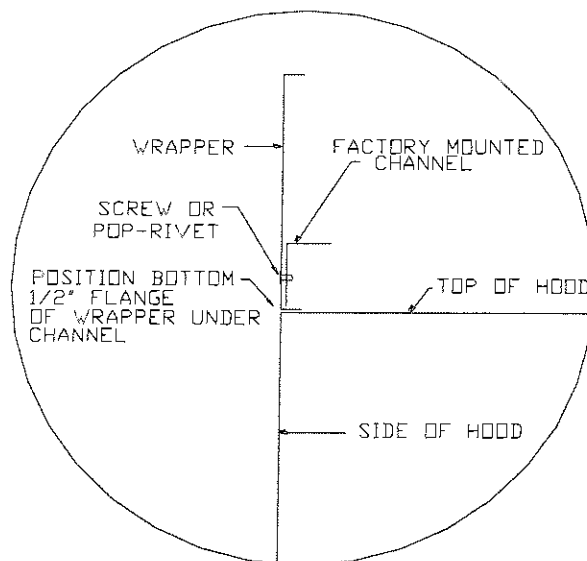


Figure 14A

Top Hood Seam Detail (Not on all models)

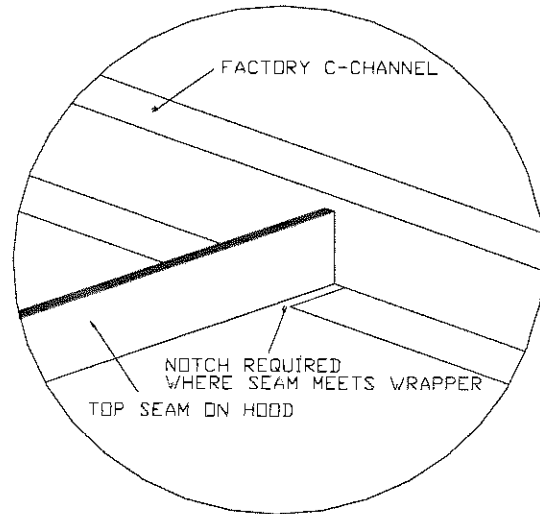


Figure 14B

Rear Wall Attachment

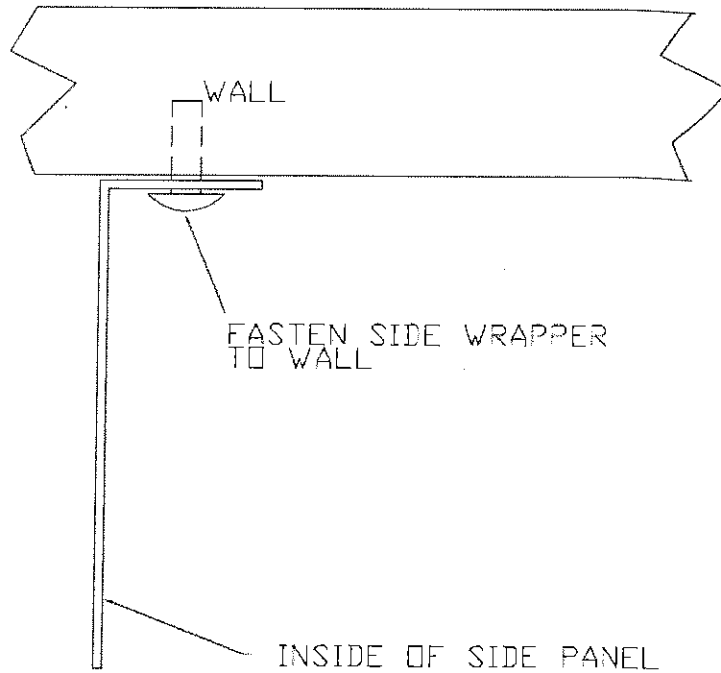


Figure 14C

Front Corner Assembly

PLACE FRONT PANEL
UNDER 90 DEGREE BEND
OF SIDE PANEL AND SCREW OR
POP-RIVET INTO POSITION

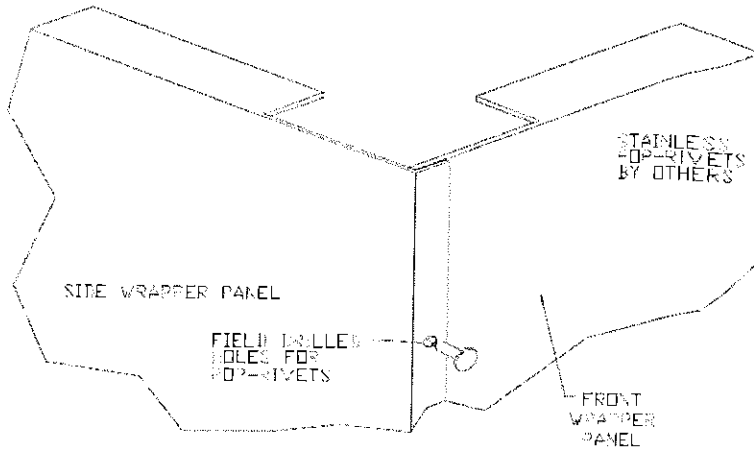


Figure 14D

Side Wall Attachment

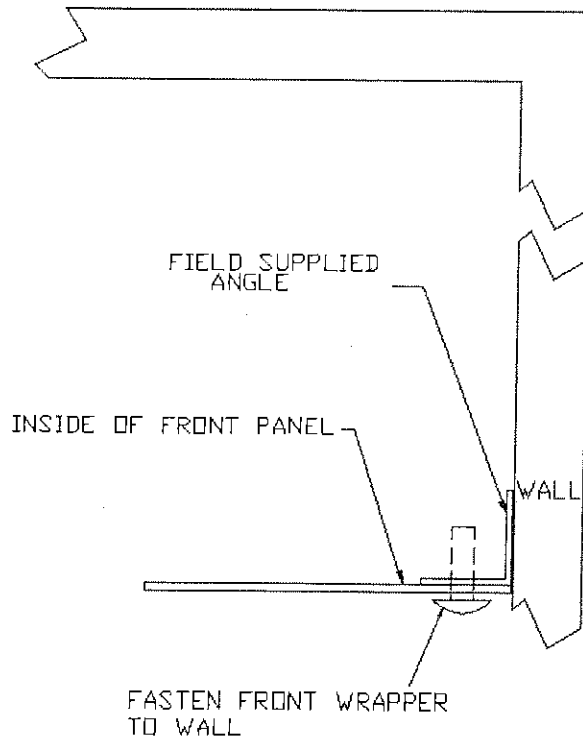
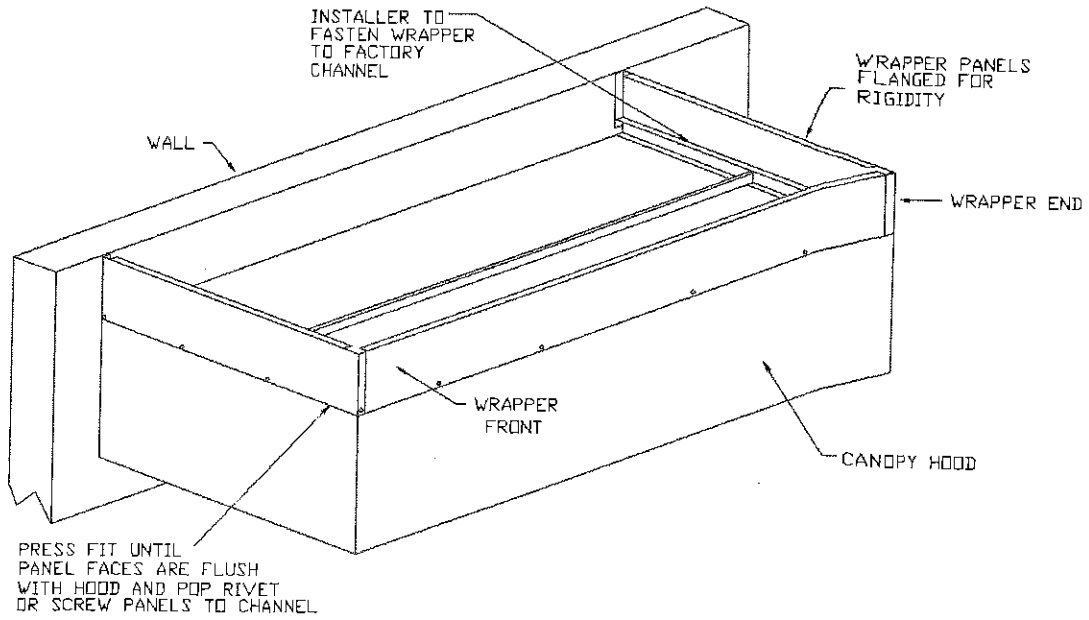


Figure 14E

Completed Wrapper Assembly



Completed Wrapper Assembly on End-to-End Hoods

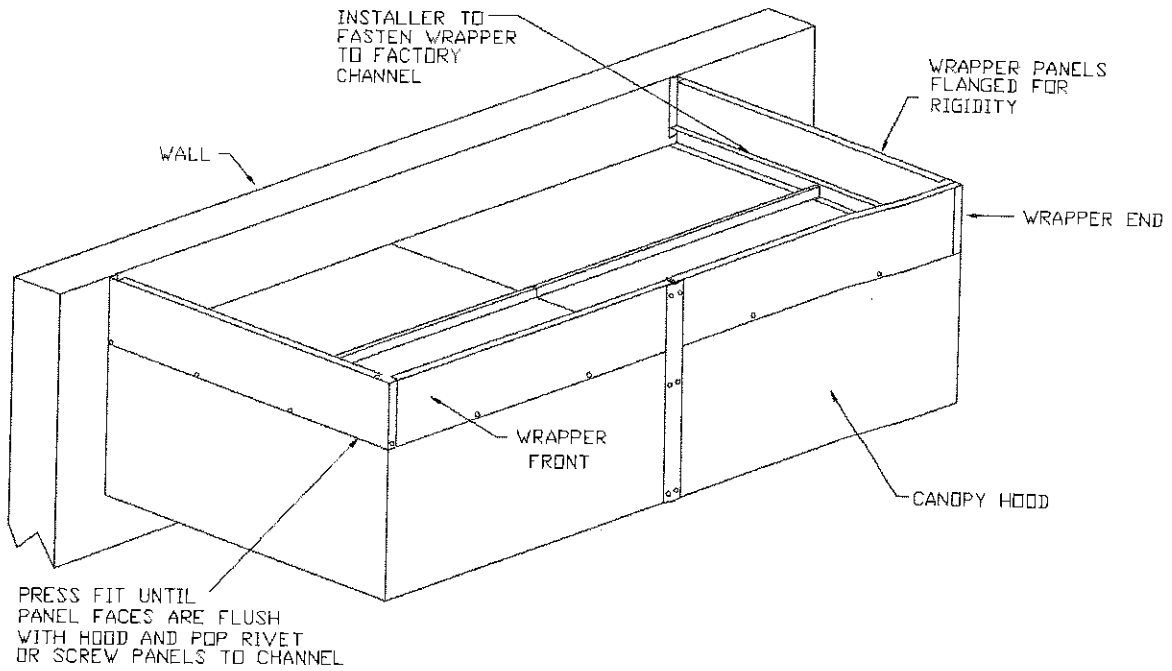


Figure 15

End-panel Installation

1. Unpack the end-panel(s) from the shipping container, being very careful not to dent or scratch the panels. **NOTE: Report any damage to the delivering freight carrier and file a claim if appropriate.**
2. Refer to the project submittal drawings to determine mounting location.
3. Position the end panel with the kinked top located flush against the inside of the hood end and the rear flange located flush against the rear wall and facing toward the interior of the hood. **Refer to Figure 16.**
4. Attach the top edge of the end-panel to the end of the hood using the acorn nuts provided. Hand tighten each acorn nut, then use a wrench to add an additional 1/4 turn — **do not over tighten.**
5. Secure the rear flange to the wall using stainless steel sheet metal screws, being sure to keep the end panel straight vertically.
6. Caulk all seams between the end-panel and the hood after the hood(s) and hood accessories have been installed.

End panel Installation (Hoods with Hems on Ends)

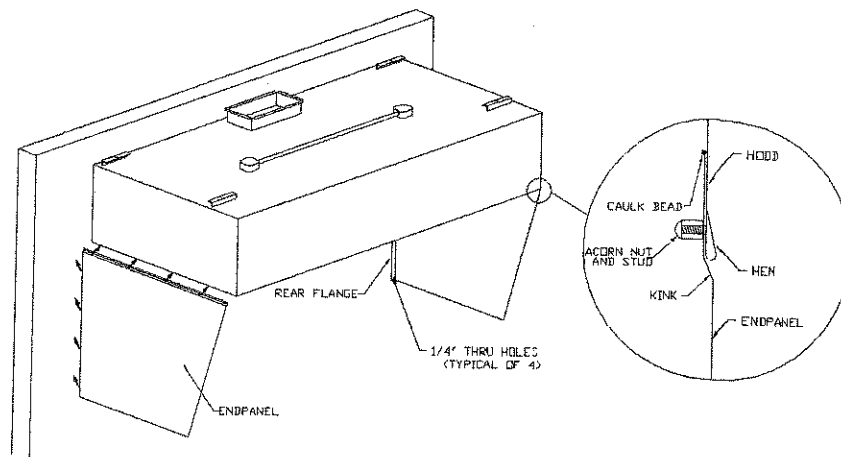


Figure 16A

End panel Installation (Hoods with Flanges on Ends)

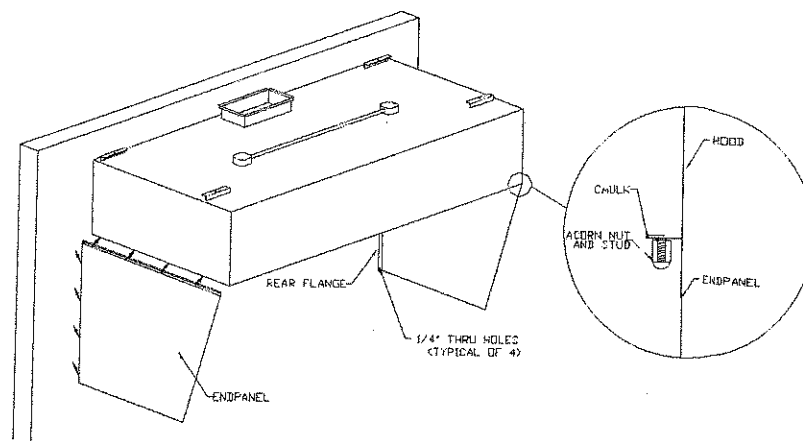


Figure 16B

Quarter End panel Installation

1. Refer to Figure 17.
2. Follow steps 1 through 6 of the end panel Installation instructions.

Quarter End panel Installation (Hoods with Hems on Ends)

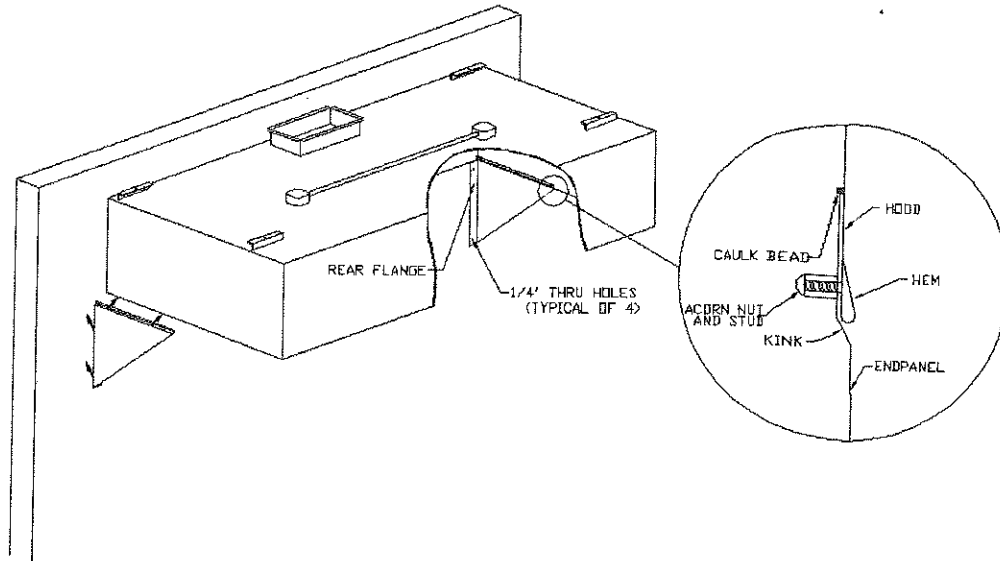


Figure 17A

Quarter End panel Installation (Hoods with Flanges on Ends)

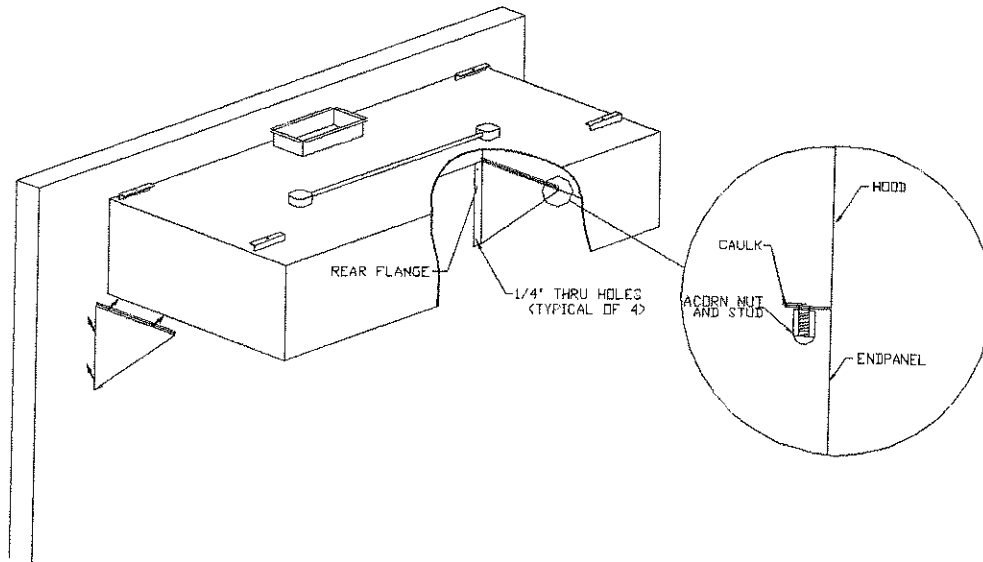


Figure 17B

Insulated End panel Installation

1. Refer to Figure 18.
2. Follow steps 1 through 6 of the end-panel Installation instructions.

Insulated End panel Installation (Hoods with Hems on Ends)

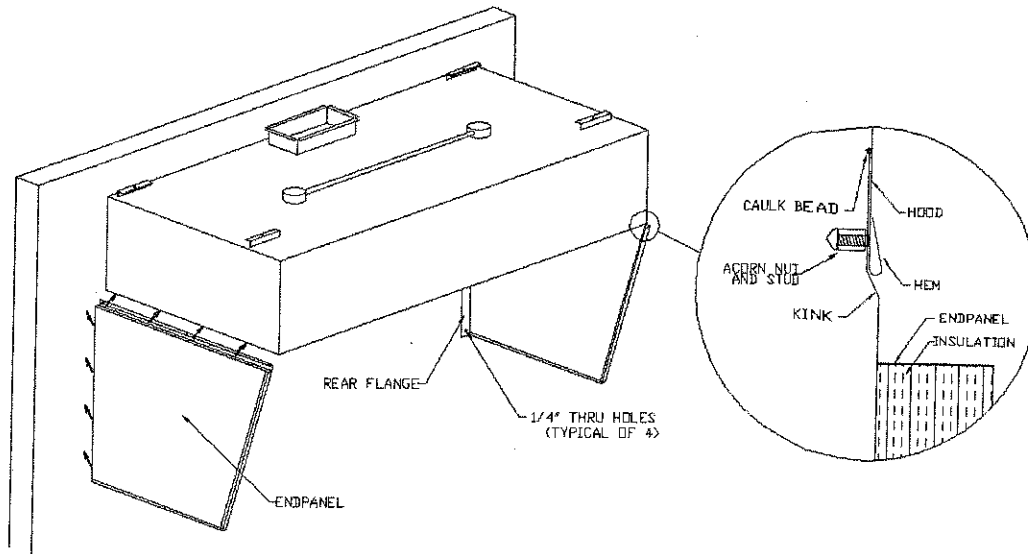


Figure 18A

Insulated End panel Installation (Hoods with Flanges on Ends)

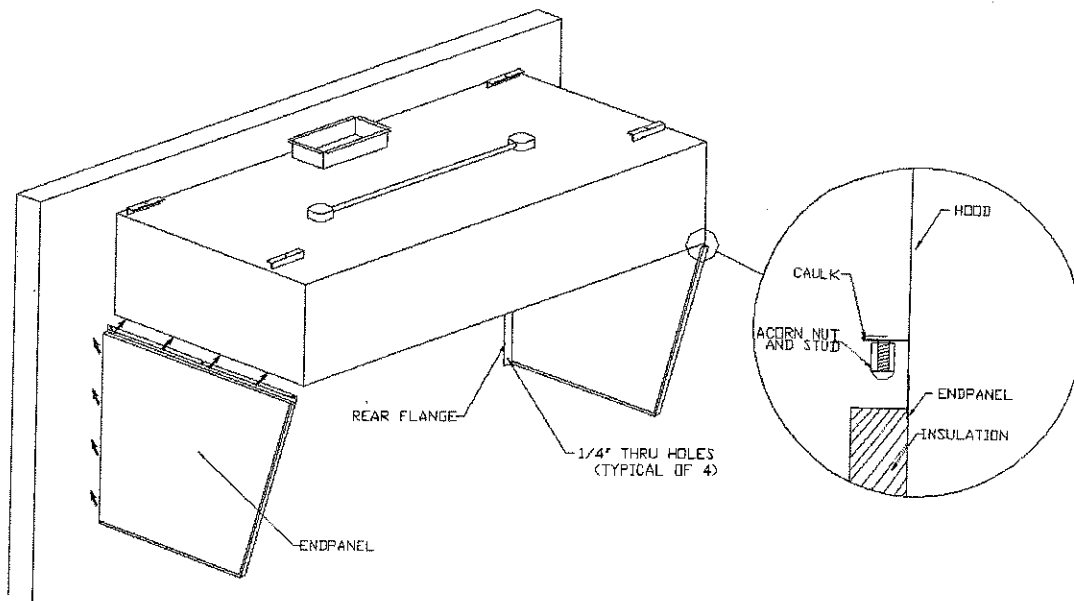


Figure 18B

Vertical End panel Installation

1. Refer to Figure 20.
2. Follow steps 1 & 2 of the end-panel Installation instructions.
3. Position the end panel with the top located flush against the bottom of the hood end and the rear flange located flush against the rear wall and facing toward the interior of the hood. Studs on bottom of hood ends should align with slots on top of vertical end panel. Refer to Figure 20.
4. Adjust legs to create slight tension between the vertical end panel and bottom of hood. Confirm that the top side of the vertical end panel is flush with the bottom of the hood.
5. Secure the rear flange to the wall using stainless steel sheet metal screws, being sure to keep the end panel straight vertically.
6. Caulk all seams between the vertical end panel and the hood after the hood(s) and hood accessories have been installed.

Vertical End panel Installation (Hoods with Flanges on Ends)

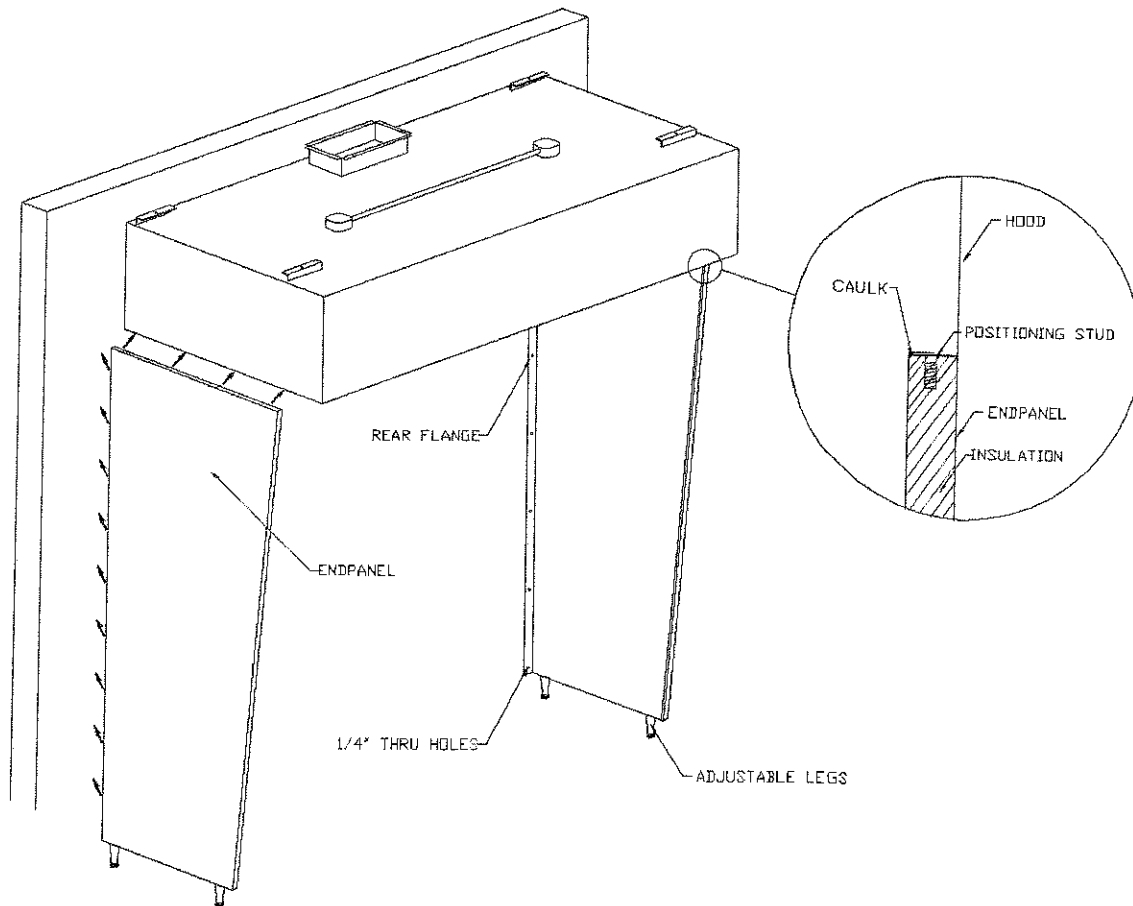


Figure 20

Backsplash Installation

1. Unpack the backsplash panels from the shipping container, being very careful not to dent or scratch the outer surface. **NOTE: Report any damage to the delivering freight carrier and file a claim if appropriate.**
2. Refer to the project submittal drawings to determine mounting orientation (vertical or horizontal) and mounting location. If panels intended for the same wall are of different widths, position them in a symmetrical arrangement.
3. Determine whether or not cutouts are required to accommodate electrical outlets, pipes, etc. and make appropriate cutouts being careful not to crease the backsplash panels.
4. Secure panels and trim pieces to the wall using construction adhesive. **See Figure 19.**

Standard Backsplash

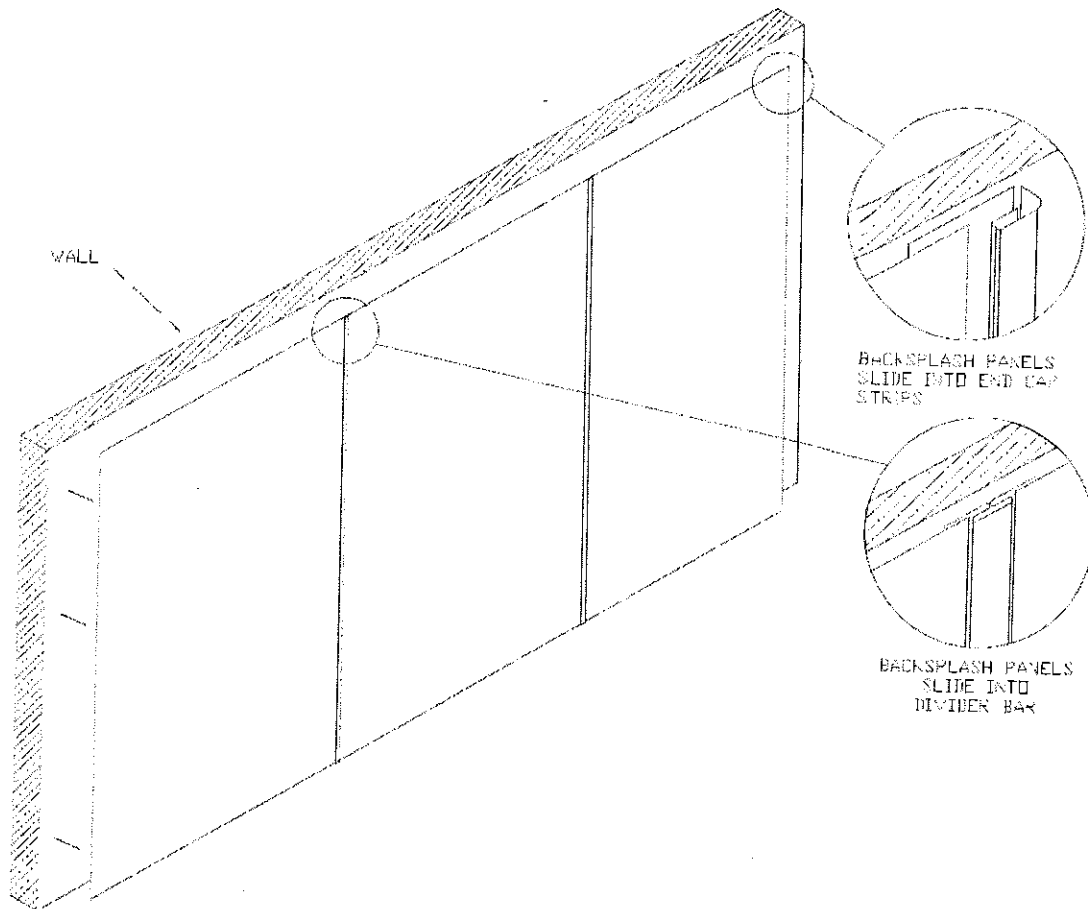


Figure 21

Insulated Backsplash Installation

1. Follow steps 1 through 3 of the Backsplash Installation instructions.
2. Slide the top flange behind the lower rear edge of the hood. Secure the bottom flange to the wall using stainless steel sheet metal screws. **See Figure 20.**
3. If there are multiple insulated backsplash sections, install the others **now**.
4. Caulk the seams between the wall and the insulated backsplash panel after the hood(s) and hood accessories have been installed.

Insulated Backsplash

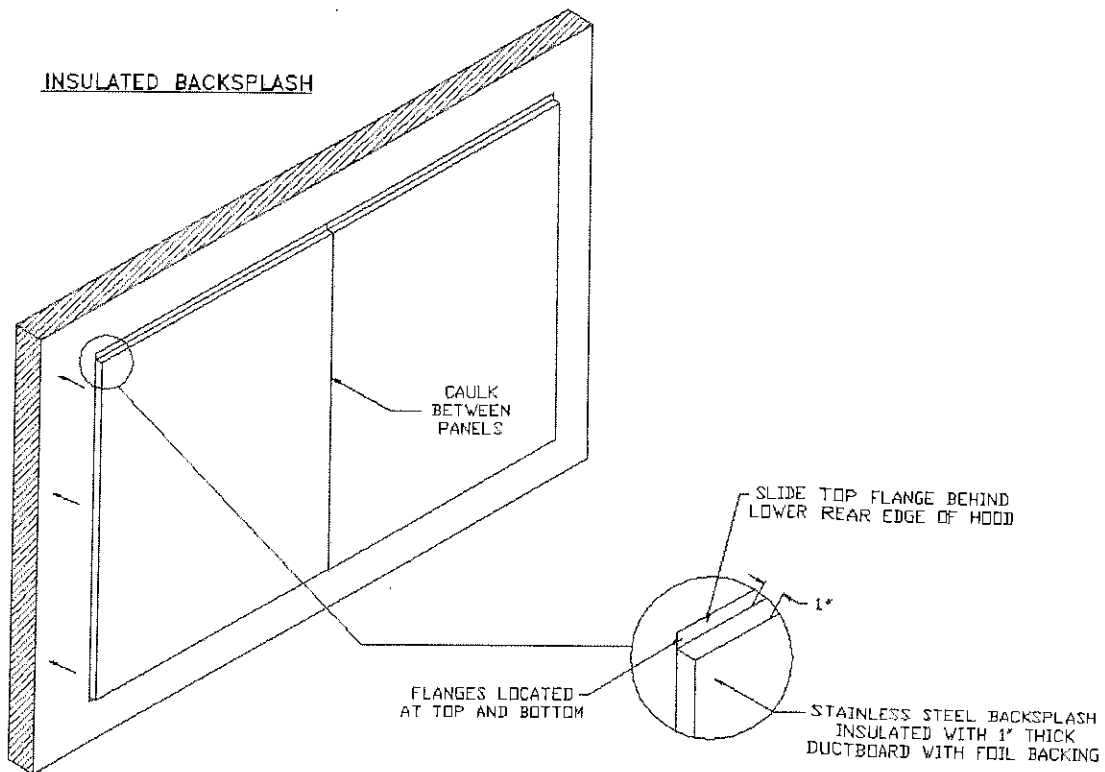


Figure 22

OPERATION

Commercial kitchen ventilation hoods are intended to be used in conjunction with ductwork and fans, which have been properly sized and properly installed in accordance with manufacturer's specifications and local code requirements.

Before turning on cooking equipment, make sure that the make-up air and exhaust fans are on. Leave fans on for at least 30 minutes after cooking equipment is shut off.

Clean hood as needed to comply with local code requirements and as directed in the Maintenance section of this manual.

Performance Evaluation

A performance evaluation of the system can be performed only after all of the following items have been verified:

1. All fans are operational and rotations visually verified by observation of the arrows stamped on them.
2. All filters are in place.
3. Equipment under the hood is in place and operational.
4. HVAC units are in place and operational with blowers operating correctly.

Guidelines before Beginning

The testing and balancing of a system is necessary to ensure proper and efficient operation of the system as it was designed. In any building where effluent and hot air is removed, the mass of air must be replaced to maintain a constant pressure in the space. Any change in the pressure differential between inside and outside air will in some way affect the operation of a system; most commonly that affect is a negative one.

A test and balance, as well as the simple performance test in International Mechanical Code Section 507.16.1 should be included in all jobs; code inspectors are increasingly enforcing these requirements. Requirements in the 2006 IMC, which is currently effective in most parts of the United States, are as follows:

"507.16 Performance test. A performance test shall be conducted upon completion and before final approval of the installation of a ventilation system serving commercial cooking appliances. The test shall verify the rate of exhaust airflow required by Section 507.13, makeup airflow required by Section 508, and proper operation as specified in this chapter. The permit holder shall furnish the necessary test equipment and devices required to perform the tests.

507.16.1 Capture and containment test. The permit holder shall verify capture and containment performance of the exhaust system. This field test shall be conducted with all appliances under the hood at operating temperatures, with all sources of outdoor air providing makeup air for the hood operating and with all sources of recirculated air providing conditioning for the space in which the hood is operating. Capture and containment shall be verified visually by observing smoke or steam produced by actual or simulated cooking, such as with smoke candles, smoke puffers, etc."

The simplest means of doing the performance test is using a T-T puffer from www.evhill.com. Activate the puffer and use it to trace effluent around the entire perimeter of the hood, emitting smoke every few inches under the lower edges of the hood.

External Factors which may affect Hood Performance

1. HVAC units are generally specified to supply 25% outside air (OA) to the room ventilation. If RTU's are not supplying the proper amount of OA to the building, then negative pressure will exist.
2. HVAC return grilles located close to a hood can cause performance problems. The return grille competes with the hood to capture air in the room. For example, a return grille for a 10-ton HVAC unit can draw anywhere from 3000 to 4000 CFM. This is equivalent to the exhaust of a 10' to 13' canopy hood. As a result, a return air grille located within six feet (6') of the hood can have a serious effect on the capture ability of the hood.
3. HVAC diffusers located near a hood can create flows in the room that detract from the capture ability of the hood. If the HVAC diffuser bounces air off the front of the hood or directs air along the hood and past the end, the air flow created can draw smoke and contaminants out of the hood.

Using a Shortridge Instrument

The Shortridge is a sophisticated instrument that, with its built-in features, is basically a self contained test and balance kit. It has a "velocity grid" for filter face readings, a "velocity probe" for ductwork readings, a "differential pressure" function to check room pressure and static pressure, as well as a "temperature probe" so it can calculate accurate values based on varying temperature (most equipment assumes standard temperature and pressure), and many other useful features.

Hood Information

To calculate the CFM, the following information must first be acquired:

1. Hood size and length
2. Filter size and length
3. PSP width and length

Measuring Hood Static and Room Pressure

Static Pressure:

1. Measure hood static pressure at exhaust collar using the Shortridge instrument.

Static Pressure = _____

Room Pressure:

For an exhaust hood to work properly, the kitchen should be at a slight negative pressure to the dining area (caused by its air removal) and the building overall slightly positive. The dining room should be a slight positive to the outdoors and the kitchen +0.02" w.c. or about 300 CFM positive. This will keep dust and bugs outside and doors will be easy to open. The kitchen should be a slight negative to the dining room to keep the odors in the kitchen. The kitchen should be balanced to slightly negative, 0" to -0.02" w.c., to the dining room. Generally, if there is not enough negative, or if there is positive pressure there will be smoke roll out from the hood that occurs due to the wind currents from people moving around in the area, while if there is too much negative, there becomes a pressure problem on the building (opening doors, drafts, hot water heaters, etc.)

1. Measure room static pressure using the Shortridge instrument. Adjust the supply fan to set room to 0.02" negative to dining area.

Room Pressure = _____

Calculating Make-up Air CFM with a Shortridge Instrument and Spreadsheet

1. Use the Velgrid mode of the Shortridge instrument to measure supply air velocity. Make sure to take measurements every twelve (12) inches along the length of the PSP.
2. Locate the appropriate Excel spreadsheet for the PSP/Supply velocity and record all necessary data. This spreadsheet will calculate the total supply CFM for the hood.
3. The spreadsheet is located on the manufacturer's website.

Calculating Make-up Air CFM without a Shortridge Instrument

1. Compute the open area of the supply plenum of the hood. This area must be calculated at the same plane that velocity readings are taken. Area can be calculated using the following formula:

$$\text{Area (ft}^2\text{)} = \text{Length (ft)} \times \text{Width (ft)}$$

If both the length and width are measured in inches, use the following formula:

$$\text{Area (ft}^2\text{)} = \text{Length (in)} \times \text{Width (in)} / 144$$

2. Record velocity of air through supply openings from left to right on raw data sheet.
3. Compute and record average velocity through supply openings.
4. Compute and record CFM through supply openings.

$$\text{CFM} = \text{Free area} \times \text{Average Velocity}$$

5. Compute total CFM through all supply openings for each hood.

Calculating Exhaust Air CFM with a Shortridge Instrument and Spreadsheet

1. Use the Velgrid mode of the Shortridge instrument to measure the velocity at each filter.
2. Locate the appropriate Excel spreadsheet for the exhaust velocity and record all necessary data. This spreadsheet will calculate the total exhaust CFM for the hood.

Calculating Exhaust CFM without a Shortridge Instrument

1. Record filter sizes of each hood on raw data sheet.
2. Compute free area of the filters.

Examples:

$$16'' \times 16'' = 14 \times 14 = 1.36 \text{ ft}^2$$

$$10'' \times 20'' = 8 \times 18 = 1.00 \text{ ft}^2$$

$$12'' \times 16'' = 10 \times 14 = 0.97 \text{ ft}^2$$

3. Record velocity of exhaust gases through filters starting top left to right (5 reading/filter).
4. Find average velocity through each filter.
5. Compute CFM through each filter.

$$\text{CFM} = \text{Free area} \times \text{Average Velocity}$$

6. Total the exhaust CFM for each hood.
7. Multiply total exhaust CFM x 0.78 (this is the K factor necessary when using the EDRA velometer).

Adjustments

1. A hood with multiple risers should be balanced according to the cooking load beneath it. For example, if a hood with multiple risers has a charbroiler in the center and several ovens on the ends, the risers should be evenly balanced. This will achieve the most efficient contaminant capture.
2. Perforated supply plenums discharging air around the hood should be set to the designed discharge velocity.
3. When fan pulleys are adjusted, belts should then be re-checked for correct tension and an amperage reading should be taken on the motor to make certain it is not overloaded.
4. The prime objective of balancing is to ensure that each hood will capture all the contaminants produced by the equipment it covers without causing undesirable conditions in the kitchen (i.e. excessive negative pressure, excessive quantities of hot or cold air in the kitchen, etc.)

If problems occur, then refer to the Troubleshooting Section of this manual.

Conclusion

1. Compare specified data to the data recorded. Adjust exhaust as necessary using adjustable pulley on fan. Adjust supply as necessary using dampers on supply risers and adjustable pulley on supply fan.
2. After setting hoods to specified data, the room parameters should be checked.
3. If room parameters are not acceptable yet, the hood can be modified to improve them without decreasing hood performance. This is an acceptable condition.
4. Use a smoke bomb to verify that the hood captures adequately. This can be your final verification.

Complete Equipment List for Performance Evaluations

- Closed End Wrenches (9/16, 1/2, 7/16, 3/8, 5/16, 1/4)
- Socket Set & Ratchet (9/16, 1/2, 7/16, 3/8, 5/16, 1/4)
- Extension for Ratchet
- Cheater Bar
- Screwdrivers (Phillips & Standard, Short & Long)
- Adjustable Wrenches (Large & Small)
- 5/32" 9" Long Allen Wrench
- Multi-key Hex Set (Standard Assortment)
- Tape Measure, Hammers (Hard & Soft)
- 2-Channel Locks
- Vise-Grip Pliers (Medium Size)
- Shortridge Air Multimeter
- Velometer or similar unit, Edra 5LV or Davis LCA6000 recommended
- Manometer or similar unit, Dwyer Magnehelic Model #2000-00 recommended
- Work Gloves
- 6' Step Ladder
- 20' Extension Ladder
- Tachometer (Mechanical)
- Amprobe (Volt & Amp Meter)

Troubleshooting

The following table lists causes and corrective actions for possible problems with exhaust hoods. Review this list prior to consulting manufacturer.

Troubleshooting Chart

Problem	Potential Cause	Corrective Action
Smoke is not being captured/Low Exhaust	Filters are clogged	Clean filters
	Extreme negative pressure in space	Increase MUA Quantity to balance building
	Exhaust Fan operating in incorrect direction	Check motor wiring to wiring diagram located on fan motor
	Hood overhang on appliance is not correct	Hood should overhang cooking appliances adequately
	Exhaust airflow too low	Increase exhaust fan RPM/HP
	Exhaust Duct Static Pressure higher than design	Increase exhaust fan RPM/HP or have ductwork re-worked
No Exhaust	Exhaust Fan not running	Turn fan disconnect on
		Check fan belts
		Check circuit breaker/voltage
	Exhaust Fan running backwards	Wheel should turn per rotation arrow on fan 3 Phase Motor direction may be reversed by switching any 2 leads 1 Phase Motors must be wired per their label
Fan is on incorrect hood	Make sure electrical package is controlling the correct fan	
No Make-Up Air	Make-Up Air Fan not running	Turn Fan disconnect on
		Check fan belts
		Check circuit breaker/voltage
	Make-Up Air Damper closed	Ensure blades open on damper
	Make-Up Air Fan running backwards	Wheel should turn per rotation arrow on fan 3 Phase Motor direction may be reversed by switching any 2 leads 1 Phase Motors must be wired per their label
		Make-Up Air Duct Static Pressure higher than design
	Clogged Make-Up Air Filters	Clean filters
Fire System activated or not armed	Microswitch on Fire System is keeping make-up air from operating and fire system must be armed	
Exhaust/Make-Up Air Motor cycles on and off	Motor Over-amping	Make sure motor amperage is below FLA of motor label Ensure motor wiring is adequately sized
	Exhaust air temperature too high	Increase exhaust airflow or use higher temperature rated motor
Grease does not drain	Grease trough full	Clean grease trough behind hood filters
Grease dripping from hood	Hood not being cleaned often enough	Clean surface of hood more frequently
	Exhaust rate too low	Speed up exhaust fan
Hood is vibrating	Vibrating Exhaust or MUA Fan	Find source of vibration in fans and correct (Often times a rag or other debris will be in exhaust fan wheel)
Light Globes are full of fluid	Duct Leak above hood	Check ductwork or fan to roof connection for leaks and seal where necessary

MAINTENANCE

To guarantee trouble free operation of this hood, the manufacturer suggests following these guidelines. Most problems associated with hoods are directly related to poor service and maintenance such as not replacing or cleaning filters.

Please record any maintenance or service performed on this fan in the documentation section located at the end of this manual.

General Maintenance

1. Proper operation of the hood depends on how well the hood is maintained. All surfaces should be kept free of grease build-up for sanitation reasons and to reduce the risk of fire.
2. Grease filters must always be installed and clean to reduce build-up of grease in the exhaust duct and to allow for proper exhaust airflow.
3. Maintain all belts, motors, and electrical connections on fans attached to the hood. Ensure MUA filters are kept clean and there are no leaks in MUA ductwork.

Daily Maintenance

1. Remove the grease baffle filters and clean in a dishwasher or soak sink daily.
2. Empty and clean grease drain and grease collection cups.
3. Carefully wipe away gritty substances clinging to stainless steel surfaces to avoid scratching.
4. Dilute ½ cup of laundry detergent (e.g. Tide) with one (1) gallon of warm water.
5. Soak a clean cloth in the water detergent solution and wring out the excess water.
6. Wipe the hood surfaces moving in the direction of the grain and periodically rinsing cloth in detergent solution.
7. Using a different clean cloth soaked in clean warm water, wipe the hood surfaces to remove all traces of the detergent solution.
8. Wipe hood surfaces dry with a clean, dry cloth. Clean the hood temperature sensor in riser if equipped with one.
9. Reapply stainless steel polish.

CAUTION

DO NOT use iron wool, Brillo or SOS pads, scrapers, or scourers to clean hood!

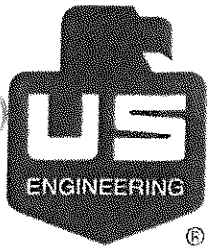
DO NOT use the following substances on or around the hood:

1. Caustic or chlorine based substances
2. Acids (e.g. static, hydrochloric, sulfuric)
3. Chlorine based substances (e.g. bleach, chlorine, ferric chloride)

Vapors of the above substances can corrode stainless steel

Quarterly Maintenance

1. Inspect the unit and duct for grease or air leaks and repair leaks where required.
2. Clean ductwork attached to hood to prevent a mass accumulation of grease.



Commercial Kitchen
Hoods Product Submittal
Information:
EH-1
EH-2

**BEATTIE
ELEMENTARY
SCHOOL**

1100 MEADOW LARK AVE
FORT COLLINS CO 80526



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
---	---	--

Date: 4/11/2014	Reference Number: 0050
------------------------	-------------------------------

Transmitted To: Chris Mallory US Engineering Co. P.O. Box 905 Loveland, CO 80539	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001 N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
--	---

Qty	Submittal Package No	Description	Due Date	Package Action
1	017 - 233813 - 0	Commercial Kitchen Hoods		Make Corrections Noted

Transmitted For	Delivered Via	Tracking Number
For your use and files.	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
		Commercial Kitchen Hoods - Product Data	233813		
		Commercial Kitchen Hoods - Shop Drawings	233813		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

COMMERCIAL KITCHEN HOOD (Make Corrections Noted)

1. Submitted hood dimensions are correct (5ft0h exhaust hood section plus 1ft 2h makeup air plenum equals 6ft2h total depth).
2. Verify that balancing dampers are included for all supply and exhaust connections for both hoods. Hood #1 notes balance damper on the exhaust connection but the drawing does not indicate this for hood #2.

_____ Signature	_____ Signed Date
---------------------------	-----------------------------

TRANSMITTAL



Belford Watkins Group
Architects

Date: 4.10.14

Project: Beattie Elementary

To: Rob Price/DJ Anderson

From: Patti Watkins

We are transmitting the following submittals with the comments listed below:

ARCHITECTURE

INTERIORS

PLANNING

NET: No Exception Taken
RR: Revise and Resubmit
CMT: See Comment Below

MCN: Make Corrections Noted
SSI: Submit Specified Item

RX: Rejected

233813 Commercial Kitchen Hood

Copies	Section	Item	Manufacturer	NET	MCN	RR	RX	SSI	CMT
1	233813	Captive Aire	Daikin		x				1

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures, there from. The Contractor remains responsible for details and accuracy, for conforming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

Notes: 1

COMMERCIAL KITCHEN HOOD (Make Corrections Noted)

1. Submitted hood dimensions are correct (5'-0" exhaust hood section plus 1'-2" makeup air plenum equals 6'-2" total depth).
2. Verify that balancing dampers are included for all supply and exhaust connections for both hoods. Hood #1 notes balance damper on the exhaust connection but the drawing does not indicate this for hood #2.



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
---	--	--

Date: 3/28/2014	Reference Number: 0025
------------------------	-------------------------------

Transmitted To: Don Watkins Belford Watkins Group P.O. Box 1306 Fort Collins, CO 80521 Tel: 970-212-1243	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001 N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
---	---

Qty	Submittal Package No	Description	Due Date	Package Action
1	017 - 233813 - 0	Commercial Kitchen Hoods	4/11/2014	

Transmitted For	Delivered Via	Tracking Number
Review & Approval	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
001		Commercial Kitchen Hoods - Product Data	233813		
002		Commercial Kitchen Hoods - Shop Drawings	233813		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

<hr style="border: 0; border-top: 1px solid black;"/> Signature	<hr style="border: 0; border-top: 1px solid black;"/> Signed Date
<i>Prolog Manager</i>	Printed on: 3/28/2014



4001 N. Valley Drive
 Longmont, CO 80504
 Phone: 970-535-4867
 Fax: 970-535-4867

DATE: 03/28/2014

SPECIFICATION SECTION(S): 233813
 SCOPE OF WORK: HVAC - Hydronic Pumps

PROJECT: Poudre School District – Beattie Elementary School

PROJECT #: 30-13-038

ARCHITECT/DESIGNER: Belford Watkins Group, LLC.
 425 West Mulberry Ave., Suite 207
 P.O. Box 1306
 Fort Collins, CO 80521

 PHONE: 970-407-0070

GENERAL CONTRACTOR: FCI CONSTRUCTORS, INC.
 4001 N. Valley Drive
 Longmont, CO 80504

 PHONE: 970-535-4725
 FAX: 970-535-4867

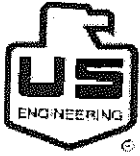
SUBMITTED BY: U.S. Engineering
 PO Box 905
 Loveland, CO 80539

 PHONE: 970-669-1666
 FAX:

CONTRACTORS STAMP:

ARCHITECT/ENGINEER STAMP

FCI CONSTRUCTORS, INC.	
Review of this submittal is subject to the provisions of the Contract Drawings and Specifications. This action is for general concurrence only.	
<input checked="" type="checkbox"/>	Reviewed
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmit with Corrections
<input type="checkbox"/>	DISAPPROVED RESUBMIT
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmittal not Required.
Submittal Reviewed By: DA	Date: 03/28/2014
Submittal No: 017	Spec. Section: 233813



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 80539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-019

Date: 3/18/2014

Revision #: _____

Discipline: Tinner

Project: Beattie Elementary

Project #: 1202

Supplier: Air Purification

Spec Sect: 23 38 13

Submitted Items:

Page Number	Paragraph Number	Description	Manufacturer
23 38 13-2	2	Commercial Kitchen Hood	
		EH-1	Captive Aire
		EH-2	Captive Aire
			Lead Time-35 Business Days

Target Dates:

Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
3/11/14	3/18/14	3/28/14		

GC/Arch/Engineer Stamp Area:

U.S. Engineering

Signed:

Chris Mallory



Air Purification Company

1861 West 64th Lane, Denver, Colorado 80221

Phone: 303.428.2800 • Fax: 303.428.2700

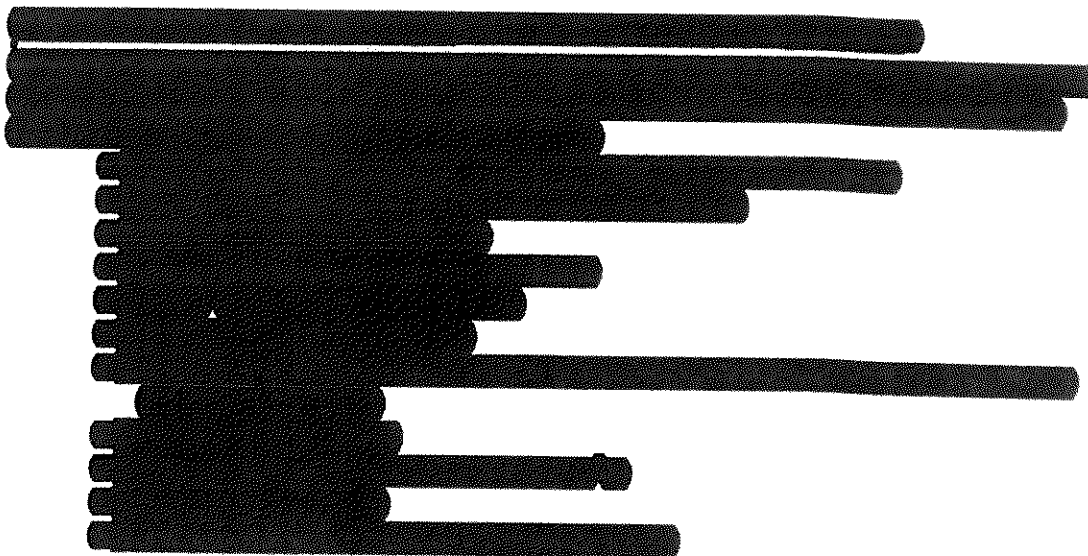
Kitchen Equipment

CONDENSATE HOOD – CAPTIVE AIRE, VHB Model (Hood #1)

- 1 – Model 6024VHB-G-PSP-F-ND, 7 ft – 0 in Long Condensate Hood with:
- Full Perimeter Gutter with Perforated Supply Plenum – Front, w/ ND Style Front
 - 304 SS – 100% Application
 - Incandescent Light Fixture – High Temp Assembly, Includes Clear Thermal and Shock Resistant Globe (L55 Fixture), *bulbs by others*
 - Exhaust Riser – Factory Installed 14" x 14"
 - Supply Riser – 12" x 20" Supply Riser with Volume Dampers
 - Balance Dampers
 - Face Mount 1st Switch and Extra Switch(es)

CONDENSATE HOOD – CAPTIVE AIRE, VHB Model (Hood #2)

- 1 – Model 6024VHB-G-PSP-F-ND, 7 ft – 0 in Long Condensate Hood with:
- Full Perimeter Gutter with Perforated Supply Plenum – Front, w/ ND Style Front
 - 304 SS – 100% Application
 - Incandescent Light Fixture – High Temp Assembly, Includes Clear Thermal and Shock Resistant Globe (L55 Fixture), *bulbs by others*
 - Exhaust Riser – Factory Installed 14" x 14"
 - Supply Riser – 12" x 20" Supply Riser with Volume Dampers
 - Back Stand-off (Flat) 8" wide x 84" long



(Continued on Next Page)

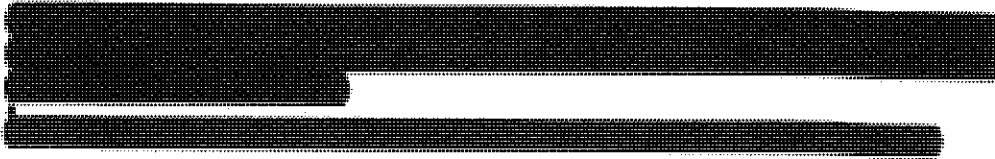


Air Purification Company

1861 West 64th Lane, Denver, Colorado 80221

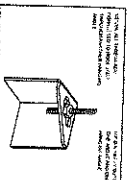
Phone: 303.428.2800 • Fax: 303.428.2700

Kitchen Equipment - Continued



ELECTRICAL SYSTEM – CAPTIVE AIRE

- 1 – SC-310110MA 3 phase w/ 1 Exhaust Fan, Exhaust on in Fire, Lights out in Fire, Relay On/Off with Supply Fan, Fan(s) On/Off Thermostatically Controlled. Room temperature sensor shipped loose for field installation. Includes (2) Duct Thermostat kits.
 - 14 x 18 Stainless Steel Box. Includes latch and backplate
 - Digital Prewire Lighting Relay Kit. Includes hood lighting relay & terminal blocks. Allows for up to 1400W of lighting each
 - 25' Thermistor Cable, 18/2 AWG Green White Plenum Rated
 - 15' CAT-5E Cable



HOOD INFORMATION - CONTINUED

NO.	TYPE	LENGTH	WIDTH	HEIGHT	AREA	PERIMETER	TYPE	HEIGHT	LENGTH	WIDTH	HEIGHT	AREA	PERIMETER
1	7' x 7' x 7'	7	7	7	343	84	ALONE	7	7	7	343	84	
2	7' x 7' x 7'	7	7	7	343	84	ALONE	7	7	7	343	84	

HOOD INFORMATION - CONTINUED

NO.	TYPE	LENGTH	WIDTH	HEIGHT	AREA	PERIMETER	TYPE	HEIGHT	LENGTH	WIDTH	HEIGHT	AREA	PERIMETER
1	7' x 7' x 7'	7	7	7	343	84	ALONE	7	7	7	343	84	
2	7' x 7' x 7'	7	7	7	343	84	ALONE	7	7	7	343	84	

ETL HOOD LISTING DETAIL

NO.	TYPE	LENGTH	WIDTH	HEIGHT	AREA	PERIMETER	TYPE	HEIGHT	LENGTH	WIDTH	HEIGHT	AREA	PERIMETER
1	7' x 7' x 7'	7	7	7	343	84	ALONE	7	7	7	343	84	
2	7' x 7' x 7'	7	7	7	343	84	ALONE	7	7	7	343	84	

HOOD OPTIONS

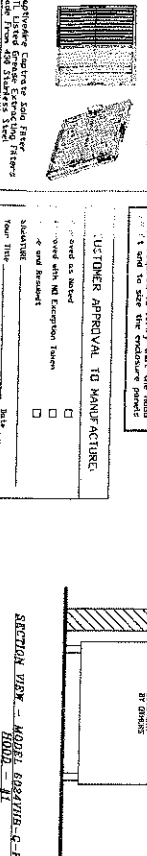
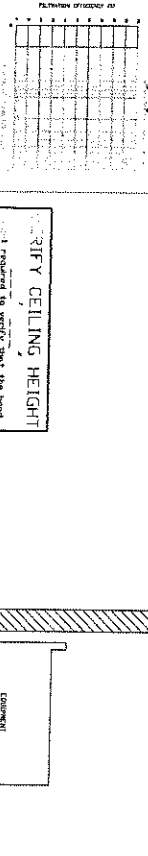
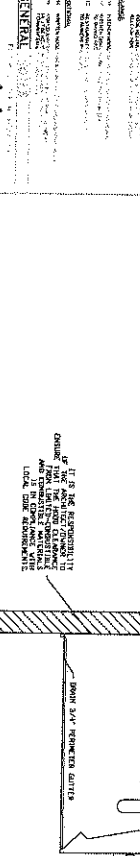
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2	7' x 7' x 7'	7	7	7	343	84	ALONE	7	7	7	343	84	

GENERAL

1. ALL DIMENSIONS ARE IN FEET AND INCHES.
2. ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE NOTED.
3. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE NOTED.
4. ALL DIMENSIONS ARE TO SURFACE UNLESS OTHERWISE NOTED.
5. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE NOTED.
6. ALL DIMENSIONS ARE TO SURFACE UNLESS OTHERWISE NOTED.
7. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE NOTED.
8. ALL DIMENSIONS ARE TO SURFACE UNLESS OTHERWISE NOTED.
9. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE NOTED.
10. ALL DIMENSIONS ARE TO SURFACE UNLESS OTHERWISE NOTED.

CLEARANCE TO COMBUSTIBLES

Plans call for 6'-2" Architect please advise which is required.



SAFETY CEILING HEIGHT

ORDER APPROVAL TO MANUFACTURER

SAFETY

REVISIONS

NO.	DATE	DESCRIPTION
1		



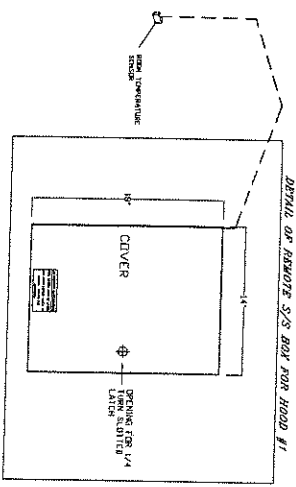
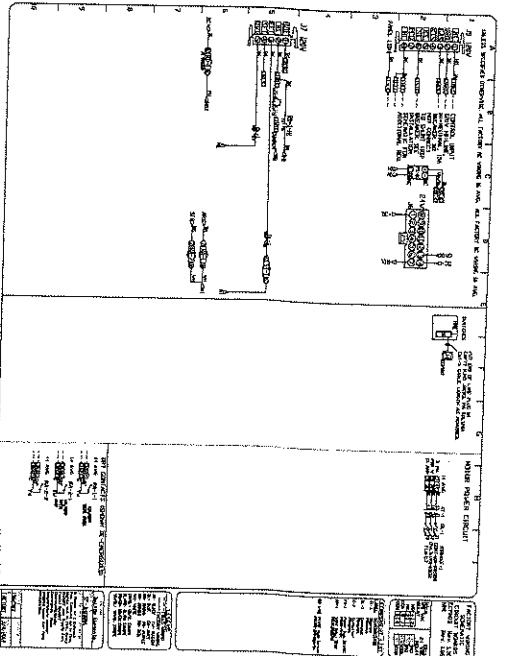
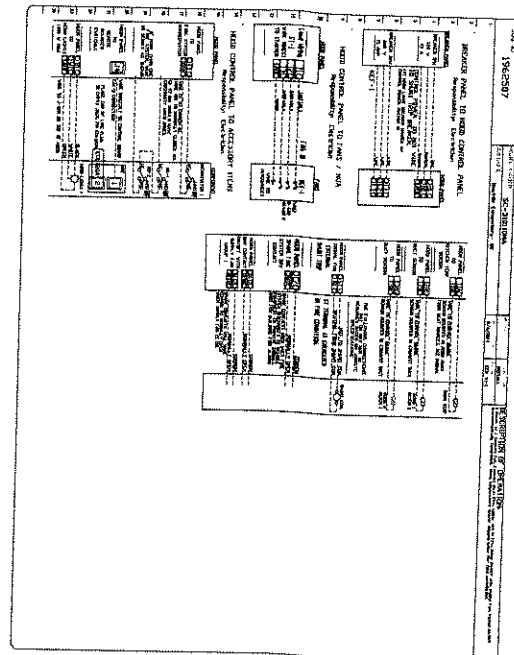
Beattie Elementar
GREELEY, CO

DATE: 3/4/2014
DRAWN BY: JBP-42
SCALE: 3/4" = 1'-0"
MASTER DRAWING

SHEET NO. 1

ELECTRICAL PACKAGES - ADM1353507

LINE NO.	PACKAGE #	LOCATION	QUANTITY	DEFINITION	FAN CONTROLLER
1	SC-301000A	Wall Mount in SS Box	1 Unit	Smart Control Temperature Control w/ Relay Driver with Supply	TYPE 9 1/2" VOLT T/A
			1 Fan		Exhaust 3 0756 288 57



Beattie Elementary- R2
 GREELEY, CO

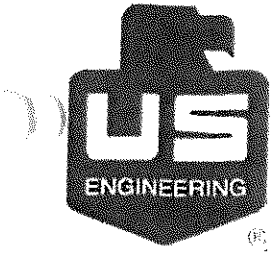
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SHEET NO. 4

CAPTIVE
 DENVER OFFICE
 www.captive-eep.com

1507 South Reno Court Suite 100, Centennial, CO 80111 PHONE: 303.270.0311 FAX: 303.270.0311 EMAIL: capt@captivewire.com

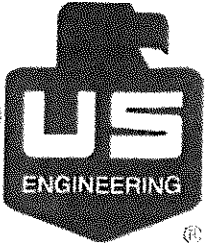
NO.	REVISIONS



Tab-7
Specification Section: 23 57 00
Heat Exchangers for HVAC:
HX-1 (Alfa Laval)

**BEATTIE
ELEMENTARY
SCHOOL**

3000 MI ADCALLARK AVE
FORT COLLINS CO 80526



Heat Exchangers for
HVAC (Alfa Laval)
O&M and Warranty
Information:
HX-1

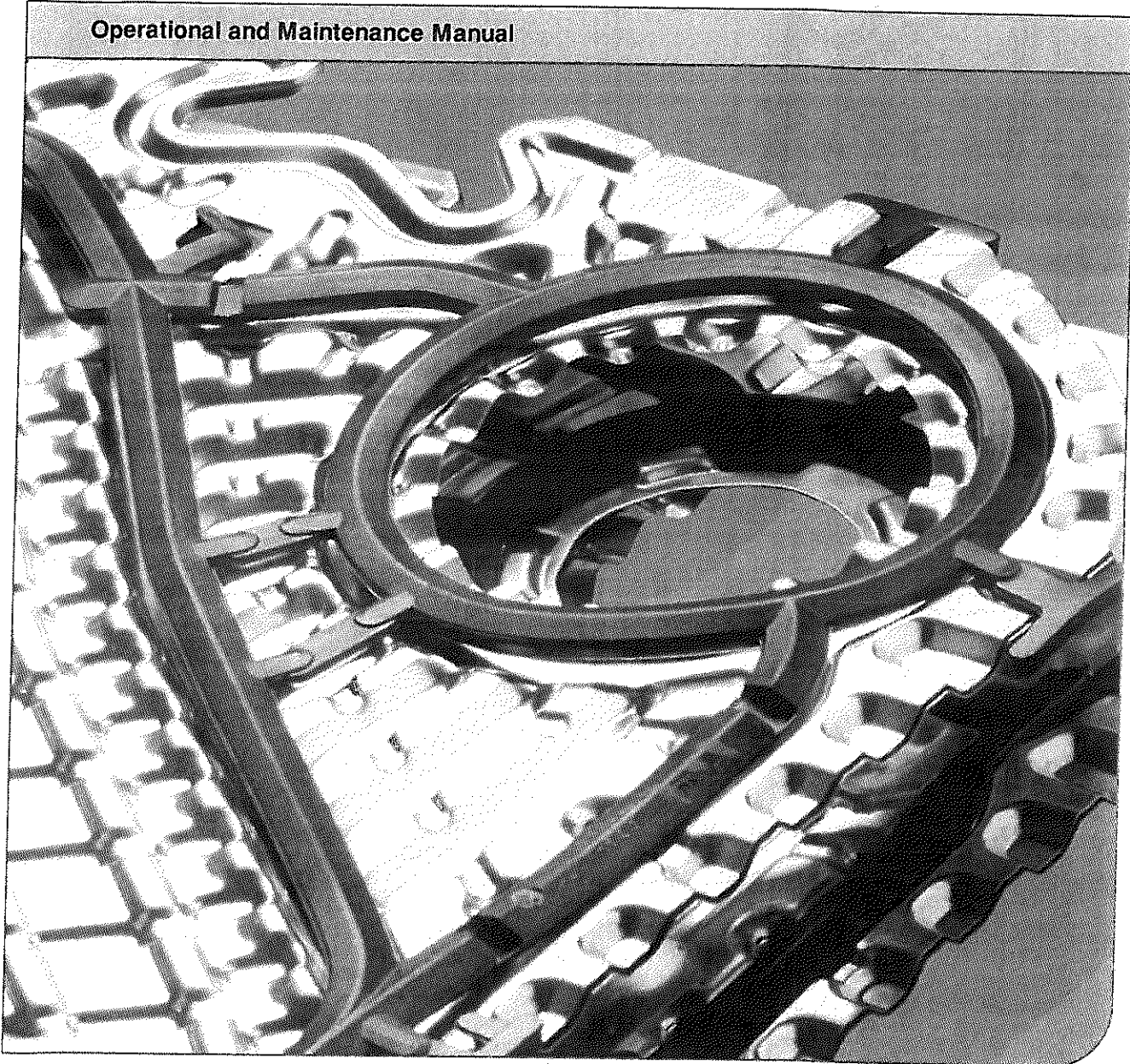
**BEATTIE
ELEMENTARY
SCHOOL**

2000 MEADOWLARK AVE
FORT COLLINS CO 80526



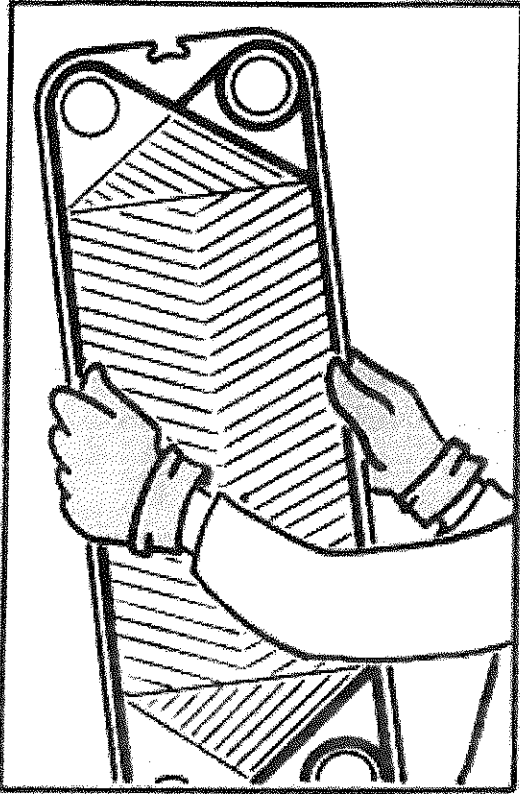
Plate Heat Exchanger

Operational and Maintenance Manual





NOTICE



**TO AVOID HAND INJURIES,
PROTECTIVE GLOVES
SHOULD ALWAYS BE WORN
WHEN HANDLING PLATES.**

PROTECTIVE SHROUDS

IT IS THE RESPONSIBILITY OF EACH PERSON OPERATING OR REPAIRING EQUIPMENT TO TAKE THE NECESSARY PRECAUTIONS TO COMPLY WITH ALL APPLICABLE SAFETY REGULATIONS.

ALFA LAVAL PROVIDES PROTECTIVE SHROUDS FOR ALL OUR PLATE HEAT EXCHANGERS. THESE SHROUDS WILL PREVENT POSSIBLE INJURIES AND/OR DAMAGE AS A RESULT OF SUDDEN LEAKAGE FROM THE PLATE PACKAGE.

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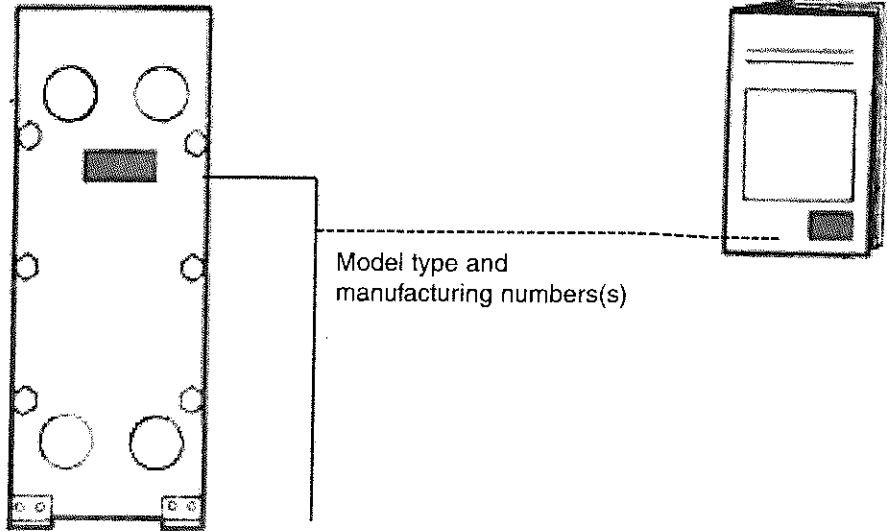
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To our valued customer:

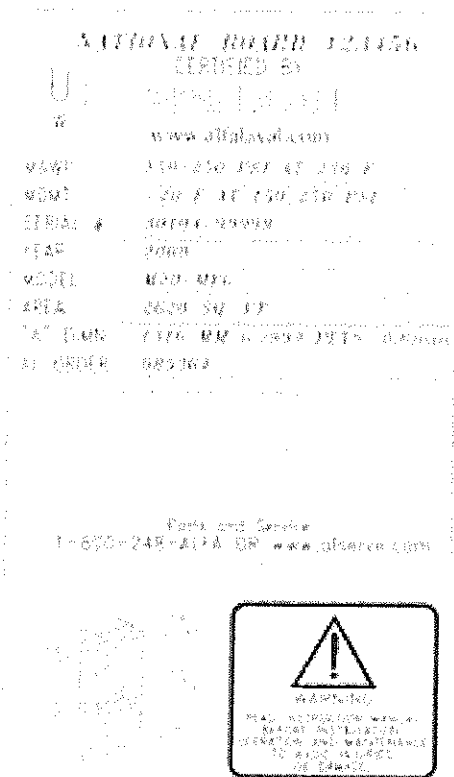
Thank you for purchasing an Alfa Laval Plate Heat Exchanger. As the world's largest manufacturer of Heat Exchangers, we are very proud of our products and services. We value you as our customer and wish to assure your satisfaction. We have prepared this Instruction Manual to assist you with your Alfa Laval Plate Heat Exchanger in various situations. We suggest that you look through it carefully, and, above all, make it readily available to any personnel who may need it for reference.

2

The name plate - and the identification of the equipment

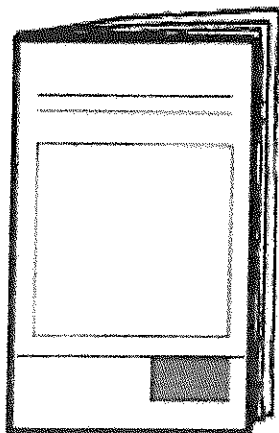


A name plate like the one shown below is fixed to the apparatus as shown above and it gives the following information



2.1

The name plate - and the identification of the equipment



This instruction manual has been issued for many different models of Alfa Laval *industrial* PHEs. There are separate manuals for *industrial, sanitary, spiral, alfa rex, brazed & evaporator/condensor* heat exchangers.

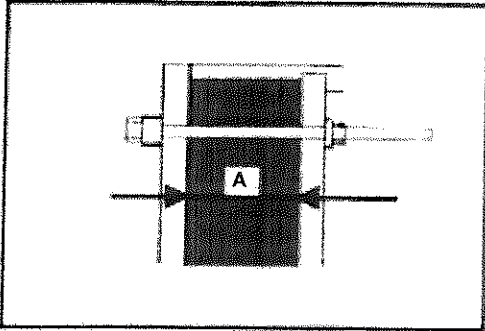
- WHENEVER USING THE MANUAL, CHECK FIRST THAT THE SERIAL NUMBER ON THE FRONT COVER IS IDENTICAL TO THAT ON THE NAME PLATE OF THE EQUIPMENT.
- IN ALL CORRESPONDENCE WITH ALFA LAVAL, PLEASE REFER TO THE MANUFACTURING SERIAL NUMBER, FOR TRUE IDENTIFICATION OF THE EQUIPMENT.
- WHENEVER CONTACTING ALFA LAVAL ABOUT A PART FOR YOUR PLATE HEAT EXCHANGER, BE SURE TO STATE THE MANUFACTURING SERIAL NO.(S), AND MODEL TYPE.

3

General

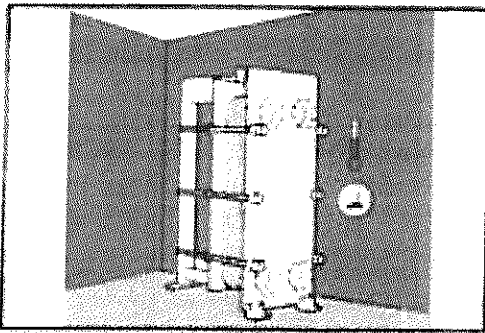
STORAGE

In this section, names of heat exchanger parts are mentioned for the first time. For your information, see Chapters 4A or 4B FUNCTION.



1. Unless otherwise agreed, ALFA LAVAL delivers the plate heat exchanger ready to be put in service upon arrival. This means that the plate package is tightened to its correct measurement A.

Should it be necessary, however, to store the equipment for a longer period (1 month or more) before, certain precautions should be made in order to prevent unnecessary wear of the equipment:

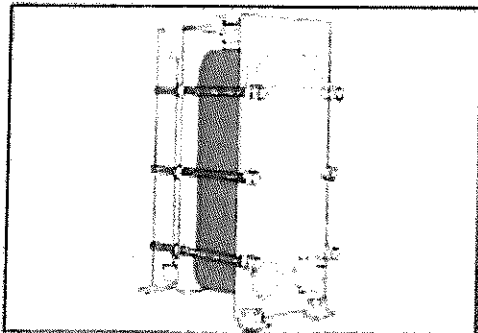


2. Preferably, the heat exchanger should be stored inside, in a room with a temperature around 15 to 20 degrees Celsius (60 to 70 degrees Fahrenheit) and humidity around 70%

There should **ABSOLUTELY NOT** be any **OZONE-PRODUCING** equipment in the room, like electric motors or arc-welding equipment, since ozone destroys many rubber materials (cracking).

Do not store organic solvents or acids in the room.

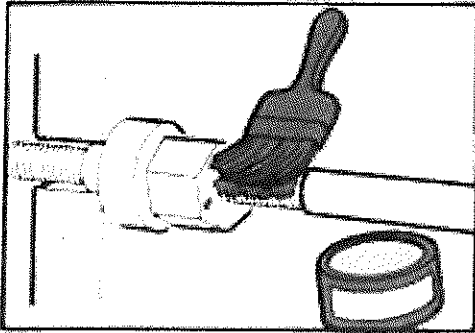
Avoid heat or ultraviolet radiation.



3. Wrapping the PHE with a non-transparent plastic film is a good precaution. Use of transparent film can alter paint color if unit is stored in direct sunlight.

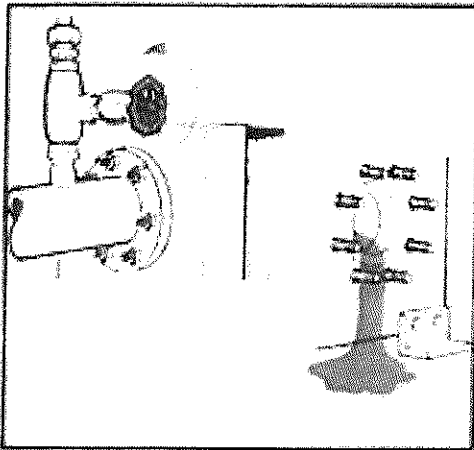
3.1

STORAGE



4. The tightening bolts should be well covered with good rust preventing coating, suitable types (LUBRIPLATE FGL-2 or Equivalent) and if not connected to the pipe system, the connections should be covered.

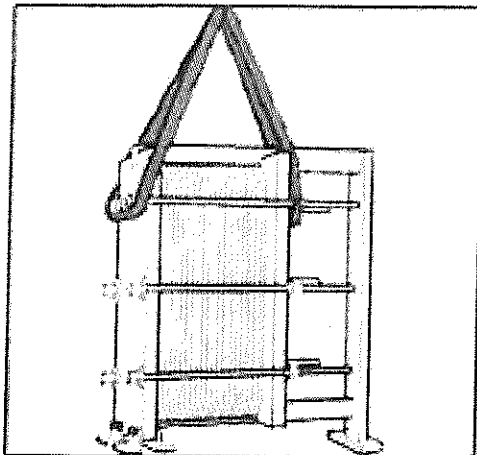
If the heat exchanger must be stored outdoors, the precautions mentioned above should be taken as far as practical. The need for protection against the climate etc. is of course even more important in this case.



5. If for any reason the heat exchanger is removed from service for a long period, it is advantageous to follow the advice above, even if the equipment is not moved from the location.

The heat exchanger should be VENTED AND DRAINED, and depending on the media processed, it is recommended to RINSE AND DRY it, before it is stored.

LIFTING



1. Whenever the heat exchanger is lifted, straps should be placed around tightening bolts on both sides of the unit, as shown in picture. If lifting lugs or lifting eyes are provided, always use chains or lifting cables rated above the published weight of the heat exchanger.

NEVER LIFT BY THE CONNECTIONS OR THE STUDS AROUND THEM!

3

General

LIFTING CONTINUED

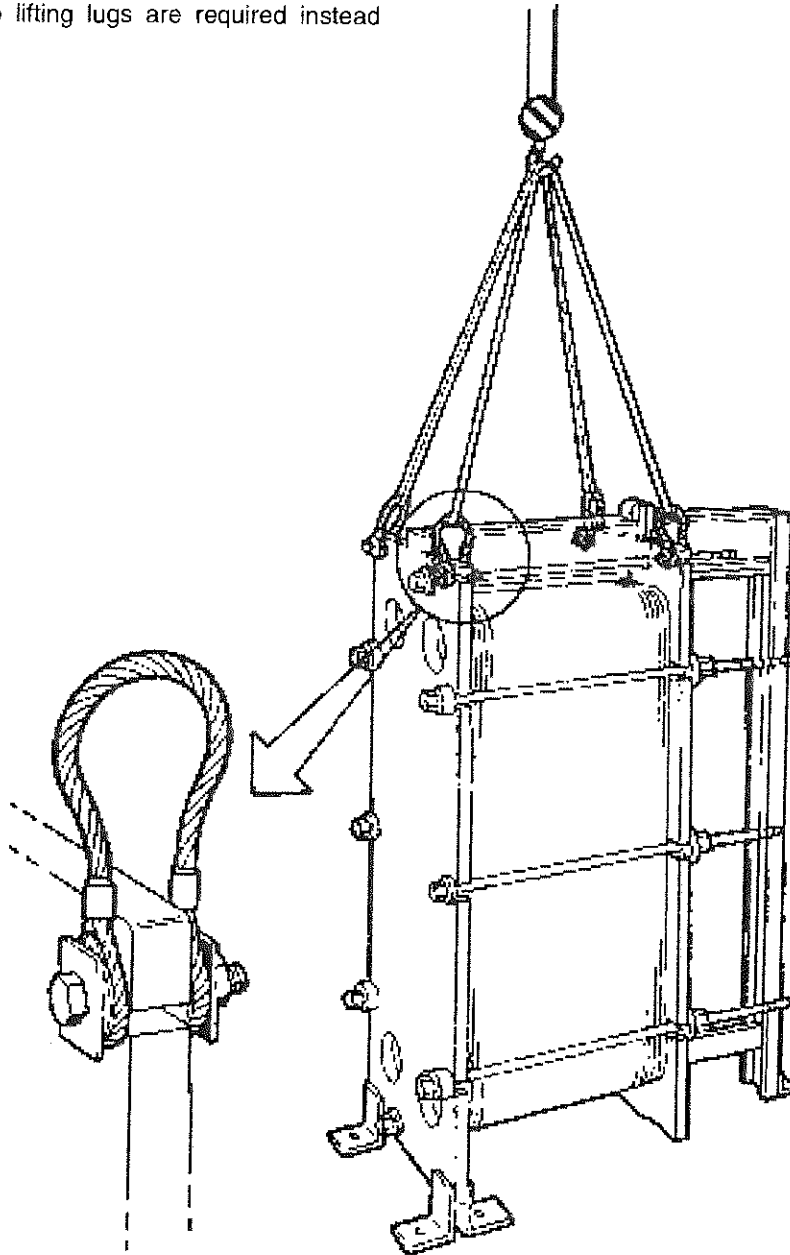
If Lifting Lugs are provided

If you are to lift the heat exchanger itself, straps should be used. They should be placed as shown on the picture.

On smaller units (4" connected size smaller) typically two lifting lugs are required instead of four.

WARNING!

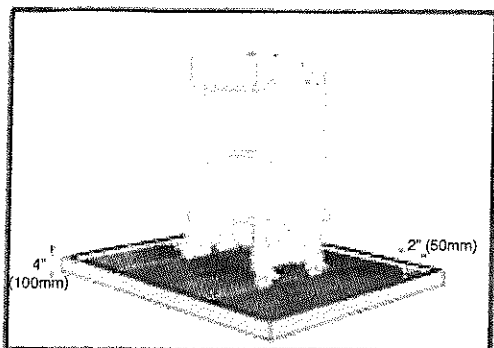
Never lift by the connections or the studs around them.



General

FOUNDATIONS.

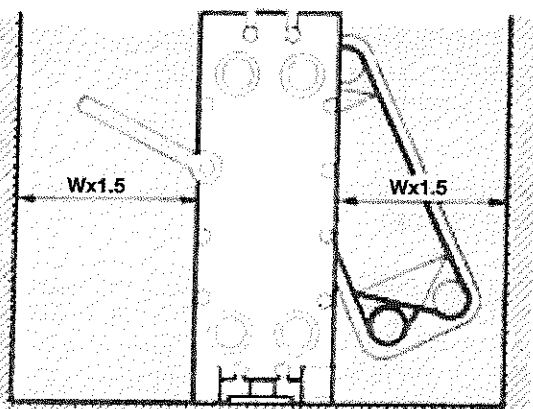
All information necessary for the preparation of the foundation appears on the data sheet provided by ALFA LAVAL.



In some cases (installation on board a ship, when processing corrosive liquids, etc.) it may be practical to place the heat exchanger in a DRAINAGE BOX (with capacity for the total volume of the heat exchanger). The outlet of the drainage box should be generously dimensioned, not less than (2") 50 mm diameter.

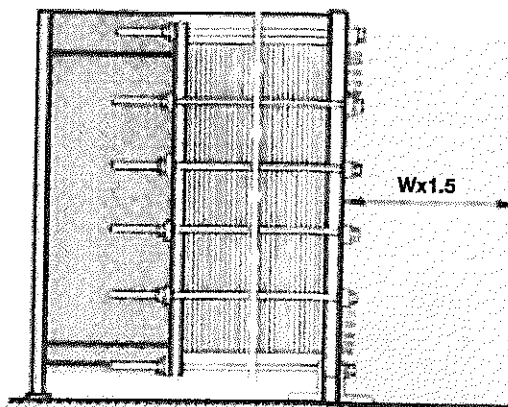
INSTALLATION.

BEFORE connecting any piping to the heat exchanger, MAKE SURE THAT ALL FOREIGN OBJECTS HAVE BEEN FLUSHED OUT OF THE SYSTEM!




PLEASE OBSERVE THAT


The measurements given in the picture above are recommended by ALFA LAVAL, it is necessary to leave free space around the equipment, to provide access and make future service possible. Except for a place to put the plates, if removed from the heat exchanger, **NO FURTHER SPACE** is required for servicing the PHE.



PLEASE OBSERVE THAT

The measurements given in the picture are recommended by ALFA LAVAL, to provide reasonably good working conditions during installation of the heat exchanger as well as for future maintenance and service. If floor space is restricted, the dimensions suggested can be reduced. It is left to the purchaser to decide just how much access space is required.

 This field should be kept free from fixed installations.

 Recommended free space for opening and closing.

PIPES

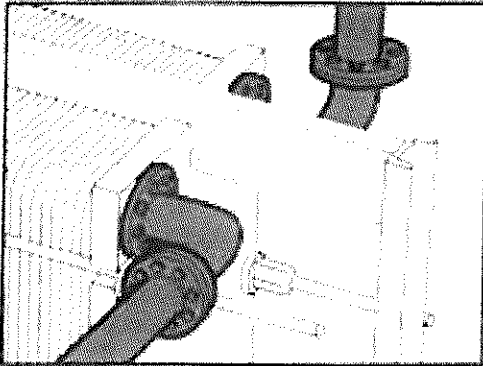
Always ensure that no measurable stress is placed on the heat exchanger by the piping system.

SHUT OFF VALVES

To enable the heat exchanger to be opened when necessary shut off valves should be provided on all connections.

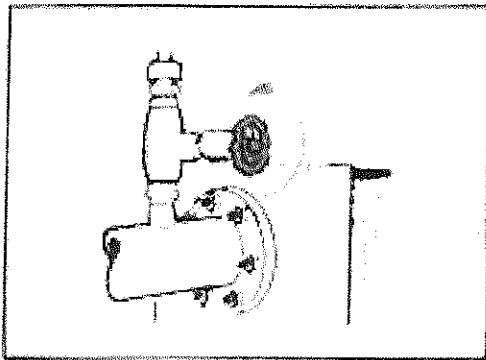
PRESSURE RELIEF DEVICES

It is the responsibility of the user to ensure that the required pressure relief devices are properly installed prior to initial operation. Refer to the applicable Code(s) and corresponding Standard(s) for proper size requirements of these pressure relief devices.



CONNECTIONS ON THE PRESSURE PLATE (REAR COVER)

Some plate heat exchangers may also have connections on the pressure plate. In such cases, it is important to check against the drawing or the name plate that the plate pack has been tightened to the right measurement before the piping is connected.



Whenever piping is connected to the pressure plate, a short 90° spool piece shall be installed between the heat exchanger and the piping. These should be directed upwards or sideways. This simplifies pressure plate removal during servicing.

Venting of both sides of the heat exchanger must be provided. This is important and enables air to be drawn from the system during start-up. It also enables air or gas to be removed during operation, and it enables faster drainage.

Special Loose Flange Connections

Loose Flanges are provided on certain model types due to interference. When provided these flanges shall be incorporated into the piping.

MODELS WITH BOTH "S" AND "T" PORT CONNECTIONS

M6-FD, M6-MFD, M6-MWFD, M10-BFD, M10-MFD, M10-BWFD, M10-BDFD, M20-MFD*, M20-MWFD*

MODEL TYPES WITH LOOSE FLANGE ON T PORT CONNECTIONS ONLY:

M6-FG, M6-MFG, M6-MWFG, M10-BFG, M10-MFG, M10-BWFG, M10-BDFG, V28-FD*, V45-FD*, M20-MFG, M20-MWFG

* Loose flange only when design pressures above 230 psi.

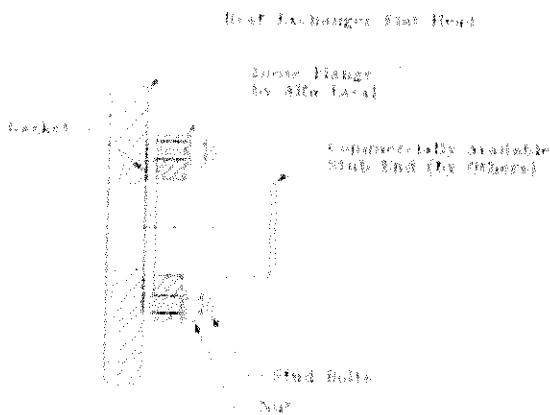
Notes:

- 1) Sports connections on these model types utilized industry standard flanges.
- 2) Not all exchangers require T port connections.

PIPING CONNECTION

The loose flange is connected to piping by use of a commercially available stub end of same material as the piping.

The stub end is installed as shown and then butt weld to the piping.



4A

LIST OF PARALLEL FLOW UNITS

“A” SERIES UNITS:

AM10-FG; AM10-FS

A15-BFL; A15-BFG; A15-BFD; A15-BWFG; A15-BWFD

A20-BFL; A20-BFG; A20-BFD

AM20-FG; AM20-BFG; AM20-WFG; AM20-SFG; AM20-DWFG

AK20-FG; AK20-FD; T200-FG; T200-FD

AX30-BFG; AX30-BFD; AX30-BWFG; AX30-BWFD

A35-HA

“M” SERIES UNITS:

M3-VG

M6-FG; M6-FD; M6-MFG; M6-MFD; M6-MWFD/FG/FDR/FGR

M10-BFM; M10-BFG; M10-BFD; M10-MFG; M10-MFD;

M10-BWFG; M10-BWFD; M10-BWFGR, M10-BWFDR

M15-BFG; M15-BFD; M15-BFS; M15-MFG;

M15-MFD; M15-MFS; MK15-BWFD; MK15-BWFG

M20-MFG; M20-MFM; M20-MFD; M20-MWFG; M20-MWFD

M30-FM; M30-FG; M30-FD

MA30-FD; MA30-FG; MA30-WFG; MA30-WFD

MX25-BFG; MX25-BFD; MX25-BFS

EC500-WTFE; EC500-WTFL

“V” SERIES UNITS:

V8-VG, V13-FG, V13-FD, V20-FG, V20-FD

PARALLEL FLOW UNITS

4A

Function

THE MAIN COMPONENTS OF THE PLATE HEAT EXCHANGER AND THEIR FUNCTIONS.

In ALFA LAVAL Plate Heat Exchangers, heat is transferred from one medium to another through thin metal plates which have been pressed into a special pattern.

1. FRAME PLATE

2. SUPPORT COLUMN

The two bars are suspended between the FRAME PLATE, to which in most cases the piping is connected, and a SUPPORT COLUMN.

4. CARRYING BAR

5. GUIDING BAR

The plates hang from a CARRYING BAR at the top and are kept in line by a GUIDING BAR at the bottom.

7. PRESSURE PLATE

The pressure plate is hung on the carrying bar and is moveable, as are the heat transfer plates. In some cases piping may be connected to the pressure plate.

3. CONNECTIONS

Holes matching the piping lead through the frame plate, permitting the media to enter into the heat exchanger. Threaded studs around the holes secure the pipes to the equipment. Depending on the application, metallic or rubber-type LININGS may protect the edges of the holes against corrosion.

6. TIGHTENING BOLTS

With the package of thin plates hanging between the frame plate and the pressure plate, a number of TIGHTENING BOLTS are used to press the thin plates together, bringing them into metallic contact, and to compress the gaskets, enough to seal off the narrow passages which have now been formed between the plates.

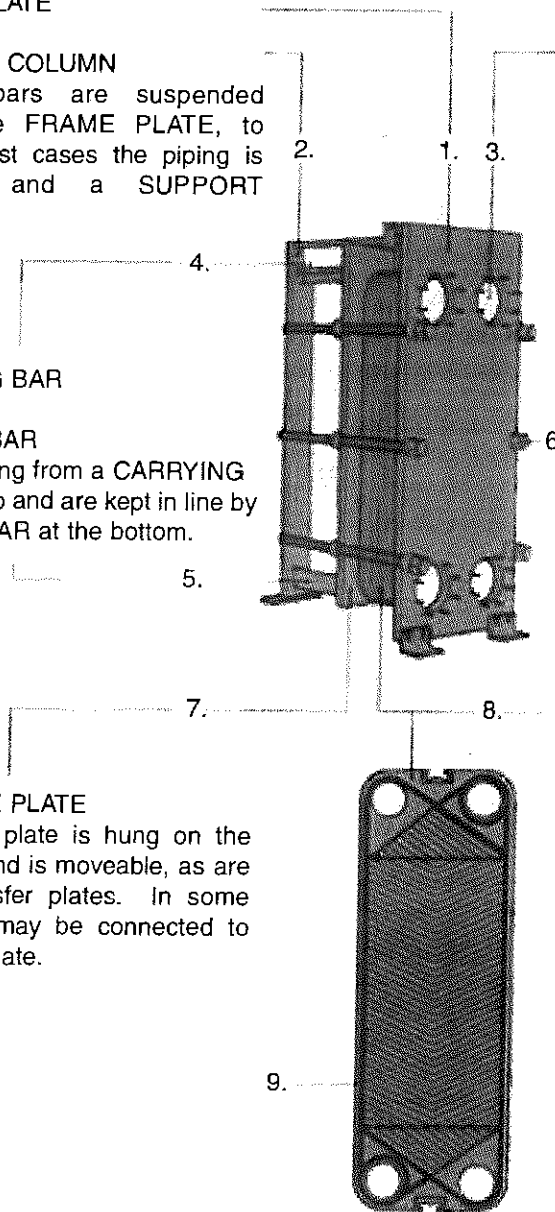
8. CHANNEL PLATES

9. GASKET

These plates are called CHANNEL PLATES. A groove along the rim of the plate and around the ports hold a GASKET, usually made of a rubber-type material.

Heat is transferred through the surface which is contained by the gasket, except for some small areas near the corners.

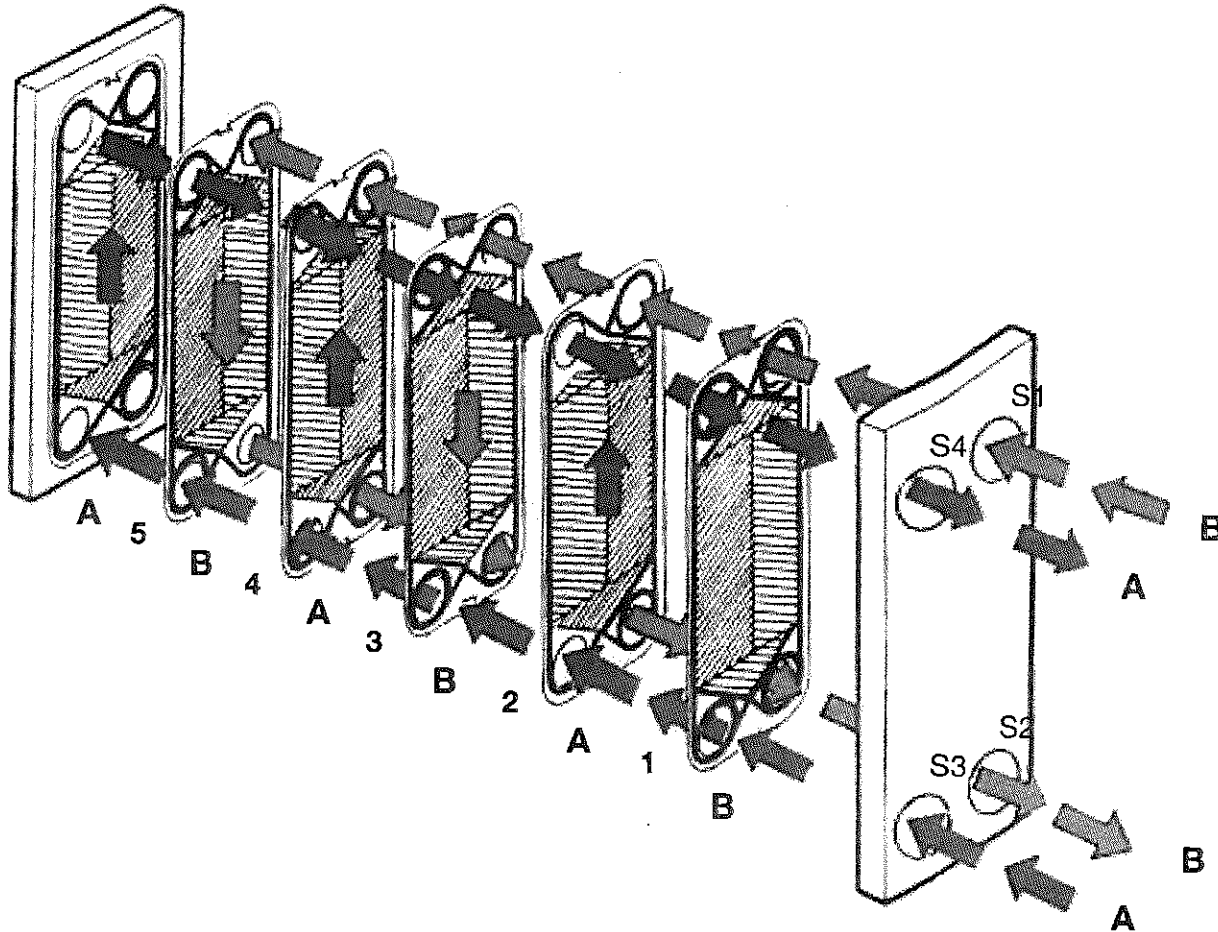
The number of plates in your heat exchanger is determined by the size of the heat transfer surface required.



4A

PARALLEL FLOW UNITS

How it works



When a package of plates are pressed together, the holes at the corners form continuous tunnels or manifolds, leading the media (which participate in the heat transfer process) from the inlets into the plate pack, where they are distributed in the narrow passages between the plates.

Because of the gasket arrangement on the plates, and the placing of "A" and "B" plates alternately, the two liquids enter alternate passages, e.g. the warm liquid between even number passages, and cold liquid between odd number passages.

Thus the media are separated by a thin metal wall. In most cases the liquids flow in opposite directions.

During the passage through the equipment, the warmer medium will give some of its heat energy to the thin wall, which instantly loses it again to the colder medium on the other side.

The warmer medium drops in temperature, while the colder one is heated up.

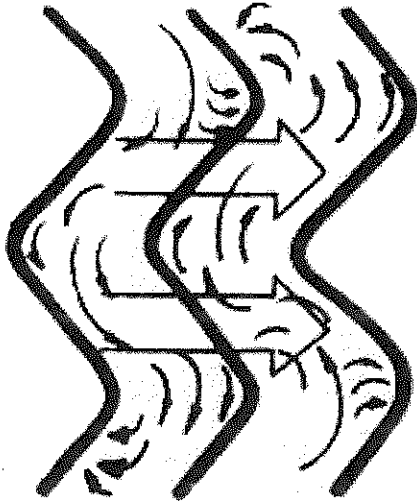
Finally, the media are led into similar hole-tunnels at the other end of the plates and discharged from the heat exchanger.

4A.3

PARALLEL FLOW UNITS

4A

Heat transfer



The purpose of the equipment is to transfer heat from one medium to another. Heat passes very easily through the thin wall separating the two media.

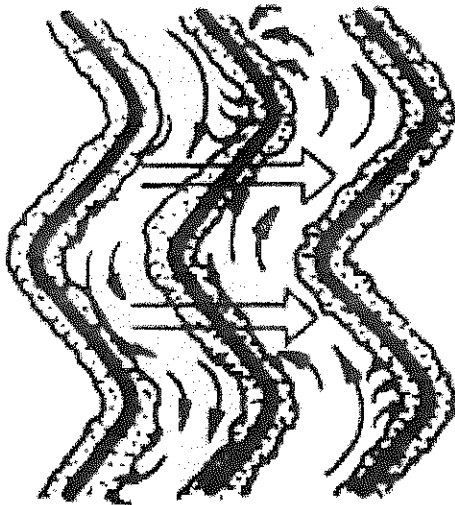
The novel pattern into which the plate material has been formed not only gives strength and rigidity, but greatly increases the rate of heat transfer from the warmer medium to the metal wall and from the wall to the other medium.

This high heat flow through the walls can be seriously reduced by the formation of deposits of various kinds on the wall surfaces.

The pattern of corrugation on Alfa Laval plates mentioned above induces highly turbulent flow. The turbulence gives strong resistance to the formation of deposits on the plate surface; however, it cannot always eliminate fouling.

The deposits may increase the total "wall thickness" substantially, and they consist of materials that have a much lower thermal conductivity than the metal plate. Consequently a layer of deposits can severely reduce the overall heat transfer rate.

The deposits will be considered in the chapter on MAINTENANCE and CLEANING. At this point we will only establish that this fouling is unwanted and can under certain circumstances, be harmful to the heat exchanger because corrosion may occur under the deposits.



Pressure drop

Pressure drops are wasted energy.

All pipe systems and equipment included in them offer resistance to media flowing through them.

Some pressure drop is unavoidable, but for a given PHE it should be kept as close as possible to the designed value.

The formation of deposits on the heat transfer surfaces instantly leads to a reduction of the free space between the plates. This means that more energy is needed to get the desired flow through the equipment.

It is clear that the fouling of the surfaces is undesirable.

Larger particles and fibers may also be drawn into the heat exchanger and clog the passage ways if strainers or other means of protection have not been provided for.

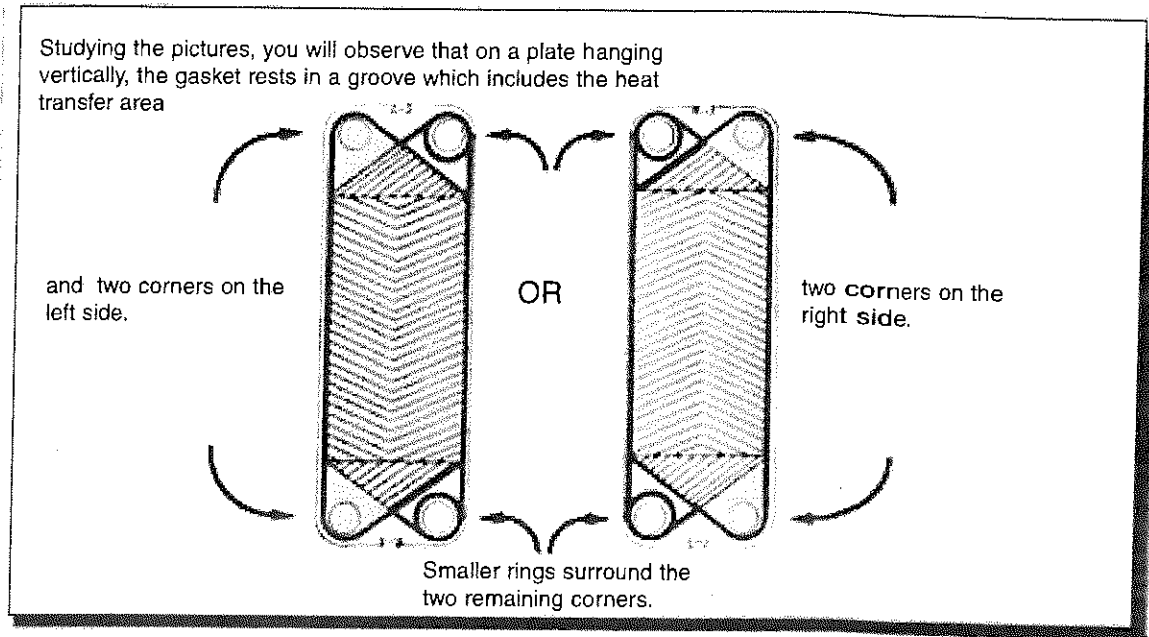
A reduced ability by the heat exchanger to hold the desired temperatures, in combination with an increased pressure drop on any of the media, indicates that fouling or clogging is taking place.

For corrective action, see MAINTENANCE and CLEANING.

4A.4

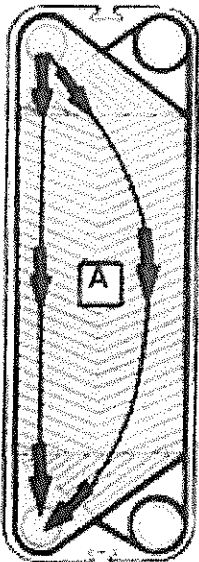
4A

PARALLEL FLOW UNITS

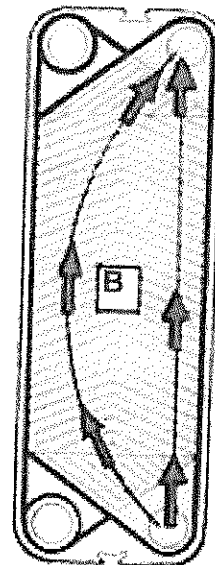


We decide that we will name the plates after these two situations.

An A-plate is a plate hanging with the chevron pointing downwards.



A B-plate is a plate hanging with the chevron pointing upwards.

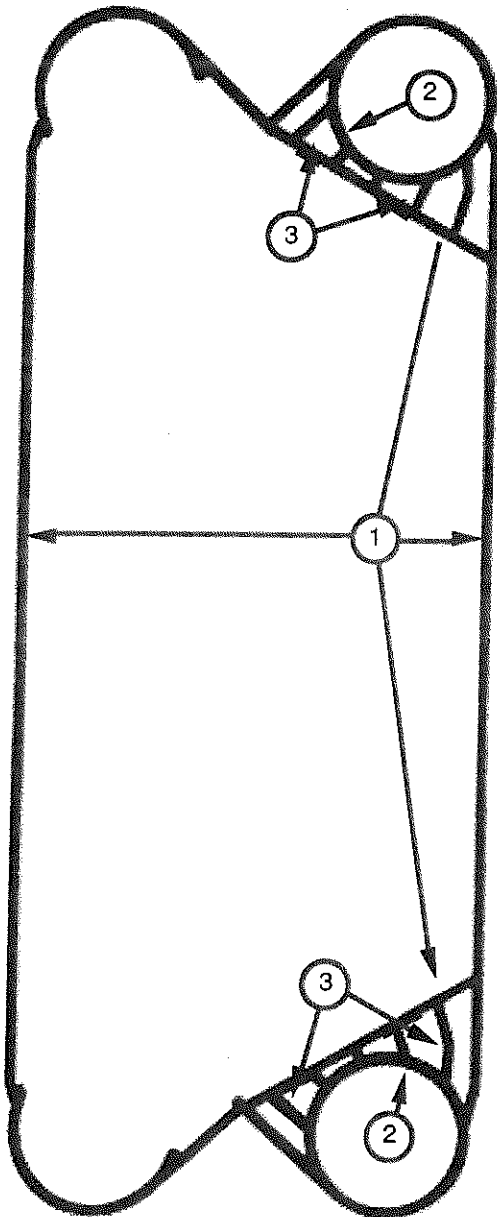


If we turn an A-plate upside down we will have a B-plate:

4A.5

Gaskets

The GASKET is molded in one piece. The material is normally an elastomer, selected to suit the actual combination of temperature, chemical environment and possible other conditions that may be present.



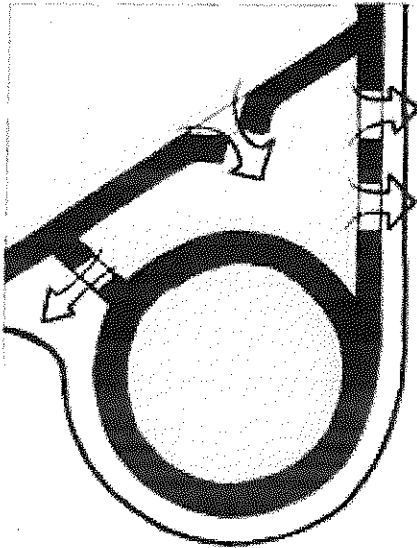
The one-piece gasket consists of:

1. One field gasket
2. Two ring gaskets
3. Links

The field gasket is by far the larger part containing the whole heat transfer area and the two corners connected to it. The ring gaskets seal off the remaining two corners.

These three pieces are held together by a few short links, which have no sealing function at all. Their purpose is simply to tie the pieces together and to add some support in certain areas. On some plate heat exchangers, the gasket is held in place on the plate by means of a suitable cement or glue.

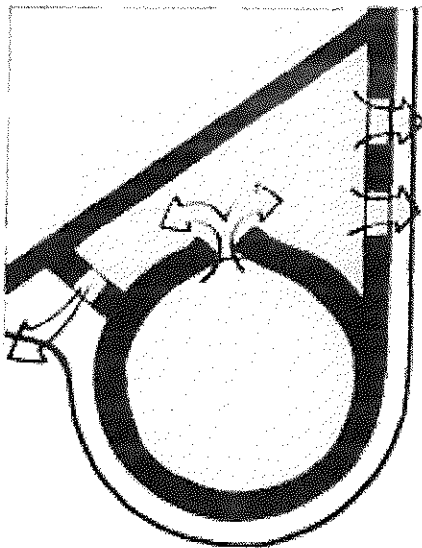
Gaskets



As already demonstrated, the two media are effectively kept apart by the ring and field gaskets. To prevent intermixing of the media in the corner areas where field and ring gaskets are very close to each other, the link pieces have a number of slots which opens the area between the field and ring gaskets to atmosphere. Any leakage of media across either gasket will escape from the heat exchanger through the slots.

It is important that these openings are kept clear. If they are not, there is a risk that should a leak occur in that region of the plate, there might be a local pressure build-up, which could allow one medium to mix with the other.

Care should be taken not to cut or scratch the gaskets while handling plates.

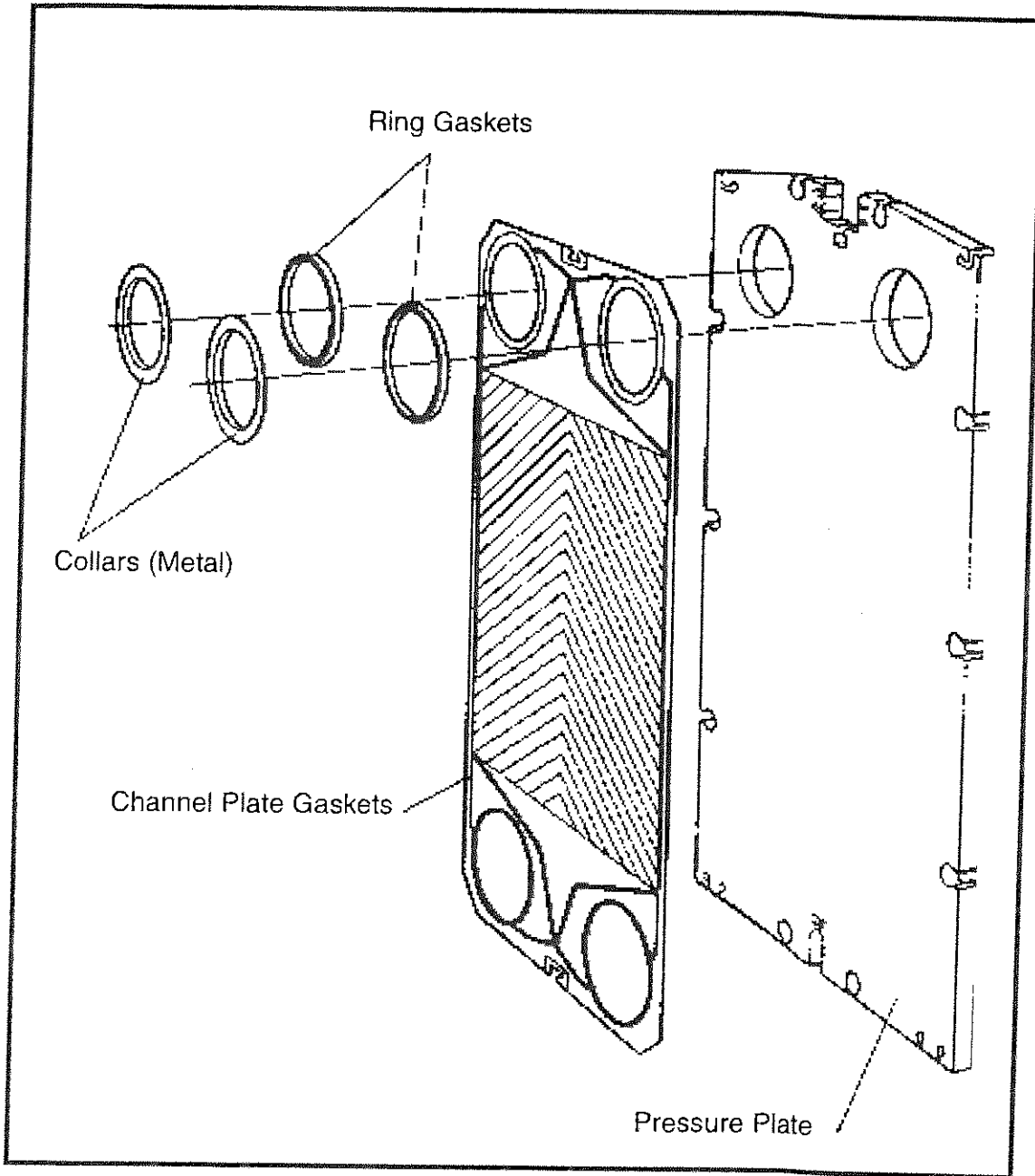


4A

PARALLEL FLOW UNITS

TRANSITION PLATE

M30, MX25, A20-B, AM20, AK20, T200, A15-B, M15, M10, M6



4B List of Diagonal Flow Units

"A" SERIES UNITS:

A10-BFG; A10-BFD

AX35-FG

A45-FG

"P" SERIES UNITS:

P2-FG; P2-VLCH; P2-DWFG

P3-E;P3-EH

"M" SERIES UNITS:

M3-XVG

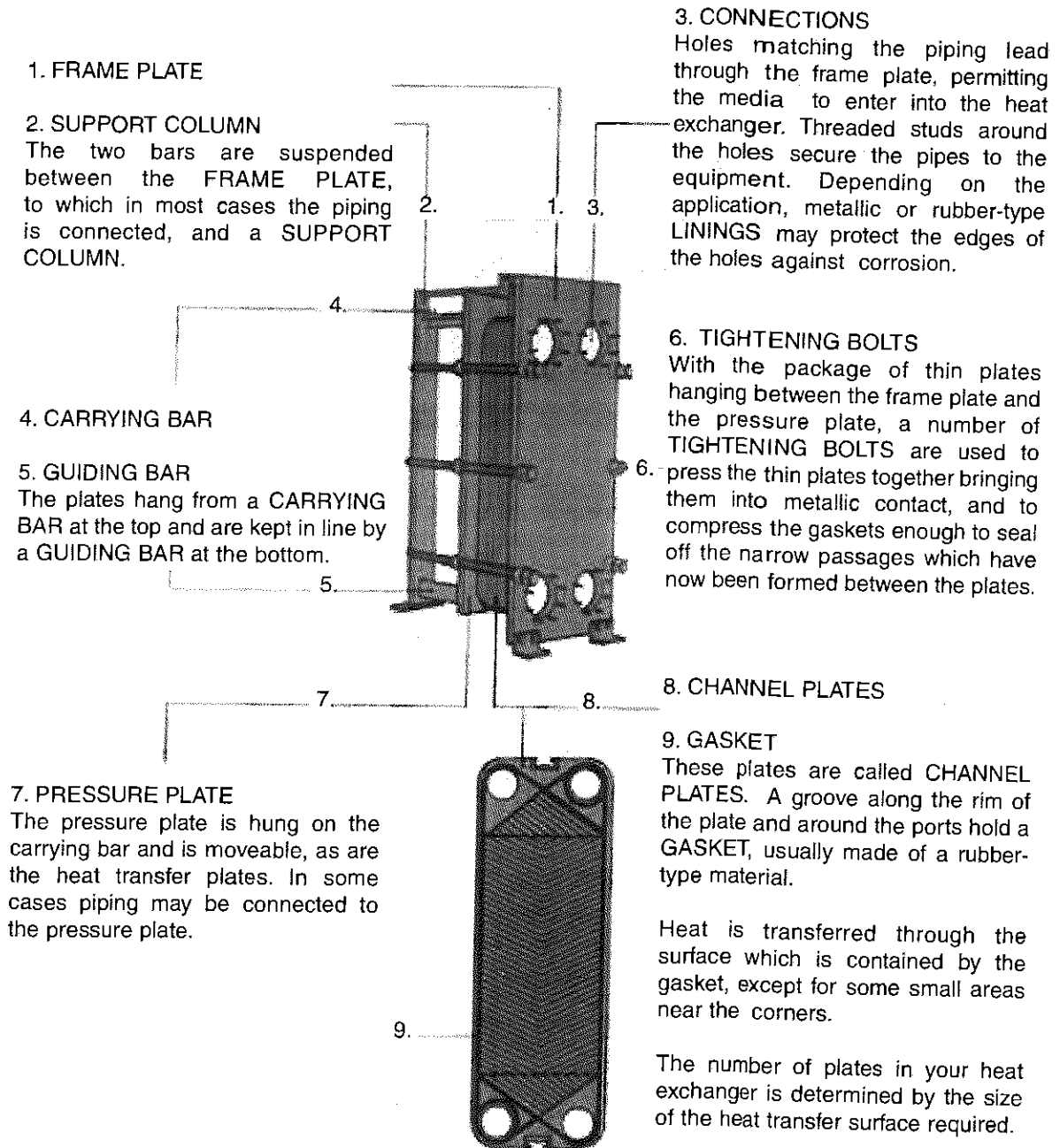
"V" SERIES UNITS:

V28-FG, V28-FD, V45-FG, V45-FD, V110-FG, V110-FD,
V170-FG, V170-FD, V280-FG, V280-FD

Function

THE MAIN COMPONENTS OF THE PLATE HEAT EXCHANGER AND THEIR FUNCTIONS.

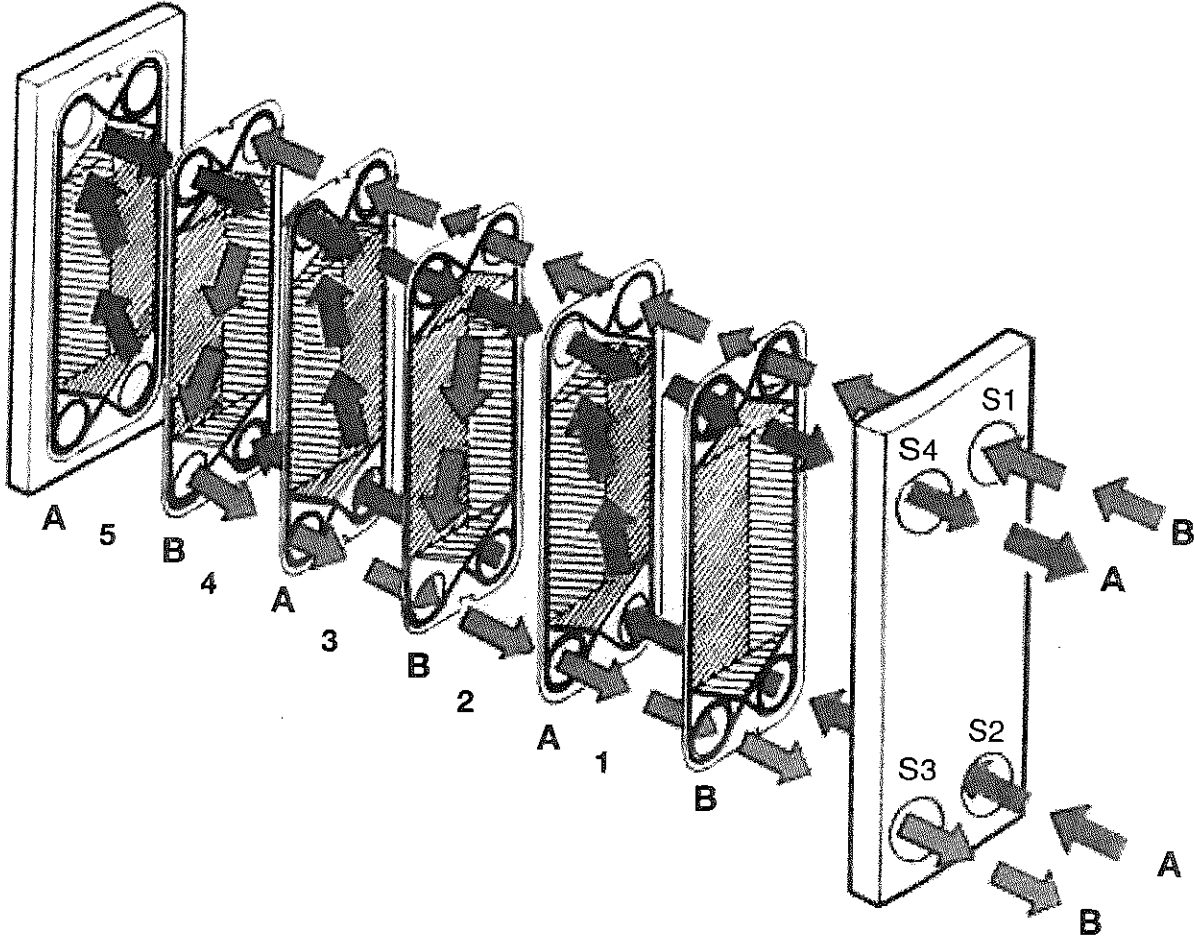
In ALFA LAVAL Plate Heat Exchangers, heat is transferred from one medium to another through thin metal plates which have been pressed into a special pattern.



4B

DIAGONAL FLOW UNITS

How it works



When a package of plates are pressed together, the holes at the corners form continuous tunnels or manifolds, leading the media (which participate in the heat transfer process) from the inlets into the plate pack, where they are distributed in the narrow passages between the plates.

Because of the gasket arrangement on the plates, and the placing of "A" and "B" plates alternately, the two liquids enter alternate passages, e.g. the warm liquid between even number passages, and cold liquid between odd number passages.

Thus the media are separated by a thin metal wall. In most cases the liquids flow in opposite directions.

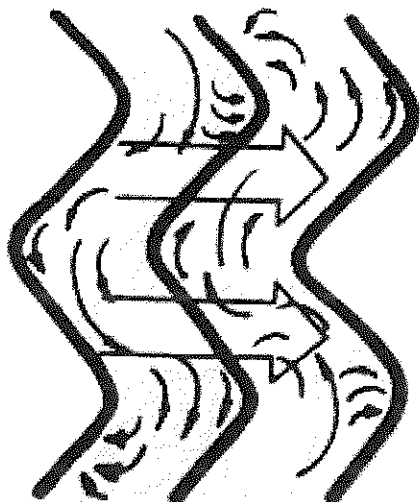
During the passage through the PHE, the warmer medium will give some of its heat energy to the thin wall, which instantly loses it again to the colder medium on the other side.

The warmer medium drops in temperature, while the colder one is heated up.

Finally, the media are led into similar hole-tunnels at the other end of the plates and discharged from the heat exchanger.

4B.3

Heat transfer



The purpose of the equipment is to transfer heat from one medium to another, and heat passes very easily through the thin wall separating the two media.

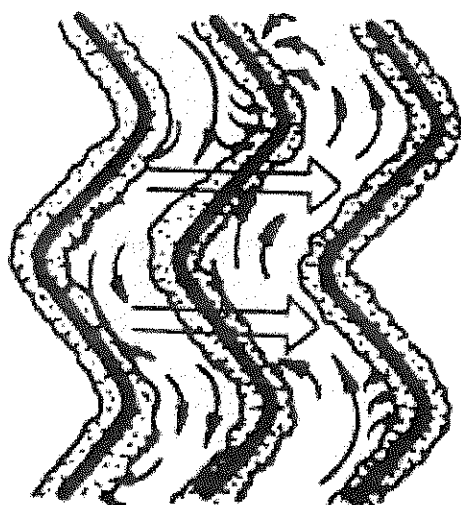
The novel pattern into which the plate material has been formed not only gives strength and rigidity, but greatly increases the rate of heat transfer from the warmer medium to the metal wall and from the wall to the other medium.

This high heat flow through the walls can be seriously reduced by the formation of deposits of various kinds on the wall surfaces.

The pattern of corrugation on Alfa Laval plates mentioned above induces highly turbulent flow. The turbulence gives strong resistance to the formation of deposits on the plate surface; however, it cannot always eliminate fouling.

The deposits may increase the total "wall thickness" substantially, and they consist of materials that have a much lower thermal conductivity than the metal plate. Consequently a layer of deposits can severely reduce the overall heat transfer rate.

The deposits will be considered in the chapter on MAINTENANCE and CLEANING. At this point we will only establish that this fouling is unwanted and can under certain circumstances, be harmful to the heat exchanger because corrosion may occur under the deposits.



Pressure drop

Pressure drops are wasted energy.

All pipe systems and equipment included in them offer resistance to media flowing through them.

Some pressure drop is unavoidable, but for a given PHE it should be kept as close as possible to the designed value.

The formation of deposits on the heat transfer surfaces instantly leads to a reduction of the free space between the plates. This means that more energy is needed to get the desired flow through the equipment.

It is clear that the fouling of the surfaces is undesirable.

Larger particles and fibers may also be drawn into the heat exchanger and clog the passage ways if strainers or other means of protection have not been provided for.

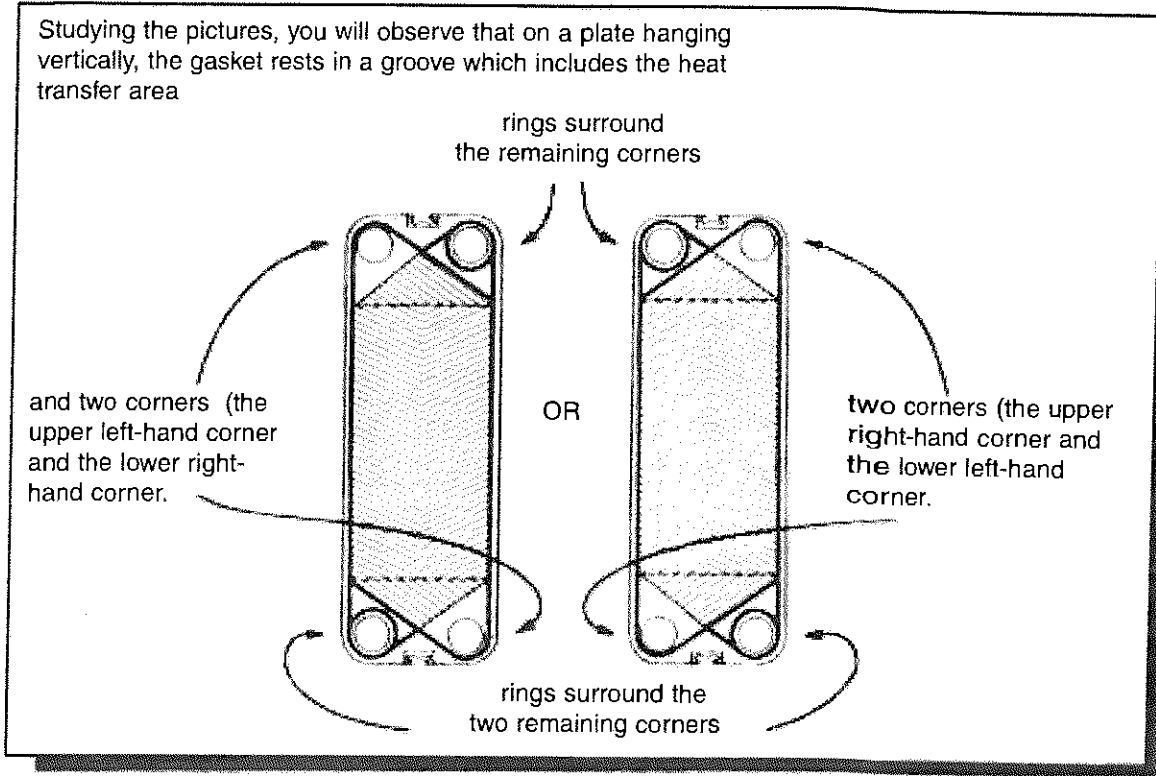
A reduced ability by the heat exchanger to hold the desired temperatures, in combination with an increased pressure drop on any of the media, indicates that fouling or clogging is taking place.

For corrective action, see MAINTENANCE and CLEANING.

4B

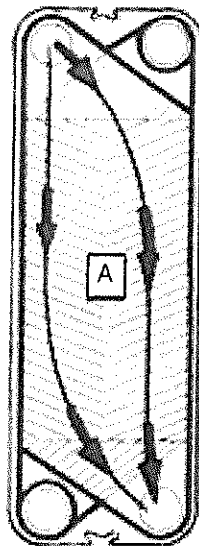
DIAGONAL FLOW UNITS

Plates

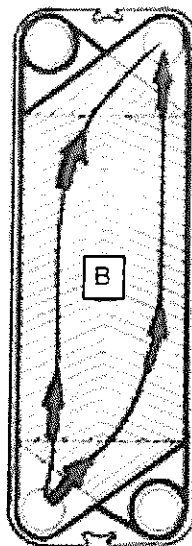


Depending on which two corners are included with the heat transfer area, the plate is called an A- or a B-Plate.

An A-plate is a plate hanging with the chevron pointing downwards.



A B-plate is a plate hanging with the chevron pointing upwards.

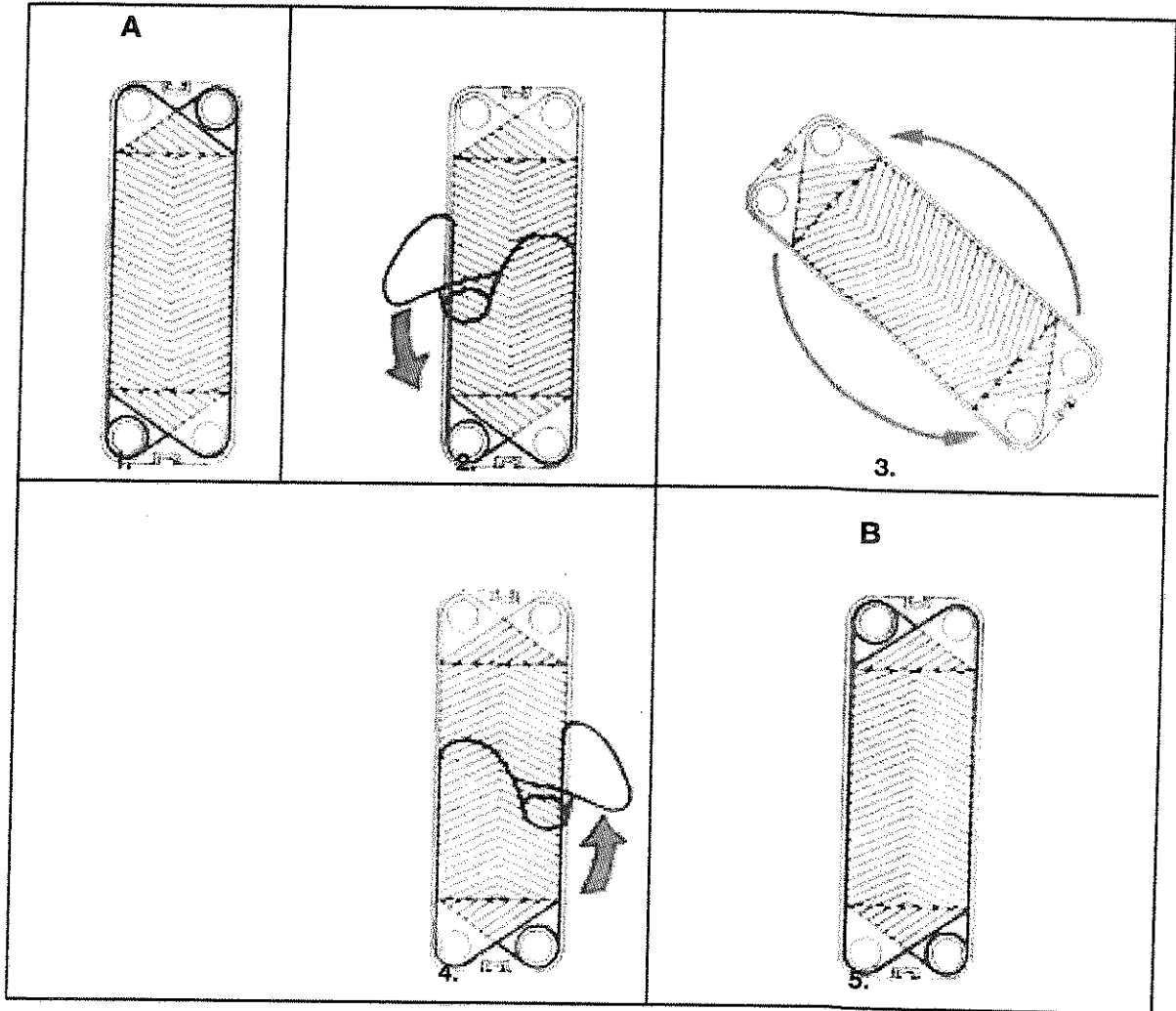


DIAGONAL FLOW UNITS

4B

Plates

We can make a B-Plate from an A-plate or the opposite, by changing the gasket and turning the plate upside down.

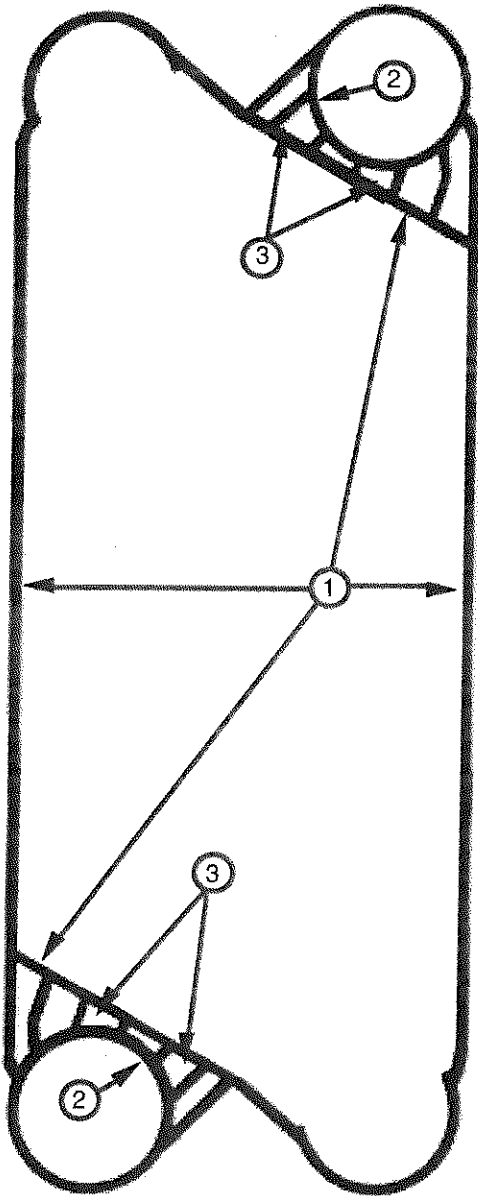


4B

DIAGONAL FLOW UNITS

Gaskets

The GASKET is molded in one piece. The material is normally an elastomer, selected to suit the actual combination of temperature, chemical environment and possible other conditions that may be present.



The one-piece gasket consists of:

1. One field gasket
2. Two ring gaskets
3. Links

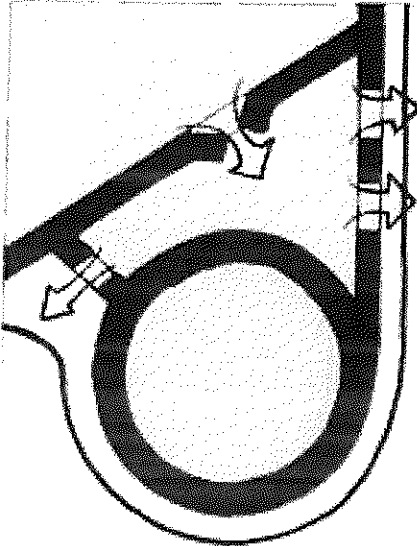
The field gasket is by far the larger part containing the whole heat transfer area and the two corners connected to it. The ring gaskets seal off the remaining two corners.

These three pieces are held together by a few short links, which have no sealing function at all. Their purpose is simply to tie the pieces together and to add some support in certain areas. On some plate heat exchangers, the gasket is held in place on the plate by means of a suitable cement or glue.

DIAGONAL FLOW UNITS

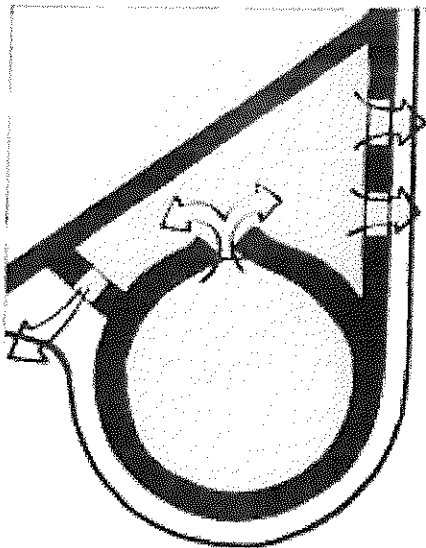
4B

Gaskets



As already demonstrated, the two media are effectively kept apart by the ring and field gaskets. To prevent intermixing of the media in the corner areas where field and ring gaskets are very close to each other, the link pieces have a number of slots which open the area between the field and ring gaskets to atmosphere. Any leakage of media across either gasket will escape from the heat exchanger through these slots.

It is important that these openings are kept clear. If they are not, there is a risk that should a leak occur in that region of the plate, there might be a local pressure build-up, which could allow one medium to mix with the other.



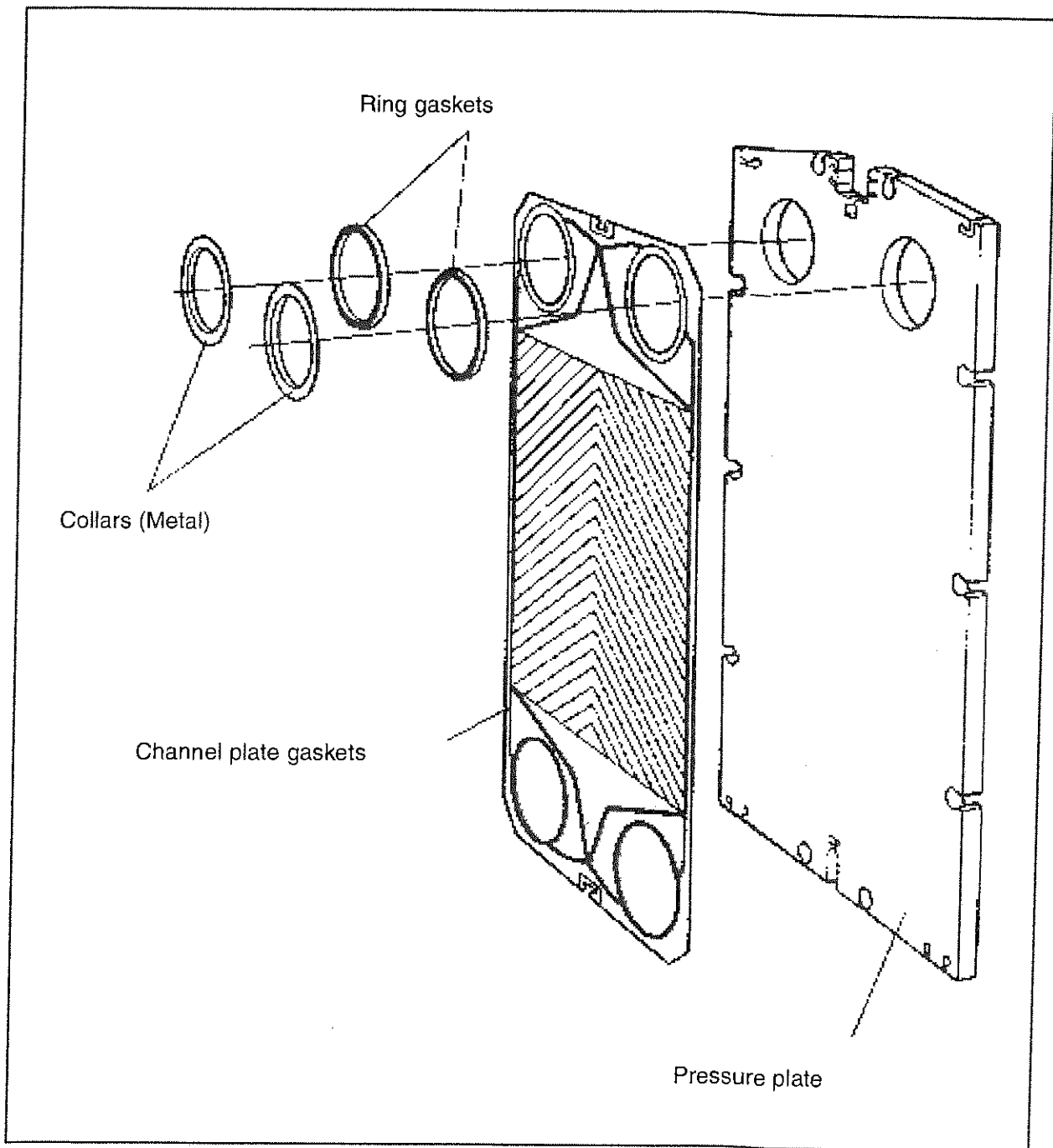
Care should be taken not to cut or scratch the gaskets while handling plates.

4B

DIAGONAL FLOW UNITS

TRANSITION PLATE

M30, MX25, A20-B, AM20, AK20, T200, A15-B, M15, M10, M6

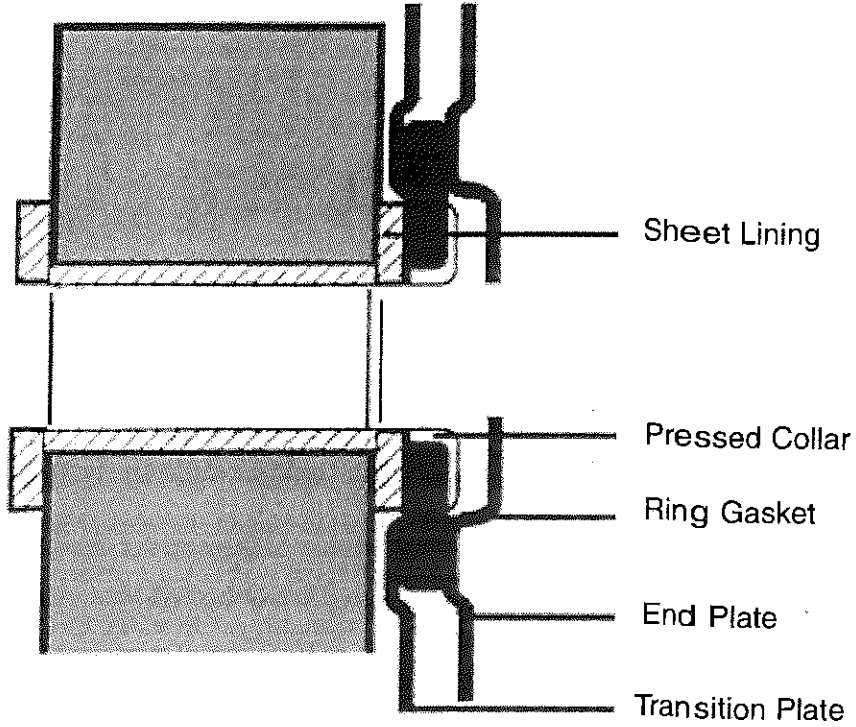


4B.10

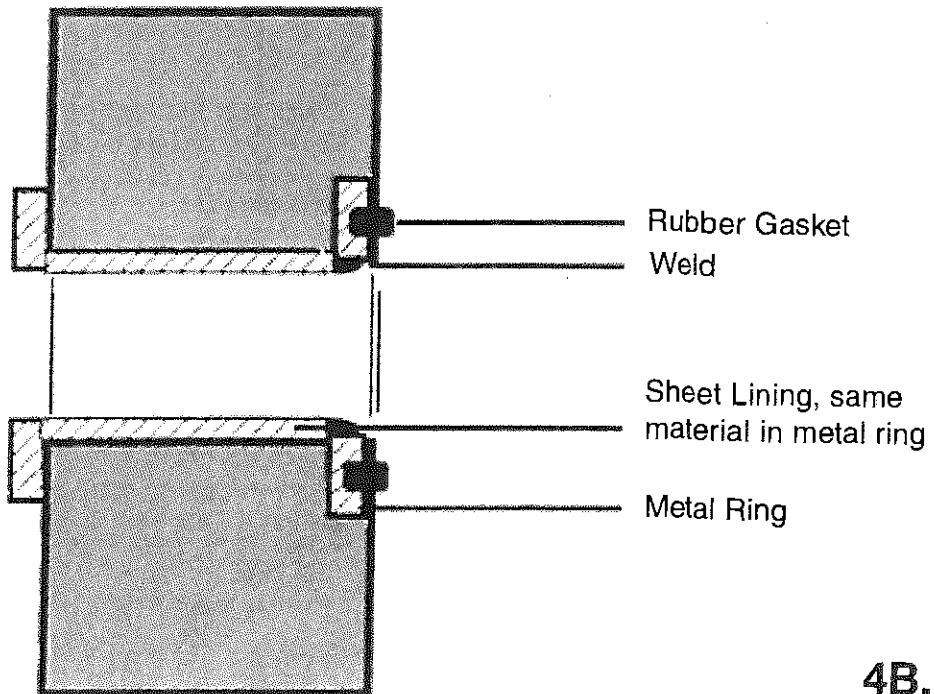
DIAGONAL FLOW UNITS

4B

NON MACHINED PRESSURE PLATE



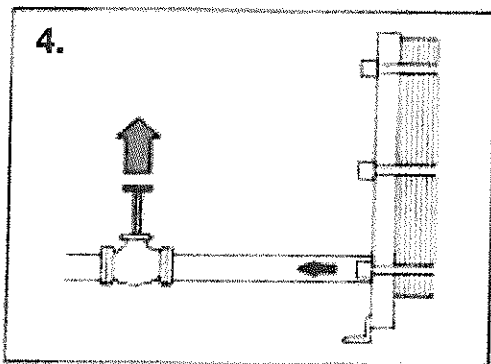
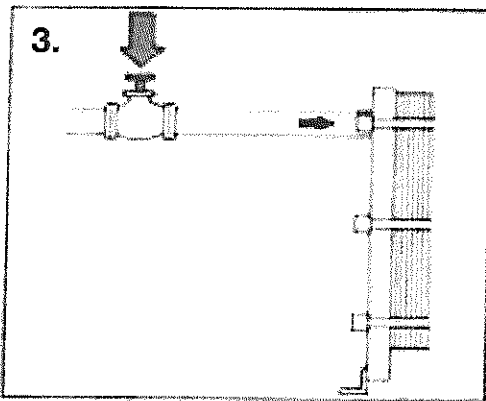
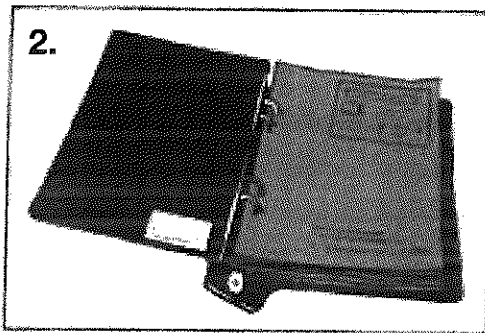
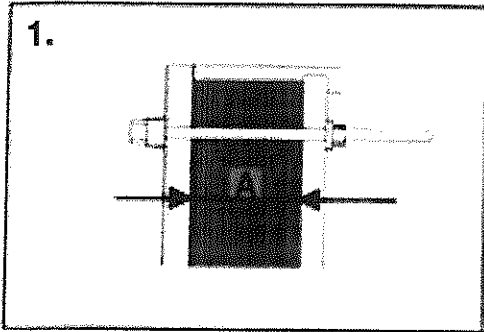
MACHINED PRESSURE PLATE (AX30, AM20 AND OBSOLETE FRAMES)



4B.11

5

Operation



START UP

1. BEFORE STARTING UP FOR THE FIRST TIME OR AFTER A LONG TIME IN STORAGE: MAKE SURE THAT THE PLATE PACK IS COMPRESSED TO THE CORRECT MEASUREMENT A! Check with the Drawing or Nameplate, which is provided with each heat exchanger.

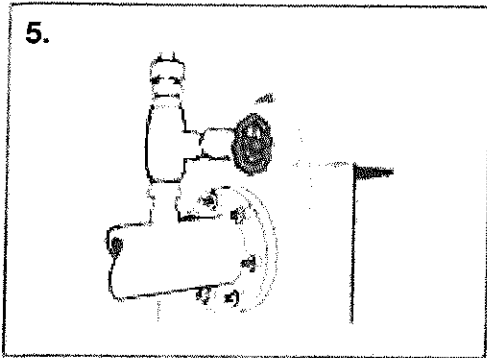
It is very important that the system to which the heat exchanger is connected, is protected against sudden and extreme variations of temperature and pressure. This is not only for the heat exchanger but also for the pipe system itself and every piece of equipment included in it.

This should be kept in mind whenever a maneuver is to be carried out, including starting up of the pumps in the system.

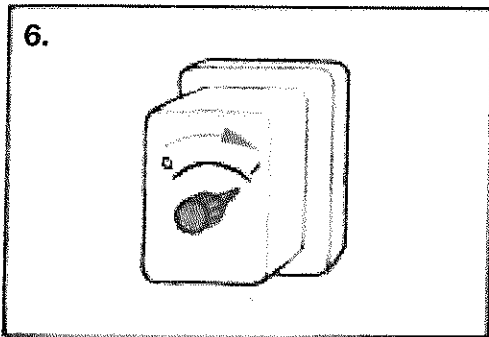
2. Before starting any pump, check whether instructions exist, telling you which pump should be started first.
3. Check that the valve between the pump and the equipment, controlling the flow rate of the system which you are about to start up is closed.
4. Check that the valve at the exit, if there is one, is fully open.

Operation

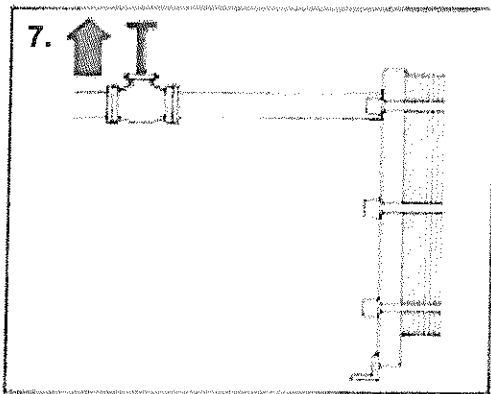
5



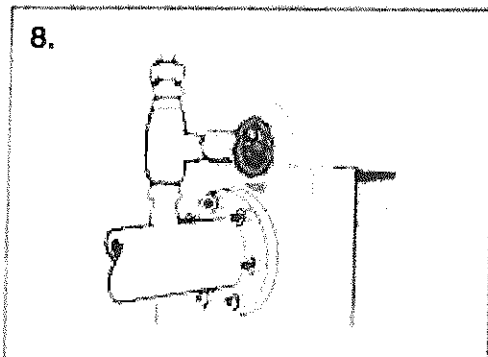
5. Open the vent.



6. Start the Pump.



7. Open the valve slowly.



8. When all air is out, close the vent.

9. Repeat the procedure for the other media.

5

Operation

UNIT IN OPERATION

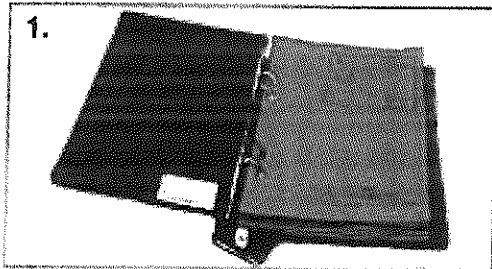
Any adjustment of the flowrates required to maintain correct temperatures or pressure drops should be made slowly, in order to prevent shocks to the system.

Problems in keeping up the performance of the heat exchanger may be caused by a change in some of the temperature conditions, the heat load or by fouling.

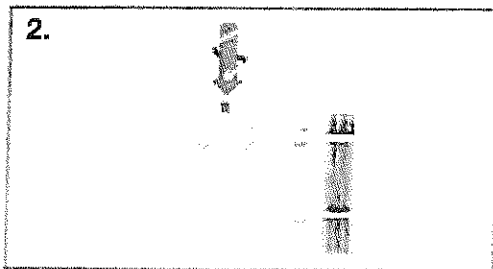
SHUT-DOWN

If the heat exchanger is going to be shut down - or if for any reason the pumps are to be stopped - the following procedure should be followed:

As long as the PHE is operating to satisfaction, it should be left without any interference.



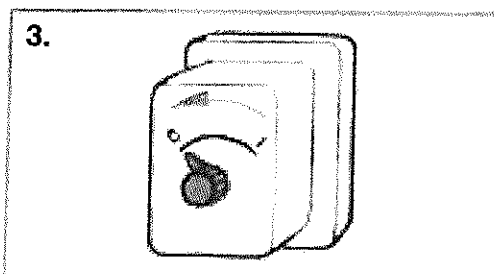
1. First establish whether instructions exist that specify which side should be stopped first.



2. SLOWLY CLOSE THE VALVE controlling the flow rate of the pump you are about to stop.

3. When the valve is closed, stop the pump.

4. Repeat the procedure for the other side.



5. Poor quality cooling water may be hazardous to metallic materials. Typical examples are corrosion of stainless steels and nickel alloys.

If for any reason the heat exchanger is shut down for a longer period (more than a number of days), it should be drained, and depending on the media processed, it is recommendable to rinse and dry it.

THE RISKS OF NOT COMPLYING WITH THE START-UP AND SHUT-DOWN PROCEDURES.

A liquid in motion in a pipe system represents a lot of energy, and it must be very carefully dealt with.

Particularly when the fluid is stopped it is imperative that this is done smoothly.

NOTE!

For this reason fast-closing valves should not be used unless the pipes of the system are very short.

Valves must be operated gradually. The longer the pipes and the higher the flow rate, the more important this becomes.

WATER HAMMER is the name given to a short duration pressure peak, traveling along the pipe as a wave at the speed of sound, and resulting from a sudden deceleration of the motion of the fluid in a closed system.

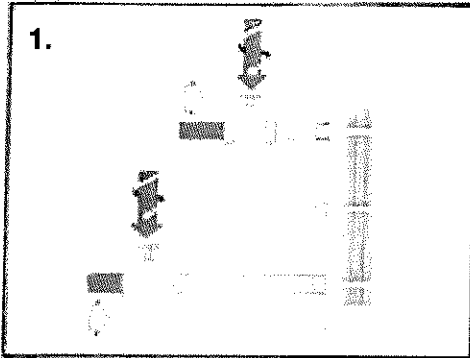
Thus, it is usually related to the shutting down of a system. However, when starting up a system with open valves and empty pipes, the fluid may burst into some obstacle, like a fine mesh strainer, a flow meter or a heat exchanger, causing a sudden reduction of the flow velocity - if not a complete halt, and so we may have the conditions of a Water Hammer.

In the worst case, the pressure surge caused by such a sudden stop of the motion of a fluid, can be several times the normal pressure of the system.

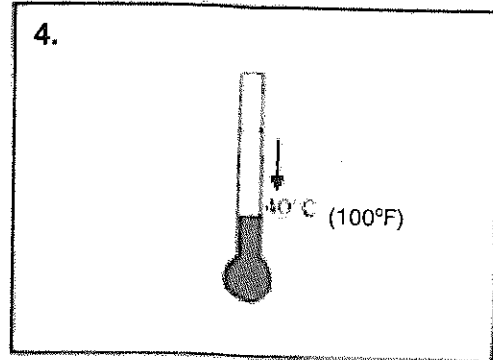
Therefore it is very important for the protection of the whole installation that start-ups and close-downs are carried out with great care.

6

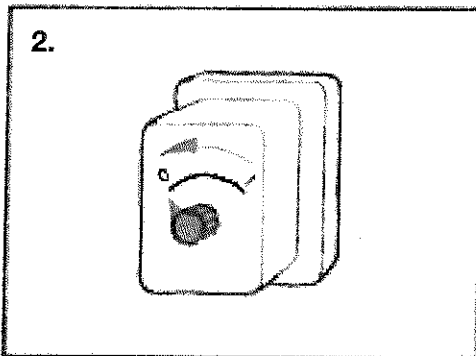
Opening



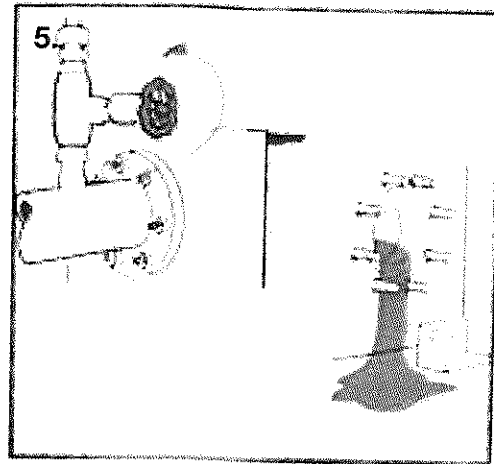
1. Slowly close the valves on the inlets. Shut off the inlet side, closing the highest pressure first.



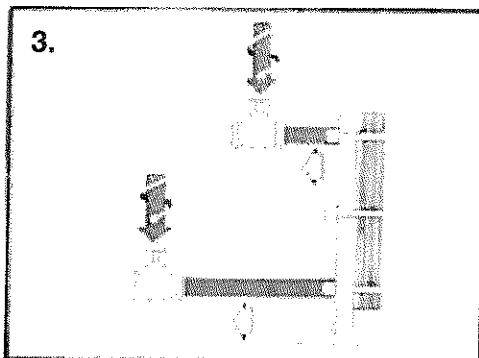
4. If the heat exchanger is hot, wait until it has cooled down to about 40°C (100°F).



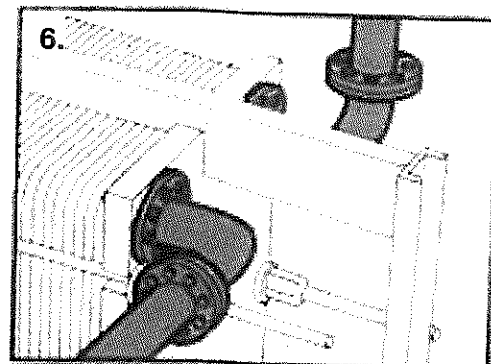
2. Switch off pumps.



5. Drain



3. Close the valves on both outlets.

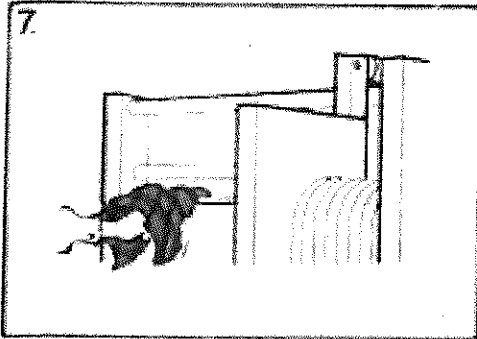


6. Dismantle any pipe bends connected to the pressure plate, so that it can be moved freely along the carrying bar.

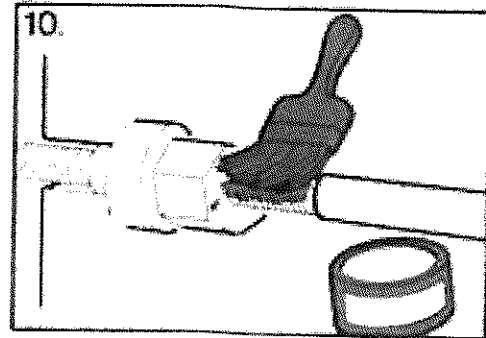
6.1

Opening

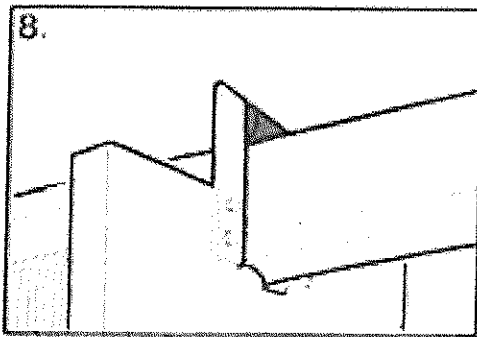
6



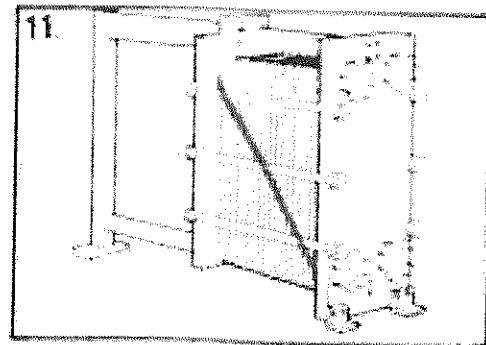
7. Inspect the sliding surfaces of the carrying bar and wipe clean



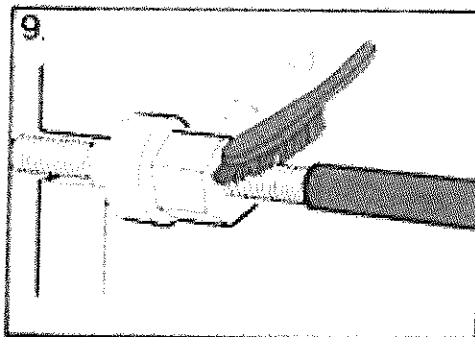
10. Lubricate the threads with a thin layer of grease, e.g LUBRIPLATE FGL-2 or equivalent.



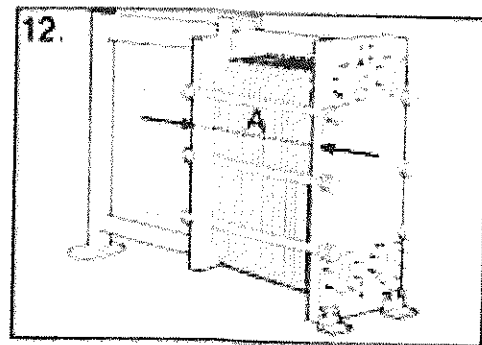
8. Inspect pressure plate roller.



11. Mark the plate assembly on the outside by a diagonal line, or number the plates in sequence.



9. Pull back the plastic covers on the tightening bolts; brush the threads clean with a steel wire brush.



12. Measure and note the dimension A. Compare with code plate and PHE documentation for this same serial number.

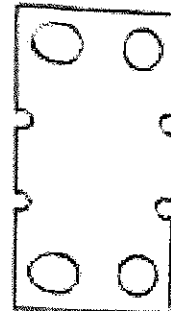
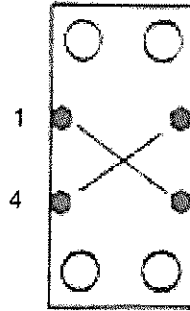
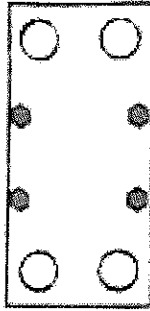
6.2

6

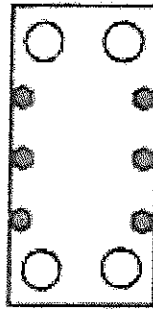
Opening

	P2	A10B	TS6-M	AM10	M10B M10M
FG	X	X	X	X	
FM					X
FD			X		

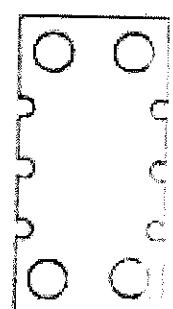
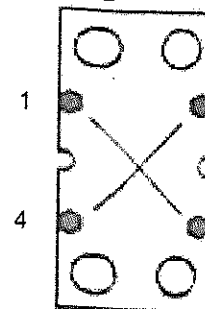
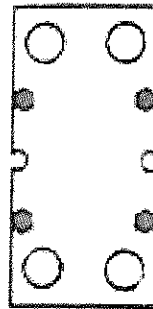
(13) (See page 6.5) (14)



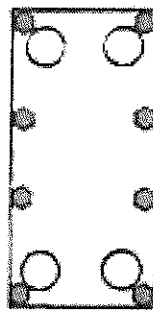
	V8	P3	V13 V20	V28	M10B M10M	M10BW M10DW	M20-M
E		X					
FD			X				
FG			X	X	X	X	
FM							X
VG	X						



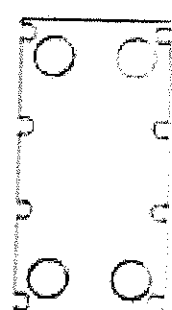
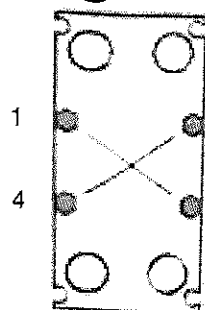
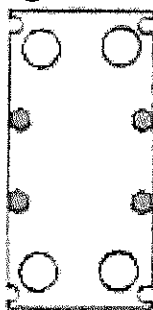
(13) (See page 6.5) (14)



	M3	P2	P3	V28	V45
EH				X	
VG	X				
VLCH		X			
FG				X	X
FD				X	X

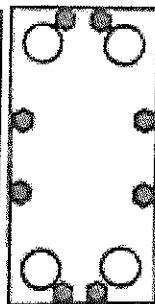


(13) (See page 6.5) (14)

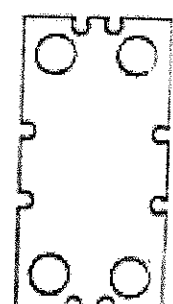
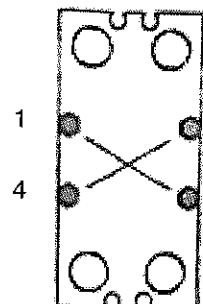
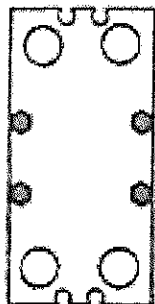


	MX25B	A15BWA	15B	TS20-M	AM20 AM20B AM20W AM20S AM20DW	M6 M6M	M15M
FG		X	X	X	X	X	X
FD		X	X	X	X	X	X
FL			X				
FM	X		X	X			X
FS			X	X			

M6/M6-MFG & MX25-BFM ONLY HAS ONE BOLT TOP AND BOTTOM



(13) (See page 6.5) (14)

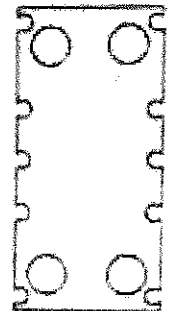
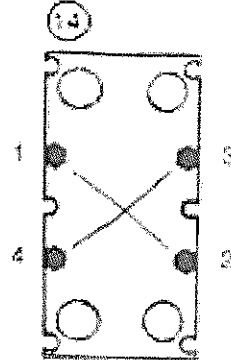
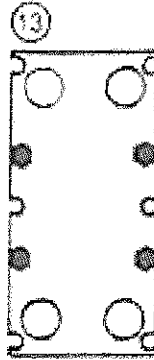
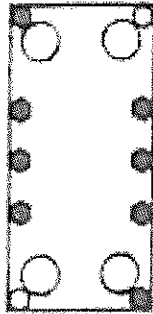


Opening

6

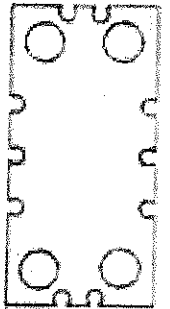
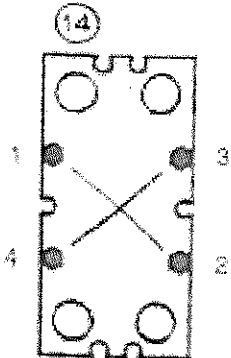
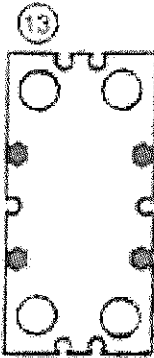
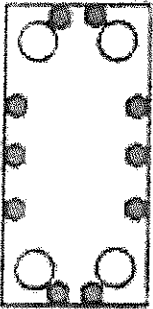
	M20-M			
FG				

M20-MFG ONLY HAS ONE BOLT TOP AND BOTTOM

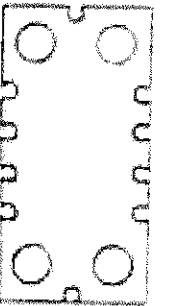
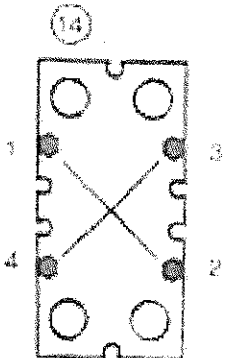
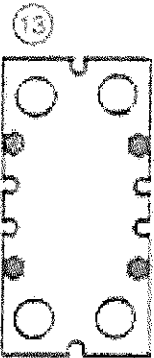
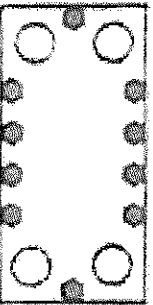


	M15B M15F	A20B	T200	M6 AK20 M6DW	M6M M30
FG		X	X		
FD				X	
FM					X
FS	X				

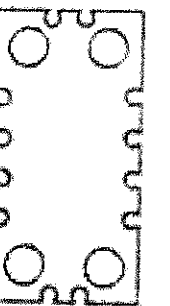
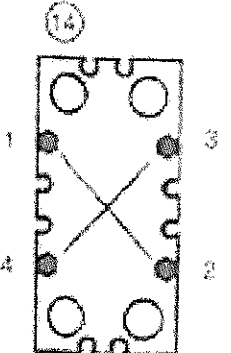
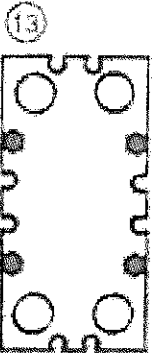
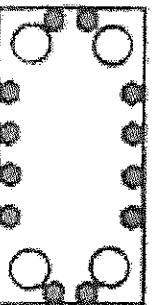
M6/M6-MFG ONLY HAS ONE BOLT TOP AND BOTTOM



	M10B M10M	M10BW		
FD	X	X		



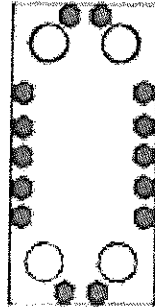
	A20B	AK20 T200	MX25B	V110
FD	X	X		
FL	X			
FG			X	X



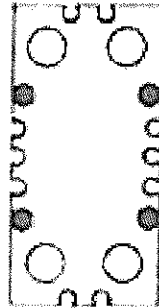
6

Opening

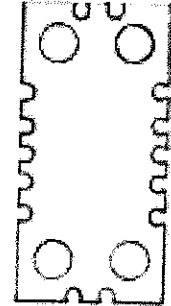
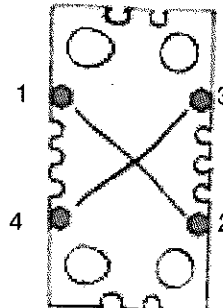
	AX30B AX30BW	V110		
FG FD	X	X		



13

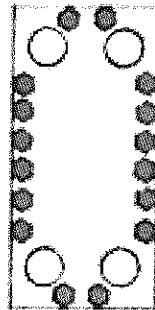


14

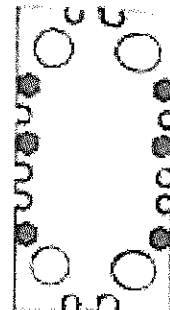


	AX30B AX30BW	A35 A45	AX35	M20M	M30	MX25B	V170 V280
FG FD HA FS	X	X	X	X	X	X	X

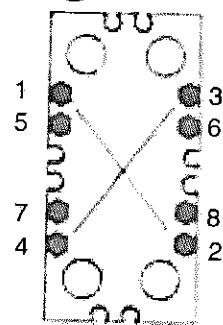
NOTE: M30-FD, MA30-FG/FD, MX25-BFS, V280-FG/FD and V170-FD have a twenty bolt or larger pattern, use this picture only as a guide. Start sequence numbers 5 and 6 at the fourth bolt down on both sides.



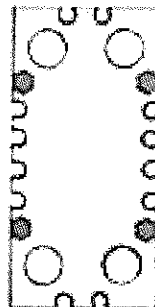
13



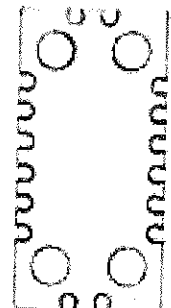
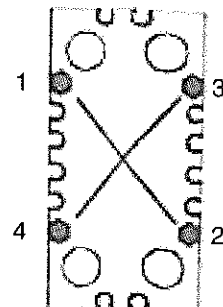
14



15



16



ORDER	BOLT NO.	TO DIM.
1	1-2-3-4-5-6	1.05A
2	1-2-3-4	1.10A
3	1-2 OR 3-4	OPENING

13 If bolts are fitted with bearing boxes loosen and remove them. If not fitted with bearing boxes, then follow the pictures above.

14 Loosen the remaining bolts, alternately and diagonally, to bring length to 1.05A.

15 Remove bolts 5 and 6 completely.

16 Continue opening, alternately and diagonally.

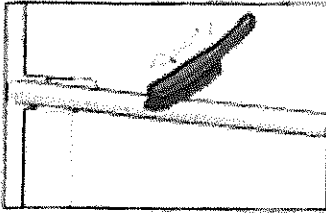
Note: Skewing of the Pressure Plate during opening must not exceed 10 mm (2 turns per bolts) across the width and 25 mm (5 turns per bolts) vertically.

6.5

Removal and insertion of plates

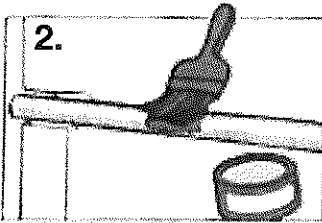
6

1.

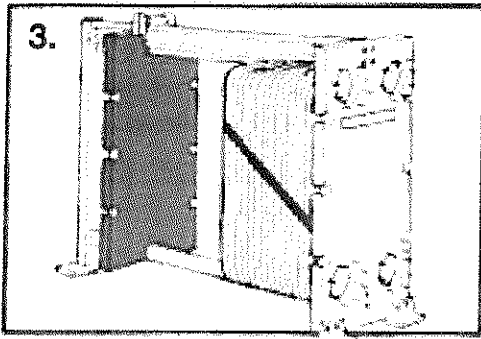


Brush the threads of the bolts clean, using a steel wire brush

2.



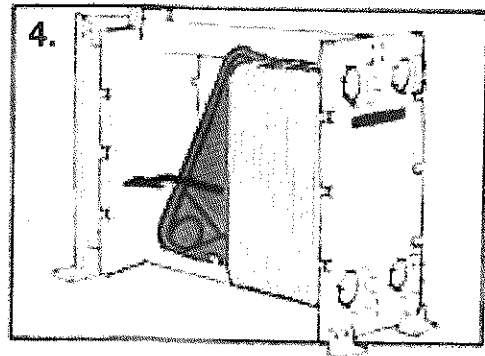
Lubricate the threads with a thin layer of grease, e.g. LUBRIPLATE FGL-2 or equivalent.



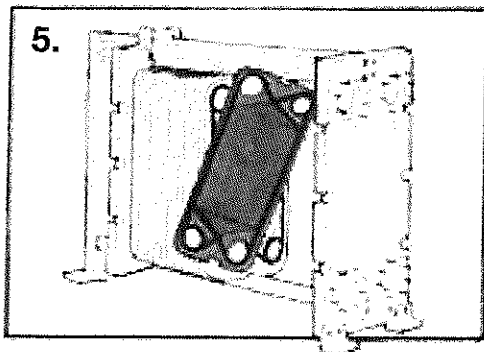
REMOVAL OF PLATES

3. Push the pressure plate against the support column.

4. Remove the plates. Stack them neatly on a skid or pallet for easy transporting.



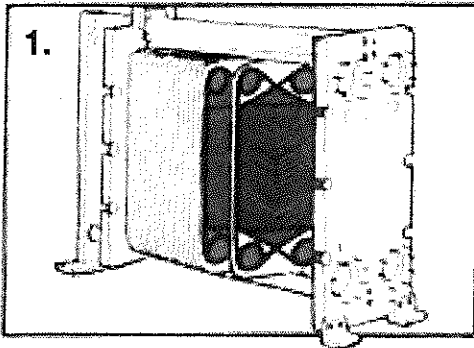
INSERTION OF PLATES



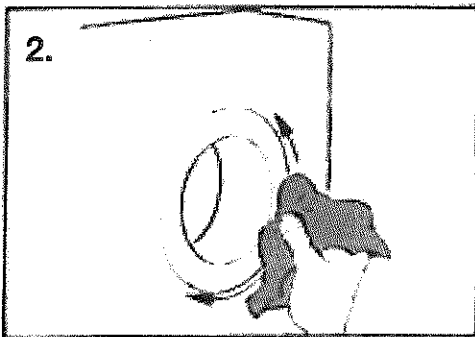
5. Hang the plates with their backs towards the pressure plate (the side without gasket).

6

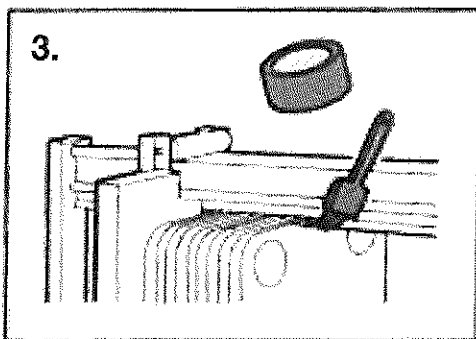
Closing



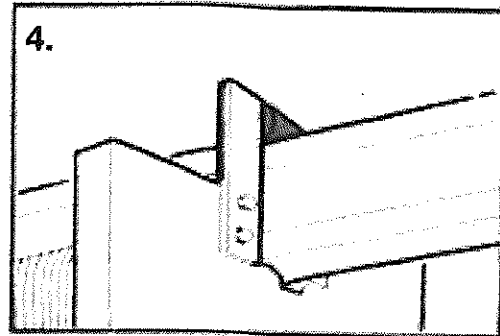
1. Check that all the sealing surfaces (i.e. surfaces in contact with the heat transfer medium) are clean.



2. Check that the ring gaskets or liners, when fitted in connections, are in position and are in good condition.

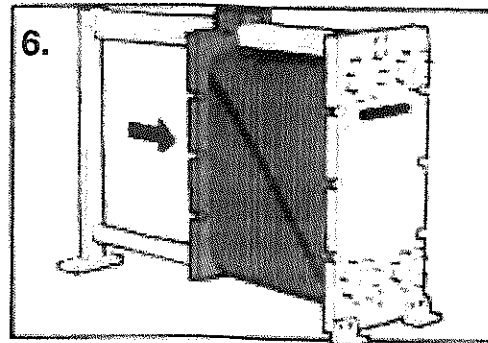


3. Clean and lubricate the sliding surfaces of the carrying bar.

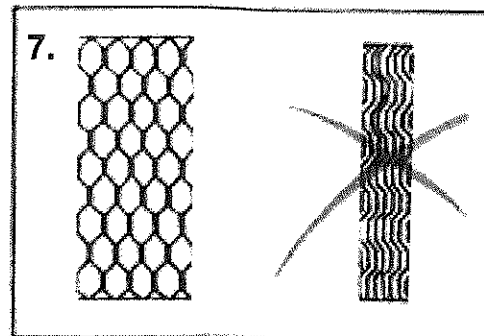


4. Inspect the pressure plate roller. Remove any debris from top surface of carrying bar.

5. Check against the drawing or flow sheet (provided with each heat exchanger) to make sure that the plates are hanging in the correct order.



6. Press the plate assembly together.



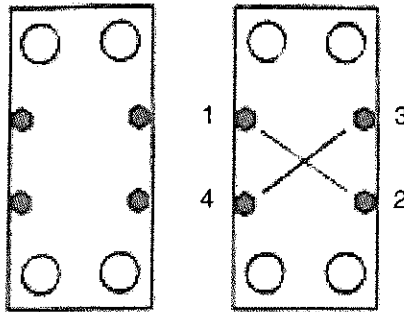
7. If the plates are correctly assembled, the edges form a "honeycomb" pattern.

If the plate pack has been marked on the outside (fig. 6) check this.

Closing

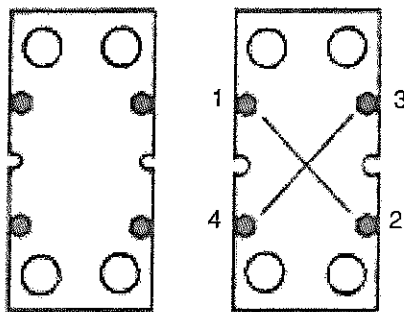
	P2	A10B	TS6-M	AM10	M10B M10M
FG	X	X	X	X	
FM					X
FD			X		

⑧ (See page 6.11) ⑪

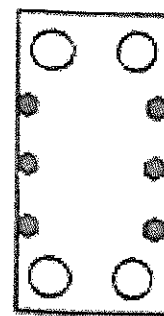


	V8	P3	V13 V20	V28	M10B M10M	M10BW M10DW	M20-M
E		X					
FD			X				
FG			X	X	X	X	
FM							X
VG	X						

⑧ (See page 6.11) ⑪

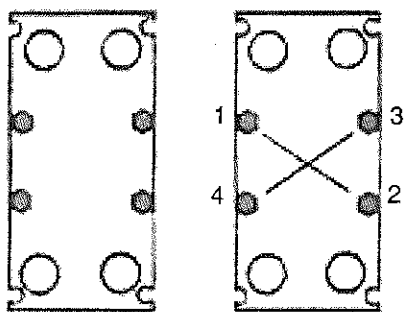


⑭ (See page 6.11)

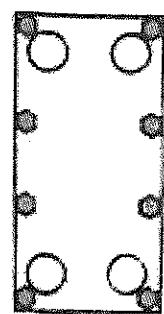


	M3	P2	P3	V28	V45
EH					
VG	X				
VLCH		X			
FG			X		
FD				X	X

⑧ (See page 6.11) ⑪

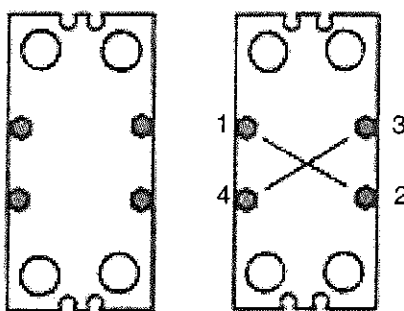


⑭ (See page 6.11)

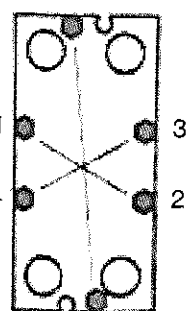


	MX25B	A15BW	A15B	TS20-M	AM20 AM20B AM20W AM20S AM20DW	M6 M6M	M15M
FG		X	X	X	X	X	X
FD		X	X	X			X
FL			X				
FM	X			X			X
FS				X			

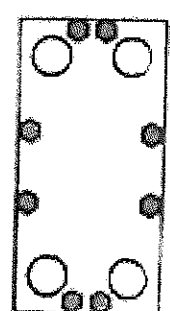
⑧ (See page 6.11) ⑪



⑭ (See page 6.11)



M6/M6-MFG & MX25-BFM ONLY HAS ONE BOLT TOP AND BOTTOM



6

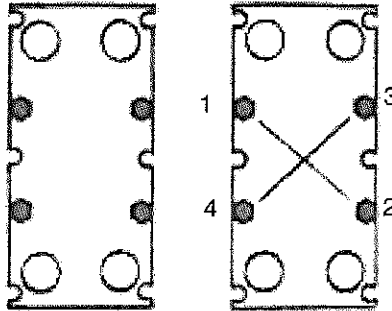
6

Closing

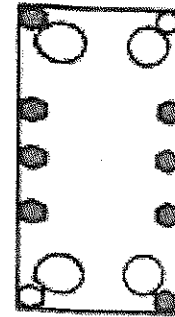
	M20-M			
FG				

M20-MFG ONLY HAS ONE BOLT TOP AND BOTTOM

⑧ (See page 6.11) ⑪



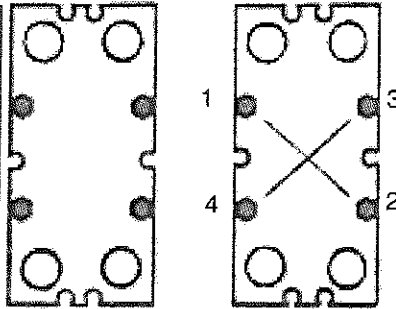
⑭ (See page 6.11)



	M15B M15F	A20B	T200	M6 AK20 M6DW	M6M M30
FG		X	X		
FD				X	
FM					X
FS	X				

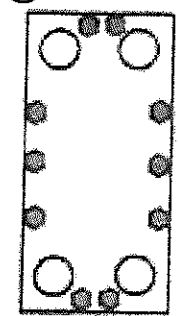
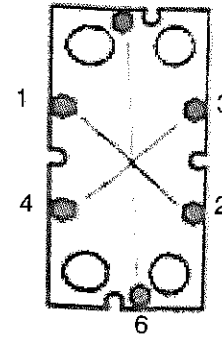
M6/M6-MFG ONLY HAS ONE BOLT TOP AND BOTTOM

⑧ (See page 6.11) ⑪



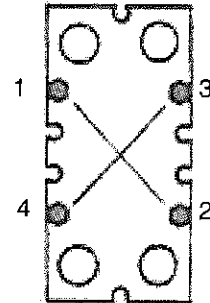
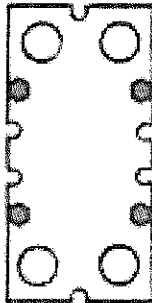
5

⑭ (See page 6.11)



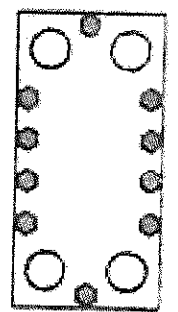
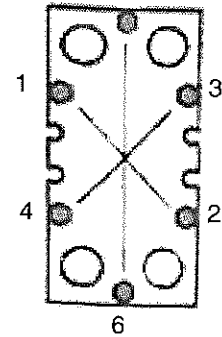
⑧ (See page 6.11) ⑪

	M10B M10M	M10BW		
FD	X	X		



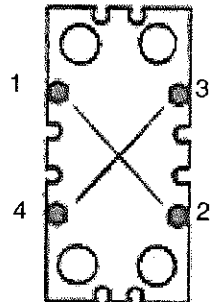
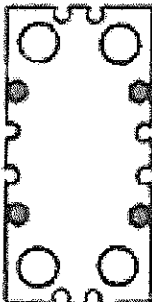
5

⑭ (See page 6.11)



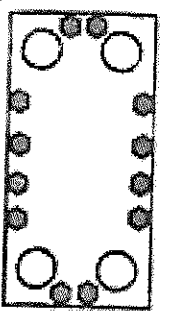
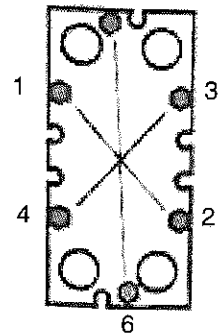
⑧ (See page 6.11) ⑪

	A20B	AK20 T200	MX25B	V110
FD	X	X		
FL	X			
FG			X	X



5

⑭ (See page 6.11)

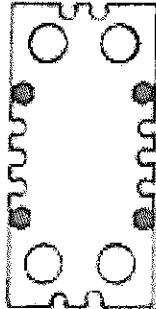


Closing

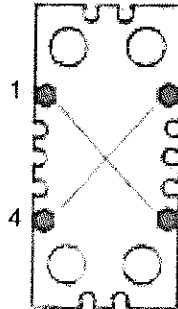
6

	AX30B AX30BW	V110		
FG FD	X	X		

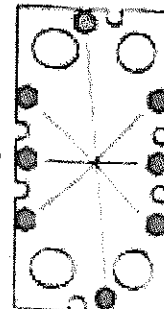
8



11

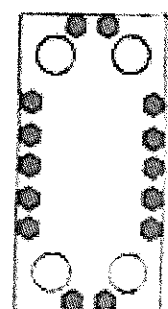


7



8

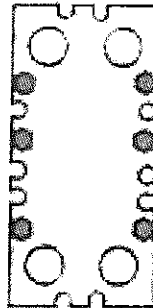
14



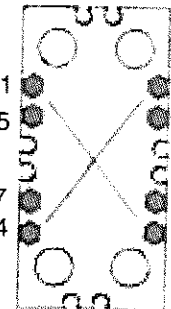
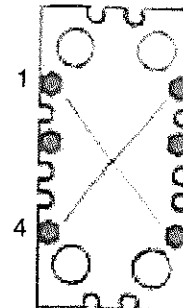
	AX30B AX30BW	A35 A45	AX35	M20M	M30	MX25B	V170 V280
FG FD HA FS	X	X	X	X	X	X	X

NOTE: M30-FD, MA30-FG/FD, MX25-BFS, V280-FG/FD and V170-FD have a twenty bolt or larger pattern, use this picture only as a guide. Start sequence numbers 5 and 6 at the fourth bolt down on both sides.

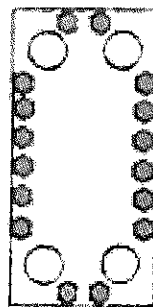
8



11



14

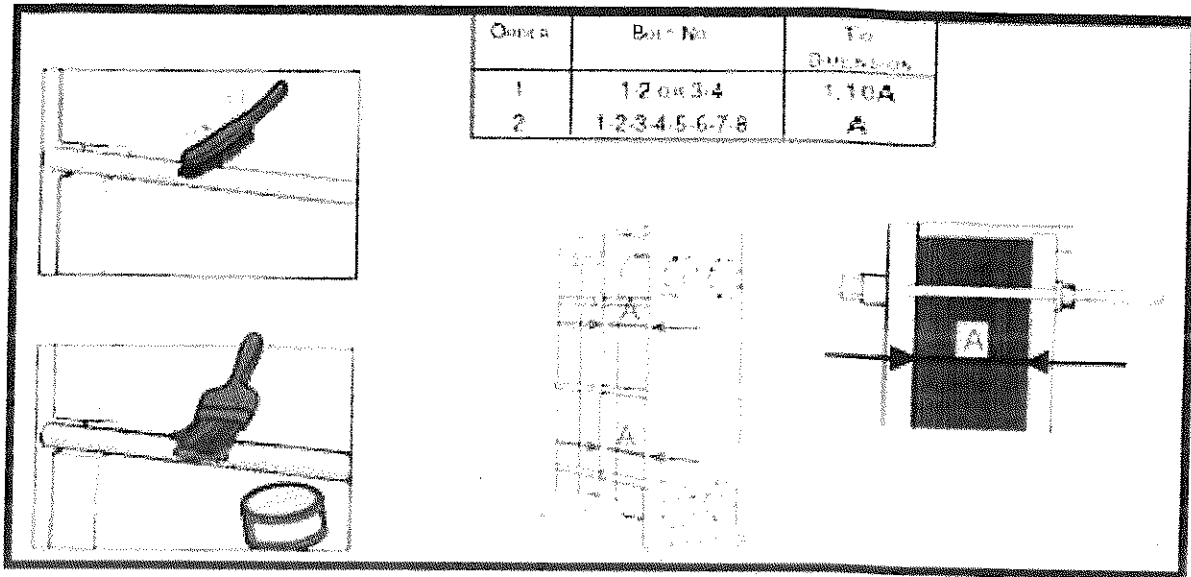


ORDER	BOLT NO.	TO DIM.
1	1-2-3-4-5-6	1.05A
2	1-2-3-4	1.10A
3	1-2 OR 3-4	OPENING

Note: See next page for closing instructions for all the models

6

Closing



8. Place all the bolts that are fitted with bearing boxes in position. If not fitted with bearing boxes then follow the pictures for your specific model.
9. Brush the threads of the bolts clean, using a steel wire brush.
10. Lubricate the threads with a thin layer of grease, e.g. LUBRIPLATE FGL-2 or equivalent.
11. Tightening is carried out alternately and diagonally, as shown on the figure above.
12. Check the dimension A during tightening at the positions of the bolts that are being used. Skewing of the pressure plate during tightening must not exceed 10mm (2 turns per bolt) across the width and 25 mm (5 turns per bolt) vertically.
13. Nominal plate pack length A can be exceeded in exceptional cases, the tightening can be stopped at the following dimensions
14. Place the other bolts in position.
 - Inspect the washers.
 - When fully tightened, the bolts should all be equally tensioned.
 - The difference between the plate pack lengths measured at adjacent bolts should not exceed:
 - 2mm when dimension A is < 1000mm
 - 4mm when dimension A is > 1000mm
 - The plate pack length at all bolts must not differ by more than 1%
 - If the unit does not seal fully, it can be tightened to the dimension A-1%.

IF DIMENSION A IS NOT REACHED WITH APPLICATION OF THE ABOVE STEPS:

- Check the number of plates and dimension A.
- Check that all the nuts and bearing boxes are running freely. If not, clean and lubricate or replace.
- Fit all the bolts, and tighten alternately.

Plate pack length/plate	Plate pack length
> 4 mm	A + 1%
> 3mm, < 4mm	A + 1.5%

Chlorine as growth inhibitor

Chlorine, commonly used as growth inhibitor in cooling water systems, reduces the corrosion resistance of stainless steels (including Hastelloy, Incoloy, Inconel and SMO).

Chlorine weakens the protection layer of these steels making them more susceptible to corrosion attacks than they otherwise should be. It is a matter of time of exposure and concentration.

In every case where chlorination of non-titanium equipment cannot be avoided, ALFA LAVAL must be consulted.

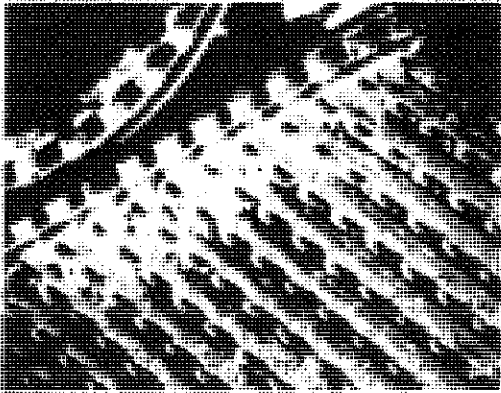
Contact the following address:

ALFA LAVAL
Heat Transfer Center
5400 International Trade Drive
Richmond, VA 23231
Phone (804) 222-5300
Fax (804) 236-3276

NOTE! Titanium is not affected by chlorine.

7

Cleaning

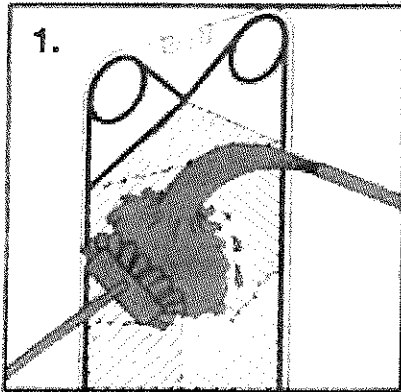


INCRUSTATION - SCALING

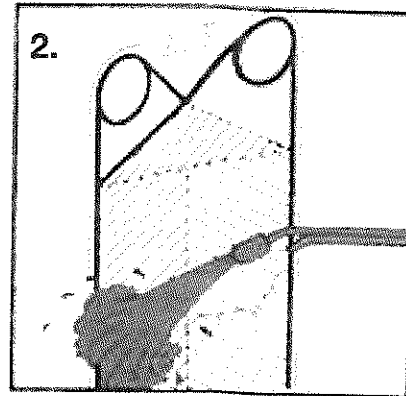
- Calcium carbonate
- Calcium sulphate
- Silicates

CLEANING

Mechanical cleaning after opening.



1. Soft brush and running water.
NOTE! Avoid gasket damage.



2. High pressure hose.

3. Chemical cleaning of opened unit by using:

- Nitric acid
- Sulfamic acid
- Citric Acid
- Phosphoric acid
- Complexing agents (EDTA, NTA)
- Sodium polyphosphates

Concentration max 4% by wt%
Temperature max 140° F

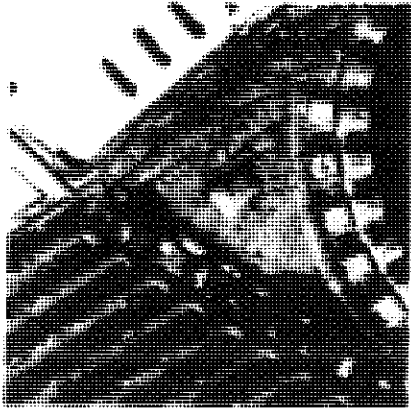
NOTE!

Under no circumstances should HYDROCHLORIC ACID be used with STAINLESS STEEL PLATES and under no circumstances should HYDROFLUORIC ACID be used with TITANIUM PLATES. Water of more than 300 ppm Chlorine may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns made of aluminum are protected against chemicals.

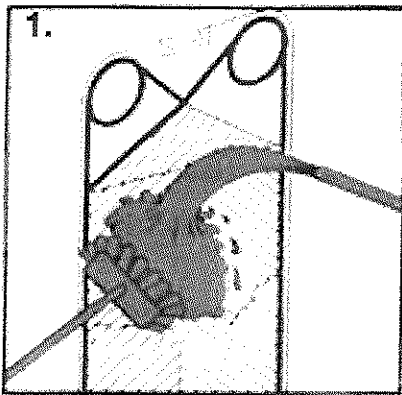
7.1

Cleaning



CLEANING

Mechanical cleaning after opening.

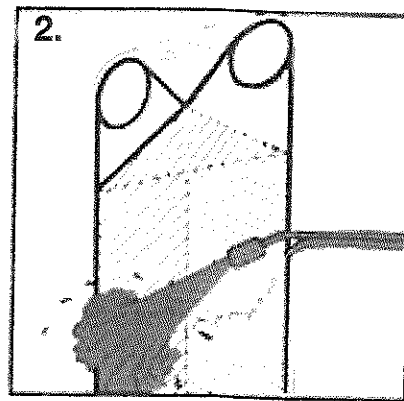


1. Soft brush and running water.
NOTE! Avoid gasket damage.
3. Chemical cleaning of opened unit by using:
 - Nitric acid
 - Sulfamic acid
 - Citric Acid
 - Phosphoric acid
 - Complexing agents (EDTA, NTA)
 - Sodium polyphosphates

Concentration max 4% by wt%
Temperature max 140° F

SEDIMENT

- Corrosion products
- Metal Oxides
- Silt
- Alumina
- Diatomic organisms and their excrement of various colors.



2. High pressure hose.
4. The addition of surfactants can improve cleaning effect.

NOTE!

Under no circumstances should HYDROCHLORIC ACID be used with STAINLESS STEEL PLATES and under no circumstances should HYDROFLUORIC ACID be used with TITANIUM PLATES. Water of more than 300 ppm Chlorine may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns made of aluminum are protected against chemicals.



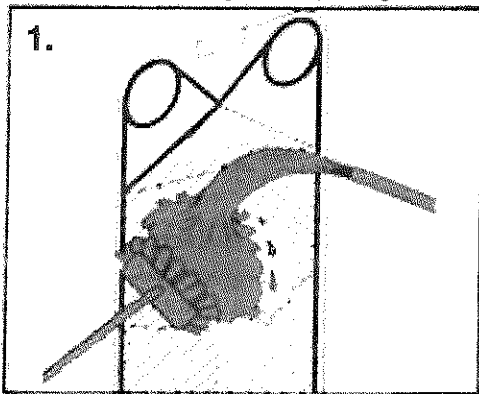
GROSS FOULING

- Seaweeds
- Wood chips/fibers
- Mussels
- Barnacles

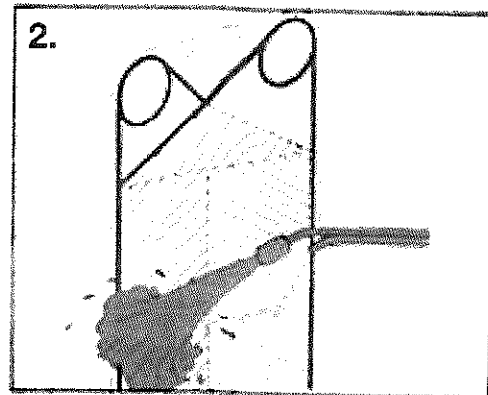
CLEANING:

NOTE: BACKFLUSHING OF THE UNOPENED HEAT EXCHANGER CAN SOMETIMES BE SUFFICIENTLY EFFECTIVE.

Mechanical cleaning after opening.



1. Soft brush and running water.
NOTE! Avoid gasket damage.



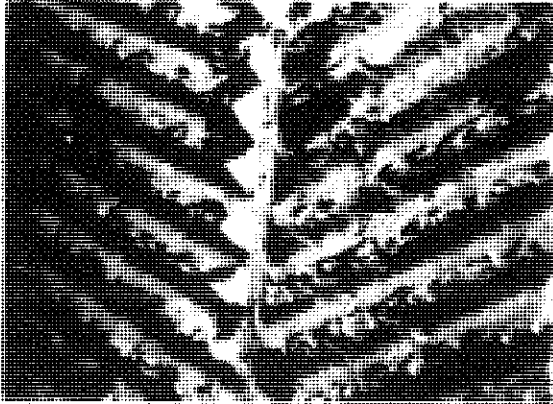
2. High pressure hose.

NOTE!

Under no circumstances should HYDROCHLORIC ACID be used with STAINLESS STEEL PLATES and under no circumstances should HYDROFLUORIC ACID be used with TITANIUM PLATES. Water of more than 300 ppm Chlorine may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns made of aluminum are protected against chemicals.

Cleaning

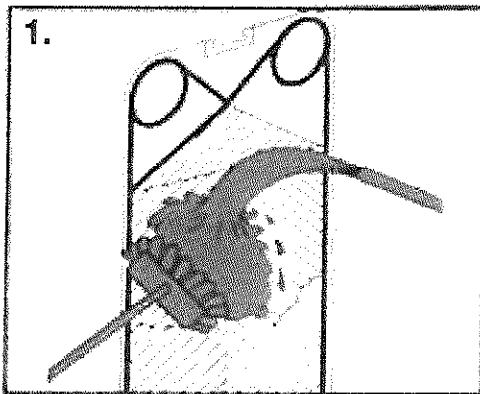


BIOLOGICAL GROWTH - SLIME

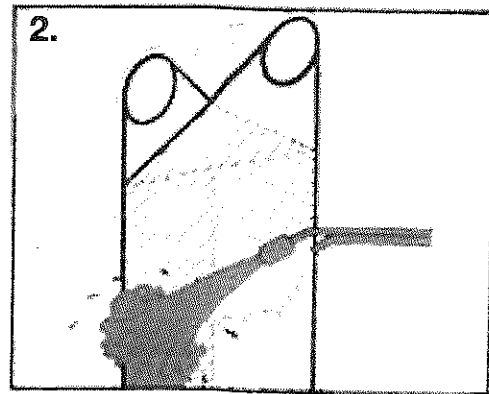
- Bacteria
- Nematodes
- Protozoa

CLEANING

Mechanical cleaning after opening.



1. Soft brush and running water.
NOTE! Avoid gasket damage.



2. High pressure hose.

3. Chemical cleaning of opened unit by using:

- Nitric acid
- Sulfamic acid
- Citric Acid
- Phosphoric acid
- Complexing agents (EDTA, NTA)
- Sodium polyphosphates

Concentration max 4% by wt%
Temperature max 140° F

NOTE!

Under no circumstances should HYDROCHLORIC ACID be used with STAINLESS STEEL PLATES and under no circumstances should HYDROFLUORIC ACID be used with TITANIUM PLATES. Water of more than 300 ppm Chlorine may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns made of aluminum are protected against chemicals.

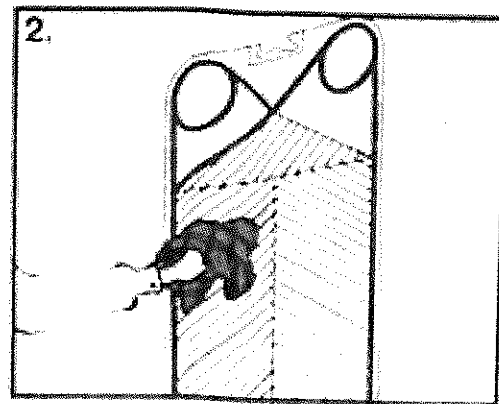
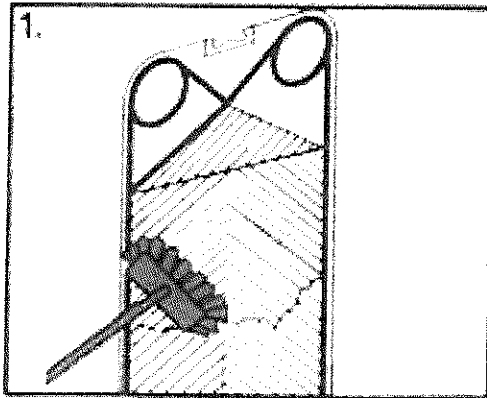
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Cleaning

- Oil residues
- Asphalt
- Fats

CLEANING

Mechanical cleaning after opening.



1. Hydrocarbon-based deposits may be removed by using a soft brush and a PARAFFINIC or NAPHTHA-BASED solvent (e.g. KEROSENE).

2. Dry with a cloth or rinse with water.

NOTE!

Gaskets in natural, butyl and EPDM rubber swell in these media.

Contact time should be limited to 0.5 hour.

THE FOLLOWING SOLVENTS SHOULD NOT BE USED

- Ketones (e.g. Acetone, Methyl ethyl ketone, Methyl isobutyl ketone)
- Esters (e.g. Ethyl acetate, Butyl acetate)
- Halogenated hydrocarbons (e.g. Chloroethene, Carbon tetrachloride, Freons)
- Aromatics (e.g. Benzene, Toluene)

Regasketing

ALFA LAVAL has two types of glue for field repairs - GC11 and GC8 for repairs and exchange of gaskets in plates. A special glue is recommended for viton and silicone gaskets.

GC11

- A two-component, cold curing epoxy glue which gives a strong joint for higher temperatures.
- Future removal of gaskets usually requires heating or freezing of the joint.
- The shelf life is limited to approx. 1 year when stored at room temperature but can be prolonged when kept in a refrigerator.

GC8

- A single-component rubber-based solvent adhesive.
- Is normally used for repair work in an uncured condition.
- Can be used for operating temperatures below 200 F
- For operating temperatures above 200° F and oil coolers/heaters, the glued joints should be cured at 200° F for one hour.
- Future removal of the gasket can usually be carried out without heating of the cement joint.
- The storage life at room temperature is about two years. This period can be extended after checking the glue.

SEPARATE GLUING INSTRUCTIONS WILL BE
DELIVERED TOGETHER WITH THE GLUE.

ALFA LAVAL RECONDITIONING SERVICE

In addition to supplying genuine gaskets for your plate heat exchangers, we are able to provide a "SPECIALIZED PLATE RECONDITIONING SERVICE" to quickly and efficiently meet your service requirements.

Our reconditioning service includes a liquid nitrogen debonding process with chemical cleaning, crack detection and regasketing using a special epoxy/phenolic resin adhesive.

This regasketing process requires special oven curing of the cement to ensure the strongest

possible bond strength between plate and gasket, similar to the process used during manufacture. This is one reason why our service is guaranteed.

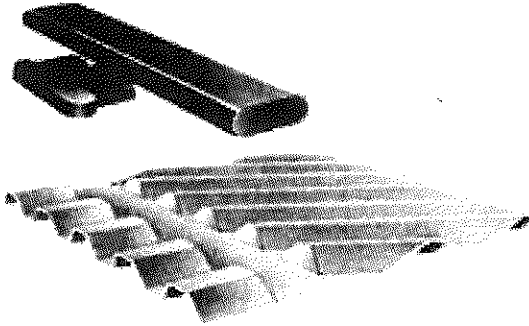
In most cases our reconditioning service has proved more economical and much faster when compared with on-site regasketing methods.

For further details, please contact your local ALFA LAVAL REPRESENTATIVE.
(See Section 1)

7

Regasketing

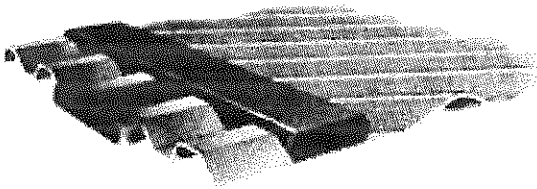
The Clip-on gasket - a glue-free gasket system



The Clip-on gasket is attached to the plate by two gasket prongs which slip under the edge of the plate to hold the gasket securely in alignment in the gasket groove.

The prongs are situated at regular intervals around the periphery of the plate.

When the plate heat exchanger is then assembled and tightened, the gasket provides a tight seal around the plate.



The Clip-on gasket in the gasket groove.

NOTE!

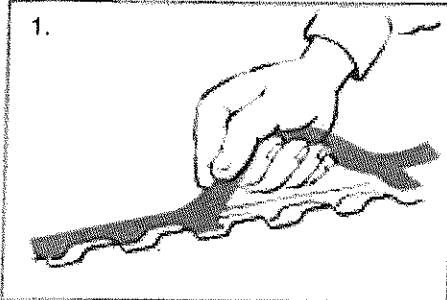
**Before closing of the equipment:
Check that the two gasket prongs
are in correct position.**

Regasketing of Snap-On Gaskets

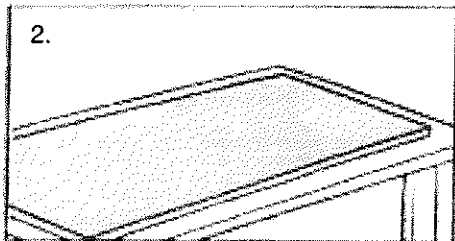
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THE PROCEDURES (2-7) ARE NOT NECESSARY FOR DOING A SMALL QUANTITY OF PLATES. THESE PROCEDURES WILL INCREASE SPEED OF REGASKETING OF LARGE QUANTITIES OF PLATES.

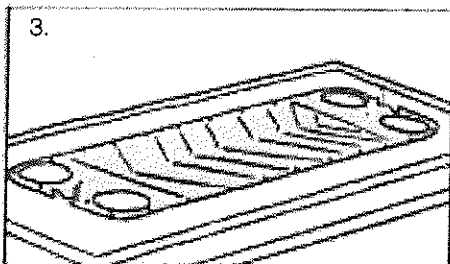
PREPARATORY PROCEDURES



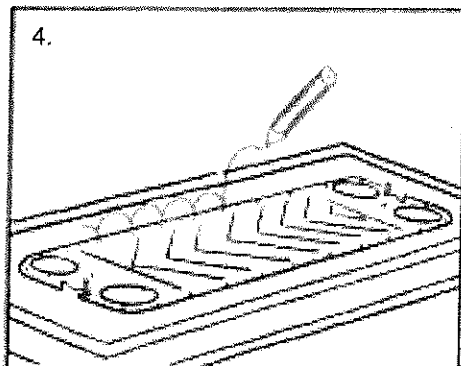
1. Pull the old gasket off the plate and clean the groove, if necessary.



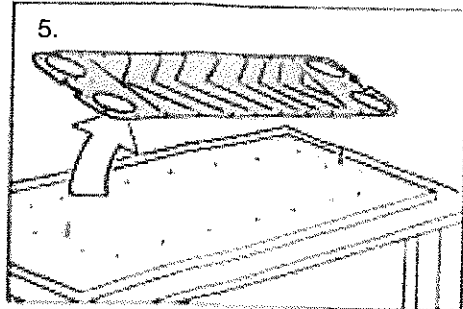
2. Place a flat sheet of plywood (somewhat larger than the PHE plate) on the table.



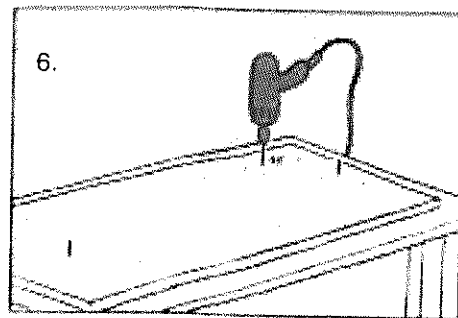
3. Place the PHE plate on the board with gasket groove upwards and fix firmly. Placing cylindrical pins in the plank at the carrying bar slots.



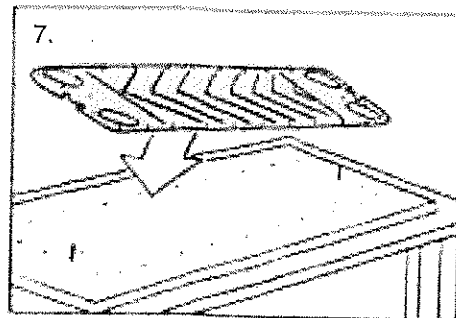
4. Make marks in the plank at all locations for gasket "snap-on".



5. Remove the plate.



6. Drill holes approx. 7mm dia and 10 mm deep in the plank at the marked spots. The plank is now a practical tool for regasketing of larger numbers of plates.

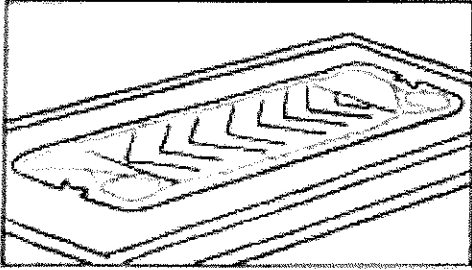


7. Replace PHE plate on the board in exactly the same location as at 3 above.

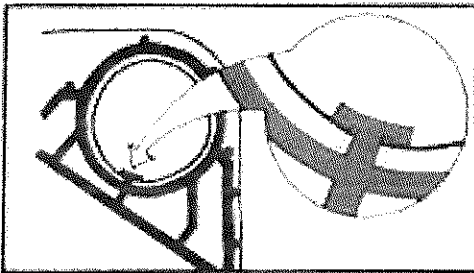
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Regasketing of Snap-On Gaskets

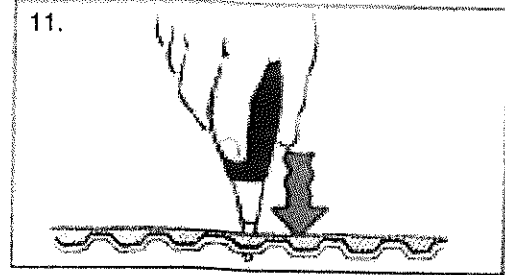
FASTENING OF THE "SNAP-ON" GASKET



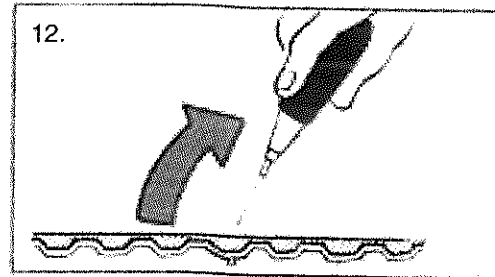
8. Place the gasket, with the "snap-on" projections downwards, in the gasket groove.



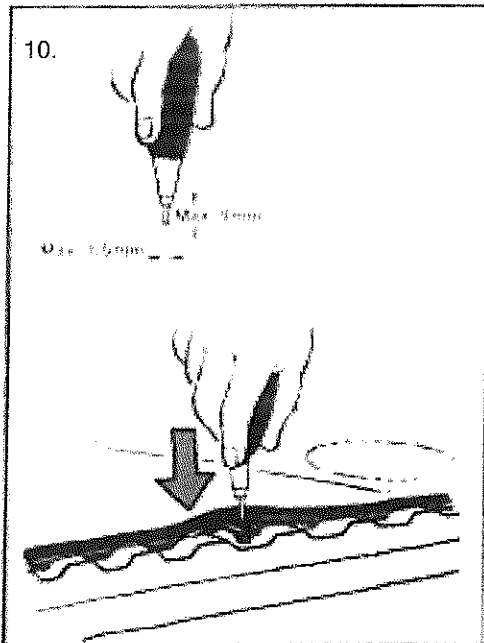
9. Place the ring gaskets in the groove and fix them with the T-flap.



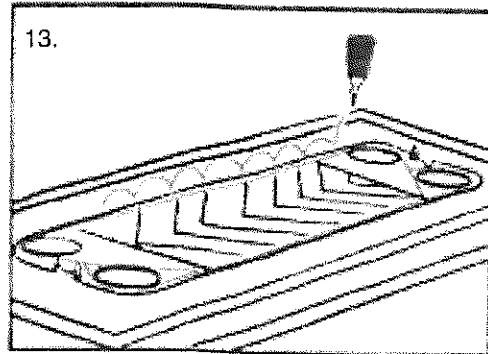
11. Push the projection through the hole in the plate.



12. Remove the tool point, and the projection is now "snapped on".



10. Insert the tool point into the recess in the projection.

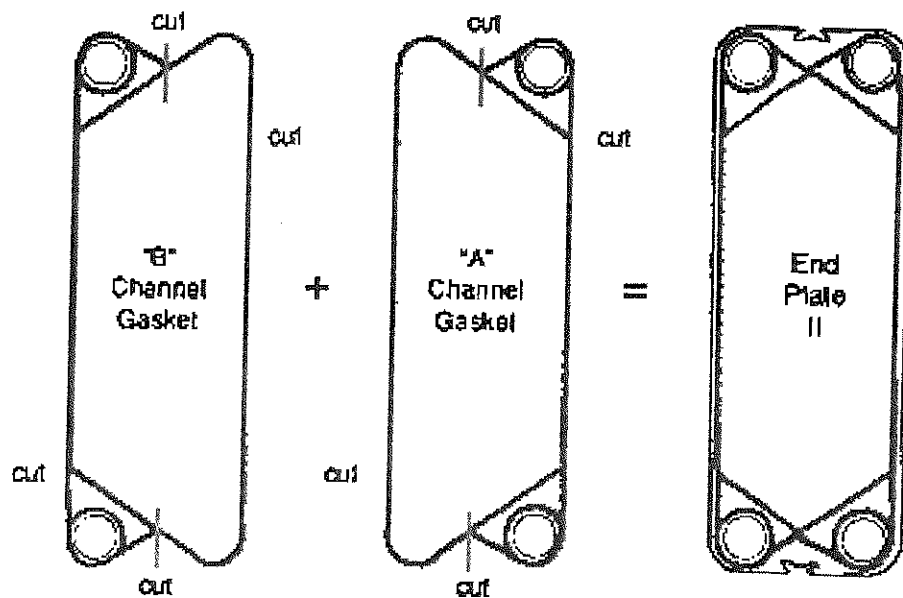


13. Repeat for all projections, and the gasket is "snapped on".

NOTE!
BEFORE CLOSING OF THE EQUIP-
MENT: CHECK THAT THE T-FLAPS
ARE IN CORRECT POSITION.

PARALLEL FLOW UNITS

The End Plate II Gasket is formed by cutting (2) channel gaskets (as shown below) and gluing the gaskets to the first plate.

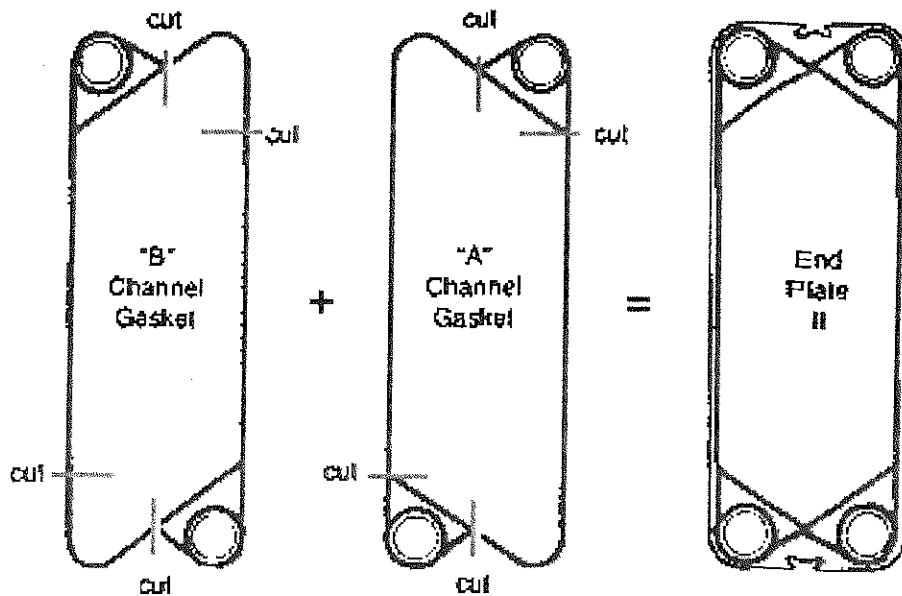


The (2) half channel gaskets should be glued to the end plate with GC-8 glue; or double sided tape (GC-1). The (4) port gasket areas are critical because these gaskets will be in contact with the process fluids.

7

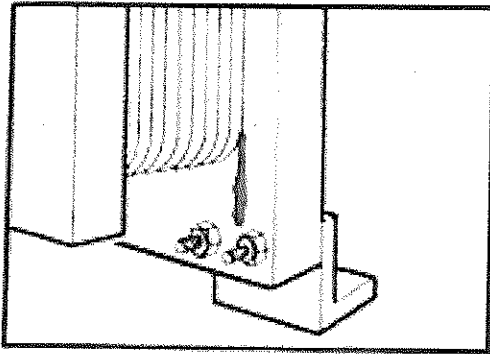
DIAGONAL FLOW UNITS

The End Plate II Gasket is formed by cutting (2) channel gaskets (as shown below) and gluing the gaskets to the first plate.



The (4) parts of the channel gaskets should be glued to the end plate with GC-8 glue; or double sided tape (GC-1). The (4) port gasket areas are critical because these gaskets will be in contact with the process fluids.

Fault detection



SYMPTOM
LEAKAGE between plates and frame.

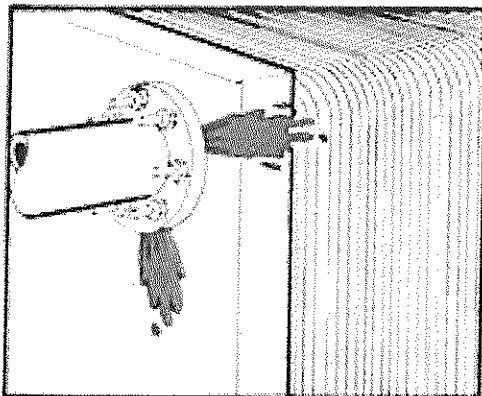
ACTION

Mark with a felt tip or similar marker, mark the area where the leakage seems to be, and open the heat exchanger

1. Investigate the gasket condition of the end plate and the connection if applicable, look for dislocation, foreign objects, scars and other damage to the gasket surfaces.
2. Check the surface of the pressure plate for unevenness, foreign objects sticking to it, etc. that might spoil the joint between the gasket and the adjacent surface.
3. Check the plate itself for cracks or holes.

CORRECTIONS

1. • Relocate gasket.
 - remove foreign matter.
 - replace connection lining if applicable.
- Remove anything disturbing the joint between gasket and pressure plate surface.
- A perforated end plate must be replaced.



SYMPTOM
LEAKAGE between flange and frame.

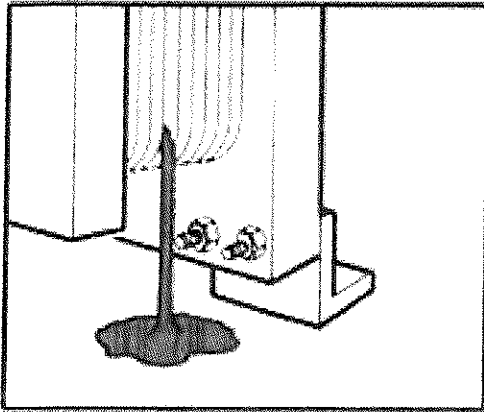
ACTION

1. Disconnect the flange, and look for misalignment between flange and connection, dislocated or damaged gasket, foreign objects on the surface of the gasket or the flange.

CORRECTIONS

1. • Rearrange the pipe in order to eliminate stress and to correct alignment.
 - relocate gasket
 - replace damaged gasket
 - replace connection lining if applicable
 - remove foreign matter from flange and gasket
 - reassemble, taking care to avoid misalignment

NOTE: On a Plate Heat Exchanger specially designed for high temperature duties, extreme and sudden temperature drops may sometimes cause a temporary leakage. A typical example is a sudden shutting-off of the hot medium flow. The heat exchanger will normally seal again, as soon as the temperatures of the equipment have stabilized.



SYMPTOM

LEAKAGE between plates to the outside.

ACTION

Mark the leakage area with a felt tip marker on the two plates next to the leakage, check and note the length of the plate pack between inside frame plate and inside pressure plate, and then open the heat exchanger.

1. Check for loose, dislocated or damaged gasket.
2. Check for plate damage in the area, and also check plate pack length against the drawing to see if possible plate or gasket damage could be caused by overtightening of the plate pack, or if the leakage itself may simply be caused by insufficient tightening.
3. Check hanger recess at both plate ends for deformations, which could cause misalignment between the plates.
4. Make sure that the plates are hanging correctly as A-B-A (see SECTION 4A or 4B).
5. Check for perforation of the plate (corrosion).

CORRECTIONS

1.
 - Relocate gasket.
 - Re-cement loose gasket, if applicable.
 - Replace damaged gasket.
2. A damaged plate must in most cases be taken out for repair or replacement. If it is a regular plate with 4 holes: take the damaged plate and the 4-hole plate just in front or just behind it out of the plate pack. The heat exchanger can now be reassembled and put back in service PROVIDED THE PLATE PACK IS TIGHTENED TO A NEW MEASUREMENT, WHICH IS EQUAL TO THE ONE ON THE DRAWING, REDUCED BY TWO TIMES THE SPACE REQUIRED PER PLATE. CONTACT ALFA LAVAL FOR ASSISTANCE IN THE RECALCULATION IF NECESSARY.
The small reduction of the heat transfer area is normally of no importance, at least not for a short period of time.
 - Insufficient tightening must be corrected - see the drawing.
3. Damaged hanger recesses must be repaired if possible, or the plate replaced. For temporary arrangement with reduced number of plates - see paragraph 2 above.
4. Incorrect sequence of plates must be corrected (A-B-A-B-...). MAKE SURE THAT NO PLATE HAS BEEN DAMAGED, BEFORE REASSEMBLING THE PLATE PACK!
5. Perforated plates must be replaced. For temporary solution, see paragraph 2.

SYMPTOM

LEAKAGE between plates.

ACTION	CORRECTIONS
--------	-------------

- | | |
|---|--|
| <ol style="list-style-type: none">1. Check that the piping is connected to the heat exchanger at correct locations.2. Open the lower connection on one side, raise pressure on the other side and by looking into the open connection try to detect any liquid from the pressurized side leaking in, and if so - approximately how far into the plate pack the leakage is located. If no leakage is detected, the reason for the mixing of media must be sought elsewhere. (see paragraph 5).3. If a leakage was detected, note the position of the leakage along the plate pack and then open the plate heat exchanger.4. Before starting on the plates themselves, check that the corner areas between the ring and the field gaskets are clear, that the leakage slots are open. This ensures that any leakage is out of the plate heat exchanger and is to atmosphere. Therefore no pressure can build up to force the media across the gasket sealing off the other liquid.5. If it has not been possible to locate the leakage as described in par. 2 above, it will be necessary to check each single plate for possible perforations, using any of the following methods:<ul style="list-style-type: none">• put a strong light behind the plate and watch for light coming through fine holes or cracks.• use a magnifying glass to check suspect area.• use a chemical penetrant, after having cleaned the plates well. | <ol style="list-style-type: none">1. Relocate piping to correct connections.4. All deposits or material which can block the free exit from the area must be removed. If the leak channels of the gasket have been destroyed, they must be reopened with a suitable tool, or the gasket replaced.5. Plates with holes must be replaced. The PHE may be temporarily operated with a reduced number of plates. See "LEAKAGE between plates to the outside". |
|---|--|

8

Fault detection

SYMPTOM PRESSURE DROP PROBLEMS, Pressure drop has increased	
ACTION	CORRECTIONS
<p>Check that all valves are open including non return valves.</p>	
<p>Measure the pressure just before and just after the heat exchanger, and the flow rate. For viscous media a membrane manometer with a diameter of at least 30 millimeters should be used. Measure or estimate the flow rate if possible. A bucket and a watch showing seconds may be sufficient for small flow rates. For larger flow rates, some type of flowmeter is required. Compare the pressure drop observed with the one specified for the actual flow rate. (see plate print out)</p>	
<p>1. If the pressure drop is higher than specified, the temperature program should also be checked:</p>	<p>1. See next paragraph.</p>
<p>1.1 If the thermometer readings correspond to those specified, the heat transfer surface is probably clean enough, but the inlet to the heat exchanger may be clogged by some objects.</p>	<p>1.1 Open the PHE and take out whatever is clogging the passage, or use the back-flush system - if there is one - to rinse out the cloggings.</p>
<p>1.2 If the thermometer readings are NOT corresponding to those specified, heat transfer is obviously dropping below specifications, because of deposits on the heat transfer surface, which at the same time also increase the pressure drop, since the passage becomes narrower.</p>	<p>1.2 If a "cleaning-in-place" system is available, follow the instruction and use it to wash out the deposits. If not, open the PHE and clean the plates.</p>
<p>2. If the pressure drop corresponds to the specifications, there is no need for any action.</p>	<p>2. See pump instruction manual.</p>
<p>3. If the pressure drop is lower than specified, the pump capacity is too small or the observation is wrong.</p>	

Fault detection

SYMPTOM: HEAT TRANSFER PROBLEMS
The heat transfer capacity is dropping

ACTION

CORRECTIONS

Measure temperatures at inlet and outlets and also flow rates on both media, if possible. At least on one of the media, both temperatures and the flow rate must be measured. Check to see if the transferred amount of heat energy corresponds to the specifications.

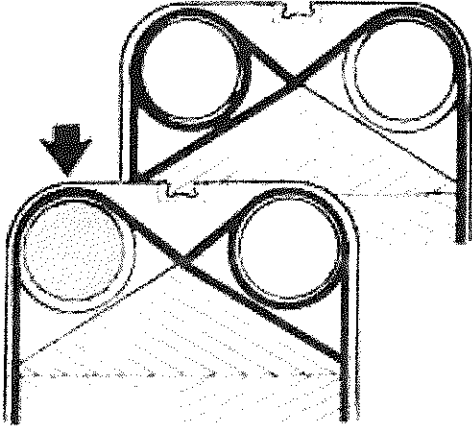
If great precision is important, it will be necessary to use laboratory thermometers with an accuracy of 0.2 degrees Fahrenheit, and also to use the best equipment available for flow measurements.

If the heat transfer capacity of the equipment has dropped below specified values, the heat transfer surface must be cleaned. Either use the "cleaning-in-place" arrangement if provided or open the heat exchanger for visual inspection and manual cleaning.

NOTE: Contact the Alfa Laval Sales & Service Division for CIP recommendations (See Section 1).

9

Supplementary Parts

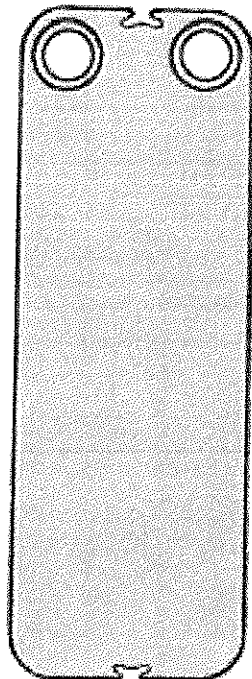


THE PARTITION PLATE - for special cases only.

If for instance, the thermal program requires that at least one of the media is to flow in more than one group through the plate package, there will be heat transfer plates with fewer than 4 holes.

To prevent the thin metal collapsing under the differential pressure, un-punched corners require extra support.

The extra support is provided by a partition plate - approximately the size of a channel plate - made of about 1/4" - 3/4" thick plate material with lined holes where a free passage is required.



The partition plate is suspended from the carrying bar. Where partition plates are required, in units with 8" ports or larger, there will be one at every turning point in a multi-grouped plate package.

Example only



TERMS AND CONDITIONS OF SALE

These Terms and Conditions Apply to All Quotations, Orders, and Contracts for Alfa Laval Inc. Products (hereafter "Equipment"). As used in these Terms and Conditions of Sale, the word "Equipment" includes all hardware, parts, components, software and options.

1. **ACCEPTANCE:** Our sale to you is limited to and expressly made conditional on your assent to the terms and conditions of sale herein and, if applicable, on the attendant quotation, both of which form a part of this order and which supersede and reject all prior agreements, representations, discussions or negotiations, whether written or oral, with respect hereto and any conflicting terms and conditions of yours, or any statement therein, whether or not signed by you. We will furnish only the quantities and Equipment specifically listed on the face hereof or the pages attached hereto. We assume no responsibility for terms or conditions of, or for furnishing other equipment or material shown in, any plans and/or specifications for a project to which the Equipment quoted or ordered herein pertain or refer.
2. **PRICES:** Unless otherwise specified in writing, all quoted prices are firm for thirty (30) days from the date of offer. Stenographic, clerical and mathematical errors are subject to correction.
3. **DELIVERY:** Dates for the furnishing of services and/or delivery or shipment of Equipment are approximate only and are subject to change. Quoted lead times are figured from the date of receipt of complete technical data and approved drawings as such may be necessary. We shall not be liable, directly or indirectly, for any delay in or failure to deliver caused by carriers or delays from labor difficulties, shortages, strikes or stoppages of any sort, failure or delay in obtaining materials from ordinary sources, fires, floods, storms, accidents, or other acts of God or *force majeure*, by any statute, regulation, administrative order or decree or order or judgment of a court of law or other causes beyond our reasonable control. Unless otherwise specifically agreed in writing by us, in no event shall we be liable for any damages or penalties whatsoever, or however designated, resulting from our failure to perform or delay in performing due to any of the causes specified in this paragraph 3.
4. **SHIPMENT, RISK OF LOSS, TAXES:** Prices are in U.S. Dollars, F.O.B. Jobsite (or shipping point), Prepaid and Allowed. Duty, brokerage fees, insurance, packing and handling as applicable are included. Our prices do not include federal, state, municipal or other government excise, sales, use, occupational, processing, transportation or like taxes now in force or enacted in the future. You shall pay any taxes we may be required to collect or pay now or at any time in the future (including interest and penalties imposed by any governmental authority), or any taxes you may be required to pay, that are imposed upon the sale, delivery or support of Equipment purchased or licensed as a part of this order, or you shall provide us with a tax exemption certificate acceptable to the appropriate taxing authorities.
5. **CREDIT AND PAYMENT:** Unless otherwise noted on the face hereof payment for Equipment shall be (30) days net. *Pro rata* payments shall become due with partial shipments. Any discount period which may be granted by us begins on the invoice date and all payments are due 30 days after the invoice date. All payments shall be made without deduction, deferment, set-off, lien or counterclaim of any nature. All amounts due not paid within 30 days after the date such amounts are due and payable shall bear interest at the lesser of 1.5 percent per month or the maximum rate of interest allowed by law. We reserve the right at any time to suspend credit or to change credit terms provided herein, when, in our sole opinion, your financial condition so warrants. Failure to pay invoices when such invoices are due and payable, at our election, shall make all subsequent invoices immediately due and payable irrespective of terms, and we may withhold all subsequent deliveries until the full account is settled. We shall not, in such event, be liable for delay of performance or nonperformance of contract in whole or in part subsequent to such event.
6. **CANCELLATIONS AND CHANGES:** Orders which have been accepted by us are not subject to cancellation or changes in specification except upon prior written agreement by us and upon terms that will indemnify us against all losses resulting from or arising out of such cancellation or change in specifications. In the

absence of such indemnification, we shall be entitled to recover all damages and costs of whatever nature permitted by the Uniform Commercial Code.

7. **DEFERRED SHIPMENT:** If shipment is deferred at your request, payment of the contract price shall become due when you are notified that the Equipment is ready for shipment. If you fail to make payment or furnish shipping instructions we may either extend the time for so doing or cancel the contract. In case of deferred shipment at your request, storage and other reasonable expenses attributable to such delay shall be payable by you.

8. **EQUIPMENT WARRANTY AND REMEDY:**

(a) For new Equipment only, we warrant to you that the Equipment that is the subject of this sale is free from defects in design (provided that we have design responsibility), material and workmanship. The duration of this warranty is twelve (12) months from delivery to you (the "Warranty Period"). If you discover within the Warranty Period a defect in design, material or workmanship, you must promptly notify us in writing. Within a reasonable time after such notification, we will correct any such defect with either new or used replacement parts, at our option. Such repair, including both parts and labor, is at our expense.

(b) For repairs, parts and service provided by us, we warrant to you that the repairs parts and service we provide to you will be free from defects in material and workmanship. The duration of this warranty is ninety (90) days from as applicable (i) the date the machine which required the repairs, parts or service is returned to you by us, (ii) the date of your receipt of the part, or (iii) the date of repair, if performed at your facility. If during this ninety day period you discover a defect in the repairs, parts or service you must promptly notify us in writing.

(c) All warranty service is subject to our prior examination and approval and will be performed by us at your facility or at service centers designated by us. All transportation to and from the designated service center will be at our expense. If we are unable to repair the Equipment to conform to the warranty after a reasonable number of attempts, we will provide, at our option, one of the following: (i) a replacement for such Equipment, or (ii) full refund of the purchase price. These remedies are your exclusive remedies for breach of warranty. Unless otherwise agreed in writing by us, our warranty extends only to you and is not assignable to or assumable by any subsequent purchaser, in whole or in part, and any such attempted transfer shall render all warranties provided hereunder null and void and of no further force or effect.

(d) We will use all reasonable efforts to obtain for you any manufacturer's guarantees or warranties for any sub-assemblies included in the Equipment. To the extent such warranties are assignable, we hereby assign to you all warranties that are granted to us by our suppliers of any sub-assemblies contained in the Equipment.

(e) The warranties set forth above are inapplicable to and exclude (i) any product, components or parts not manufactured by us or covered by the warranty of another manufacturer, (ii) damage caused by accident or the negligence of you or any third party, normal wear and tear, erosion, corrosion or by disasters such as fire, flood, wind and lightning, (iii) damage caused by your failure to follow all installation and operation instructions or manuals or to provide normal maintenance, (iv) damage caused by unauthorized or improper installation of attachments, repairs or modifications, (v) damage caused by a product or component part which we did not design, manufacture, supply or repair, or (vi) any other abuse or misuse by you or any third party.

(f) **EXCEPT AS SET FORTH IN SUBPARAGRAPHS (a) THROUGH (e) ABOVE, WE DISCLAIM ALL EXPRESS AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YOU AGREE THAT THE WARRANTIES SET FORTH IN SUBPARAGRAPHS (a) THROUGH (c) ABOVE ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.**

9. **LIMITATION OF LIABILITY:** In no event shall we be liable, and you hereby waive any claims against us and release us from liability to you, for any indirect, special, punitive, incidental, or consequential damages whatsoever based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory. Excluded damages include, but are not limited to, loss of profits, loss of savings or revenue, loss of use of the Equipment or any associated equipment, cost of capital, cost of any substitute Equipment, facilities or services, downtime, the

claims of third parties including customers, and injury to property. This limitation does not apply to claims for personal injury. Some states do not allow limits on warranties, or on remedies for breach in certain transactions. In such states, certain of the limitations in this paragraph and in subparagraph 8(c) may not apply.

10. **OWNERSHIP:** All drawings, designs and specifications supplied in connection with the proposal have been prepared or assembled by us and are solely our property. Such drawings, designs and specifications have been furnished in order that this proposal may be fully documented and on the condition that they shall not be reproduced or copied in any manner whatsoever, in whole or in part, except for your internal use as necessary to consider this proposal, and upon the further condition that, as our sole property, they shall not be used, in whole or in part, for furnishing information to others or for any purpose not specifically authorized in a writing signed by one of our corporate officers. These ownership provisions shall not be superseded by any printed form used in connection with or arising out of a sale induced by this proposal.

11. **PATENT INFRINGEMENT:**

(a) We will defend, indemnify, and hold you harmless from and against any action at law or in equity based on a claim alleging that the Equipment or any component or documentation provided to you by us (collectively the "Alfa Laval Product") infringes any third party: (i) presently issued and live patent(s) covering the Alfa Laval Product; (ii) copyright; (iii) trademark; or (iv) trade secret, and we shall indemnify you against all costs, expenses, including reasonable attorneys' fees, and damages arising from any such action.

(b) If at any time the Alfa Laval Product is found to infringe any third party rights as specified in subparagraphs (a)(i) - (a)(iv) hereof inclusive, and as a result thereof you are enjoined or restrained in your use of the Alfa Laval Product, we may elect at our expense either to (i) secure for you the right to continue use of the Alfa Laval Product without restriction, (ii) replace the Alfa Laval Product with another noninfringing product reasonably acceptable to you, or (iii) accept return of the Alfa Laval Product and refund to you the then-current fair market value of the Alfa Laval Product. Unless otherwise agreed in writing by us, our indemnity hereunder extends only to you and is not assignable to or assumable by any subsequent purchaser, in whole or in part, and any such attempted transfer shall render the indemnity provided hereunder null and void and of no further force or effect.

(c) This indemnification is contingent upon your providing us with available information and cooperating in the defense of the claim. We will control the defense of, and at our sole option, defend or settle any and all such claims, including any settlement negotiations or appeals. Our obligations under this provision as to any claim or action shall be terminated and of no further force and effect in the event you fail to notify us in writing promptly upon your receipt of any claim or action threatened, asserted or instituted against you for any matter which may be subject to your claim for indemnification under this provision.

(d) Notwithstanding the provisions of subparagraph (a) hereof, we make no express or implied warranties to you as to any infringement of third party rights referred to in subparagraphs (a)(i) - (a)(iv) hereof inclusive, where: (i) the infringement is based upon or related to any Alfa Laval Product manufactured to your designs or specifications; (ii) the infringement is based upon or related to equipment or any component furnished by you or any third party; (iii) the infringement is based upon or relates to any method or process practiced by you and employing in whole or in part, the Alfa Laval Product.

(e) This paragraph 11 sets forth your exclusive remedy against us with respect to any action or claim for an alleged infringement by the Alfa Laval Product or any component thereof.

12. **SAFETY AND HEALTH STANDARDS:** The Equipment described herein (or on the specifications provided herewith) complies with applicable safety and health standards issued pursuant to the Occupational Safety and Health Act of 1970 (the Act) and in effect on this date as such standards are interpreted and understood by us. These standards may be amended and/or their meaning may be clarified prior to shipment or performance, and if such change or clarification requires changes in the Equipment described herein, we shall make the necessary changes available to you. You shall pay for any and all such changes at our prices therefor in effect at time of shipment or performance, as the case may be. Because actual compliance by employers with the Act is beyond our control, we cannot and do not represent that the use of the Equipment described herein, nor the location,

installation or maintenance thereof, will comply with the Act or regulations and standards issued pursuant thereto. We make no representation of compliance with safety and health standards contained in any statute, regulations or ordinance of any state or political subdivision thereof applicable to the Equipment described herein unless you have notified us of the existence and contents of such standards and we have agreed in writing to the incorporation of such standards in the specifications relating to such Equipment. Nothing in this provision shall operate to modify or affect in any manner whatsoever our disclaimer of any liability for consequential damages contained elsewhere in these terms and conditions of sale.

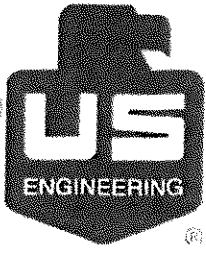
13. **INSPECTION:** Upon prior written notice, you may make reasonable inspections of Equipment at our facility. We reserve the right to determine the reasonableness of the request and to select an appropriate time and location for such inspection. You agree to execute appropriate confidentiality provisions upon our request prior to visiting our facility. All costs of inspection shall be solely determined by us and shall be payable by you. No inspection or expediting by you at the facilities of our suppliers is authorized.

14. **SOFTWARE PROVISIONS:** If software is provided hereunder, you are granted a nonexclusive, royalty free license only for your use of the software provided with our Equipment. Under this license you may: (i) use our software in machine readable object code only and only with the Equipment provided; (ii) copy our software into any machine readable object code form for back up purposes in support of your use of our software on the Equipment provided; and (iii) create one additional copy of the software for archival purposes only. This license may not be assigned, sublicensed or otherwise transferred by you without our prior written consent. You hereby recognize and acknowledge that the software provided to you hereunder comprises valuable trade secret and/or copyright property of Alfa Laval [or its licensor] and you covenant that you will take adequate precautions against access to the software by, or disclosure of the software to, anyone not authorized hereunder to use or have access to the software.

15. **TIME LIMIT FOR BRINGING SUIT:** Any action you file against us, whether for breach of contract, including but not limited to breach of warranty, or for negligence or strict tort, must be commenced within 90 days following the expiration of the Warranty Period.

16. **APPLICABLE LAW:** The rights and duties of the parties shall be governed by the laws of the State of Wisconsin, without giving effect to the provisions thereof relating to conflict of laws.

THE EQUIPMENT AND PARTS DESCRIBED IN THESE TERMS AND CONDITIONS OF SALE MAY CAUSE INJURY IF NOT OPERATED PROPERLY AND FOR THIS REASON ALL OPERATORS SHOULD BECOME THOROUGHLY FAMILIAR WITH THE OPERATING INSTRUCTIONS BEFORE OPERATING THE EQUIPMENT.



Heat Exchangers for
HVAC Product Submittal
Information:
HX-1

**BEATTIE
ELEMENTARY
SCHOOL**

3009 NE ADAMS LARK AVE
FORT COLLINS, CO 80526



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary
3000 Meadowlark Avenue
Fort Collins, CO 80526

Project # 30-13-038
Tel: Fax:

FCI Constructors, Inc. - Longmont

Date: 4/11/2014

Reference Number: 0051

Transmitted To: Chris Mallory
US Engineering Co.
P.O. Box 905
Loveland, CO 80539

Transmitted By: DJ Anderson
FCI Constructors, Inc. - Longmont
4001 N. Valley Drive
Longmont, CO 80504
Tel: 970-535-4725
Fax: 970-535-4867

Qty	Submittal Package No	Description	Due Date	Package Action
1	019 - 235700 - 0	Heat Exchanger For HVAC		Reviewed w/o Comment

Transmitted For	Delivered Via	Tracking Number
For your use and files.	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
001		Heat Exchangers For HVAC - Product Data	235700		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

Signature

Signed Date

TRANSMITTAL



Belford Watkins Group
Architects

Date: 4.10.14

Project: Beattie Elementary

To: Rob Price/DJ Anderson

From: Patti Watkins

We are transmitting the following submittals with the comments listed below:

ARCHITECTURE

INTERIORS

PLANNING

NET: No Exception Taken **MCN: Make Corrections Noted** **RX: Rejected**
RR: Revise and Resubmit **SSI: Submit Specified Item**
CMT: See Comment Below

235700 Heat Exchanger

Copies	Section	Item	Manufacturer	NET	MCN	RR	RX	SSI	CMT
1	235700	Product Data	Alfa Laval	X					1

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures, there from. The Contractor remains responsible for details and accuracy, for conforming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

Notes: 1: HEAT EXCHANGER (No Exception Taken)



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
---	--	--

Date: 3/28/2014	Reference Number: 0027
------------------------	-------------------------------

Transmitted To: Don Watkins Belford Watkins Group P.O. Box 1306 Fort Collins, CO 80521 Tel: 970-212-1243	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001 N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
--	--

Qty	Submittal Package No	Description	Due Date	Package Action
1	019 - 235700 - 0	Heat Exchanger For HVAC	4/11/2014	

Transmitted For Review & Approval	Delivered Via Email	Tracking Number
---	-------------------------------	------------------------

Items	Qty	Description	Spec Section	Sub Section	Item Action
	001	Heat Exchangers For HVAC - Product Data	235700		

Cc: Company Name FCI Constructors, Inc. - Longmont	Contact Name File	Copies 1	Notes
--	-----------------------------	--------------------	--------------

Remarks

_____ Signature	_____ Signed Date
---------------------------	-----------------------------



4001 N. Valley Drive
Longmont, CO 80504
Phone: 970-535-4867
Fax: 970-535-4867

DATE: 03/28/2014

SPECIFICATION SECTION(S): 235700
SCOPE OF WORK: HVAC - Heat Exchanger

PROJECT: Poudre School District – Beattie Elementary School

PROJECT #: 30-13-038

ARCHITECT/DESIGNER: Belford Watkins Group, LLC.
425 West Mulberry Ave., Suite 207
P.O. Box 1306
Fort Collins, CO 80521

PHONE: 970-407-0070

GENERAL CONTRACTOR: FCI CONSTRUCTORS, INC.
4001 N. Valley Drive
Longmont, CO 80504

PHONE: 970-535-4725
FAX: 970-535-4867

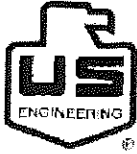
SUBMITTED BY: U.S. Engineering
PO Box 905
Loveland, CO 80539

PHONE: 970-669-1666
FAX:

CONTRACTORS STAMP:

ARCHITECT/ENGINEER STAMP

FCI CONSTRUCTORS, INC.	
Review of this submittal is subject to the provisions of the Contract Drawings and Specifications. This action is for general concurrence only.	
<input checked="" type="checkbox"/>	Reviewed
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmit with Corrections
<input type="checkbox"/>	DISAPPROVED RESUBMIT
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmittal not Required.
Submittal Reviewed By: DA	Date:03/28/2014
Submittal No: 019	Spec. Section: 235700



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 80539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-020

Date: 3/18/2014

Revision #: _____

Discipline: Piping

Project : Beattie Elementary

Project #: 1202

Supplier : CFM Company

Spec Sect: 23 57 00

Submitted Items:

Page Number	Paragraph Number	Description	Manufacturer
23 57 00-1	2	Heat Exchanger-HX-1	Alfa Laval
			Lead Time-30 Business Days

Target Dates:

Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
3/11/14	3/18/14	3/28/14		

GC/Arch/Engineer Stamp Area:

U.S. Engineering

Signed:

Chris Mallory



CFM COMPANY

AIR CONDITIONING / HEATING / VENTILATING EQUIPMENT

413D North Highway 287 - Ft. Collins, CO 80524

Phone: (970) 493-7293 / Fax: (970) 493-7297

PSD - Beattie Elementary

TAG: HX-1

Alfa Laval Model TL6-BFG Plate & Frame HX

Specification Section:

235700

Submittal Date: 3/12/2014

Submitted by: Justin Dunkin

Alfa Laval Plate Heat Exchanger Specification



Customer: US Engineering
Model: TL6B-FG
Project: PSD - Beattie
Item: HX-1

Date: 3/11/2014

		Hot Side	Cold Side
Fluid		30.0% Prop.glycol	Water
Density	lb/ft ³	63.96	62.29
Specific heat capacity	Btu/lb, °F	0.94	1.00
Thermal conductivity	Btu/ft,h, °F	0.269	0.347
Viscosity.inlet	cP	2.67	1.11
Viscosity.outlet	cP	3.32	0.973
Volume flow rate	GPM	100.0	100.0
Inlet temperature	°F	72.0	61.0
Outlet temperature	°F	62.0	70.6
Pressure drop	psi	2.23	1.82
Heat exchanged	kBtu/h	479.2	
L.M.T.D.	°F	1.2	
Heat transfer area	ft ²	576.4	
Rel. directions of fluids		Countercurrent	
Number of plates		212	
Number of passes		1	1
Additional plate capacity		15	
Plate material / Thickness		ALLOY 304 / 0.40 mm	
Gasket material		NBRB CLIP-ON	NBRB CLIP-ON
Connection material		Stainless steel	Stainless steel
Connection diameter	in	2	2
Nozzle orientation		S1 -> S2	S4 <- S3
Pressure vessel code		ASME	
Design Pressure	psi	150.0	150.0
Test pressure	psi	195.0	195.0
Design temperature	°F	150.0	150.0
Overall length x width x height	in	58 x 13 x 51	
Liquid volume	ft ³	1.6	1.6
Net weight, empty / operating	lb	941 / 1140	



TL6

Plate Heat Exchanger

Applications

General heating and cooling duties.

Standard design

The plate heat exchanger consists of a pack of corrugated metal plates with portholes for the passage of the two fluids between which heat transfer will take place.

The plate pack is assembled between a fix frame plate and a movable pressure plate and compressed by tightening bolts. The plates are fitted with a gasket which seals the interplate channel and directs the fluids into alternate channels. The number of plates is determined by the flow rate, physical properties of the fluids, pressure drop and temperature program. The plate corrugations promote fluid turbulence and support the plates against differential pressure.

The plate and the pressure plate are suspended from an upper carrying bar and located by a lower guiding bar, both of which are fixed to a support column.

Connections are located in the frame plate or, if either or both fluids make more than a single pass within the unit, in the frame and pressure plates.

Typical capacities

Liquid flow rate

Up to 20 kg/s (317 g.p.m), depending on media, permitted pressure drop and temperature program.

Plate types

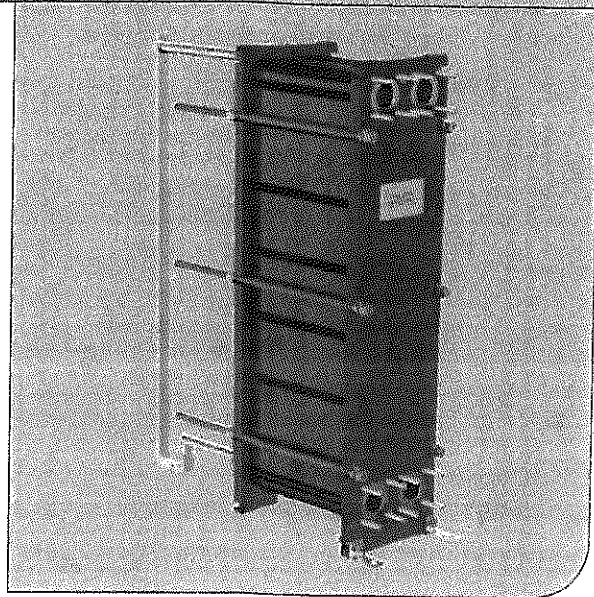
TL6-B

Frame types

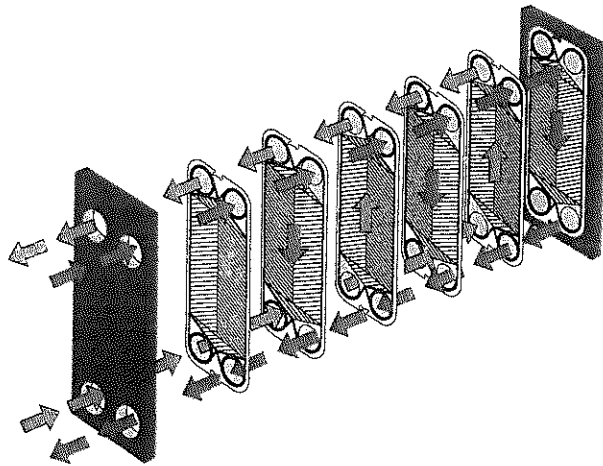
FM, FG and FD

Working principle

Channels are formed between the plates and the corner ports are arranged so that the two media flow through alternate channels. The heat is transferred through the plate between the channels, and complete counter-current flow is created for highest possible efficiency. The corrugation of the plates provides the passage between the plates, supports each plate against the adjacent one and enhances the turbulence, resulting in efficient heat transfer.



TL6-FG



Flow principle of a plate heat exchanger

STANDARD MATERIALS

Frame plate

Mild steel, Epoxy painted

Nozzles

Carbon steel

Metal lined: Stainless steel, Titanium

Rubber lined: Nitrile, EPDM

Pipe: Stainless steel

Plates

Stainless steel Alloy 316 / Alloy 304, Titanium, Alloy 254 SMO, Alloy C276

Gaskets

Nitrile, EPDM, Viton®

Other grades and material available on request

TECHNICAL DATA

Pressure vessel codes, PED, ASME, pvcALS™

Mechanical design pressure (g) / temperature

FM	pvcALS™	1.0 MPa / 180°C
FM	PED	1.0 MPa / 180°C
FG	pvcALS™	1.6 MPa / 180°C
FG	PED	1.6 MPa / 180°C
FG	ASME	150 psig / 482°F
FD	pvcALS™	2.5 MPa / 180°C
FD	PED	2.5 MPa / 180°C
FD	ASME	300 psig / 482°F

Connections

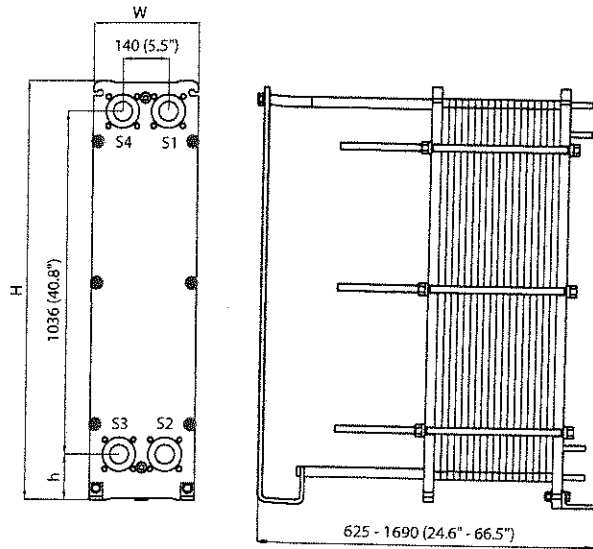
Pipe connections (not for frame type FD)

Straight threaded	Size 50 mm	ISO G2", NPT 2"
Threaded inlet port	Size 50 mm	ISO G2"

Flange connections

	Size:	
FM pvcALS™	50/65 mm	DIN/GB/GOST PN16, ASME Cl.150, JIS 10K
FM PED	50/65 mm	DIN PN16, ASME Cl. 150
FG pvcALS™	50/65 mm	DIN/GB/GOST PN16, ASME Cl. 150, JIS 10K, JIS 16K
FG PED	50/65 mm	DIN PN16, ASME Cl. 150
FG ASME	2-2½" in	ASME Cl.150
FD pvcALS™	50/65 mm	DIN/GB/GOST PN40, ASME Cl.300, JIS 20K
FD PED	50/65 mm	DIN PN40, ASME Cl. 300
FD ASME	2-2½" in	ASME Cl. 300

Dimensions



Measurements mm (inch)

Type	H	W	h
TL6-FM / PED / pvcALS™	1264 (49.8")	320 (12.6")	137 (5.4")
TL6-FG / PED / pvcALS™	1264 (49.8")	320 (12.6")	137 (5.4")
TL6-FG / ASME	1299 (51.1")	320 (12.6")	142 (5.6")
TL6-FD / PED / pvcALS™	1264 (49.8")	330 (13.0")	137 (5.4")
TL6-FD / ASME	1308 (51.5")	330 (13.0")	142 (5.6")

The number of tightening bolts may vary depending on pressure rating.

Maximum heat transfer surface

102.0 m² (1097 sq.ft)

Particulars required for quotation

- Flow rates or heat load
- Temperature program
- Physical properties of liquids in question (if not water)
- Desired working pressure
- Maximum permitted pressure drop

PCT00102EN 1203

Alfa Laval reserves the right to change specifications without prior notification.

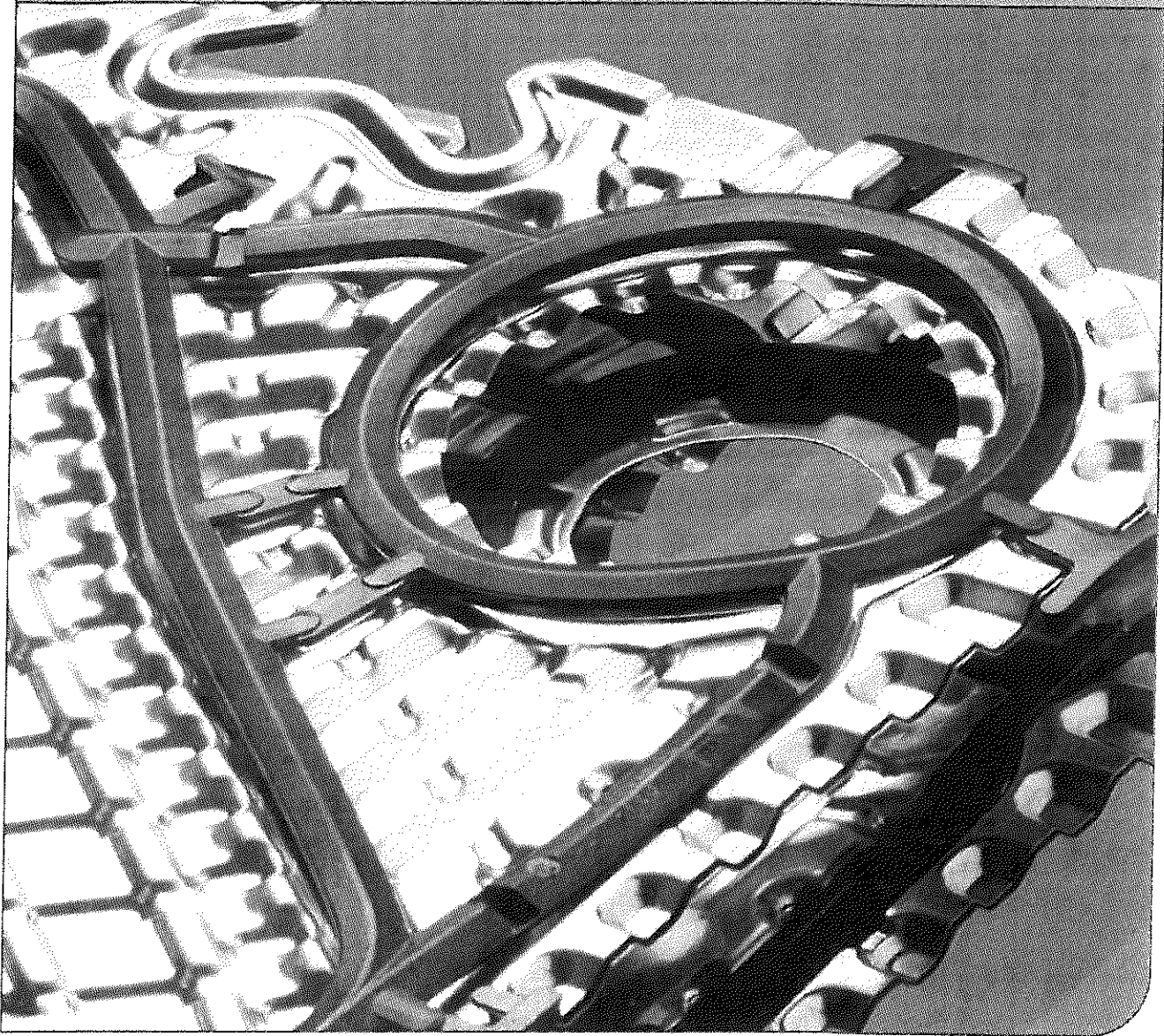
How to contact Alfa Laval

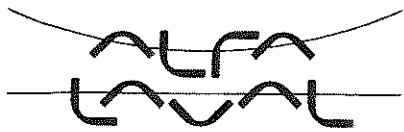
Up-to-date AlfaLaval contact details for all countries are always available on our website on www.alfalaval.com



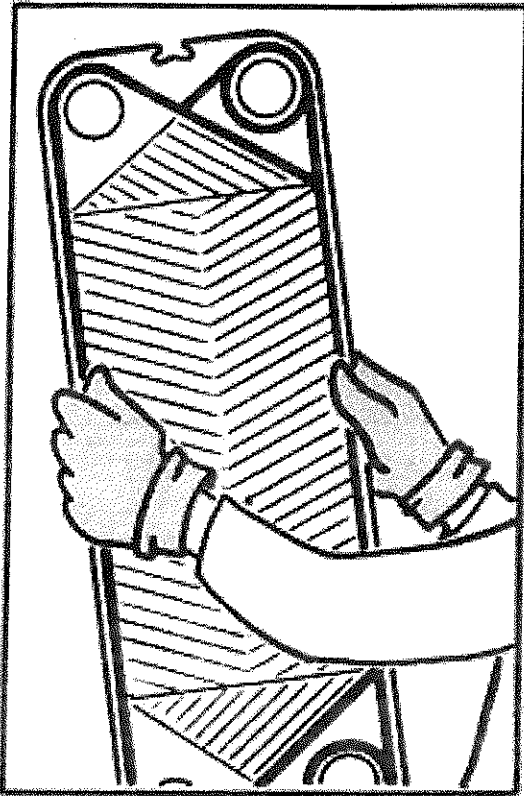
Plate Heat Exchanger

Operational and Maintenance Manual





NOTICE



**TO AVOID HAND INJURIES,
PROTECTIVE GLOVES
SHOULD ALWAYS BE WORN
WHEN HANDLING PLATES.**

PROTECTIVE SHROUDS

IT IS THE RESPONSIBILITY OF EACH PERSON OPERATING OR REPAIRING EQUIPMENT TO TAKE THE NECESSARY PRECAUTIONS TO COMPLY WITH ALL APPLICABLE SAFETY REGULATIONS.

ALFA LAVAL PROVIDES PROTECTIVE SHROUDS FOR ALL OUR PLATE HEAT EXCHANGERS. THESE SHROUDS WILL PREVENT POSSIBLE INJURIES AND/OR DAMAGE AS A RESULT OF SUDDEN LEAKAGE FROM THE PLATE PACKAGE.

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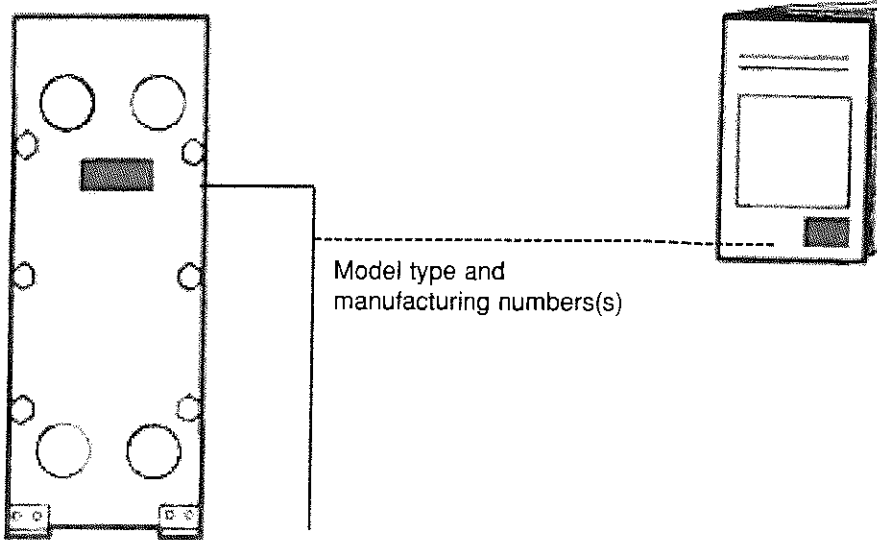
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• Partition Plate	9.1
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To our valued customer:

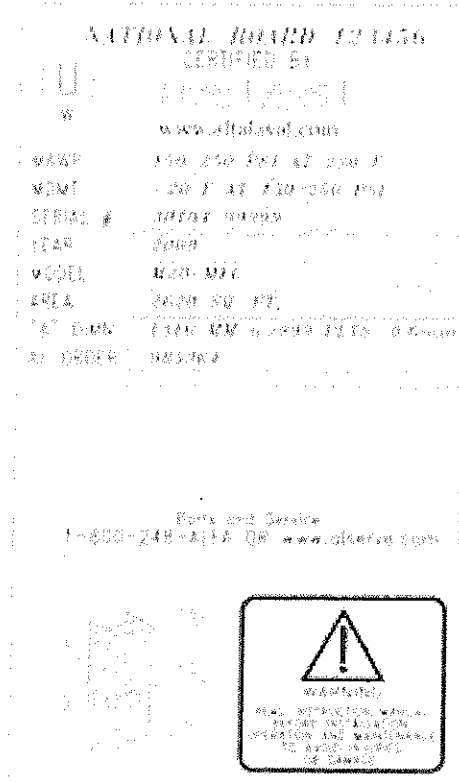
Thank you for purchasing an Alfa Laval Plate Heat Exchanger. As the world's largest manufacturer of Heat Exchangers, we are very proud of our products and services. We value you as our customer and wish to assure your satisfaction. We have prepared this Instruction Manual to assist you with your Alfa Laval Plate Heat Exchanger in various situations. We suggest that you look through it carefully, and, above all, make it readily available to any personnel who may need it for reference.

2

The name plate - and the identification of the equipment

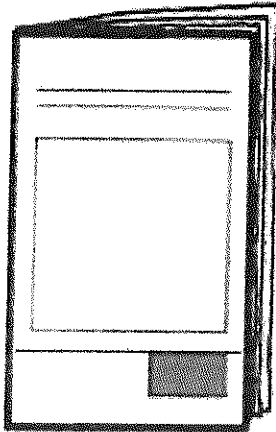


A name plate like the one shown below is fixed to the apparatus as shown above and it gives the following information



2.1

The name plate - and the identification of the equipment



This instruction manual has been issued for many different models of Alfa Laval *industrial* PHEs. There are separate manuals for *industrial, sanitary, spiral, alfa rex, brazed & evaporator/condensor* heat exchangers.

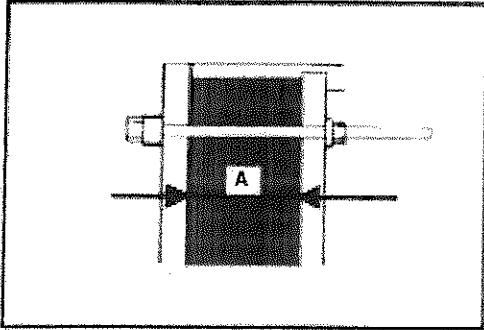
- WHENEVER USING THE MANUAL, CHECK FIRST THAT THE SERIAL NUMBER ON THE FRONT COVER IS IDENTICAL TO THAT ON THE NAME PLATE OF THE EQUIPMENT.
- IN ALL CORRESPONDENCE WITH ALFA LAVAL, PLEASE REFER TO THE MANUFACTURING SERIAL NUMBER, FOR TRUE IDENTIFICATION OF THE EQUIPMENT.
- WHENEVER CONTACTING ALFA LAVAL ABOUT A PART FOR YOUR PLATE HEAT EXCHANGER, BE SURE TO STATE THE MANUFACTURING SERIAL NO.(S), AND MODEL TYPE.

3

General

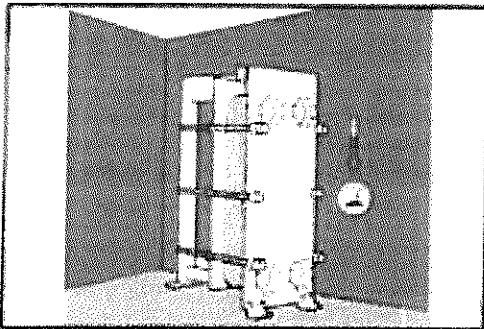
STORAGE

In this section, names of heat exchanger parts are mentioned for the first time. For your information, see Chapters 4A or 4B FUNCTION.



1. Unless otherwise agreed, ALFA LAVAL delivers the plate heat exchanger ready to be put in service upon arrival. This means that the plate package is tightened to its correct measurement A.

Should it be necessary, however, to store the equipment for a longer period (1 month or more) before, certain precautions should be made in order to prevent unnecessary wear of the equipment:

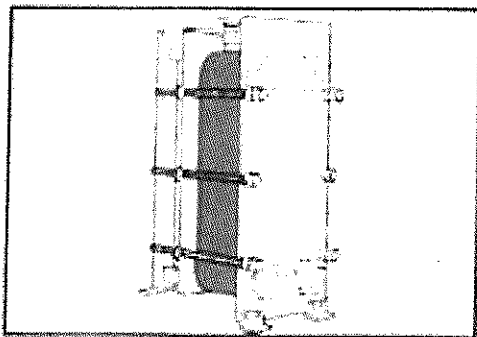


2. Preferably, the heat exchanger should be stored inside, in a room with a temperature around 15 to 20 degrees Celsius (60 to 70 degrees Fahrenheit) and humidity around 70%

There should **ABSOLUTELY NOT** be any **OZONE-PRODUCING** equipment in the room, like electric motors or arc-welding equipment, since ozone destroys many rubber materials (cracking).

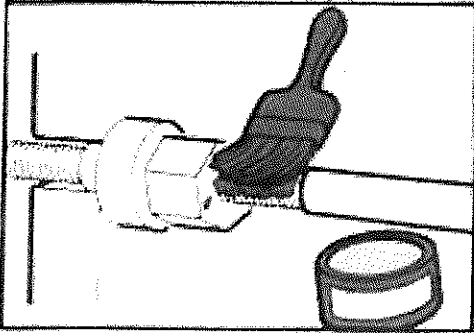
Do not store organic solvents or acids in the room.

Avoid heat or ultraviolet radiation.



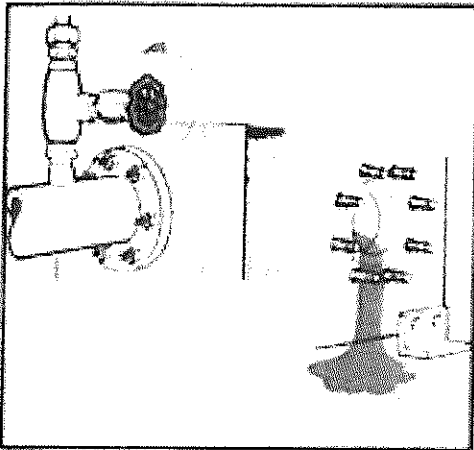
3. Wrapping the PHE with a non-transparent plastic film is a good precaution. Use of transparent film can alter paint color if unit is stored in direct sunlight.

STORAGE



4. The tightening bolts should be well covered with good rust preventing coating, suitable types (LUBRIPLATE FGL-2 or Equivalent) and if not connected to the pipe system, the connections should be covered.

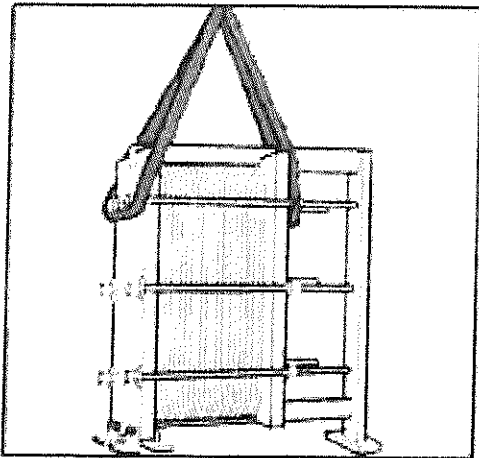
If the heat exchanger must be stored outdoors, the precautions mentioned above should be taken as far as practical. The need for protection against the climate etc. is of course even more important in this case.



5. If for any reason the heat exchanger is removed from service for a long period, it is advantageous to follow the advice above, even if the equipment is not moved from the location.

The heat exchanger should be VENTED AND DRAINED, and depending on the media processed, it is recommended to RINSE AND DRY it, before it is stored.

LIFTING



1. Whenever the heat exchanger is lifted, straps should be placed around tightening bolts on both sides of the unit, as shown in picture. If lifting lugs or lifting eyes are provided, always use chains or lifting cables rated above the published weight of the heat exchanger.

NEVER LIFT BY THE CONNECTIONS OR THE STUDS AROUND THEM!

3

General

LIFTING CONTINUED

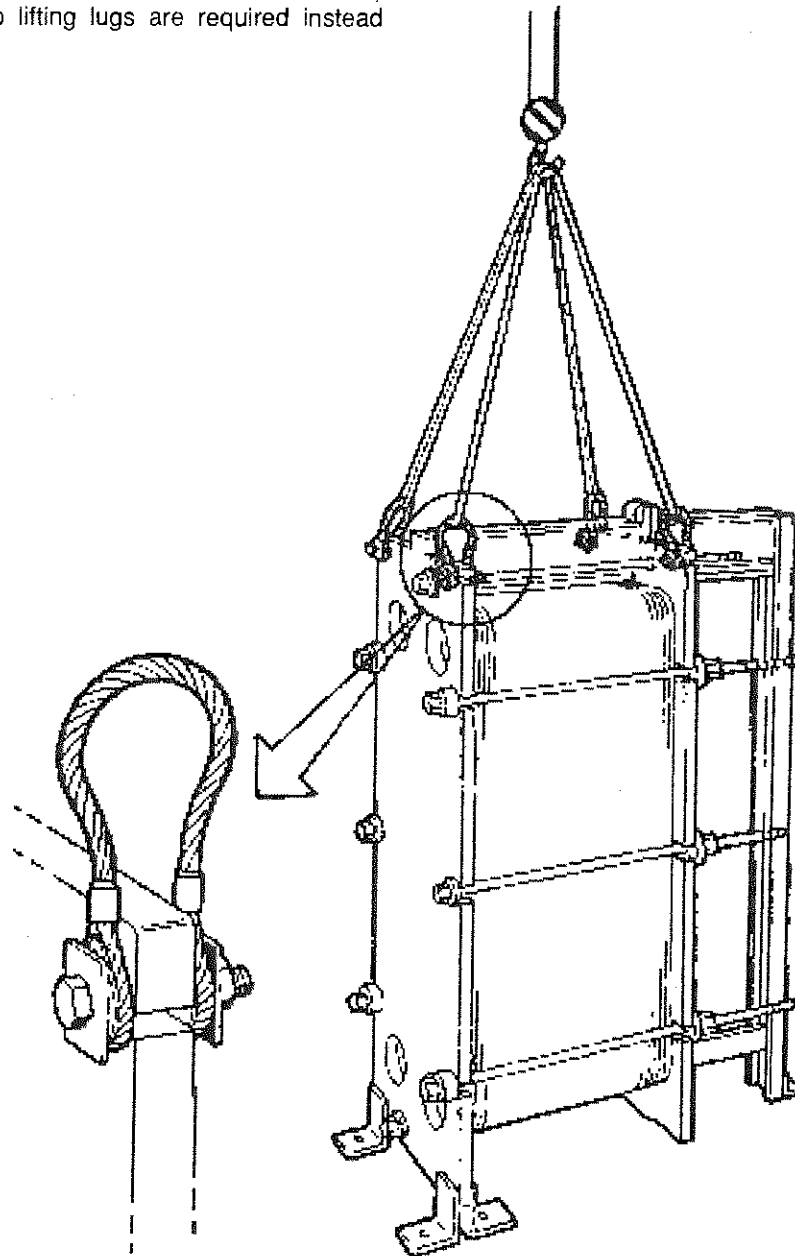
If Lifting Lugs are provided

If you are to lift the heat exchanger itself, straps should be used. They should be placed as shown on the picture.

On smaller units (4" connected size smaller) typically two lifting lugs are required instead of four.

WARNING!

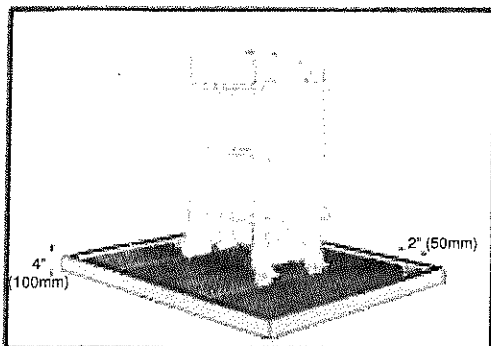
Never lift by the connections or the studs around them.



General

FOUNDATIONS.

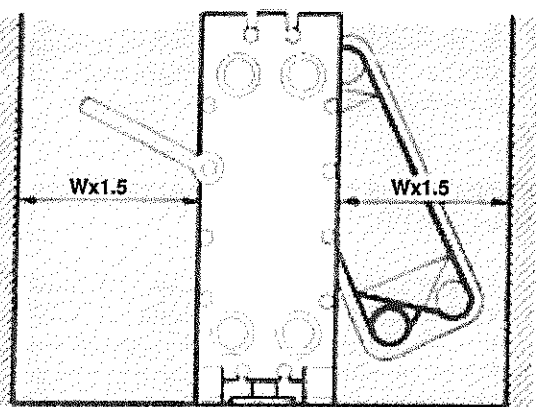
All information necessary for the preparation of the foundation appears on the data sheet provided by ALFA LAVAL.



In some cases (installation on board a ship, when processing corrosive liquids, etc.) it may be practical to place the heat exchanger in a DRAINAGE BOX (with capacity for the total volume of the heat exchanger). The outlet of the drainage box should be generously dimensioned, not less than (2") 50 mm diameter.

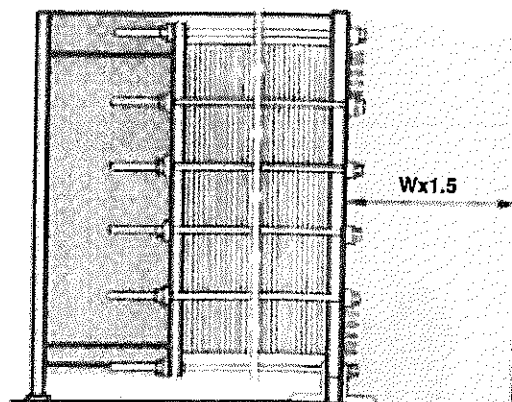
INSTALLATION.

BEFORE connecting any piping to the heat exchanger, **MAKE SURE THAT ALL FOREIGN OBJECTS HAVE BEEN FLUSHED OUT OF THE SYSTEM!**



PLEASE OBSERVE THAT

The measurements given in the picture above are recommended by ALFA LAVAL, it is necessary to leave free space around the equipment, to provide access and make future service possible. Except for a place to put the plates, if removed from the heat exchanger, **NO FURTHER SPACE** is required for servicing the PHE.



PLEASE OBSERVE THAT

The measurements given in the picture are recommended by ALFA LAVAL, to provide reasonably good working conditions during installation of the heat exchanger as well as for future maintenance and service. If floor space is restricted, the dimensions suggested can be reduced. It is left to the purchaser to decide just how much access space is required.



This field should be kept free from fixed installations.



Recommended free space for opening and closing.

PIPES

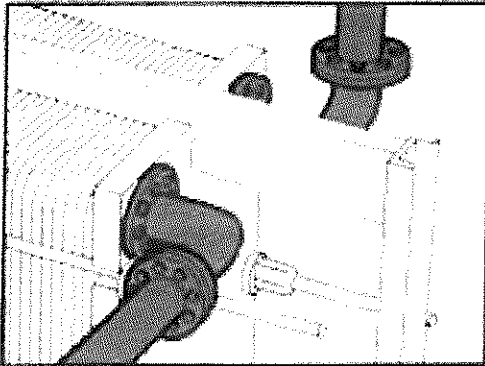
Always ensure that **no** measurable stress is placed on the heat exchanger by the piping system.

SHUT OFF VALVES

To enable the heat exchanger to be opened when necessary shut off valves should be provided on all connections.

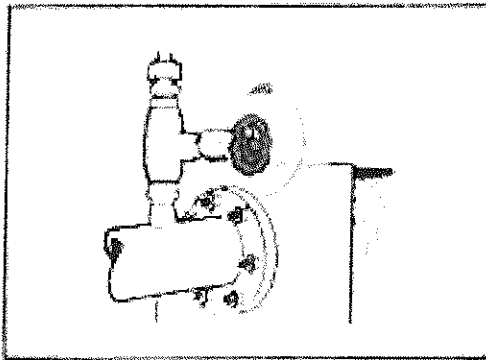
PRESSURE RELIEF DEVICES

It is the responsibility of the user to ensure that the required pressure relief devices are properly installed prior to initial operation. Refer to the applicable Code(s) and corresponding Standard(s) for proper size requirements of these pressure relief devices.



CONNECTIONS ON THE PRESSURE PLATE (REAR COVER)

Some plate heat exchangers may also have connections on the pressure plate. In such cases, it is important to check against the drawing or the name plate that the plate pack has been tightened to the right measurement before the piping is connected.



Whenever piping is connected to the pressure plate, a short 90° spool piece shall be installed between the heat exchanger and the piping. These should be directed upwards or sideways. This simplifies pressure plate removal during servicing.

Venting of both sides of the heat exchanger must be provided. This is important and enables air to be drawn from the system during start-up. It also enables air or gas to be removed during operation, and it enables faster drainage.

Special Loose Flange Connections

Loose Flanges are provided on certain model types due to interference. When provided these flanges shall be incorporated into the piping.

MODELS WITH BOTH "S" AND "T" PORT CONNECTIONS

M6-FD, M6-MFD, M6-MWFD, M10-BFD, M10-MFD, M10-BWFD, M10-BDFD, M20-MFD*, M20-MWFD*

MODEL TYPES WITH LOOSE FLANGE ON T PORT CONNECTIONS ONLY:

M6-FG, M6-MFG, M6-MWFG, M10-BFG, M10-MFG, M10-BWFG, M10-BDFG, V28-FD*, V45-FD*, M20-MFG, M20-MWFG

* Loose flange only when design pressures above 230 psi.

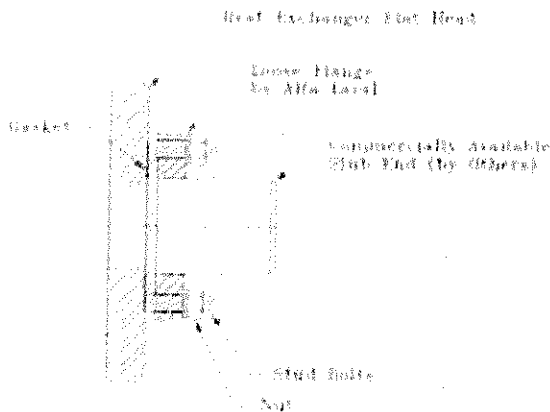
Notes:

- 1) Sports connections on these model types utilized industry standard flanges.
- 2) Not all exchangers require T port connections.

PIPING CONNECTION

The loose flange is connected to piping by use of a commercially available stub end of same material as the piping.

The stub end is installed as shown and then butt weld to the piping.



4A

LIST OF PARALLEL FLOW UNITS

“A” SERIES UNITS:

AM10-FG; AM10-FS

A15-BFL; A15-BFG; A15-BFD; A15-BWFG; A15-BWFD

A20-BFL; A20-BFG; A20-BFD

AM20-FG; AM20-BFG; AM20-WFG; AM20-SFG; AM20-DWFG

AK20-FG; AK20-FD; T200-FG; T200-FD

AX30-BFG; AX30-BFD; AX30-BWFG; AX30-BWFD

A35-HA

“M” SERIES UNITS:

M3-VG

M6-FG; M6-FD; M6-MFG; M6-MFD; M6-MWFD/FG/FDR/FGR

M10-BFM; M10-BFG; M10-BFD; M10-MFG; M10-MFD;

M10-BWFG; M10-BWFD; M10-BWFGR, M10-BWFDR

M15-BFG; M15-BFD; M15-BFS; M15-MFG;

M15-MFD; M15-MFS; MK15-BWFD; MK15-BWFG

M20-MFG; M20-MFM; M20-MFD; M20-MWFG; M20-MWFD

M30-FM; M30-FG; M30-FD

MA30-FD; MA30-FG; MA30-WFG; MA30-WFD

MX25-BFG; MX25-BFD; MX25-BFS

EC500-WTFE; EC500-WTFL

“V” SERIES UNITS:

V8-VG, V13-FG, V13-FD, V20-FG, V20-FD

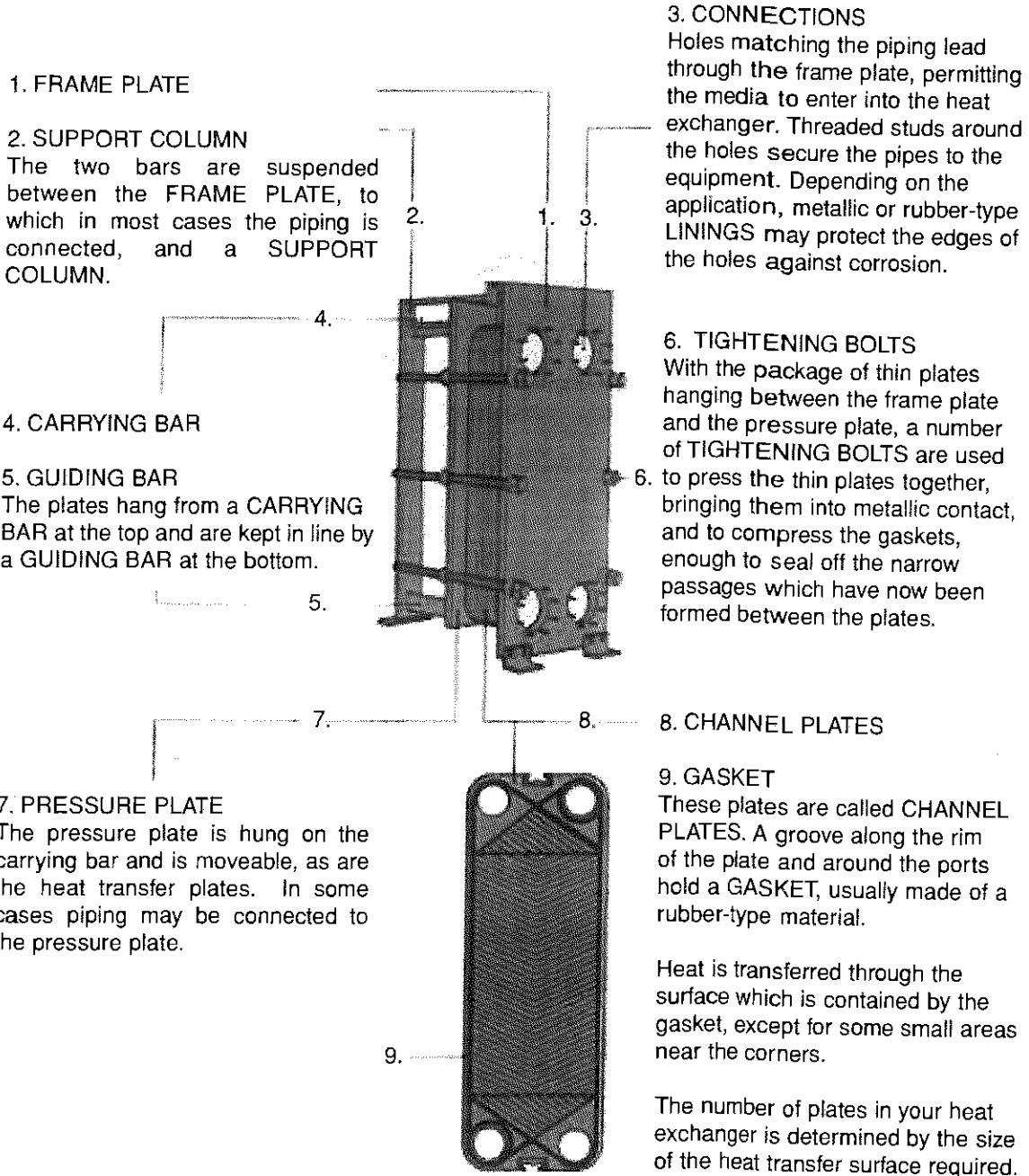
PARALLEL FLOW UNITS

4A

Function

THE MAIN COMPONENTS OF THE PLATE HEAT EXCHANGER AND THEIR FUNCTIONS.

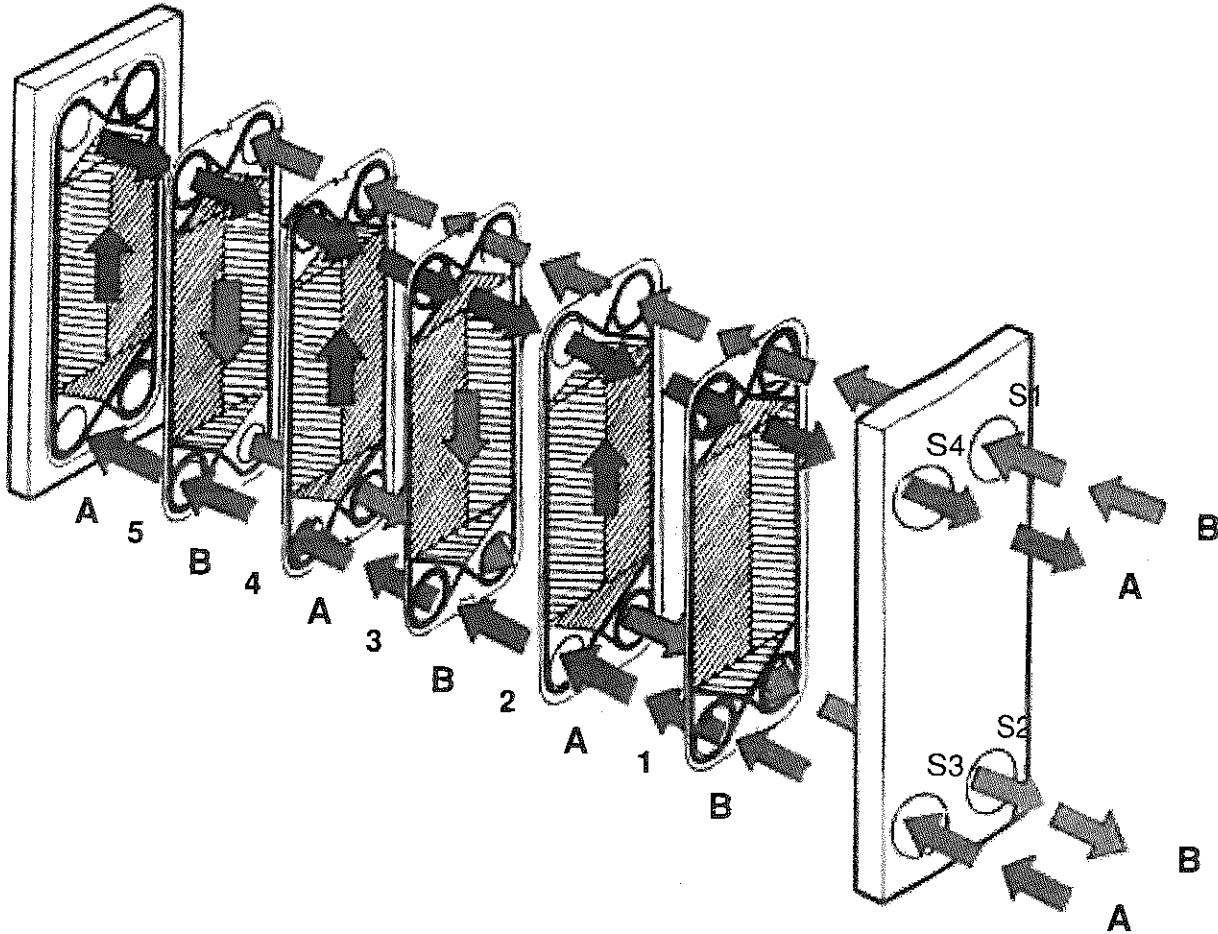
In ALFA LAVAL Plate Heat Exchangers, heat is transferred from one medium to another through thin metal plates which have been pressed into a special pattern.



4A

PARALLEL FLOW UNITS

How it works



When a package of plates are pressed together, the holes at the corners form continuous tunnels or manifolds, leading the media (which participate in the heat transfer process) from the inlets into the plate pack, where they are distributed in the narrow passages between the plates.

Because of the gasket arrangement on the plates, and the placing of "A" and "B" plates alternately, the two liquids enter alternate passages, e.g. the warm liquid between even number passages, and cold liquid between odd number passages.

Thus the media are separated by a thin metal wall. In most cases the liquids flow in opposite directions.

During the passage through the equipment, the warmer medium will give some of its heat energy to the thin wall, which instantly loses it again to the colder medium on the other side.

The warmer medium drops in temperature, while the colder one is heated up.

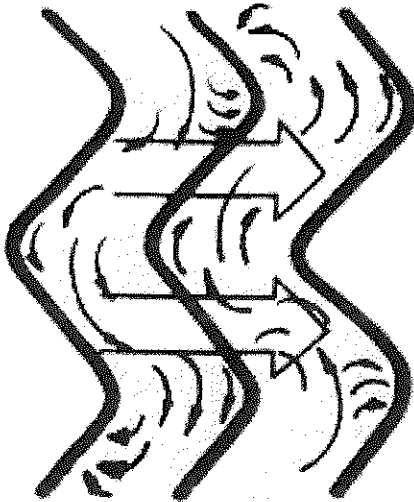
Finally, the media are led into similar hole-tunnels at the other end of the plates and discharged from the heat exchanger.

4A.3

PARALLEL FLOW UNITS

4A

Heat transfer



The purpose of the equipment is to transfer heat from one medium to another. Heat passes very easily through the thin wall separating the two media.

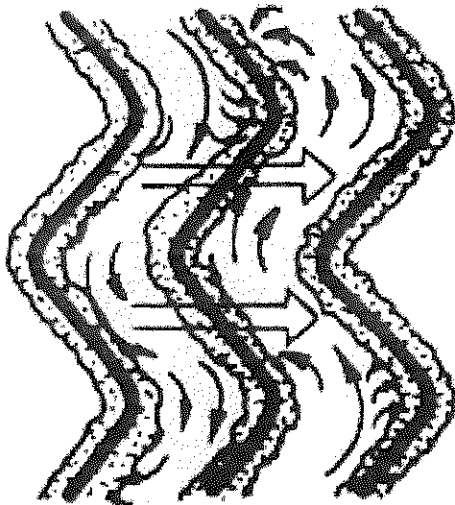
The novel pattern into which the plate material has been formed not only gives strength and rigidity, but greatly increases the rate of heat transfer from the warmer medium to the metal wall and from the wall to the other medium.

This high heat flow through the walls can be seriously reduced by the formation of deposits of various kinds on the wall surfaces.

The pattern of corrugation on Alfa Laval plates mentioned above induces highly turbulent flow. The turbulence gives strong resistance to the formation of deposits on the plate surface; however, it cannot always eliminate fouling.

The deposits may increase the total "wall thickness" substantially, and they consist of materials that have a much lower thermal conductivity than the metal plate. Consequently a layer of deposits can severely reduce the overall heat transfer rate.

The deposits will be considered in the chapter on MAINTENANCE and CLEANING. At this point we will only establish that this fouling is unwanted and can under certain circumstances, be harmful to the heat exchanger because corrosion may occur under the deposits.



Pressure drop

Pressure drops are wasted energy.

All pipe systems and equipment included in them offer resistance to media flowing through them.

Some pressure drop is unavoidable, but for a given PHE it should be kept as close as possible to the designed value.

The formation of deposits on the heat transfer surfaces instantly leads to a reduction of the free space between the plates. This means that more energy is needed to get the desired flow through the equipment.

It is clear that the fouling of the surfaces is undesirable.

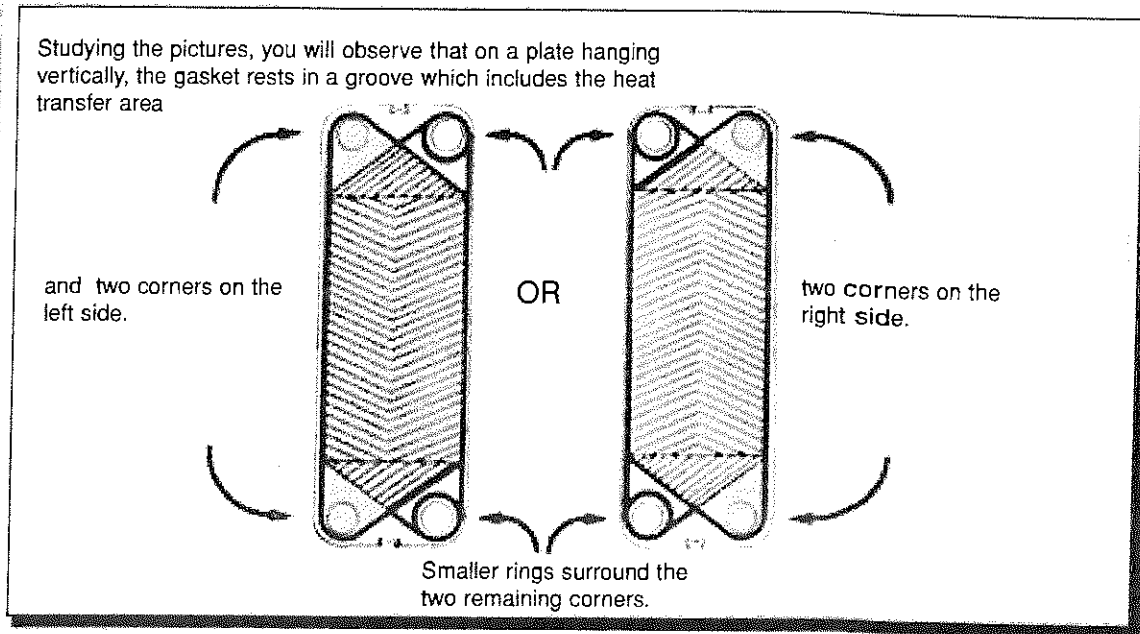
Larger particles and fibers may also be drawn into the heat exchanger and clog the passage ways if strainers or other means of protection have not been provided for.

A reduced ability by the heat exchanger to hold the desired temperatures, in combination with an increased pressure drop on any of the media, indicates that fouling or clogging is taking place.

For corrective action, see MAINTENANCE and CLEANING.

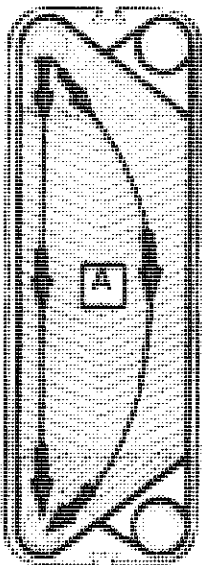
4A

PARALLEL FLOW UNITS

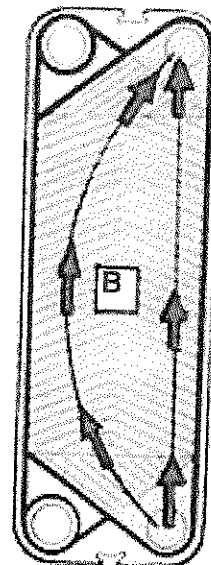
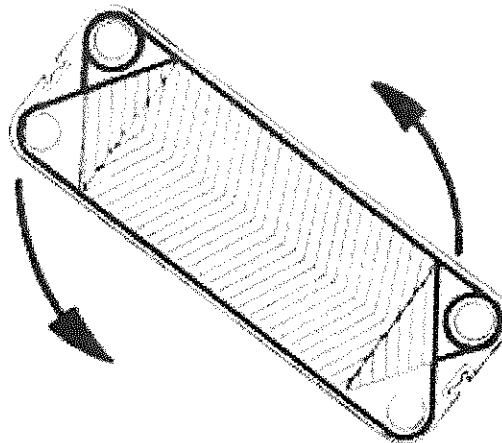


We decide that we will name the plates after these two situations.

An A-plate is a plate hanging with the chevron pointing downwards.



A B-plate is a plate hanging with the chevron pointing upwards.

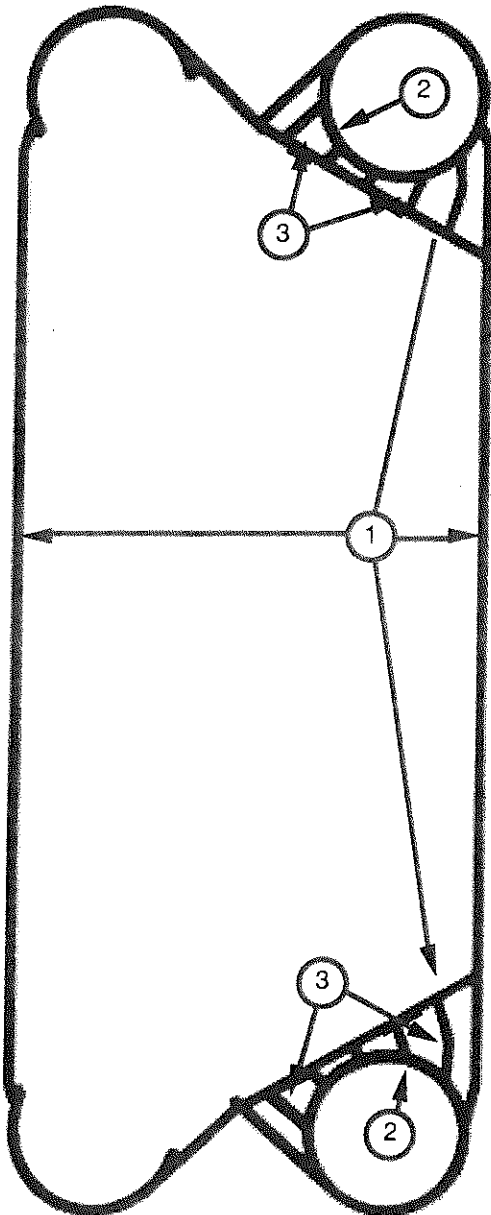


If we turn an A-plate upside down we will have a B-plate:

4A.5

Gaskets

The GASKET is molded in one piece. The material is normally an elastomer, selected to suit the actual combination of temperature, chemical environment and possible other conditions that may be present.



The one-piece gasket consists of:

1. One field gasket
2. Two ring gaskets
3. Links

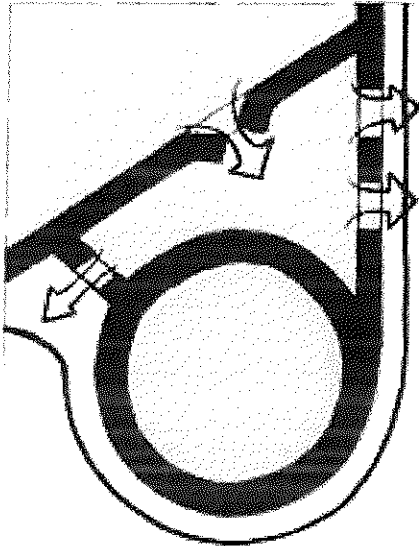
The field gasket is by far the larger part containing the whole heat transfer area and the two corners connected to it. The ring gaskets seal off the remaining two corners.

These three pieces are held together by a few short links, which have no sealing function at all. Their purpose is simply to tie the pieces together and to add some support in certain areas. On some plate heat exchangers, the gasket is held in place on the plate by means of a suitable cement or glue.

4A

PARALLEL FLOW UNITS

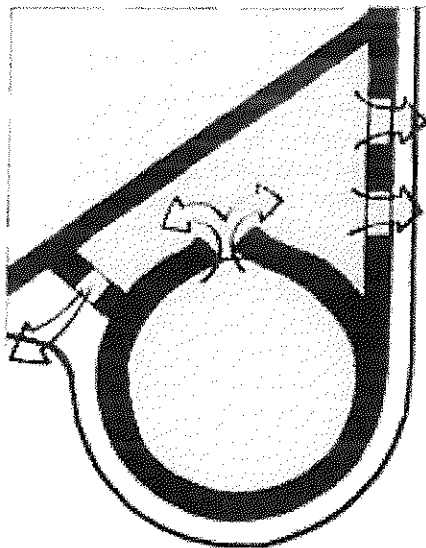
Gaskets



As already demonstrated, the two media are effectively kept apart by the ring and field gaskets. To prevent intermixing of the media in the corner areas where field and ring gaskets are very close to each other, the link pieces have a number of slots which opens the area between the field and ring gaskets to atmosphere. Any leakage of media across either gasket will escape from the heat exchanger through the slots.

It is important that these openings are kept clear. If they are not, there is a risk that should a leak occur in that region of the plate, there might be a local pressure build-up, which could allow one medium to mix with the other.

Care should be taken not to cut or scratch the gaskets while handling plates.

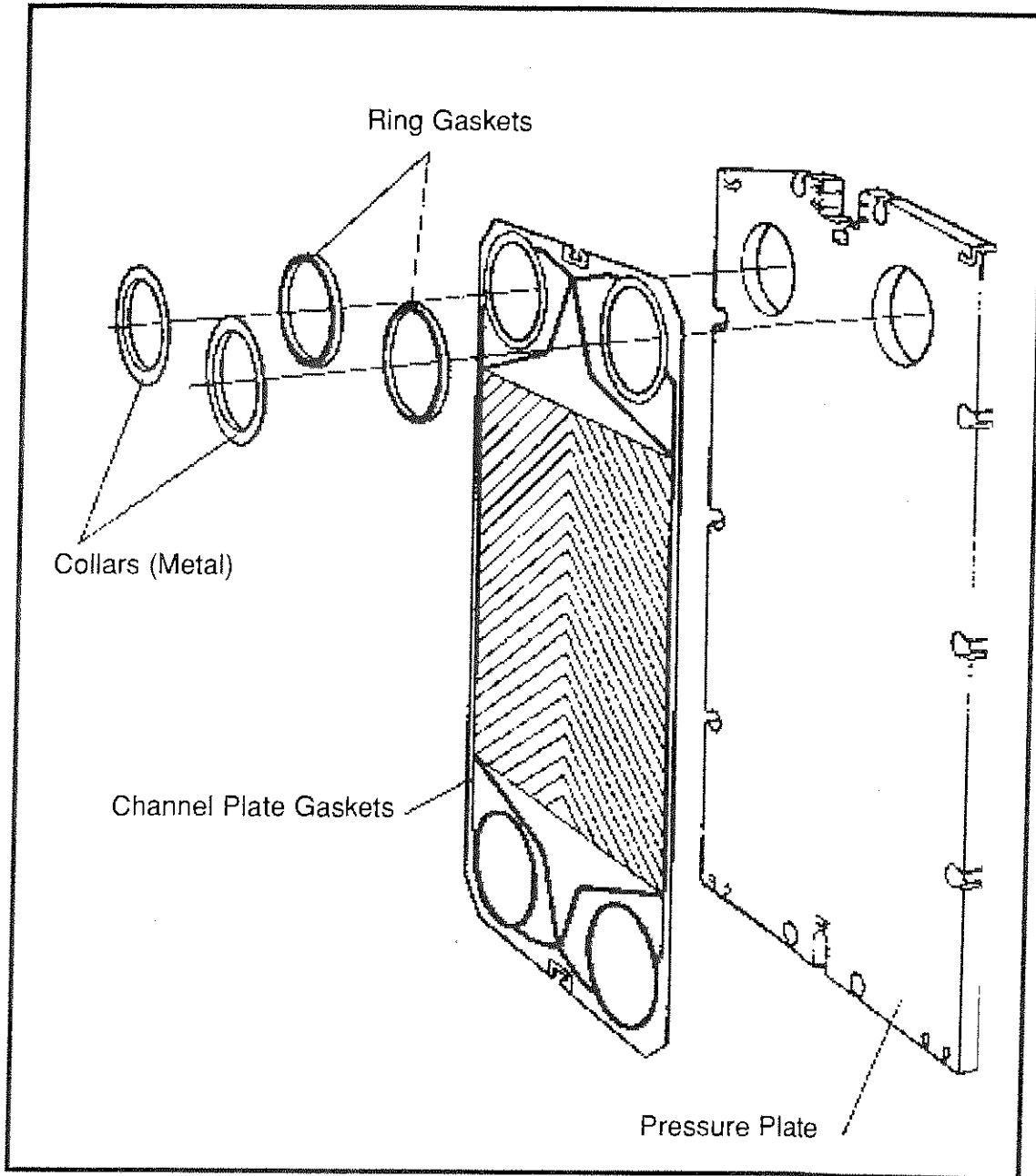


4A

PARALLEL FLOW UNITS

TRANSITION PLATE

M30, MX25, A20-B, AM20, AK20, T200, A15-B, M15, M10, M6



4B List of Diagonal Flow Units

"A" SERIES UNITS:

A10-BFG; A10-BFD

AX35-FG

A45-FG

"P" SERIES UNITS:

P2-FG; P2-VLCH; P2-DWFG

P3-E; P3-EH

"M" SERIES UNITS:

M3-XVG

"V" SERIES UNITS:

V28-FG, V28-FD, V45-FG, V45-FD, V110-FG, V110-FD,
V170-FG, V170-FD, V280-FG, V280-FD

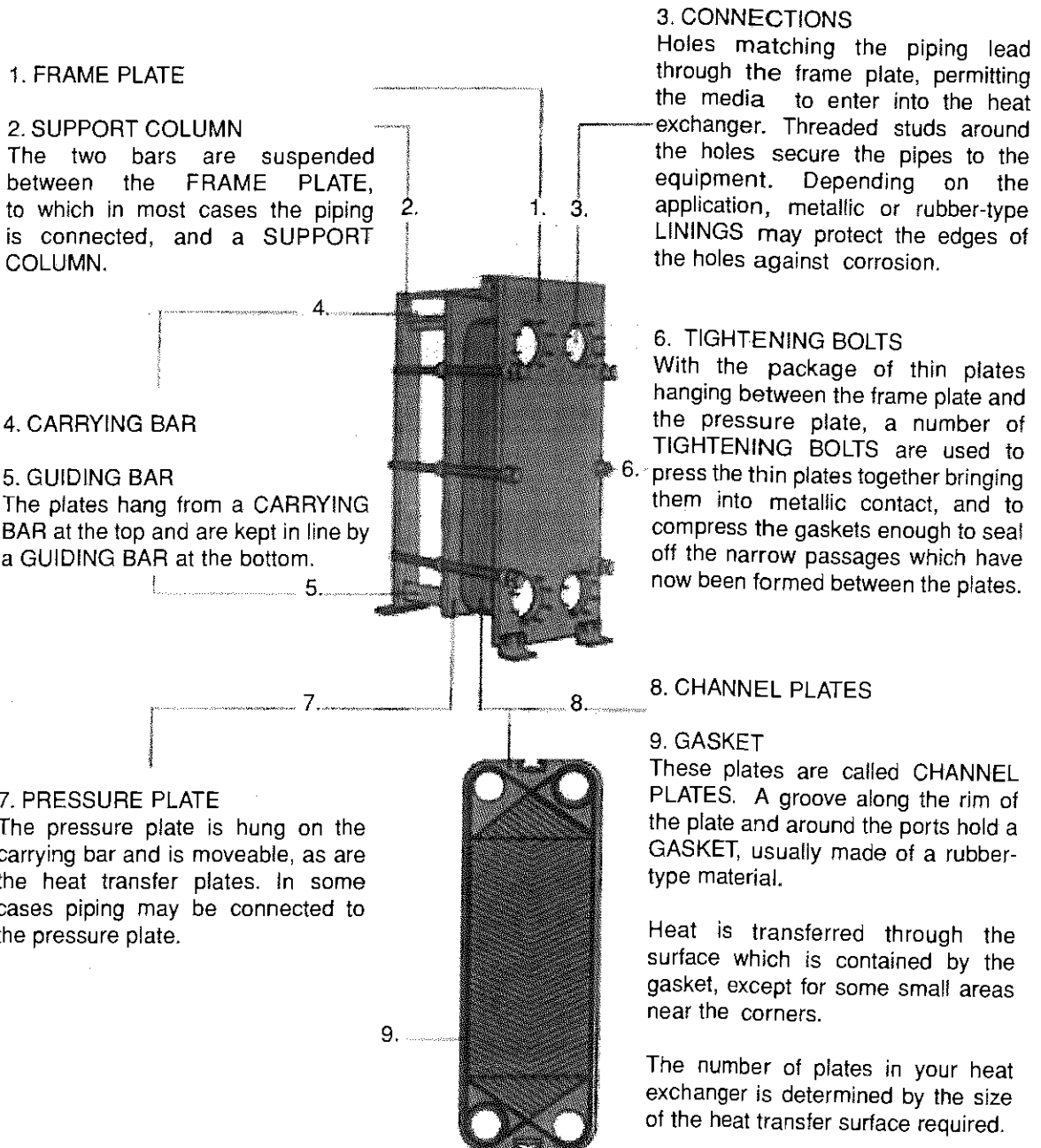
DIAGONAL FLOW UNITS

4B

Function

THE MAIN COMPONENTS OF THE PLATE HEAT EXCHANGER AND THEIR FUNCTIONS.

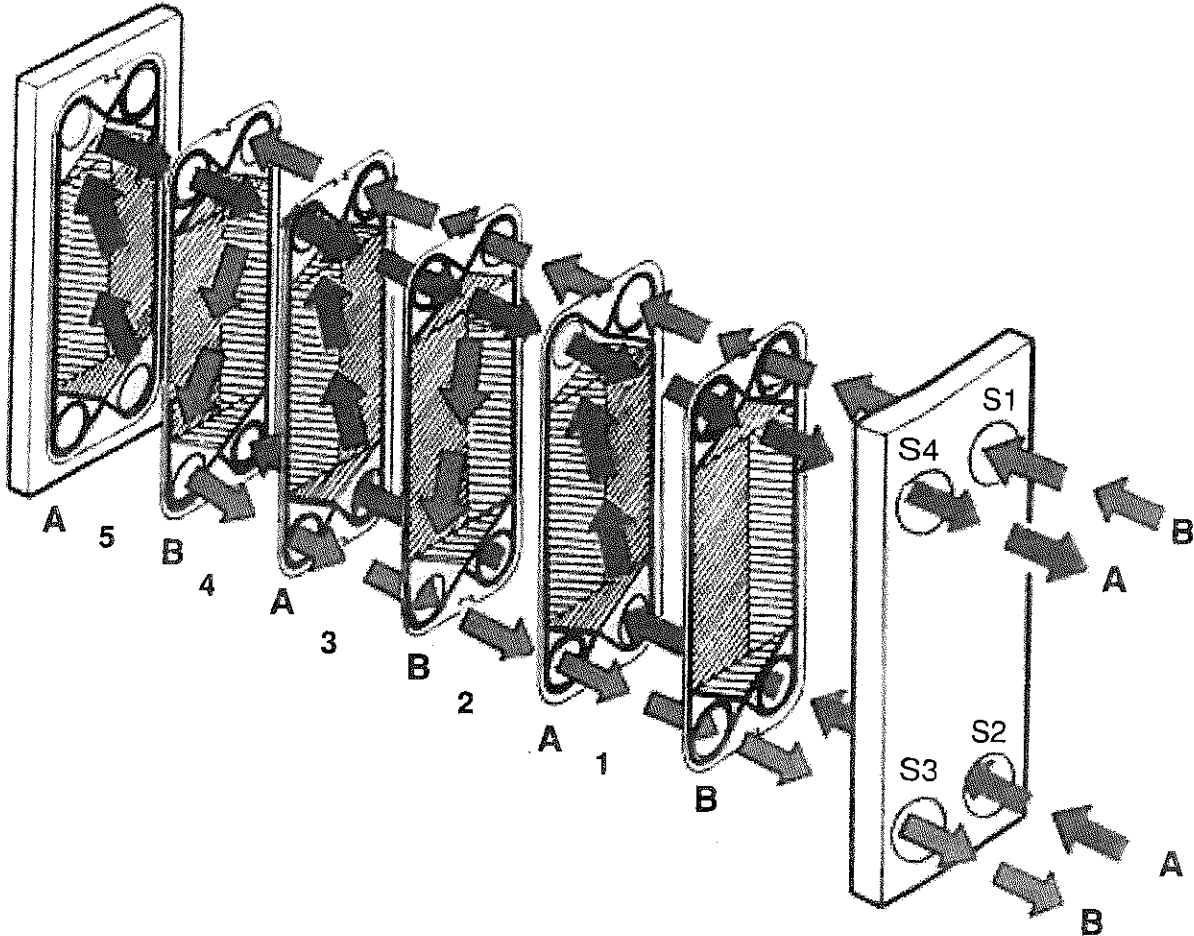
In ALFA LAVAL Plate Heat Exchangers, heat is transferred from one medium to another through thin metal plates which have been pressed into a special pattern.



4B

DIAGONAL FLOW UNITS

How it works



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Because of the gasket arrangement on the plates, and the placing of "A" and "B" plates alternately, the two liquids enter alternate passages, e.g. the warm liquid between even number passages, and cold liquid between odd number passages.

Thus the media are separated by a thin metal wall. In most cases the liquids flow in opposite directions.

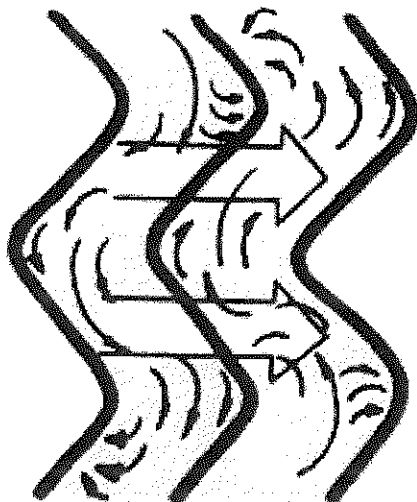
During the passage through the PHE, the warmer medium will give some of its heat energy to the thin wall, which instantly loses it again to the colder medium on the other side.

The warmer medium drops in temperature, while the colder one is heated up.

Finally, the media are led into similar hole-tunnels at the other end of the plates and discharged from the heat exchanger.

4B.3

Heat transfer

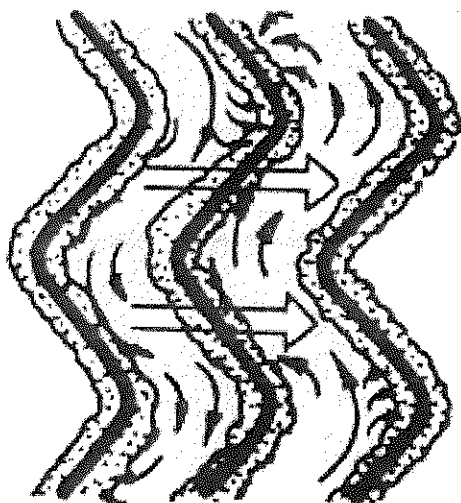


The purpose of the equipment is to transfer heat from one medium to another, and heat passes very easily through the thin wall separating the two media.

The novel pattern into which the plate material has been formed not only gives strength and rigidity, but greatly increases the rate of heat transfer from the warmer medium to the metal wall and from the wall to the other medium.

This high heat flow through the walls can be seriously reduced by the formation of deposits of various kinds on the wall surfaces.

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The deposits may increase the total "wall thickness" substantially, and they consist of materials that have a much lower thermal conductivity than the metal plate. Consequently a layer of deposits can severely reduce the overall heat transfer rate.

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It is clear that the fouling of the surfaces is undesirable.

Larger particles and fibers may also be drawn into the heat exchanger and clog the passage ways if strainers or other means of protection have not been provided for.

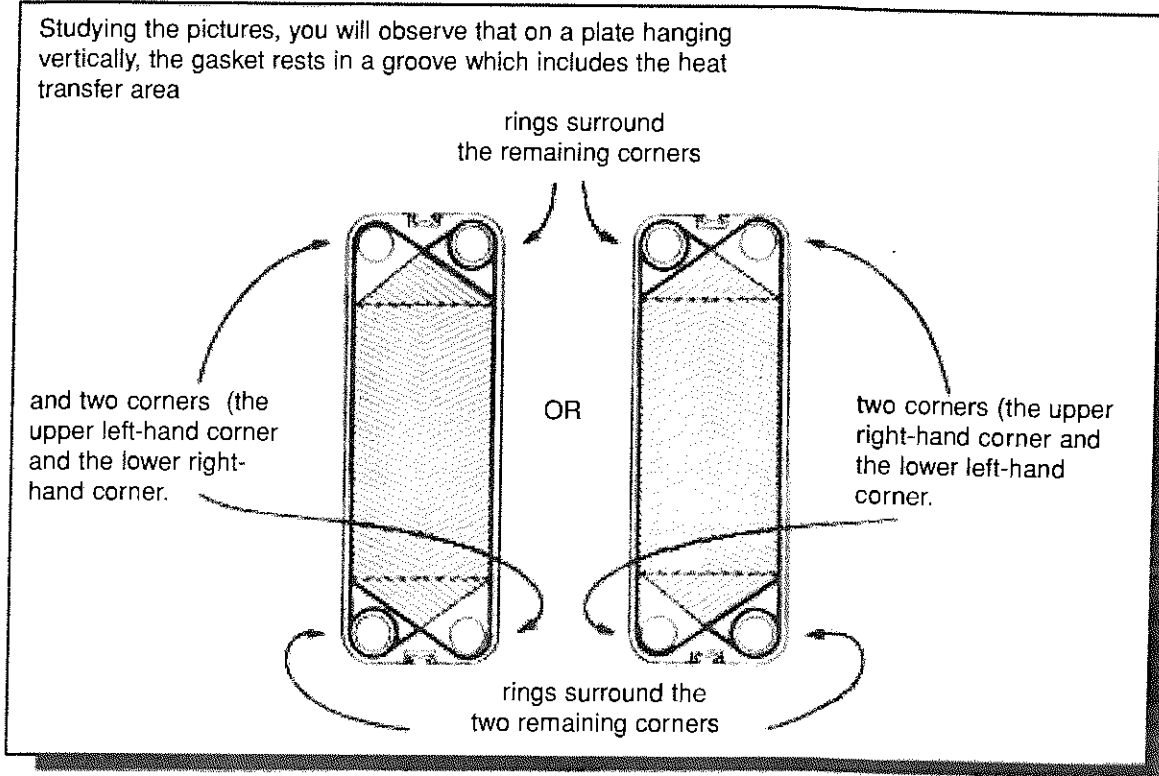
A reduced ability by the heat exchanger to hold the desired temperatures, in combination with an increased pressure drop on any of the media, indicates that fouling or clogging is taking place.

For corrective action, see MAINTENANCE and CLEANING.

4B

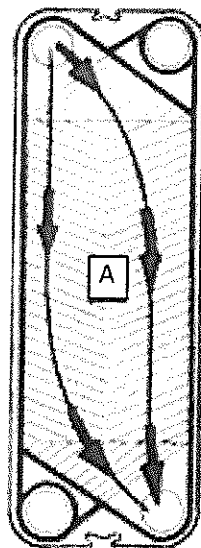
DIAGONAL FLOW UNITS

Plates

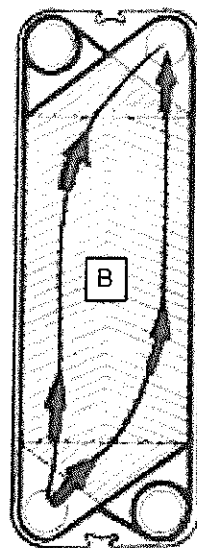


Depending on which two corners are included with the heat transfer area, the plate is called an A- or a B-Plate.

An A-plate is a plate hanging with the chevron pointing downwards.



A B-plate is a plate hanging with the chevron pointing upwards.

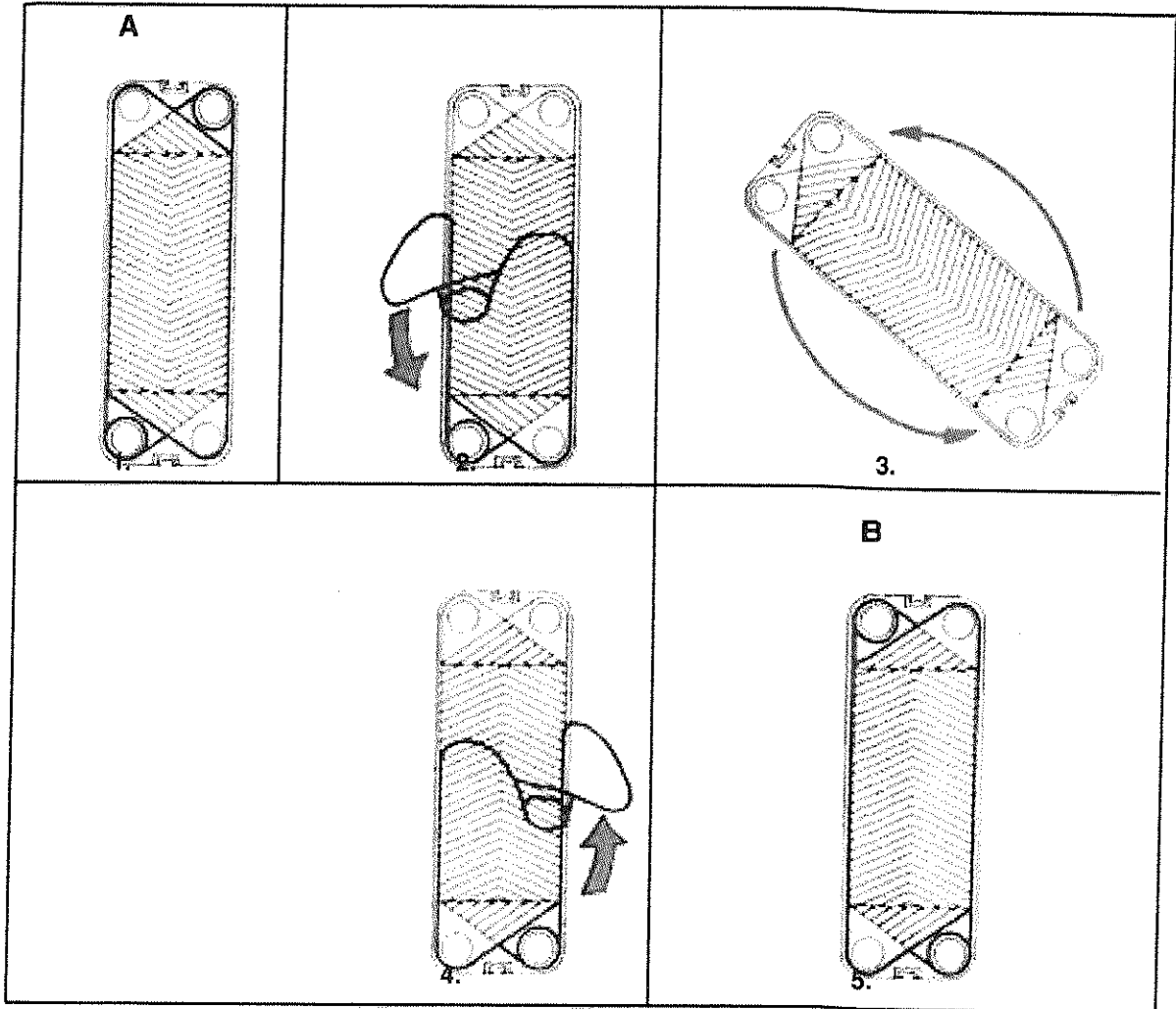


DIAGONAL FLOW UNITS

4B

Plates

We can make a B-Plate from an A-plate or the opposite, by changing the gasket and turning the plate upside down.

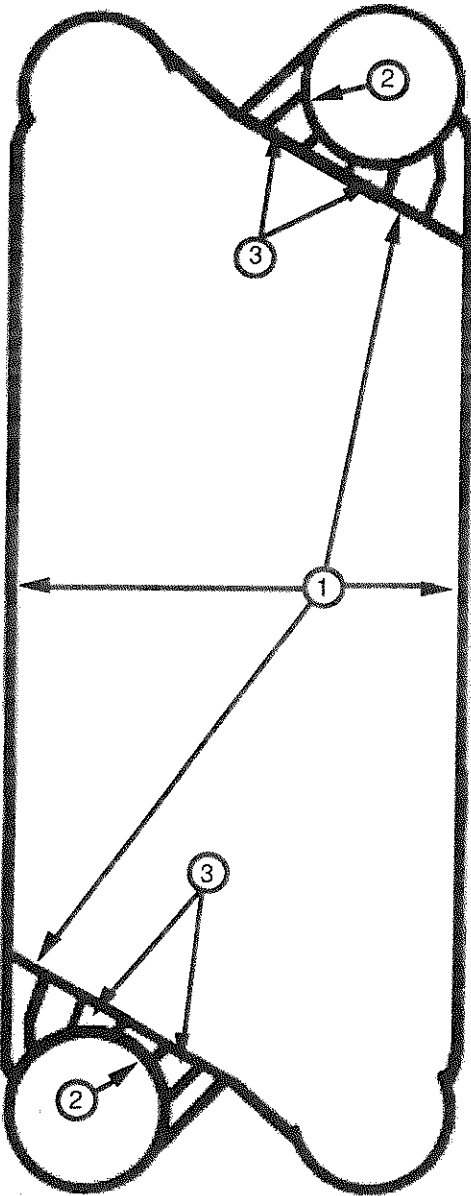


4B

DIAGONAL FLOW UNITS

Gaskets

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The one-piece gasket consists of:

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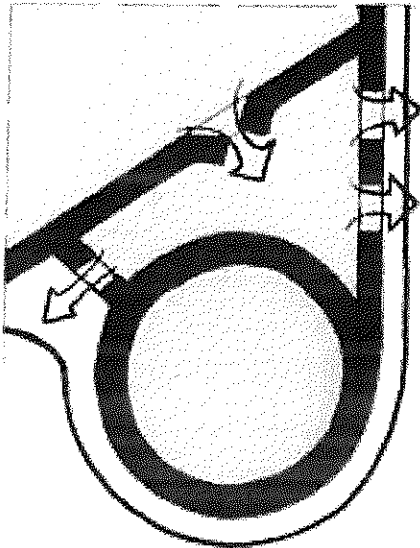
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DIAGONAL FLOW UNITS

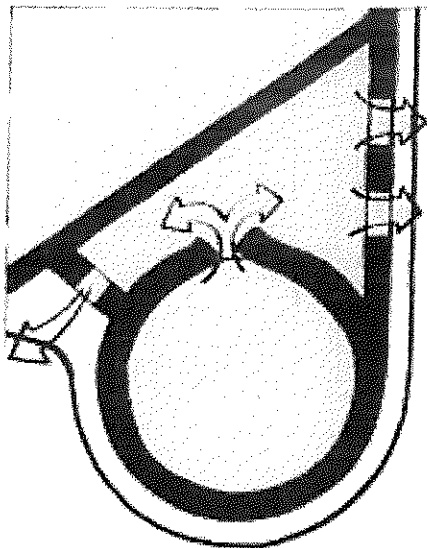
4B

Gaskets



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It is important that these openings are kept clear. If they are not, there is a risk that should a leak occur in that region of the plate, there might be a local pressure build-up, which could allow one medium to mix with the other.



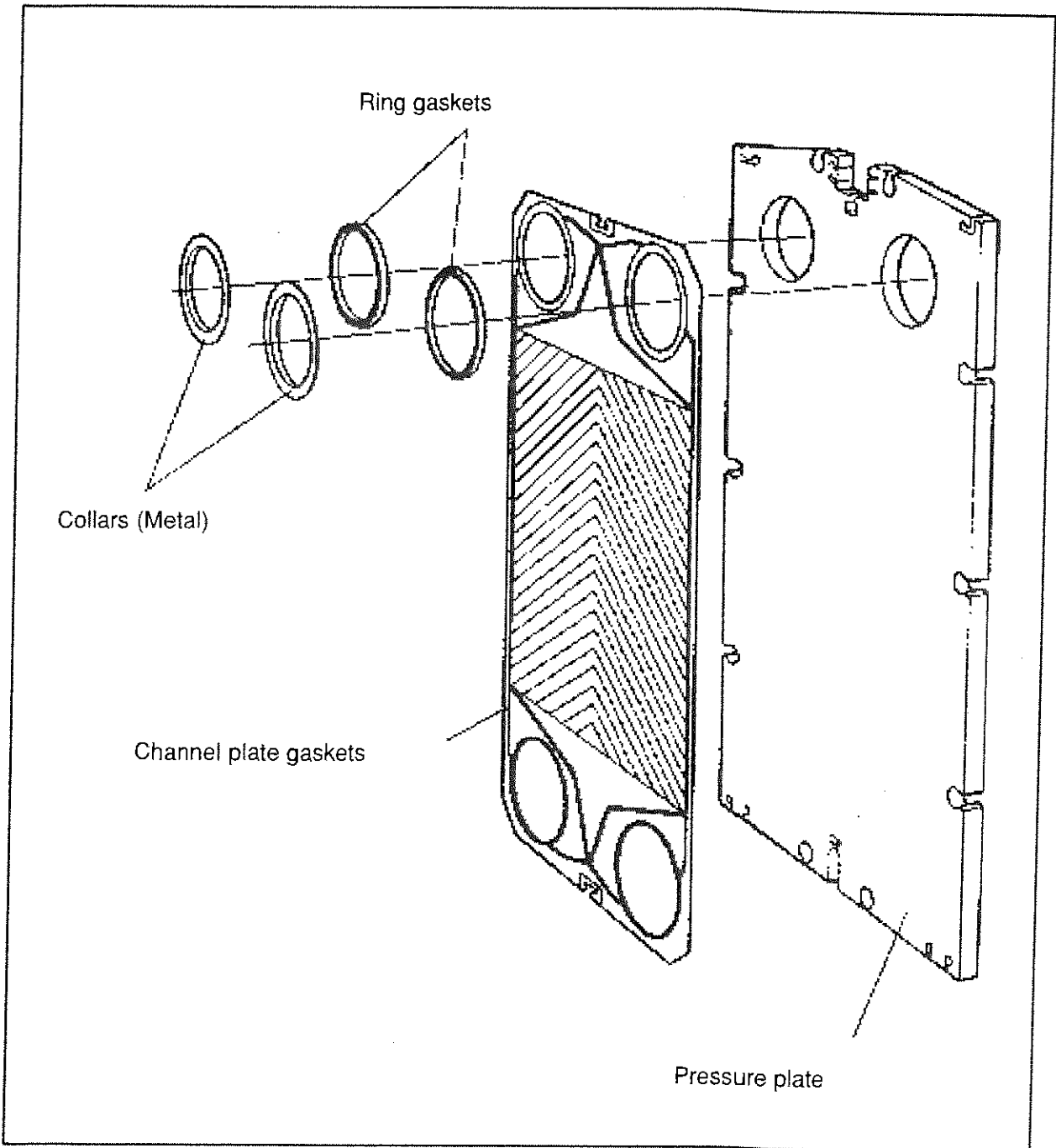
Care should be taken not to cut or scratch the gaskets while handling plates.

4B

DIAGONAL FLOW UNITS

TRANSITION PLATE

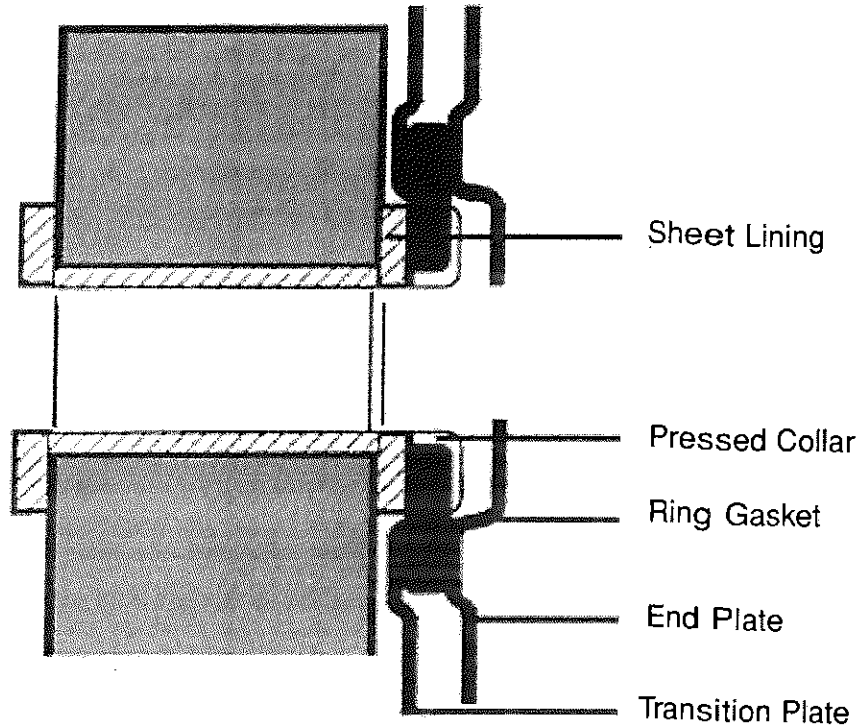
M30, MX25, A20-B, AM20, AK20, T200, A15-B, M15, M10, M6



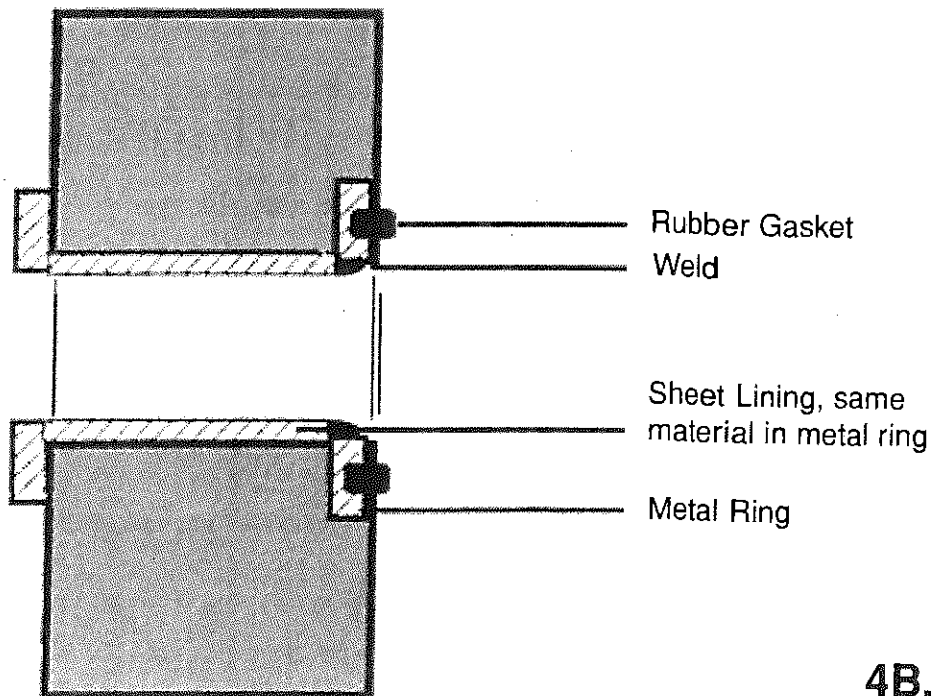
DIAGONAL FLOW UNITS

4B

NON MACHINED PRESSURE PLATE



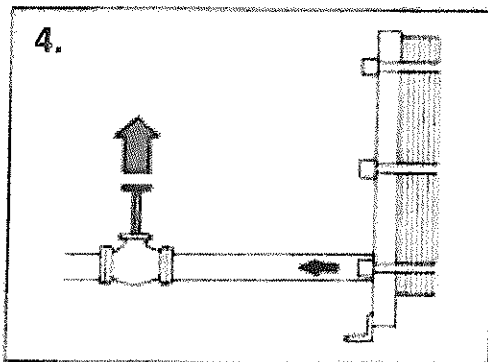
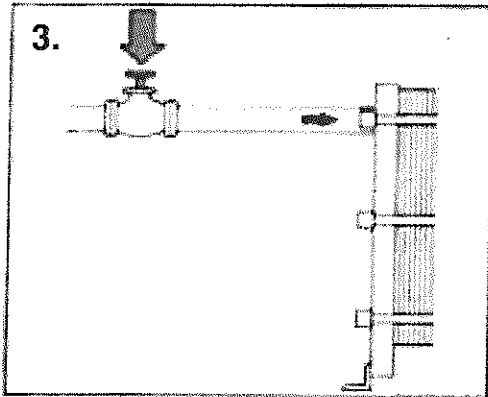
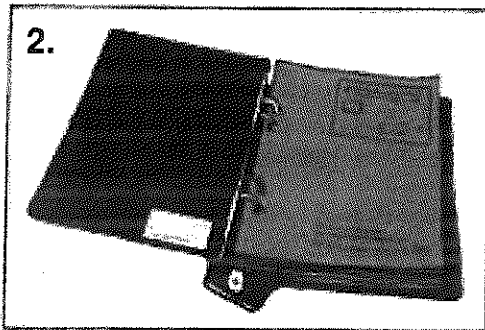
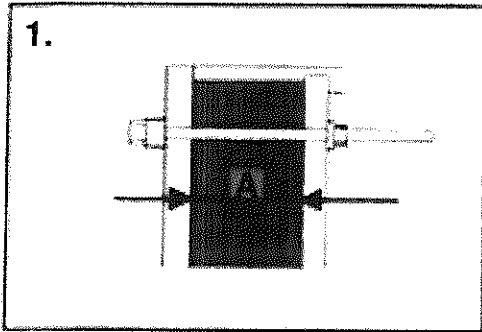
MACHINED PRESSURE PLATE (AX30, AM20 AND OBSOLETE FRAMES)



4B.11

5

Operation



START UP

1. BEFORE STARTING UP FOR THE FIRST TIME OR AFTER A LONG TIME IN STORAGE: MAKE SURE THAT THE PLATE PACK IS COMPRESSED TO THE CORRECT MEASUREMENT A! Check with the Drawing or Nameplate, which is provided with each heat exchanger.

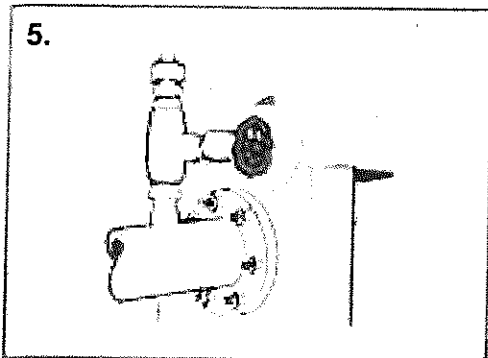
It is very important that the system to which the heat exchanger is connected, is protected against sudden and extreme variations of temperature and pressure. This is not only for the heat exchanger but also for the pipe system itself and every piece of equipment included in it.

This should be kept in mind whenever a maneuver is to be carried out, including starting up of the pumps in the system.

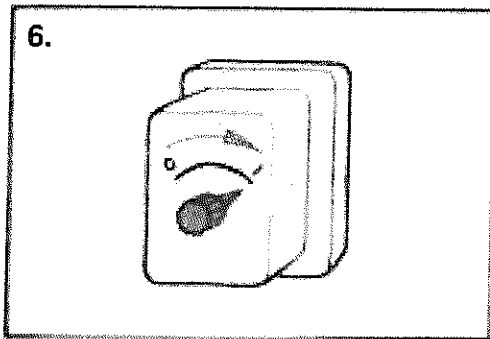
2. Before starting any pump, check whether instructions exist, telling you which pump should be started first.
3. Check that the valve between the pump and the equipment, controlling the flow rate of the system which you are about to start up is closed.
4. Check that the valve at the exit, if there is one, is fully open.

Operation

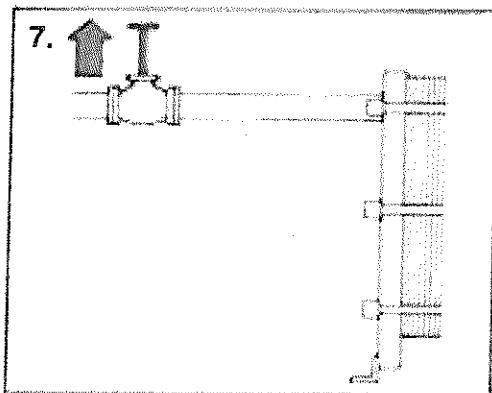
5



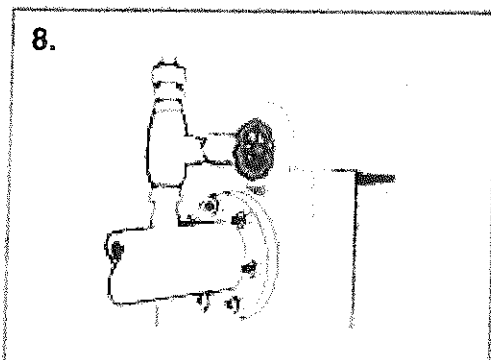
5. Open the vent.



6. Start the Pump.



7. Open the valve slowly.



8. When all air is out, close the vent.

9. Repeat the procedure for the other media.

5

Operation

UNIT IN OPERATION

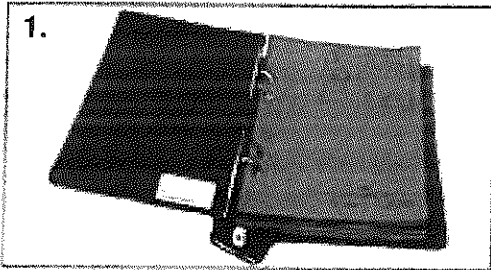
Any adjustment of the flowrates required to maintain correct temperatures or pressure drops should be made slowly, in order to prevent shocks to the system.

Problems in keeping up the performance of the heat exchanger may be caused by a change in some of the temperature conditions, the heat load or by fouling.

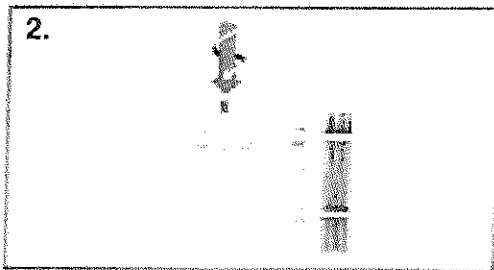
As long as the PHE is operating to satisfaction, it should be left without any interference.

SHUT-DOWN

If the heat exchanger is going to be shut down - or if for any reason the pumps are to be stopped - the following procedure should be followed:



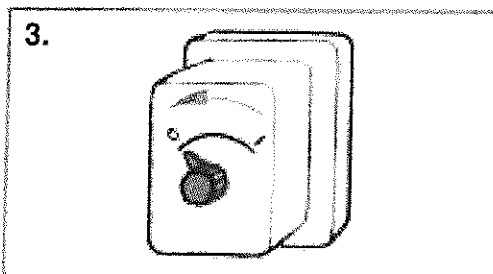
1. First establish whether instructions exist that specify which side should be stopped first.



2. SLOWLY CLOSE THE VALVE controlling the flow rate of the pump you are about to stop.

3. When the valve is closed, stop the pump.

4. Repeat the procedure for the other side.



5. Poor quality cooling water may be hazardous to metallic materials. Typical examples are corrosion of stainless steels and nickel alloys.

If for any reason the heat exchanger is shut down for a longer period (more than a number of days), it should be drained, and depending on the media processed, it is recommendable to rinse and dry it.

THE RISKS OF NOT COMPLYING WITH THE START-UP AND SHUT-DOWN PROCEDURES.

A liquid in motion in a pipe system represents a lot of energy, and it must be very carefully dealt with.

Particularly when the fluid is stopped it is imperative that this is done smoothly.

NOTE!

For this reason fast-closing valves should not be used unless the pipes of the system are very short.

Valves must be operated gradually. The longer the pipes and the higher the flow rate, the more important this becomes.

WATER HAMMER is the name given to a short duration pressure peak, traveling along the pipe as a wave at the speed of sound, and resulting from a sudden deceleration of the motion of the fluid in a closed system.

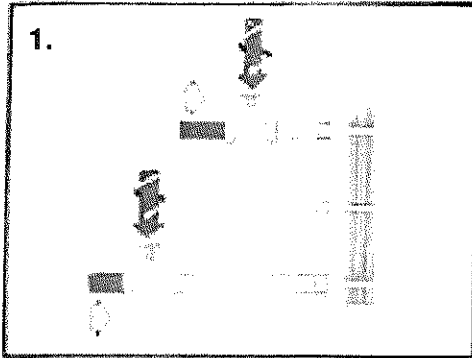
Thus, it is usually related to the shutting down of a system. However, when starting up a system with open valves and empty pipes, the fluid may burst into some obstacle, like a fine mesh strainer, a flow meter or a heat exchanger, causing a sudden reduction of the flow velocity - if not a complete halt, and so we may have the conditions of a Water Hammer.

In the worst case, the pressure surge caused by such a sudden stop of the motion of a fluid, can be several times the normal pressure of the system.

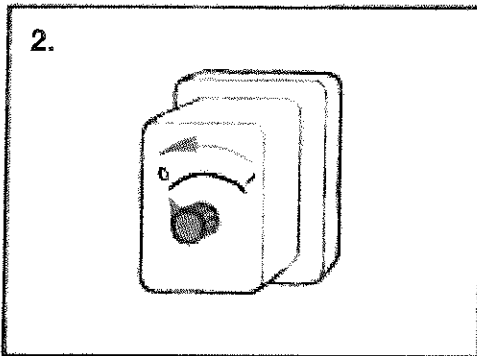
Therefore it is very important for the protection of the whole installation that start-ups and close-downs are carried out with great care.

6

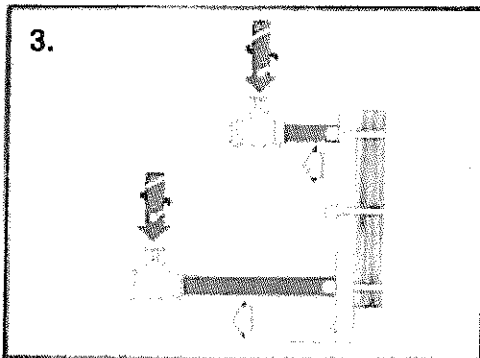
Opening



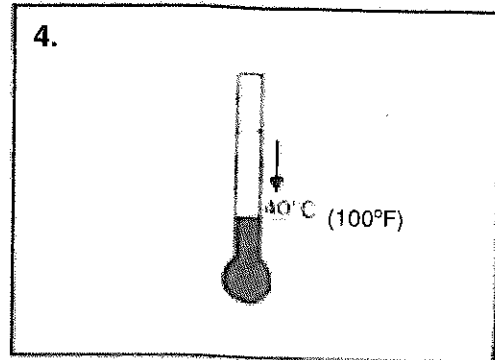
1. Slowly close the valves on the inlets. Shut off the inlet side, closing the highest pressure first.



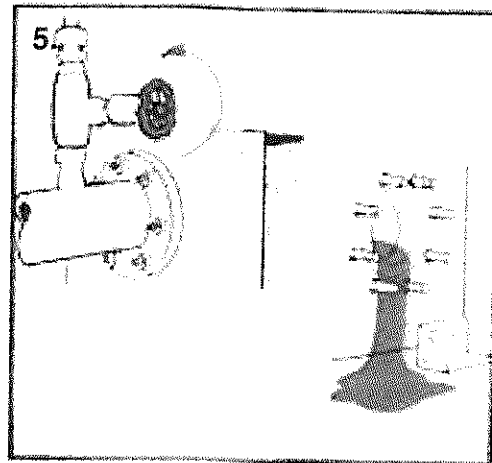
2. Switch off pumps.



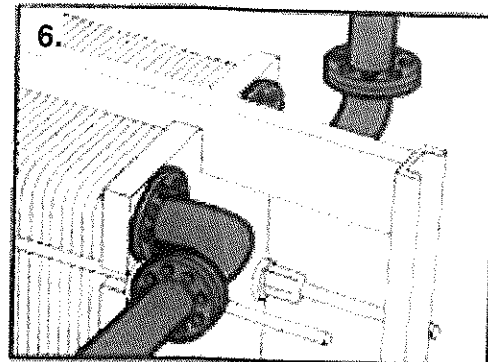
3. Close the valves on both outlets.



4. If the heat exchanger is hot, wait until it has cooled down to about 40°C (100°F).



5. Drain

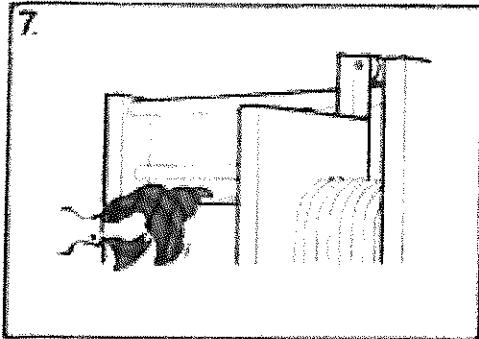


6. Dismantle any pipe bends connected to the pressure plate, so that it can be moved freely along the carrying bar.

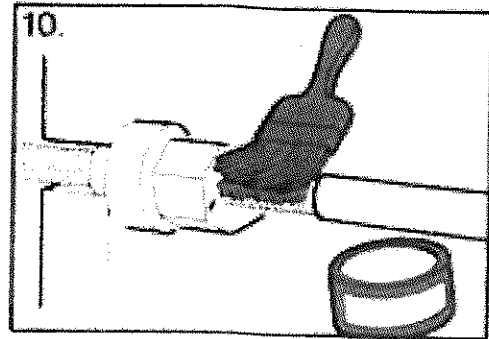
6.1

Opening

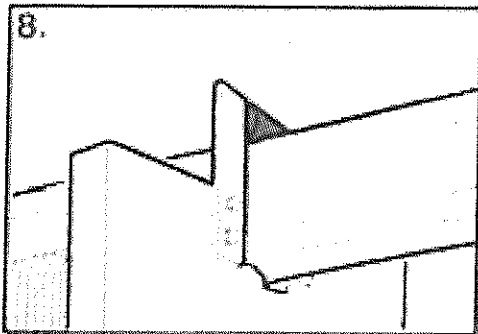
6



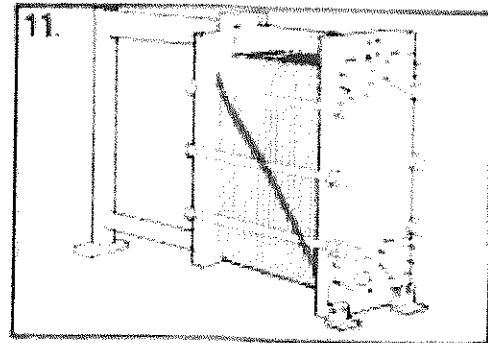
7. Inspect the sliding surfaces of the carrying bar and wipe clean



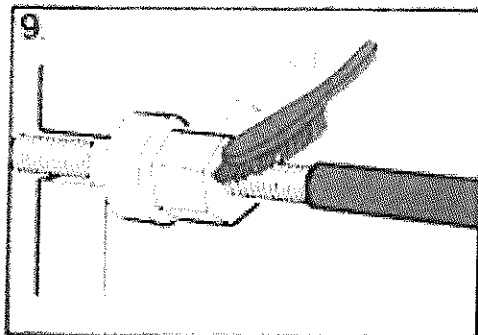
10. Lubricate the threads with a thin layer of grease, e.g LUBRIPLATE FGL-2 or equivalent.



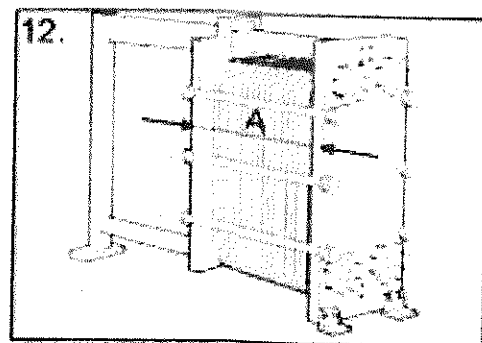
8. Inspect pressure plate roller.



11. Mark the plate assembly on the outside by a diagonal line, or number the plates in sequence.



9. Pull back the plastic covers on the tightening bolts; brush the threads clean with a steel wire brush.



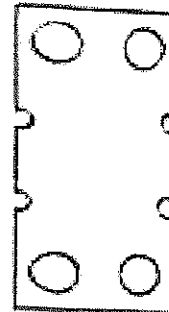
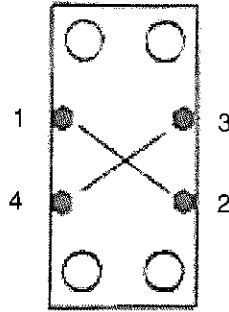
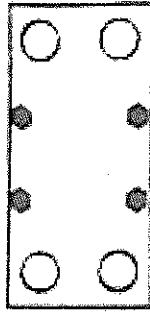
12. Measure and note the dimension A. Compare with code plate and PHE documentation for this same serial number.

6

Opening

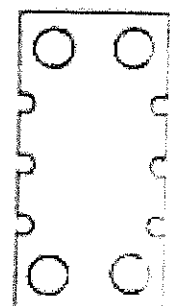
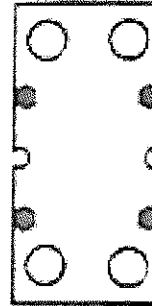
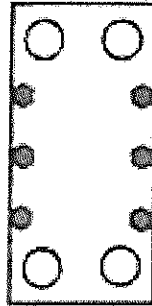
(13) (See page 6.5) (14)

	P2	A10B	TS6-M	AM10	M10B M10M
FG	X	X	X	X	
FM					X
FD			X		



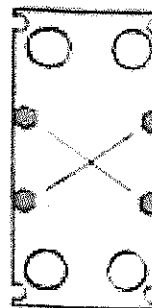
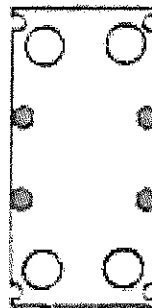
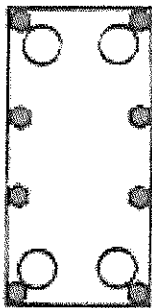
(13) (See page 6.5) (14)

	V8	P3	V13 V20	V28	M10B M10M	M10BW M10DW	M20-M
E		X					
FD			X				
FG			X	X	X	X	
FM							X
VG	X						



(13) (See page 6.5) (14)

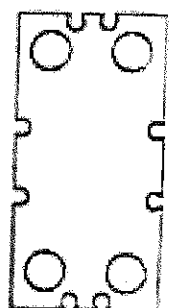
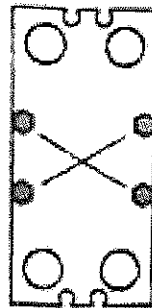
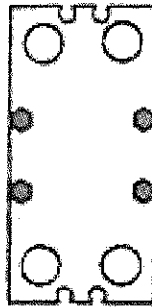
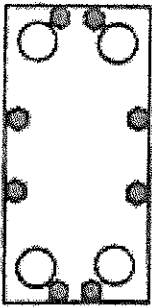
	M3	P2	P3	V28	V45
EH			X		
VG	X				
VLCH		X			
FG				X	X
FD				X	X



(13) (See page 6.5) (14)

	MX25B	A15BWA	15B	TS20-M	AM20 AM20B AM20W AM20S	M6	M15M
FG		X	X	X	X	X	X
FD		X	X	X	X	X	X
FL			X				
FM	X			X			X
FS				X			

M6/M6-MFG & MX25-BFM ONLY HAS ONE BOLT TOP AND BOTTOM

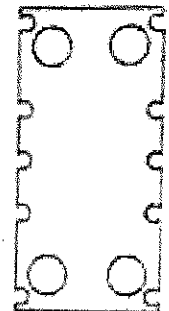
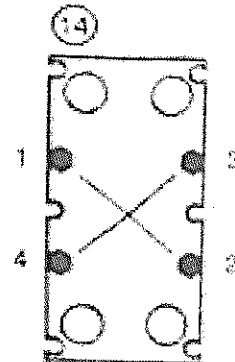
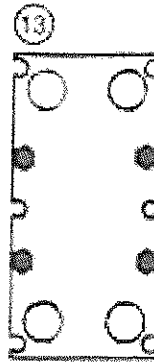
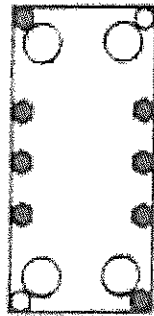


Opening

6

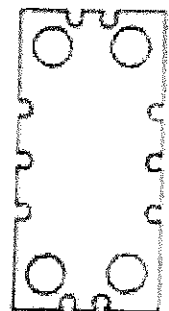
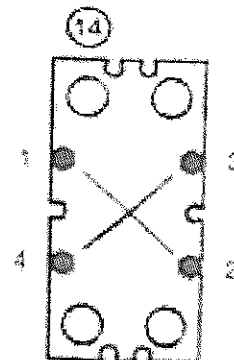
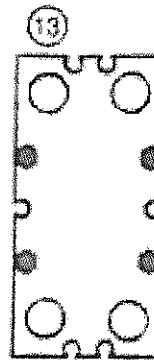
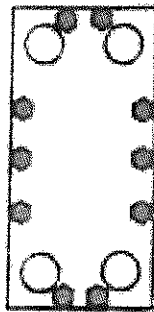
	M20-M			
FG				

M20-MFG ONLY HAS ONE BOLT TOP AND BOTTOM

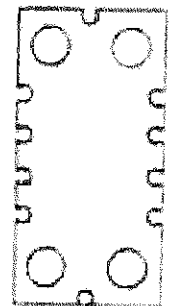
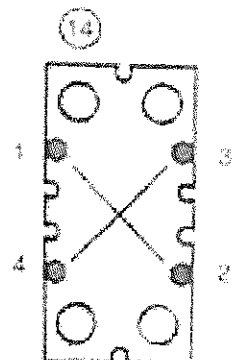
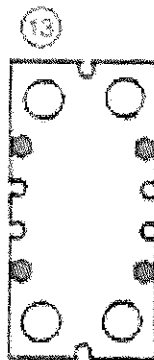
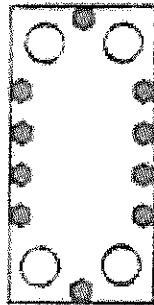


	M15B M15F	A20B	T200	M6 AK20 M6DW	M6M M30
FG		X	X		
FD				X	
FM					X
FS	X				

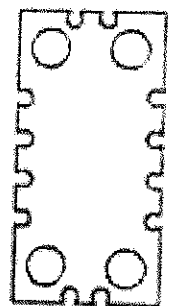
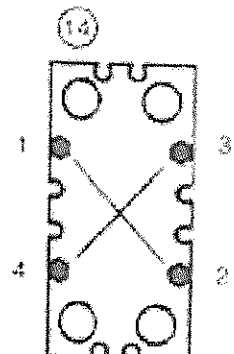
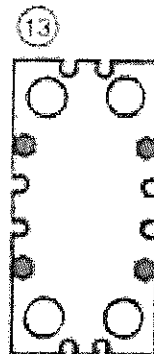
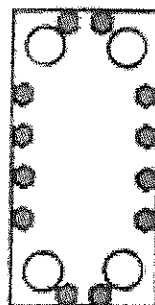
M6/M6-MFG ONLY HAS ONE BOLT TOP AND BOTTOM



	M10B M10M	M10BW		
FD	X	X		



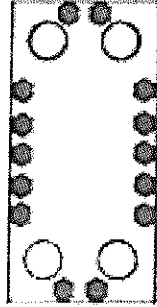
	A20B	AK20 T200	MX25B	V110
FD	X	X		
FL	X			
FG			X	X



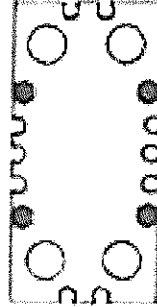
6

Opening

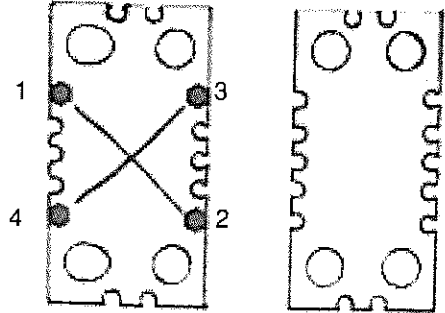
	AX30B AX30BW	V110		
FG FD	X	X		



13

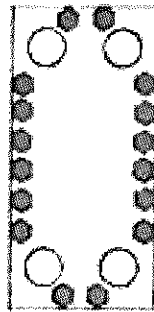


14

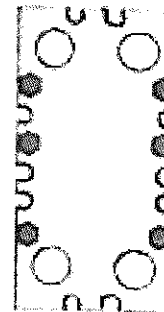


	AX30B AX30BW	A35 A45	AX35	M20M	M30	MX25B	V170 V280
FG FD HA FS	X	X	X	X	X	X	X

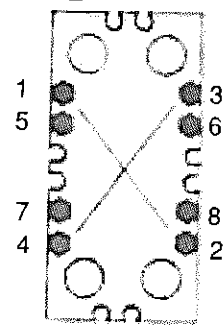
NOTE: M30-FD, MA30-FG/FD, MX25-BFS, V280-FG/FD and V170-FD have a twenty bolt or larger pattern, use this picture only as a guide. Start sequence numbers 5 and 6 at the fourth bolt down on both sides.



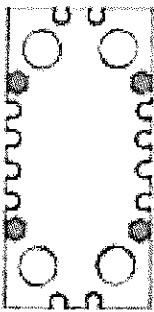
13



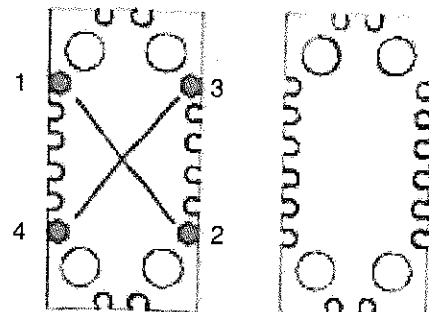
14



15



16



ORDER	BOLT NO.	TO DIM.
1	1-2-3-4-5-6	1.05A
2	1-2-3-4	1.10A
3	1-2 OR 3-4	OPENING

- 13 If bolts are fitted with bearing boxes loosen and remove them. If not fitted with bearing boxes, then follow the pictures above.
- 14 Loosen the remaining bolts, alternately and diagonally, to bring length to 1.05A.
- 15 Remove bolts 5 and 6 completely.

- 16 Continue opening, alternately and diagonally.

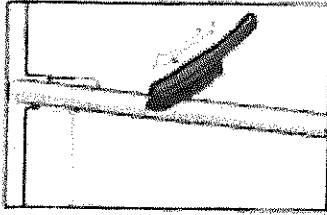
Note: Skewing of the Pressure Plate during opening must not exceed 10 mm (2 turns per bolts) across the width and 25 mm (5 turns per bolts) vertically.

6.5

Removal and insertion of plates

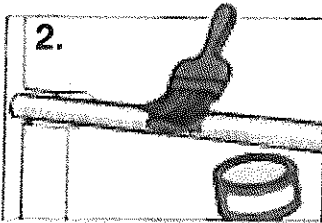
6

1.



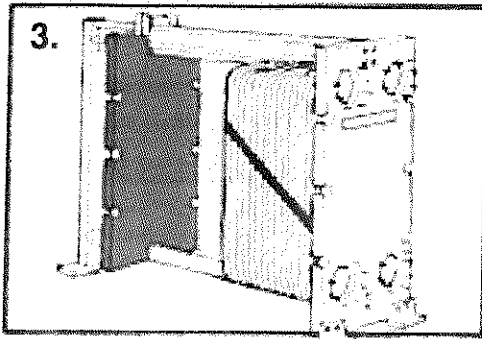
Brush the threads of the bolts clean, using a steel wire brush

2.



Lubricate the threads with a thin layer of grease, e.g. LUBRIPLATE FGL-2 or equivalent.

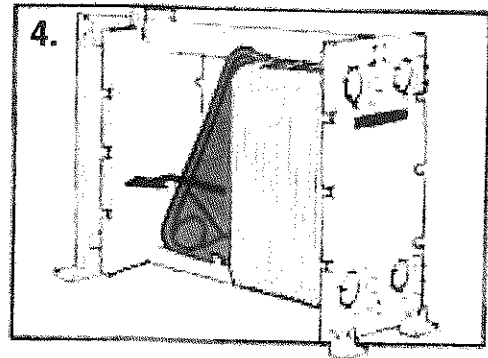
3.



REMOVAL OF PLATES

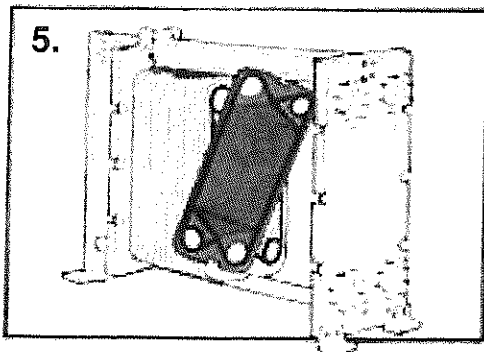
3. Push the pressure plate against the support column.
4. Remove the plates. Stack them neatly on a skid or pallet for easy transporting.

4.



INSERTION OF PLATES

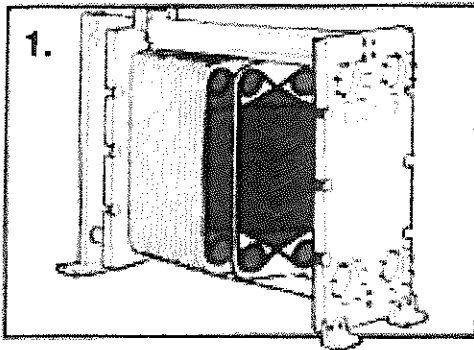
5.



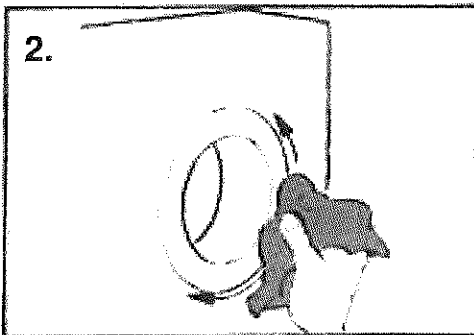
5. Hang the plates with their backs towards the pressure plate (the side without gasket).

6

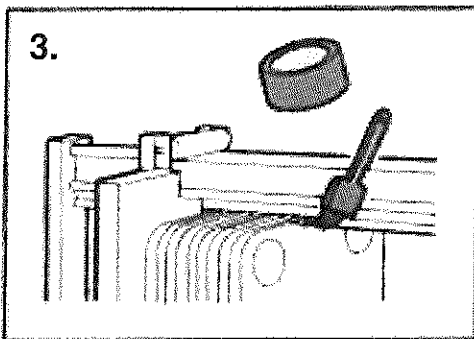
Closing



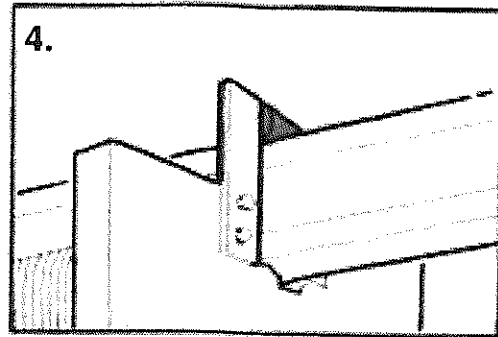
1. Check that all the sealing surfaces (i.e. surfaces in contact with the heat transfer medium) are clean.



2. Check that the ring gaskets or liners, when fitted in connections, are in position and are in good condition.

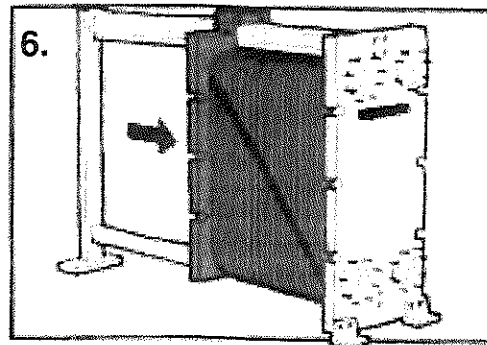


3. Clean and lubricate the sliding surfaces of the carrying bar.

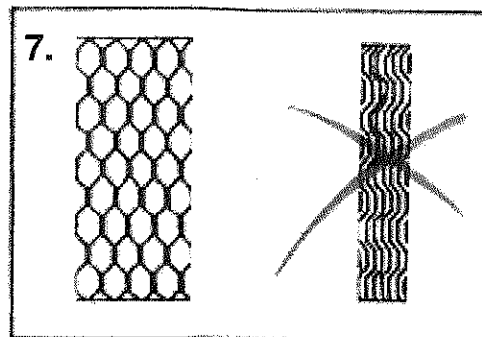


4. Inspect the pressure plate roller. Remove any debris from top surface of carrying bar.

5. Check against the drawing or flow sheet (provided with each heat exchanger) to make sure that the plates are hanging in the correct order.



6. Press the plate assembly together.



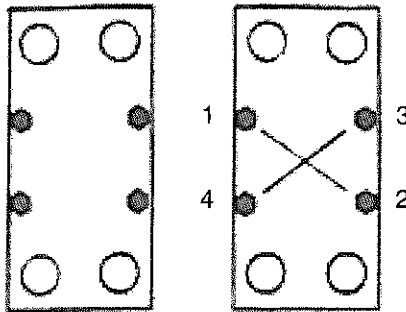
7. If the plates are correctly assembled, the edges form a "honeycomb" pattern.

If the plate pack has been marked on the outside (fig. 6) check this.

Closing

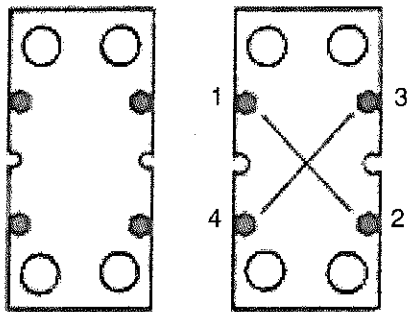
	P2	A10B	TS6-M	AM10	M10B M10M
FG	X	X	X	X	
FM					X
FD			X		

⑧ (See page 6.11) ⑪

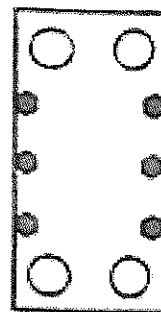


	V6	P3	V13 V20	V28	M10B M10M	M10BW M10DW	M20-M
E		X					
FD			X				
FG			X	X	X	X	
FM							X
VG	X						

⑧ (See page 6.11) ⑪

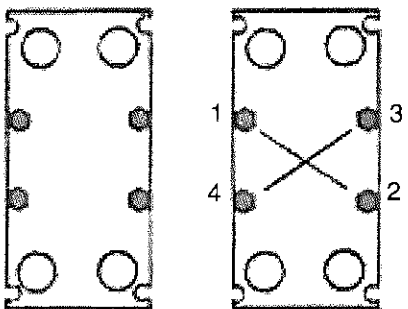


⑭ (See page 6.11)

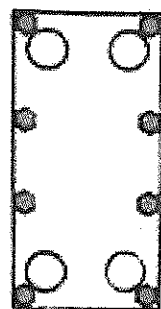


	M3	P2	P3	V28	V45
EH			X		
VG	X				
VLCH		X			
FG				X	X
FD				X	X

⑧ (See page 6.11) ⑪

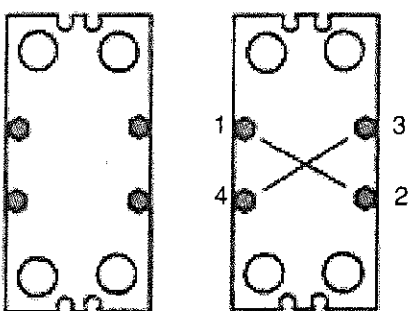


⑭ (See page 6.11)

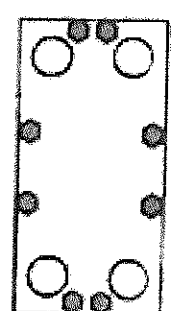
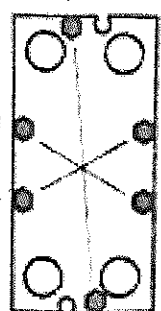


	MX25B	A15BW	A15B	TS20-M	AM20 AM20B AM20W AM20S AM20DW	M6 M6M	M15M
FG		X	X	X	X	X	X
FD		X	X	X			X
FL			X				
FM	X		X	X			X
FS				X			

⑧ (See page 6.11) ⑪



⑭ (See page 6.11)



M6/M6-MFG & MX25-BFM ONLY HAS ONE BOLT TOP AND BOTTOM

6

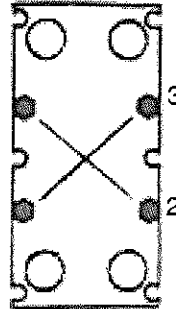
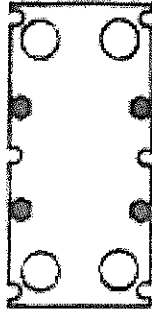
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Closing

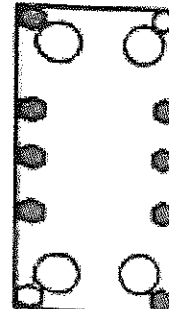
	M20-M			
FG				

M20-MFG ONLY HAS ONE BOLT TOP AND BOTTOM

8 (See page 6.11) 11



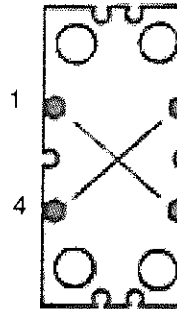
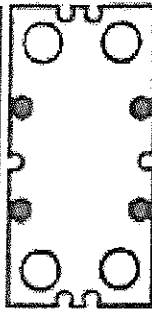
14 (See page 6.11)



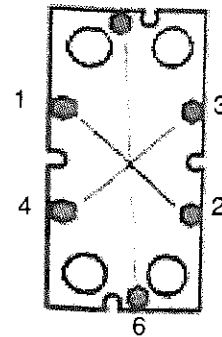
	M15B M15F	A20B	T200	M6 AK20 M6DW	M6M M30
FG		X	X		
FD				X	
FM					X
FS	X				

M6/M6-MFG ONLY HAS ONE BOLT TOP AND BOTTOM

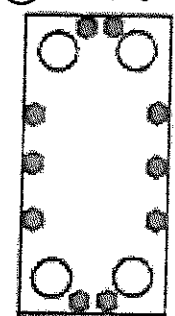
8 (See page 6.11) 11



5

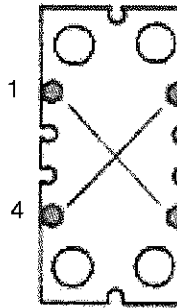
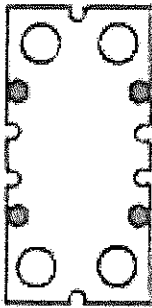


14 (See page 6.11)

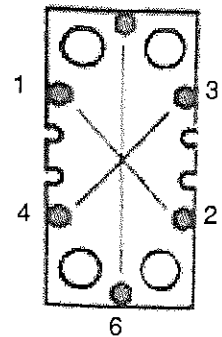


8 (See page 6.11) 11

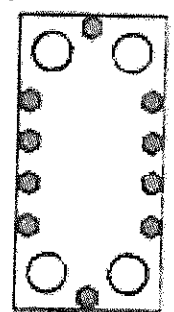
	M10B M10M	M10BW		
FD	X	X		



5

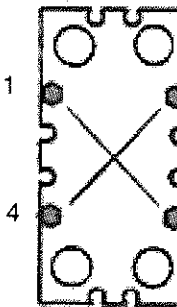
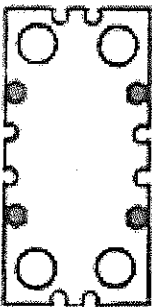


14 (See page 6.11)

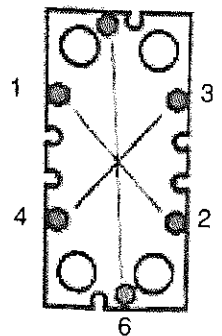


8 (See page 6.11) 11

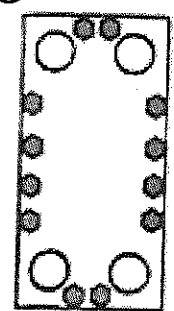
	A20B	AK20 T200	MX25B	V110
FD	X	X		
FL	X			
FG			X	X



5



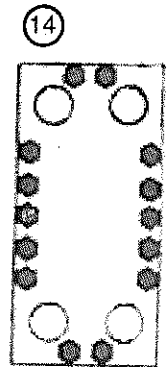
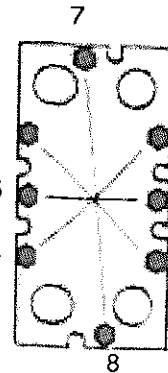
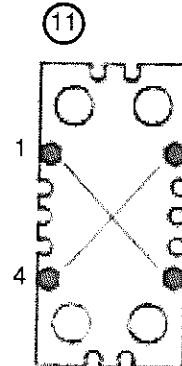
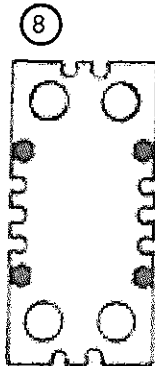
14 (See page 6.11)



Closing

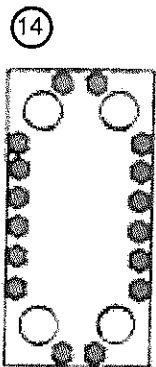
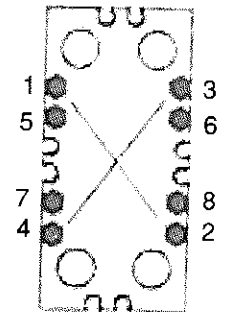
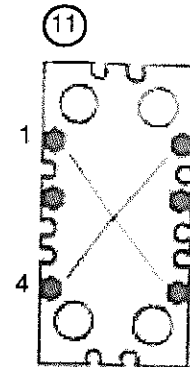
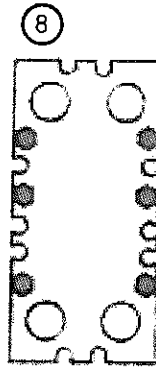
6

	AX30B AX30BW	V110		
FG FD	X	X		



	AX30B AX30BW	A35 A45	AX35	M20M	M30	MX25B	V170 V280
FG FD HA FS	X	X	X	X	X	X	X

NOTE: M30-FD, MA30-FG/FD, MX25-BFS, V280-FG/FD and V170-FD have a twenty bolt or larger pattern, use this picture only as a guide. Start sequence numbers 5 and 6 at the fourth bolt down on both sides.

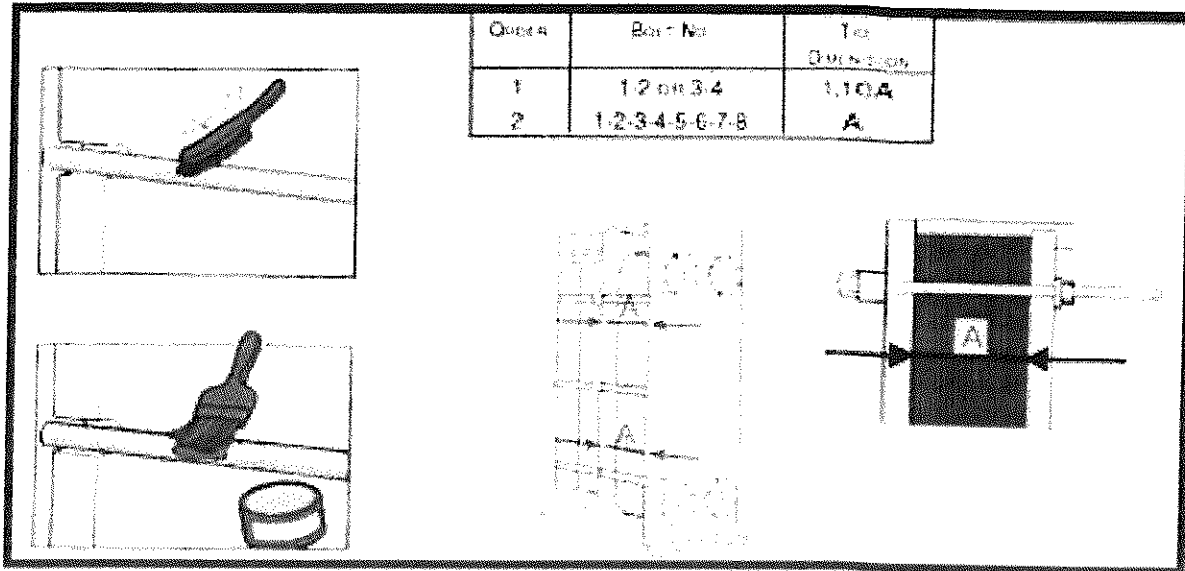


ORDER	BOLT NO.	TO DIM.
1	1-2-3-4-5-6	1.05A
2	1-2-3-4	1.10A
3	1-2 OR 3-4	OPENING

Note: See next page for closing instructions for all the models

6

Closing



8. Place all the bolts that are fitted with bearing boxes in position. If not fitted with bearing boxes then follow the pictures for your specific model.
9. Brush the threads of the bolts clean, using a steel wire brush.
10. Lubricate the threads with a thin layer of grease, e.g. LUBRIPLATE FGL-2 or equivalent.
11. Tightening is carried out alternately and diagonally, as shown on the figure above.
12. Check the dimension A during tightening at the positions of the bolts that are being used. Skewing of the pressure plate during tightening must not exceed 10mm (2 turns per bolt) across the width and 25 mm (5 turns per bolt) vertically.
13. Nominal plate pack length A can be exceeded in exceptional cases, the tightening can be stopped at the following dimensions

Plate pack length/plat	Plate pack length
> 4 mm	A + 1%
> 3mm, < 4mm	A + 1.5%

14. Place the other bolts in position.
 - Inspect the washers.
 - When fully tightened, the bolts should all be equally tensioned.
 - The difference between the plate pack lengths measured at adjacent bolts should not exceed:
 - 2mm when dimension A is < 1000mm
 - 4mm when dimension A is > 1000mm
 - The plate pack length at all bolts must not differ by more than 1%
 - If the unit does not seal fully, it can be tightened to the dimension A-1%.

IF DIMENSION A IS NOT REACHED WITH APPLICATION OF THE ABOVE STEPS:

- Check the number of plates and dimension A.
- Check that all the nuts and bearing boxes are running freely. If not, clean and lubricate or replace.
- Fit all the bolts, and tighten alternately.

Chlorine as growth inhibitor

Chlorine, commonly used as growth inhibitor in cooling water systems, reduces the corrosion resistance of stainless steels (including Hastelloy, Incoloy, Inconel and SMO).

Chlorine weakens the protection layer of these steels making them more susceptible to corrosion attacks than they otherwise should be. It is a matter of time of exposure and concentration.

In every case where chlorination of non-titanium equipment cannot be avoided, ALFA LAVAL must be consulted.

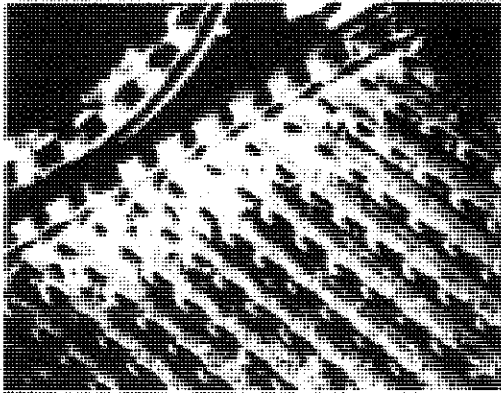
Contact the following address:

ALFA LAVAL
Heat Transfer Center
5400 International Trade Drive
Richmond, VA 23231
Phone (804) 222-5300
Fax (804) 236-3276

NOTE! Titanium is not affected by chlorine.

7

Cleaning

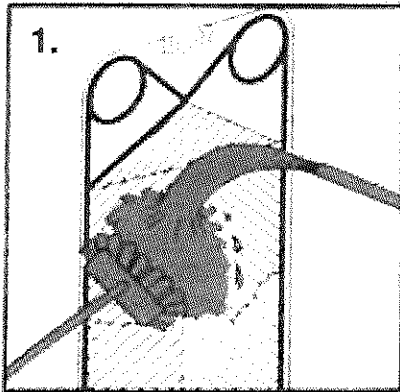


INCRUSTATION - SCALING

- Calcium carbonate
- Calcium sulphate
- Silicates

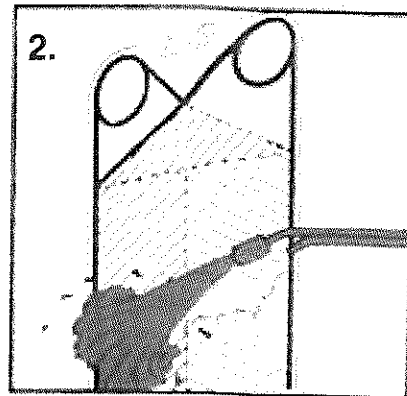
CLEANING

Mechanical cleaning after opening.



1. Soft brush and running water.
NOTE! Avoid gasket damage.
3. Chemical cleaning of opened unit by using:
 - Nitric acid
 - Sulfamic acid
 - Citric Acid
 - Phosphoric acid
 - Complexing agents (EDTA, NTA)
 - Sodium polyphosphates

Concentration max 4% by wt%
Temperature max 140° F



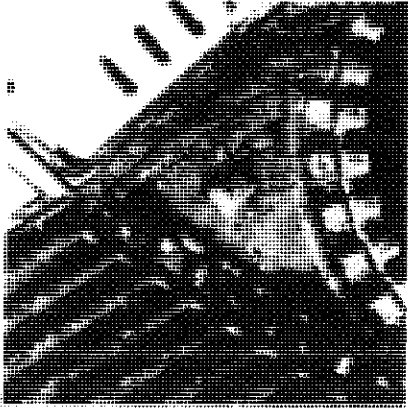
2. High pressure hose.

NOTE!

Under no circumstances should HYDROCHLORIC ACID be used with STAINLESS STEEL PLATES and under no circumstances should HYDROFLUORIC ACID be used with TITANIUM PLATES. Water of more than 300 ppm Chlorine may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns made of aluminum are protected against chemicals.

Cleaning

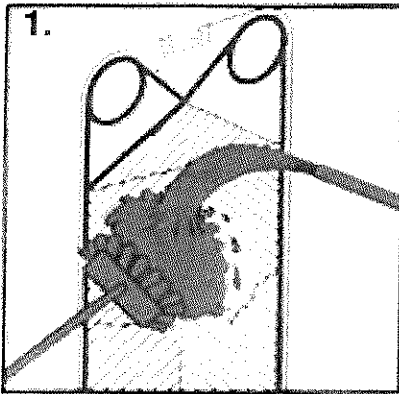


SEDIMENT

- Corrosion products
- Metal Oxides
- Silt
- Alumina
- Diatomic organisms and their excrement of various colors.

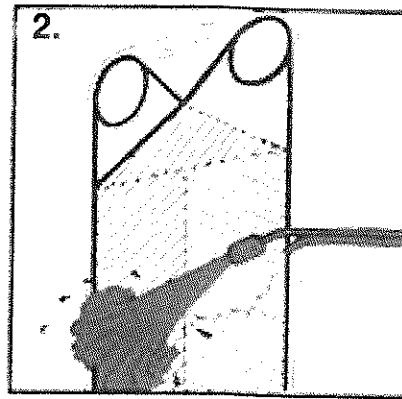
CLEANING

Mechanical cleaning after opening.



1. Soft brush and running water.
NOTE! Avoid gasket damage.
3. Chemical cleaning of opened unit by using:
 - Nitric acid
 - Sulfamic acid
 - Citric Acid
 - Phosphoric acid
 - Complexing agents (EDTA, NTA)
 - Sodium polyphosphates

Concentration max 4% by wt%
Temperature max 140° F



2. High pressure hose.
4. The addition of surfactants can improve cleaning effect.

NOTE!

Under no circumstances should HYDROCHLORIC ACID be used with STAINLESS STEEL PLATES and under no circumstances should HYDROFLUORIC ACID be used with TITANIUM PLATES. Water of more than 300 ppm Chlorine may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns made of aluminum are protected against chemicals.



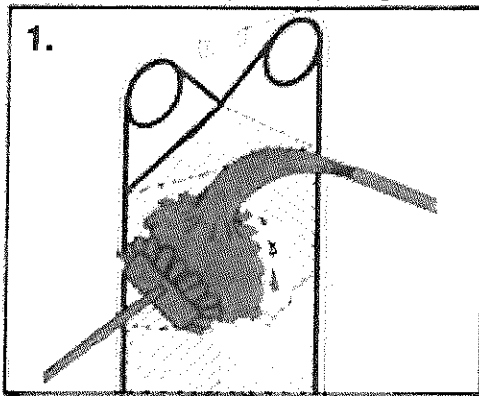
GROSS FOULING

- Seaweeds
- Wood chips/fibers
- Mussels
- Barnacles

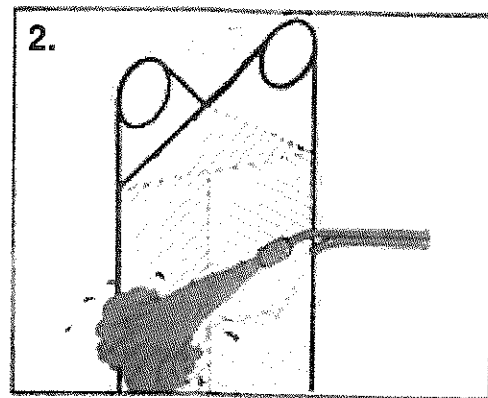
CLEANING:

NOTE: BACKFLUSHING OF THE UNOPENED HEAT EXCHANGER CAN SOMETIMES BE SUFFICIENTLY EFFECTIVE.

Mechanical cleaning after opening.



1. Soft brush and running water.
NOTE! Avoid gasket damage.



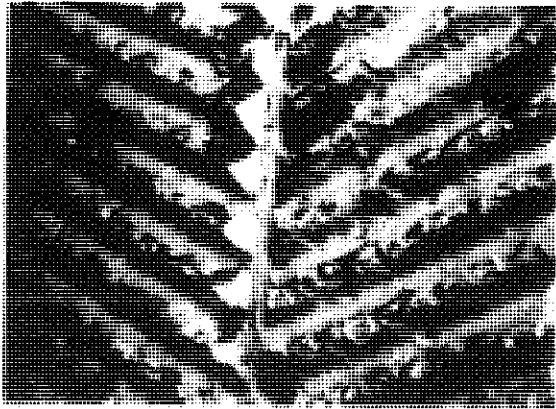
2. High pressure hose.

NOTE!

Under no circumstances should HYDROCHLORIC ACID be used with STAINLESS STEEL PLATES and under no circumstances should HYDROFLUORIC ACID be used with TITANIUM PLATES. Water of more than 300 ppm Chlorine may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns made of aluminum are protected against chemicals.

Cleaning

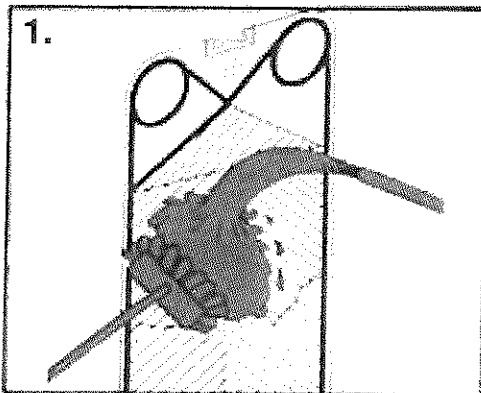


BIOLOGICAL GROWTH - SLIME

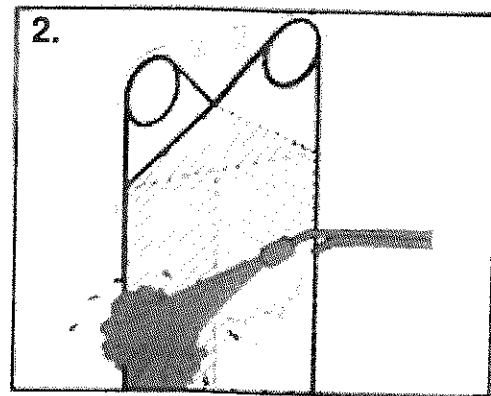
- Bacteria
- Nematodes
- Protozoa

CLEANING

Mechanical cleaning after opening.



1. Soft brush and running water.
NOTE! Avoid gasket damage.



2. High pressure hose.

3. Chemical cleaning of opened unit by using:
- Nitric acid
 - Sulfamic acid
 - Citric Acid
 - Phosphoric acid
 - Complexing agents (EDTA, NTA)
 - Sodium polyphosphates

Concentration max 4% by wt%
Temperature max 140° F

NOTE!
Under no circumstances should HYDROCHLORIC ACID be used with STAINLESS STEEL PLATES and under no circumstances should HYDROFLUORIC ACID be used with TITANIUM PLATES. Water of more than 300 ppm Chlorine may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns made of aluminum are protected against chemicals.

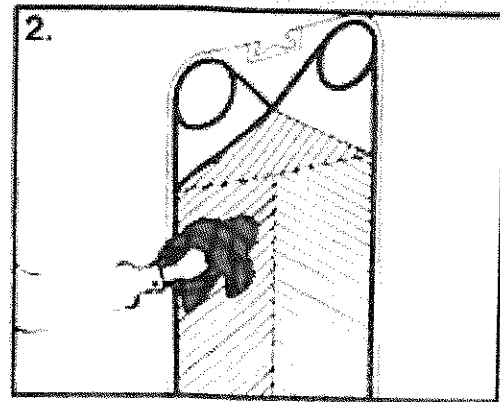
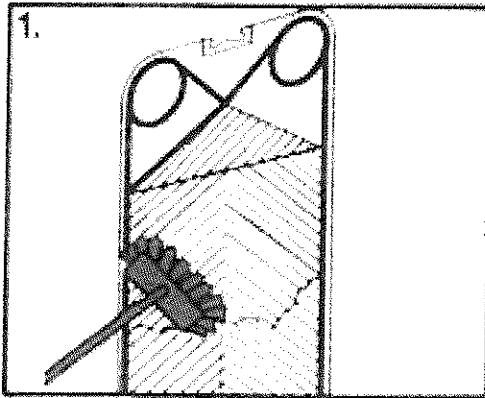
7

Cleaning

- Oil residues
- Asphalt
- Fats

CLEANING

Mechanical cleaning after opening.



1. Hydrocarbon-based deposits may be removed by using a soft brush and a PARAFFINIC or NAPHTHA-BASED solvent (e.g. KEROSENE).

2. Dry with a cloth or rinse with water.

NOTE!

Gaskets in natural, butyl and EPDM rubber swell in these media.

Contact time should be limited to 0.5 hour.

THE FOLLOWING SOLVENTS SHOULD NOT BE USED

- Ketones (e.g. Acetone, Methyl ethyl ketone, Methyl isobutyl ketone)
- Esters (e.g. Ethyl acetate, Butyl acetate)
- Halogenated hydrocarbons (e.g. Chloroethene, Carbon tetrachloride, Freons)
- Aromatics (e.g. Benzene, Toluene)

Regasketing

ALFA LAVAL has two types of glue for field repairs - GC11 and GC8 for repairs and exchange of gaskets in plates. A special glue is recommended for viton and silicone gaskets.

GC11

- A two-component, cold curing epoxy glue which gives a strong joint for higher temperatures.
- Future removal of gaskets usually requires heating or freezing of the joint.
- The shelf life is limited to approx. 1 year when stored at room temperature but can be prolonged when kept in a refrigerator.

GC8

- A single-component rubber-based solvent adhesive.
- Is normally used for repair work in an uncured condition.
- Can be used for operating temperatures below 200 F
- For operating temperatures above 200° F and oil coolers/heaters, the glued joints should be cured at 200° F for one hour.
- Future removal of the gasket can usually be carried out without heating of the cement joint.
- The storage life at room temperature is about two years. This period can be extended after checking the glue.

SEPARATE GLUING INSTRUCTIONS WILL BE DELIVERED TOGETHER WITH THE GLUE.

ALFA LAVAL RECONDITIONING SERVICE

In addition to supplying genuine gaskets for your plate heat exchangers, we are able to provide a "SPECIALIZED PLATE RECONDITIONING SERVICE" to quickly and efficiently meet your service requirements.

Our reconditioning service includes a liquid nitrogen debonding process with chemical cleaning, crack detection and regasketing using a special epoxy/phenolic resin adhesive.

This regasketing process requires special oven curing of the cement to ensure the strongest

possible bond strength between plate and gasket, similar to the process used during manufacture. This is one reason why our service is guaranteed.

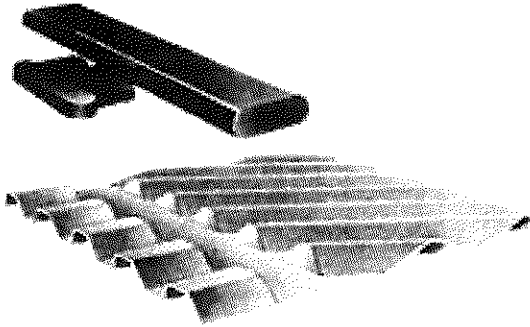
In most cases our reconditioning service has proved more economical and much faster when compared with on-site regasketing methods.

For further details, please contact your local ALFA LAVAL REPRESENTATIVE.
(See Section 1)

7

Regasketing

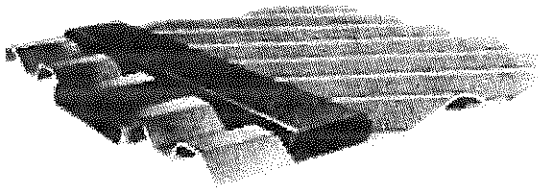
The Clip-on gasket - a glue-free gasket system



The Clip-on gasket is attached to the plate by two gasket prongs which slip under the edge of the plate to hold the gasket securely in alignment in the gasket groove.

The prongs are situated at regular intervals around the periphery of the plate.

When the plate heat exchanger is then assembled and tightened, the gasket provides a tight seal around the plate.



The Clip-on gasket in the gasket groove.

NOTE!

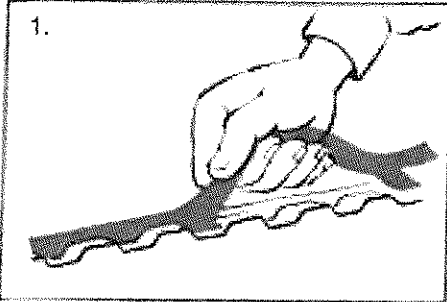
**Before closing of the equipment:
Check that the two gasket prongs
are in correct position.**

Regasketing of Snap-On Gaskets

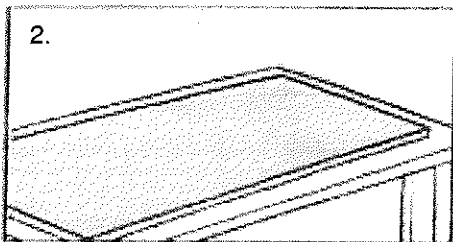
7

THE PROCEDURES (2-7) ARE NOT NECESSARY FOR DOING A SMALL QUANTITY OF PLATES. THESE PROCEDURES WILL INCREASE SPEED OF REGASKETING OF LARGE QUANTITIES OF PLATES.

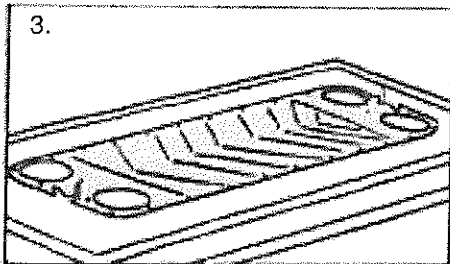
PREPARATORY PROCEDURES



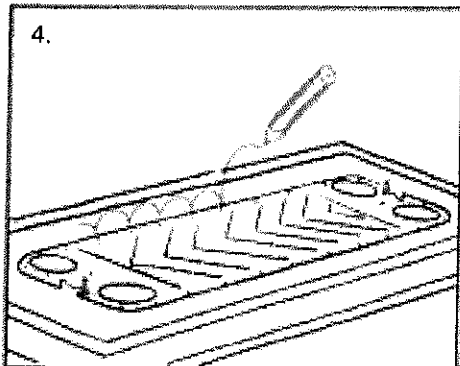
1. Pull the old gasket off the plate and clean the groove, if necessary.



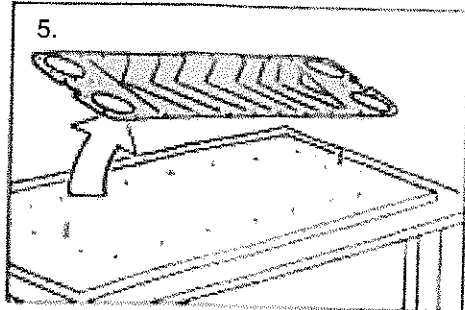
2. Place a flat sheet of plywood (somewhat larger than the PHE plate) on the table.



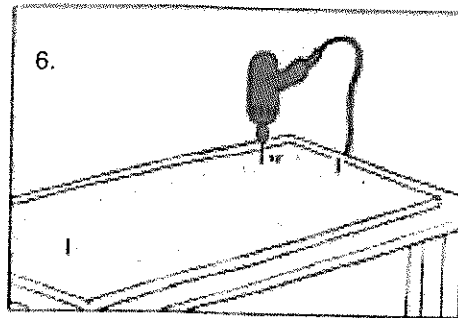
3. Place the PHE plate on the board with gasket groove upwards and fix firmly. Placing cylindrical pins in the plank at the carrying bar slots.



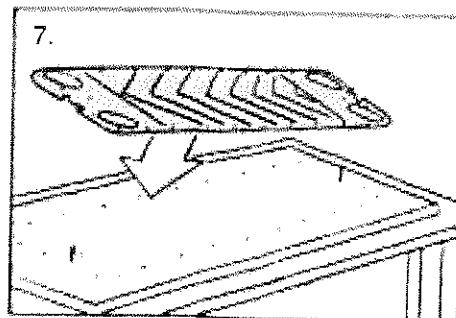
4. Make marks in the plank at all locations for gasket "snap-on".



5. Remove the plate.



6. Drill holes approx. 7mm dia and 10 mm deep in the plank at the marked spots. The plank is now a practical tool for regasketing of larger numbers of plates.

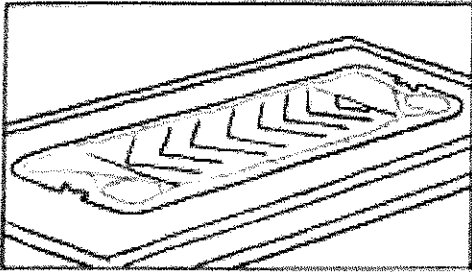


7. Replace PHE plate on the board in exactly the same location as at 3 above.

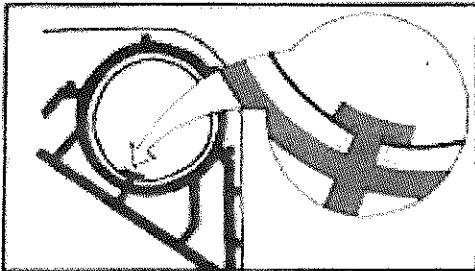
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Regasketing of Snap-On Gaskets

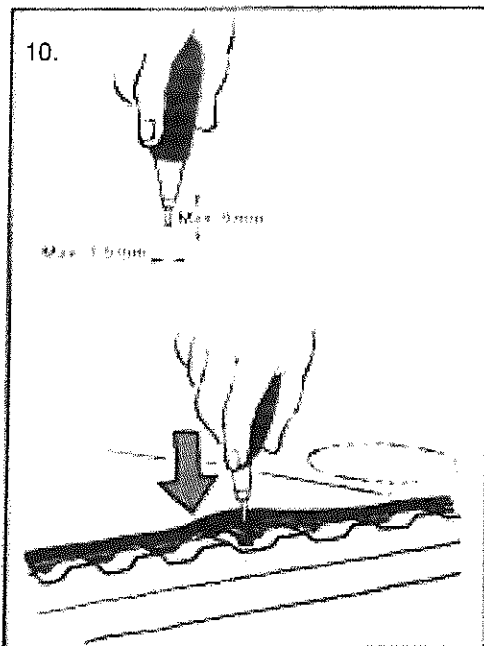
FASTENING OF THE "SNAP-ON" GASKET



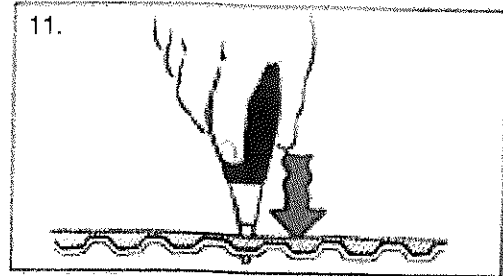
8. Place the gasket, with the "snap-on" projections downwards, in the gasket groove.



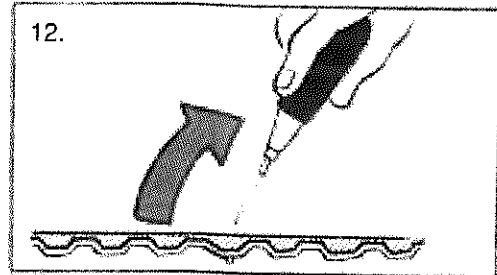
9. Place the ring gaskets in the groove and fix them with the T-flap.



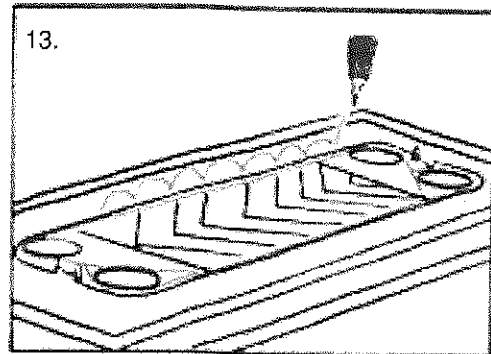
10. Insert the tool point into the recess in the projection.



11. Push the projection through the hole in the plate.



12. Remove the tool point, and the projection is now "snapped on".

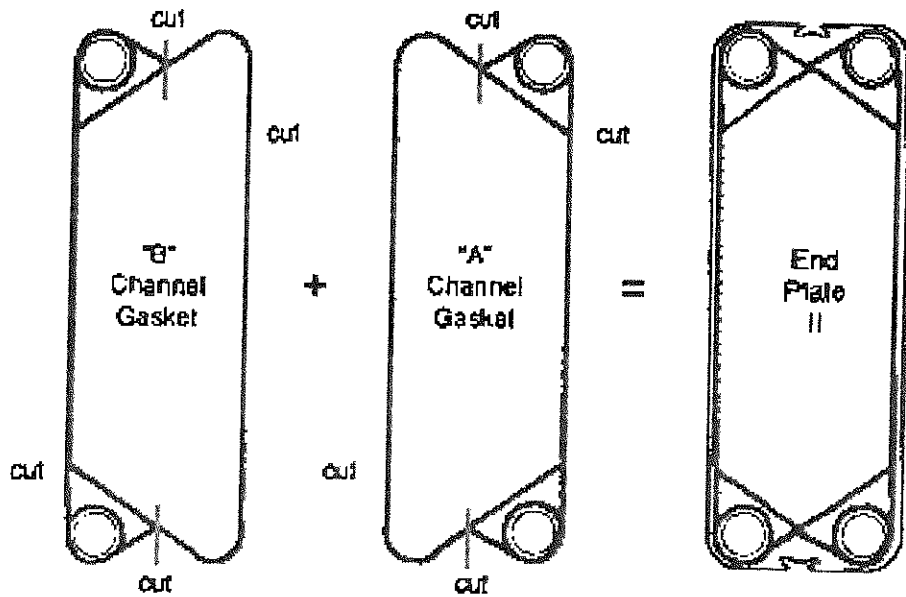


13. Repeat for all projections, and the gasket is "snapped on".

NOTE:
BEFORE CLOSING OF THE EQUIP-
MENT: CHECK THAT THE T-FLAPS
ARE IN CORRECT POSITION.

PARALLEL FLOW UNITS

The End Plate II Gasket is formed by cutting (2) channel gaskets (as shown below) and gluing the gaskets to the first plate.

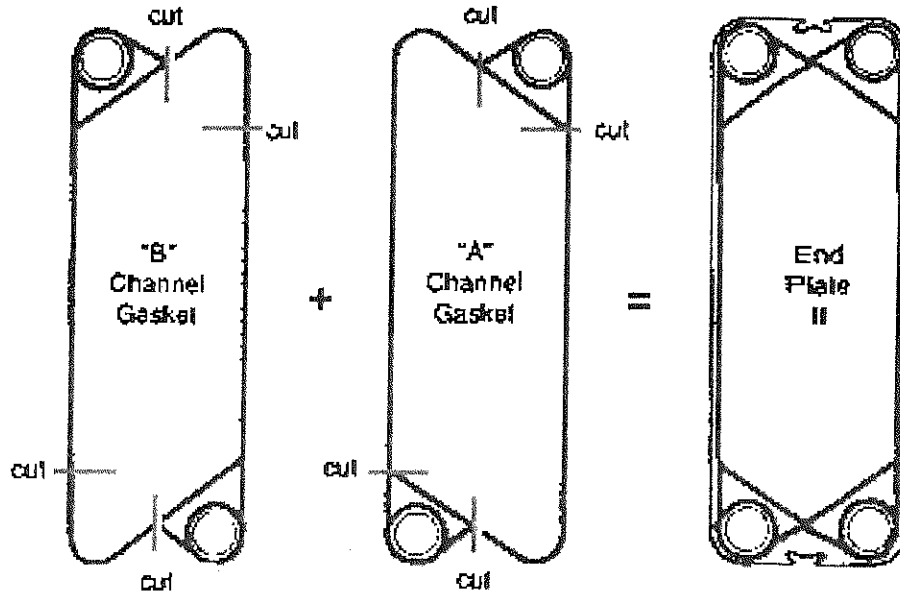


The (2) half channel gaskets should be glued to the end plate with GC-8 glue; or double sided tape (GC-1). The (4) port gasket areas are critical because these gaskets will be in contact with the process fluids.

7

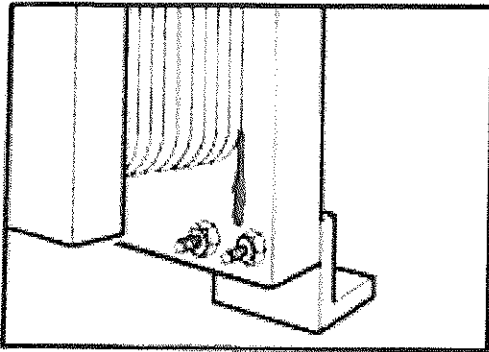
DIAGONAL FLOW UNITS

The End Plate II Gasket is formed by cutting (2) channel gaskets (as shown below) and gluing the gaskets to the first plate.



The (4) parts of the channel gaskets should be glued to the end plate with GC-8 glue; or double sided tape (GC-1). The (4) port gasket areas are critical because these gaskets will be in contact with the process fluids.

Fault detection



SYMPTOM
LEAKAGE between plates and frame.

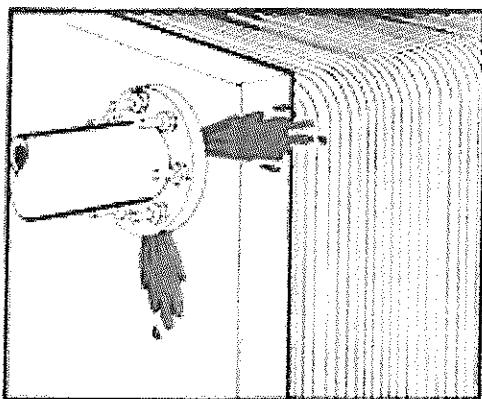
ACTION

Mark with a felt tip or similar marker, mark the area where the leakage seems to be, and open the heat exchanger

1. Investigate the gasket condition of the end plate and the connection if applicable, look for dislocation, foreign objects, scars and other damage to the gasket surfaces.
2. Check the surface of the pressure plate for unevenness, foreign objects sticking to it, etc. that might spoil the joint between the gasket and the adjacent surface.
3. Check the plate itself for cracks or holes.

CORRECTIONS

1. • Relocate gasket.
• remove foreign matter.
• replace connection lining if applicable.
Remove anything disturbing the joint between gasket and pressure plate surface.
A perforated end plate must be replaced.



SYMPTOM
LEAKAGE between flange and frame.

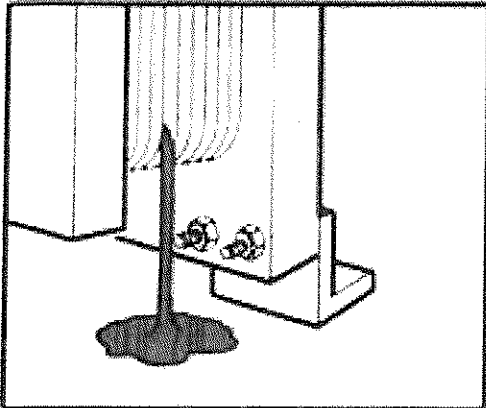
ACTION

1. Disconnect the flange, and look for misalignment between flange and connection, dislocated or damaged gasket, foreign objects on the surface of the gasket or the flange.

CORRECTIONS

1. • Rearrange the pipe in order to eliminate stress and to correct alignment.
• relocate gasket
• replace damaged gasket
• replace connection lining if applicable
• remove foreign matter from flange and gasket
• reassemble, taking care to avoid misalignment

NOTE: On a Plate Heat Exchanger specially designed for high temperature duties, extreme and sudden temperature drops may sometimes cause a temporary leakage. A typical example is a sudden shutting-off of the hot medium flow. The heat exchanger will normally seal again, as soon as the temperatures of the equipment have stabilized.



SYMPTOM

LEAKAGE between plates to the outside.

ACTION

Mark the leakage area with a felt tip marker on the two plates next to the leakage, check and note the length of the plate pack between inside frame plate and inside pressure plate, and then open the heat exchanger.

1. Check for loose, dislocated or damaged gasket.
2. Check for plate damage in the area, and also check plate pack length against the drawing to see if possible plate or gasket damage could be caused by overtightening of the plate pack, or if the leakage itself may simply be caused by insufficient tightening.
3. Check hanger recess at both plate ends for deformations, which could cause misalignment between the plates.
4. Make sure that the plates are hanging correctly as A-B-A (see SECTION 4A or 4B).
5. Check for perforation of the plate (corrosion).

CORRECTIONS

1.
 - Relocate gasket.
 - Re-cement loose gasket, if applicable.
 - Replace damaged gasket.
2. A damaged plate must in most cases be taken out for repair or replacement. If it is a regular plate with 4 holes: take the damaged plate and the 4-hole plate just in front or just behind it out of the plate pack. The heat exchanger can now be reassembled and put back in service PROVIDED THE PLATE PACK IS TIGHTENED TO A NEW MEASUREMENT, WHICH IS EQUAL TO THE ONE ON THE DRAWING, REDUCED BY TWO TIMES THE SPACE REQUIRED PER PLATE. CONTACT ALFA LAVAL FOR ASSISTANCE IN THE RECALCULATION IF NECESSARY.
The small reduction of the heat transfer area is normally of no importance, at least not for a short period of time.
 - Insufficient tightening must be corrected - see the drawing.
3. Damaged hanger recesses must be repaired if possible, or the plate replaced. For temporary arrangement with reduced number of plates - see paragraph 2 above.
4. Incorrect sequence of plates must be corrected (A-B-A-B-..). MAKE SURE THAT NO PLATE HAS BEEN DAMAGED, BEFORE REASSEMBLING THE PLATE PACK!
5. Perforated plates must be replaced. For temporary solution, see paragraph 2.

SYMPTOM

LEAKAGE between plates.

ACTION	CORRECTIONS
--------	-------------

- | | |
|---|--|
| <ol style="list-style-type: none">1. Check that the piping is connected to the heat exchanger at correct locations.2. Open the lower connection on one side, raise pressure on the other side and by looking into the open connection try to detect any liquid from the pressurized side leaking in, and if so - approximately how far into the plate pack the leakage is located. If no leakage is detected, the reason for the mixing of media must be sought elsewhere. (see paragraph 5).3. If a leakage was detected, note the position of the leakage along the plate pack and then open the plate heat exchanger.4. Before starting on the plates themselves, check that the corner areas between the ring and the field gaskets are clear, that the leakage slots are open. This ensures that any leakage is out of the plate heat exchanger and is to atmosphere. Therefore no pressure can build up to force the media across the gasket sealing off the other liquid.5. If it has not been possible to locate the leakage as described in par. 2 above, it will be necessary to check each single plate for possible perforations, using any of the following methods:<ul style="list-style-type: none">• put a strong light behind the plate and watch for light coming through fine holes or cracks.• use a magnifying glass to check suspect area.• use a chemical penetrant, after having cleaned the plates well. | <ol style="list-style-type: none">1. Relocate piping to correct connections.4. All deposits or material which can block the free exit from the area must be removed. If the leak channels of the gasket have been destroyed, they must be reopened with a suitable tool, or the gasket replaced.5. Plates with holes must be replaced. The PHE may be temporarily operated with a reduced number of plates. See "LEAKAGE between plates to the outside". |
|---|--|

SYMPTOM

PRESSURE DROP PROBLEMS,

Pressure drop has increased

ACTION

CORRECTIONS

Check that all valves are open including non return valves.

Measure the pressure just before and just after the heat exchanger, and the flow rate. For viscous media a membrane manometer with a diameter of at least 30 millimeters should be used. Measure or estimate the flow rate if possible. A bucket and a watch showing seconds may be sufficient for small flow rates. For larger flow rates, some type of flowmeter is required. Compare the pressure drop observed with the one specified for the actual flow rate. (see plate print out)

1. If the pressure drop is higher than specified, the temperature program should also be checked:
 - 1.1 If the thermometer readings correspond to those specified, the heat transfer surface is probably clean enough, but the inlet to the heat exchanger may be clogged by some objects.
 - 1.2 If the thermometer readings are NOT corresponding to those specified, heat transfer is obviously dropping below specifications, because of deposits on the heat transfer surface, which at the same time also increase the pressure drop, since the passage becomes narrower.
2. If the pressure drop corresponds to the specifications, there is no need for any action.
3. If the pressure drop is lower than specified, the pump capacity is too small or the observation is wrong.

1. See next paragraph.
 - 1.1 Open the PHE and take out whatever is clogging the passage, or use the back-flush system - if there is one - to rinse out the cloggings.
 - 1.2 If a "cleaning-in-place" system is available, follow the instruction and use it to wash out the deposits. If not, open the PHE and clean the plates.
2. See pump instruction manual.

SYMPTOM: HEAT TRANSFER PROBLEMS

The heat transfer capacity is dropping

ACTION

CORRECTIONS

Measure temperatures at inlet and outlets and also flow rates on both media, if possible. At least on one of the media, both temperatures and the flow rate must be measured. Check to see if the transferred amount of heat energy corresponds to the specifications.

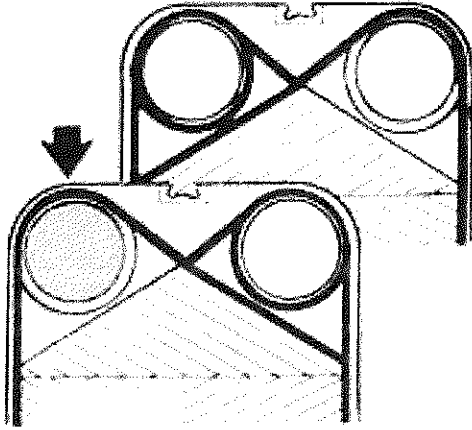
If great precision is important, it will be necessary to use laboratory thermometers with an accuracy of 0.2 degrees Fahrenheit, and also to use the best equipment available for flow measurements.

If the heat transfer capacity of the equipment has dropped below specified values, the heat transfer surface must be cleaned. Either use the "cleaning-in-place" arrangement if provided or open the heat exchanger for visual inspection and manual cleaning.

NOTE: Contact the Alfa Laval Sales & Service Division for CIP recommendations (See Section 1).

9

Supplementary Parts



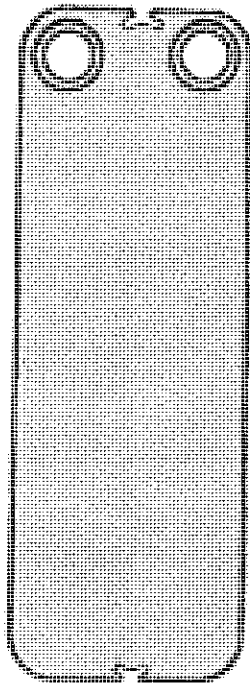
THE PARTITION PLATE - for special cases only.

If for instance, the thermal program requires that at least one of the media is to flow in more than one group through the plate package, there will be heat transfer plates with fewer than 4 holes.

To prevent the thin metal collapsing under the differential pressure, un-punched corners require extra support.

The extra support is provided by a partition plate - approximately the size of a channel plate - made of about 1/4" - 3/4" thick plate material with lined holes where a free passage is required.

The partition plate is suspended from the carrying bar. Where partition plates are required, in units with 8" ports or larger, there will be one at every turning point in a multi-grouped plate package.



Example only

9.1

Beattie Elementary



Warranties

Operation & Maintenance Manuals

Vol. 2

Spec. Sections Division 23 to 28 3100#

BEATTIE ELEMENTARY

Table of Contents

VOLUME 2

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Division 23 – Mechanical (Continued)

23 6500 – Mechanical U.S. Engineering Co.
07 8400 – Firestopping

Division 26 - Electrical

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27 1000 – Structured Cabling System
27 5123 – Programmable Electronic Comm.
28 1353 – Access System
28 1600 – Intrusion Detection

Division 27 – Communications

27 1000 – Structured Cabling Systems H&H Data Services
27 5123 – Intercom Testing Beacon Communications

Division 28 – Electronic Safety & Security

28 0500 – Electronic Safety & Security Tri Tech Security, Inc.
28 1353 – Access System
28 3100 – Fire Detection & Alarm Bret's Electric

Specification Section

Division 22 - Plumbing

Division 23 - Mechanical

(CONTINUED)

U.S. Engineering Co.

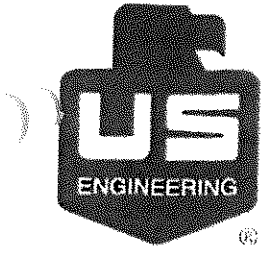
P.O. Box 905

Loveland, CO 80539

Telephone: 970-669-1666

Fax: 970-663-0685

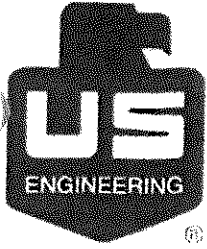
Contact: Chris Mallory



Tab-8
Specification Section: 23 65 00
Cooling Towers:
CT-1 (Baltimore Aircoil)

**BEATTIE
ELEMENTARY
SCHOOL**

3000 MEADOW LARK AVE
FORT COLLINS CO 80526



Cooling Towers
(Baltimore Aircoil)
O&M and Warranty
Information:
CT-1

**BEATTIE
ELEMENTARY
SCHOOL**

100 MEADOWLARK AVE
FORT COLLINS, CO 80526



Series V and Low Profile Series V

Cooling Towers

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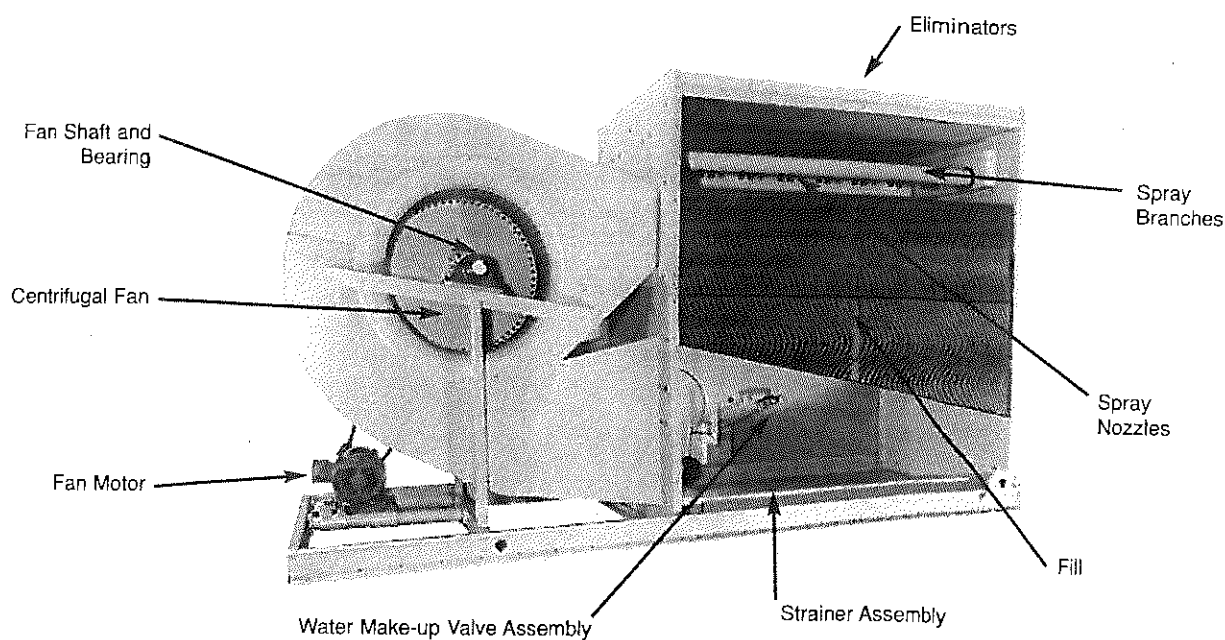


Figure 1 - VTL Low Profile Series V Cooling Tower



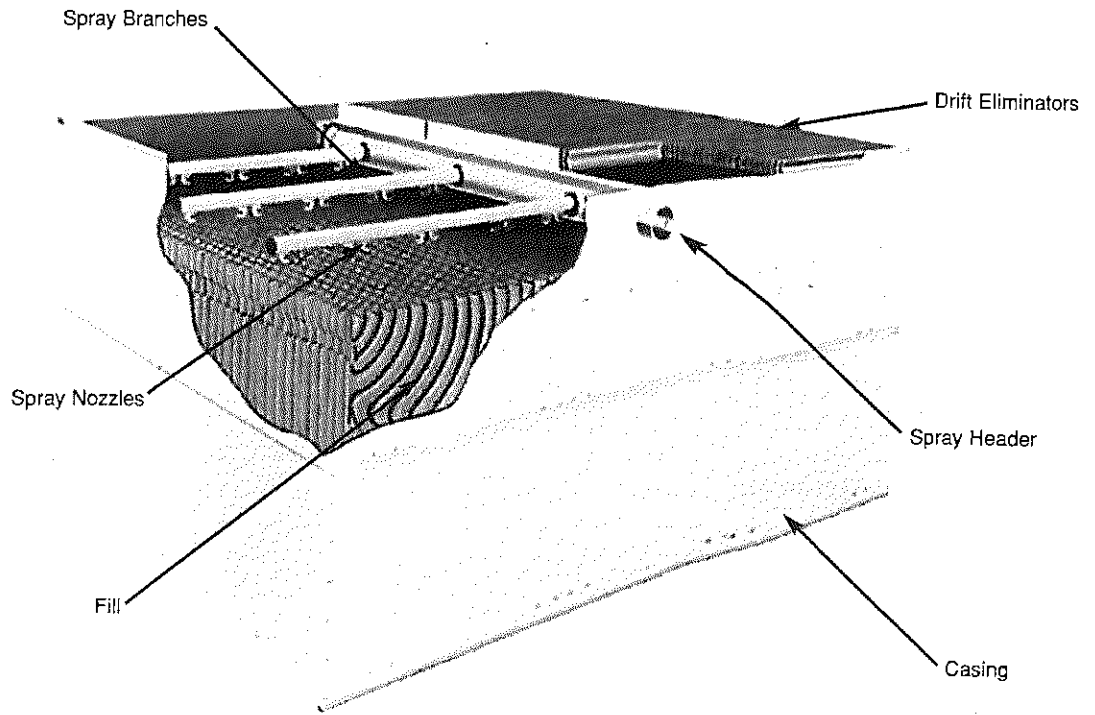


Figure 2a - Heat Transfer Casing Section for VT0 and VT1 Cooling Towers

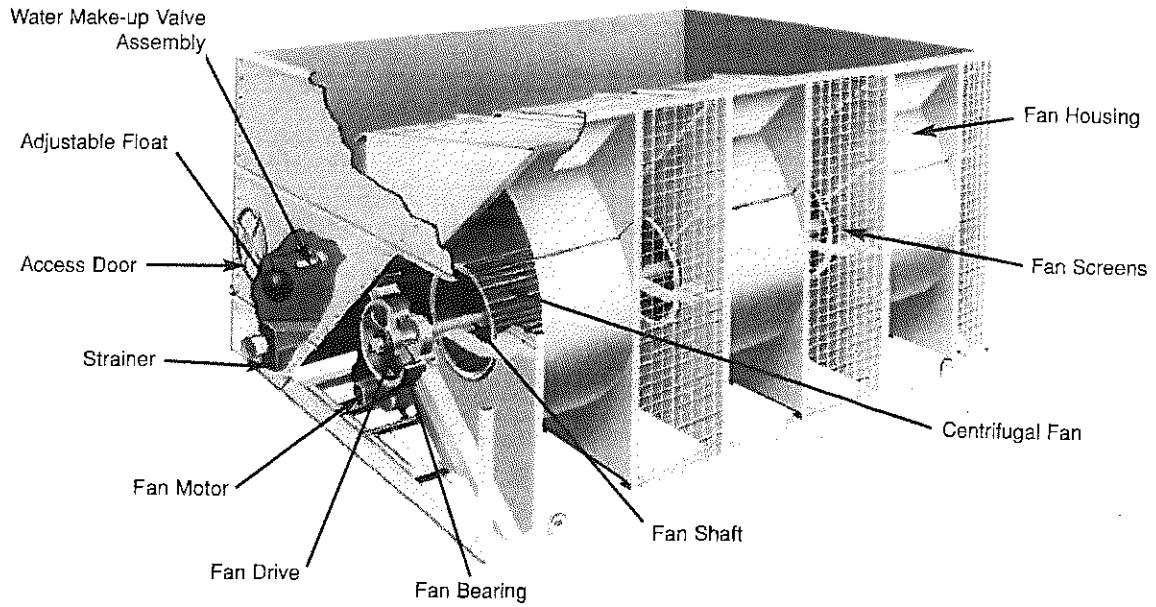


Figure 2b - Basin Section for VT0 and VT1 Cooling Towers



Table 1: Recommended Maintenance Services⁽¹⁾

Type Service	Start-Up	Monthly	Quarterly	Annually	Shutdown
Inspect and clean as necessary:					
Inspect general condition of the unit ⁽²⁾ and check unit for unusual noise or vibration	X	X			
Clean and flush basin	X	X			X
Inspect spray nozzles	X	X			X
Clean basin strainer	X	X			X
Drain basin and piping					X
Check and adjust water level in basin	X	X			
Check operation of make-up valve	X	X			
Check and adjust bleed rate	X	X			
Inspect heat transfer section	X	X			
Inspect protective finish				X	
Mechanical equipment system:					
Check belt condition	X	X			
Adjust belt tension ⁽³⁾	X		X		
Lubricate fan shaft bearings	X		X		X
Lubricate motor base adjusting nut	X		X		X
Check drive alignment				X	
Check motor voltage and current	X		X		
Check fan bearing locking collars	X		X		
Check fan motors for proper rotation	X				
Check fans for rotation without obstruction	X		X		

WARNING: Do not perform any service on or near the fans, motors, drives, or inside the unit without first ensuring that the fans and the pumps are disconnected and locked out.

NOTES:

1. Recommended service intervals are for typical installations. Different environmental conditions may dictate more frequent servicing.
2. When operating in ambient temperatures below freezing, the tower should be inspected more frequently. Refer to "Cold Weather Operation" on Page N102 for more details.
3. Tension on new belts must be readjusted after the first 24 hours of operation and quarterly, thereafter.

Operation and Maintenance

Initial and Seasonal Start-up

General

- If the unit is mounted on vibration isolators or isolation rails, refer to the vibration isolation manufacturer's guidelines before loading/unloading weight from the unit.
- Verify fan and system pump motors are disconnected and locked out.
- Conduct external inspection of the equipment. Check for leaks, corrosion, and any structural damage.
- Inspect piping and connections.

Cleaning

- Drain the cold water basin with the strainers in place.
- Remove all dirt and debris from the fan guards.
- Clean all mechanical components.
- Flush the cold water basin interior to remove any accumulated dirt and debris.
- Remove, clean, and replace the strainers.



Inspection

WARNING: Do not perform any service on or near the fans, motors, drives, or inside the unit without first ensuring that the fans and the pumps are disconnected and locked out.

- At seasonal start-up or after prolonged shutdown, check the motor insulation with an insulation tester prior to the motor start-up.
- Prior to the seasonal start-up, check and adjust the belt tension. At the initial start-up, the belt tension may not require adjustment as the drive will be properly tensioned at the factory prior to shipment.
- Start the fan motors and check for proper fan rotation.
- Run the fans in manual mode for several minutes to check for any unusual noise or vibrations.
- Check that the float operated make-up valve is operating freely.

WARNING: Check to ensure the controls for the fan motors are set to allow a maximum of 6 on-off cycles per hour.

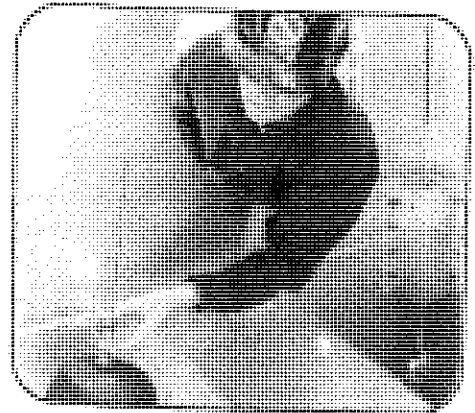


Figure 3 - Water Make-up Valve Assembly

Start-up

WARNING: Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and the pumps are disconnected and locked out.

- Prior to seasonal start-up, lubricate the motor base adjusting screws (see Figure 6 on Page N55) and the fan shaft bearings. At initial start-up, no bearing lubrication is required since the bearings are factory lubricated prior to shipment.
- Fill the cold water basin with fresh water to the overflow level via the make-up valve.
 - Water treatment for new installations: Initiate the biocide water treatment program at this time. Refer to "Biological Control" on Page N106 for more details.
 - Water treatment for seasonal start-up or after a shutdown period in excess of 3 days: Resume the biocide treatment program and administer a shock treatment of appropriate biocides prior to operating the fans. This will eliminate accumulated biological contaminants. Refer to "Biological Control" on Page N106 for more details.
- Set the make-up valve float so the water shuts off at the overflow level.
- Start the system pump. See "Water Distribution System" on Page N56 for more details.
- Open the valve in the tower bleed line, and adjust the bleed by closing or opening the valve.
- Once the unit is operating, check the current and voltage of all three phases (legs) of the fan motors with a heat load on the tower under warm ambient conditions. The current must not exceed the nameplate ratings.
- Check the operation of the optional vibration cutout switch.

After 24 hours of operation under thermal load, perform the following services:

- Check the tower for any unusual noise or vibrations.
- Check the operating water level in the cold water basin.
- Adjust make-up valve if necessary.
- Check the belt tension and readjust if necessary.

Extended Shutdown

WARNING: Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and the pumps are disconnected and locked out.

Perform the following services whenever the cooling tower is shutdown in excess of 3 days:

- If the unit is mounted on vibration isolators or isolation rails, refer to the manufacturer's guidelines before loading/unloading weight from the unit.



- Drain the cold water basin and all the piping that will be exposed to freezing temperatures. Heat trace and insulate all exposed piping.
- Clean all debris, such as leaves and dirt, from the interior and exterior of the unit.
- Clean and flush the cold water basin with the basin strainers in place.
- Leave the cold water basin drain open so rain and melting snow will drain from the tower.
- Clean the basin strainer and re-install.
- Lubricate the fan shaft bearings, motor base, and motor base adjusting screw.
- Close the shut off valve in the make-up water line (supplied by others), and drain all exposed make-up water piping. Heat trace and insulate all exposed piping.
- Inspect the protective finish on the unit. Clean and refinish as required. Refer to "Corrosion Protection" on Page N104 for more details.
- Secure the fan motors starting device in the "OFF" position to ensure personal safety in case of future inspection or service.

Detailed Component Maintenance Procedures

Cold Water Basin

As water circulating through the cooling tower is cooled, it collects in the cold water basin and passes through the suction strainer into the system. The cold water basin is constructed from one of the following materials of construction and the following maintenance applies to all basin materials of construction:

- Galvanized steel
- Thermosetting Hybrid Polymer
- Type 304 stainless steel

Water Levels

Table 2: Cold Water Basin Water Levels

Model Number	At Overflow Level (in.)	At Operating Level (in.)
VTL	10"	5 1/2"
VT0-12 to VT0-116	19 1/8"	12 7/8"
VT0-132 to VT0-176	22 1/2"	15 1/2"
VT1-N-xxx	31"	17"
VT1-xxx	24 1/2"	14"

- The make-up valve controls the operating level, which is maintained at the levels shown in Table 2.
- The operating water level in the cold water basin will vary with system thermal load (evaporation rate), the bleed rate employed, and the make-up water supply pressure.
- Check the operating water level monthly, and readjust the float when necessary to maintain the recommended operating level.

Inspection and Maintenance

WARNING: Openings and/or submerged obstructions may exist in the bottom of the cold water basin. Use caution when walking inside this equipment.

- Inspect the cold water basin regularly. Remove trash or debris accumulated in the basin or on the strainer.
- Quarterly, or more often if necessary, drain, clean, and flush the entire cold water basin with fresh water. This will remove the silt and sediment, which normally collects in the basin during operation. If not removed, sediment can become corrosive and cause deterioration of the protective finish of metallic basins.
- When flushing the basin, leave the strainers in place to prevent the sediment from re-entering the system.
- Remove the strainers after the basin has been flushed.
- Clean and replace the strainers before refilling the basin with fresh water.
- Adjust the float to maintain the design operating level. See Table 2: "Cold Water Basin Water Levels."



Fan

Series V and Low Profile Series V Cooling Towers use centrifugal fans. Thoroughly inspect the fans for damaged or deteriorated fan blades and replace the fan as required.

Inspection and Maintenance

- If the unit is already in operation, while the fans are still running, check for **any** unusual noise or vibration.
- With the fans off and the motor locked out and tagged, check the general **condition** of the fans:
 - Inspect for any loose or missing bolts in the locking collar and fan shaft bearings.
- **Rotation:** Turn the fan shift by hand to ensure that the fan moves freely with **no** rough spots, binding or other malfunctions that could cause vibration or fan motor overload.
- **Direction of Rotation:** On initial start-up, or if the fan motor has been rewired, bump the fan motor and note the direction of rotation.
- **Operation:** On initial start-up, run the fan in the manual position for several minutes and check for any unusual noises or vibration.

Fan Drive System

Inspection and Maintenance

- These drives require a periodic check of the belt condition and, when necessary, tension adjustment. The recommended service intervals are as follows:
 - **Initial Start-up:** Servicing is not required prior to initial tower start-up. The drive has been tensioned and aligned at the factory.
 - **Seasonal Start-up:** Readjust the belt tension.
 - **Operation:** After the first 24 hours of operation, readjust the belt tension on a new unit start-up or installation of a new belt. Thereafter, check the belt condition monthly, and adjust tension as necessary. Readjust tension at least once every 3 months.
- Belt tension check:
 - Place a straight edge along the belt from sheave to sheave as shown in Figure 4a, or use a tape measure as shown in Figure 4b, to measure belt deflection.
 - Apply a moderate force by hand (approximately 15 lbs/6.8 kg) evenly across the width of the belt in the center of the span between the sheaves.
 - There is adequate belt tension if the belt deflects between 1/4" and 3/8" as shown in Figures 4a and 4b.

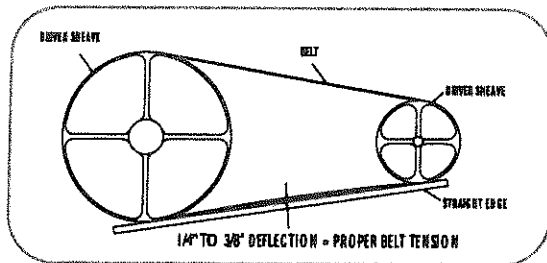


Figure 4a

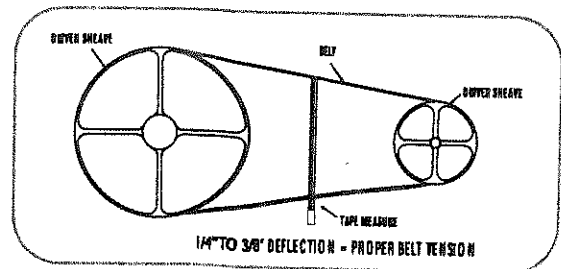


Figure 4b

Belt Tension

- Belt tension adjustment (if required):
 - Loosen the lock nut on the motor base adjusting screw.
 - Turn the motor base adjusting screw clockwise to tension the belt, or counterclockwise to relieve belt tension. During adjustment of belt tension, rotate the drives several times by hand to evenly distribute the tension throughout the belt.
- When the belt is properly tensioned, retighten the lock nut on the motor base adjusting screw.

NOTE: There should be no "chirp" or "squeal" when the fan motor is started.

Alignment:

- Check the drive alignment annually to ensure maximum belt life.
- Drive alignment check and adjustment:
 - Place a straight edge across the driver and the driven sheaves as shown in Figure 5.
 - The straight edge should contact all four points as shown in Figure 5 indicating proper drive alignment.
 - There should be no more than 1/16" deviation from four points of contact.
 - In case of realignment, loosen the motor sheave and align it with the fan sheave. Allow 1/4" for draw-up as the bushing screw is retightened.

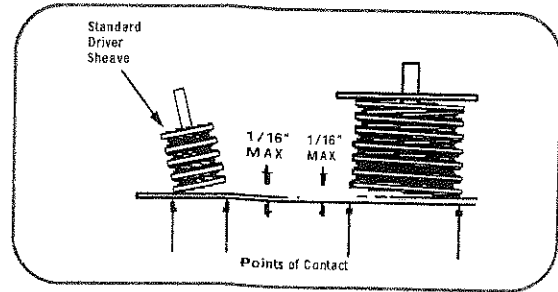


Figure 5 - Standard Drive Alignment

Fan Motors

Series V Cooling Towers and Low Profile Cooling Towers use cooling tower duty, premium efficient, totally enclosed, single-speed, single-winding, reversible ball bearing type motor(s).

Inspection and Maintenance

- Clean the outside of the motor at least quarterly to ensure proper motor cooling.
- After prolonged shutdowns, check the motor insulation with an insulation tester prior to restarting the motor.

Adjustable Motor Base

Coat the motor base slides and adjusting screws (see Figure 6) every 3 months using good quality corrosion inhibiting grease such as one recommended for lubricating the fan shaft bearings.

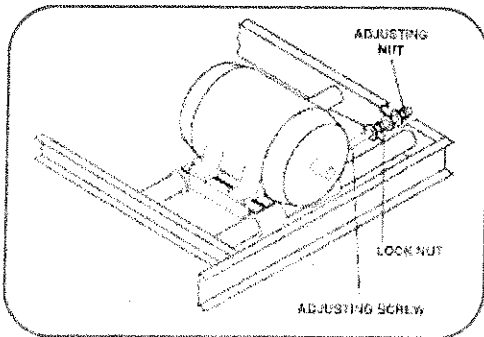


Figure 6 - Adjustable Motor Base

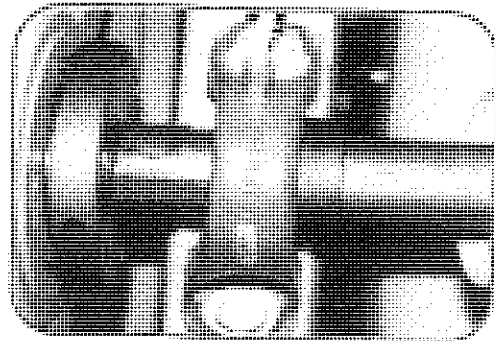


Figure 7 - Ball Bearing

Fan Shaft Bearings

The fan shafts are supported by ball bearings (see Figure 7). Each bearing is equipped with a lubrication fitting and locking collar.

Ball Bearings

Under normal operating conditions, the bearings should be greased every 2,000 operating hours or at least quarterly. The bearings should also be greased at seasonal start-up and shutdown. **Only lubricate the bearings with one of the following water resistant inhibited greases which are good for ambient temperatures ranging from -65°F (-53.9°C) to 250°F (121.1°C):**

Amoco - Rycon Premium #3
Chevron - SRI
Citgo - Polyurea MP2™
Conoco - Polyurea 2™

Exxon - Polyrex® EM
Exxon - Unirex N™
MobilGrease® - AW2
Shell - Alvania RL3™

Shell - Alvania #3
Shell - Dolium "R"
SKF - LGHP2™
Unocal 76 - Unilife Grease™

Only lubricate the bearings with a hand grease gun. Do not use high pressure grease guns since they may rupture the bearing seals. When lubricating, purge the old grease from the bearing by gradually adding grease until a bead of new grease appears at the seal.



Sleeve Bearings

Prior to start-up and during the first week of operation, the bearing oil cup (see Figure 8) must be refilled with an industrial-type mineral oil (see Table 3) to saturate the felt wick in the bearing reservoir. After the initial start-up, fill the bearing oil cup every 1,000 operating hours or at least every six months. When ambient temperatures below 0°F are expected, a light oil must be used. With such light oils, the bearing oil cup should be checked and refilled several times during the first several hours of operation until the bearings reach operating temperature.

Table 3: Sleeve Bearing Lubricants

Temp Ambient	BAC P/N	Texaco	EXXON
70°F to 100°F 30°F to 70°F	582628PI	Regal R & O 320 Regal R & O 150	Teresstic 220 Teresstic 100
5°F to 30°F -25°F to 5°F	582627PI	Regal R & O 32 Capella 32	Teresstic 32

Caution: Do not use oils containing detergents for bearing lubrication. Detergent oils will remove the graphite in the bearing sleeve and cause bearing failure. Also, do not disturb bearing alignment by tightening the bearing cap adjustment on a new unit as it is torque-adjusted at the factory.



Figure 8 - Sleeve Bearing

Locking Collars

Each eccentric locking collar should be checked quarterly to ensure that the inner bearing race is secured to the fan shaft. The locking collar can be set using the following procedure (see Figure 9):

- Loosen the set screw.
- Using a drift pin or center punch, tap the collar (in the hole provided) tangentially in the direction of rotation while holding the shaft.
- Retighten the set screw.

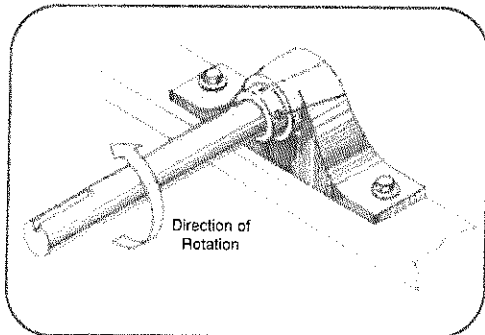


Figure 9 - Locking Collar Assembly

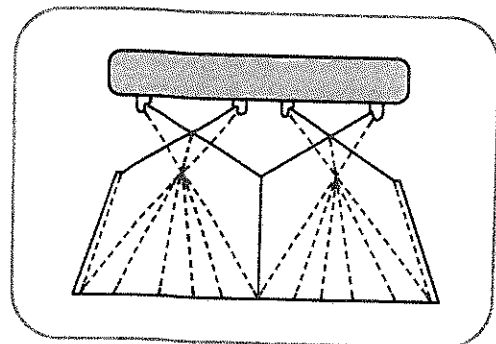


Figure 10 - Nozzle Spray Pattern

Water Distribution System

The hot water is distributed through a corrosion resistant polyvinyl chloride (PVC) spray distribution system. The drift eliminators are also made of PVC, which require no protection against rot, decay, rust, or biological attack.

The spray nozzles and heat transfer section should be inspected and cleaned each month. The inspection procedure is as follows:

- Shut off the fan, lock out and tag out the fan motor, but leave the system pump running.
- Remove the drift eliminators to allow a clear view of the spray distribution system and nozzle patterns.
- Check to see if the nozzles are all spraying consistently and producing the spray pattern in Figure 10.

- Quarterly or more often as required, turn off the system pump. Flush any dirt or debris from the water distribution system to prevent clogged nozzles. If necessary, remove the nozzle and the grommet for cleaning. To remove, grasp the nozzle and pull while twisting. Replace any damaged nozzles.
- Inspect the fill surface for bent edges or scale build-up.

Caution: Don't use steam or high pressure water to clean PVC eliminators or materials other than steel.

Water Level Control

There are two types of water level controls used on BAC units:

- Mechanical make-up valve assembly
- Optional electric water level control package

The Series V water make-up valve assembly is located within easy reach from the access door at the connection end of the unit.

Mechanical Make-up Valve Assembly

A float-operated mechanical water make-up assembly is furnished as standard equipment on the unit. The standard make-up assembly consists of a corrosion resistant make-up valve connected to a float arm assembly actuated by a polystyrene-filled plastic float. The float is mounted on an all-thread rod held in place by wing nuts. The cold water basin operating water level can be adjusted by repositioning the float and all-thread rod using the wing nuts provided.

NOTE: If the unit has been ordered with the optional electric water level control package or is intended for remote sump application, a mechanical water make-up valve will not be provided.

Inspection and Maintenance:

- Inspect the make-up valve assembly monthly and adjust if necessary.
- Inspect the valve annually for leakage. Replace the valve seat if necessary.
- Maintain the make-up water supply pressure between 15 psig and 50 psig for proper operation. BAC recommends a surge protector (provided by others) for pressures over 50 psig.
- Set the initial basin water level by adjusting the wing nuts, so that the make-up valve is completely closed when the water level in the cold water basin is at the overflow connection.
- With the design thermal load and the average water pressure (15 to 50 psig) at the valve, the above setting will produce operating water levels as stated in Table 2 on Page N53.
- If the thermal load is less than the design load at the time of unit start-up, the procedure may produce operating levels greater than those shown in Table 2. If operating levels are higher than specified, readjust the float in order to attain the recommended operating level.
- Closely monitor the water level in the cold water basin and adjust the level if necessary during the first 24 hours of operation.
- Operating at the recommended water level will ensure that the unit basin contains sufficient water volume to prevent air entrainment in the circulating pump during system start-up and provides sufficient excess basin capacity to accept the total system pull-down volume.

Optional Electric Water Level Control Package

As an option, an electric water level control package is available in lieu of the mechanical make-up assembly. The package consists of a probe-type liquid level control assembly and a slow-closing solenoid valve. Stainless steel electrodes, factory-set at predetermined lengths, extend from an electrode holder into the cold water basin.

Inspection and Maintenance:

- Clean the stainless steel electrodes periodically to prevent accumulations of scale, corrosion, sludge or biological growth, which could interfere with the electrical circuit.
- The water level is maintained at the recommended operating level regardless of the system thermal load. Therefore, it is not recommended that the operating level be adjusted.
- During the start-up of units equipped with the electric water level control package, by-pass the control unit in order to fill the unit to the overflow connection.



Recommended Spare Parts

BAC parts are the "Perfect Fit" for your cooling tower. These parts are specifically designed, engineered and manufactured to work in a cooling tower environment. They are the right parts, at competitive pricing levels, and BAC offers the best deliveries in the industry.

BAC stocks most common repair and retrofit parts in our Parts DepotSM and can ship other parts, often overnight, from any of our three manufacturing facilities strategically located in California, Delaware, and Illinois. In addition, most BAC Representatives maintain a local inventory of commonly used parts.

Even with this fast delivery capability, it is still recommended that certain essential, emergency repair parts be maintained in your local inventory, to minimize any potential downtime.

Basic Recommended Spare Parts

Bearing set

Float valve or repair kit

Float ball

Solenoid valve (if unit is equipped with electric water level control)

Powerband or set of belts

Spray nozzle kit with grommets

Basin heater and low water cut out

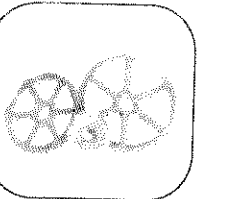
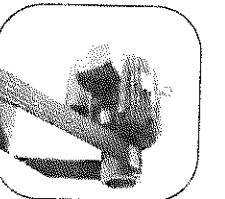
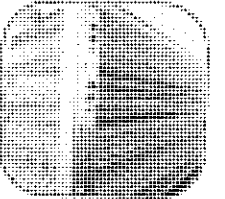
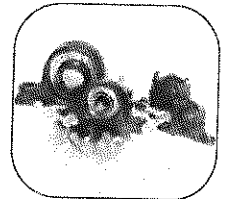
Door gasket

Strainer (inlet and suction)

Fan and sheave bushings

Pump seal and gasket kit for coil products

Automatic bearing greaser refill kit



Parts to Consider if Extended Downtime is a Concern

Spray pump for coil products

Fan or fan wheel

Fan shaft

Sheave set

Fan motor

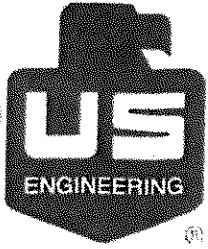


Baltimore Aircoil Company Warranties

Warranties: Seller warrants that the equipment sold under this contract shall be free from defects in material and workmanship for a period of twelve (12) months from the date of equipment startup or eighteen (18) months from the date of shipment, whichever occurs first. The following original equipment components only are warranted against defects in materials and workmanship for a period of five (5) years from date of shipment: fans, fan shafts, fan motors, bearings, sheaves, gearboxes, driveshafts, couplings, and mechanical equipment support. Details of option-specific warranties follow:

- **JE Premier Series™ Construction** is warranted to be free from defects in material and workmanship for a period of five (5) years from date of shipment.
- **EVERTOUGH™ Construction** is warranted to be free from defects in material and workmanship for a period of five (5) years from date of shipment excluding heat transfer coils which are warranted to be free from defects in material and workmanship for a period of twelve (12) months from the date of equipment startup or eighteen (18) months from the date of shipment, whichever occurs first.
- **TriArmor® Corrosion Protection System** Cold Water Basins are warranted against leaks and corrosion for a period of five (5) years from date of shipment. For the purposes of this warranty, "corrosion" means red rust formation on the interior of the cold water basin panels due to a failure of the TriArmor® Corrosion Protection System. The leak or corrosion must be caused by a defect in the application of the TriArmor® Corrosion Protection System. This warranty does not apply to cold water basin field connections, field installed options or modifications by others.
- **Welded 304 Stainless Steel** Cold Water Basins are warranted against leaks for a period of five (5) years from date of shipment. Only leaks from the factory seams of the cold water basin are covered; this warranty does not apply to cold water basin field connections, field installed options or modifications by others.
- **Replacement Parts** provided by Seller under its original equipment warranty obligations are warranted against defects in materials and workmanship for a period of twelve (12) months from date of shipment or until expiration of their original warranty, whichever occurs first. Parts purchased after expiration of the original equipment warranty are warranted against defects in materials and workmanship for a period of twelve (12) months from date of shipment.

Written notice of any defect shall be given to Seller immediately upon discovery by Buyer, and shall fully describe the claimed defect. Defective parts shall be repaired or replaced F.O.B. point of shipment, provided that inspection by Seller verifies the claimed defect(s). This shall be Buyer's exclusive remedy. **This warranty does not cover the costs of removing, shipping or reinstalling the equipment. Repairs made without the prior written approval of Seller shall void all warranties covering material and workmanship.** Any descriptions of the product(s) in the contract are for the sole purpose of identification and do not constitute a warranty. In the interest of product improvement, Seller reserves the right to change specifications and product design without incurring any liability therefore. The foregoing express warranties or those set forth elsewhere on this document are the only warranties of Seller applicable to the product(s) sold under this contract. **All other warranties, whether verbal or written, and all warranties implied by law, including any warranties of merchantability or fitness for a particular purpose, are hereby excluded. Failure on the part of Buyer or of other parties to properly maintain the product(s) sold under this contract, or the operation of such product(s), by Buyer and/or other parties under conditions more severe than those for which such product(s) were designed, shall void all warranties covering materials and workmanship. Seller's warranties do not apply to defects in product(s) for which payment in full has not been received by Seller, and said warranties do not cover normal wear and tear or the erosion, corrosion and/or deterioration of the product(s) from unusual causes. No warranties by Seller shall apply to accessories manufactured by others, inasmuch as they are warranted separately by their respective manufacturers, except as stated above.** Buyer assumes liability for and shall bear the costs of compliance with all laws, regulations, codes standards or ordinances applicable to the location, operation and maintenance of the product(s) sold under this contract, including those requirements pertaining to the distances between such product(s) and air-conditioning system duct intakes. No representative or agent of Seller is authorized to enlarge upon the express warranties of Seller.



Cooling Towers Product
Submittal Information:
CT-1

**BEATTIE
ELEMENTARY
SCHOOL**

300 MEADOWLARK AVE
FORT COLLINS CO 80526

TRANSMITTAL

Belford Watkins Group
Architects



Date: 4.10.14

Project: Beattie Elementary

To: Rob Price/DJ Anderson

From: Patti Watkins

We are transmitting the following submittals with the comments listed below:

ARCHITECTURE

INTERIORS

PLANNING

NET: No Exception Taken MCN: Make Corrections Noted RX: Rejected
 RR: Revise and Resubmit SSI: Submit Specified Item
 CMT: See Comment Below

236500 Cooling Tower

Copies	Section	Item	Manufacturer	NET	MCN	RR	RX	SSI	CMT
1	236500	Product Data, shop drawings, certificates, reports	Baltimore Aircoil		x				1

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures, there from. The Contractor remains responsible for details and accuracy, for conforming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

Notes: 1. COOLING TOWER (Make Corrections Noted)

1. Submittal wiring diagram shall be shared with electrical contractor for field coordination.
2. Provide factory startup per specification requirements.



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary
3000 Meadowlark Avenue
Fort Collins, CO 80526

Project # 30-13-038
Tel: Fax:

FCI Constructors, Inc. - Longmont

Date: 3/28/2014

Reference Number: 0020

Transmitted To: Don Watkins
Belford Watkins Group
P.O. Box 1306
Fort Collins, CO 80521
Tel: 970-212-1243

Transmitted By: DJ Anderson
FCI Constructors, Inc. - Longmont
4001N. Valley Drive
Longmont, CO 80504
Tel: 970-535-4725
Fax: 970-535-4867

Qty	Submittal Package No	Description	Due Date	Package Action
1	012 - 236500 - 0	Cooling Towers	4/11/2014	

Transmitted For	Delivered Via	Tracking Number
Review & Approval	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
001		Cooling Towers - Product Data	236500		
002		Cooling Towers - Shop Drawings	236500		
003		Cooling Towers - Certificates	236500		
004		Cooling Towers - Source Quality Control Reports	236500		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

Signature

Signed Date

Prolog Manager

Printed on: 3/28/2014 FCI PM Data



4001 N. Valley Drive
Longmont, CO 80504
Phone: 970-535-4867
Fax: 970-535-4867

DATE: 03/28/2014

SPECIFICATION SECTION(S): 236500
SCOPE OF WORK: HVAC - Cooling Towers

PROJECT: Poudre School District – Beattie Elementary School

PROJECT #: 30-13-038

ARCHITECT/DESIGNER: Belford Watkins Group, LLC.
425 West Mulberry Ave., Suite 207
P.O. Box 1306
Fort Collins, CO 80521

PHONE: 970-407-0070

GENERAL CONTRACTOR: FCI CONSTRUCTORS, INC.
4001 N. Valley Drive
Longmont, CO 80504

PHONE: 970-535-4725
FAX: 970-535-4867

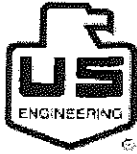
SUBMITTED BY: U.S. Engineering
PO Box 905
Loveland, CO 80539

PHONE: 970-669-1666
FAX:

CONTRACTORS STAMP:

ARCHITECT/ENGINEER STAMP

FCI CONSTRUCTORS, INC.
Review of this submittal is subject to the provisions of the Contract Drawings and Specifications. This action is for general concurrence only.
<input checked="" type="checkbox"/> Reviewed
<input type="checkbox"/> Reviewed with Notations Indicated - Resubmit with Corrections
<input type="checkbox"/> DISAPPROVED RESUBMIT
<input type="checkbox"/> Reviewed with Notations Indicated - Resubmittal not Required.
Submittal Reviewed By: DA Date:03/28/2014
Submittal No: 012 Spec. Section: 236500



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 80539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-021

Date: 3/18/2014

Revision #: _____

Discipline: Piping

Project : Beattie Elementary

Project #: 1202

Supplier : CFM Company

Spec Sect: 23 65 00

Submitted Items:

Page Number	Paragraph Number	Description	Manufacturer
23 65 00-2	2	Cooling Tower CT-1	Baltimore Aircoil Company
		Vibration Isolation CT-1	The VMC Group
			Lead Time-35 Business Days

Target Dates:

Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
3/11/14	3/18/14	3/28/14		

GC/Arch/Engineer Stamp Area:

U.S. Engineering

Signed:

Chris Mallory



CFM COMPANY

AIR CONDITIONING / HEATING / VENTILATING EQUIPMENT

413D North Highway 287 - Ft. Collins, CO 80524

Phone: (970) 493-7293 / Fax: (970) 493-7297

PSD - Beattie Elementary

TAG: CT-1

BAC Model VTL-079-K Cooling Tower

**Specification Section:
236500**

Submittal Date: 3/12/2014

Submitted by: Justin Dunkin



**BALTIMORE
AIRCOIL COMPANY**

**Submittal Data Form
3-11-2014**

Sold To : **US ENGINEERING CO-SPRING HILL**
729 S.E. 8th St
Loveland, CO 80537
United States

Project: PSD - Beattie Elementary
Purchase Order No:
Engineer: AE Associates
BAC Order # U147493303
Representative: CFM COMPANY

All Information is per Unit

Quantity: 1 Model VTL-079-K/X COOLING TOWER

Certified Capacity: 100.00 USGPM of water from 71.01°F to 61.01°F at 59.00°F entering air wet bulb and 4.03 PSIG of total (static lift + spray) pump head from the unit base.

Fan Motor(s): One (1) 10 HP fan motor(s): Totally Enclosed, Fan Cooled (TEFC),
1 Speed/1 Winding - Premium Efficiency (Inverter Duty), suitable for 200 volt, 3 phase,
60 hertz electrical service. Drives are based on 0 inches ESP.

NOTE: Inverter Duty fan motors, furnished in accordance with NEMA Standard Mg.1 -- Part 31, are required for applications using variable frequency drives for fan motor control.

Submittal Information	Equipment Summary
BAC Terms and Conditions of Sale Mechanical Specifications Performance Curves Sound Data Submittal Drawings/Diagrams UP-U147493303 Unit Print - RH SS-U147493303 Unit Support VL-U147493303 VCOS Location VW-U147493303 VCOS Wiring	Forced Draft, Counterflow Cooling Tower Quality Assurance - ISO 9001 Certified Unit Energy Efficiency per ASHRAE Standard 90.1-2010 Steel Panels and Structural Elements are Constructed of Heavy Gauge Galvanized Steel Galvanized Steel Fan Wheel(s) Non-Corroding PVC Film Fill Material with a Flame Spread Rating of 5 Galvanized Steel Upper Drift Eliminators and PVC Lower Drift Eliminators Standard Unit Anchorage End Outlet Pump Suction Connection Mechanical Float Valve Assembly Electronic Vibration Cutout Switch with Alarm Contact Extended Bearing Lubrication Lines

THANK YOU FOR YOUR BUSINESS!

Rigging and Installation Instructions, as well as Operating and Maintenance Instructions are available at www.baltimoreaircoil.com



BALTIMORE AIRCOIL COMPANY

Mechanical Specifications 3-11-2014

Customer: US ENGINEERING CO-SPRING HILL
Project: PSD - Beattie Elementary
Purchase Order No:
Engineer: AE Associates
BAC Order # U147493303

All Information is per Unit

Quantity: 1 Model VTL-079-K/X COOLING TOWER

Unit Type:

Factory fabricated, forced draft, counterflow cooling tower with vertical discharge.

Quality Assurance:

Each unit is manufactured under closely-controlled conditions using standardized parts to ensure each unit is built precisely to the same high-quality design and construction standards. The design, manufacture, and business processes of Baltimore Aircoil Company are ISO 9001:2000 certified.

Unit Efficiency:

The unit(s) complies with the energy efficiency requirements established by ASHRAE Standard 90.1-2010.

Materials of Construction:

Heavy gauge panel construction of G-235 (Z700 metric) hot-dip galvanized steel utilizing double break flanges for maximum strength, rigidity, and reliable sealing at watertight joints. The edges of the hot-dip galvanized steel components are given a protective coat of zinc-rich compound. Circular access doors provided for interior inspection, cleaning, and adjustments are constructed of G-235 (Z700 metric) hot-dip galvanized steel and are held in place with phenolic knob screws. The heat transfer casing section is constructed of G-235 (Z700 metric) hot-dip galvanized steel.

The fan(s) is located in the dry air stream to provide greater reliability and ease of maintenance. Fan wheels are forwardly curved, centrifugal, squirrel-cage type which are statically and dynamically balanced, and are mounted on a steel shaft supported by heavy-duty, self-aligning, re-lubricatable bearings with cast iron housings. Fan housings have curved inlet rings for efficient air entry and are constructed of G-235 (Z700 metric) hot-dip galvanized steel. The fan housings are of split design to facilitate fan wheel and shaft removal.

V-belt sheaves, selected for 150% motor nameplate horsepower, are mounted and aligned at the factory. Drive and all moving parts are protected by removable screens and panels made of G-235 (Z700 metric) hot-dip galvanized steel. The fan(s), fan shaft(s), bearings, mechanical equipment support and fan motors are warranted against defects in materials and workmanship for five (5) years from date of shipment.

Fan Wheels:

Forwardly curved, centrifugal, squirrel cage type fan wheels, constructed from G-235 (Z700 metric) hot-dip galvanized steel, are statically and dynamically balanced. Fan housings have curved inlet rings for efficient air entry.

Wet Deck Material:

Serpentine polyvinyl chloride (PVC) BACount® Wet Deck Surface is impervious to rot, decay, fungus or biological attack and has a flame spread rating of 5 per ASTM Standard E84-77a. Wet deck is suitable for a maximum entering water temperature of 130°F(54°C). The process water is distributed over the wet deck surface via a spray header with schedule 40 PVC removable branch(es) with large orifice plastic spray nozzles which are held in place with snap-in rubber grommets.

Drift Eliminators:

Upper set of drift eliminators are constructed of G-235 (Z700 metric) hot-dip galvanized steel and lower set of drift eliminators are constructed of polyvinyl chloride (PVC). Both sets of drift eliminators are removable in easily handled sections. They will impart three distinct changes in air direction to effectively strip entrained moisture from the leaving airstream with minimum air resistance.

Unit Anchorage:

When supported as recommended, the unit has anchorage to resist windloads up to 30 psf (146.6 kg/m²) acting on the full vertical projected area with 16 psf (78.1 kg/m²) acting simultaneously on the full horizontal projected area or seismic forces of 112% of the operating weight acting in the horizontal direction, and 14% of the operating weight acting in the vertical direction applied at the center of gravity.

Water Outlet(s):

A pipe stub connection(s) of a metal compatible with the cold water basin material and appropriately sized for design flow is provided. Please see the submittal package for the connection type, size and location. Also included is a large area, lift out strainer which matches the cold water basin material of construction and has perforated openings sized smaller than the water distribution nozzle orifices. Strainer includes anti-vortexing baffle to prevent air entrainment.

Basin Water Level Control:

A make-up valve with unsinkable polystyrene filled plastic float arranged for easy adjustment. The corrosion resistant make-up valve is suitable for water supply pressures between 15 psig (103 kPa) and 50 psig (345 kPa).

Vibration Cutout Switch:

Fan system is provided with an appropriate number of vibration cutout switches to limit collateral damage to the unit in the event of a catastrophic fan failure. The vibration switch(es), including external alarm capability, is solid state with a frequency range of 2 to 1,000 Hz (120 to 60,000 RPM), a velocity set point of 0.1 to 1.5 in./Sec., and a time delay adjustable from 2 to 15 seconds. Input power required is 110 V, 50/60 Hz, 3 Watts plus alarm current. Alarm or shutdown switch is rated at 5 Amperes, 110 VAC TRIAC. Field wiring is by others.

Extended Lube Line(s):

Bearing lubrication lines are extended to grease fittings located on the face of the unit.

Baltimore Aircoil Company, Inc.
Cooling Tower Selection Program

Version: 8.1.4 NA
 Product data correct as of: February 07, 2014

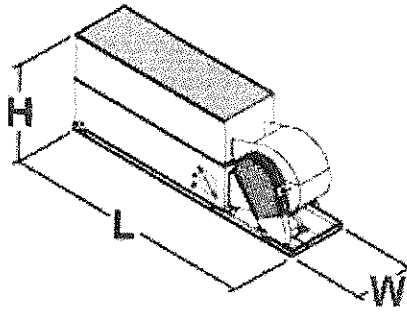
Project Name:
 Selection Name: U147493303
 Project State/Province:
 Project Country: United States
 Date: March 11, 2014

Model Information

Product Line: Low Profile Series V (VTL)
 Model: VTL-079-K
 Number of Units: 1
 Fan Type: Standard Fan
 Fan Motor: Full Speed, 10.00 BHP
 Total Standard Fan Power: (1) 10.00 = 10.00 HP/Unit
 Intake Option: None
 Internal Option: None
 Discharge Option: None
 External Static Pressure: 0.00 in. H2O

Design Conditions

Flow Rate: 100.00 USGPM
 Hot Water Temp.: 71.01 °F
 Cold Water Temp.: 61.01 °F
 Wet Bulb Temp.: 59.00 °F
 Tower Pumping Head: 4.03 psi
 Static Lift: 3.08 psi
 Spray Pressure: 0.95 psi
 Reserve Capability: 0.11%



Engineering Data, per Unit

Unit Length: 10' 11.75"
 Unit Width: 4' 1.25"
 Unit Height: 8' 1.81"
 Air Flow: 17,500 CFM
 Approximate Shipping Weight: 2,040 pounds
 Heaviest Section: 2,040 pounds
 Approximate Operating Weight: 3,100 pounds

Minimum Distance Required

From Solid Wall: 3 ft.
 From 50% Open Wall: 3 ft.

Energy Rating:

28.10 per ASHRAE 90.1, ASHRAE 189 and CA Title 24.

Note: These unit dimensions do not account for any options/accessories. Please contact your local BAC sales representative for dimensions of units with options/accessories.

Warning

1. One or more selection parameters are outside of CTI Certification limits.

Baltimore Aircoil Company, Inc.
Cooling Tower Selection Program

Version: 8.1.4 NA
 Product data correct as of: February 07, 2014

Project Name:
 Selection Name: U147493303
 Project State/Province:
 Project Country: United States
 Date: March 11, 2014

Model & Fan Motor

Product Line: Low Profile Series V (VTL)
 Model: VTL-079-K
 Number of Units: 1
 Fan Motor: Full Speed, 10.00 BHP
 Total Standard Fan Power: (1) 10.00 = 10.00 HP/Unit

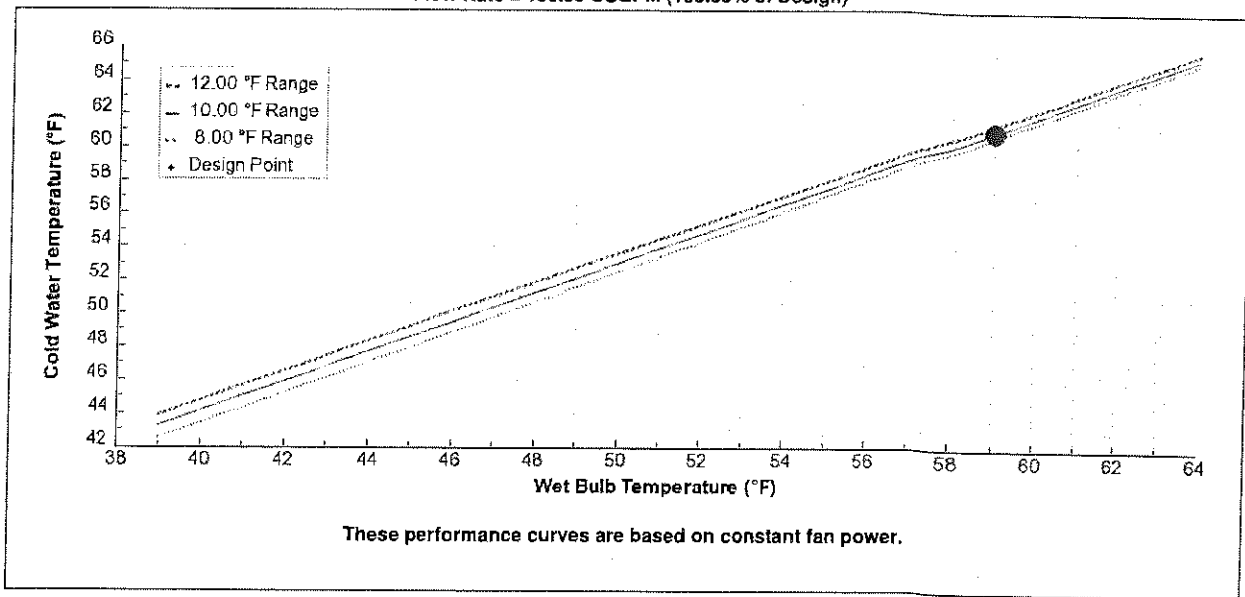
Model Accessories

Intake Option: None
 Internal Option: None
 Discharge Option: None
 Fan Type: Standard Fan
 External Static Pressure: 0.00 in. H2O

Design Conditions @ Standard Total Fan Motor Power per Unit (10.00 HP)

Flow Rate: 100.00 USGPM
 Hot Water Temp.: 71.01 °F
 Cold Water Temp.: 61.01 °F
 Wet Bulb Temp.: 59.00 °F

Predicted Performance
 Fan Motor Alternative = Full Speed, 10.00 BHP
 Flow Rate = 100.00 USGPM (100.00% of Design)



Warning	Applies to Design Conditions	Applies to Off Design Conditions
1. One or more selection parameters are outside of CT1 Certification limits.	Yes	Yes

Baltimore Aircoil Company, Inc.
Cooling Tower Selection Program

Version: 8.1.4 NA
 Product data correct as of: February 07, 2014

Project Name:
 Selection Name: U147493303
 Project State/Province:
 Project Country: United States
 Date: March 11, 2014

Model Information

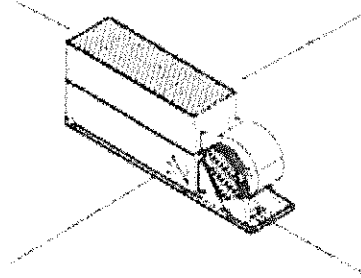
Product Line: Low Profile Series V (VTL) Intake Option: None
 Model: VTL-079-K Internal Option: None
 Number of Units: 1 Discharge Option: None
 Fan Type: Standard Fan External Static Pressure: 0.00 in. H2O
 Fan Motor: Full Speed, 10.00 BHP/Unit
 Total Standard Fan Power: (1) 10.00 = 10.00 HP/Unit

Octave band and A-weighted sound pressure levels (Lp) are expressed in decibels (dB) reference 0.0002 microbar. Sound power levels (Lw) are expressed in decibels (dB) reference one picowatt. Octave band 1 has a center frequency of 63 Hertz.

Top Sound Pressure (dB)		
Octave Band	Distance	
	5 ft.	50 ft.
1	72	63
2	72	62
3	71	62
4	71	60
5	71	57
6	70	56
7	66	51
8	62	46
A-wgtd	76	63

Back Sound Pressure (dB)		
Octave Band	Distance	
	5 ft.	50 ft.
1	68	63
2	68	59
3	66	59
4	66	58
5	61	55
6	56	48
7	48	41
8	44	35
A-wgtd	67	59

End Sound Pressure (dB)		
Octave Band	Distance	
	5 ft.	50 ft.
1	70	62
2	71	61
3	69	61
4	71	59
5	70	56
6	70	55
7	66	50
8	61	45
A-wgtd	76	62

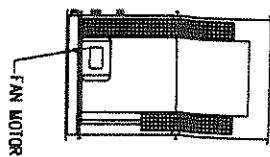
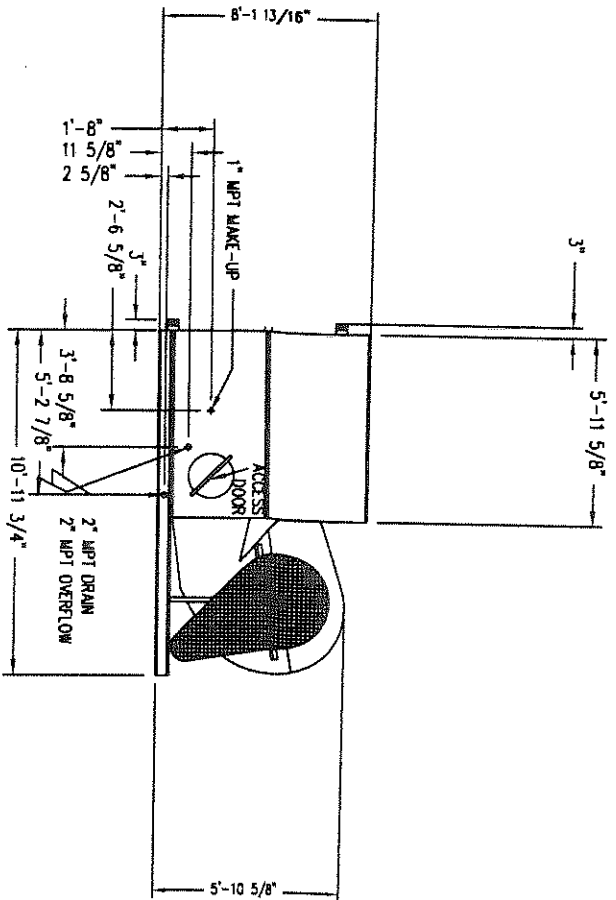
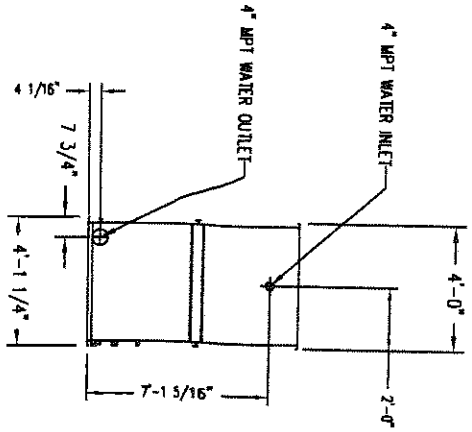


End Sound Pressure (dB)		
Octave Band	Distance	
	5 ft.	50 ft.
1	70	62
2	71	61
3	69	61
4	71	59
5	70	56
6	70	55
7	66	50
8	61	45
A-wgtd	76	62

Fan Side Sound Pressure (dB)		
Octave Band	Distance	
	5 ft.	50 ft.
1	68	62
2	66	60
3	66	59
4	66	60
5	64	60
6	62	55
7	56	49
8	51	45
A-wgtd	69	63

Sound Power (dB)		
Octave Band	Center Frequency (Hertz)	Lw
1	63	94
2	125	93
3	250	93
4	500	91
5	1000	89
6	2000	86
7	4000	81
8	8000	76

Note: The use of frequency inverters (variable frequency drives) can increase sound levels.



- Notes
- 1) Drawings are not to scale. All dimensions are in feet and inches. Weights are in pounds and include options and accessories.
 - 2) Unless otherwise indicated, connections 3" and smaller are MPT. Connections 4" and larger are grooved to suit a mechanical coupling and beveled for welding.
 - 3) Field piping should be fabricated at time of installation. Pre-fabrication of pipe work is not recommended.
 - 4) Do not support piping from unit connections. All necessary piping supports to be supplied by others.
 - 5) For weight loadings and support requirements, refer to the suggested unit support drawing.
 - 6) Due to height limitations on truck shipments, some items shown may ship loose for field installation.

Model Number	Shipping Weight	Operating Weight	Heaviest Section
VTL-079-K/X	2040	3100	2040

ORDER NO: **U147493303**

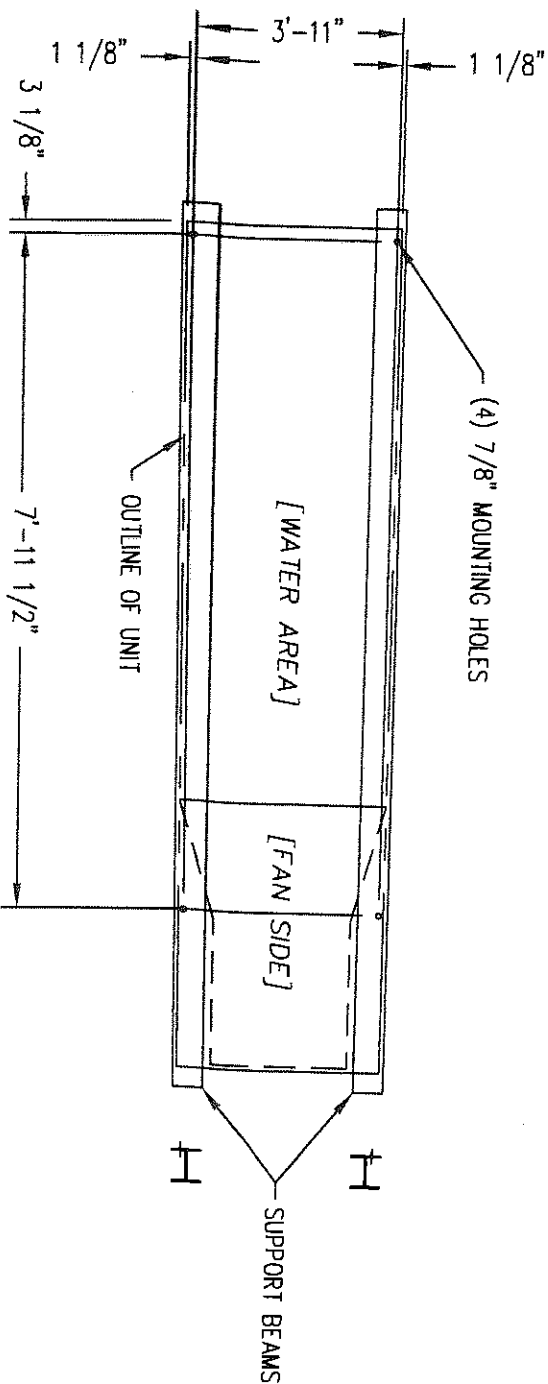
DATE: **3/11/14**



BALTIMORE AIRCOIL COMPANY

Unit Print
4' Wide Models

DRAWING NUMBER:
UP-U147493303



- Notes
- 1) Drawings are not to scale. All dimensions are in feet and inches. Weights are in pounds and include options and accessories.
 - 2) Operating weight and weight loading are for units with water level in basin at overflow.
 - 3) Unit support beams and anchor bolts to be designed and furnished by others.
 - 4) Support beams must be flush and level at top.
 - 5) Recommended design loads for each beam should be 70% of the total unit operating weight applied as a uniform load to each beam.
 - 6) If vibration isolators are used, a beam must be provided between the unit and the isolators to provide continuous unit support. Additionally, the support beams must be design to accommodate the overall length and mounting hole location of the isolators which may differ from those of the unit.

Model Number	Shipping Weight	Operating Weight
VTL-079-K/X	2040	3100

ORDER NO: **U147493303**

DATE: **3/17/14**



BALTIMORE AIRCOIL COMPANY

Unit Support

DRAWING NUMBER:
SS-U147493303

OPERATING INSTRUCTIONS

Follow the installation drawings and wiring diagram to ensure the proper operation of the vibration switch. Direct any questions to your local BAC Representative.

SELF TEST FEATURE

The test position on the set-point adjustment knob is used to test the switch functions without the need for the fan motor(s) to be in operation. With the vibration switch powered, the LED should illuminate when the set-point adjustment knob is set to the test position. The time it takes to activate the shutdown relay after the LED is illuminated is the running time delay. This self test procedure should be performed periodically (at least once a year) to ensure the switch is operating properly.

SETTING THE TIME DELAYS

The vibration cutout switch has two built in time delays - a fixed 20 second start-up time delay and an adjustable running time delay. These time delays help to avoid nuisance trips from transitory startup vibrations and momentary vibrations during normal operation.

When the switch is wired such that AC power is always applied to the switch, the 20 second time delay can be activated by means of opening a contact between terminals 5 and 7. This contact can be achieved by a N/C relay (by others) wired with the starter circuit as shown in the wiring diagram. This relay must open when power is applied to the starter circuit. This is the preferred method because the 3.5 watt dissipation provides a small amount of heating within the switch enclosure to help keep the switch moisture free. Alternately, when the vibration switch is wired in such a way that the switch is only powered when the starter circuit is powered, the 20 second time delay is automatically activated when power is applied to the switch. The running time delay is factory set at 3 seconds to avoid nuisance trips. This time delay can be field adjusted from 1 to 7 seconds. To readjust, turn the running time delay adjustment screw clockwise (CW) to increase and counterclockwise (CCW) to decrease (one complete turn is approximately 0.5 seconds). To determine the running time delay, refer to the "SELF TEST FEATURE" section above.

SETTING OF TRIP POINTS

The shutdown relay is activated by vibration severity (velocity in inches/second). This trip level is factory set at 0.45 in/sec, which is a typical trip level for evaporative cooling equipment and should prove to be satisfactory in the majority of installations. Should it be necessary, the shutdown relay trip limit may be field adjusted from 0.1 to 1.5 in/sec by turning the set-point adjustment knob CW to increase and CCW to decrease the vibration trip point. This adjustment should be made in increments of approximately 0.10 in/sec until the desired setting is obtained. This adjustment must be done with the unit off and all the equipment locked out.

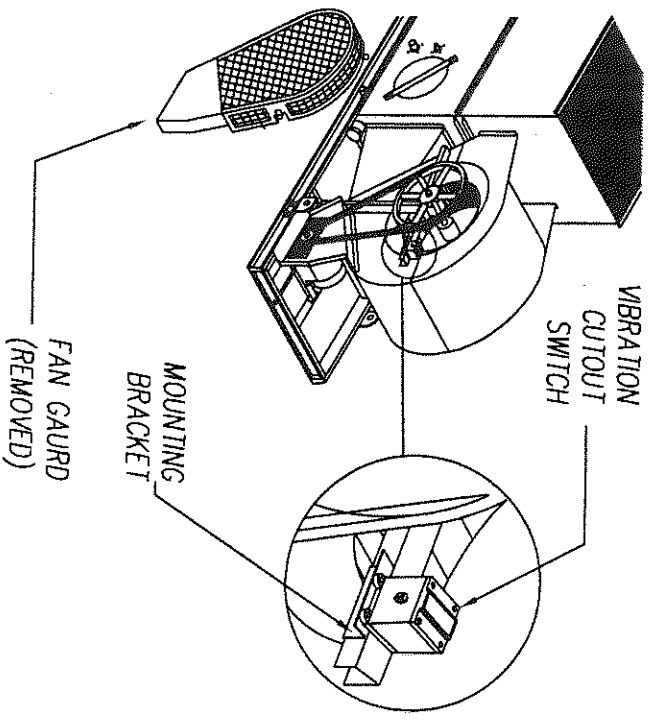
NOTE

Moisture inside the switch can lead to switch failure. Care must be taken when replacing the cover on the vibration switch to ensure that the proper watertight seal is obtained.

CAUTION

Before performing any maintenance, adjustment or inspection of the switch, make certain that all power has been disconnected and locked in the off position.

**SWITCH LOCATION
LOW PROFILE SERIES V**



ORDER NO: **U147493303**

DATE: **3/11/14**



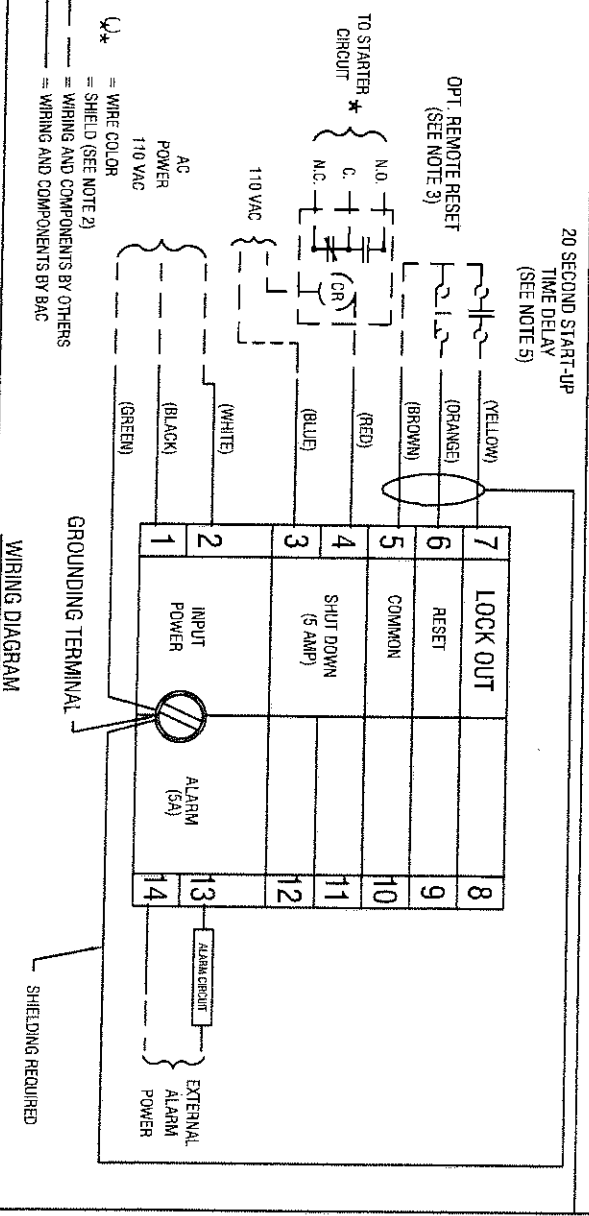
**BALTIMORE
AIRCOIL COMPANY**

VTL VCOS Location

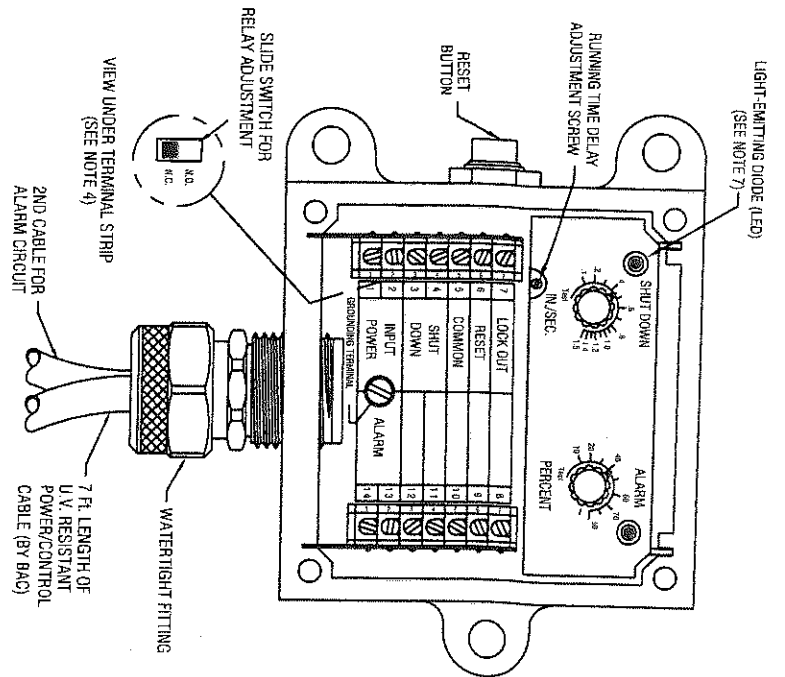
DRAWING NUMBER:
VL-U147493303

NOTES:

1. THE VIBRATION CUTOUT SWITCH TIME DELAY AND VIBRATION LEVELS HAVE BEEN FACTORY SET AT TYPICAL VALUES FOR EVAPORATIVE COOLING EQUIPMENT. SHOULD ADJUSTMENT FROM THESE SETTINGS BE NECESSARY, PLEASE REFER TO THE OPERATING INSTRUCTIONS. (DRAWINGS BAC-10876A, BAC-10877, BAC-10878, OR BAC-11489).
2. THE VIBRATION SWITCH IS SHIPPED FROM THE FACTORY WITH SHIELDED POWER CABLE PRE-WIRED INSIDE THE SWITCH FOR CONNECTION TO WIRING IN A JUNCTION BOX (BY OTHERS) OUTSIDE THE UNIT. THE WIRES FROM TERMINALS 5, 6, AND 7 ARE ENCLOSED IN A SHIELD. IF EXTERNAL WIRING FOR START-UP DELAY OR REMOTE RESET IS USED (BY OTHERS), IT MUST BE SHIELDED AND THE SHIELD CONNECTED TO THE BAC SUPPLIED SHIELD. THIS SHIELD WIRE SHOULD NOT BE GROUNDED AT THE JUNCTION BOX.
3. IF A REMOTE RESET (N/R) IS DESIRED, A MOMENTARY NORMALLY CLOSED (N/C) CONTACT MUST BE PROVIDED BY OTHERS. THE REMOTE RESET IS ACTIVATED BY MOMENTARILY OPENING THE CONTACT BETWEEN TERMINALS 5 AND 6. AS SUPPLIED FROM THE FACTORY, TERMINALS 5 AND 6 ARE CONNECTED BY A WIRE NUT FOR LOCAL RESET.
4. THE SHUTDOWN (SD) RELAY IS FACTORY SET IN THE N/C POSITION. THE SD RELAY CAN BE FIELD ADJUSTED TO NORMALLY OPEN (N/O) BY MEANS OF A SLIDE SWITCH LOCATED UNDER THE TERMINAL STRIP INSIDE SWITCH ENCLOSURE. (SEE SHUTDOWN CIRCUIT CURRENT LIMIT NOTE).
5. THE VIBRATION SWITCH HAS A FIXED 20 SECOND START-UP TIME DELAY CAPABILITY. WHEN THE SWITCH IS WIRED SUCH THAT AC POWER IS ALWAYS APPLIED TO THE SWITCH, THE 20 SECOND TIME DELAY CAN BE ACTIVATED BY MEANS OF A MOMENTARY CONTACT CLOSURE BETWEEN TERMINALS 5 AND 7. THIS CONTACT CAN BE ACHIEVED BY A ONE SHOT RELAY (BY OTHERS) WIRED WITH THE STARTER CIRCUIT AS SHOWN. ALTERNATELY, WHEN THE VIBRATION SWITCH IS WIRED IN SUCH A WAY THAT THE SWITCH IS ONLY POWERED WHEN THE STARTER CIRCUIT IS POWERED, THE 20 SECOND TIME DELAY IS AUTOMATICALLY ACTIVATED WHEN THE POWER IS APPLIED TO THE SWITCH.
6. THE RUNNING TIME DELAY IS FACTORY SET AT 3 SECONDS AND CAN BE FIELD ADJUSTED FROM 1 TO 7 SECONDS FOR FURTHER DETAILS SEE TIME DELAY SECTION OF THE OPERATING INSTRUCTIONS.
7. THE LIGHT EMITTING DIODE (LED) IS ILLUMINATED WHEN THE VIBRATION LEVELS ABOVE THE TRIP SETTING. THE LED WILL REMAIN ILLUMINATED UNTIL THE UNIT VIBRATION LEVEL DROPS BELOW THE TRIP POINT.
8. A CONTROL RELAY IS REQUIRED IF THE SWITCH IS USED AS INPUT TO A BUILDING MANAGEMENT SYSTEM (N/O TRAC CURRENT LEAKAGE IS 1 mA). THE RELAY COIL CURRENT MUST BE GREATER THAN 50 MA CONTINUOUS. A CONTROL RELAY IS ALSO REQUIRED FOR STARTER LOADS GREATER THAN 5 AMPS CONTINUOUS, 50 AMPS PEAK FOR 16 MS.
9. IF DESIRED, A SINGLE POLE DOUBLE THROW CLASS C RELAY (1 POLE N/C) CAN BE USED IN THE SHUTDOWN CIRCUIT TO POWER AN ALARM (BY OTHERS) TO PROVIDE AN AUDIBLE OR VISUAL INDICATION OF VIBRATION TRIP AS WELL AS SHUTTING DOWN THE MOTOR.



ELECTRONIC VIBRATION CUTOUT SWITCH
 (W/WEATHER-PROOF COVER REMOVED)
 (INTERNAL FACTORY PRE-WIRING NOT SHOWN FOR CLARITY)



SHUT DOWN CIRCUIT CURRENT LIMIT

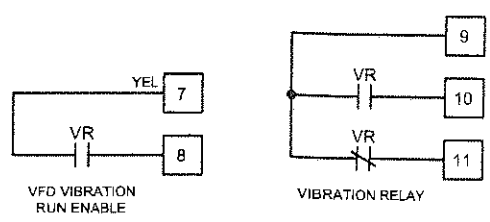
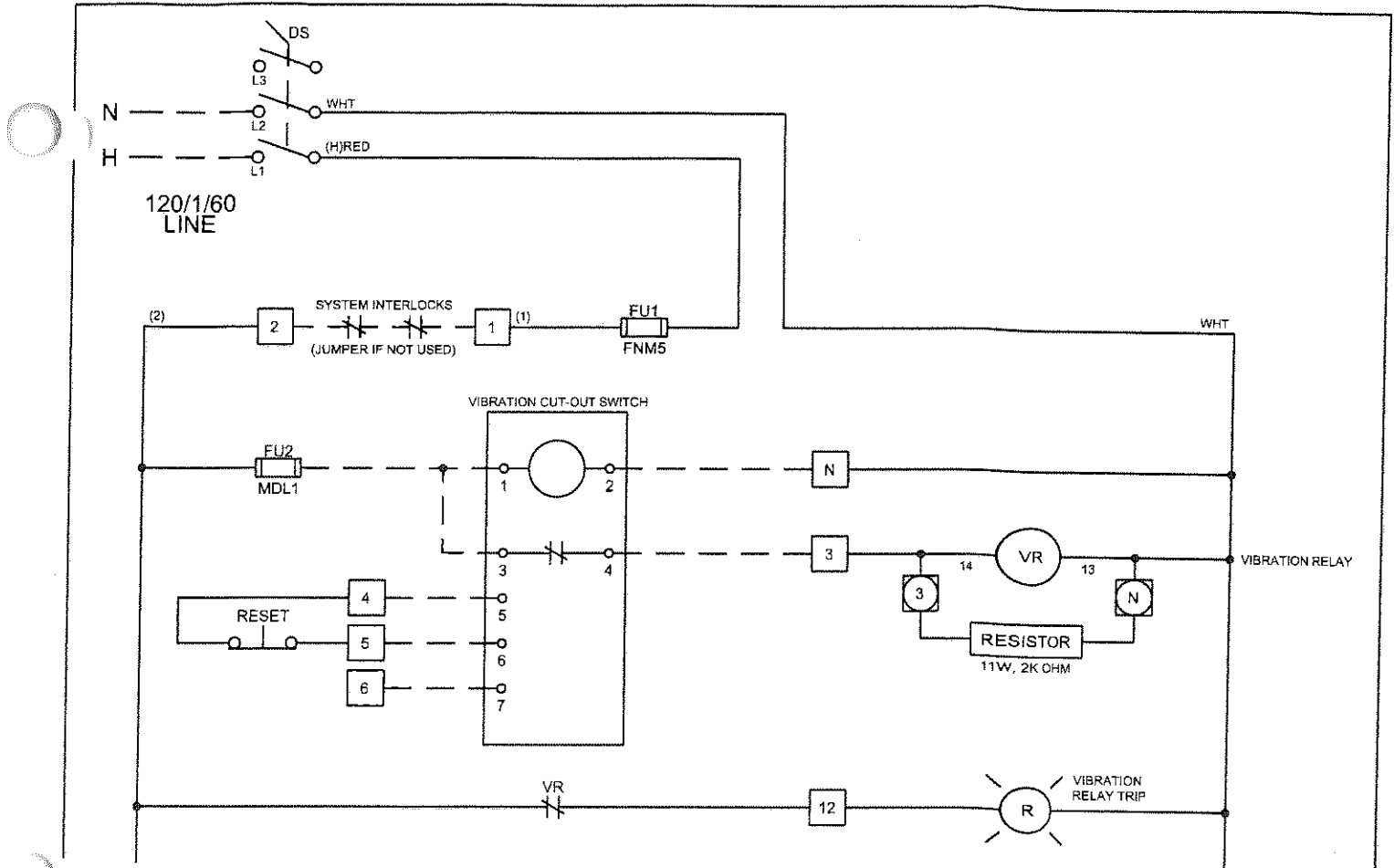
THE SHUTDOWN RELAY IS RATED AT 5 AMPS CONTINUOUS, 50 AMPS PEAK FOR 16MS AT 110 VAC.

BEFORE PERFORMING ANY MAINTENANCE, ADJUSTMENT OR INSPECTION OF THE SWITCH, MAKE CERTAIN THAT ALL POWER HAS BEEN DISCONNECTED AND LOCKED IN THE OFF POSITION.

ORDER NO: **U147493303**
 DATE: **3/11/14**



Electronic VCOs Wiring
 With Remote/Local Reset & Delay & Alarm (110 VAC)
 DRAWING NUMBER: **VW-U147493303**



(#) = WIRE NUMBER
 — = FACTORY WIRING
 - - = FIELD WIRING

					SCALE	NONE			WIRING DIAGRAM				
					DATE	01/09/14			NEMA 3R BAC				
					DRTR	JRP			CONTROL PANEL				
DATE	DESCRIPTION	BY	CHKD	ENGR	CUSTOMER PALMER DCS ENGLEWOOD, CO 720-484-8547			DWG NO.	11473-E01	REV	-		
PROJECT					CUST ORDER NO. 27266-JD-D			CAD FILE	11473	SHEET	1	OF	1

Series V and Low Profile Series V Cooling Towers



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Fan Shaft Bearings	N55
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Water Distribution System	N56
Water Level Control	N57

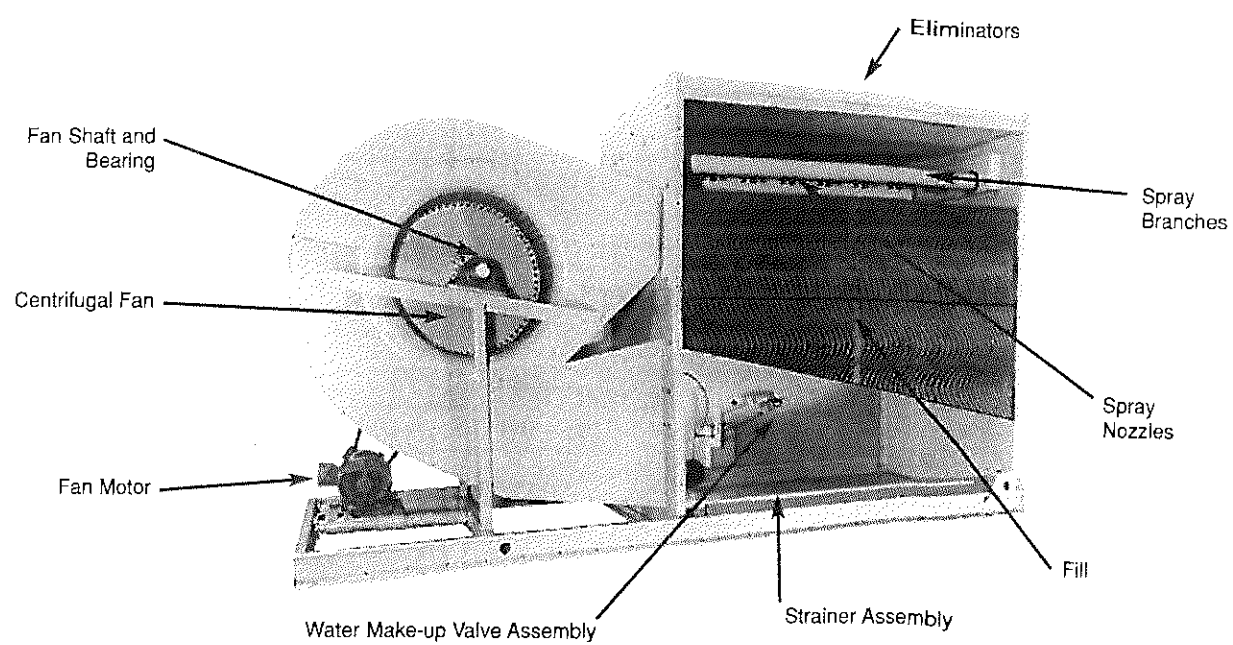


Figure 1 - VTL Low Profile Series V Cooling Tower



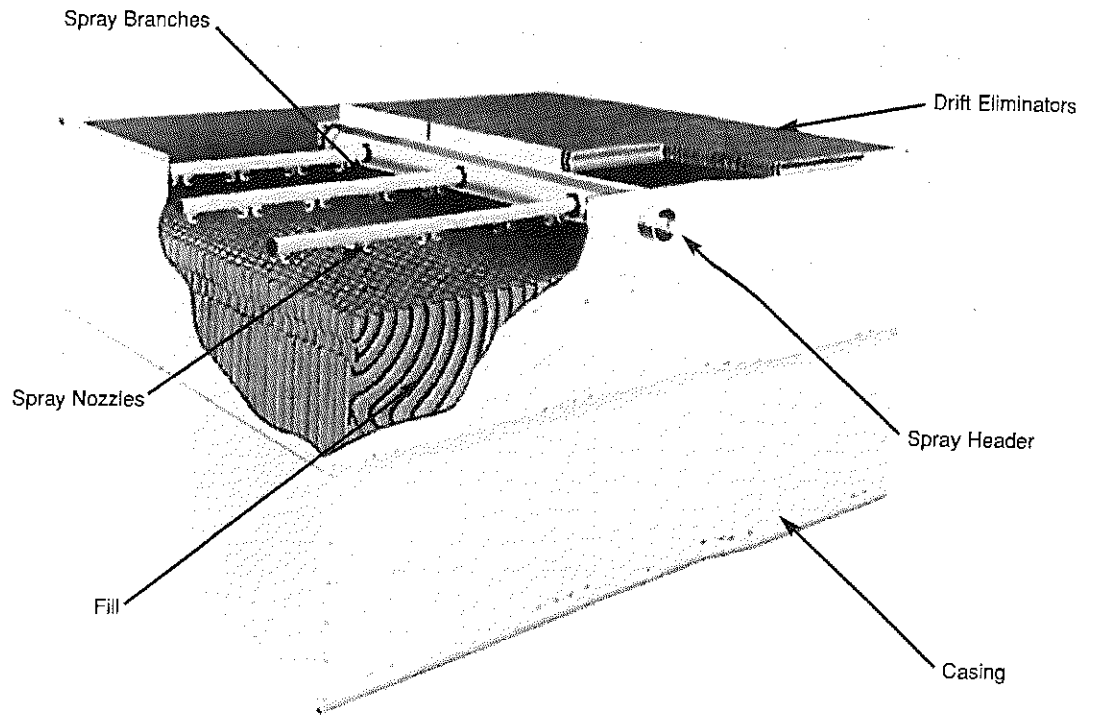


Figure 2a - Heat Transfer Casing Section for VT0 and VT1 Cooling Towers

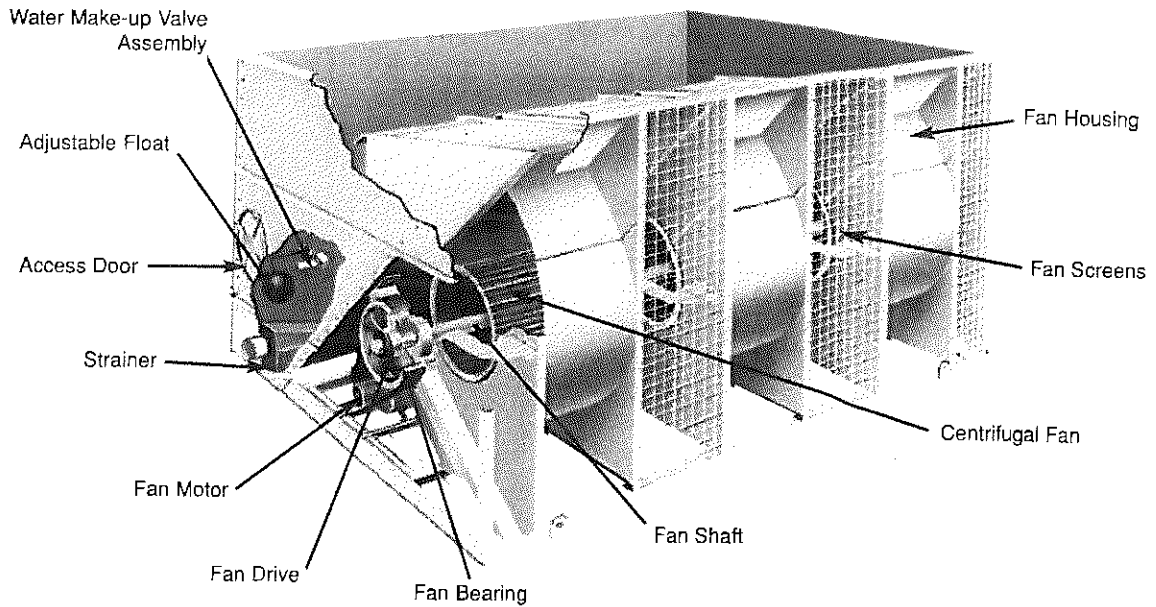


Figure 2b - Basin Section for VT0 and VT1 Cooling Towers



Table 1: Recommended Maintenance Services⁽¹⁾

Type Service	Start-Up	Monthly	Quarterly	Annually	Shutdown
Inspect and clean as necessary:					
Inspect general condition of the unit ⁽²⁾ and check unit for unusual noise or vibration	X	X			
Clean and flush basin	X	X			X
Inspect spray nozzles	X	X			X
Clean basin strainer	X	X			X
Drain basin and piping					X
Check and adjust water level in basin	X	X			
Check operation of make-up valve	X	X			
Check and adjust bleed rate	X	X			
Inspect heat transfer section	X	X			
Inspect protective finish				X	
Mechanical equipment system:					
Check belt condition	X	X			
Adjust belt tension ⁽³⁾	X		X		
Lubricate fan shaft bearings	X		X		X
Lubricate motor base adjusting nut	X		X		X
Check drive alignment				X	
Check motor voltage and current	X		X		
Check fan bearing locking collars	X		X		
Check fan motors for proper rotation	X				
Check fans for rotation without obstruction	X		X		

WARNING: Do not perform any service on or near the fans, motors, drives, or inside the unit without first ensuring that the fans and the pumps are disconnected and locked out.

NOTES:

1. Recommended service intervals are for typical installations. Different environmental conditions may dictate more frequent servicing.
2. When operating in ambient temperatures below freezing, the tower should be inspected more frequently. Refer to "Cold Weather Operation" on Page N102 for more details.
3. Tension on new belts must be readjusted after the first 24 hours of operation and quarterly, thereafter.

Operation and Maintenance

Initial and Seasonal Start-up

General

- If the unit is mounted on vibration isolators or isolation rails, refer to the vibration isolation manufacturer's guidelines before loading/unloading weight from the unit.
- Verify fan and system pump motors are disconnected and locked out.
- Conduct external inspection of the equipment. Check for leaks, corrosion, and any structural damage.
- Inspect piping and connections.

Cleaning

- Drain the cold water basin with the strainers in place.
- Remove all dirt and debris from the fan guards.
- Clean all mechanical components.
- Flush the cold water basin interior to remove any accumulated dirt and debris.
- Remove, clean, and replace the strainers.



Inspection

WARNING: Do not perform any service on or near the fans, motors, drives, or inside the unit without first ensuring that the fans and the pumps are disconnected and locked out.

- At seasonal start-up or after prolonged shutdown, check the motor insulation with an insulation tester prior to the motor start-up.
- Prior to the seasonal start-up, check and adjust the belt tension. At the initial start-up, the belt tension may not require adjustment as the drive will be properly tensioned at the factory prior to shipment.
- Start the fan motors and check for proper fan rotation.
- Run the fans in manual mode for several minutes to check for any unusual noise or vibrations.
- Check that the float operated make-up valve is operating freely.

WARNING: Check to ensure the controls for the fan motors are set to allow a maximum of 6 on-off cycles per hour.

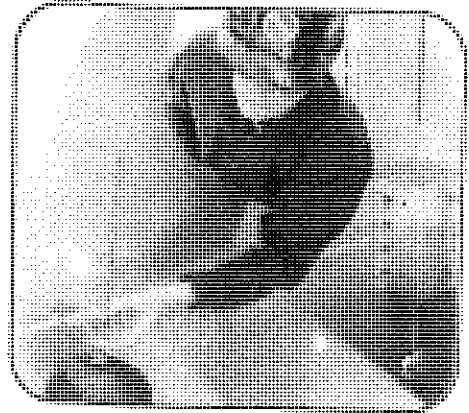


Figure 3 - Water Make-up Valve Assembly

Start-up

WARNING: Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and the pumps are disconnected and locked out.

- Prior to seasonal start-up, lubricate the motor base adjusting screws (see Figure 6 on Page N55) and the fan shaft bearings. At initial start-up, no bearing lubrication is required since the bearings are factory lubricated prior to shipment.
- Fill the cold water basin with fresh water to the overflow level via the make-up valve.
 - o Water treatment for new installations: Initiate the biocide water treatment program at this time. Refer to "Biological Control" on Page N106 for more details.
 - o Water treatment for seasonal start-up or after a shutdown period in excess of 3 days: Resume the biocide treatment program and administer a shock treatment of appropriate biocides prior to operating the fans. This will eliminate accumulated biological contaminants. Refer to "Biological Control" on Page N106 for more details.
- Set the make-up valve float so the water shuts off at the overflow level.
- Start the system pump. See "Water Distribution System" on Page N56 for more details.
- Open the valve in the tower bleed line, and adjust the bleed by closing or opening the valve.
- Once the unit is operating, check the current and voltage of all three phases (legs) of the fan motors with a heat load on the tower under warm ambient conditions. The current must not exceed the nameplate ratings.
- Check the operation of the optional vibration cutout switch.

After 24 hours of operation under thermal load, perform the following services:

- Check the tower for any unusual noise or vibrations.
- Check the operating water level in the cold water basin.
- Adjust make-up valve if necessary.
- Check the belt tension and readjust if necessary.

Extended Shutdown

WARNING: Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and the pumps are disconnected and locked out.

Perform the following services whenever the cooling tower is shutdown in excess of 3 days:

- If the unit is mounted on vibration isolators or isolation rails, refer to the manufacturer's guidelines before loading/unloading weight from the unit.



- Drain the cold water basin and all the piping that will be exposed to freezing temperatures. Heat trace and insulate all exposed piping.
- Clean all debris, such as leaves and dirt, from the interior and exterior of the unit.
- Clean and flush the cold water basin with the basin strainers in place.
- Leave the cold water basin drain open so rain and melting snow will drain from the tower.
- Clean the basin strainer and re-install.
- Lubricate the fan shaft bearings, motor base, and motor base adjusting screw.
- Close the shut off valve in the make-up water line (supplied by others), and drain all exposed make-up water piping. Heat trace and insulate all exposed piping.
- Inspect the protective finish on the unit. Clean and refinish as required. Refer to "Corrosion Protection" on Page N104 for more details.
- Secure the fan motors starting device in the "OFF" position to ensure personal safety in case of future inspection or service.

Detailed Component Maintenance Procedures

Cold Water Basin

As water circulating through the cooling tower is cooled, it collects in the cold water basin and passes through the suction strainer into the system. The cold water basin is constructed from one of the following materials of construction and the following maintenance applies to all basin materials of construction:

- Galvanized steel
- Thermosetting Hybrid Polymer
- Type 304 stainless steel

Water Levels

Table 2: Cold Water Basin Water Levels

Model Number	At Overflow Level (in.)	At Operating Level (in.)
VTL	10"	5 1/2"
VT0-12 to VT0-116	19 1/8"	12 7/8"
VT0-132 to VT0-176	22 1/2"	15 1/2"
VT1-N-xxx	31"	17"
VT1-xxx	24 1/2"	14"

- The make-up valve controls the operating level, which is maintained at the levels shown in Table 2.
- The operating water level in the cold water basin will vary with system thermal load (evaporation rate), the bleed rate employed, and the make-up water supply pressure.
- Check the operating water level monthly, and readjust the float when necessary to maintain the recommended operating level.

Inspection and Maintenance

WARNING: Openings and/or submerged obstructions may exist in the bottom of the cold water basin. Use caution when walking inside this equipment.

- Inspect the cold water basin regularly. Remove trash or debris accumulated in the basin or on the strainer.
- Quarterly, or more often if necessary, drain, clean, and flush the entire cold water basin with fresh water. This will remove the silt and sediment, which normally collects in the basin during operation. If not removed, sediment can become corrosive and cause deterioration of the protective finish of metallic basins.
- When flushing the basin, leave the strainers in place to prevent the sediment from re-entering the system.
- Remove the strainers after the basin has been flushed.
- Clean and replace the strainers before refilling the basin with fresh water.
- Adjust the float to maintain the design operating level. See Table 2: "Cold Water Basin Water Levels."



Fan

Series V and Low Profile Series V Cooling Towers use centrifugal fans. Thoroughly inspect the fans for damaged or deteriorated fan blades and replace the fan as required.

Inspection and Maintenance

- If the unit is already in operation, while the fans are still running, check for any unusual noise or vibration.
- With the fans off and the motor locked out and tagged, check the general condition of the fans:
 - Inspect for any loose or missing bolts in the locking collar and fan shaft bearings.
- **Rotation:** Turn the fan shift by hand to ensure that the fan moves freely with no rough spots, binding or other malfunctions that could cause vibration or fan motor overload.
- **Direction of Rotation:** On initial start-up, or if the fan motor has been rewired, bump the fan motor and note the direction of rotation.
- **Operation:** On initial start-up, run the fan in the manual position for several minutes and check for any unusual noises or vibration.

Fan Drive System

Inspection and Maintenance

- These drives require a periodic check of the belt condition and, when necessary, tension adjustment. The recommended service intervals are as follows:
 - **Initial Start-up:** Servicing is not required prior to initial tower start-up. The drive has been tensioned and aligned at the factory.
 - **Seasonal Start-up:** Readjust the belt tension.
 - **Operation:** After the first 24 hours of operation, readjust the belt tension on a new unit start-up or installation of a new belt. Thereafter, check the belt condition monthly, and adjust tension as necessary. Readjust tension at least once every 3 months.
- Belt tension check:
 - Place a straight edge along the belt from sheave to sheave as shown in Figure 4a, or use a tape measure as shown in Figure 4b, to measure belt deflection.
 - Apply a moderate force by hand (approximately 15 lbs/6.8 kg) evenly across the width of the belt in the center of the span between the sheaves.
 - There is adequate belt tension if the belt deflects between 1/4" and 3/8" as shown in Figures 4a and 4b.

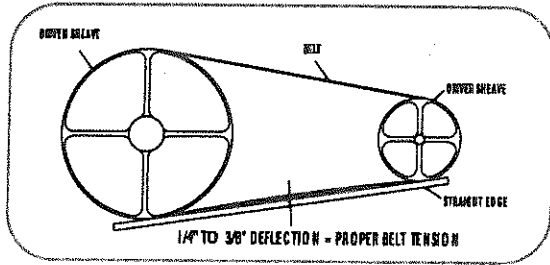


Figure 4a

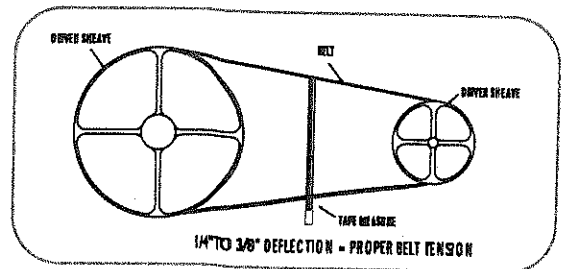


Figure 4b

Belt Tension

- Belt tension adjustment (if required):
 - Loosen the lock nut on the motor base adjusting screw.
 - Turn the motor base adjusting screw clockwise to tension the belt, or counterclockwise to relieve belt tension. During adjustment of belt tension, rotate the drives several times by hand to evenly distribute the tension throughout the belt.
- When the belt is properly tensioned, retighten the lock nut on the motor base adjusting screw.

NOTE: There should be no "chirp" or "squeal" when the fan motor is started.

Alignment:

- Check the drive alignment annually to ensure maximum belt life.
- Drive alignment check and adjustment:
 - Place a straight edge across the driver and the driven sheaves as shown in Figure 5.
 - The straight edge should contact all four points as shown in Figure 5 indicating proper drive alignment.
 - There should be no more than 1/16" deviation from four points of contact.
 - In case of realignment, loosen the motor sheave and align it with the fan sheave. Allow 1/4" for draw-up as the bushing screw is retightened.

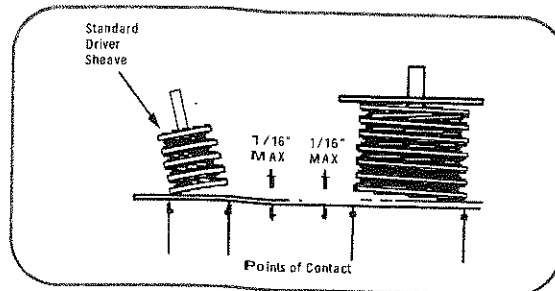


Figure 5 - Standard Drive Alignment

Fan Motors

Series V Cooling Towers and Low Profile Cooling Towers use cooling tower duty, premium efficient, totally enclosed, single-speed, single-winding, reversible ball bearing type motor(s).

Inspection and Maintenance

- Clean the outside of the motor at least quarterly to ensure proper motor cooling.
- After prolonged shutdowns, check the motor insulation with an insulation tester prior to restarting the motor.

Adjustable Motor Base

Coat the motor base slides and adjusting screws (see Figure 6) every 3 months using good quality corrosion inhibiting grease such as one recommended for lubricating the fan shaft bearings.

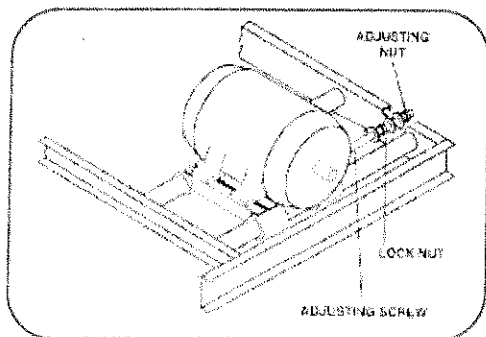


Figure 6 - Adjustable Motor Base

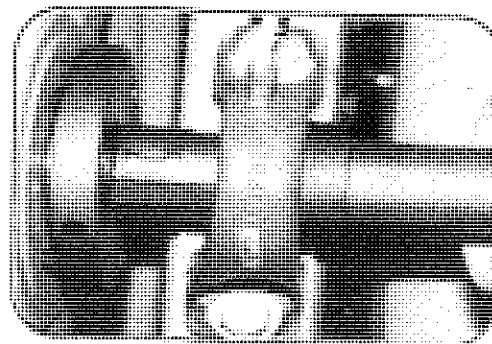


Figure 7 - Ball Bearing

Fan Shaft Bearings

The fan shafts are supported by ball bearings (see Figure 7). Each bearing is equipped with a lubrication fitting and locking collar.

Ball Bearings

Under normal operating conditions, the bearings should be greased every 2,000 operating hours or at least quarterly. The bearings should also be greased at seasonal start-up and shutdown. **Only lubricate the bearings with one of the following water resistant inhibited greases which are good for ambient temperatures ranging from -65°F (-53.9°C) to 250°F (121.1°C):**

- | | | |
|-----------------------------------|----------------------------------|---|
| Amoco - Rycon Premium #3 | Exxon - Polyrex [®] EM | Shell - Alvania #3 |
| Chevron - SRI | Exxon - Unirex N [™] | Shell - Dolium "R" |
| Citgo - Polyurea MP2 [™] | MobilGrease [®] - AW2 | SKF - LGHP2 [™] |
| Conoco - Polyurea 2 [™] | Shell - Alvania RL3 [™] | Unocal 76 - Unilife Grease [™] |

Only lubricate the bearings with a hand grease gun. Do not use high pressure grease guns since they may rupture the bearing seals. When lubricating, purge the old grease from the bearing by gradually adding grease until a bead of new grease appears at the seal.



Sleeve Bearings

Prior to start-up and during the first week of operation, the bearing oil cup (see Figure 8) must be refilled with an industrial-type mineral oil (see Table 3) to saturate the felt wick in the bearing reservoir. After the initial start-up, fill the bearing oil cup every 1,000 operating hours or at least every six months. When ambient temperatures below 0°F are expected, a light oil must be used. With such light oils, the bearing oil cup should be checked and refilled several times during the first several hours of operation until the bearings reach operating temperature.

Table 3: Sleeve Bearing Lubricants

Temp Ambient	BAC P/N	Texaco	EXXON
70°F to 100°F 30°F to 70°F	582628PI	Regal R & O 320 Regal R & O 150	Teresstic 220 Teresstic 100
5°F to 30°F -25°F to 5°F	582627PI	Regal R & O 32 Capella 32	Teresstic 32

Caution: Do not use oils containing detergents for bearing lubrication. Detergent oils will remove the graphite in the bearing sleeve and cause bearing failure. Also, do not disturb bearing alignment by tightening the bearing cap adjustment on a new unit as it is torque-adjusted at the factory.

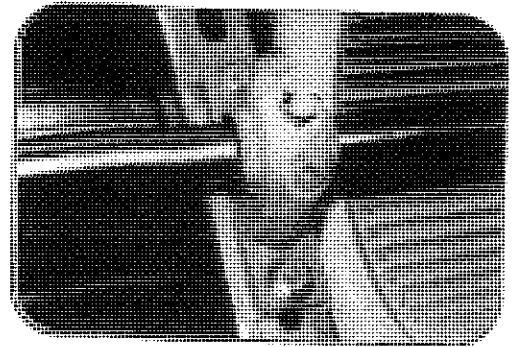


Figure 8 - Sleeve Bearing

Locking Collars

Each eccentric locking collar should be checked quarterly to ensure that the inner bearing race is secured to the fan shaft. The locking collar can be set using the following procedure (see Figure 9):

- Loosen the set screw.
- Using a drift pin or center punch, tap the collar (in the hole provided) tangentially in the direction of rotation while holding the shaft.
- Retighten the set screw.

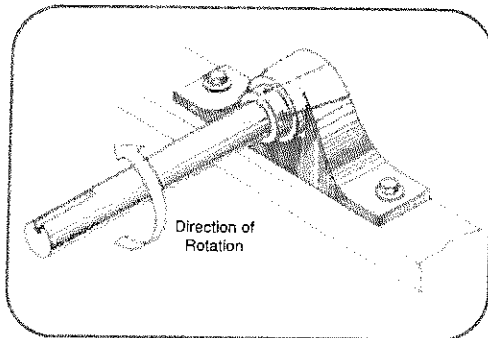


Figure 9 - Locking Collar Assembly

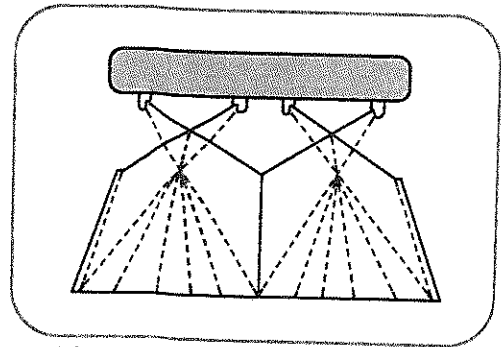


Figure 10 - Nozzle Spray Pattern

Water Distribution System

The hot water is distributed through a corrosion resistant polyvinyl chloride (PVC) spray distribution system. The drift eliminators are also made of PVC, which require no protection against rot, decay, rust, or biological attack.

The spray nozzles and heat transfer section should be inspected and cleaned each month. The inspection procedure is as follows:

- Shut off the fan, lock out and tag out the fan motor, but leave the system pump running.
- Remove the drift eliminators to allow a clear view of the spray distribution system and nozzle patterns.
- Check to see if the nozzles are all spraying consistently and producing the spray pattern in Figure 10.

- Quarterly or more often as required, turn off the system pump. Flush any dirt or debris from the water distribution system to prevent clogged nozzles. If necessary, remove the nozzle and the grommet for cleaning. To remove, grasp the nozzle and pull while twisting. Replace any damaged nozzles.
- Inspect the fill surface for bent edges or scale build-up.

Caution: Don't use steam or high pressure water to clean PVC eliminators or materials other than steel.

Water Level Control

There are two types of water level controls used on BAC units:

- Mechanical make-up valve assembly
- Optional electric water level control package

The Series V water make-up valve assembly is located within easy reach from the access door at the connection end of the unit.

Mechanical Make-up Valve Assembly

A float-operated mechanical water make-up assembly is furnished as standard equipment on the unit. The standard make-up assembly consists of a corrosion resistant make-up valve connected to a float arm assembly actuated by a polystyrene-filled plastic float. The float is mounted on an all-thread rod held in place by wing nuts. The cold water basin operating water level can be adjusted by repositioning the float and all-thread rod using the wing nuts provided.

NOTE: If the unit has been ordered with the optional electric water level control package or is intended for remote sump application, a mechanical water make-up valve will not be provided.

Inspection and Maintenance:

- Inspect the make-up valve assembly monthly and adjust if necessary.
- Inspect the valve annually for leakage. Replace the valve seat if necessary.
- Maintain the make-up water supply pressure between 15 psig and 50 psig for proper operation. BAC recommends a surge protector (provided by others) for pressures over 50 psig.
- Set the initial basin water level by adjusting the wing nuts, so that the make-up valve is completely closed when the water level in the cold water basin is at the overflow connection.
- With the design thermal load and the average water pressure (15 to 50 psig) at the valve, the above setting will produce operating water levels as stated in Table 2 on Page N53.
- If the thermal load is less than the design load at the time of unit start-up, the procedure may produce operating levels greater than those shown in Table 2. If operating levels are higher than specified, readjust the float in order to attain the recommended operating level.
- Closely monitor the water level in the cold water basin and adjust the level if necessary during the first 24 hours of operation.
- Operating at the recommended water level will ensure that the unit basin contains sufficient water volume to prevent air entrainment in the circulating pump during system start-up and provides sufficient excess basin capacity to accept the total system pull-down volume.

Optional Electric Water Level Control Package

As an option, an electric water level control package is available in lieu of the mechanical make-up assembly. The package consists of a probe-type liquid level control assembly and a slow-closing solenoid valve. Stainless steel electrodes, factory-set at predetermined lengths, extend from an electrode holder into the cold water basin.

Inspection and Maintenance:

- Clean the stainless steel electrodes periodically to prevent accumulations of scale, corrosion, sludge or biological growth, which could interfere with the electrical circuit.
- The water level is maintained at the recommended operating level regardless of the system thermal load. Therefore, it is not recommended that the operating level be adjusted.
- During the start-up of units equipped with the electric water level control package, by-pass the control unit in order to fill the unit to the overflow connection.



Recommended Spare Parts

BAC parts are the "Perfect Fit" for your cooling tower. These parts are specifically designed, engineered and manufactured to work in a cooling tower environment. They are the right parts, at competitive pricing levels, and BAC offers the best deliveries in the industry.

BAC stocks most common repair and retrofit parts in our Parts DepotSM and can ship other parts, often overnight, from any of our three manufacturing facilities strategically located in California, Delaware, and Illinois. In addition, most BAC Representatives maintain a local inventory of commonly used parts.

Even with this fast delivery capability, it is still recommended that certain essential, emergency repair parts be maintained in your local inventory, to minimize any potential downtime.

Basic Recommended Spare Parts

Bearing set

Float valve or repair kit

Float ball

Solenoid valve (if unit is equipped with electric water level control)

Powerband or set of belts

Spray nozzle kit with grommets

Basin heater and low water cut out

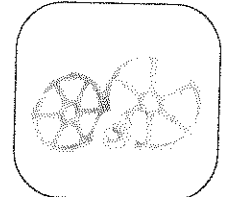
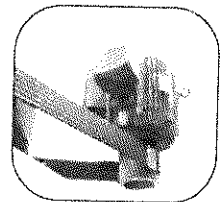
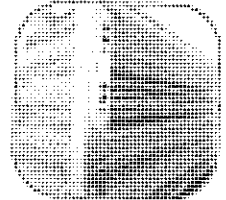
Door gasket

Strainer (inlet and suction)

Fan and sheave bushings

Pump seal and gasket kit for coil products

Automatic bearing greaser refill kit



Parts to Consider if Extended Downtime is a Concern

Spray pump for coil products

Fan or fan wheel

Fan shaft

Sheave set

Fan motor





CFM COMPANY

AIR CONDITIONING / HEATING / VENTILATING EQUIPMENT

413D North Highway 287 - Ft. Collins, CO 80524

Phone: (970) 493-7293 / Fax: (970) 493-7297

PSD - Beattie Elementary

TAG: CT-1 VI

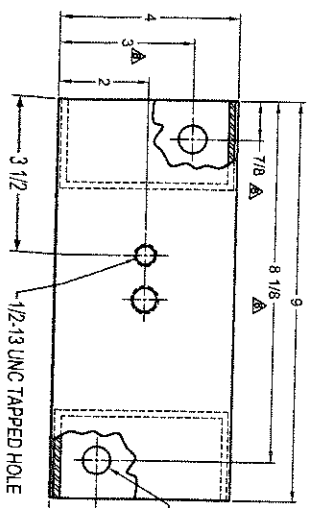
VMC Spring Isolators for Tag: CT-1

**Specification Section:
236500**

Submittal Date: 3/12/2014

Submitted by: Justin Dunkin

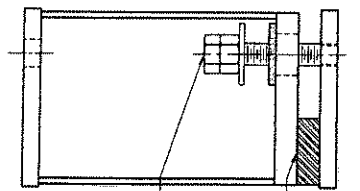
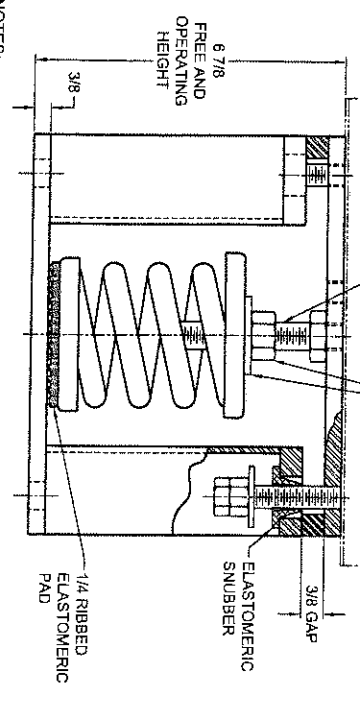
LOAD = 3100lbs Operating x 1.25
Safety Factor = 3,875 lbs
Qty (4) Isolators @ 1,000 lbs/Ea



REMOVABLE ADJUSTING BOLT (NOT SHOWN IN OTHER VIEWS FOR CLARITY)

BOLT OR WELD EQUIPMENT SUPPORT BEAM TO MOUNT (BY OTHERS NOT SHOWN IN OTHER VIEWS FOR CLARITY)

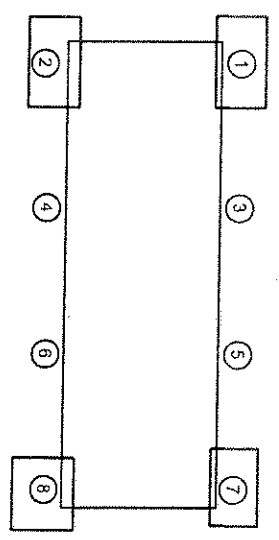
ADJUSTING NUT AND WASHER (NOT SHOWN IN OTHER VIEWS FOR CLARITY)



4 Isolators

MODEL	MAX LOAD (LBS)	DEFLECTION (IN)	SPRING RATE (LBS/IN)	SPRING COLOR CODE
MH-1E-195	195	1.95	100	DK BLUE
MH-1E-400	400	1.32	303	BLACK
MH-1E-530N ¹	530	1.17	453	BLACK/ DK BLUE
MH-1E-650	650	1.05	619	RED
MH-1E-825N ¹	825	1.07	771	RED/ DK BLUE
MH-1E-1000	1000	1.00	1000	TAN
MH-1E-1200N ¹	1200	1.04	1154	TAN/ DK BLUE
MH-1E-1400	1400	1.00	1400	PINK
MH-1E-1700N ¹	1700	1.10	1545	PINK/ DK BLUE
MH-1E-2000	2000	1.11	1800	WHITE
MH-1E-2350N ¹	2350	1.11	2100	WHITE/ RED
MH-1E-2575N ¹	2575	1.11	2313	WHITE/ DK PURPLE
MH-1E-2990N ¹	2990	1.12	2681	WHITE/ DK GREEN
MH-1E-3250N ¹	3250	1.04	3125	WHITE/ GRAY

¹ TYPED-INSTEEL SPRINGS YIELD TO 1.51 LOAD. THE COLOR CODE S FOR CUTTER SPRINGS VARY SPRINGS



ISOLATOR SELECTIONS

LOC 1:	LOC 2:
LOC 3:	LOC 4:
LOC 5:	LOC 6:
LOC 7:	LOC 8:
CUSTOMER EQPT. TAG:	

NOTE: MATERIAL SHOWN IS FOR (1) SET.

OTHER MATERIALS, COMPOUNDS, OR FINISHES WITH EQUAL OR SUPERIOR PROPERTIES MAY BE SUBSTITUTED AS THEY BECOME AVAILABLE.

- NOTES:
1. ALL DIMENSIONS ARE IN INCHES. INTERPRET PER ANSI Y14.
 2. UNLESS OTHERWISE NOTED, DIMENSIONS FOR STYLE APPLY TO ALL OTHER STYLES.
 3. FINISH: HOUSINGS- POWDER COAT, SPRINGS- POWDER COAT, HARDWARE- ZINC ELECTROPLATE.
 4. REFER TO SHEET 2 OF 2 FOR INSTALLATION INSTRUCTIONS.
 5. INNER SPRING (WHEN USED) NOT SHOWN.
 6. ALL SPRINGS ARE DESIGNED WITH 50% OVER TRAVEL.
 7. SPRING PACKAGE MAY BE REMOVED WITH SHIMS IN PLACE. CONTACT A FACTORY REPRESENTATIVE FOR SPRING REMOVAL INSTRUCTIONS.
 8. DIMENSIONS APPLY TO BOTH TOP BOLT DOWN AND BASE PLATE ANCHORING HOLE.

CERTIFIED FOR:

JOB NAME: **PSD - Beattie**

CUSTOMER: **US Engineering**

CUSTOMER P.O.:

SALES ORDER:

TYPE MH-1E
SPRING MOUNTS
WITH INTERNAL ADJUSTMENT
1" NOMINAL DEFLECTION



SCALE: **NONE**

SHEET: **1 OF 2**




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READ INSTRUCTIONS IN THEIR ENTIRETY BEFORE BEGINNING.

1. LOCATE MOUNTS UNDER EQUIPMENT AFTER DETERMINING POSITIONS DESIGNATED IN THE VMC GROUP SUBMITTAL SHEET 1.
2. ALL LIMIT BOLTS ARE FACTORY SET AND BONDED IN PLACE. THE SHIPPING NUT ON THE LIMIT BOLT MUST BE LOWERED UNTIL IT TOUCHES THE BOLT HEAD. THE NUT WAS SHIPPED IN THE RAISED POSITION. DO NOT ATTEMPT TO READJUST THE LIMIT BOLTS. FACTORY SETTING ASSURES UNIFORM BOLT LOADING IF UPLIFT OCCURS, AS IN THE CASE OF A COOLING TOWER BEING DRAINED.
3. THE VMC GROUP RECOMMENDS BOLTING ALL MOUNTS TO A FLAT SURFACE WHEN A WEIGHT CHANGE OCCURS IN EXCESS OF 20% OF EQUIPMENT OPERATING WEIGHT. THE MOUNT BASE PLATE MUST BE BOLTED. THE LOAD MUST BE CENTERED ON THE MOUNT TO AVOID ECCENTRIC LOADING OF TOP PLATE, WHICH WOULD TILT THE TOP PLATE OF THE MOUNT. THE TOP PLATE OF THE MOUNT MUST BE UNIFORMLY LOADED ACROSS ENTIRE LENGTH OF TOP PLATE OR THE EQUIPMENT MUST BE BLOCKED UNTIL LOAD IS TRANSFERRED TO THE MOUNT. THE VMC GROUP MUST BE ADVISED BEFORE THE MOUNTS ARE RELEASED FOR PRODUCTION TO EVALUATE ANY VARIANCE TO THESE REQUIREMENTS.
4. WHEN THE APPLICATION IS OUTDOORS AND THE EQUIPMENT WILL BE SUBJECT TO HIGH WINDS, THE OWNER'S REPRESENTATIVE MUST EVALUATE ANCHOR TYPE AND SIZE TO EFFECTIVELY RESIST WIND FORCES. TYPE MH MOUNTS ARE NOT SUITABLE FOR SEISMIC APPLICATIONS. USE VMC GROUP TYPES MS MOUNTS TO ISOLATE EQUIPMENT THAT WILL BE SUBJECT TO SEISMIC FORCES.
5. MOUNTS ARE SHIPPED TO THE JOB SITE WITH SHIMS BETWEEN THE TOP PLATE AND HOUSING. THESE SHIMS MUST BE IN PLACE WHEN MOUNT IS POSITIONED UNDER EQUIPMENT.
6. THE ADJUSTMENT PROCESS CAN ONLY BEGIN AFTER FULL OPERATING WEIGHT IS REACHED. THE ADJUSTMENTS CAN BE MADE BY STARTING AT ANY MOUNT AND TURNING THE ADJUSTING NUT CLOCKWISE TWO TURNS. PROCEED AROUND THE EQUIPMENT TO EACH ISOLATOR ADJUSTING EACH TWO TURNS TO COMPRESS THE SPRINGS UNIFORMLY. CONTINUE THIS ADJUSTING PROCESS UNTIL ONE MOUNT JUST RISES OFF THE SHIMS. STOP ADJUSTMENT ON THAT AND OTHER MOUNTS AS THEY RISE OFF SHIMS APPROXIMATELY 1/32". WHEN ALL MOUNTS HAVE RISEN ABOVE THE SHIMS, THE ADJUSTMENT PROCESS IS COMPLETE. REMOVE ALL SHIMS.
7. FURTHER ATTENTION TO THE INSTALLATION IS NOT NORMALLY REQUIRED. THE VMC GROUP SUGGESTS A SEMIANNUAL INSPECTION OF THE COMPONENTS FOR POSSIBLE CORROSION PROBLEMS. IF PROBLEMS ARE OBSERVED, CONSULT THE VMC GROUP OR CORROSION CONTROL EXPERTS TO RECTIFY THE PROBLEM.
8. IF THE SPRING PACKAGE MUST BE REMOVED, CONTACT A FACTORY REPRESENTATIVE FOR DETAILED PROCEDURE.

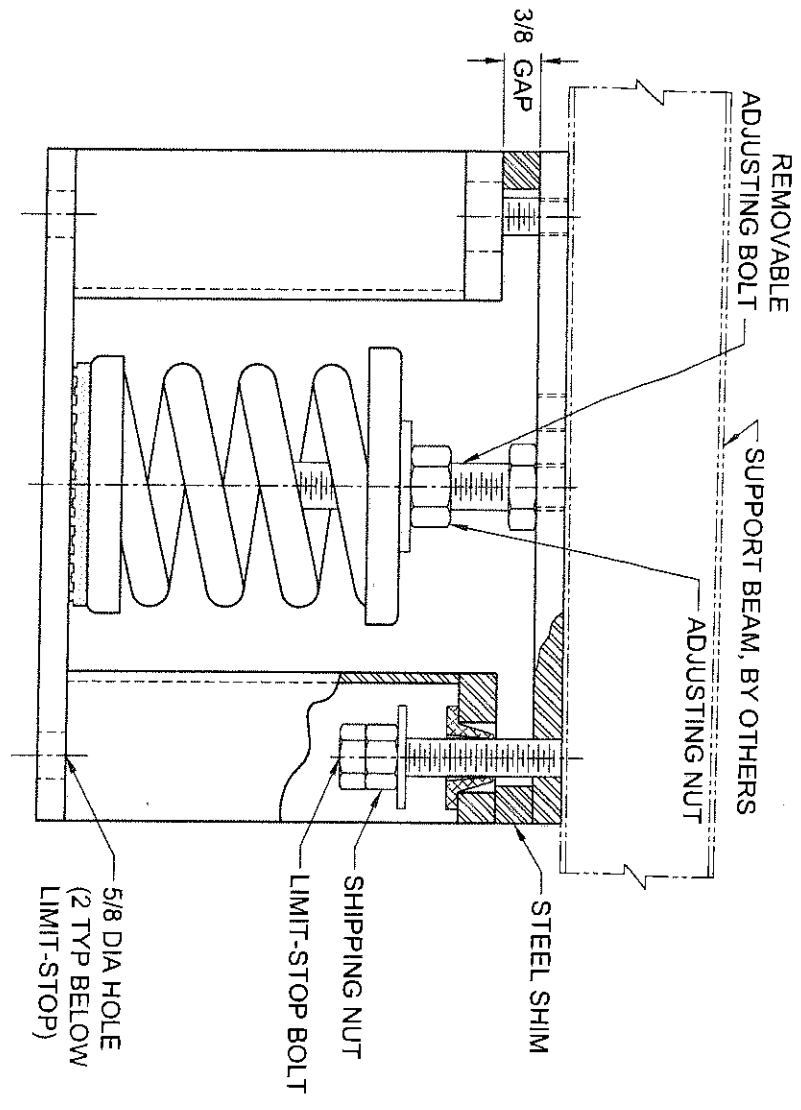
CERTIFIED FOR:
 JOB NAME: PSD - Beattie
 CUSTOMER: US Engineering
 CUSTOMER P.O.: _____
 SALES ORDER: _____

**TYPE MH-1E
 SPRING MOUNTS
 WITH INTERNAL ADJUSTMENT
 INSTALLATION INSTRUCTIONS**



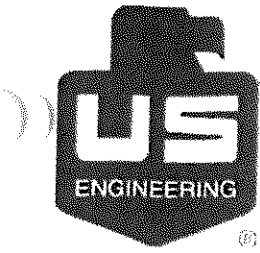
THE VMC GROUP
The Power of Together
 Bloomington, NJ 07403
 Houston, TX 77041

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 SCALE: NONE
 SHEET: 2 OF 2
 DRAWING NO.: _____
 REVISION: _____



REV.	DESCRIPTION	DATE	BY

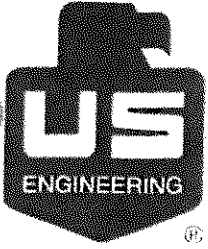
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Tab-9
Specification Section: 23 73 23
Mod Outdoor Central Station
AHU:
RTU-6 (Daikin)

**BEATTIE
ELEMENTARY
SCHOOL**

2000 MEADOWLARK AVE
FORT COLLINS CO 80526



Mod Outdoor Central
Station AHU (Daikin)
O&M and Warranty
Information:
RTU-6

**BEATTIE
ELEMENTARY
SCHOOL**

3000 MEADOWLARK AVE
FORT COLLINS CO 80526

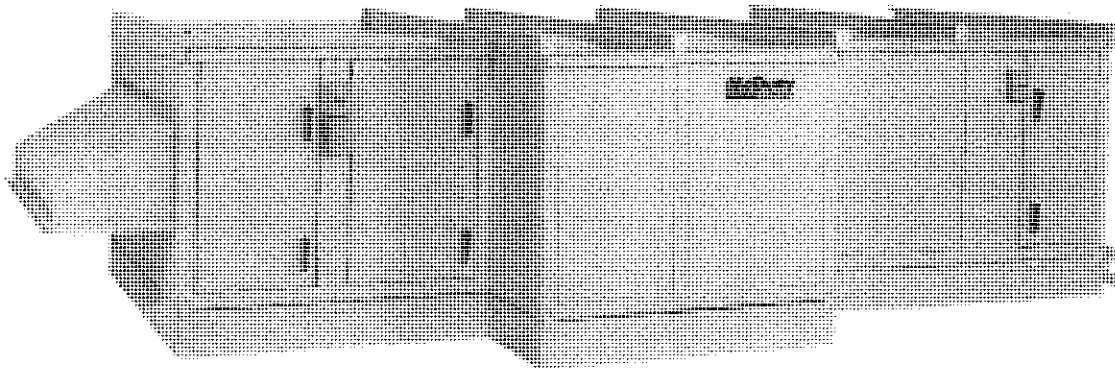
Skyline™ Air Handler

Group: **Applied Air Systems**

Part Number: **IM 777**

Date: **May 2009**

Models OAC/OAH 003G – 090G



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General Information

The system design and installation must follow accepted industry practice as described in the ASHRAE Handbook, the National Electric Code, and other applicable standards. Install this equipment in accordance with regulations of authorities having jurisdiction and all applicable codes.

Installation and maintenance must be performed by qualified personnel familiar with applicable codes and regulations and experienced with this type of equipment. Sheet metal parts, self-tapping screws, fins, clips, and such items inherently have sharp edges; the installer should exercise caution.

CAUTION

Sharp edges and coil surfaces are a potential injury hazard. Avoid contact with them.

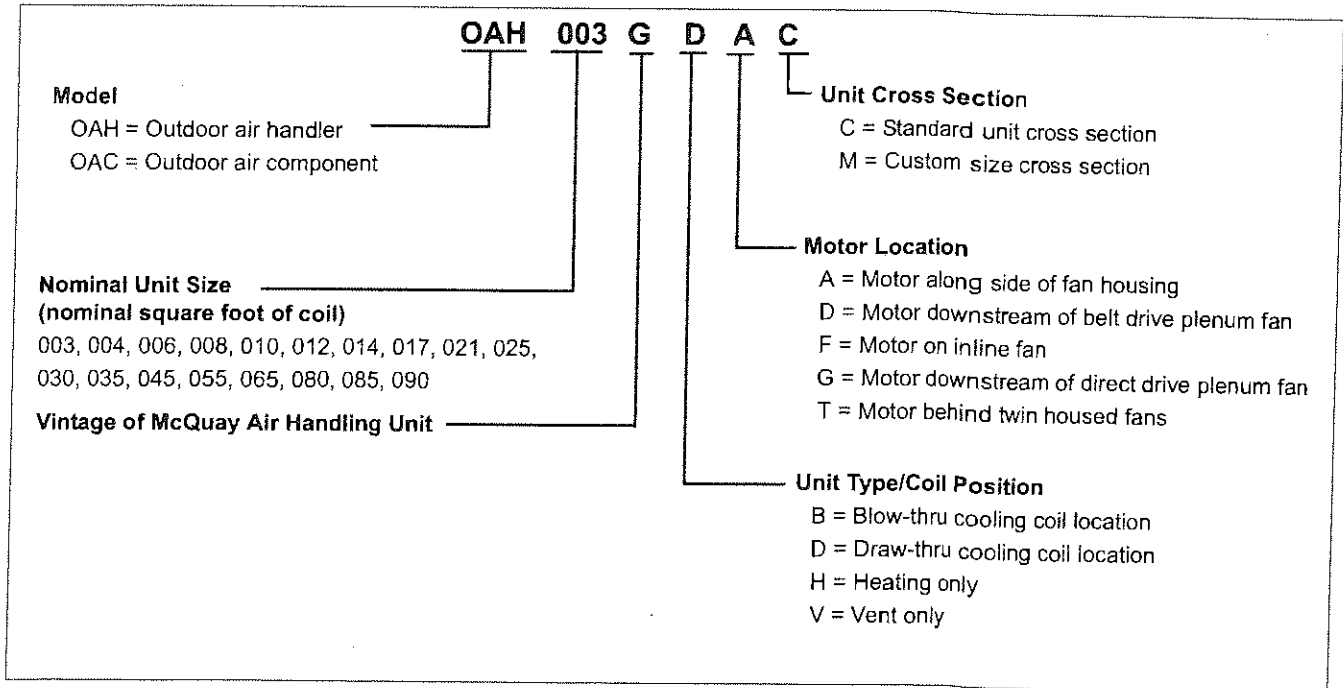
ATTENTION

Les bords tranchants et les surfaces des bobines sont un risque de blessure. Ne les touchez pas.

Receiving and Handling

- Carefully check items against the bills of lading to verify all crates and cartons have been received. Carefully

Nomenclature



inspect all units for shipping damage. Report damage immediately to the carrier and file a claim.

- Skyline air handler units are constructed of galvanized or painted steel and are inspected thoroughly before leaving the factory. Take care during installation to prevent damage to units.
- Take special care when handling the blower section. All fans are dynamically balanced before leaving the factory. Rough handling can cause misalignment or a damaged bearings or shaft. Carefully inspect fans and shaft before unit installation to verify this has not happened.

Note: Screws, bolts, etc., for assembling sections are supplied in a bag attached to each section. All necessary gasketing is applied in the factory for section-to-section mounting, unless the unit has a curb ready base. Units require caulk sealant between sections.

Unit Storage

Store unit on a level surface. If air handling units are stored for any period of time, periodically rotate the fan wheel to prevent permanent distortion of drive components. In addition, grease may settle in the lower part of the bearing, which can lead to oxidation on the upper portion of the bearing surface. Keep the fan bearings lubricated.

Installation Guidelines

Mechanical Installation

Service Clearances

In addition to providing adequate space around the unit for piping coils and drains, access to at least one side of the unit is always required to allow for regular service and routine maintenance, which includes filter replacement, drain pan inspection and cleaning, fan bearing lubrication, and belt adjustment. Provide sufficient space—at least equal to the length of the coil—on the side of the unit for coil removal. See Figure 1 for servicing space requirements.

Maintain at least 54" of clearance in front of electrical power devices. Electrical power devices that are mounted on the side of the unit typically are up to 12" deep (Figure 2).

Figure 1: Servicing Space Requirements

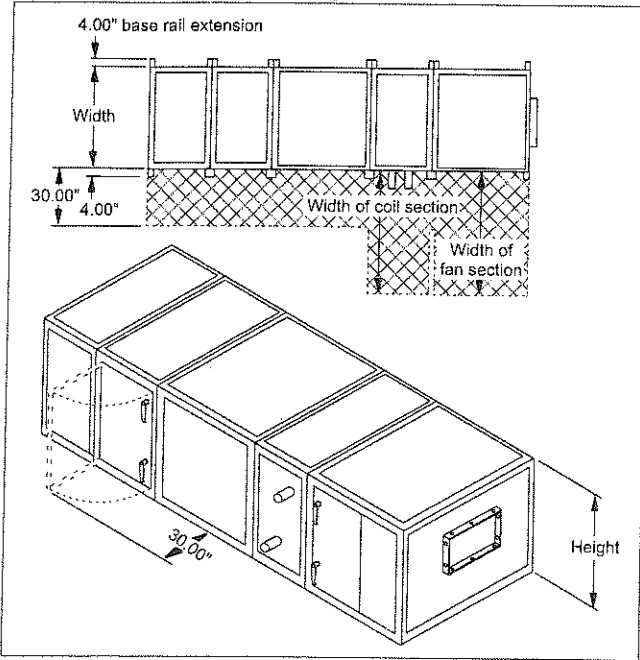
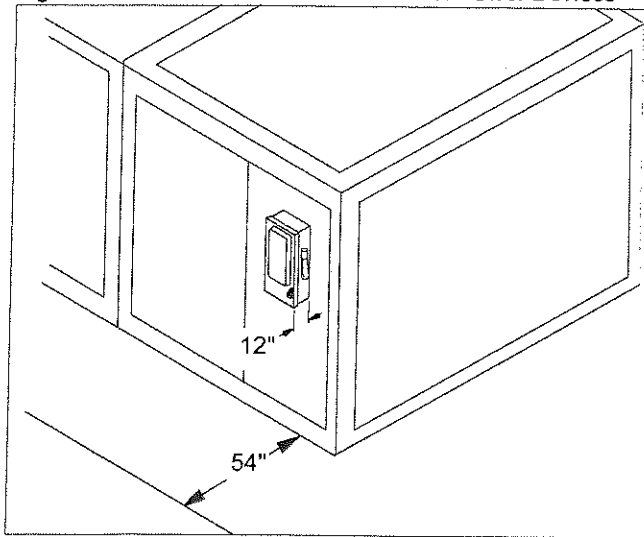


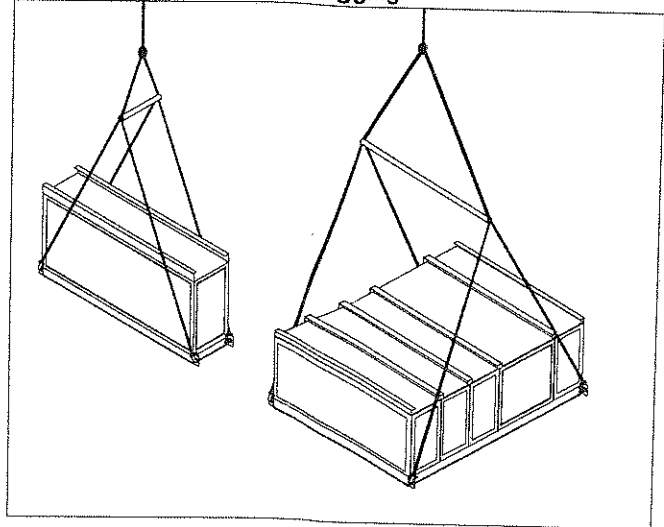
Figure 2: Service Clearance for Electrical Power Devices



Rigging

Skyline air handlers ship as separate sections, completely assembled, or in modules of assembled sections. **The unit must be rigged as it ships from the factory. Do not rig units after assembly.** Units are provided with a factory-installed base rail and can be lifted using the 2" diameter lifting holes located in the corners of each shipping section. To prevent damage to the unit cabinetry, use spreader bars. Position spreader bars to prevent cables from rubbing the frame or panels. Before hoisting into position, test lift for stability and balance. Avoid twisting or uneven lifting of unit.

Figure 3: Unit and Section Rigging

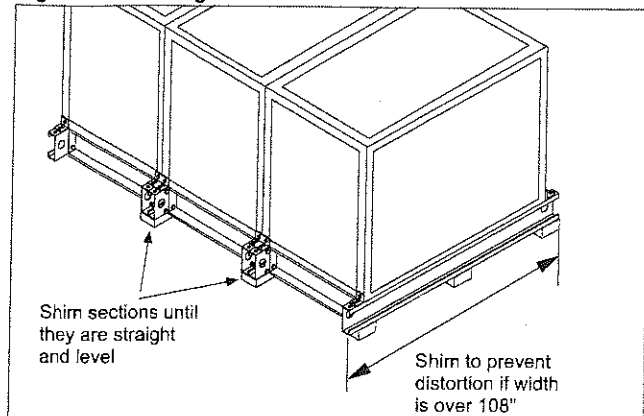


Curb Mounting and Unit Leveling

Do not place a Skyline unit over an open curb unless it is equipped with a curb-ready base. Installation instructions for mounting units on a roof curb are provided in IM 770. For a copy, contact your local McQuay representative or visit www.mcquay.com. Make provisions under the unit to divert any moisture from entering the building below.

For units without roof curb mounting, place the equipment on a flat and level surface. Where surface irregularities exist, shim the base of the unit at one or more points along the length of the rails to prevent distortion or sagging of the support rails. Uneven or distorted sections cause misfit or binding of the doors and panels and improper draining of drain pans (Figure 4).

Figure 4: Leveling the Unit



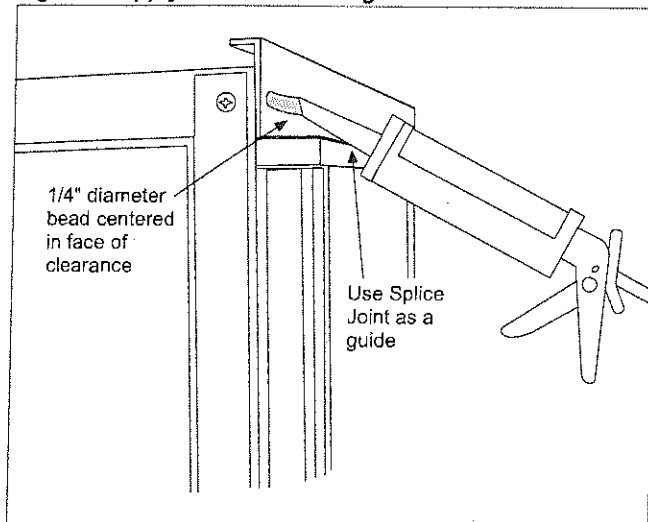
Assembling Sections

If the unit is shipped in more than one shipping section, rig each section into position separately. Shipping sections are provided with a connection splice joint attached on the leaving air side of the shipping section that seals against the frame channel on the entering-air side of the adjoining. The splice joint is insulated and provides an air-tight seal between two sections once they are assembled together. Align the splice joint to seat into the mating gasket to provide an air seal. If the splice joint was bent during shipping or rigging, restore it to its original position (Figure 8).

Shipping Sections

- 1 Caulk all assembly joints of the unit—Before joining the sections, apply at least 1/4 inch diameter bead of sealant to the mating faces of the cabinet. Use the splice joint as a guide for applying the sealant (Figure 5).

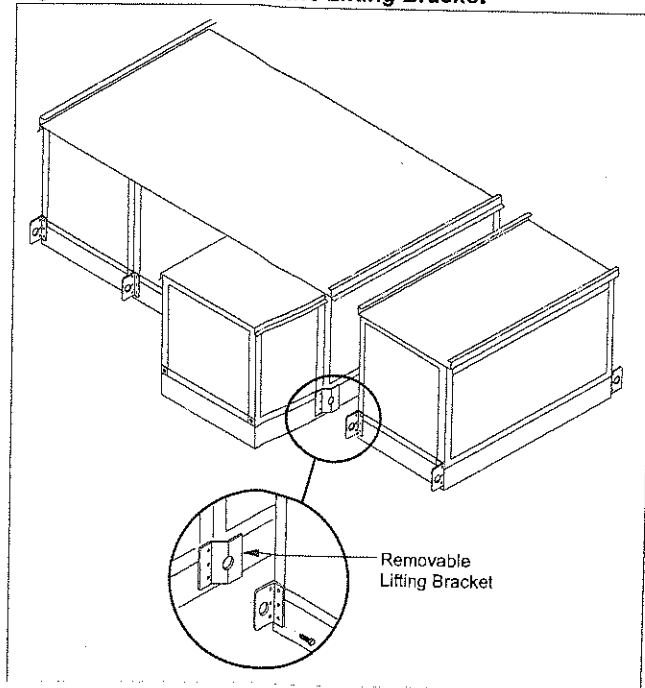
Figure 5: Apply Sealant to Mating Faces



- 2 Pull sections together to fasten. Use straps and a ratchet to help pull the sections together securely. Apply sealant to any gaps that may admit moisture.
- 3 Fasten base rails together first using the 3/8"-16 x 5" bolts located in the splice kit provided with the unit (Figure 7).
 - a To fasten two shipping sections together, four bolts are needed (two on each side of the unit). The bolts are run from one base rail into the other and fastened with a nut. Complete each section bottom and top before attaching additional sections.
 - b If desired, shipping sections for non curb-ready units can be fastened together internally. To fasten internally, run field-provided #10 sheet metal screws or drill screws (4" long, maximum) through the interior frame channel of one unit into the splice joint of the neighboring section.
 - c Handle units with curb-ready bases and vestibules so the lifting bracket can be removed after the unit is placed on the curbing.

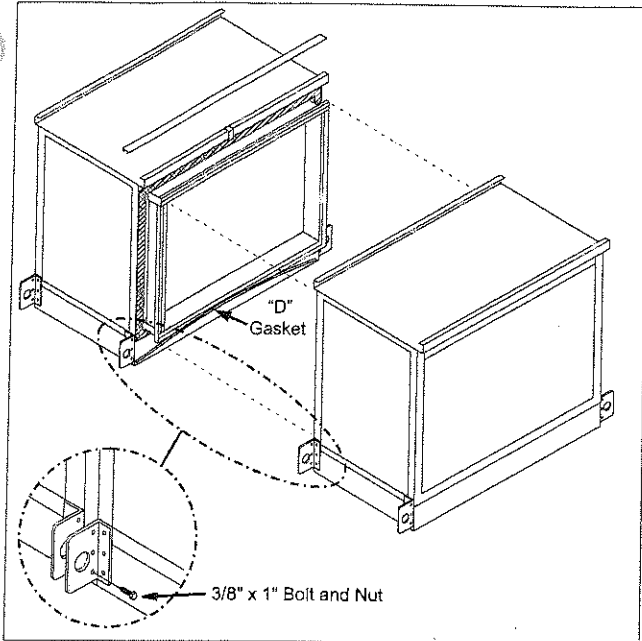
Note: Remove the lifting bracket that projects inward over the curbing. Save the self tapping screws. When the adjacent section is placed in position, use self tapping screw to secure the bases together.

Figure 6: Remove Vestibule Lifting Bracket



Mechanical Installation

Figure 7: Fasten Bottom of Section



d A length of "D" gasket is attached to each section (Figure 7). This gasket **MUST** be installed to the unit base section.

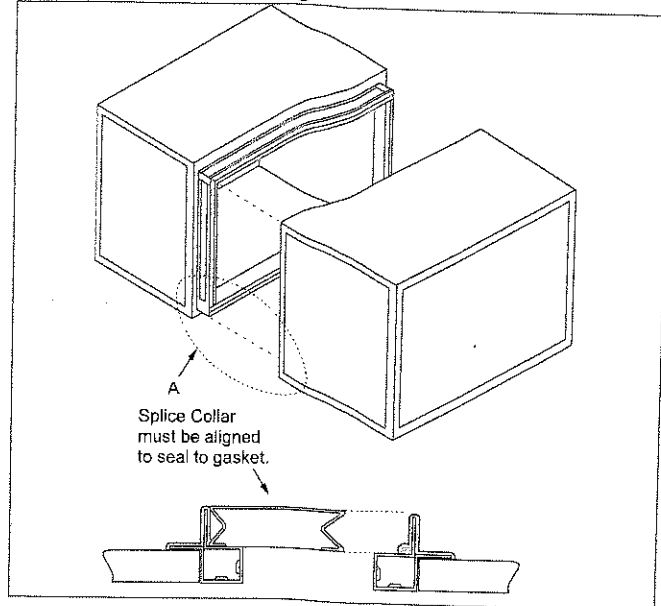
IMPORTANT

The gasket is to be installed in an arc shape with the ends lower than the center, so that any moisture that may reach the gasket will be drained to the outside of the unit.

e Handle units with curb-ready bases and vestibules so the lifting bracket can be removed after the unit is placed on the curbing.

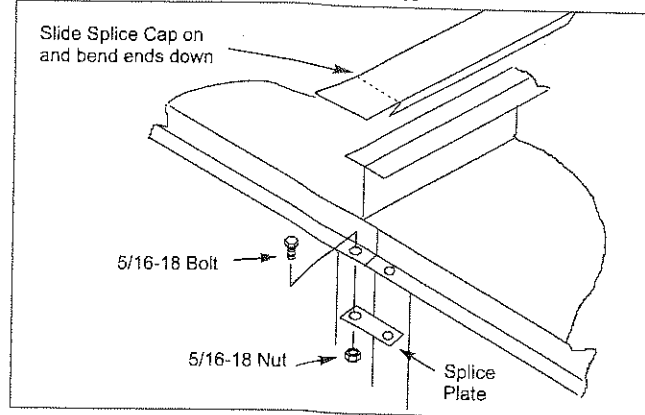
Note: Remove the lifting bracket that projects inward over the curbing. Save the self tapping screws. When the adjacent section is placed in position, use self tapping screw to secure the bases together.

Figure 8: Internal Fastening



- 1** Check that the sealant is compressed between the mating channels when the unit sections are joined. Touch up any places where gaps are noted.
- 2** After sections are seated tightly together, slip the splice cap over the top panel flanges. Bend the ends of the splice cap down to secure in place (Figure 9).
- 3** Assemble the small splice plate at the top rail to secure the sections together at the top. Use 5/16" bolts (Figure 9).

Figure 9: Splice Cap and Splice Plate



Panels, Frame Channels, and Doors

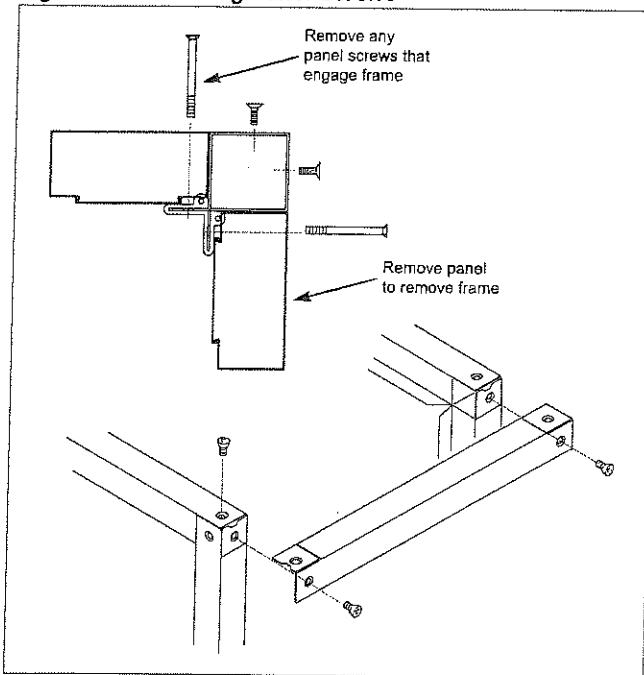
Panel Removal

To remove a side or top panel, remove the flat head Torx 30 fasteners along the sides of the panel. Lift off the panel after removing all fasteners.

Frame Channel Removal

Frame channels that run the length of the unit along the top can be removed to allow access to both the side and top of the unit. To remove the frame channel, first remove the side panel(s). Once the side panel is off, remove the flat head Torx 30 fasteners in the corner of the frame channels. Then pull the frame channel out the side. Remove any panel screws that are within one inch of the of the frame since they are engaged into the gasketed flange of the frame (Figure 10).

Figure 10: Removing Panel Screws



Access Doors and Panels

For routine maintenance, access normally is obtained through access doors or by removing side panels. Removing all flat head fasteners along the sides of a panel allow it to be removed.

Fan and filter sections are always provided with a service door on one side of the unit. If requested on order, doors can be provided on both sides of the unit. Optional service doors are available for most section types and are provided based on customer request.

Fan Section Doors

Note: Opening fan section doors requires using a 1/2" socket wrench, which satisfies ANSI standards and other codes

that require the "use of tools" to access compartments containing moving parts or electrical wiring. See Figure 11.

- 1 Remove padlock if one is present.

CAUTION

Sharp edges and coil surfaces are a potential injury hazard. Avoid contact with them.

ATTENTION

Les bords tranchants et les surfaces des bobines sont un risque de blessure. Ne les touchez pas.

CAUTION

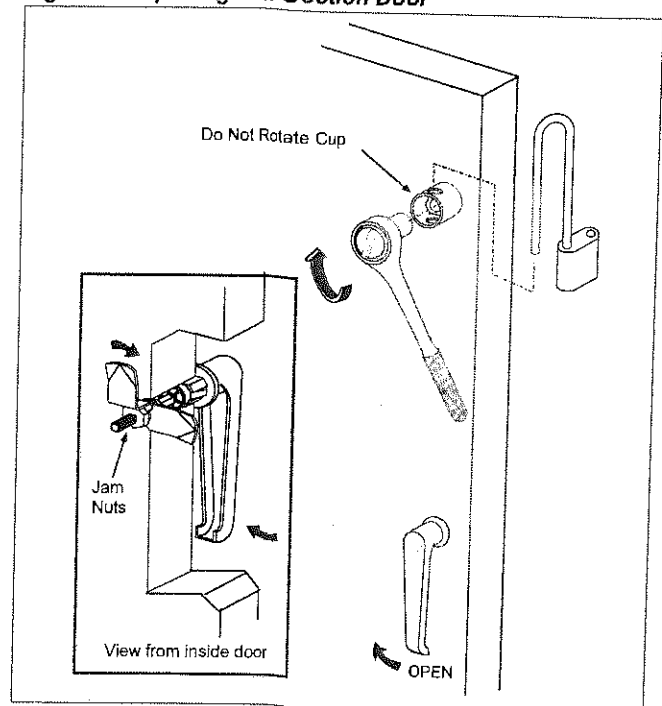
DO NOT attempt to rotate the cup. Damage to the unit will occur.

ATTENTION

NE PAS tenter de faire tourner la cuvette (cup). Ceci va d'endommager l'unité.

- 2 Insert 1/2" socket into cup and rotate 1/4 turn clockwise as shown in Figure 11. If the cup and handle are on the left side of the door, rotate 1/4 turn counterclockwise.
- 3 Rotate the door handle 1/4 turn clockwise and then 1/4 turn counterclockwise to release any internal pressure or vacuum and open the door. If the cup and handle are on the right side of the door, rotate the door handle 1/4 turn counterclockwise and then 1/4 turn clockwise.
- 4 To prevent air leakage, tighten the door panels by adjusting the jam nuts.

Figure 11: Opening Fan Section Door



Mechanical Installation

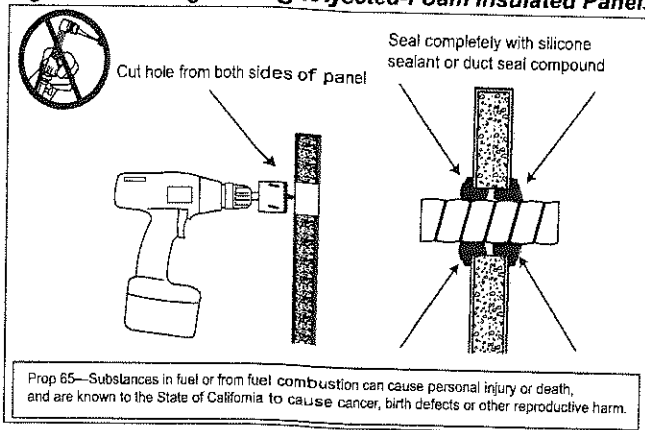
Injected-Foam Insulated Panels

Skyline air handlers now are furnished with double-wall, injected-foam insulated panels. Foam panels are stronger, more rigid, and lighter than panels with fiberglass insulation. The insulation R-value is improved to 13. However, foam insulation can burn when exposed to flame or other ignition sources and release toxic fumes. Take care in cutting and sealing all field-cut openings in these panels.

Panel Cutting Procedure

- 1 Determine the number and location of holes required for electrical conduit, piping, and control wiring as follows:
 - a Check that adequate space is available inside the unit for conduit or pipe routing.
 - b Do not locate holes in a panel that provides access to key maintenance components such as filters and fan assemblies.
 - c Do not locate where the conduit or piping blocks airflow or obstructs hinged access doors.
- 2 Once a proper location is determined, drill a small pilot hole completely through the panel. Then use a sharp hole saw or a saber saw and cut from each side of the panel.
- 3 Seal the double-wall panel on each side with an industrial/commercial grade silicone sealant or duct seal compound. It is extremely important to seal each panel hole or penetration securely so it is airtight, watertight, and so that there is **no exposed insulation**.

Figure 12: Cutting/Sealing Injected-Foam Insulated Panels



Field Mounting Junction Boxes and Other Components

For field mounting 4" x 4" or smaller junction boxes to the standard panel exterior, use a minimum quantity of four, 3/16" diameter pop rivets. **Do not use self-tapping drill screws. They will not tighten nor secure properly and panel damage can occur.**

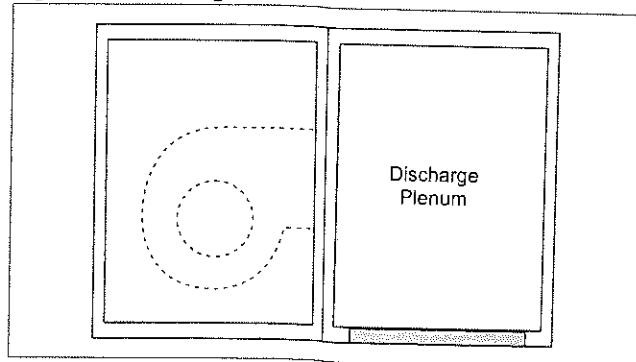
If larger, heavier components require mounting on unit panels, use through-bolts with flat washers through both outer and inner panels. To maintain panel integrity, seal both ends with an industrial/commercial grade silicone sealant or duct seal compound.

The unit frame channel is another excellent location for securing heavier components; self-tapping screws are not acceptable. Ensure that the location permits the full operation of all access doors and panels and does not interfere with other vital components.

Duct Connections

Use flexible connectors on the outlet and inlet duct connections of all units. Do not position down flow fans over air ducts that are routed down into the building. Use a discharge plenum when bottom connections are necessary (Figure 13).

Figure 13: Discharge Plenum



WARNING

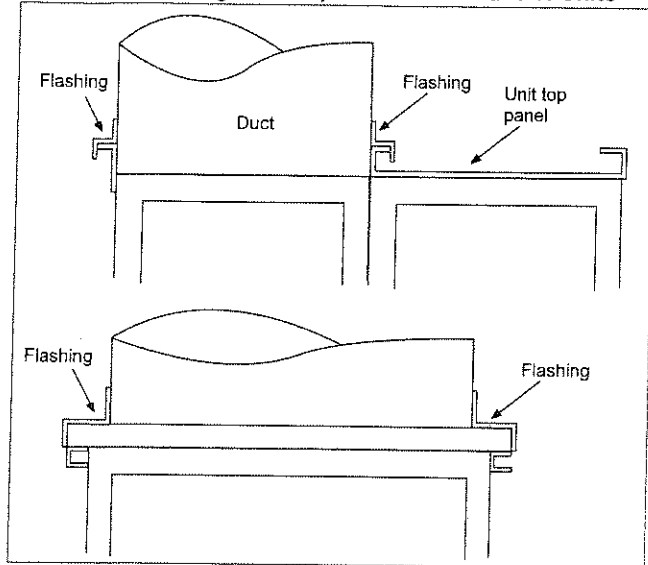
Flame and smoke can cause equipment damage, severe personal injury, or death. Before operating unit, seal all piping and wiring holes on both inner and outer panels with an industrial grade silicone sealant or duct seal compound. **Do not use a cutting torch or expose panel to fire. Panel damage can occur.**

WARNING

La fumée et les flammes peuvent endommager le matériel et causer des blessures graves ou la mort. Avant d'utiliser le dispositif, obturer tous les trous de passage de tubulaires et de fils ménagés dans les panneaux intérieurs et extérieurs au moyen d'une pâte à base de silicone ou d'un mastic d'étanchéité à conduits de qualité industrielle. Ne pas se servir d'un chalumeau coupeur ni exposer les panneaux à une flamme nue pour ne pas risquer de les endommager.

If the unit has a top mixing box or economizer damper or a top duct connection, field fabricate and install flashing to divert moisture from the connection. The flashing must lap over the standing seams of the top panels. The flashing also must lap over the side edges of the unit (Figure 14).

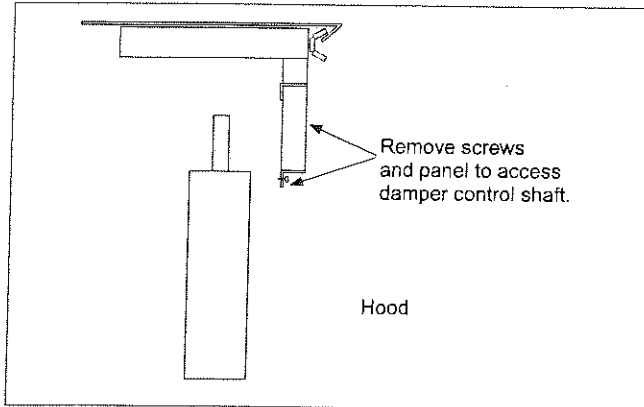
Figure 14: Flashing Over Top Panels and Sides of Units



Dampers and Hoods

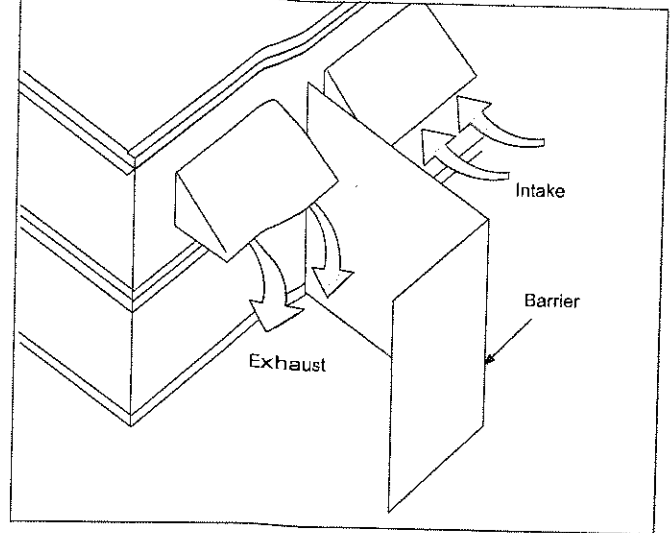
Side dampers may be provided in the mixing box and economizer sections of units. When dampers are provided, a removable panel is located above the weather hood to provide access to the damper drive shaft. Other access may be available depending on the specific construction of the unit (Figure 15).

Figure 15: Filler Panel Over the Weather Hood



When units are ordered with exhaust hoods and intake hoods adjacent to each other, install a field-supplied barrier to prevent recirculation of exhaust air into the intake openings. (Figure 16).

Figure 16: Field-Installed Barrier Between Hoods



Mounting Actuators

The installing contractor is responsible for the mounting of all field-installed actuators. No provisions are made for the location of these actuators due to the number of options and arrangements available and the variety of specific applications. Typically, actuators are mounted inside the cabinet. Provide proper support for the actuator to avoid excessive stress in the cabinet, linkage, or damper shafts.

Note: Damper blades are at full flow when open to 70 degrees. Do not open blades further than 70 degrees.

Fresh air and return air dampers can be linked together and driven from the same actuator if the dampers are the same size. If the dampers are different sizes, they must be driven by separate actuators and controlled appropriately. Exhaust dampers are always driven by a separate actuator.

A typical rotary electric actuator can handle up to 40 sq. ft. of damper. For pneumatic actuators, allow 5 in-lb per square foot of damper area.

CAUTION

Maximum damper rotation is 70°. Maximum shaft torque is 205 inches/pound. Greater rotation or torque can cause equipment damage.

ATTENTION

La rotation maximale des volets est de 70°. Le couple (torque) maximum de l'arbre est de 205po/lb. Une plus grande rotation (ou torque) peut endommager l'équipement.

Mechanical Installation

Face and Bypass Section Mounting

Internal and external face and bypass sections are mounted together using the instructions for horizontal components and do not require additional instruction. Skyline air handlers are provided with a bypass duct that is integral to the unit construction and requires no field assembly.

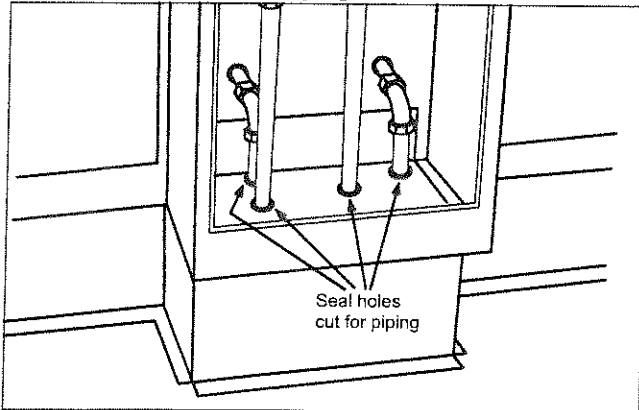
Face and bypass dampers may or may not be linked together. When dampers are placed before a single bank of coils, they always are linked together and require a single actuator. When dampers bypass a stacked or staggered coil, the dampers are not linked and require multiple actuators.

Face and bypass dampers have a torque requirement of 10 in-lbs per square foot of damper face area.

Piping Vestibules

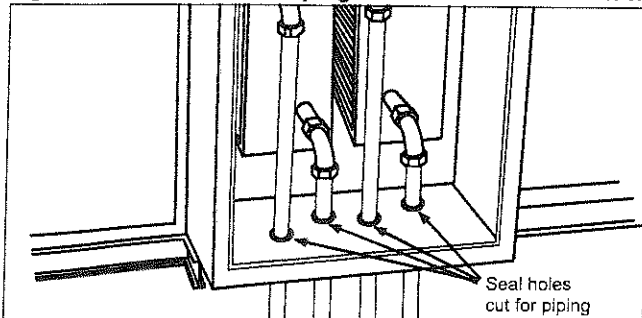
For units that include a piping vestibule, cut the openings for routing the field piping as required in the field. Carefully seal passages cut through the panels to prevent air leakage. A single metal thickness pan is provided in the bottom of the curb-mounted vestibule. The pan can be removed if necessary. If holes are cut into the pan for a piping passage, seal the holes to prevent moisture leakage (Figure 17).

Figure 17: Seal Holes for Piping—Curb Mounted Units



For units with standard base rails, the vestibule is open to the coil section; therefore, seal all holes to prevent air leakage.

Figure 18: Seal Holes for Piping—Standard Base Rail Units



Piping and Coils

When designing and installing piping:

- Follow applicable piping design, sizing, and installation information in ASHRAE handbooks.
- Observe all local codes and industry standards.
- Do not apply undue stress at the connection to coil headers; **always use a backup pipe wrench.**
- Support pipework independently of the coils.

Water Cooling Coils

Note: Use glycol in water coils for outdoor air handlers. Power failures and other mechanical issues can expose coils to freezing temperatures.

- Water supply, water return, drain, and vent connections extend through the end panel of the coil section. All connections are labeled on the end panel.
- Water supply and water return connections are typically male NPT iron pipe.
- When installing couplings, do not apply undue stress to the connection extending through unit panel. **Use a backup pipe wrench to avoid breaking the weld between coil connection and header.**
- Follow recommendations of the control manufacturer regarding types, sizing, and installation of controls.

Direct Expansion Coils

- The coil distributor and suction connection extend through the end panel of the coil section.
- Check nozzle in distributor for proper tonnage.
- When a (field supplied) thermostatic expansion valve is located outside the unit and connected directly to the distributor (except on units with piping vestibules). Do not apply heat to the body of the expansion valve.
- The thermostatic expansion valve must be the external equalizer tube type. Connect the 1/4-inch diameter external equalizer tube provided on the coil to the connection on the expansion valve.
- Use care when piping the system, making sure all joints are tight and all lines are dry and free of foreign material. For typical refrigerant piping, see condensing unit product manual.

Steam Coils

Piping (see Figure 19)

- Steam supply and steam return connections typically are male NPT iron pipe and are labeled on the end panel of coil section. Connections extend through the coil section end panel.
- When installing couplings, do not apply undue stress to the connection extending through unit panel. **Use a backup pipe wrench to avoid breaking the weld between coil connection and header.**
- Support piping independently of coils and provide adequate piping flexibility. Stresses resulting from expansion of closely coupled piping can cause serious damage.
- Do not reduce pipe size at the coil return connection. Carry return connection size through the dirt pocket, making the reduction at the branch leading to the trap.

Coils

- Pitch all steam coils in units toward the return connection.
- Do not drip supply mains through the coil.
- Do not attempt to lift condensate when using modulating or on/off control.
- Install vacuum breakers on all applications to prevent retaining condensate in the coil. Generally, connect the vacuum breaker between the coil inlet and the return main. The vacuum breaker should be open to the atmosphere and the trap design should allow venting of large quantities of air.

Traps

Note: Do not place steam traps outdoors.

- Size traps in accordance with the manufacturers' recommendations. Make sure the required pressure differential is always available. **Do not undersize.**
- Use float and thermostatic or bucket traps for low pressure steam. On high pressure steam, use bucket traps. Use thermostatic traps only for air venting.
- Use bucket traps for on/off control only.
- Locate traps at least 12 inches below the coil return connection.

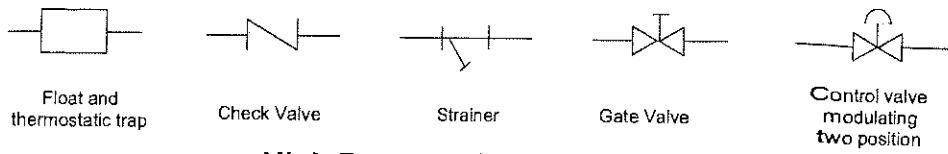
- Multiple coil installation—individually trap each coil or group of coils.
- Coils in series—use separate traps for each coil, or a bank of coils.
- Coils in parallel—a single trap can be used, but an individual trap for each coil is preferred.
- Do not attempt to lift condensate when using modulating or on/off control.
- With coils arranged for series airflow, use a separate control on each bank or coil in the direction of airflow.

Valves

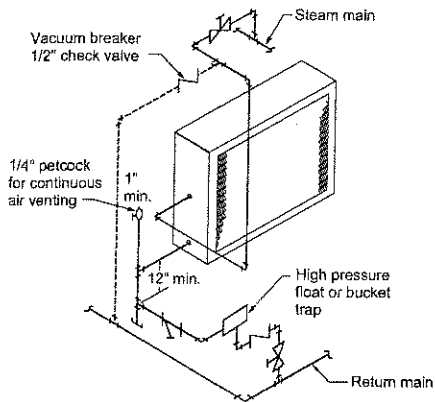
- Do not use modulating steam valves on high pressure systems.
- Properly size modulating valves. **Do not undersize.**
- Avoid freezing conditions (entering air temperatures below 35°F).
- McQuay strongly recommends 5JA, 8JA, 5RA and 8RA coils.
- Supply 5 psi steam to coils at all times.
- Do not use modulating valves. Provide control by face and bypass dampers.
- Consider using two or three coils in series with two position steam control valves on the coil or coils that handle 35°F or colder air. Use a modulating valve on the downstream coil to provide the desired degree of control.
- Thoroughly mix fresh air and return air before it enters the coil. Also, to obtain true air mixture temperatures, properly locate temperature control elements.
- As additional protection against freeze-up, install the trap sufficiently below the coil to provide an adequate hydrostatic head to remove condensate during an interruption in the steam pressure. Estimate three feet for each 1 psi of trap differential required.
- On startup, admit steam to coil ten minutes before admitting outdoor air.
- Close fresh air dampers if steam supply pressure falls below the minimum specified.

Mechanical Installation

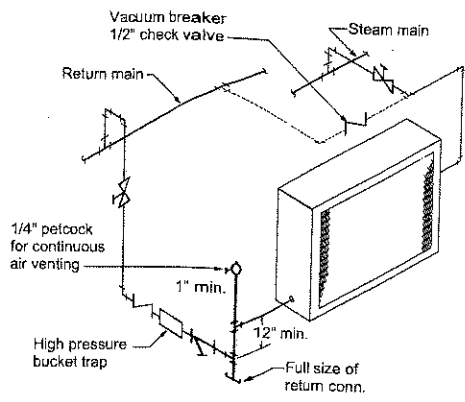
Figure 19: Piping Arrangements



High Pressure (over 25 psi)

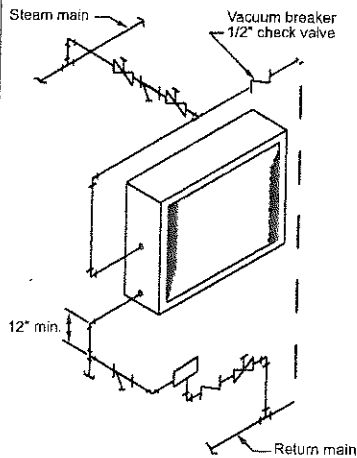


5GA or 8GA coils. Note that the addition of a vacuum breaker to permit the coil to drain during shutdown.

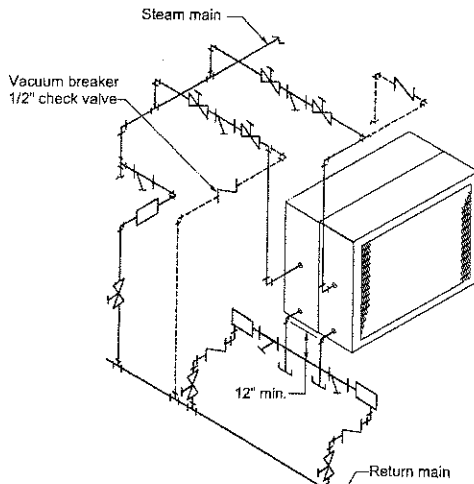


5TA, 8TA, or 5HA coils. Condensate is lifted to overhead return main

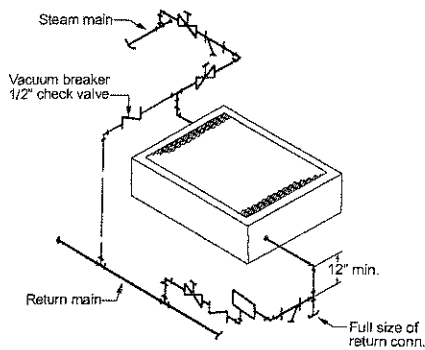
Low Pressure (to 25 psi)



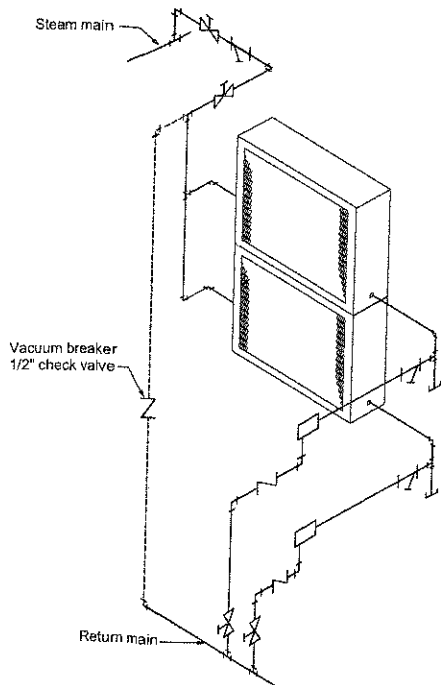
5J, 5G, 8J or 8G coils.



5JA or 8JA coil. Installed in series. Note that each coil must have a separate control valve and trap.



5RA, 8RA, or 5SA coils. Installed



5RA, 8RA, or 5SA coils. Banked two high, individual trapping of each coil as shown is preferred.

Water Heating Coils

CAUTION

Improper installation, use, or maintenance of water heating coils can cause equipment damage. Read and follow instructions carefully.

ATTENTION

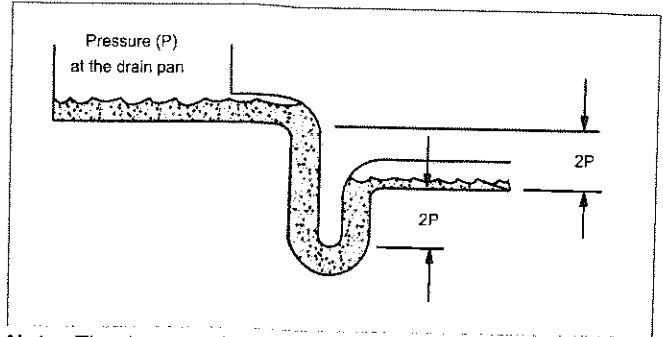
Si l'installation, l'utilisation ou l'entretien des serpentins de chauffage à eau sont inadéquats, ceci endommagera l'équipement. Lire et suivre attentivement les instructions.

- Water supply and water return connections extend through the end panel of the coil section. All connections are labeled on the end panel.
- Water supply and water return connections are male NPT iron pipe.
- When installing couplings, do not apply undue stress to the connection extending through unit panel. Use a backup pipe wrench to avoid breaking the weld between the coil connection and header.
- Follow recommendations of the control manufacturer regarding types, sizes, and installation of controls.
- Do not use hot water coils with entering air below 40°F.
- If fresh air and return air are to be heated by a hot water coil, carefully design the system to provide thorough mixing before air enters the coil.
- To prepare coils for winter operation, see Winterizing Water Coils, page 29.

Drain Pan Traps

Run drain lines and traps full size from the drain pan connection. Install drain pan trap to allow condensate to drain freely. On both blow-through and draw-through units, the trap depth and the distance between the trap outlet and the drain pan outlet must be twice the static pressure in the drain pan section under normal operation so the trap remains sealed (Figure 20).

Figure 20: Allow Adequate Distance Between Trap Outlet and Drain Pan Outlet

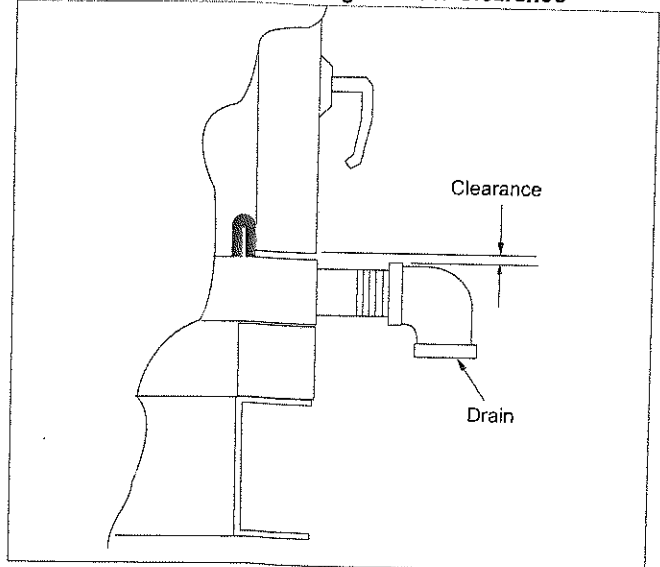


Note: The door panels on some applications have a close clearance over the drain pipes. Extend the drain fitting with a coupling if necessary for door clearance (Figure 21).

Note: Use material that can withstand freezing temperatures for outdoor drain traps.

Note: Drain traps that dry out can allow cold air to seep into the equipment.

Figure 21: Extend Drain Fitting for Door Clearance



Mechanical Installation

Internal Isolation Assembly Adjustment

On units with internally isolated fan and motor assemblies, the assemblies are secured for shipment with a tie-down at each point of isolation.

Before Operating the Unit:

Remove the shipping brackets and tie-down bolts (see Figure 23 and Figure 24) and discard. The shipping brackets located on the opposite drive side of the unit are difficult to access from the drive side of the unit. Either remove them before the unit is assembled or remove the panel on the opposite drive side to gain access.

The spring isolators under the four corners of the fan and motor assembly are factory adjusted while the fan was not running. See Table 1 and Table 2 below. With the unit operating at normal cfm and static pressure, all the isolators should be at the same height opening. If adjustments are required, loosen the 1/2" cap screw on top of the isolator and turn the adjusting bolt to lower or raise the fan and motor base. Retighten the cap screw when adjustments are completed.

Table 1: Motor Beside Fan Spring Mount Adjustments

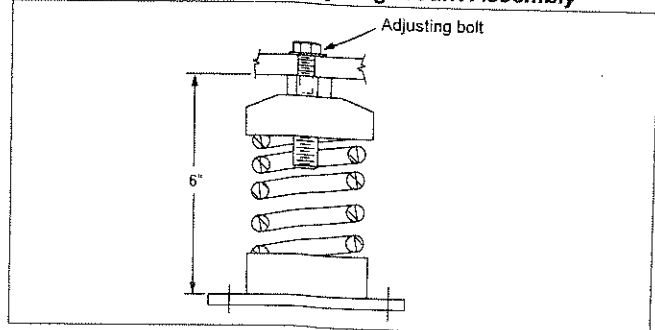
Spring mount adjustment at rest			
Fan discharge position	Top or bottom horz. H	Downblast H	Upblast H
Unit sizes 003 – 035			
1	3.75	3.75	4.25
2	4.25	3.75	4.25
3	4.25	3.75	4.25
4	3.75	3.75	4.25
Unit sizes 040 – 090			
1	6.00	6.75	6.75
2	6.50	6.75	6.75
3	6.50	6.75	6.75
4	6.00	6.75	6.75

Table 2: Motor Behind Fan Spring Mount Adjustments

Spring mount adjustment at rest			
Fan discharge position	Top or bottom horz. H	Downblast H	Upblast H
Unit sizes 003 – 035			
1	6.75	6.75	6.75
2	6.75	6.75	6.75
3	6.75	6.75	6.75
4	6.75	6.75	6.75
Unit sizes 040 – 090			
1	6.75	6.75	6.75
2	6.75	6.75	6.75
3	6.75	6.75	6.75
4	6.75	6.75	6.75

For models 040 through 090, the isolators should be at equal height during fan operation (6"). Center the fan outlet in the outlet panel opening. If adjustment is required, loosen the cap screw on top of the isolator assembly. Turn the adjustment nut below the fan frame to lower or raise the fan motor and frame assembly. Retighten the cap screw on top of the isolator assembly.

Figure 22: Adjusting Large Spring Mount Assembly



Mechanical Installation

Figure 23: Removing "Motor Behind" Shipping Brackets

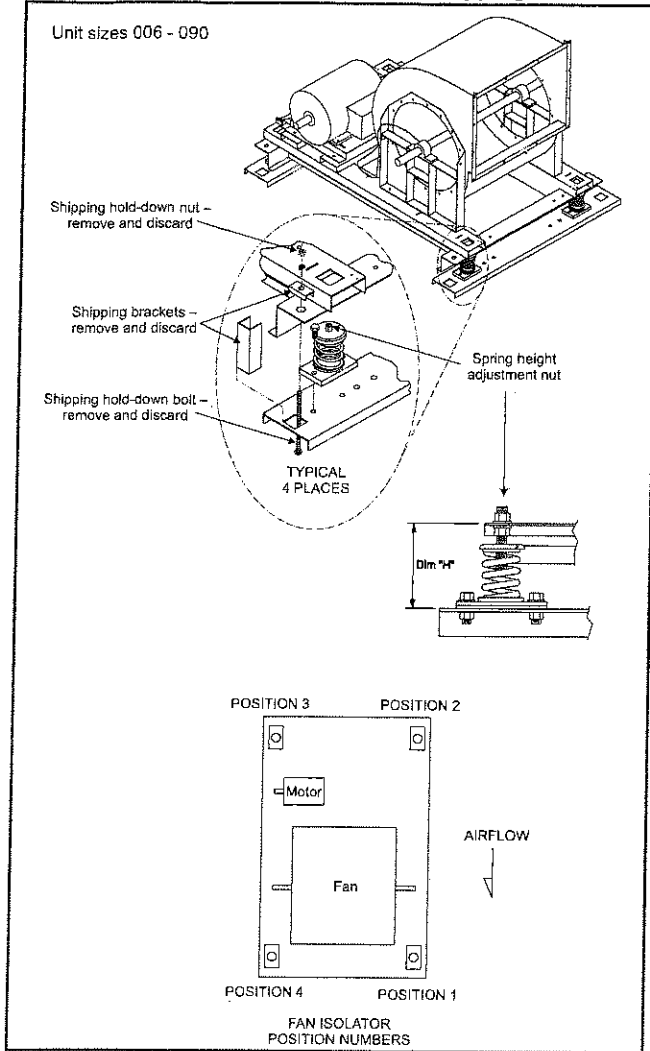
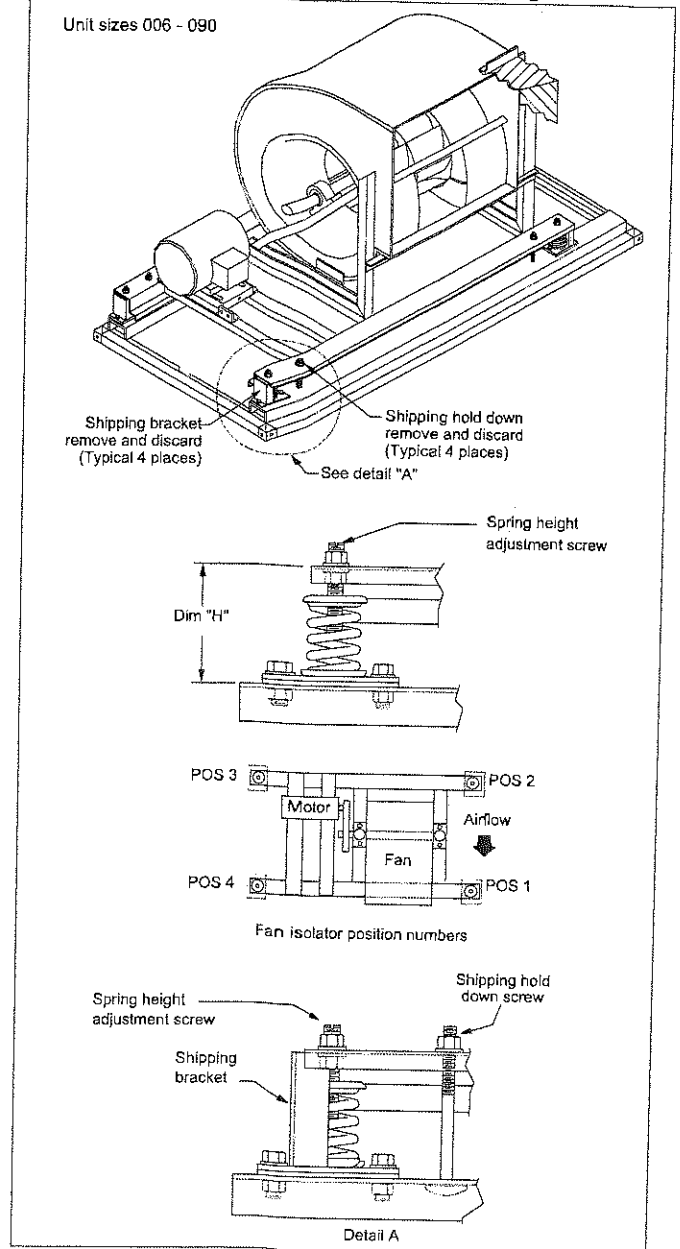


Figure 24: Removing "Motor Beside" Shipping Brackets



Electrical Installation

Wiring

⚠ DANGER

Capacitor hazardous voltage! Failure to disconnect power and discharge capacitors before servicing will result in serious injury or death.

Disconnect all electric power (including remote disconnects) before servicing. Perform lockout/tagout procedures to ensure that power can not be energized. For variable frequency drives, or other energy storing components that have been furnished and mounted by either McQuay, or by others, refer to the specific manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify capacitors have been discharged using an appropriate voltmeter.

⚠ ADVERTISSEMENT

Voltage de condensateur à risque de danger! À défaut de débrancher la puissance électrique et de décharger le condensateur avant de faire le service, il peut en résulter des blessures sérieuses et même la mort.

Débranchez toute puissance électrique (incluant les sectionneurs à distance) avant de faire du service. Assurez-vous de procéder au cadenassage et à la pose d'avis assurant que la puissance ne peut être rétablie.

Pour le variateur de fréquence variable ou tout autre composante pouvant accumuler de l'énergie qui auraient été fournis et installés par McQuay ou autres, se référer à la littérature spécifique du manufacturier donnant les périodes spécifiques d'attente nécessaires pour la décharge du condensateur. Vérifier que le condensateur est totalement déchargé avec les voltmètres appropriés.

⚠ CAUTION

Use copper conductors only. Failure to use copper conductors can result in equipment damage.

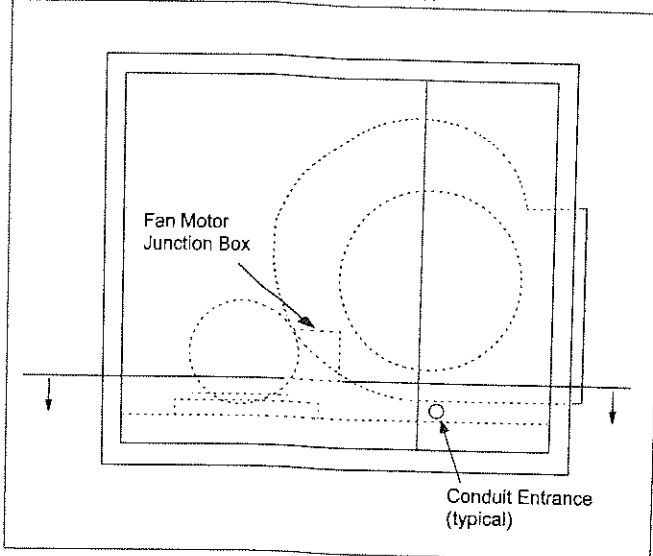
⚠ ATTENTION

Utiliser du fil de cuivre seulement. La non utilisation de fil de cuivre peut causer des dommages à l'équipement.

- Electrical service to the fan must correspond to the rated voltage on the motor or electrical panel nameplate and conform to the National Electric Code and local restrictions.
- Connect the fan section metal frame to the building electrical ground.
- A door electrical interlock is not provided as standard.
- Thermal motor protection is external to the unit.

Locate electrical conduit entrances for units above the bottom of the unit, high enough to clear components inside, but below the bottom of the fan motor junction box (Figure 25).

Figure 25: Electrical Conduit Location



⚠ CAUTION

The base section of each cabinet has a drip pan installed below every panel that drains to the outside frame trough. Any holes cut through the bottom of the unit must also penetrate the drip pan. If holes are cut in the drip pan, seal them to prevent moisture leakage.

⚠ ATTENTION

Chaque cabinet est muni d'une base avec une panne d'égouttement installée en-dessous de chaque panneau qui évacuera l'eau vers la gouttière extérieure. Tous les trous percés au bas de l'unité doivent pénétrer la panne d'égouttement. S'il y a des trous dans la panne d'égouttement, les sceller pour empêcher les fuites d'eau.

- When the unit is provided with an external junction box and variable frequency drive (VFD), the VFD itself will be mounted on the drive side fan panel inside the fan cabinet. The external junction box will provide loose wire connection to the VFD and to the motor. An external mounted keypad/display control box will be provided and connected to the VFD for manual adjustment of the VFD.
- When not being serviced, close and secure electrical panel doors to prevent accidental contact with live parts and prevent ingress of moisture and airborne contaminants.
- Control wiring—access to the VFD is through the fan cabinet access door. Provide shielded cable only as described in the VFD manual provided with the unit. Route wire through panel so that it not interfere with any other components or in the way of any access doors. Do not drill through drip or drain pans. Refer to the VFD installation manual provided with the unit for detailed control wiring instructions.

Startup Checks

When performing startup and service, always take thorough safety precautions. Only trained, experienced personnel should perform these functions.

WARNING

Rotating fan. Can cause severe injury or death. Before servicing fans, lockout and tag out power.

AVERTISSEMENT

Ventilateur en rotation. Peut causer des blessures sévères ou même la mort. Avant d'effectuer l'entretien des ventilateurs, bloquer et couper la tension.

WARNING

Fire/electric shock hazard. Can cause property damage, personal injury or death. Wire fan power supply and ground motor frame in accordance with local electric codes.

AVERTISSEMENT

Risques d'incendie et d'électrocution pouvant causer des dommages matériels, des blessures et même la mort. L'alimentation électrique du moteur du ventilateur de même que la mise à la terre du châssis du moteur doivent être faits conformément aux codes d'installations électriques en vigueur.

WARNING

Fan motor requires overload protection. Failure to provide motor overload protection can result in fire, property damage, electric shock, personal injury, or death. Connect motor to an overload protective device rated in compliance with local electric codes.

AVERTISSEMENT

Risques d'incendie et d'électrocution pouvant causer des dommages matériels, des blessures et même la mort. Connecter au moteur du ventilateur électrique un dispositif de protection contre les surcharges conforme aux codes d'installations électriques en vigueur.

CAUTION

Do not overheat fan motor. High air temperatures in the fan section can cause the fan motor to burnout. On draw-through air handlers or air handlers with the fan section down the air stream from the heating section, the discharge air temperature of the heating section must not exceed 104°F (40°C).

ATTENTION

Risques de dommages dans le moteur du ventilateur électrique. Si la température de l'air à proximité du ventilateur est élevée, le moteur du ventilateur électrique peut chauffer et brûler. Sur les transmetteurs d'air à circulation transversale ou les transmetteurs dont le ventilateur est en aval de l'unité de chauffage, régler la température de l'air sortant de l'unité de chauffage à 40°C (104°F).

Before Starting the Unit:

Before entering fan section, make sure that fan electrical power source is disconnected and locked in the OFF position.

- 1 Check that the unit is completely and properly installed with ductwork connected.
- 2 Check that construction debris is removed/filters are clean.
- 3 Check that all electrical work is complete and properly terminated.
- 4 Check that all electrical connections are tight and that the proper voltage is connected. Phase imbalance must not exceed 2%.
- 5 Check that ball bearings on the fan shaft and motor are prelubricated and do not need grease before startup.
- 6 Check tightness of setscrews in bearings and fan wheel(s). If retightening is needed, position the fan wheel(s) per Table 3 or Table 4, page 18. Torque set screws per Table 7, page 19.

CAUTION

Equipment damage due to loose fasteners represents improper start-up and equipment abuse. It is not covered by the warranty.

AVERTISSEMENT

Les dommages dus à des attaches installées de façon inappropriée représentent un démarrage inadéquat et un abus d'équipement. Ceci n'est pas couvert par la garantie.

- 1 Check alignment of fan and motor sheaves and belt tension. Adjust if necessary. Check tightness of sheave setscrews and/or capscrews. See Table 7, page 19.
- 2 Leak test the thermal system to verify that connections are tight.
- 3 Check that the condensate drain is trapped.
- 4 Rotate the shaft by hand to be sure it is free.

Fan Startup:

Start and run fan. Observe the rotation. If the fan operates backward, reverse two legs of the three-phase motor connections.

Operation Guidelines

Note: Variable pitch fan drives usually are provided for operation in the mid-speed adjustment range. However, the drives usually ship with the adjustment opened up for minimum fan speed. Adjust the drives for the proper airflow. See Fan Drive, page 23.

After the First 48 Hours of Operation:

- 1 Disconnect and lock electrical power source.
- 2 Check tightness of all bearing, wheel, and sheave setscrews (or capscrews). See Table 7, page 19.
- 3 Recheck belt tension and adjust if necessary. Belts that are tensioned sufficiently to slip one to two seconds at startup perform satisfactorily, extending life and reducing vibration. If retensioning is necessary, be certain to retain sheave alignment.

Fan Wheel Alignment

Figure 26: Wheel-to-Inlet Tunnel Relationship—Airfoil Type Fan Wheels (Housed)

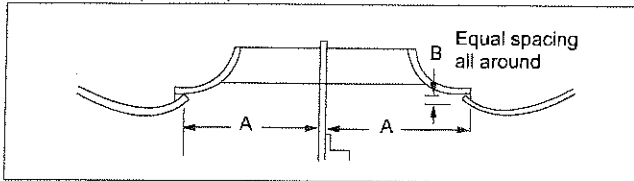


Table 3: Wheel-to-Inlet Funnel Relationship—Airfoil Type

Airfoil									
Unit sizes 003 to 035					Unit sizes 040 to 090				
Dia.	A (in)	A (mm)	B (in)	B (mm)	Dia.	A (in)	A (mm)	A (in)	B (mm)
13.22	4.56	116	0.21	5.33	20.00	7.19	183	0.31	7.87
14.56	5.06	129	0.21	5.33	22.25	7.69	195	0.33	8.38
16.18	5.62	143	0.21	5.33	24.50	8.56	217	0.31	7.87
17.69	6.90	175	0.22	5.59	27.00	9.47	241	0.63	16.00
21.56	7.59	193	0.24	6.10	30.00	10.47	266	0.39	9.91
24.00	8.45	215	0.23	5.84	33.00	11.75	298	0.38	9.65
					36.50	12.78	325	0.38	9.65
					40.25	14.31	363	0.50	12.70

- Note:**
1. To obtain rated air performance, dimensional relationship must be held.
 2. To obtain dimension A, loosen setscrews in wheel hub(s), shifting wheel(s) axially as needed, and retightening setscrews.
 3. To obtain dimension B, loosen screw and washer fasteners around periphery of funnel(s), shifting funnel radially as required, and re-torquing fasteners.

Figure 27: Wheel-to-Inlet Funnel Relationship—Forward Curved Type Fan Wheels

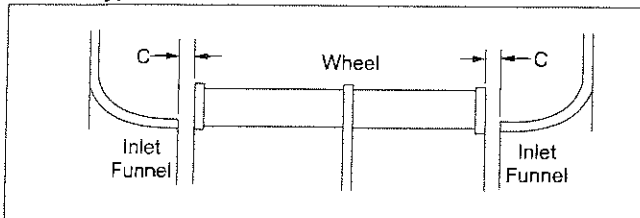


Table 4: Wheel-to-Inlet Funnel Relationship—Forward Curved Type Fan Wheels

Forward curved					
Unit sizes 003 to 035			Unit sizes 040 to 090		
Diameter (in)	C (in)	C (mm)	Diameter (in)	C (in)	C (mm)
9 x 4	0.25	6.35	20 (Class 1 & 2)	0.24	6.10
9 x 7	0.13	3.30	22.38 (Class 1 & 2)	0.41	10.41
9 x 9	0.25	6.35	25 (Class 1 & 2)	0.47	11.94
10	0.22	5.59	27.62 (Class 1 & 2)	0.47	11.94
12	0.35	8.89	30 (Class 1 & 2)	0.47	11.94
15	0.44	11.18	33 (Class 1 & 2)	0.50	12.70
18	0.25	6.35	36 (Class 1 & 2)	0.75	19.05
20 (Class 1 & 2)	0.73	8.54			
22 1/2 (Class 1 & 2)	0.59	14.99			
24 1/2 (Class 1 & 2)	0.56	14.22			

- Note:**
1. To obtain rated air performance, dimensional relationship must be held.
 2. Adjust dimension C by loosening wheel hub setscrews, shifting wheel(s) axially as needed, and retightening setscrews

Figure 28: Wheel-to-Inlet Funnel Relationship—Plenum Fans

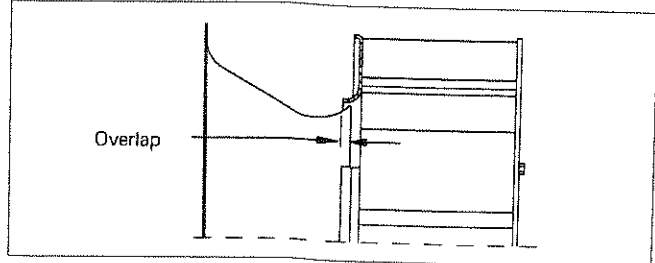


Table 5: Wheel-to-Inlet Funnel Relationship—Plenum Fans

Wheel—funnel overlap	
Size	Overlap
13.5	.25
15	.31
16.5	.38
18.25	.44
20	.50
22.25	.56
24.5	.62
27	.69
30	.75
33	.81
36.5	.88
40.25	1.00
44.5	1.12
49	1.25
54.25	1.38
60	1.50

Operation Guidelines

Figure 29: Wheel-to-Inlet Funnel Relationship—Inline Fans

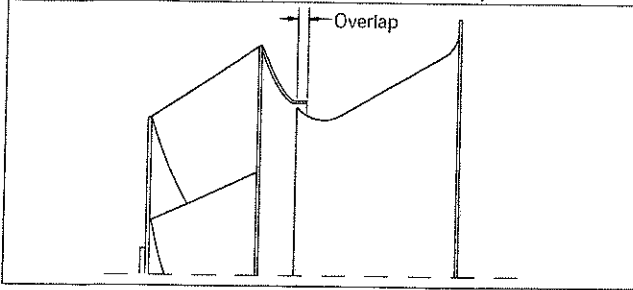


Table 6: Wheel-to-Inlet Funnel Relationship—Inline Fans

Wheel—funnel overlap	
Size	Overlap
150	.375
165	.438
182	.562
200	.625
222	.688
245	.750
270	.812
300	.875

Table 6: Wheel-to-Inlet Funnel Relationship—Inline Fans

330	1.000
365	1.125
402	1.250
445	1.375

Table 7: Bearing Collar and Wheel Hub Set Screw Torque

Set screw	Minimum torque	
	Diameter (in)	ft/lbs
1/4	5.5	.76
1/16	10.5	1.45
3/8	19.0	2.63
7/16	29.0	4.01
1/2	42.0	5.81
5/8	92.0	12.72

Operating Limits

Do not exceed the operating limits in Table 8. A fan wheel operated beyond the rpm and temperature limits shown can suffer permanent distortion or fracture. The resulting unbalance can cause severe unit vibration.

Table 8: Unit Sizes 003 to 035

Fan operating limits										
Forward curved—housed										
Diameter	9 × 4	9 × 7	9 × 9	10.62	12.62	15	18	20	22.25	24.50
Maximum rpm Class I	N/A	2189	2223	1934	1614	1328	1155	1050	944	858
Maximum rpm Class II	2700	2854	2896	2518	2091	1725	1450	1200	1030	910
Airfoil—housed										
Diameter	13.22	14.56	16.19	19.69	21.56	24.00				
Maximum rpm Class I	3000	3000	2300	2000	1700	1500				
Maximum rpm Class II	4335	3918	3457	2858	2427	2255				

Figure 30: Torque for FC Variable Inlet Vanes (in-lb)

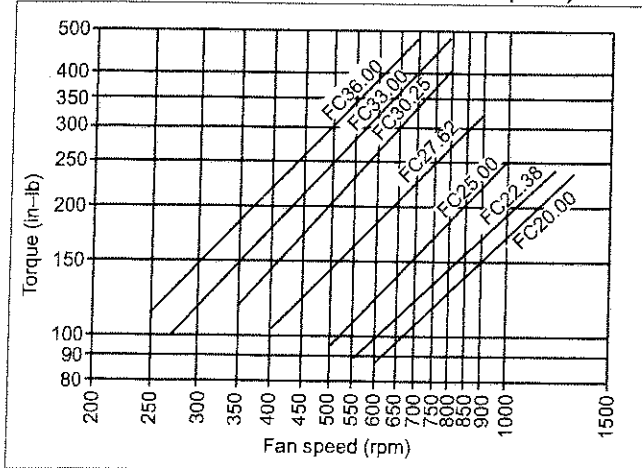
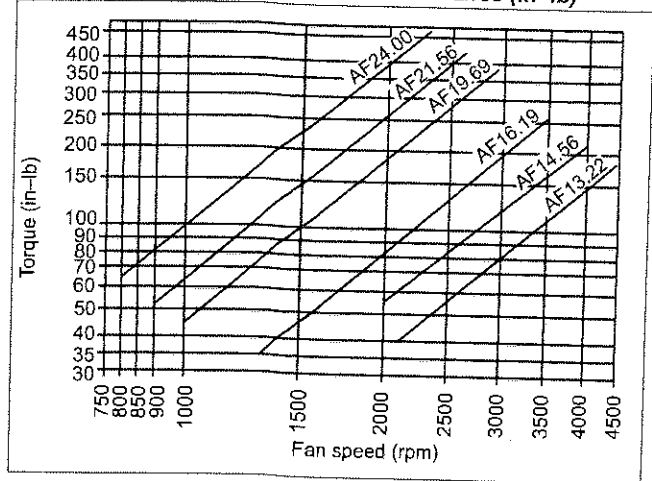


Figure 31: Torque for AF Variable Inlet Vanes (in-lb)



Operation Guidelines

Table 9: Unit Sizes 040 to 090

Fan operating limits							
Forward curved—housed							
Diameter	20	22.38	25	27.62	30.25	33	36
Maximum rpm Class I	1010	930	790	690	650	600	560
Maximum rpm Class II	1281	1178	1011	910	835	763	715
Airfoil—housed							
Diameter	20	22.25	24.5	27	30	33	36.5
Maximum rpm Class I	2077	1875	1691	1479	1328	1209	1073
Maximum rpm Class II	2703	2413	2199	1928	1730	1579	1401

Figure 32: Torque for FC Variable Inlet Vanes (in-lb)

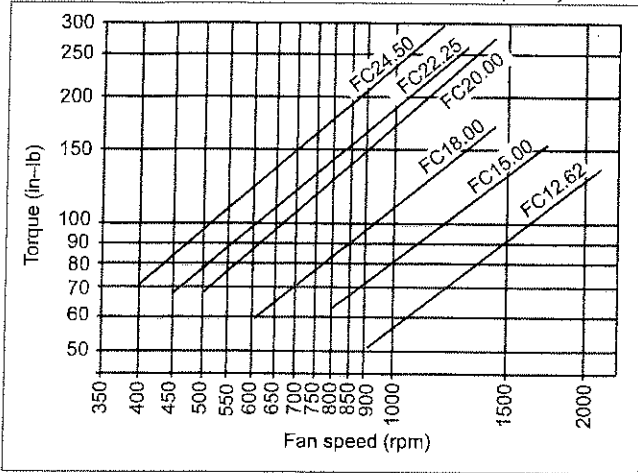


Figure 33: Torque for AF Variable Inlet Vanes (in-lb)

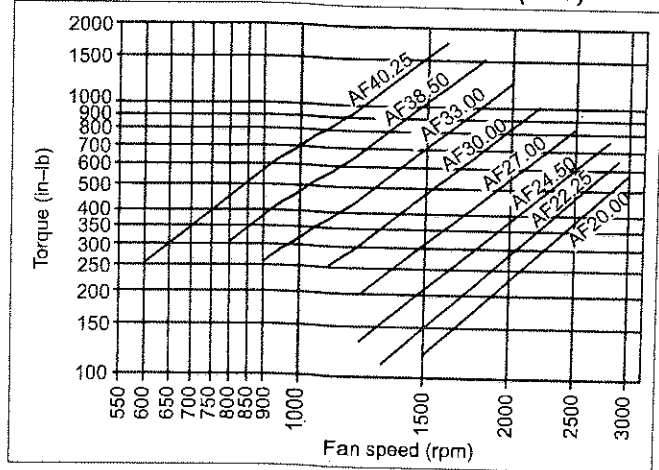


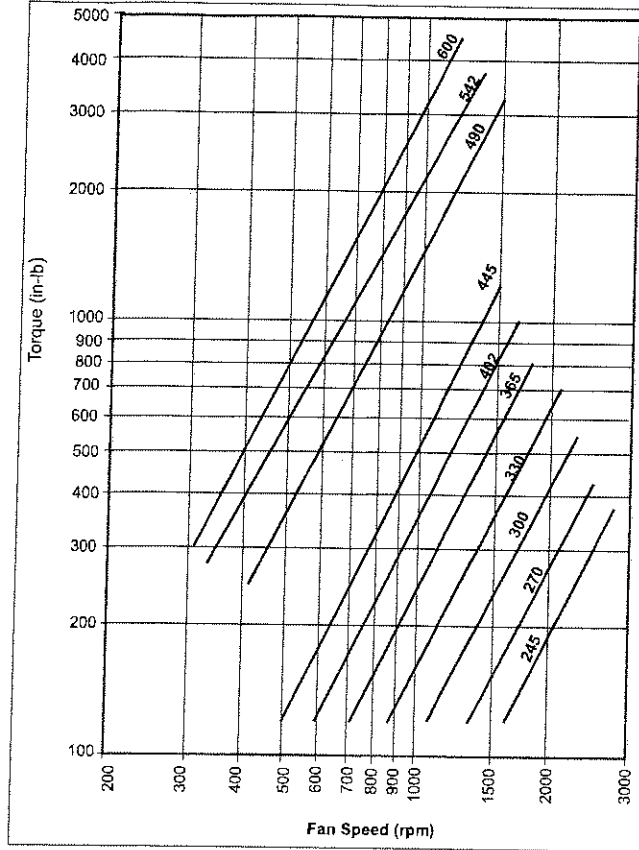
Table 10: Operating Limits—Plenum Fans

Fan operating limits																
Plenum fans																
Diameter	13.5	15	16.5	18.25	20	22.25	24.5	27	30	33	36.5	40.25	44.50	49	54.25	60
Maximum rpm Class I	2895	2589	2376	2256	2077	1875	1691	1479	1328	1209	1073	972	882	799	725	651
Maximum rpm Class II	3786	3384	3100	2959	2703	2413	2199	1928	1730	1579	1401	1264	1150	1043	938	847
Maximum rpm Class III	4000	4000	3887	3735	3409	3065	2780	2423	2182	1984	1756	1598	1447	1314	1178	1071

Table 11: Operating Limits—Inline Fans, Twin Fans

Fan operating limits													
Inline fans													
Diameter	18.25	20	22.25	24.5	27	30	33	36.5	40.25	44.50	49	54.25	
Maximum rpm Class I	2727	2488	2236	2041	1835	1665	1476	1330	1208	1072	973	880	
Maximum rpm Class II	3409	3111	2796	2551	2294	2082	1846	1662	1510	1340	1216	1100	
Twin fans													
Diameter	9 x 9	10.62	12.62	15	18.12	20							
Maximum rpm	2575	2400	2000	1700	1400	1200							
Maximum HP	10	15	15	30	40	40							

Figure 34: Torque Requirements at 100% WOV for SWSI Plenum Fans with NESTED Inlet Vane



Fan Vibration Levels

Each unit as shipped is trim balanced to operate smoothly. To provide satisfactory operation after shipping and installation, use the accepted industry guidelines for field balancing fans. See Table 12.

Table 12: Vibration Levels

Fan speed (rpm)	Vibration
800 or less	5 mils maximum displacement
801 or greater	0.20 in/sec. maximum velocity

Note: Excessive vibration from any cause contributes to premature fan and motor bearing failure. Monitor overall vibration levels every six months of operation. An increase in levels is an indication of potential trouble.

Vibration Causes

- 1 Wheel imbalance.
 - a Dirt or debris on wheel blades.
 - b Loose set screws in wheel hub or bearing-to-shaft.
 - c Wheel distorted from overspeed.
- 2 Bent shaft.
- 3 Drive faulty.
 - a Variable pitch sheaves—Axial and radial runout of flanges; uneven groove spacing; out of balance. Also similar faults in driven sheave.
 - b Bad V-belts; lumpy, or mismatched; belt tension too tight or too loose.
- 4 Bad bearings, loose bearing hold-down bolts
- 5 Motor imbalance
- 6 Fan section not supported evenly on foundation

Service and Maintenance

Periodic Maintenance

- 1 Check all moving parts for wear every six months.
- 2 Check bearing collar, sheave, and wheel hub setscrews, sheave capscrews, and bearing hold-down bolts for tightness every six months.
- 3 Annually check and snug all electrical connections. Inspect for signs of water damage such as corrosion and repair if necessary. Check ground conductor and connection integrity. Service if needed.

Ball Bearing Lubrication

⚠ CAUTION

Bearing overheating potential. Can damage the equipment. Do not overlubricate bearings. Use only a high grade mineral grease with a 200°F safe operating temperature. See below for specific recommended lubricants.

Motor Bearings

Supply and return fans—Supply and return fan motors should have grease added after every 2000 hours of operation. Using the following procedure, relubricate the bearings while the motor is warm, but not running. Use one of the greases shown in Table 13.

Table 13: Recommended Lubricants and Amounts for Fan Motor Bearings

Mfr. Grease	NEMA Size	Amount to Add (oz.)
Texaco, Polystar or Polyrex EM (Exxon Mobile) or Rykon Premium #2 or Penzoil Pen 2 Lube	56 to 140	0.08
	140	0.15
	180	0.19
	210	0.30
	250	0.47
	280	0.61
	320	0.76
	360	0.81
	400	1.25
440	2.12	

- 1 Remove and clean upper and lower grease plugs.
- 2 Insert a grease fitting into the upper hole and add clean grease (Table 13) with a low pressure gun.
- 3 Run the motor for five minutes before replacing the plugs.

Note: Specific greasing instructions are located on a tag attached to the motor. If special lubrication instructions are on the motor, they supersede all other instructions.

Fan Shaft Bearings

Any good quality lithium or lithium complex base grease, using mineral oil, conforming to NLGI grade 2 consistency, and an oil viscosity of 455-1135 SUS at 100°F (100-200 cSt at 40°C) may be used for relubrication.

Compatibility of grease is **critical**. Relubricatable bearings are supplied with grease fittings or zerks for ease of lubrication with hand or automatic grease guns. Always wipe the fitting and grease nozzle clean.

⚠ CAUTION

For safety, stop rotating equipment. Add one half of the recommended amount shown in Figure 16. Start bearing, and run for a few minutes. Stop bearing and add the second half of the recommended amount. A temperature rise, sometimes 30°F (1°C), after relubrication is normal. Bearing should operate at temperature less than 200°F (94°C) and should not exceed 225°F (107°C) for intermittent operation. For a relubrication schedule, see Table 14. For applications that are not in the ranges of the table, contact McQuay.

⚠ CAUTION

The tables below state general lubrication recommendations based on our experience and are intended as suggested or starting points only. For best results, specific applications should be monitored regularly and lubrication intervals and amounts adjusted accordingly.

Table 14: Relubrication Intervals

(Use NLGI #2 Lithium or Lithium Complex Grease)			
Speed	Temperature	Cleanliness	Relub. intervals
100 rpm	Up to 120°F (50°C)	Clean	6 to 12 months
500 rpm	Up to 150°F (65°C)	Clean	2 to 6 months
1000 rpm	Up to 210°F (100°C)	Clean	2 weeks to 2 months
1500 rpm	Over 210°F (100°C) to 250°F (120°C)	Clean	Weekly
Above 1500 rpm	Up to 150°F (65°C)	Dirty/wet	1 week to 1 month
Max catalog rating	Over 150°F (65°C) to 250°F (120°C)	Dirty/wet	Daily to 2 weeks
	Above 250°F (120°C)		Contact Browning

Table 15: Recommended Lubricants for Fan Shaft Ball Bearings

Name	Temperature	Base	Thickener	NLGI grade
Texaco, Premium RB	30° to 350°F (34° to 177°C)	Parafinic mineral oil	Lithium	2
Mobile, AW2	40° to 437°F (40° to 175°C)	Mineral oil	Lithium	2
Mobile, SHC 100	68° to 356°F (50° to 180°C)	Synthetic	Lithium	2
Chevron, AltipleX Synthetic	60° to 450°F (51° to 232°C)	Synthetic	Lithium	2
Exxon, ronex MP	40° to 300°F (40° to 149°C)	Mineral oil	Lithium	2

Note: Temperature ranges over 225°F are shown for lubricants only. High temperature applications are not suitable for standard air handler components.

Table 16: Recommended Fan Relubrication Grease Charge

Shaft Size (in)	OZ.	Shaft Size	Grams
1/2 to 3/4	0.03	20 mm	0.85
7/8 to 1-3/16	0.10	25-30 mm	2.84
1-1/4 to 1-1/2	0.15	35-40 mm	4.25
1-11/16 to 1-15/16	0.20	45-50 mm	5.67
2 to 2-7/16	0.30	55-60 mm	8.51
2-1/2 to 2-15/16	0.50	65-70 mm	15.59
3 to 3-7/16	0.85	75-80 mm	24.10
3-1/2 to 4	1.50	85-105 mm	42.53

Fan Drive

WARNING
Before servicing fans, lock out and tag out all power to the unit. Fans or belts can cause severe personal injury or death.

AVERTISSEMENT
Avant de faire le service sur les ventilateurs, couper et indiquer que le courant est coupé. Les ventilateurs ou les courroies peuvent causer des blessures personnelles graves ou entraîner la mort.

WARNING
Do not open the hinged access door and screw-fastened access panels while the unit is operating. Moving parts and strong suction forces can cause severe personal injury or death.

AVERTISSEMENT
Ne pas ouvrir les portes d'accès à charnières et les panneaux à vis lorsque l'unité fonctionne. Les pièces mobiles et le niveau de succion peuvent causer des blessures personnelles graves ou même entraîner la mort.

Upon completion of the air balance, replace the variable pitched motor sheave with a properly sized, fixed sheave. A matching fixed sheave provides longer belt and bearing life and minimizes vibration. Initially, it is best to have a variable pitched motor sheave for the purpose of air balancing. Once the balance is achieved, fixed sheaves maintain balancing and alignment more effectively. Replace the adjustable sheaves with fixed sheaves.

With the electrical power disconnected, locked and tagged out, measure the diameter of the V-belt outer surface where it passes around the sheave (pitch diameter). Calculate fan speed from the motor nameplate rpm.

$$\text{Fan rpm} = \text{motor rpm} \times \frac{\text{Measured diameter at motor sheave}}{\text{Measured diameter at fan sheave}}$$

VM and VP Variable Pitch Key Type Sheaves

Mounting

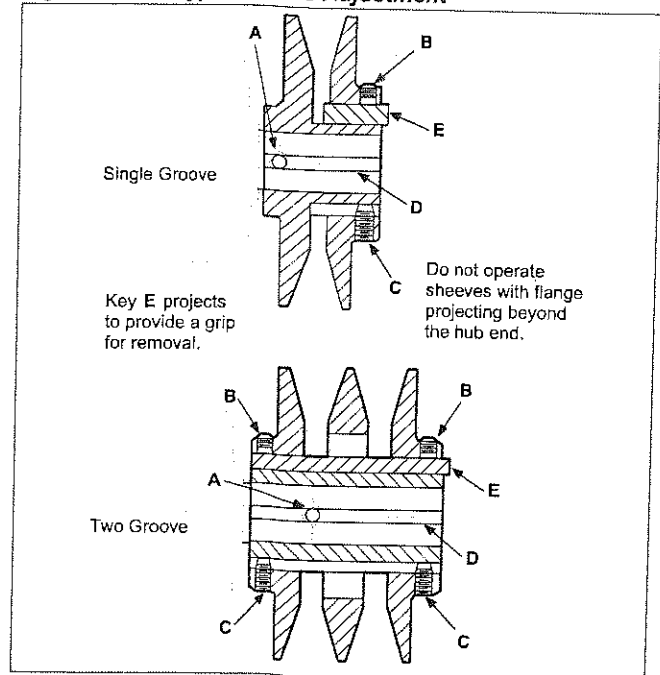
- 1 Mount all sheaves on the motor or driving shaft with the setscrews **A** toward the motor.

- 2 Verify that both driving and driven sheaves are in alignment and that shafts are parallel.
- 3 Fit internal key **D** between sheave and shaft and lock setscrew **A** securely in place.

Adjusting

- 1 Loosen setscrews **B** and **C** in moving parts of sheave and pull out external key **E**. (This key projects a small amount to provide a grip for removing.)
- 2 To adjust sheave pitch diameter for desired speed, open moving parts by half or full turns from closed position. **Do not open more than five full turns for A belts or six full turns for B belts.**
- 3 Replace external key **E** and securely tighten setscrews **B** over key and setscrews **C** into keyway in fixed half of the sheave.
- 4 Put on belts and adjust belt tension. **Do not force belts over grooves.** See Fan Drive Belt, page 26.
- 5 Make future adjustments by loosening the belt tension and increasing or decreasing the pitch diameter of the sheave by half or full turns as required. Readjust belt tension before starting drive.
- 6 To provide the same pitch diameter, adjust both halves of the two-groove sheaves by the same number of turns from closed position.
- 7 Verify that all keys are in place and that all set screws are tight before starting drive. Check setscrews and belt tension after 24 hours service.

Figure 35: VP Type Sheave Adjustment



Service and Maintenance

LVP Variable Speed Sheaves

Mounting

- 1 Slide sheave on motor shaft so that the side of the sheave with setscrew **A** is next to the motor when setscrew **A** is in the hub or barrel of the sheave.
- 2 When setscrew **A** is at an angle in the center flange **B**, mount it away from the motor so that the outer locking ring and flange can be removed to get to the setscrew.
- 3 To remove the flange and locking ring:
 - a Loosen setscrews **D**.
 - b Loosen but **do not remove** capscrews **E**.
 - c Remove key **F**.
 - d Rotate the flange counterclockwise until it disengages the threads on the sheave barrel.
- 4 Verify that the driving and driven sheaves are in alignment and the shafts are parallel. When aligning two-groove sheaves, allow room between the sheave and motor to access capscrews **E**.
- 5 Insert key **C** between the sheave and the shaft and tighten setscrew **A** securely.
- 6 If flange and locking ring have been removed, when replacing them make sure that the inner and outer flanges are open from the closed position by the same amount as the other flange. Determine this by accurately measuring the top width of the grooves.
- 7 Insert key **F**.
- 8 Tighten setscrews **D** and capscrews **E**.

- 9 Put on belts and adjust belt tension. **Do not force belts over grooves.** See Fan Drive Belt, page 26.
- 10 Before starting the drive, ensure that all keys are in place and all setscrews and all capscrews are tight. Check and retighten all screws and retension belts after approximately 24 hours of service.

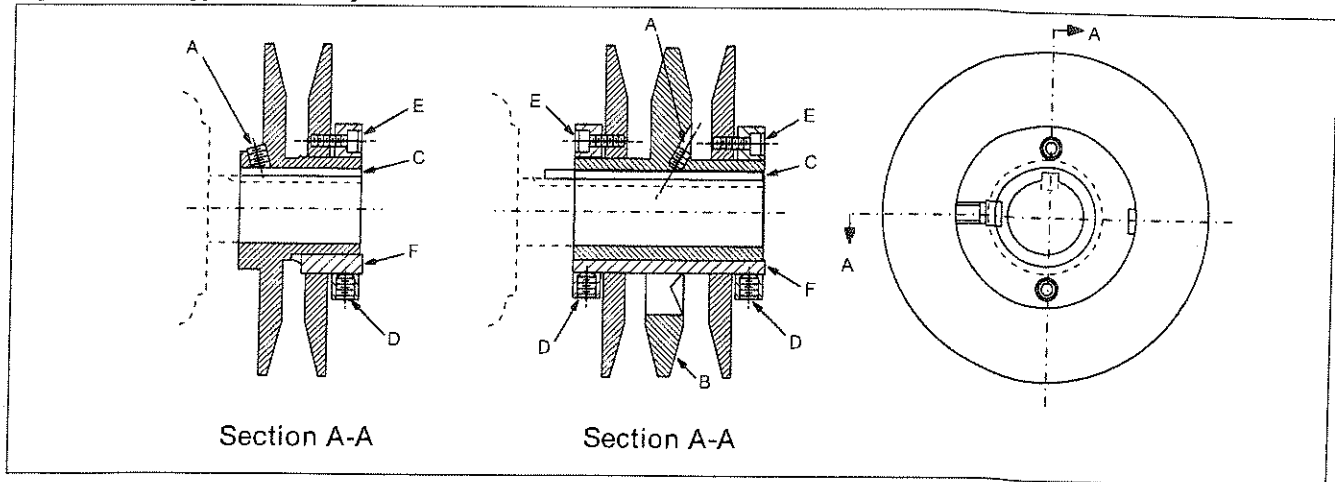
Adjusting

- 1 Slack off belt tension if belts have been installed.
- 2 Loosen setscrews **D**.
- 3 Loosen but **do not remove** capscrews **E**.
- 4 Remove key **F**.

Note: This key projects a small amount to provide a grip for removing.
- 5 Adjust pitch diameter by opening or closing the movable flanges by half or full turns.

Note: Two-groove sheaves are supplied with both grooves set at the same pitch diameter.
- 6 To provide the same pitch diameter for satisfactory operation, move both movable flanges the same number of turns. Do not open sheaves more than five turns for **A** belts or six turns for **B** belts.
- 7 Replace key **F**.
- 8 Tighten setscrews **D** and capscrews **E**.
- 9 If belts have been installed, readjust belt tension. If belts have not been installed, install them and adjust belt tension. **Do not force belts over grooves.** See Fan Drive Belt, page 26.
- 10 Before starting the drive, ensure that all keys are in place and all setscrews and all capscrews are tight. Check and retighten all screws and retension belts after approximately 24 hours of operation.

Figure 36: LVP Type Sheave Adjustment



MVP Variable Speed Sheaves

Mounting

- 1 Verify both driving and driven sheaves are in alignment and the shafts are parallel. The centerline of the driving sheave must be in line with the centerline of the driven sheave. See Figure 37, page 26.
- 2 Verify that all setscrews are torqued to the values shown in Figure 17, page 25 before starting drive. Check setscrew torque and belt tension after 24 hours of service.

Adjusting

- 1 Adjust motor base forward to release belt tension. Remove the belts for easier adjustment.
- 2 Loosen, but do not remove both of the locking setscrews **A** in the outer locking ring by using a hex key or torque wrench with a hex bit.
- 3 Adjust sheave to desired pitch diameter by turning the outer locking ring. Use a spanner wrench or drift inserted

into the three holes that are located 120° apart on the ring.

- 4 Any pitch diameter can be obtained within the sheave range. One complete turn of the outer locking ring changes the pitch diameter 0.233".
- 5 Do not open sheaves more than the following:
 - a Do not open **B** sheaves more than 4 3/4 turns for the **A** belts or 6 turns for the **B** belts.
 - b Do not open **C** sheaves more than 9 1/2 turns.
 - c Do not open **5V** sheaves more than 6 turns.
 - d Do not open **8V** sheaves more than 8 turns.
- 6 Tighten BOTH locking screws **A** in the outer locking ring before operating the drive. Use a torque wrench and tighten to the value shown in Table 17.
- 7 Replace belts and adjust the motor base to tension the belts properly. See Fan Drive Belt, page 26.
- 8 Do not loosen any screws other than the two locking screws **A** in the outer locking ring when adjusting the sheave pitch. Do not operate the drive until the locking screws have been set to the torque specifications.

Table 17: Screw Torque Values

Nominal screw size (dia—thds/in)	Socket head cap screws		Flat head socket screws	Hollow head set screws only			
	Seating torque		Seating torque	Lengths equal or greater than dia		For lengths (L) less than dia	
	(in-lbs)	(in-lbs)	(in-lbs)	Seating torque (in-lbs)	Seating torque (in-lbs)	Length (L) (in-lbs)	Seating torque (in-lbs)
1/4-20NC	150	12.5	100	87	7.3	3/16	50
5/16-11NC	305	25.4	200	165	13.8	1/4	90
3/8-16NC	545	45.4	350	290	24.2	1/4, 5/16	150, 250
1/2-13NC	1300	108.3	N/A	620	51.7	N/A	N/A
5/8-11NC	N/A	N/A	N/A	1225	102.1	N/A	N/A

Service and Maintenance

Figure 37: Sheave Adjustment

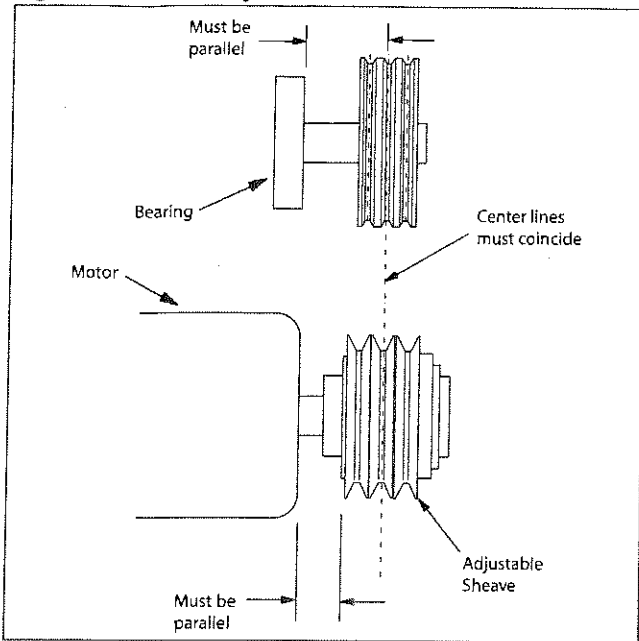
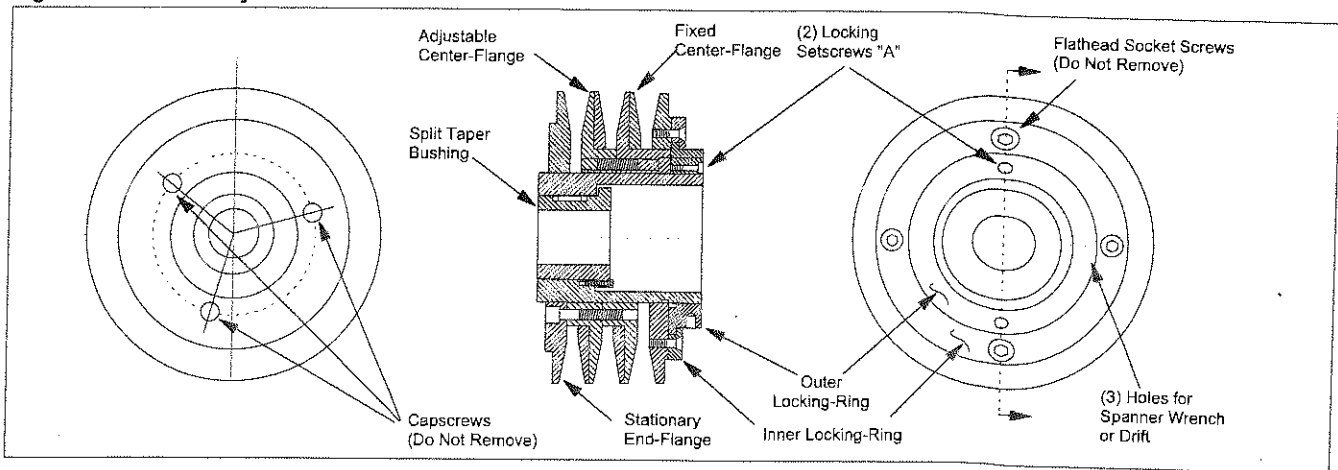


Figure 38: Sheave Adjustment



Fan Drive Belt

General Rules of Tensioning

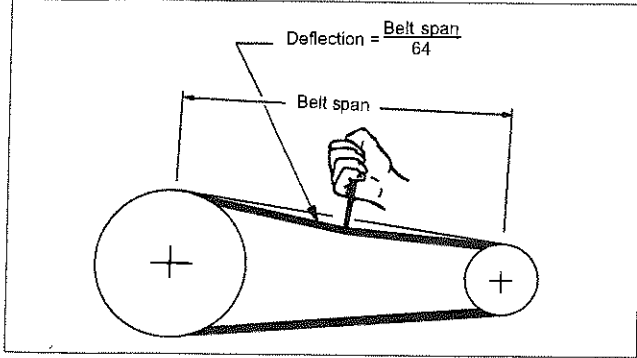
- 1 The ideal tension is the lowest tension at which the belt does not slip under peak load conditions.
- 2 Check tension frequently during the first 24 to 48 hours of operation.
- 3 Over tensioning shortens belt and bearing life.
- 4 Keep belts free from foreign material that can cause slippage.

- 5 Inspect V-drive on a periodic basis. Adjust tension if the belt is slipping. Do not apply belt dressing. This can damage the belt and cause early failure.

Tension Measurement Procedure

- 1 Measure the belt span. See Figure 39, page 27.
- 2 Place belt tension checker squarely on one belt at the center of the belt span. Apply force to the checker, perpendicular to the belt span, until the belt deflection equals belt span distance divided by 64. Determine the force applied while in this position.
- 3 Compare this force to the values in Belt Deflection Force (per Browning® specifications), page 27.

Figure 39: Drive Belt Adjustment



WARNING

Moving belt and fan can cause severe personal injury or death. During installation and filter maintenance:

- Verify that the belt and fan guards on plenum fan units are always in place.
- Lock and tag out fans to prevent accidental start up.
- Do not enter the filter compartment until the fan is completely stopped.
- Use approved equipment for reaching filters located above normal reach. Do not step on filter frames or unit components.
- Floor surfaces must be dry and free of oil or grease.

WARNING

Pendant l'installation et où l'entretien des filtres, une courroie en mouvement ou un ventilateur en opération peuvent causer des blessures graves où même causer la mort.

- S'assurer que les gardes de courroie et de ventilateur sont toujours en place.
- Verrouiller les démarreurs des ventilateurs et afficher un avis de mise-en-garde afin de prévenir tout accident ou démarrage.
- Attendre que le ventilateur soit complètement arrêté avant d'entrer dans l'unité.
- Utiliser seulement des équipements approuvé pour joindre les bancs de filtres; ne pas mettre soit sur les cadres des filtres ou même sur toutes composantes de l'unité.
- La surface des planchers doit être sec et libre de toute trace d'huile et où de graisse.

Table 18: Belt Deflection Force (per Browning® specifications)

Cross section	Sheave diameter (in)		Deflection force (lbs)			
	Smallest sheave diameter range	rpm range	Cross section A, B, 5V		Cross section AX, BX, 5VX	
			Used belt	New belt	Used belt	New belt
A, AX	3.0 to 3.6	1000 to 2500	3.7	5.5	4.1	6.1
		2501 to 4000	2.8	4.2	3.4	5.0
	3.8 to 4.8	100 to 2500	4.5	6.8	5.0	7.4
		2501 to 4000	3.8	5.7	4.3	6.4
	5.0 to 7.0	1000 to 2500	5.4	8.0	5.7	9.4
		2501 to 4000	4.7	7.0	5.1	7.6
B, BX	3.4 to 4.2	850 to 2500			4.9	7.2
		2501 to 4000			4.2	6.2
	4.4 to 5.6	860 to 2500	5.3	7.9	7.1	10.5
		2501 to 4000	4.5	6.7	7.1	9.1
	5.8 to 8.6	860 to 2500	6.3	9.4	8.5	12.6
		250 to -4000	6.0	8.9	7.3	10.9
5V, 5VX	4.4-6.7	500-1749			10.2	15.2
		1750-3000			8.8	13.2
		3001-4000			5.6	8.5
	7.1-10.9	500-1740	12.7	18.9	14.8	22.1
		1741-3000	11.2	16.7	13.7	20.1
	11.8-16.0	500-1740	15.5	23.4	17.1	25.5
1741-3000		14.6	21.8	16.8	25.0	

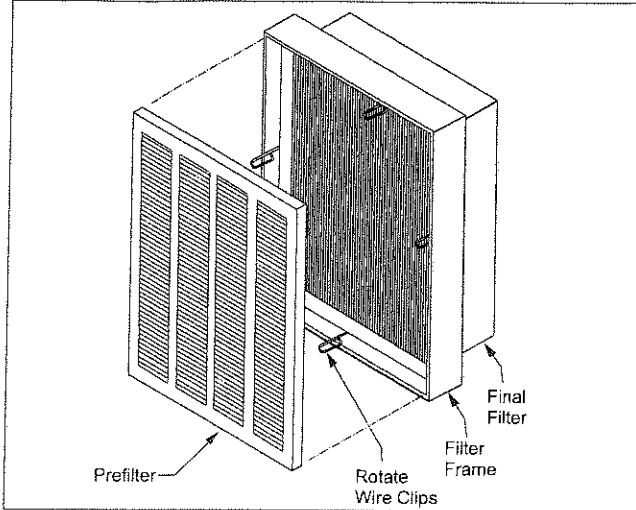
Service and Maintenance

Front Load Filter Option

Front loaded filter options require that the filters be removed and replaced from inside the unit.

To remove filters, rotate the wire clips. This releases both the prefilter and the final filter. When installing clean filters, check to verify the filters are fully seated in the frame (Figure 40).

Figure 40: Frame and Filters with Holding Clips



Filter Gauges

Filter gauges indicate pressure drop for installed filters.

Table 19 shows the typical filter pressure drop for clean filters at rated air flow. The tables also show a final pressure drop for front loaded filters.

Where a single filter gauge is used, the prefilters can be removed to check the pressure drop of the final filters.

Figure 41: Filter Gauge

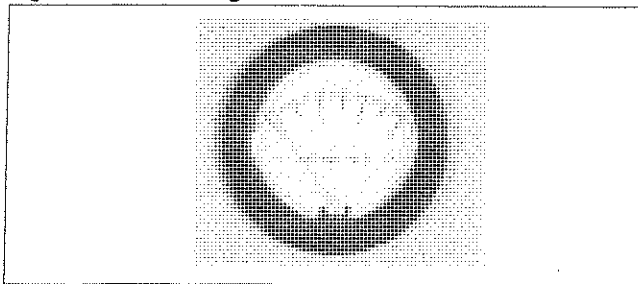


Table 19: Filter Pressure Drops

Bag filters—DriPak 2000				
Efficiency	45%	65%	85%	95%
Rated velocity (fpm)	625	500	500	500
Initial pressure drop	.20-.26	.21-.30	.34-.48	.50-.70
Final pressure drop	1.0	1.0	1.0	1.0
Cartridge filters—Varicel II MH, 4.25" deep				
Efficiency	65%	85%	95%	Efficiency
Rated velocity (fpm)	500	500	500	Rated velocity (fpm)
Initial pressure drop	.43	.61	.70	Initial pressure drop
Final pressure drop	1.5	1.5	1.5	Final pressure drop
Cartridge filters—Varicel SH, 12" deep				
Efficiency	70%			
Rated velocity (fpm)	500			
Initial pressure drop	.39			
Final pressure drop	1.2			
Pleated panel filters				
Type	Perfect pleat		AMAir 300 4"	
Efficiency	30%		30%	
Rated Velocity (fpm)	500		625	
Initial Pressure Drop	.36		.36	
Final Pressure Drop	1.0		1.0	
5700 filters				
Efficiency	N/A			
Rated velocity (fpm)	500			
Initial pressure drop	.25			
Final pressure drop	1.0			
Pleated 62 Plus filters				
Size	2"	4"		
Efficiency	70%	70%		
Initial pressure drop	.42	.37		
Final pressure drop	1.0	1.0		

Coils

- 1 The coil must be clean to obtain maximum performance. Check once a year under normal operating conditions and, if dirty, brush or vacuum clean. Use a chemical coil cleaner on multiple row coils. Read and follow the chemical cleaner's instructions as some cleaners may contain harsh chemicals. Take care not to damage fins while cleaning.
- 2 Drain pans in any air conditioning unit may have some moisture. Algae, etc., can grow due to airborne spores and bacteria. Periodic cleaning is necessary to prevent this buildup from plugging the drain and causing the drain pan to overflow. Also, keep the drain pans clean to prevent the spread of disease. Cleaning should be performed by qualified personnel.

- 3 Dirt and lint can clog the condensate drain, especially with dirty filters. Inspect twice a year to help avoid overflow.

Winterizing Water Coils

Coils can freeze due to air stratification or failure of outdoor air dampers and/or preheat controls. Do not depend on routine draining of water cooling coils for winter shutdown as insurance against freeze-up. Severe coil damage can result. Drain all coils as thoroughly as possible and then treat in the following manner.

- Fill each coil independently with an antifreeze solution using a small circulating pump and again thoroughly drain.
- Check freezing point of antifreeze before proceeding to next coil. Due to a small amount of water always remaining in each coil, there is a diluting effect. The small amount of antifreeze solution remaining in the coil must always be concentrated enough to prevent freeze-up.

Note: Carefully read instructions for mixing antifreeze solution used. Some products have a higher freezing point in their natural state when mixed with water. **McQuay International is not responsible for the freezing of coils.**

WARNING

Mold can cause personal injury. Clean drain pan regularly so mold does not develop.

AVERTISSEMENT

La moisissure présente un danger respiratoire. Pour éviter la moisissure, nettoyer régulièrement le bassin de drainage.

Removing and Replacing Components

See Access Doors and Panels, page 7 for instructions on removing panels and opening fan access doors to remove or replace components.

WARNING

Before removing any component, lock out and tag out all power to the unit. Fans and belts can cause severe personal injury or death.

AVERTISSEMENT

Avant d'enlever toute composante, couper et indiquer que l'alimentation électrique à l'unité est coupée. Les ventilateurs et les courroies peuvent entraîner des blessures personnelles graves ou même la mort.

Removing the Fan Section

The fan shaft, motor, and any drive components can be removed and replaced through the access door opening. If required, the side panel can be removed for additional access.

If fan replacement is required, the entire fan assembly can be pulled out the side of the cabinet. The fan assembly includes the fan housing, the bearing support, and the fan base.

Removing the Fan Assembly

- 1 Remove the side panels and any intermediate supports (follow instructions for side panel removal).
- 2 Once the panels and any intermediate supports are removed, disconnect the neoprene bulk head seal that is attached to the fan discharge.
- 3 Remove the four discharge angles that hold the neoprene canvas in place around the discharge opening.
- 4 Disconnect the fan sled from each of the corner mounts and pull the entire assembly out the side of the unit.
- 5 After the fan sled is out, loosen the fan bearings and pull out the shaft.
- 6 Disconnect the fan housing from the fan sled, and bearing support by removing the attaching bolts.
- 7 Replace the new fan, reconnect the shaft and bearings and put the fan assembly in the cabinet.
- 8 Replace panels and fasteners.

Removing and Replacing the Coil

Removing Single Coils

Note: Single coils are bolted to the unit on the connection end. The connection end is held in place with a clamp.

- 1 Disconnect all piping and remove the brass plugs for the vents and drains located in the connections.
- 2 Remove all screws and remove the access panel.
- 3 Remove the screws holding the coil in place.
- 4 Lift and pull the coil out the side.

Installing Single Coils

- 1 Slide the coil through the opening in the coil section onto the bottom coil rests.
- 2 To prevent any air bypass around the coil, place coils up against the coil bulkheads. See Single Coil Top Installation/Removal, page 30.
- 3 Once the coil is in place, fasten the coil to the section.
- 4 Caulk the seams between the coil casings and bulkheads.
- 5 If this is an additional coil being installed and not a replacement, locate the coil supply and return connections dimensionally. Carefully drill holes in the end panels of the unit.
- 6 Remove the brass plugs for the vents and drains on the connections.
- 7 Slip the panel over the connections.
- 8 Replace the brass plugs and panel fasteners.

Service and Maintenance

Figure 42: Single Coil Top Installation/Removal

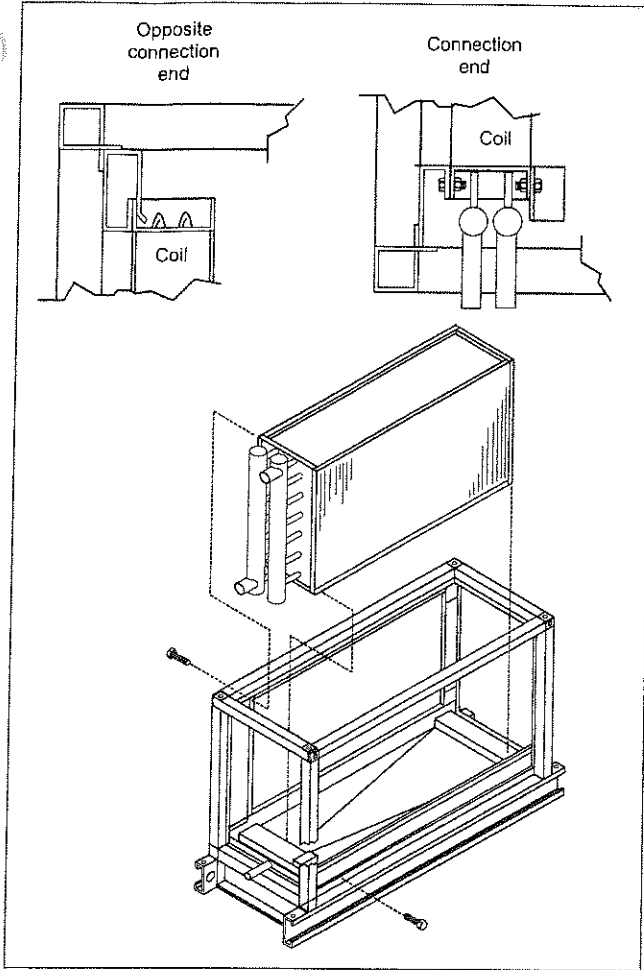
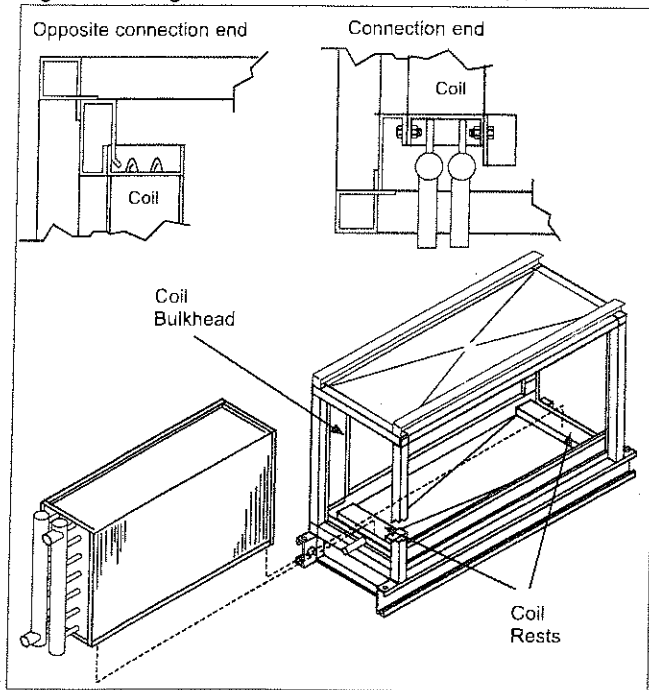


Figure 43: Single Coil Side Installation/Removal



Removing Stacked Coils

Note: Top and bottom stacked coils are held together with steel plate and screws on **one** side and drain trough and screws on the other **side**. Remove the plate and trough before removing the **coils**. The coils cannot be removed attached together.

- 1 Disconnect all piping and remove the brass plugs for the vents and drains located in the connections.
- 2 Remove all screws and remove the access panel.
- 3 Remove the bolts holding the coil in place and then lift and pull out the coil from the side.
- 4 Remove the steel plate and the drain trough that holds the coils together.
- 5 Remove the bolts on **both** ends of the top coil holding it in place and then lift and slide the coil out.
- 6 Remove the bolts on **both** ends of the bottom coil holding it in place and then lift and slide the coil out.

Installing Stacked Coils

- 1 Slide the bottom coil through the opening in the coil section onto the bottom coil rests.
- 2 Place the coil up against the coil bulkheads to prevent any air bypass around the coil.
- 3 Once the coil is in place, bolt the coil to the section.
- 4 Caulk the mounting surface of the steel plate and install the plate on the coils.
- 5 Caulk the mounting surface of the drain trough and install the drain trough on the coils.
- 6 Caulk the seams between the coil casings and blockoffs.
- 7 Connect all piping and install the brass plugs for the vents and drains located in the connections.
- 8 Install the access panel.

Removing and Installing Staggered Coils

Staggered coils have two banks of coils positioned a few inches apart in the direction of airflow. Both coils are secured to the unit on the connection and opposite connection end of the unit.

- 1 Disconnect all piping and remove the brass plugs for the vents and drains located in the connections.
- 2 To access bolts holding the coils in place, remove the panels on both the connection and opposite connection end of the coil section.
- 3 Each coil is held in place with bolts located in the corners of the coil side plates. Remove the bolts and then lift and pull the coil out the side.
- 4 The bottom coil is fastened to the air block off plate. Remove the screws attaching this plate to the coil.
- 5 Once the fasteners holding the coil in place are removed, pull out the coil from either side of the unit.
- 6 Install the coils in reverse order of removal.

Replacement Parts

When writing to McQuay for service or replacement parts, refer to the model number and serial number of the unit stamped on the serial plate attached to the unit. If replacement parts are required, mention the date of installation of the unit and date of failure, along with an explanation of the malfunctions and a description of the replacement parts required.

Service and Warranty Procedure

Warranty

Consult your local McQuay Representative for warranty details. Refer to Form 933-43285Y. To find your local McQuay Representative, go to www.mcquay.com.

Warranty Return Material Procedure

Defective material may not be returned without permission of authorized factory service personnel of McQuay International in Minneapolis, Minnesota, (763) 553-5330. A "Return Goods" tag must be included with the returned material. Enter the required information to expedite handling and prompt issuance of credits. All parts must be returned to the

appropriate McQuay facility, designated on the "Return Goods" tag. Transportation charges must be prepaid.

The return of the part does **not** constitute an order for replacement. Therefore, a **purchase** order must be entered through the nearest McQuay representative. The order should include part number, model number, and serial number of the unit involved.

Credit will be issued on customer's purchase order following an inspection of the return **part** and upon determination that the failure is due to faulty **material** or workmanship during the warranty period.

McQuay Training and Development

Now that you have made an investment in modern, efficient McQuay equipment, its care should be a high priority. For training information on all McQuay HVAC products, please visit us at www.mcquay.com and click on training, or call 540-248-9646 and ask for the Training Department.

Warranty

All McQuay equipment is sold pursuant to its standard terms and conditions of sale, including Limited Product Warranty. Consult your local McQuay Representative for warranty details. Refer to Form 933-43285Y. To find your local McQuay Representative, go to www.mcquay.com.

This document contains the most current product information as of this printing. For the most up-to-date product information, please go to www.mcquay.com.





**DAIKIN APPLIED AMERICAS INC.
LIMITED PRODUCT WARRANTY
(North America)**

Daikin Applied Americas Inc. dba Daikin Applied ("Company") warrants to contractor, purchaser and any owner of the product (collectively "Owner") that Company, at its option, will repair or replace defective parts in the event any product manufactured by Company, including products sold under the brand name Daikin and used in the United States or Canada, proves defective in material or workmanship within twelve (12) months from initial startup or eighteen (18) months from the date shipped by Company, whichever occurs first. Authorized replaced parts are warranted for the duration of the original warranty. All shipments of such parts will be made FOB factory, freight prepaid and allowed. Company reserves the right to select carrier and method of shipment.

In addition, labor to repair or replace warranty parts is provided during Company normal working hours on products with rotary screw compressors, centrifugal compressors and on absorption chillers. Warranty labor is not provided for any other products.

Company's liability to Owner under this warranty shall not exceed the lesser of the cost of correcting defects in the products sold or the original purchase price of the products.

PRODUCT STARTUP ON ABSORPTION, CENTRIFUGAL AND SCREW COMPRESSOR PRODUCTS IS MANDATORY and must be performed by a Daikin Applied or a Company authorized service representative.

It is Owner's responsibility to complete and return the Registration and Startup Forms accompanying the product to Company within ten (10) days of original startup. If this is not done, the ship date and the startup date will be deemed the same for warranty period determination, and this warranty shall expire twelve (12) months from that date.

EXCEPTIONS

1. If free warranty labor is available as set forth above, such free labor does not include diagnostic visits, inspections, travel time and related expenses, or unusual access time or costs required by product location.
2. Refrigerants, fluids, oils and expendable items such as filters are not covered by this warranty.
3. This warranty shall not apply to products or parts which (a) have been opened, disassembled, repaired, or altered by anyone other than Company or its authorized service representative; or (b) have been subjected to misuse, negligence, accidents, damage, or abnormal use or service; or (c) have been operated, installed, or startup has been provided in a manner contrary to Company's printed instructions, or (d) were manufactured or furnished by others and which are not an integral part of a product manufactured by Company; (e) have been exposed to contaminants, or corrosive agents, chemicals, or minerals, from the water supply source, or (f) have not been fully paid for by Owner.

ASSISTANCE

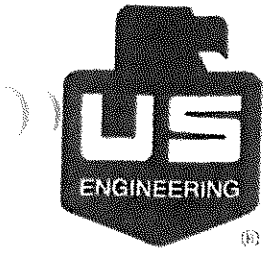
To obtain assistance or information regarding this warranty, please contact your local sales representative or a Daikin Applied office.

SOLE REMEDY

THIS WARRANTY CONSTITUTES THE OWNER'S SOLE REMEDY. IT IS GIVEN IN LIEU OF ALL OTHER WARRANTIES. THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT AND UNDER NO CIRCUMSTANCE SHALL COMPANY BE LIABLE FOR INCIDENTAL, INDIRECT, SPECIAL, CONTINGENT OR CONSEQUENTIAL DAMAGES, WHETHER THE THEORY BE BREACH OF THIS OR ANY OTHER WARRANTY, NEGLIGENCE OR STRICT LIABILITY IN TORT.

No person (including any agent, sales representative, dealer or distributor) has the authority to expand the Company's obligation beyond the terms of this express warranty or to state that the performance of the product is other than that published by Company.

For additional consideration, Company will provide an extended warranty(ies) on certain products or components thereof. The terms of the extended warranty(ies) are shown on a separate extended warranty statement.



Mod Outdoor Central
Station AHU Product
Submittal Information:
RTU-6

**BEATTIE
ELEMENTARY
SCHOOL**

3100 MEADOWLARK AVE
FORT COLLINS CO 80526



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
---	--	--

Date: 4/11/2014	Reference Number: 0042
------------------------	-------------------------------

Transmitted To: Chris Mallory US Engineering Co. P.O. Box 905 Loveland, CO 80539	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001 N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
--	---

Qty	Submittal Package No	Description	Due Date	Package Action
1	018 - 237323 - 0	Modular Outdoor AHU & Curb		Make Corrections Noted

Transmitted For	Delivered Via	Tracking Number
For Your Use and Corrections	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
001		Outdoor Air Handling Units - Product Data	237323		
002		Outdoor Air Handling Units - Source Quality Control Reports	237323		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

SUBMITTAL COMMENTS
 MODULAR OUTDOOR AIR HANDLING UNIT (Make Corrections Noted)

1. Contractor shall confirm engineer's measurements of unit, curb and opening locations prior to release of equipment. Final field coordination with existing conditions is the responsibility of the contractor.
2. Verify that manufacturer's startup is included per specification section 237323.3.5.
3. Provide stainless steel drain pan per the specifications.

_____ Signature	_____ Signed Date
Prolog Manager Printed on: 4/11/2014 FCI PM Data	Page 1

TRANSMITTAL



Belford Watkins Group
Architects

Date: 4.10.14

Project: Beattie Elementary

To: Rob Price/DJ Anderson

From: Patti Watkins

We are transmitting the following submittals with the comments listed below:

ARCHITECTURE

INTERIORS

PLANNING

NET: No Exception Taken
RR: Revise and Resubmit
CMT: See Comment Below

MCN: Make Corrections Noted
SSI: Submit Specified Item

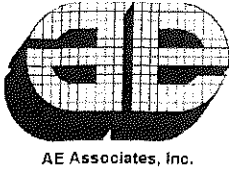
RX: Rejected

237323 Outdoor Air Handling Unit

Copies	Section	Item	Manufacturer	NET	MCN	RR	RX	SSI	CMT
1	237323	Product Data	Daikin						1

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures, there from. The Contractor remains responsible for details and accuracy, for conforming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

Notes: 1. Please see attached comments from AE



5587 W. 19th Street
Greeley, Colorado 80634
Phone 970.330.5587
Fax 970.330.3040

SUBMITTAL REVIEW COMMENTS

Date:	April 2, 2014	Specification Section:	237323
Project:	Beattie Elementary School	Submittal Description:	Modular Outdoor AHU
Project Location:	Fort Collins, Colorado	Date Received:	March 31, 2014
AEAI Project #	2013952.00	# Copies Received:	1 (via e-mail)
Mech. Contractor:	US Engineering	# Copies Returned:	1 (via e-mail)

Submittal Status: *Make Corrections Noted*

No Exception Taken	<input type="checkbox"/>	Make Corrections Noted	<input checked="" type="checkbox"/> *
Rejected	<input type="checkbox"/>	(* Resubmission not required)	
Submit Specified Item	<input type="checkbox"/>	Revise and Resubmit	<input type="checkbox"/>

CHECKING IS ONLY FOR GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE INFORMATION GIVEN IN THE CONTRACT DOCUMENTS. ANY ACTION SHOWN IS SUBJECT TO THE REQUIREMENTS OF THE PLANS AND SPECIFICATIONS. CONTRACTOR IS RESPONSIBLE FOR DIMENSIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE. FABRICATION PROCESSES AND TECHNIQUES OF CONSTRUCTION, COORDINATION OF HIS WORK WITH THAT OF ALL OTHER TRADES AND THE SATISFACTORY PERFORMANCE OF HIS WORK.

AE ASSOCIATES, INC.
CONSULTING ENGINEERS

Date: April 2, 2014 By: Alicia Thorpe, PE

This comment form is considered part of the referenced submittal review. All comments contained within shall be considered part of the submittal review for all copies of the submittal as if the comments were written on the submittal.

SUBMITTAL COMMENTS

MODULAR OUTDOOR AIR HANDLING UNIT *(Make Corrections Noted)*

- Contractor shall confirm engineer's measurements of unit, curb and opening locations prior to release of equipment. Final field coordination with existing conditions is the responsibility of the contractor.
- Verify that manufacturer's startup is included per specification section 237323.3.5.
- Provide stainless steel drain pan per the specifications.

END OF COMMENTS



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
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Date: 3/28/2014	Reference Number: 0026
------------------------	-------------------------------

Transmitted To: Don Watkins Belford Watkins Group P.O. Box 1306 Fort Collins, CO 80521 Tel: 970-212-1243	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001 N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
--	--

Qty	Submittal Package No	Description	Due Date	Package Action
1	018 - 237323 - 0	Modular Outdoor AHU & Curb	4/11/2014	

Transmitted For Review & Approval	Delivered Via Email	Tracking Number
---	-------------------------------	------------------------

Items	Qty	Description	Spec Section	Sub Section	Item Action
		Outdoor Air Handling Units - Product Data	237323		
		Outdoor Air Handling Units - Source Quality Control Reports	237323		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks
Please provide an Expedited Review of this submittal due to 7 week lead time.



4001 N. Valley Drive
 Longmont, CO 80504
 Phone: 970-535-4867
 Fax: 970-535-4867

DATE: 03/28/2014

SPECIFICATION SECTION(S): 237323
 SCOPE OF WORK: HVAC - Modular Outdoor AHU & Curb

PROJECT: Poudre School District – Beattie Elementary School

PROJECT #: 30-13-038

ARCHITECT/DESIGNER: Belford Watkins Group, LLC.
 425 West Mulberry Ave., Suite 207
 P.O. Box 1306
 Fort Collins, CO 80521

 PHONE: 970-407-0070

GENERAL CONTRACTOR: FCI CONSTRUCTORS, INC.
 4001 N. Valley Drive
 Longmont, CO 80504

 PHONE: 970-535-4725
 FAX: 970-535-4867

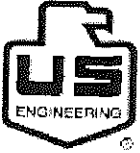
SUBMITTED BY: U.S. Engineering
 PO Box 905
 Loveland, CO 80539

 PHONE: 970-669-1666
 FAX:

CONTRACTORS STAMP:

ARCHITECT/ENGINEER STAMP

FCI CONSTRUCTORS, INC.	
Review of this submittal is subject to the provisions of the Contract Drawings and Specifications. This action is for general concurrence only.	
<input checked="" type="checkbox"/>	Reviewed
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmit with Corrections
<input type="checkbox"/>	DISAPPROVED RESUBMIT
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmittal not Required.
Submittal Reviewed By: DA	Date: 03/28/2014
Submittal No: 018	Spec. Section: 237323



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 80539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-022

Date: 3/18/2014

Revision #: _____

Discipline: Tinner

Project : Beattie Elementary

Project #: 1202

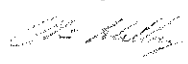
Supplier : Long Building Environments

Spec Sect: 23 73 23

Submitted Items:			
Page Number	Paragraph Number	Description	Manufacturer
23 73 23-3	2.1	Modular Outdoor AHU and Curb	Daikin Lead Time-7 weeks

Target Dates:				
Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
3/11/14	3/18/14	3/28/14		

GC/Arch/Engineer Stamp Area:

Signed: 
Chris Mallory

U.S. Engineering



SUBMITTAL DATA

for

BEATTIE ELEMENTARY

Sold to

US Engineering

Prepared for

Dave Richards

Prepared by

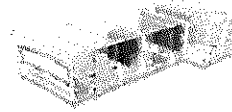
John Stumpf

3/5/2014

Technical Data Sheet for AHU-6

Job Information	Technical Data Sheet
------------------------	-----------------------------

Job Name: BEATTIE ELEMENTARY
Date: March 05 2014
Submitted By: DWK
Software Version: 10.11
Unit Tag: AHU-6



Model Number	Air Volume CFM	Air Pressure		Height ft	External Dimensions	
		External in	Total in		Width in	Length in

*Not including base rails, wall connections, sheet connections, unistrut included, control bases and hoods.

Unit

Model Number:	OAH022GBGM		
Approval:	ETL Listed / ETL Listed to Canadian Safety Standards (ETL Label / ETLc Label)		
Outer Panel:	Painted standard G60 Galvanized Steel		
Liner:	Galvanized Steel (unless noted per section)		
Insulation:	R-13 Injected Foam		
Unit Configuration:	Inline horizontal	Drive (Handling) Location:	Right
Base:	Curb ready	Wall Thickness:	2 in
Roof Curb Kit:	0 in	Shrink Wrapping:	Yes
Altitude:	5000 ft	Parts Warranty:	Standard One Year

Mixing Box	Component 1		Length: 26 in		Shipping Section: 1			
Portion	Damper		Location	Type	Rated CFM	Air Pressure Drop	Quantity	Hoods
	Size (length x width) Overall	Opening						
Outside Air	22 in x 82 in	18 in x 72 in	End	UltraSeal Low Leak	10000 cfm	0.09 insWg	1	None
Return Air	22 in x 82 in	18 in x 72 in	Bottom	UltraSeal Low Leak	10000 cfm		1	
Door								
Location				Width	Opening			
Drive side				22 in	Outward			

Technical Data Sheet for AHU-6

Panel Filter		Component: 2		Length: 30 in		Shipping Section: 1	
Type	Efficiency	Face Velocity	Face Area	Air Volume	Filter Loading		
Pleated	MERV 8	252 ft/min	39.7 ft ²	10000 cfm	Side		
Air Pressure Drop		Number of Filters		Height	Width	Depth	
Clean Air	Mean Air	Dirty Air					
0.13 inWc	0.57 inWc	1.00 inWc	3	24 in	24 in	2 in	
			9	24 in	20 in	2 in	
Door							
Location				Width		Opening	
Drive side				26 in		Outward	
Special Options							
Special Text							
Intersept Antimicrobial treatment							

Access Section		Component: 3		Length: 40 in		Shipping Section: 1	
Air Pressure Drop							
0.00 inWc							
Door							
Location				Width		Opening	
Drive side				30 in		Outward	

Supply Fan		Component: 4		Length: 46 in		Shipping Section: 2			
Fan Performance									
Air Volume	External	Static Pressure	Cabinet	Brake Horsepower	Operating	Speed	Outlet Velocity		
10000 cfm	1.45 inWc	3.33 inWc	0.00 inWc	7.88 BHP	1709 rpm	2183 rpm	0 ft/min		
Fan Data									
Fan Type	Blade Type / Class	Quantity of Fans	Wheel Diameter	Material Type	Number of Blades	Discharge	Motor Location		
Centrifugal - Plenum	Airfoil / 2	1	24.50 in	Aluminium	12	Axial	Behind Fan		
Motor Data									
Power	Electrical Supply	Speed	Efficiency	Enclosure	Frame Size	Supplier	Number of Poles	Lock Rotor Current	Full Load Current
10.0 HP	200/60/3 V/Hz/Phase	1750 rpm	Premium	ODP	215 T frame	Generic	4	179.13 A	26.92 A

Fan Options							
Wheel Guard:	Provided			Shaft Grounding Kit:	Provided		
Isolator Type:	Spring						
VFD/Starter/Disconnect Data							
Selection Type:	External J-Box - NEMA 1				Vendor:	Factory Standard	
Voltage:	200 v				Height x Width x Depth:	4.00 in x 6.00 in x 6.00 in	
Mounting:	Door Side				Enclosure:	NEMA 3R	
Door							
Location				Width		Opening	
Drive side				30 in		Outward	

Access Section		Component: 5		Length: 26 in		Shipping Section: 2	
Air Pressure Drop							
0.00 inWc							
Door							
Location				Width		Opening	
Drive side				22 in		Outward	

Technical Data Sheet for AHU-6

Hot Water Coil		Component: 6			Length: 32 in		Shipping Section: 3	
Coil Model	Total Capacity	Number of Coils		Number of Rows	Fins per Inch	Tube Diameter	Tube Spacing (Face x Row)	
5WB1101C	208575 Btu/hr	1		1	11	0.625 in	3.00 in x 1.299 in	
Air Volume	Air Temperature		Coil Air Pressure	Finned Height	Finned Length	Face Area	Face Velocity	
	Entering	Leaving	Drop					
10000 cfm	47.6 °F	70.6 °F	0.15 inWc	42 in	70 in	20.42 ft²	490 ft/min	
	Dry Bulb	Dry Bulb						
	Fluid	Flow Rate	Pressure Drop	Velocity	Volume	Weight	Piping Vestibule	
Entering	Leaving							
180.0 °F	139.0 °F	10.70 gpm	0.90 ftHd	1.60 ft/s	3.0 gal	29.00 lb	30 in	
Type	Quantity	Connection		Material	Glycol Type	Min. Fin Surface Temp.	Min. Tube Wall Surface Temp.	Fouling Factor
		Size	Location					
Threaded	2	1.50 in	Drive side	Carbon steel	Propylene (30%)	139.0 °F	139.0 °F	0.000
		Material		Header	Case			
Fin		Tube		Copper	Galvanized track			
Aluminum .0075 in		Copper .020 in						

AHRI 410 Certification



Certified in accordance with the AHRI Forced-Circulation Air-Cooling and Air-Heating Coils Certification Program which is based on AHRI Standard 410 within the Range of Standard Rating Conditions listed in Table 1 of the Standard. Certified units may be found in the AHRI Directory at www.ahridirectory.org

Door		
Location	Width	Opening
Drive side	22 in	Outward

Chilled Water Coil		Component: 7			Length: 28 in		Shipping Section: 3	
Coil Model	Total Capacity	Sensible Capacity	Number of Coils		Number of Rows	Fins per Inch	Tube Diameter	Tube Spacing (Face x Row)
5WH1212B	125543 Btu/hr	125543 Btu/hr	1		12	12	0.625 in	1.50 in x 1.299 in
Air Volume	Air Temperature		Coil Air Pressure		Finned Height	Finned Length	Face Area	Face Velocity
	Entering	Leaving	Drop					
	Dry Bulb	Wet Bulb	Dry Bulb	Wet Bulb				
10000 cfm	80.0 °F	61.0 °F	66.2 °F	56.4 °F	1.05 inWc	42 in	73 in	21.29 ft²
	Dry Bulb							
	Fluid	Flow Rate	Pressure Drop	Velocity	Volume	Weight	Piping Vestibule	
Entering	Leaving							
62.0 °F	73.7 °F	22.50 gpm	7.50 ftHd	1.70 ft/s	32.0 gal	273.00 lb	30 in	
Type	Quantity	Connection		Material	Glycol Type	Min. Fin Surface Temp.	Min. Tube Wall Surface Temp.	Fouling Factor
		Size	Location					
Threaded	2	2.00 in	Drive side	Carbon steel	Propylene (30%)	62.0 °F	62.0 °F	0.000
		Material		Header	Case	Drain Pan	Drain Side	
Fin		Tube		Copper	Galv. steel	Microbial resistant coated galvanized	Opp drive side	
Aluminum .0075 in		Copper .020 in						

AHRI 410 Certification

Coil is NOT certified by AHRI

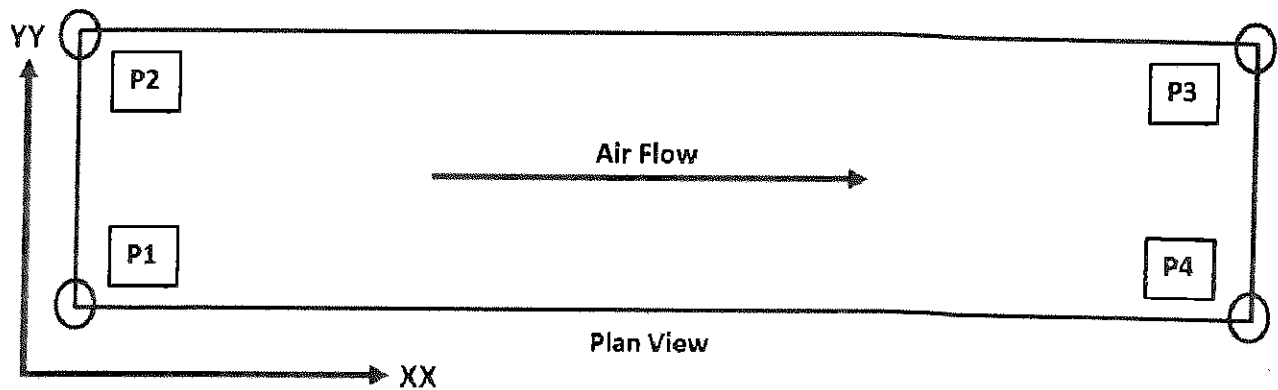
Door		
Location	Width	Opening
Drive side	- in	Outward

Technical Data Sheet for AHU-6

Plenum Section	Component: 8	Length: 28 in	Shipping Section: 3
Opening Location	Opening Size		Air Pressure Drop
Bottom	24.00" x 82.00"		0.02 inWc
Door			
Location	Width		Opening
Drive side	24 in		Outward

Unit Sound Power (dB)								
Type	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Radiated:	72	68	75	63	63	58	44	35
Unit Discharge:	80	76	82	79	82	80	77	69
Unit Return:	77	75	89	79	78	78	75	68

Shipping Section Details									
Section	Length in	Weight lb	Corner Weights (lb)				Center of Gravity (in)		
			P1	P2	P3	P4	XX	YY	ZZ
1	96	1474	390	390	347	347	45	43	29
2	72	1376	408	408	280	280	29	43	26
3	88	2451	651	602	576	623	43	41	29
4	60	346	86	86	86	86	30	15	29
Entire Unit	256	5647	1333	1092	1450	1771	146	39	28



NOTE: Piping vestibule shipping section length(s) not included in the total shipping section length.

NOTE: Special components aren't included in the corner weights and center of gravity data.

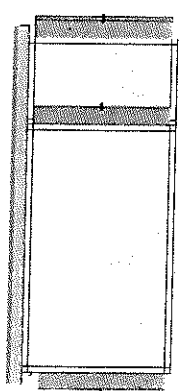
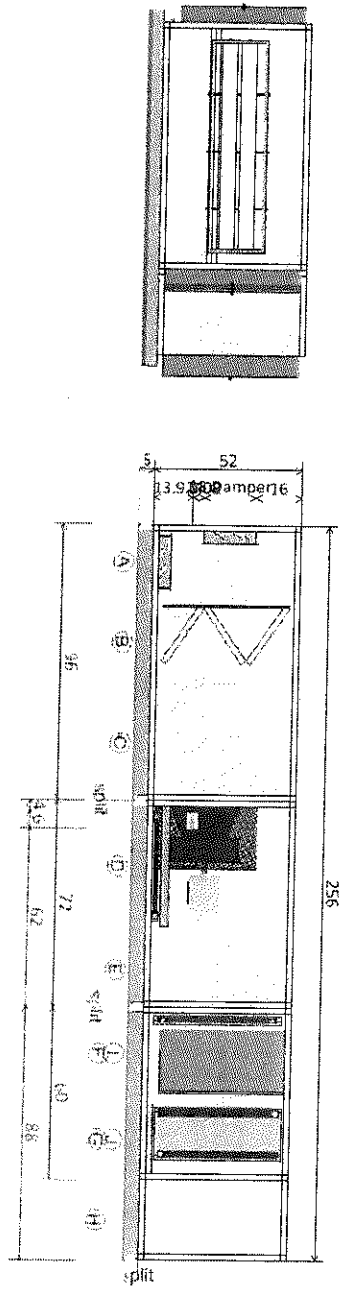
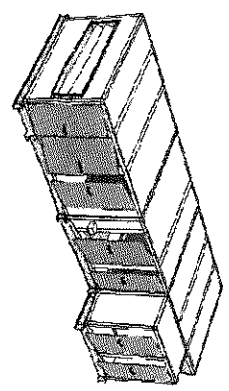
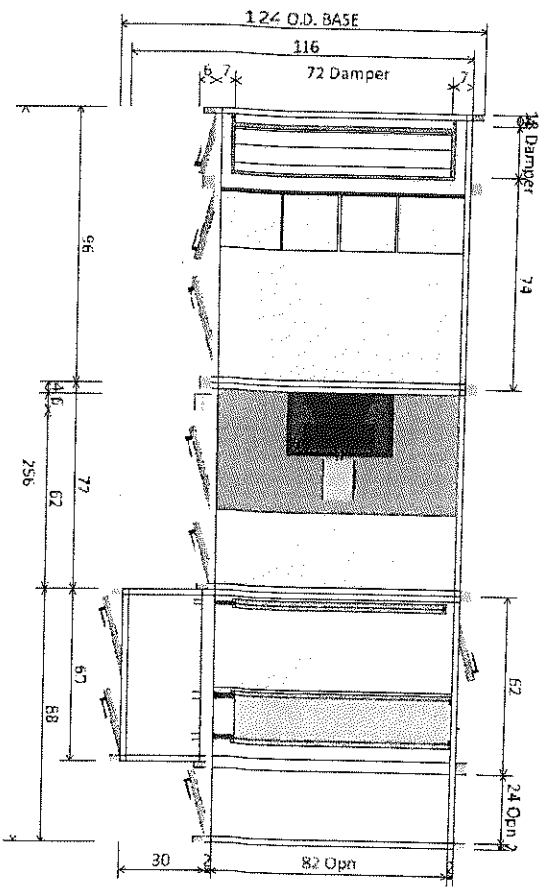
AHRI Certification

The air-handler is selected outside of the scope of AHRI 430

Notes

Standard

1. As a standalone component, unit meets or exceeds requirements of ASHRAE 90.1 - 2007. The approving authority is responsible for compliance of multi-component building systems.



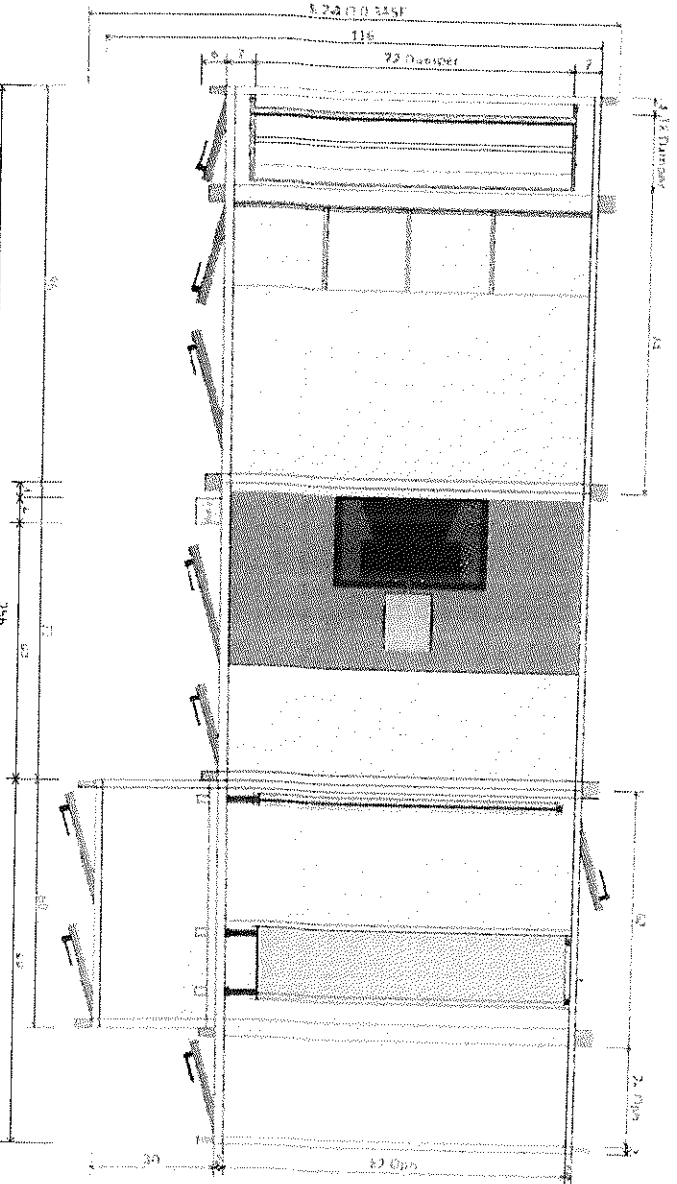
Product: Skyline Air Handler
 Model: OAH022GBGM

Unit Tag: AHU-6
 Project Name: SEATTLE ELEMENTARY
 Mar 3, 2014
 Ver/Rev:

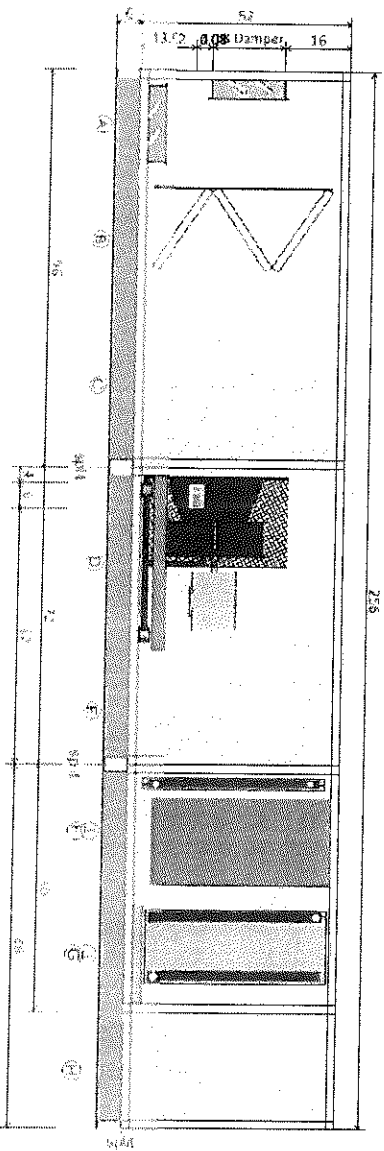
Sales Office:
 Sales Engineer:
 KCR-NIS
 Elevator: +/- 25"
 3/4" Split

DAKIM
 13500 Industrial Park Blvd, Morehead, VA 24441
 www.DakimAppl.com Software Version: 10.11

Prepared Date:



PLAN VIEW



ELEVATION VIEW

Product Drawing		Unit Tag: AHU-6		Sales Office:	
Product: Skyline Air Handler		Project Name: BEATTIE ELEMENTARY		Sales Engineer:	
Model: OAH022GBGM		Mar 5, 2014		Ver/Rev:	
		Sheet: 1 of 1		Scale: NTS	
				Tolerance: +/- .025"	
				Dwg. Units: in	

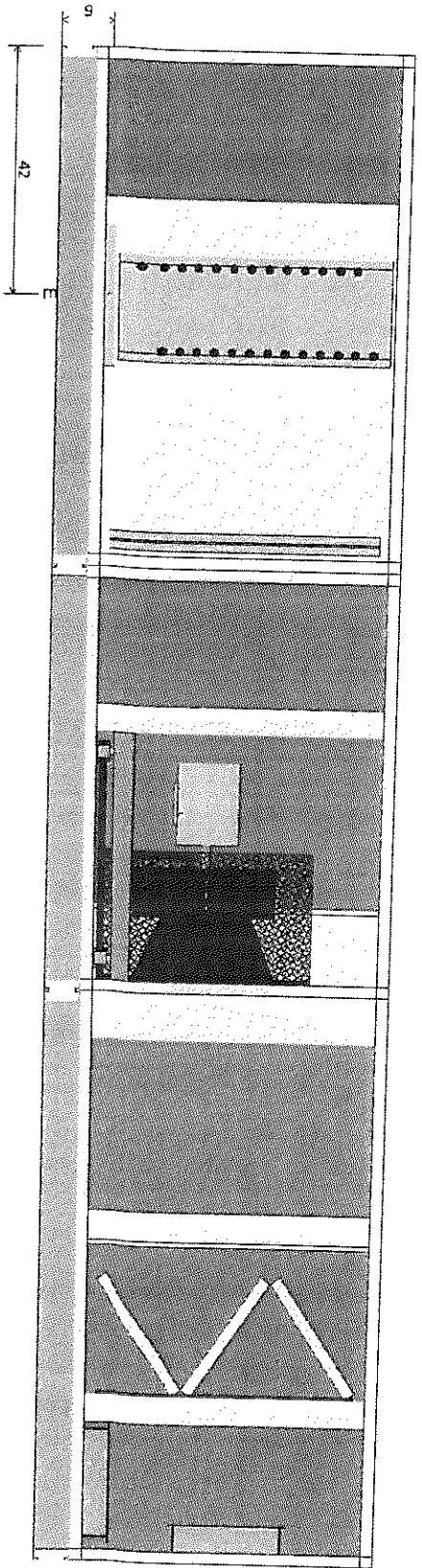
Component Key

- A. Mixing Box
- B. Right door width: 22 ins
- C. Panel Filter
- D. Filter Type: Pleated (WEFV S)
- E. Right door width: 26 ins
- F. Access Section
- G. Right door width: 30 ins
- H. Fan Type: Centrifugal - Plenum
- I. Fan Size (Class): 24 (2)
- J. Air Flowrate: 10000 cfm
- K. Motor Power: 3.33 insW/g
- L. Motor Power: 10 HP
- M. Right door width: 30 ins
- N. Access Section
- O. Right door width: 22 ins
- P. Hot Water Coil
- Q. Coil Model: 5W/B1101C
- R. Total Capacity: 208575 Btu/hr
- S. Left door width: 22 ins
- T. Chilled Water coil
- U. Coil Model: 5W/H1212B
- V. Total Capacity: 125543 Btu/hr
- W. Plenum Section
- X. Opening Location: Bottom
- Y. Opening Size: 24 ins x 82 ins
- Z. Right door width: 24 ins
- AA. Vestibule Section
- AB. Right door width: 28 ins
- AC. Vestibule Section
- AD. Right door width: 24 ins

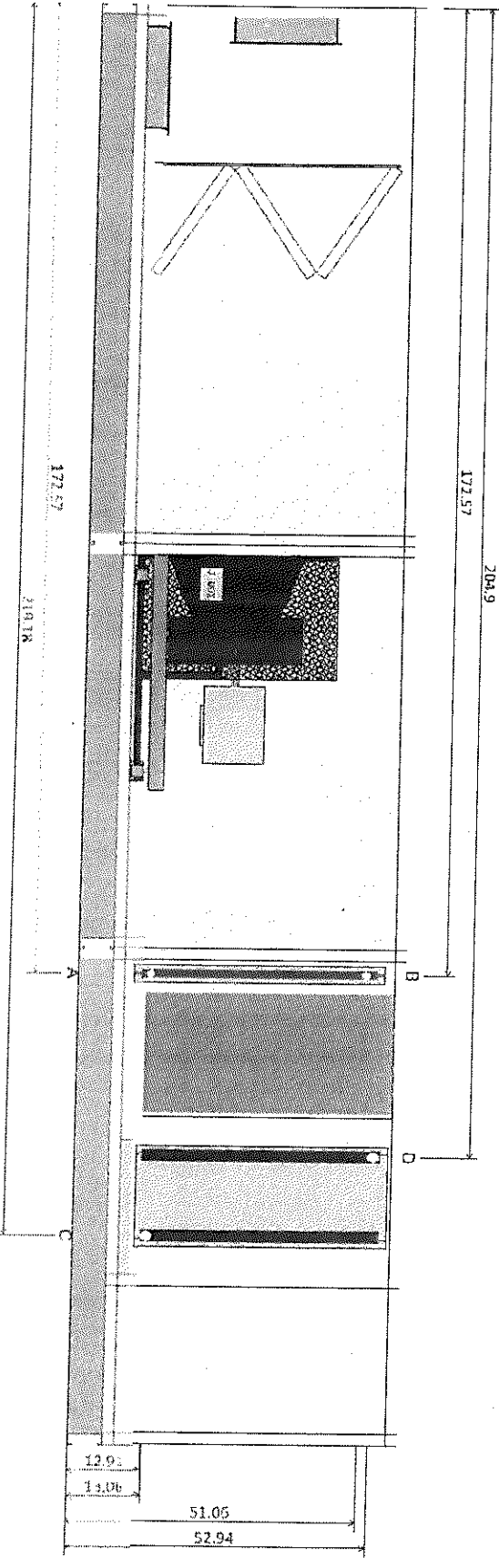
Curb Ready Base 5" deep, Lifting lugs extend 4" on each side of the unit.



1360 Industrial Park Blvd, Minneapolis, MN 55441
 www.DaikinApplied.com



LEFT ELEVATION VIEW



RIGHT ELEVATION VIEW

Unit Connections		Unit Tag: AHU-6		Project Name: BEATTIE ELEMENTARY		Spec: 1 of 1		Scale: R/S		Tolerance: +/- 0.25"		Orig. Units: in	
Product: Skyline Air Handler		Project Name: BEATTIE ELEMENTARY		Mar 5, 2014		Var/Rev		Sales Office:		DAIKIN		13620 Industrial Park Blvd, Minneapolis, MN 55441	
Model: OAH022GB8GM		Project Name: BEATTIE ELEMENTARY		Mar 5, 2014		Var/Rev		Sales Engineer:		www.DaikinApplied.com		2/5/2014	

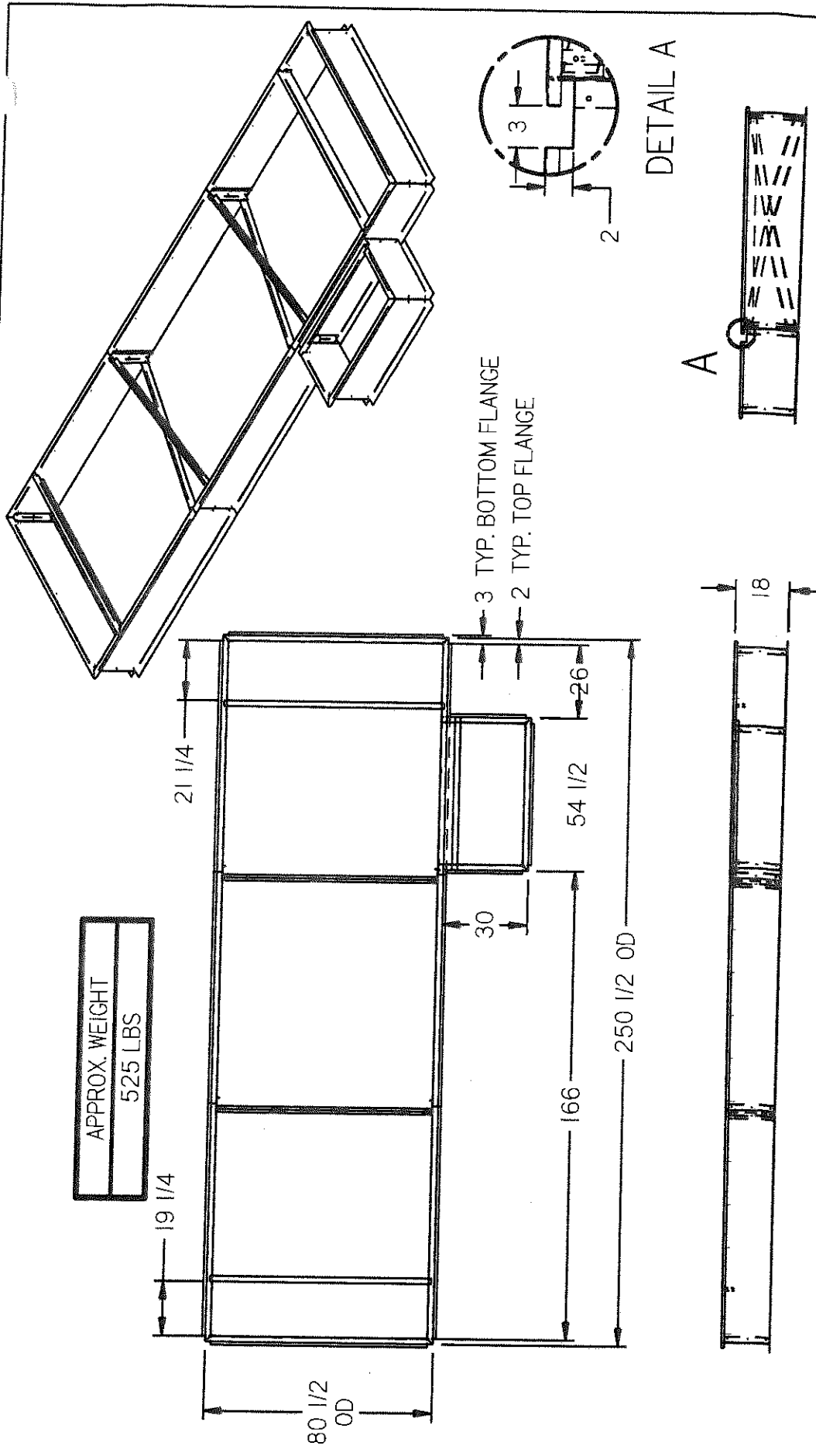
Prepared Date:

Date: 2/5/14

Job Number: R20002
 Job Name: BEATTIE ELEMENTARY

DAIKIN
 13620 Industrial Park Blvd, Minneapolis, MN 55441
 www.DaikinApplied.com

Roof Curb Data



NOTES:

1. CURB SHIPPED IN PIECES FOR FIELD ASSEMBLY
2. CURB MUST BE INSTALLED SQUARE AND LEVEL
3. MATERIAL IS GALVANIZED 14ga STEEL
4. FACTORY INSTALLED P.T. 2x4 WOOD NAILER
5. SUPPLIED WITH 1-1/2x1/4" CLOSED CELL NEOPRENE GASKET

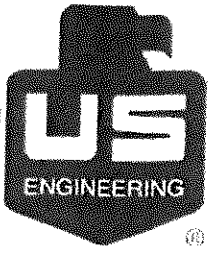


QUANTITY: 1
 DIMENSIONS: INCHES
 DRAWN BY TBB

CURB TECHNOLOGIES™

PROJECT: PSD Beattie (140305-TG16)
 UNIT TAG: AHU-6
 MODEL: MQ_OAH022GBGM

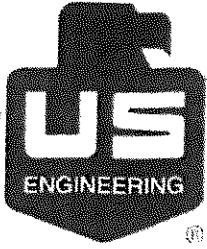
Rev. 00 3/5/14



Tab-10
Specification Section: 23 74 33
Packaged, Outdoor, Heating
and Cooling MAU:
MAU-1 (Captive Aire)

**BEATTIE
ELEMENTARY
SCHOOL**

3100 MEADOWLAKE AVE
FORT COLLINS, CO 80526

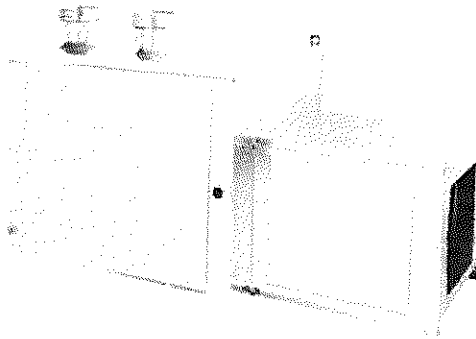


Packaged, Outdoor,
Heating and Cooling
MAU (Captive Aire)
O&M and Warranty
Information:
MAU-1

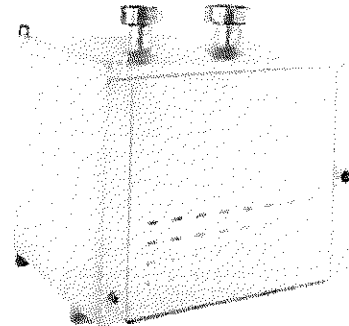
**BEATTIE
ELEMENTARY
SCHOOL**

1000 MEADOWLARK AVE
FORT COLLINS CO 80526

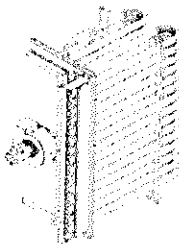
Modular In-Direct Fired Heaters and Inserts Installation, Operation, and Maintenance Manual



Modular In-Direct Fired Heater



In-Direct Fired Module



In-Direct Fired Furnace

FOR YOUR SAFETY

1. If you smell gas.
2. Open windows.
3. Don't touch electrical switches.
4. Extinguish any open flames.
5. Immediately call your gas supplier.

FOR YOUR SAFETY

The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.

RECEIVING AND INSPECTION

Upon receiving unit, check for any interior and exterior damage, and if found, report it immediately to the carrier. Also check that all accessory items are accounted for and are damage free. Turn the blower wheel by hand to verify free rotation and check the damper if supplied for free operation.

WARNING!

Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment. ALWAYS disconnect power and gas prior to working on heater.

Save these instructions. This document is the property of the owner of this equipment and is required for future maintenance. Leave this document with the owner when installation or service is complete.

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WARRANTY

This equipment is warranted to be free from defects in materials and workmanship, under normal use and service, for a period of 12 months from date of shipment. All Heat Exchangers have a standard 10 year Pro-rated manufacturer-backed warranty. This warranty shall not apply if:

1. The equipment is not installed by a qualified installer per the MANUFACTURER'S installation instructions shipped with the product,
2. The equipment is not installed in accordance with federal, state and local codes and regulations,
3. The equipment is misused or neglected,
4. The equipment is not operated within its published capacity,
5. The invoice is not paid within the terms of the sales agreement.

The MANUFACTURER shall not be liable for incidental and consequential losses and damages potentially attributable to malfunctioning equipment. Should any part of the equipment prove to be defective in material or workmanship within the 12-month warranty period, upon examination by the MANUFACTURER, such part will be repaired or replaced by MANUFACTURER at no charge. The BUYER shall pay all labor costs incurred in connection with such repair or replacement. Equipment shall not be returned without MANUFACTURER'S prior authorization and all returned equipment shall be shipped by the BUYER, freight prepaid to a destination determined by the MANUFACTURER.

INSTALLATION

It is imperative that this unit is installed and operated with the designed airflow, gas, and electrical supply in accordance with this manual. If there are any questions about any items, please call the service department at 1-866-784-6900 for warranty and technical support issues.

Mechanical

WARNING: DO NOT RAISE VENTILATOR BY THE INTAKE HOOD, BLOWER OR MOTOR SHAFT, OR BEARINGS – USE LIFTING LUGS PROVIDED OR A SLING

Site Preparation

1. Provide clearance around installation site to safely rig and lift equipment into its final position. Supports must adequately support equipment. Refer to manufacturer's estimated weights.
2. Consider general service and installation space when locating unit.
3. Locate unit close to the space it will serve to reduce long, twisted duct runs.
4. Do not allow air intake to face prevailing winds. Support unit above ground or at roof level high enough to prevent precipitation from being drawn into its inlet. The inlet must also be located at least 10 feet away from any exhaust vents. The heater inlet shall be located in accordance with the applicable building code provisions for ventilation air.

CLEARANCES
The top, back, and front surfaces of this heater may not be installed less than 6" from combustible materials. The heater base may be installed on combustible surfaces. Allow 24" minimum service clearance on both sides of the heater.

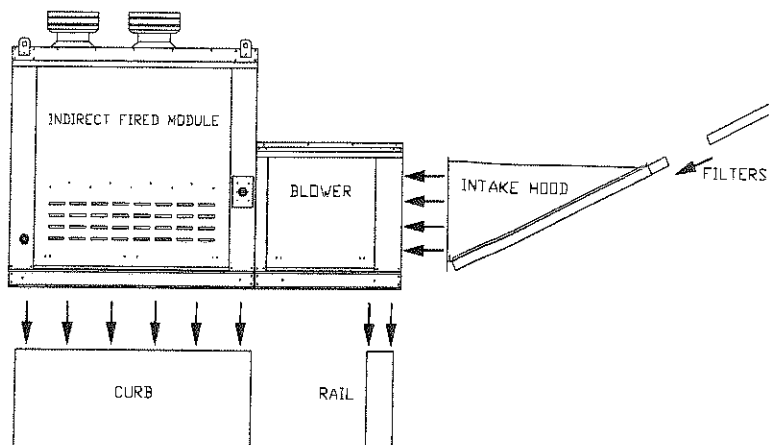
IMPORTANT
To prevent premature heat exchanger failure, do not locate any gas fired unit in areas where chlorinated, halogenated, or acid vapors are present in the atmosphere.

Assembly

Intakes and curbs are shipped unassembled to heater module. Upon unit arrival, use the following procedure to assemble the intake to the heater.

1. Apply silicone or weather-proof gasket on the back side of the flanges of the intake hood or v-bank intake.
2. Screw the flanges of the intake hood or v-bank to the unit with the supplied sheet metal screws.

Place caulk on the outside of the screws to prevent water leaks. If the unit is a modular unit with a v-bank or evaporative cooler section, the v-bank or evaporative cooler will bolt to the heater with the bolts provided.



Curb and Ductwork

This fan was specified for a specific CFM and static pressure. The ductwork attached to this unit will significantly affect the airflow performance. Flexible ductwork

and square elbows should not be used. Also, transitions and turns in ductwork near the fan outlet will cause system effect and will drastically increase the static pressure and reduce airflow. The chart below shows the minimum fan outlet duct sizes and straight lengths recommended for optimal fan performance. **Follow SMACNA guides and recommendations for the remaining duct run.** Fans designed for rooftop installation should be installed on a prefabricated or factory built roof curb. Follow

Recommended Supply Ductwork Sizes

Blower Size	Duct Size	Straight Duct Length
10	14 x 14	48 in.
12	16 x 16	54 in.
15	20 x 20	72 in.
18	24 x 24	86 in.
20	26 x 26	108 in.
25	32 x 32	168 in.

curb manufacturer's instructions for proper curb installation. The unit should be installed on a curb and/or rail elevated not less than 20" above any surface. Be sure duct connection and fan outlet are properly aligned and sealed. Secure fan to curb through vertical portion of the ventilator base assembly flange using a minimum of eight (8) lug screws, anchor bolts, or other suitable fasteners (not furnished). Shims may be required depending upon curb installation and roofing material. Check all fasteners for tightness. The diagrams below show different mechanical installation configurations.

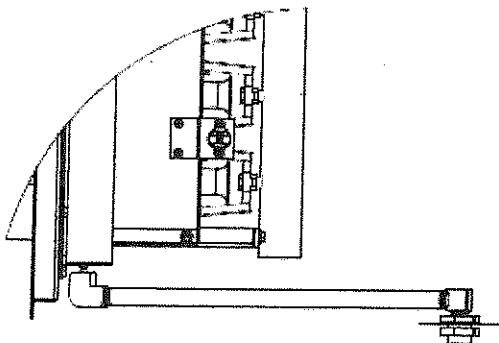
Condensation Drain

In some applications, condensation can form in the flue collection box, especially when furnaces are located downstream of cooling coils. In the event that condensation occurs in the flue collection boxes, there are barbed fittings in the bottom of the flue collection boxes to drain condensation out of the boxes. Each burner in the unit is provided with a burner drain pan or a condensation drain assembly located underneath this fitting for the condensation to collect. If the drain assembly is installed on the heater, it will have 1/4" quick seals located below the front access door for field piping or drainage onto the roof. Consult your local code as to the proper drainage regulations of the condensation. The internal drain piping is heated to prevent freezing. If drains are field piped, ensure that the field piping is piped in a fashion to prevent the condensation from freezing. Do not plug the holes under any circumstance as it will cause the burners to overflow.

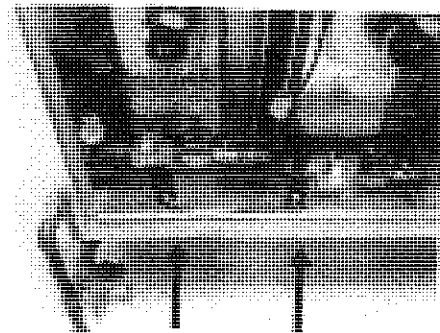
In the event the IBT does not have condensation drains and condensation exceeds the pan capacity, IBT condensation drain kits can be ordered for installation in the field.

The part names for the kits are:

- "IBT Condensation Kit-1" Single Furnace IBT
- "IBT Condensation Kit-2" Double Furnace IBT
- "IBT Condensation Kit-3" Triple Furnace IBT
- "IBT Condensation Kit-4" Quadruple Furnace IBT

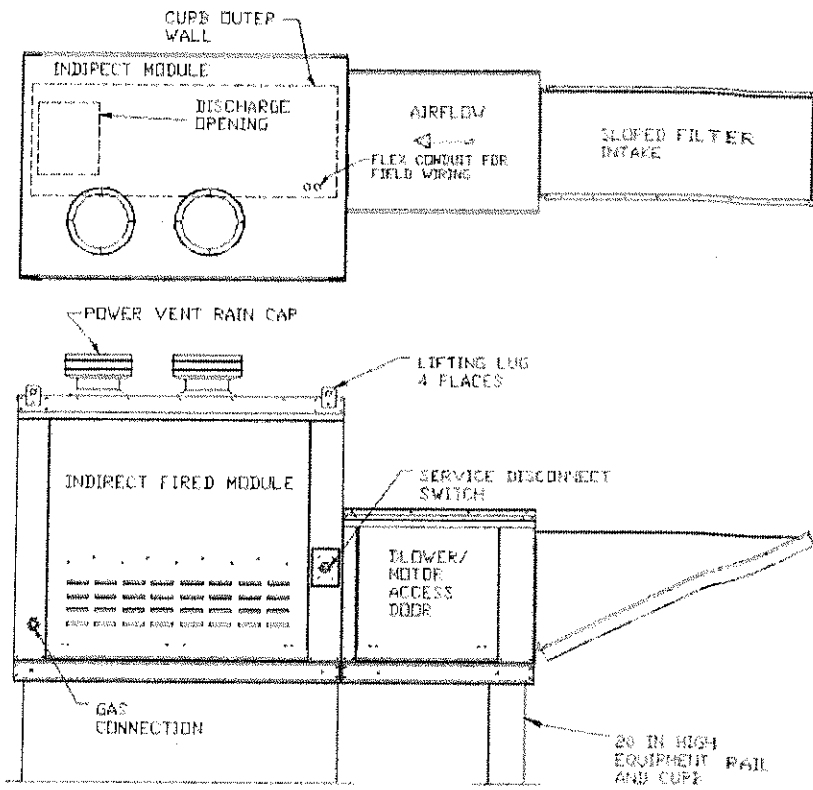


IBT Condensation Drain Assembly

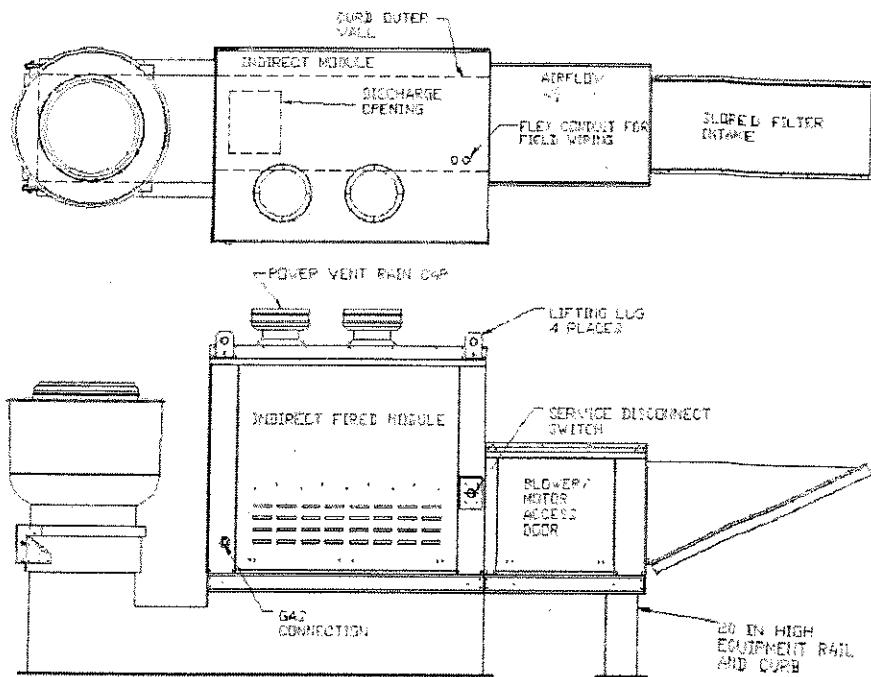


1/4" NPT Condensation Drain Connections

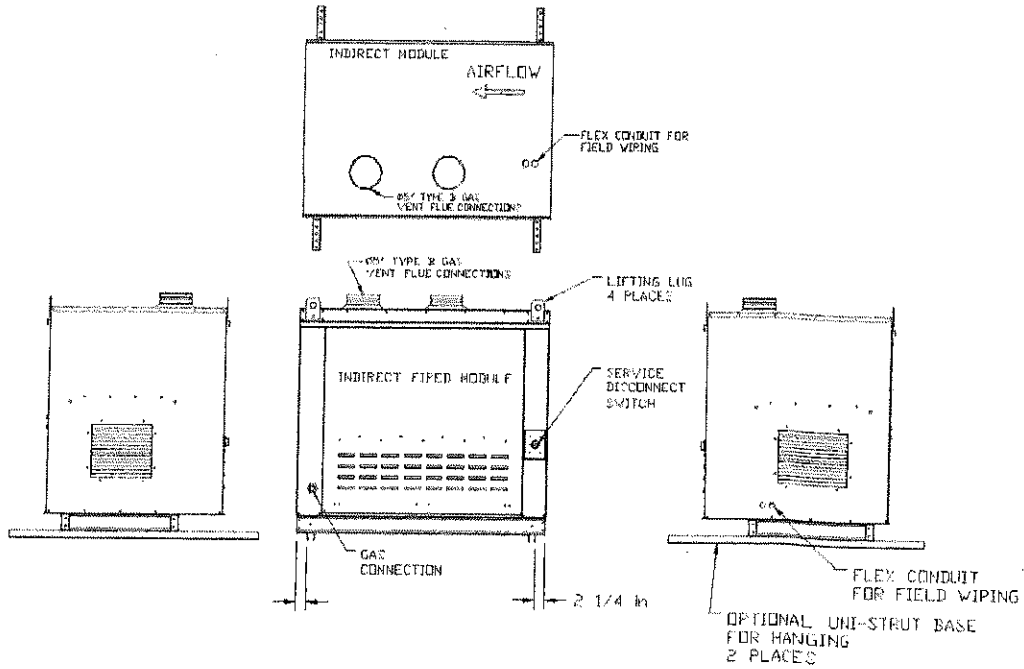
Roof Mount Installation



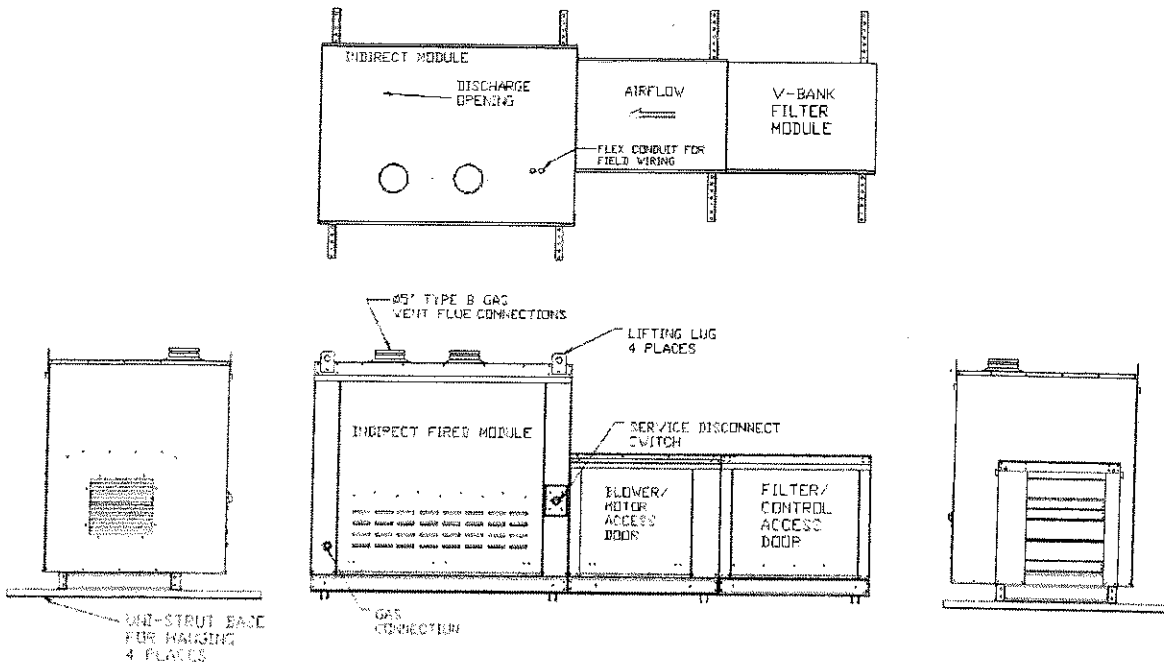
Installation with Exhaust Fan



Indirect Fired Module Installation

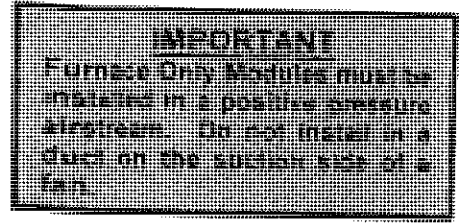


Indoor (INLINE) Installation



Indoor Flue Venting

Indoor gas fired heating equipment must be vented. **Do not operate un-vented.** Gas fired heating equipment which has been improperly vented, or which experiences a blocked vent condition may emit flue gases into heated spaces.

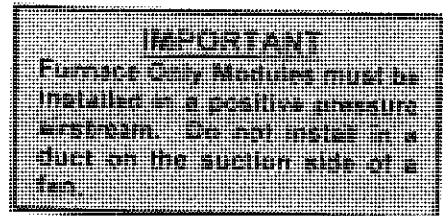


General Venting Guidelines

1. Installation of venting must conform with local building codes, or in the absence of local codes, follow the National Fuel Gas Code.
2. **On Units with multiple furnaces, each furnace must be ducted to the outside using its own isolated duct run. Ducts used on each single furnace must Not be Connected together in any fashion. Failure to adhere to this may result in a build-up of Carbon-Monoxide in the space when the furnace is operating with less than all of its furnaces powered.**
3. Do not use a vent pipe smaller than the size of the outlet on the heater.
4. Install with a minimum upward slope from unit of $\frac{1}{4}$ inch per foot and suspend from overhead structure at points no greater than 3 feet apart. For best venting, put as much vertical vent as close to the unit as possible.
5. Fasten individual lengths of vent together with at least three corrosion resistant sheet metal screws.
6. Vent pipes should be fitted with a tee with a drip leg and clean out tap at the low point in the vent run. This should be inspected and cleaned out periodically during the heating season.
7. Do NOT use dampers or other devices in the vent or combustion air pipes.
8. Use a vent terminal to reduce downdrafts and moisture in the vent line.
9. A vent system that terminates vertically but has a horizontal run that exceeds 75% of the vertical rise is considered horizontal.
10. Pressures in Category III venting systems are positive and therefore care must be taken to prevent flue products from entering the heated space. Use only venting materials and components that are UL listed and approved for Category III venting systems.
11. Vent pipes must all be sealed and gastight.

Vertically Vented Furnaces

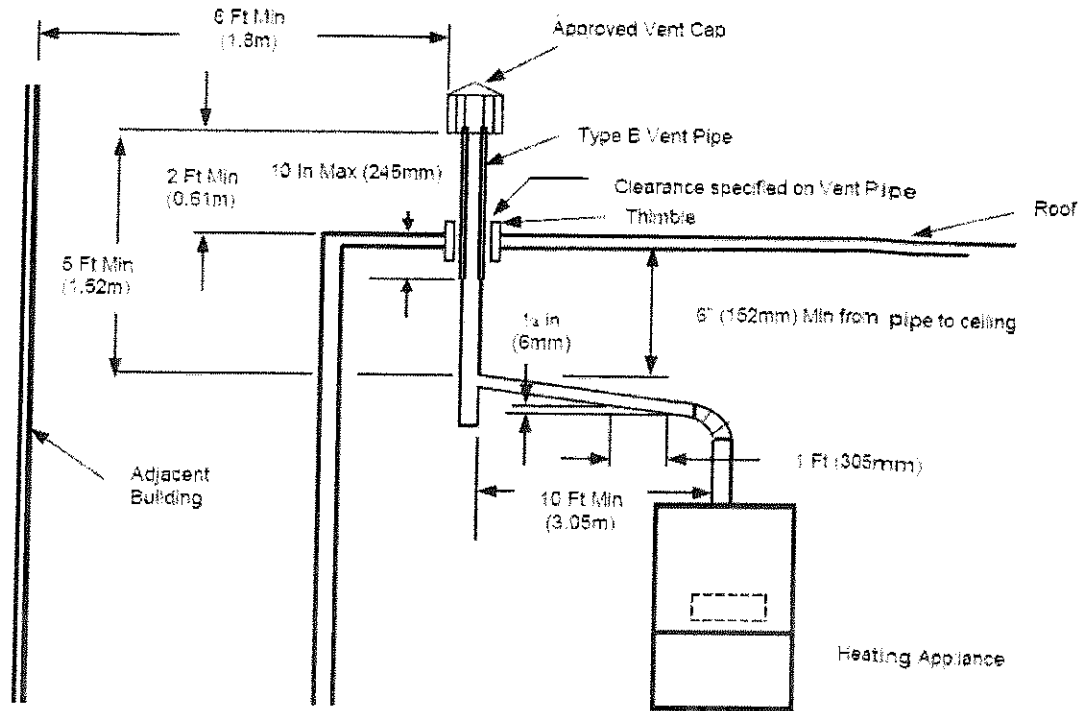
1. Use single wall or double wall (Type B) vent pipe of a diameter listed in the following table for the appropriate model.
2. Maximize the height of the vertical run of vent pipe. A minimum of five (5) feet (1.5m) of vertical pipe is required. The top of the vent pipe must extend at least two (2) feet (0.61m) above the highest point on the roof. Use Listed Type B vent for external runs. An approved weatherproof vent cap must be installed on the vent termination.
3. Horizontal runs should be pitched upward $\frac{1}{4}$ in. per foot (21mm/m) and should be supported at three (3) foot (1m) maximum intervals.
4. Design vent pipe runs to minimize the use of elbows. Each 90° elbow is equivalent to five (5) feet (1.5m) of straight vent pipe.
5. Vent pipe should not be run through unheated spaces. If such runs cannot be avoided, insulate the vent pipe to prevent condensation. Insulation should be a minimum of $\frac{1}{2}$ in. (12.7mm) thick foil faced fiberglass minimum of 1½ # density.
6. Dampers must not be used in vent piping runs, as spillage of flue gases into the occupied space could result.
7. Vent connectors serving Category 1 heaters must not be connected into any portion of a mechanical draft system operating under positive pressure.



National Fuel Gas Code Venting Pipe requirement

75,000-149,999	Use 5-inch pipe
150,000-400,000	Use 6-inch pipe

Vertical Venting



Horizontally Vented Furnaces – Category III

Horizontal vent systems terminate horizontally (sideways)

WARNING: Do not use Type B vent within a building on horizontally vented units.

1. All vent pipe joints must be sealed to prevent leakage. Follow the instructions provided with the approved venting materials.
2. The total equivalent length of vent pipe must not exceed 50 ft. (15.25m). Equivalent length is the total length of straight sections, plus 5 ft. (1.52m) for each 90° elbow and 2.5 ft. (0.76m) for each 45° elbow.
3. The vent system must also be installed to prevent collection of condensate. Horizontal runs should be pitched upward ¼ in. per foot (21mm/m) and should be supported at three (3) foot (1m) maximum intervals.
4. Insulate vent pipe exposed to cold air or routed through unheated areas. Insulate vent pipe runs longer than 10 ft. (3m). Insulation should be a minimum of ½ in. (12mm) thick foil faced fiberglass of 1 ½ # density. Maintain 6 in. (152mm) clearance between vent pipe and combustible materials.
5. An approved Breidert Type L, Field Starkap or equivalent vent cap must be provided. Vent cap inlet diameter must be the same as the vent pipe diameter.
6. The vent terminal must be at least 12 in. (305mm) from the exterior wall that it passes through to prevent degradation of building material by flue gases.
7. The vent terminal must be located at least 12 in. (305mm) above grade, or in snow areas, at least 3 ft. (1m) above snow line to prevent blockage.
8. The vent terminal must be installed with a minimum horizontal clearance of 4 ft. (1.2m) from electric meters, gas meters, regulators or relief equipment.

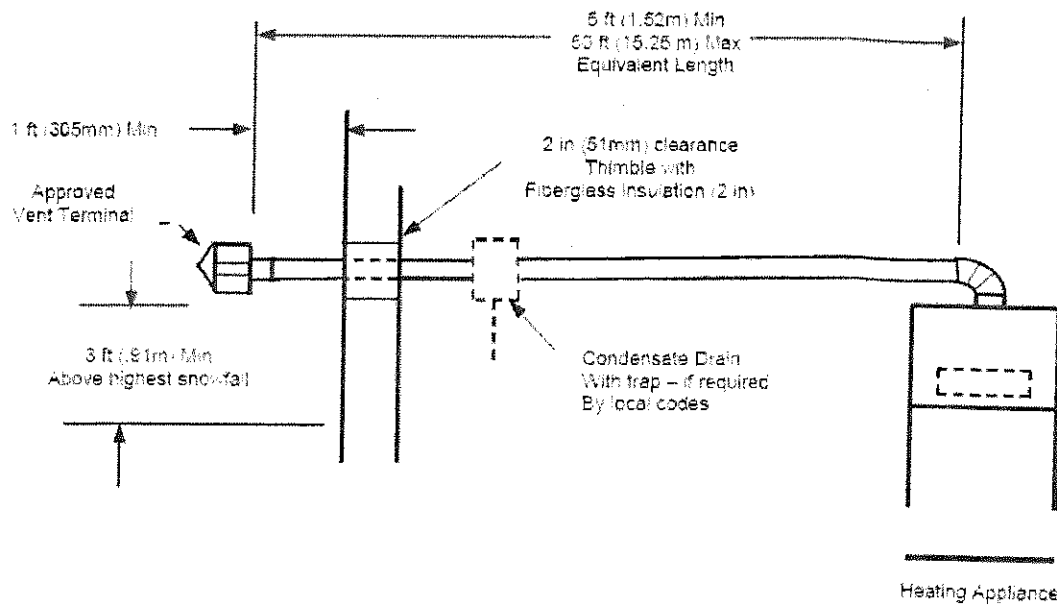
Through-the-wall vents shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard. Provide vent termination clearances to building or structure features as follows:

Structure Minimum

Clearance

Door, Window or gravity inlet	4 ft. (1.2 m) below 4 ft. (1.2 m) horizontally 1 ft. (305 mm) above
Forced air inlet within 10 ft. (3m)	3 ft. (.91 m) above
Adjoining building or parapet	6 ft. (1.8 m)
Adjacent public walkways	7 ft. (2.1 m) above grade

Horizontal Venting



EACH APPLIANCE MUST HAVE ITS OWN INDIVIDUAL VENT PIPE AND TERMINAL. Do not connect vent system from horizontally vented units to other vent systems or a chimney

Gas

Installation of gas piping must conform with local building codes, or in the absence of local codes, with the National Fuel Gas Code, ANSI Z223.1 (NFPA 54) – latest edition. In Canada, installation must be in accordance with CAN/CGA-B149.1 for natural gas units and CAN/CGA-B149.2 for propane units.

WARNING: INLET GAS PRESSURE MUST NOT EXCEED 14 IN. W.C. SEE UNIT RATING PLATE FOR PROPER GAS SUPPLY PRESSURE AND GAS TYPE.

1. Always **disconnect power** before working on or near a heater. Lock and tag the disconnect switch or breaker to prevent accidental power up.
2. Piping to the unit should conform with local and national requirements for type and volume of gas handled, and pressure drop allowed in the line. Refer to the Gas Engineer's Handbook for gas line capacities.
3. The incoming pipe near the heater should be sized to match the connection on the outside of the unit. Unit inlet sizes are shown in the table to the right. Avoid multiple taps in the gas supply so the unit has a steady supply of gas at all times.
4. Install a ground joint union with brass seat and a manual shut-off valve external to the unit casing, as shown below, adjacent to the unit for emergency shut-off and easy servicing of controls.
5. Provide a sediment trap, as shown below, before each unit and where low spots in the pipe line cannot be avoided.
6. Blow out the gas line to remove debris before making connections. Purge line to remove air before attempting to start unit. Purging of air from gas lines should be performed as described in ANSI Z223.1-latest edition "National Fuel Gas Code", or in Canada in CAN/CGA-B149.
7. All field gas piping must be pressure/leak tested prior to unit operation. Use a non-corrosive bubble forming solution or equivalent for leak testing. The heater and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing of that system at test

Cabinet Size	# of Furnaces	Module 1 Gas Pipe Size (NPT)	Module 2 Gas Pipe Size (NPT)
1	1	3/4"	N/A
1	2	3/4"	N/A
2	1	1"	N/A
2	2	1"	N/A
3	1	1"	N/A
3	2	1"	N/A
3	3	1"	1"
4	2	1"	N/A
4	3	1"	1"
4	4	1"	1"
5	2	1"	N/A
5	3	1"	1"
5	4	1"	1"

pressures in excess of ½ psi. The heater must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than ½ psi.

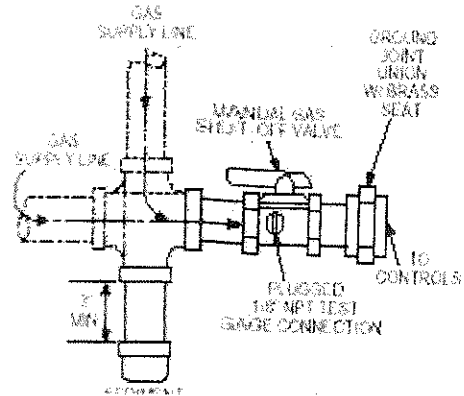
Gas Pressure Table

Gas Pressure Type	Gas Pressure
Inlet Pressure - Natural Gas	7 in. w.c. – 14 in. w.c.
Inlet Pressure - Propane	11 in. w.c. – 14 in. w.c.
Max. Manifold Pressure - Natural Gas	3.5 in. w.c. maximum
Max. Manifold Pressure - Propane	10 in. w.c. maximum
Min. Manifold Pressure - Natural Gas	0.15 in. w.c. minimum
Min. Manifold Pressure - Propane	0.75 in. w.c. minimum

8. This unit requires a constant **7 in. w.c. minimum natural gas supply, (LP should be 11 in. w.c. minimum)** when the unit is operating at maximum gas flow. If the gas supply exceeds **14 in. w.c.** it will damage the internal valve components, and if it is below 7 in. w.c., the heater may not perform to specifications.

Gas Connection Diagram

NOTICE
Refer to the heater rating plate for determining the maximum gas supply pressure for obtaining the maximum gas capacity for which this heater is designed.



Electrical

Before connecting power to the heater, read and understand this entire section of this document. As-built wiring diagrams are furnished with each fan by the factory, and are attached to the door of the unit.

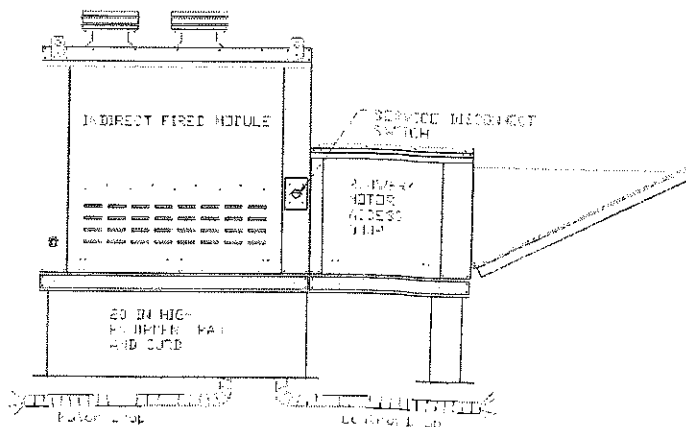
WARNING!
Disconnect power before working on or servicing fan. High voltage electrical input is needed for this equipment. This work should be performed by a qualified electrician.

Electrical wiring and connections should be done in accordance with local ordinances and the National Electric Code, ANSI/NFPA70. Be sure the voltage and phase of the power supply and the wire amperage capacity is in accordance with the motor nameplate. For additional safety information refer to AMCA publication 410-96, *Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans*.

1. Always **disconnect power** before working on or near a heater. Lock and tag the disconnect switch or breaker to prevent accidental power up.
2. An electrical drop containing the motor power wiring is shipped with every fan. The electrical drop should be brought through one of the conduit openings located in the base of the unit, run through the curb, and connected to a junction box inside the building.
3. A dedicated branch circuit should supply the motor circuit with short circuit protection according to the National Electric Code. This dedicated branch should be run to the junction box mentioned above and connected as shown in a following illustration labeled "Fan to Building Wiring Connection".
4. Make certain that the power source is compatible with the requirements of your equipment. The heater nameplate identifies

Copper Wire Ampacity

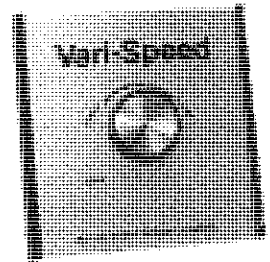
Wire Size AWG	Maximum Amps
14	20
12	25
10	30
8	40
6	55



- the **proper phase and voltage** of the motor.
5. Units shipped with an optional remote panel have two electrical circuit drops. It is important to run the motor wires in a separate conduit from the remote control wiring. The DC wires from the unit temperature controller, located in the control drop, should either be shielded cable or be run in a separate conduit.
 6. Before connecting heater to the building power source, verify power line wiring is de-energized.
 7. Secure the power cables to prevent contact with sharp objects.
 8. Do not kink power cable and never allow the cable to come in contact with oil, grease, hot surfaces or chemicals.
 9. Before powering up the heater, check fan wheel for free rotation and make sure that the interior of the heater is free of loose debris or shipping materials.
 10. If any of the original wire supplied with the heater must be replaced, it must be replaced with type TW wire or equivalent.

PSC (Permanent Split Capacitor) Motor Speed Control

Some single phase direct drive fans contain speed controls that regulate the amount of voltage going to the motor. Specific PSC motors must be used in conjunction with speed controls. The speed control has a knob with an off position, and high to low range. At high speed, the speed control allows all of the line voltage to pass right to the motor.



A minimum speed adjustment is provided to allow independent control of the minimum speed setting. Minimum speed adjustment ensures motor runs with sufficient torque to prevent stalling. To adjust this:

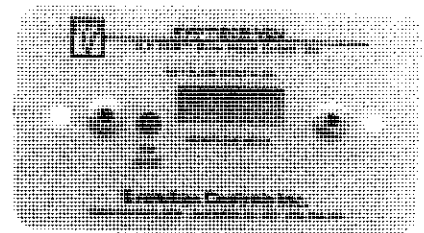
- 1) Motor must be in actual operating conditions to achieve proper speed adjustment. Motor will not slow down unless proper load is applied.
- 2) Turn main control knob to lowest speed position.
- 3) Locate and adjust minimum speed setting and adjust with small screw driver. This can be found under the speed control faceplate. (rotate clockwise to decrease minimum speed; counter-clockwise to increase minimum speed).
- 4) Motor will now operate from this preset minimum speed to full speed.

The lowest minimum voltage that may be applied to these motors is 65VAC. Running lower voltages to the motor can cause premature failure and overheating problems.

ECM (Electronically Controlled Motor) Speed Control

ECM motors and control allows accurate manual adjustment of fan speed. The benefit of ECM motors is exceptional efficiency, performance, and motor life.

The control used with ECM motors features a 4 digit LED numerical display. The blue knob on the control allows the user to set the flow index with a screwdriver. Twenty seconds later, the display shows the motor RPM. Then, the display periodically alternates between the flow index and motor RPM. The flow index has a range of 0 to 100% and is typically linear with motor RPM.



The ECM control requires a 24 VAC input and can locally turn the motor on and off. The motor can be adjusted between 300 RPM and maximum speed with this control.

NOTE: To adjust the speed of 3 phase direct drive motors, a variable frequency drive is required.

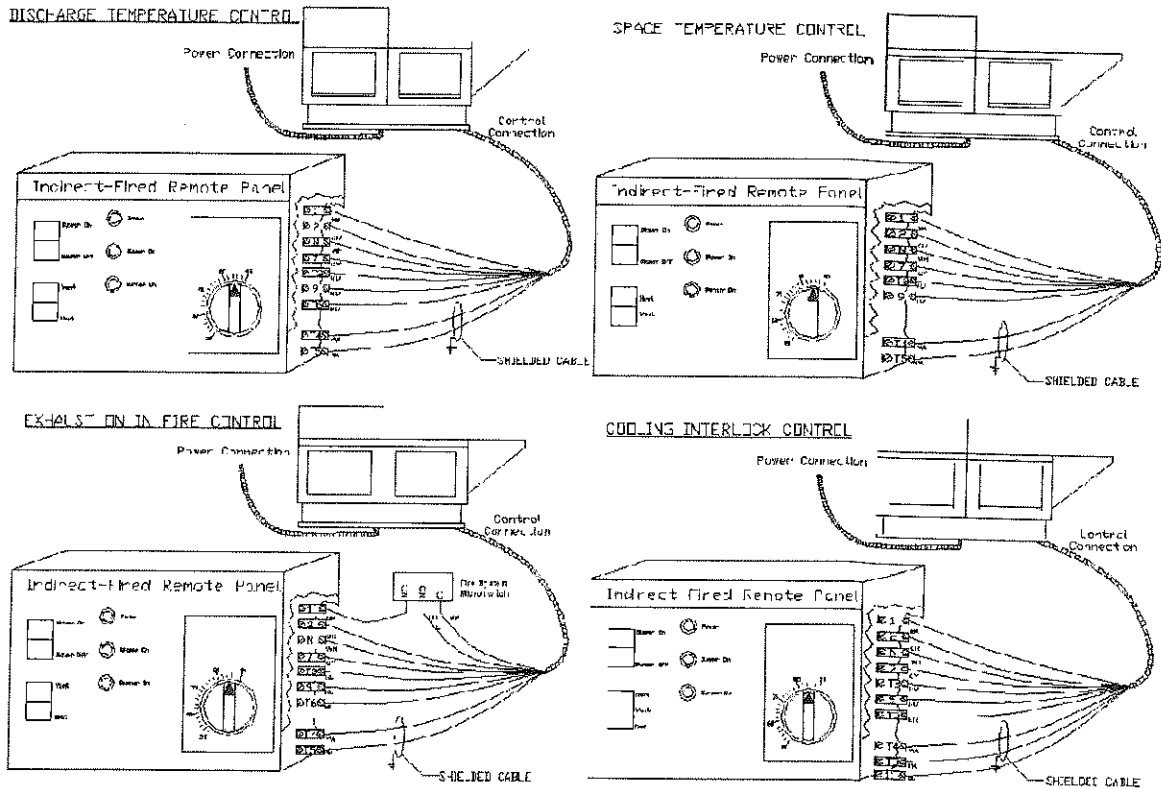
Electric Cabinet Heater

On units shipped with an optional electric cabinet heater, ensure that the heater is wired to a **separate** 120V, 15 amp input, the thermostat sensing bulb is mounted correctly in the control vestibule where the heater is located, and the **thermostat set to 0 Degrees Fahrenheit.**

Motorized Intake Damper

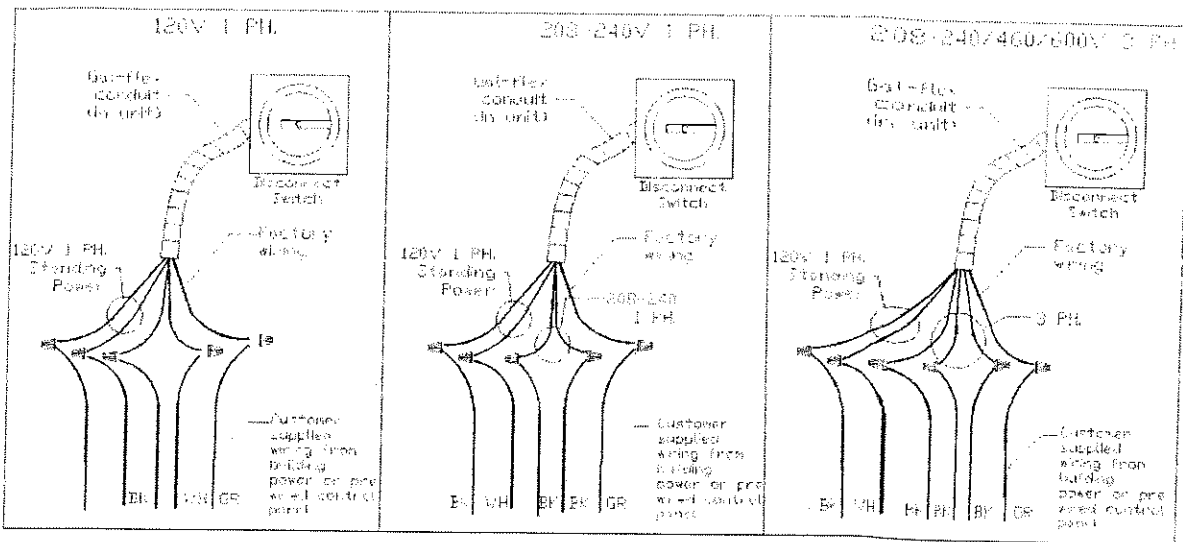
On units shipped with the optional motorized intake damper, a power transformer is supplied with the unit if the main incoming voltage is greater than 120V. The damper motor is automatically energized when the main disconnect switch is in the ON position. **No external wiring to the damper motor is required.**

Remote Control Panel



On units shipped with the optional remote control panel, an electrical drop containing the panel wiring is provided with the heater. There is a terminal strip inside the remote panel that matches the terminals in the heater unit. The remote panel should be wired as shown below.

Fan to Building Wiring Connection



OPERATION

Prior to starting up or operating the heater, check all fasteners for tightness. In particular, check the set screw in the wheel hub, bearings and the fan sheaves (pulleys). With power and gas to the heater OFF or prior to connecting ventilator to power, turn the fan wheel by hand to be sure it is not striking the inlet or any obstacles. Re-center if necessary.

Start Up

Special Tools Required

- AC Voltage Meter
- Tachometer
- Standard hand Tools
- Amperage Meter
- Manometer
- Thermometer

Start Up Procedure

1. Check all electrical connections for tightness and continuity.
2. Check pulley alignment and belt tension as described below.
3. Inspect the condition of the intake damper and damper linkage, if provided.
4. Inspect the air-stream for obstructions and install intake filters if missing.
5. Compare the supplied **motor voltage** with the fan's nameplate motor voltage. If this does not match, correct the problem.
6. Start the fan up, by turning the external disconnect to the **ON** position, and shut it **OFF** immediately to **check rotation of the wheel** with the directional arrow on the blower scroll. Reversed rotation will result in poor air performance, motor overloading and possible burnout. For units equipped with a single-phase motor check the motor wiring diagram to change rotation. For 3-phase motors, any two power leads can be interchanged to reverse motor direction.
7. When the fan is started up, observe the operation and check for any unusual noises.

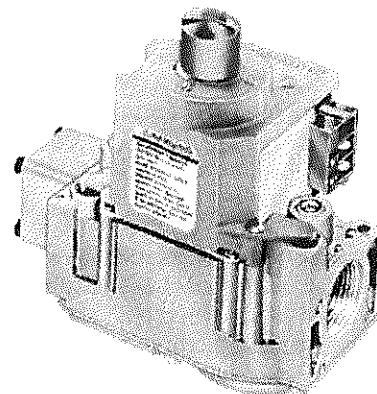
Forced High Fire Light-Off (Modulating Stages)

1. Restart the fan and check the gas supply pressure at the inlet gas tap upstream of all electronic valves. The inlet pressure should be **7 in. - 14 in. w.c. on natural gas and 11 in. - 14 in. w.c. on propane gas**. If the inlet pressure is too high, install an additional pressure regulator external to the unit.
2. Open the field installed manual gas shut-off valve and the manual main gas valve on the combination gas control valve.
3. Check the inlets to all of the firing tubes on the furnace and ensure that they are all clear of foreign debris and line up properly with each nozzle of the gas manifold.
4. Configuring the FVFAB component for low fire by selecting "menu", "test mode" and then "low fire". Allow the furnace to light (Note: There is a 1 minute standard power-vent flue pre-purge time prior to the unit attempting to light). If the furnace does not light, purge the gas train and gas manifold.
5. Upon successfully sensing flame at the upper most firing tube, the unit will fire at full high fire for a period of 17 seconds. At the end of this timing sequence, it will modulate down to low fire in accordance with the FVFAB test mode.
6. Check the characteristics of the flames in every firing tube of the furnace. Non-existence of or a lazy flame can be caused by low gas pressure, a dirty nozzle orifice, or clogged section of exhaust flue. To take the FVFAB out of low fire test mode, press any key.

High-Fire and Low-Fire Burner Adjustment

1. After it has been verified that the furnace is lighting off properly, the manifold gas pressure should be adjusted to jobsite conditions. The gas pressure regulator (integral to the On/Off gas control) is adjusted at the factory for average gas conditions. It is important that the gas be supplied to the furnace in accordance with the input rating on the rating plate.
2. (Skip this step and continue with step # 3 if unit contains only modulating furnaces.) If there are additional ON/OFF furnaces in the heater, it must be verified that they are all running at high-fire manifold pressure before setting high and low fire on the modulating stage. Reference "Gas Pressure Adjustment Reference Information" in this manual for an overview of proper pressure settings of all furnaces and a visual representation of the layout of the modulating and ON/OFF Furnaces. All ON/OFF furnaces must be running in full fire while setting high and low fire on the modulating gas valve. To do this, the entire unit must be locked into high fire mode. This is achieved by configuring the heat controller FVFAB by going to "menu", "test mode" and then "high fire". An alternative method is to disconnect one of the wire leads to the discharge air sensor, or if the unit is set up for space temperature control, momentarily configure the unit to discharge temp control and lock the unit into high fire mode by changing the dipswitch settings inside of the remote-mounted, white Viconics temperature selector Dial/Thermostat in the tempered space. Refer to the "Modulating Furnace Thermostat Dipswitch Settings" section of this manual for proper dip-switch settings. If the Unit is set up for BAS (Building Automation Control), lock the unit into high fire by configuring the heat controller FVFAB by going to "menu", "test mode" and then "high fire" or alternatively, sending the unit a constant 10Vdc or 20mA signal. With all burners lit, set the manifold gas pressure on the non-modulating stages using the adjustment screw on the ON/OFF Gas Valve. Non-modulating furnaces can be easily identified as the ones with only a single ON/OFF gas valve on their gas train. Read the manifold gas pressure off of the 0-10" w.c. pressure indicator gauge on each of these non-modulating stages.

Honeywell ON/OFF Gas Valve

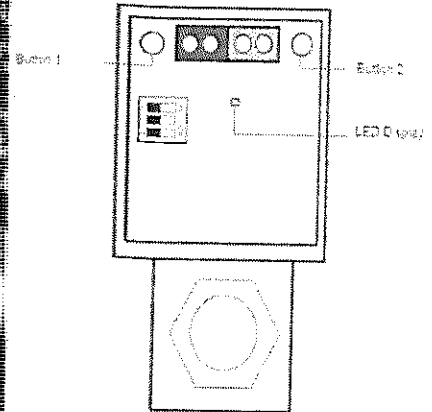
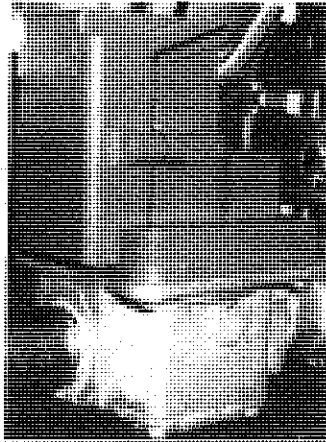


The gas pressure should be set at **3.5 in. w.c.** for natural gas and **10 in. w.c.** for propane to obtain maximum efficiency. If the gas pressure needs to be adjusted remove the pressure regulator adjustment cap and screw on the ON/OFF valve and using a screwdriver, turn the inner adjustment screw clockwise to increase the gas pressure. Once proper gas pressure has been set for these non-modulating stages leave them lit and move on to step # 3.

3. Create a high fire call for heat on the modulating gas valve(s). This should be done with the blower on and all gas controls on as described in step # 2. High fire can be achieved using the

Maxitrol Modulating Valve

heat controller FVFAB by going to "menu", "test mode" and then "high fire". An alternative method is to disconnect the leads going from the discharge temperature sensor to the thermostat. Next, remove the cover on the Maxitrol Modulating Valve and press button #1 until the LED lights solid red. Release. The valve is now in high fire setting mode. Buttons #1 and #2 are used to set desired high fire setting. Press or hold button #1 to increase gas flow. Each button press equates to the minimum available step size



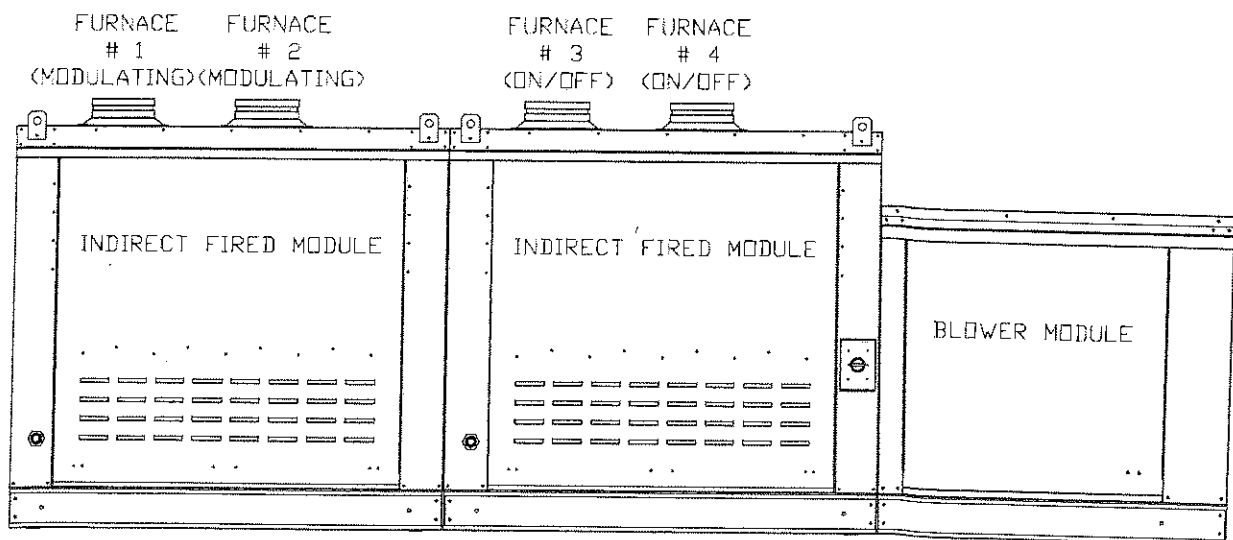
and will decrease slowly. Holding the button down auto steps and eliminates the need to continuously press the button. Use this feature to rapidly decrease the flow. Manifold pressure can be read off of the 0-10" w.c. gas pressure gauge located directly on the gas manifold. For natural gas systems, the high fire manifold pressure should be set at **3.5 in. w.c.** For propane gas, the high fire manifold pressure should be set to **10 in. w.c.** To save the high fire setting, simultaneously hold buttons #1 and #2 until the LED turns off. If 3.5" w.c. gas pressure cannot be achieved at high fire by adjusting the modulating gas valve and it has been verified that the inlet gas pressure is within the acceptable range of 7-14" w.c., adjust the regulator of the ON/OFF gas valve located upstream of the modulating gas valve. To do this remove the pressure regulator adjustment cap and screw on the ON/OFF valve and using a screwdriver, turn the inner adjustment screw clockwise to increase the gas pressure at the inlet of the modulating gas valve.

4. Using buttons #1 and #2, adjust the high fire manifold pressure to 3.5 in. w.c. for natural gas and 10 in. w.c. for propane gas. If button #1 is at the end of its adjustment and more pressure is needed, then adjust the main gas pressure regulator spring (on the On/Off valve) to achieve the proper manifold pressure. Turning the regulator screw clockwise will increase pressure and counter-clockwise will decrease pressure.
5. Save the high fire setting by simultaneously holding down buttons #1 and #2 until the LED turns off. Press any button on the FVFAB to exit high fire mode.
6. The low fire manifold pressure must now be set. Low fire mode from the FVFAB is achieved by going to "menu", "test mode" and then "low fire". An alternative method is to connect together the two leads coming from the discharge thermostat instead of them each connecting to the discharge air sensor. This ensures a reading of 0 Ohms to the thermostat. Next, press and hold button #2 on the Maxitrol modulating valve until the LED light blinks red. Release. The valve is now in low fire setting mode. Buttons #1 and #2 are used to set desired low fire setting at this point. Press or hold button #2 to decrease gas flow. Each button press equates to the minimum available step size and will decrease flow slowly. Holding the button auto steps and eliminates the need to continuously press the button. Use this feature to rapidly decrease the flow. Press or hold button #1 to increase gas flow. Each button press equates to the minimum available step size and will increase slowly. Holding the button down auto steps and eliminates the need to continuously press the button. Use this feature to rapidly increase the flow.

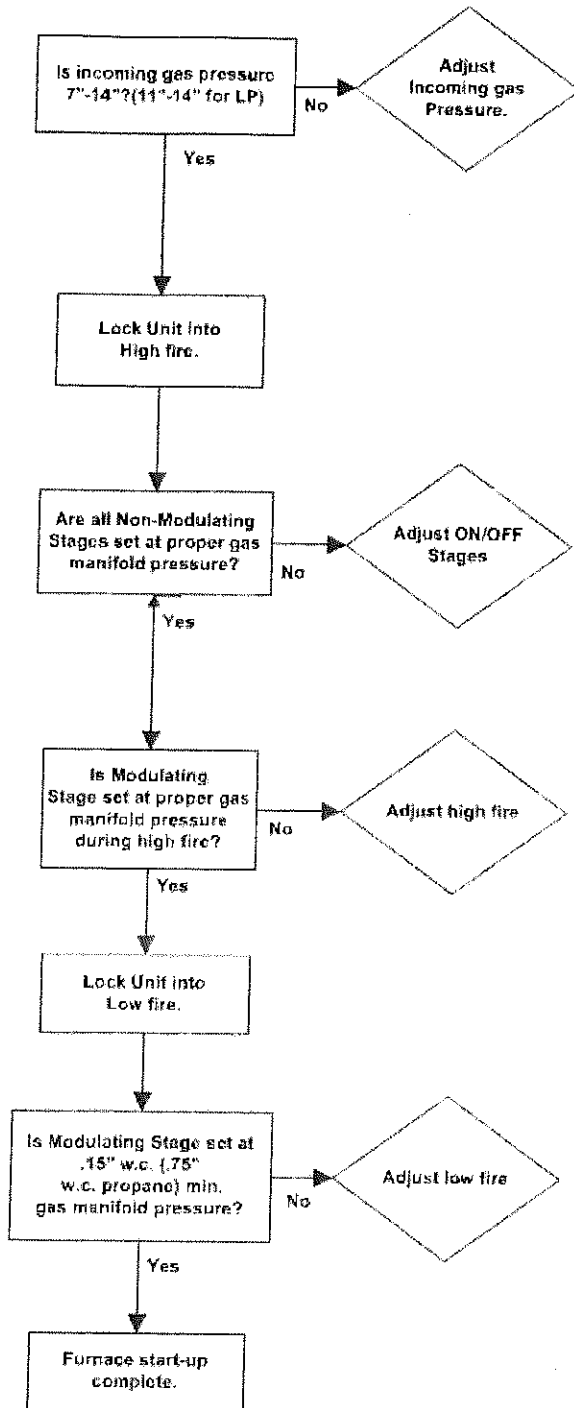
7. Using buttons #1 and #2, adjust the low fire manifold pressure to **0.15 in. w.c.** for natural gas and **.75 in. w.c.** for propane gas.
8. Save the low fire setting by simultaneously holding down buttons #1 and #2 until the blinking LED turns off. Press any button on the FVFAB to exit low fire mode or reconnect the wires leading from the thermostat to the discharge air sensor.
9. There are 3 dip switches on the Maxitrol modulating valve. All switches should be in the "OFF" position. In the image above, all three dip switches are shown in the "OFF" position.
10. Replace the cap to the Maxitrol modulating gas valve and all pressure regulator adjustment caps on the ON/OFF gas valves.
11. If necessary, reconnect the wire to the discharge air temperature sensor and set the dipswitch settings on the thermostat back to space control mode if these were changed during step # 2.
12. A final gas leak check shall be performed to verify the gas-tightness of the heater's components and piping under normal operating conditions.

Gas Pressure Adjustment Reference Information (Natural Gas)

		# of Furnaces in Unit			
		1 Furnace	2 Furnaces	3 Furnaces	4 Furnaces
Gas Valve Regulator Settings	1st Furnace (Modulating)	ON/OFF Valve Fully Open Maxitrol Modulating Valve @ 3.5" w.c.	ON/OFF Valve Fully Open Maxitrol Modulating Valve @ 3.5" w.c.	ON/OFF Valve Fully Open Maxitrol Modulating Valve @ 3.5" w.c.	ON/OFF Valve Fully Open Maxitrol Modulating Valve @ 3.5" w.c.
	2nd Furnace (ON/OFF or Modulating)	N/A	ON/OFF Valve Fully Open Maxitrol Modulating Valve @ 3.5" w.c.	ON/OFF Valve Fully Open Maxitrol Modulating Valve @ 3.5" w.c.	ON/OFF Valve Fully Open Maxitrol Modulating Valve @ 3.5" w.c.
	3rd Furnace (ON/OFF)	N/A	N/A	3.5" w.c.	3.5" w.c.
	4th Furnace (ON/OFF)	N/A	N/A	N/A	3.5" w.c.



Furnace Start-Up Summary



Setting incoming pressure:

Pressure must be measured at the first "T" in the supply gas line before the first gas valve.

Adjusting ON/OFF Stages:

Remove the pressure regulator adjustment cap and screw on the ON/OFF valve and using a screwdriver. Refer to the table on pg. 15 of this manual for proper adjustment settings based on # of furnaces in the unit. Turn the inner adjustment screw clockwise to increase the gas flow and counter-clockwise to decrease the gas flow. Replace the pressure regulator adjustment cap and screw.

Adjusting high fire(Modulating Stage):

Refer to the table on pg. 15 of this manual for proper adjustment settings based on # of furnaces in the unit. Press and hold button #1 down on the modulating gas valve until the LED lights solid red. This will drive the valve into its full open position. Adjust high fire. Press or hold button #1 to increase gas flow. Press or hold button #2 to decrease gas flow. Hold down both buttons to save the high fire setting. Replace cover.

Adjusting low fire (Modulating Stage):

Low fire manifold pressure should be .15" for natural gas and .75" for propane. Press and hold button #2 down on the modulating gas valve until the LED blinks red. This will drive the valve into its minimum flow position. Adjust low fire. Press or hold button #1 to increase gas flow. Press or hold button #2 to decrease gas flow. Hold down both buttons to save the low fire setting. Replace cover.

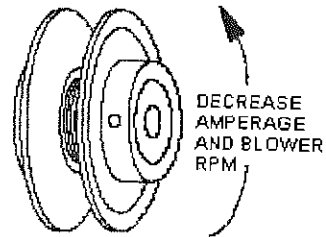
Final Start-Up Procedure

1. With the air and burner systems in full operation and all ducts attached, measure the system airflow. Motor sheave (pulley) is variable pitch, and allows for an increase or decrease of the fan RPM to adjust the airflow, as shown in the illustration below. For your convenience, a RPM chart is included in the following pages.
2. Once the proper airflow is achieved, measure and record the fan speed with a reliable tachometer. **Caution - Excessive speed will result in motor overloading or bearing failure. Do not set fan RPMs higher than specified in the maximum RPM chart.** See the troubleshooting guide for more information.
3. Measure and record the **voltage** and **amperage** to the motor and compare with the motor nameplate to determine if the motor is operating under safe load condition.
4. Once the rpm of the ventilator has been properly set, disconnect power and recheck belt tension and pulley alignment as described below.

Maximum RPM and HP Chart

Blower Size	Maximum RPM	Maximum HP
10"	1800	2
12"	1500	3
15"	1400	5
18"	1200	5
20"	1000	10
25"	900	20

Pulley Adjustment Illustration



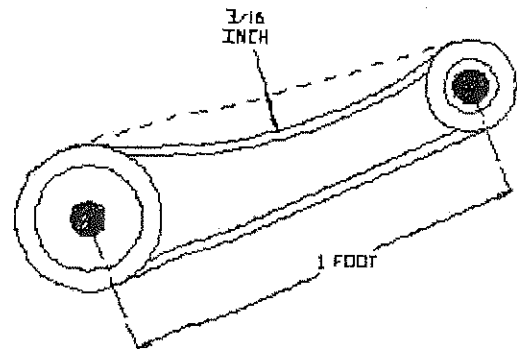
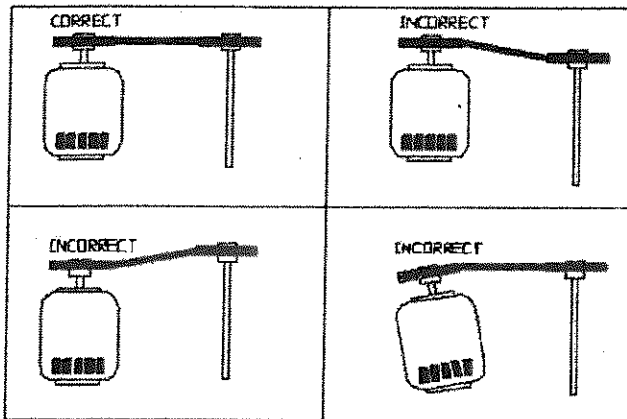
Pulley Adjustment

The adjustable motor pulley is factory set for the RPM specified. Speed can be increased by closing or decreased by opening the adjustable motor sheave. Two groove variable pitch pulleys must be adjusted an equal number of turns open or closed. Any increase in speed represents a substantial increase in horsepower required by the unit. Motor amperage should always be checked to avoid serious damage to the motor when the speed is varied. Always torque setscrews according to the setscrew torque chart.

Setscrew Torque

Thread Size	Torque (IN/Lb)
No. 10	32
1/4"	72
5/16"	130
3/8"	275
7/16"	384
1/2"	600

Pulley Alignment/Proper Belt Tension



Pulley Combination Chart

Motor RPM		1725																	
1/3 to 1-1/2 HP AX BELTS		MOTOR PULLEY 1V134		Dd1	Dd2	Pd1	Pd2												
		Open		TURNS ON MOTOR PULLEY															
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	Closed						
AK114	11	11.2	308	323	339	354	370	385	400	416	431	447	462	0					

1/3 to 2 HP AX BELTS		MOTOR PULLEY 1V140		Dd1	Dd2	Pd1	Pd2												
		Open		TURNS ON MOTOR PULLEY															
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	Closed						
AK114	11	11.2	400	416	431	447	462	477	493	508	524	539	554	0					
AK94	9	9.2	488	506	525	544	563	581	600	619	638	656	675	0					
AK79	7.5	7.7	582	605	627	650	672	694	717	739	762	784	806	0					
AK66	6.2	6.4	701	728	755	782	809	836	863	889	916	943	970	0					
AK54	5	5.2	863	896	929	962	995	1028	1062	1095	1128	1161	1194	0					
AK46	4.2	4.4	1019	1059	1098	1137	1176	1215	1255	1294	1333	1372	1411	0					
AK39	3.5	3.7	1212	1259	1305	1352	1399	1445	1492	1539	1585	1632	1678	0					
AK32	3	3.2	1402	1455	1509	1563	1617	1671	1725	1779	1833	1887	1941	0					

3 to 5 HP AX BELTS		MOTOR PULLEY 2VP42		Dd1	Dd2	Pd1	Pd2												
		Open		TURNS ON MOTOR PULLEY															
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	6	5 1/2	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	Closed				
2BK160H	15.4	15.7	330	339	348	357	366	375	385	394	403	412	421	430	0				
2BK140H	13.4	13.7	378	388	399	409	420	430	441	451	462	472	483	493	0				
2BK120H	11.4	11.7	442	455	467	479	491	504	516	528	541	553	565	577	0				
2BK110H	10.4	10.7	484	497	511	524	537	551	564	578	591	605	618	631	0				
2BK100H	9.4	9.7	534	548	563	578	593	608	622	637	652	667	682	697	0				
2BK90H	8.4	8.7	595	611	628	644	661	677	694	710	727	744	760	777	0				
2BK80H	7.4	7.7	672	691	709	728	747	765	784	803	821	840	859	877	0				
2BK70H	6.4	6.7	772	794	815	837	859	880	901	923	944	965	987	1008	0				
2BK60H	5.4	5.7	908	933	958	984	1009	1034	1059	1084	1110	1135	1160	1185	0				
2BK55H	4.9	5.2	995	1023	1050	1078	1106	1133	1161	1189	1216	1244	1272	1299	0				
2BK50H	4.4	4.7	1101	1132	1162	1193	1223	1254	1285	1315	1346	1376	1407	1438	0				

7-1/2 to 10 HP AX BELTS		MOTOR PULLEY 2VP60		Dd1	Dd2	Pd1	Pd2												
		Open		TURNS ON MOTOR PULLEY															
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	6	5 1/2	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	Closed				
2BK160H	15.4	15.7	516	527	538	549	560	571	582	593	604	615	626	637	0				
2BK140H	13.4	13.7	592	604	617	630	642	655	667	680	693	705	718	730	0				
2BK120H	11.4	11.7	693	708	722	737	752	767	781	796	811	826	840	855	0				
2BK110H	10.4	10.7	758	774	790	806	822	838	854	871	887	903	919	935	0				
2BK100H	9.4	9.7	836	854	871	889	907	925	943	960	978	996	1014	1031	0				
2BK90H	8.4	8.7	932	952	972	991	1011	1031	1051	1071	1091	1110	1130	1150	0				
2BK80H	7.4	7.7	1053	1075	1098	1120	1143	1165	1187	1210	1232	1255	1277	1299	0				

3 to 5 HP AX BELTS		MOTOR PULLEY 2VP42		Dd1	Dd2	Pd1	Pd2												
		Open		TURNS ON MOTOR PULLEY															
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	6	5 1/2	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	Closed				
2BSV278	27.8	28.1	184	189	194	200	205	210	215	220	225	230	235	240	0				
2BSV250	25	25.3	205	210	216	222	227	233	239	244	250	256	261	267	0				
2BSV234	23.4	23.7	218	224	230	237	243	249	255	261	267	273	279	285	0				
2BSV200	20	20.3	255	262	269	276	283	290	297	304	312	319	326	333	0				
2BSV184	18.4	18.7	277	284	292	300	307	315	323	331	338	346	354	361	0				
2BSV160	16	16.3	317	326	335	344	353	362	370	379	388	397	406	414	0				
2BSV154	15.4	15.7	330	339	348	357	366	375	385	394	403	412	421	430	0				
2BSV136	12.6	12.9	401	412	423	435	446	457	468	479	490	501	513	524	0				
2BSV124	12.4	12.7	407	419	430	441	453	464	475	487	498	509	521	532	0				
2BSV110	11	11.3	458	471	483	496	509	522	534	547	560	572	585	598	0				

7-1/2 to 10 HP AX BELTS		MOTOR PULLEY 2VP60		Dd1	Dd2	Pd1	Pd2												
		Open		TURNS ON MOTOR PULLEY															
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	6	5 1/2	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	Closed				
2BSV278	27.8	28.1	289	295	301	307	313	319	325	331	338	344	350	356	0				
2BSV250	25	25.3	320	327	334	341	348	355	361	368	375	382	389	395	0				
2BSV234	23.4	23.7	342	349	357	364	371	378	386	393	400	408	415	422	0				
2BSV200	20	20.3	399	408	416	425	433	442	450	459	467	476	484	493	0				
2BSV184	18.4	18.7	434	443	452	461	470	480	489	498	507	517	526	534	0				
2BSV160	16	16.3	497	508	519	529	540	550	561	571	582	593	603	614	0				
2BSV154	15.4	15.7	516	527	538	549	560	571	582	593	604	615	626	637	0				
2BSV136	12.6	12.9	628	642	655	669	682	695	709	722	735	749	762	776	0				
2BSV124	12.4	12.7	638	652	666	679	693	706	720	733	747	761	774	788	0				
2BSV110	11	11.3	717	733	748	763	779	794	809	824	840	855	870	885	0				

1.5 to 20 HP AX BELTS		MOTOR PULLEY 2VP72		Dd1	Dd2	Pd1	Pd2												
		Open		TURNS ON MOTOR PULLEY															
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	6	5 1/2	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	Closed				
2BSV278	27.8	28.1	381	387	393	399	405	411	417	424	430	436	442	448	0				
2BSV250	25	25.3	423	430	436	443	450	457	464	470	477	484	491	498	0				
2BSV234	23.4	23.7	451	459	466	473	480	488	495	502	509	517	524	531	0				
2BSV200	20	20.3	527	535	544	552	561	569	578	586	595	603	612	620	0				
2BSV184	18.4	18.7	572	581	590	600	609	618	627	636	646	655	664	673	0				
2BSV160	16	16.3	656	667	677	688	698	709	720	730	741	751	762	773	0				
2BSV154	15.4	15.7	681	692	703	714	725	736	747	758	769	780	791	802	0				
2BSV136	12.6	12.9	829	842	856	869	883	896	909	923	936	949	963	976	0				

10 - 20 IN. BLOWER**

25 IN. BLOWER

** 2HP Motors on 20 IN Blowers use 2VP42 Pulleys

Sequence of Operation

The Indirect-fired heater is most easily understood when broken down into smaller individual systems. There are two main systems; a make-up air fan and a heater. The make-up air fan consists of a heavy-duty blower and motor. The heater may be further broken down into two control systems, the Modulating Gas System (MGS) and the Flame Safety Control (FSC). The burner mixes air with the gas (Natural or Propane) which heats a heat exchanger which heats the air. There are between one and four furnaces in each heater depending on the total required heating output capacity for the application. Included in every unit is at least one modulating furnace, located furthest downstream, closest to the discharge of the heating module. The modulating furnace(s) and additional On/Off furnaces (if used) are controlled using vernier-type modulation methods resulting in fully linear heating output over the entire gas-firing range.

Modulating Gas System

The first system, the **Modulating Gas System**, consists of an Intake Air Thermostat, a Temperature Selector Dial, a Functional Vernier Functional Auto Balancing Module (FVFAB), a Discharge Air Sensor (only on discharge temp control option), and a modulating gas valve(s). The Intake Air Thermostat is only used to give a call for heat signal to the Flame Safety Controller. It is important to understand that this intake air thermostat is only used for this purpose and does not control the discharge/space temperature in which the module tries to maintain. For Kitchen MUA heating applications, the dial setting on the Intake Air Thermostat should be set at 45 °F, whereas the Temperature Selector Dial should be set at 55 °F. For all other applications, the dial settings should be set appropriately based on the end-users preferences and on-site conditions.

There are 3 different options for controlling the gas firing output of these units. These include Discharge Temperature Control, Space Temperature Control, and Building Automation Control. Refer to page 24 for how to configure for each type of control:

1. **Discharge Control:** When wired for discharge control, the thermostat utilizes a discharge air sensor in the unit and heats the incoming air to the selected setting on the Temperature Selector Dial or programmable stat by sending signal voltage to the FVFAB.
2. **Space Control:** When the space control option has been selected, the Temperature Selector Dial or programmable stat is mounted in the space, sensing the temperature in the room with use of an internal sensor. The discharge sensor in the unit is not used and the stat sends a signal voltage directly to the FVFAB.
3. **Building Automation Control/Direct Digital Control (DDC):** Use of the Temperature Selector Dial is completely eliminated and a 0-10vdc or 0-20mA signal is sent to the FVFAB from the building control system to regulate the heating output of the unit.

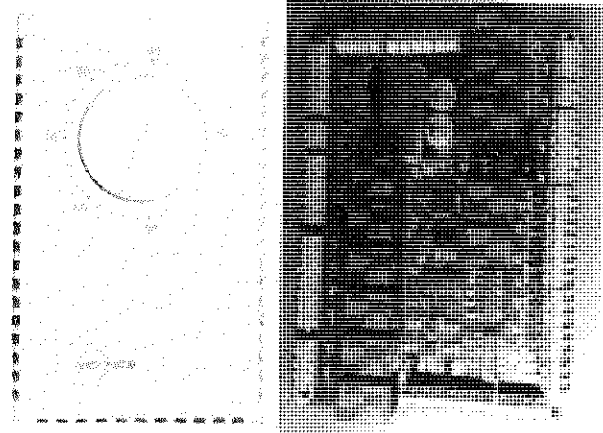
In all cases, the FVFAB controls the amount of gas to the burner based on the signal from the temperature control components. When the modulating gas valve is all the way open and achieving the maximum BTUs and temperature rise of the unit, it is called "high fire".

Intake Air
Thermostat



Temperature
Selector Dial

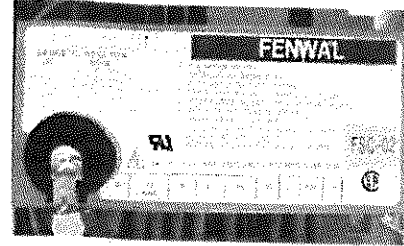
FVFAB



Flame Safety Control

The second system to understand is the **Flame Safety Control**. The FSC is present **only** to monitor the flame, NOT to control temperature. The FSC uses a sensor mounted at the intake of the upper-most firing tube of the furnace to sense the existence of a flame. The FSC controls the opening of the redundant solenoid gas valves and the operation of the spark igniter to initiate a flame upon start up. When there is a call for heat, the LED on the FSC is energized indicating that the unit has power. Then, there is a one minute pre-purge in which the power-vent blower on the furnace is sent to high speed to exhaust any gas in the Heat-exchanger/Control Cabinet that may be present prior to trial for ignition. As soon as the pre-purge has initiated, the FSC checks that airflow is sensed by the power-vent airflow switch* and that the High Limit and Roll-out switches are not tripped. (*NOTE: If while *trouble-shooting* the unit it is necessary to jumper-out this airflow switch, the jumpers must be applied to the contacts immediately **after** the power-vent motor is turned on and the FSC begins to check for airflow, otherwise the unit will go into lock-out mode.) Upon successful sensing of induced power-vent airflow and continuity of temperature limit and Roll-out switches, the FSC initiates a 15 second ignition sequence. During this ignition sequence, the FSC opens the On/Off gas valves and allows gas to pass through to the Gas Manifold. At the same moment, the spark igniter begins to spark, causing the electrode on the burner to ignite the gas. This results in a flame at the lowest firing tube of the furnace which immediately ignites the flow of gas in each succeeding firing tube moving vertically until the entire furnace is lit. When the sensor detects the flame at the intake of the upper-most firing tube the FSC continues to power the On/Off gas valve until there is a loss of flame presence. This is the normal operating mode.

Flame Safety

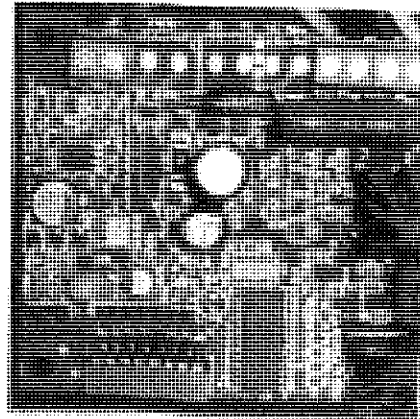


Flame Safety Ignition Sequence

Interval Description:	Initial Call for Heat	1 Min. Pre-purge	15 Sec. Trial for ignition	1 Min. Inter-purge	15 Sec. Trial for ignition	1 Min. Inter-purge	15 Sec. Trial for ignition	2 Min. Post-purge	1 hr Lockout	Repeat Cycle
Time{Min:Sec}: {Non-Linear Scale}	0:00	1:00	1:15	2:15	2:30	3:30	3:45	5:45	End of Cycle	

Modulating Stage Sequence

As mentioned in the previous sections, every unit is equipped with a modulating furnace(s) located furthest downstream at the discharge of the heater module. The modulating stage(s) operates differently than the other On/Off staged furnaces in that instead of being "On" or "Off", the gas flow to this furnace is modulated up and down to account for varying calls for heat during the unit's operating period. In addition, the speed of its power-vent blower is varied as the gas flow changes in order to maintain constant combustion efficiency over the entire firing range. The modulating furnaces Power-vent blower(s) is controlled by a speed controller that varies the output voltage to the motor based on a 0-10Vdc signal from the FVFAB. There is one Speed Controller board per modulating furnace. The Output voltage (True RMS) to the motor varies non-linearly between 120Vac @ 10Vdc for high fire and 81.6Vac @ 0Vdc for low fire. *NOTE: Red dip switches located on the modulating furnaces Power-vent Blower Speed Controller are de-activated and should not be adjusted.



FVFAB and High Fire Start

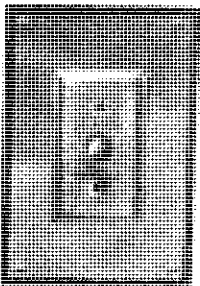
The FVFAB translates the 0-10 VDC or 0-20 mA signal from a stat or BAS control to the modulating furnace(s). The signal is linearized such that input voltage is directly proportional to amount of gas being delivered to the modulating valve(s). If that signal is greater than a high voltage threshold for a certain interval it will relay 24 V to the FSC on the next furnace. This will repeat if the heat capacity is still not enough and more stages will be turned on. If the call for heat is lower than a low voltage threshold for a certain period of time the FVFAB will cut power to the last stage that turned on, starting the post purge sequence and repeat the process for subsequent stages if needed. On furnaces that have two modulating burners the linearized signal is sent to one of these burners depending on the need for heat while the furnace not receiving the modulating signal is locked into high fire, low fire or off.

In order to ensure proper light-off in all conditions, every unit's FVFAB contains software that forces the modulating furnace(s) to light at high fire when that furnace's main gas valve is first opened. There is a built in timer that allows it to send a constant 10Vdc signal to the modulating gas valve(s) and power-vent blower speed controller(s) and force the furnace(s) into high fire for a period of 17 seconds after the initial spark is sent by the FSC. After this forced high-fire light-off period has expired, the modulating furnace's power-vent blower and modulating gas valve will receive a modulating signal from the FVFAB as mentioned above.

Re-Circulating Control Options

Manual Positioning Control (Potentiometer)

The dampers can be controlled at a remote location by a manual potentiometer to any position from 20% to 100% fresh air. This will allow manually setting the dampers to match the building ventilation requirements. It will take an extra 3 control wires at the remote location. On a power failure, or if the unit is turned off, the return air damper will close by spring return.



Two Position Control

The dampers can be controlled by a two position switch (a field supplied switching device) to open the fresh air to 100%. On opening of the circuit, power failure, or if the unit is shutoff, the return air damper will close by spring return.

Static Pressure Control (Photohelic)

The dampers can be controlled by a building static pressure control. This controller will sense the difference between pressure inside the building, and pressure outside the building (sensed at the A306 outdoor sensor), and position the dampers to maintain the pressure setting on the controller. The controller has two set points and an indicator. The two set points are a minimum desired static pressure point, and a maximum static pressure point.

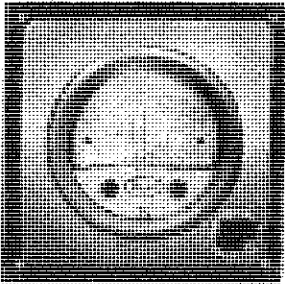
The actual building static pressure will be shown by a visual indicator between these two settings. The controller will modulate the dampers to maintain a static pressure between these set points.

When building static pressure is below the minimum setting, the damper motor will proportionally open the fresh air damper and close the return air damper until static increases above the minimum setting. At this point, the damper motor will stop and hold this proportion.

If the building static continues to climb and goes above maximum setting, the damper motor will reverse proportion, closing the fresh air damper and opening the return air damper until static drops below maximum setting.

During the "OFF" or "Night" cycle of the unit, an internal switching circuit will close the return air damper.

See additional wiring and installation information on the static pressure controller and A306 outdoor sensor.

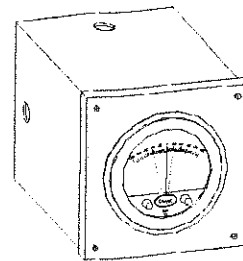
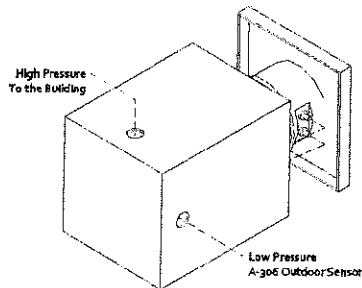


Static Pressure Controller Installation Instructions

Avoid locating the front of the static pressure controller in sun light or other areas with high ambient light or corrosive levels. Bright light shining on the photocells can cause false actuation of the load relays.

The static pressure controller should be zeroed out before attaching the low and high pressure hoses. The zero adjustment is located between the minimum and maximum dials.

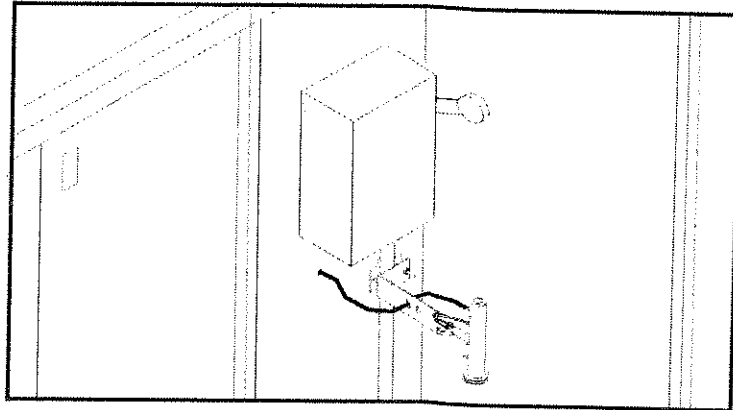
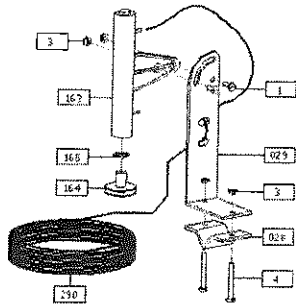
Using the supplied rubber tubing the high side of the static pressure controller should be plumbed to the inside of the building. The low side of the static pressure controller should be plumbed to the A306 outdoor sensor. See the A306 installation instructions.



A306 Outdoor Sensor

Use the installation instructions shipped with the A306 outdoor sensor.

PART #	DESCRIPTION
1	(2) NO. 10-32 X 1/2" MACHINE SCREW
2	(2) NO. 10-32 NUT
4	(2) NO. 10-32 X 1 7/8" MACHINE SCREW
029	ANTENNA CLAMP
029	MOUNTING BRACKET
162	DIG. LIP BODY
164	STATIC PRESSURE PLATES
165	NO. 8 BUSH SEAL
169	MOLE PLUG
290	TELEPHONE FT.



Building Signal Damper Control

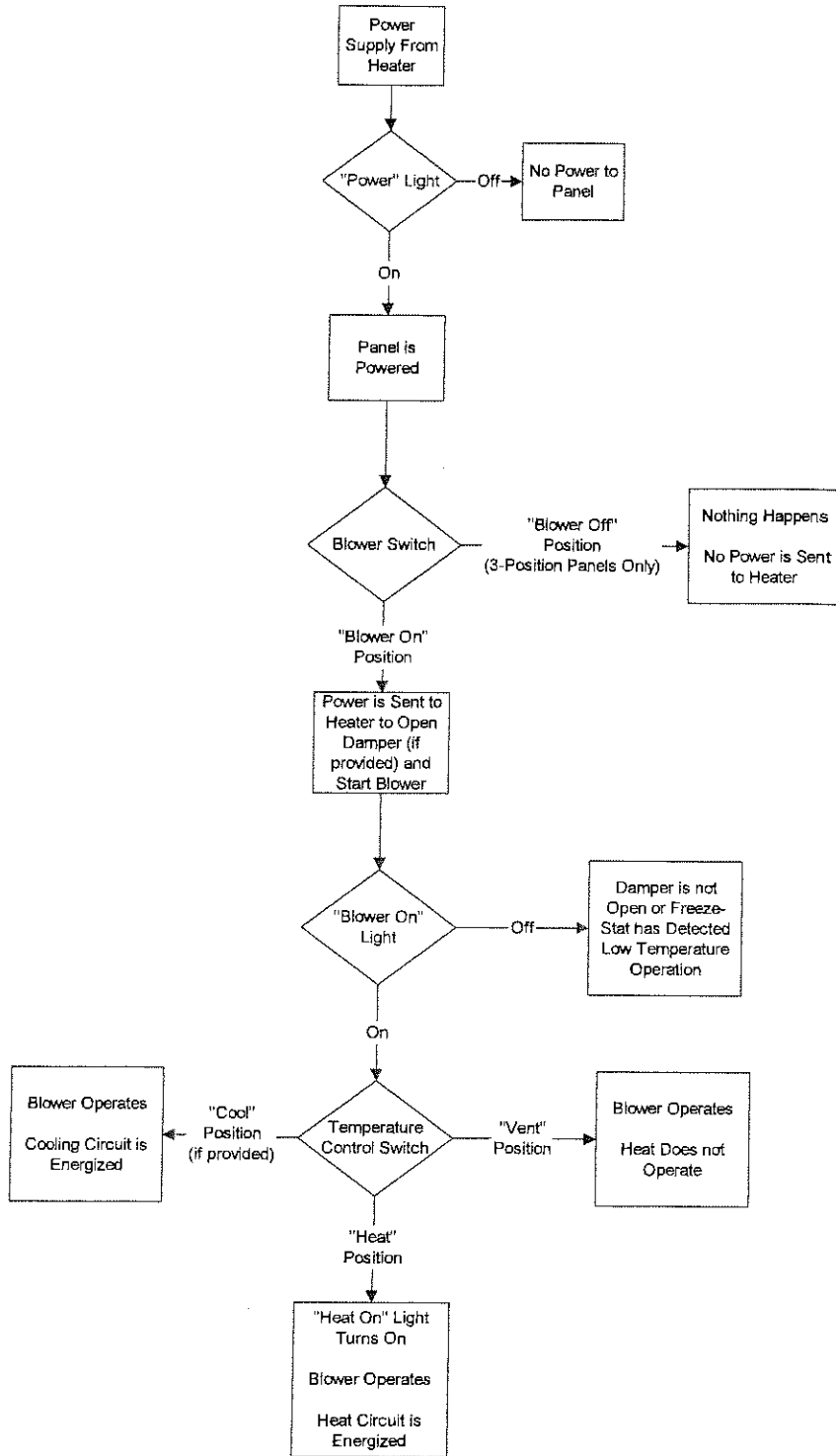
When this option is ordered, the supply and return dampers will modulate based on a 0-10 VDC signal from the Building automation system.

Operation Summary

- Main Blower is turned "On" and the Main Airflow Switch is proven.
- Air temperature at the intake of the unit falls below the setting of the Intake Air Thermostat sending 24Vac power "Call for Heat" to FSC-1 and FVFAB.
- FSC-1 sends 120Vac power to the line input of the Power-vent Blower Speed Controller.
- Air temperature at discharge of the unit falls below the setting on the Temperature Selector Dial.
- Power-vent Blower Speed Controller is controlled by the 10Vdc input signal from FVFAB and sends a 120Vac signal to Power-vent Blower Motor to initiate 1 min pre-purge at high speed.
- 24Vac signal runs through the safety circuit (Power-vent Airflow Switch/High Temperature Limit/Flame Roll-out Switch) and into FSC-1.
- FSC-1 initiates Trial for Ignition by sending signal to Spark Igniter to light furnace and 24Vac power to On/Off Gas Valve and signal to FVFAB that it is sparking. This opens On/Off Gas Valve and triggers the start of the 17 seconds of 10 VDC from the FVFAB to the Power-vent Blower Speed Controller(s) and modulating valve(s).
- Flame is sensed by FSC-1's Remote Flame Sensor at the upper-most firing tube of furnace.
- FVFAB's 17 second high-fire off-delay time sequence runs out and 0-10Vdc modulating signal from FVFAB is output to Modulating Gas Valve and Power-vent Blower Speed Controller.
- FVFAB continues to modulate the heat output of MAU by adjusting the 0-10Vdc signal to Modulating Gas Valve and turning other modulating furnaces or On/Off Staged Furnaces on and off as required to satisfy the Temperature Selector Dial setting.

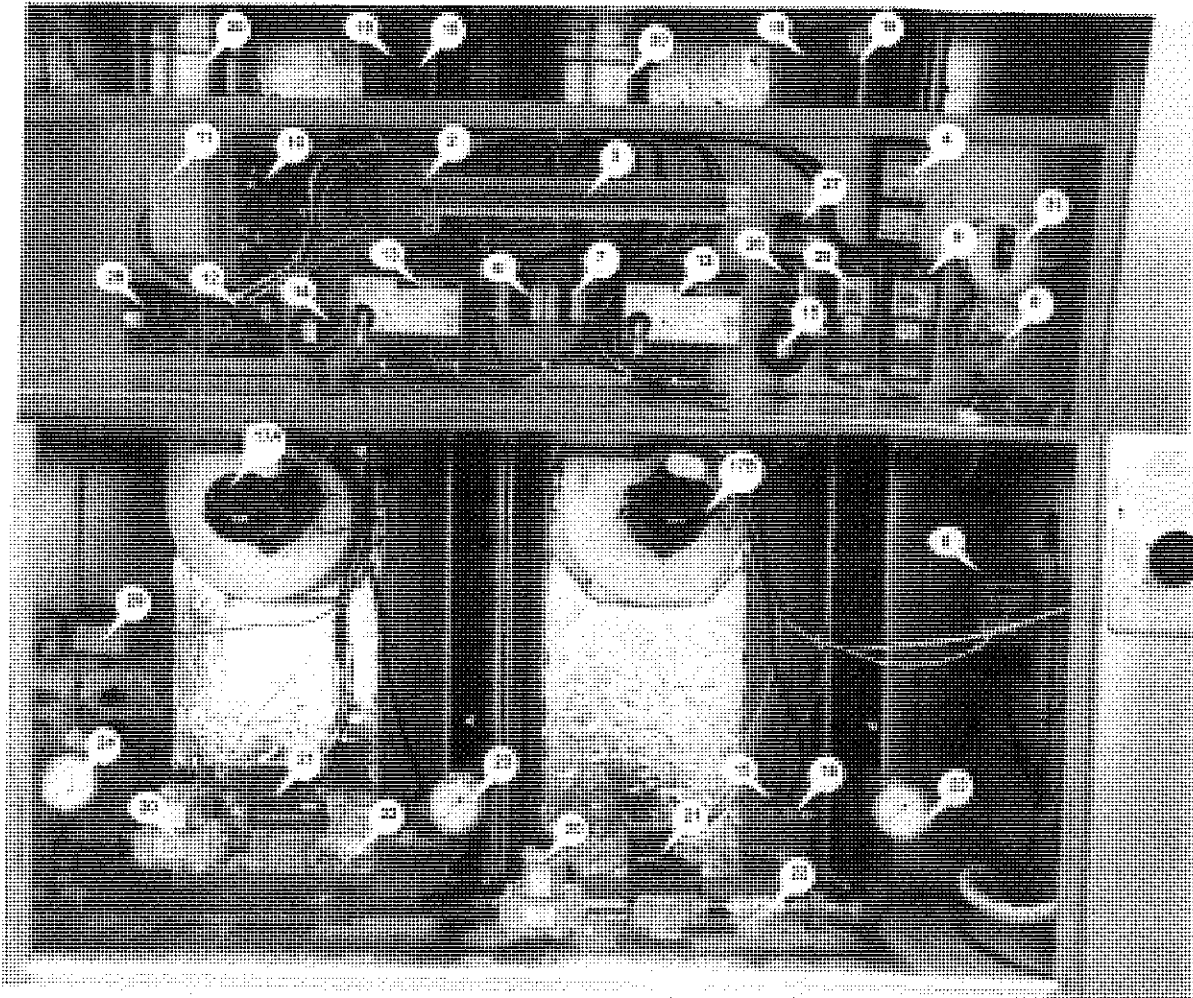
Note: If two modulating furnaces are present this sequence occurs with FSC-2 and a second speed controller if the call for heat dictates a need for a second furnace.

Optional Remote Panel Circuit



Components

The following image and list outlines the typical in-direct fired heater components and their functions.



1. **Main Disconnect Switch** – Controls all electrical power to entire unit.
2. **Circuit Breaker** – Protects electrical components from high current spikes.
3. **Terminal Strip** – Central location to terminate control wiring. Should be used for troubleshooting.
4. **Motor Starter** – Contactor with overload protection to start and protect motor.
5. **Variable Frequency Drive (Optional)** – Used in place of motor starter to protect main blower motor and to control the speed of the main blower to vary main airflow across unit.
6. **Control Transformer** – 120V primary; 24V secondary control transformer.
7. **Modulating Gas Valve Control Transformer** – 120V primary; 24V secondary control transformer. Provides standing 24V power to Modulating Gas Valve.
8. **Main Airflow Switch** – Senses that there is main airflow across the Heat-exchanger of the furnace. Adjustable set-point. Heater circuit will not energize unless proven.
9. **Intake Air Thermostat** – Energizes Flame safety control for the modulating furnace and the FVFAB controller if ambient temperature at intake drops below set-point. DOES NOT CONTROL THE TEMPERATURE AT WHICH THE UNIT HEATS THE DISCHARGE AIR TO (COMPONENT #11 USED FOR THIS PURPOSE).
10. **FVFAB** – Controls the 0-10 VDC signal to modulating furnace controls, modulating gas valve(s) and speed controller(s) and 24 VAC signals to staged furnace controls. Works in conjunction with component # 11.

11. **Discharge/Space Dial Temperature Control** – Controls the Discharge or Space temperature to which the heating module heats to and constantly tries to maintain. Mounted in the unit for discharge temperature control and remotely for space control.
12. **Modulating Furnace Power-vent blower Speed controller** – Controls the speed of the power-vent blower on the modulating furnace to maintain constant combustion efficiency. Dip-switches de-activated. Non-adjustable, comes pre-programmed from factory.
13. **Flame Safety Control** – Initiates and monitors flame. Equipped with non-adjustable time settings for pre-purge, inter-purge, and post-post of the exhaust flue and control cabinet.
14. **Power-vent Airflow proving Switch** – Normally open, non-adjustable airflow switch. Senses whether the power-vent blower is running and allows furnace to spark when airflow is proven.
15. **High Limit Switch** – Normally closed high temperature switch. De-energizes heater circuit on individual furnace if temperature exceeds mechanical set-point. Automatic recycling. 200°F set-point.
16. **Flame Roll-Out Switch** – Normally closed temperature activated switch. Mounted on bracket at inlet of the upper-most firing tube. Senses for any flame roll-out in the event of a blocked tube, low airflow, or low gas pressure. If flame-rollout is present, de-energizes heater circuit on individual furnace. Must be manually reset. 325°F set-point.
17. **Power-vent Motor**– Induces airflow through heat exchanger and flue of furnaces A) Modulating furnace variable speed blower motor. B) Non-modulating furnace constant speed blower motor.

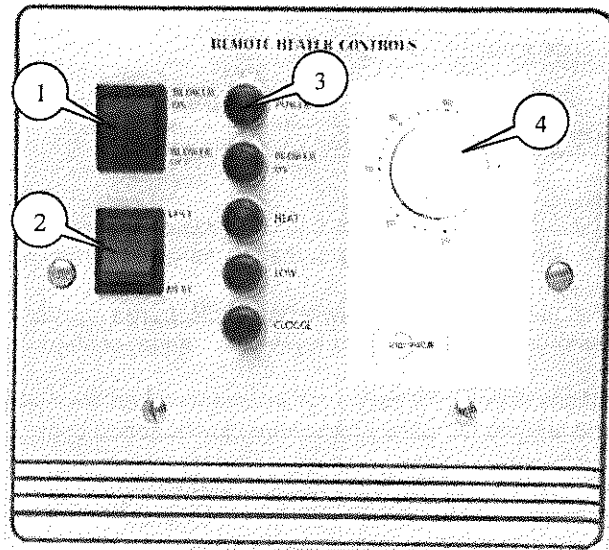
Power Vent Motor Orifice Size

Furnace BTU (x1000/hr)	Dia. (in.)
400	2.625
300	2.25
200	2.375
150	1.875

18. **Spark Igniter** – Powered by Flame safety control to initiate light-off.
19. **Flame Sensor** – Continuously Senses for the presence of flame in heating mode after ignition has commenced. Wired to Flame Safety Control.
20. **On/Off Redundant Gas Valve** – On/off gas valve with built in regulator and manual shut off switch. One used on each furnace gas train.
21. **Modulating Gas Valve** – Controls the amount of gas to the modulating furnace to meet desired discharge/Space temperature.
22. **Manual Gas Shut-Off Valve** - Allows gas flow to burner to be shut off to leak test gas train.
23. **Manifold Gas Pressure Gauge** – Indicates manifold gas pressure on individual furnace.
24. **Main Inlet Gas Pressure Gauge** – Indicates inlet gas pressure to unit.
25. **Cooling thermostat (Optional)** – Senses intake air temperature and initiates call for cooling if temperature rises above set-point.
26. **Cooling Relays (Optional)** – Powered by cooling thermostat. Contacts used to send power to the compressors in the condensing unit during a call for cooling.
27. **Remote Panel indicating light Relay (Optional)** – Contacts energize appropriate circuits to indicate to the user that the main Blower is running, there is a call for heat, or clogged filters.
28. **Freeze-Stat (Optional)** – Senses discharge temperature and shuts down power to the main blower if the temperature drops below the set-point for a time longer than what is set on the adjustable dial.
29. **Discharge Air Sensor** – Used on units with discharge temperature control to sense the temperature at discharge
30. **Exhaust Flue Pipe** – Ventilates combustion exhaust between the power-vent discharge and top of the unit.
31. **Dirty Filter Airflow Switch (Optional)** – Senses whether the filters at the intake to the main blower are free of dirt and contaminant.

Remote Panel Option

The Remote Panel is a device used to control the operation of the heater from a remote location. This unit is available in both a "2 Position" or "3 Position" configuration and with or without a cooling output. It also will accommodate both the Discharge and Space Temperature Control options. It is important to understand the following Remote Panel controls and uses:



- 1. Blower On/Blower Off Switch** - Used to control blower operation and tempering mode of unit. The **Blower On** position sends power to the blower motor and the heater begins to ventilate. The **Blower Off** position turns the blower and heating functionality off. This switch is disabled when the "2 Position" remote panel is ordered and fan power is then controlled by the pre-wire package.
- 2. Heat/Vent Switch** - This switch is used to control the tempering mode of the unit. The **VENT** position will prevent the burner from operating and the heater will deliver un-tempered air. The **HEAT** position will force the burner on and the unit will heat the incoming air. This switch becomes a Heat/Vent/Cool switch when the cooling interlock is ordered. This option provides a 120V cooling output from the remote panel.
- 3. Lights**- Displays the current status of unit features. The light definitions are as follows:
 - POWER** - Illuminated when there is power to Remote Panel.
 - BLOWER ON** - Illuminated when the blower motor is powered and airflow is present.
 - HEAT ON** - Illuminates after pilot flame has established and main valve is powered.
 - LOW TEMP** - (Optional) Illuminated when the Freeze-stat turns off blower.
 - CLOGGED FILTER** - (Optional) Illuminated when the Intake Filters are Dirty.
- 4. Temperature Control** - Controls the discharge temperature of a standard unit. The Temperature Selector Dial is included on the remote panel in Space Heating applications and is used to control the space temperature.

Modulating Furnace Thermostat Dip Switch Settings

C1025 Thermostat*		C1025-1000 Thermostat*		T920D-F Thermostat*	
Discharge Control		Discharge Control		Discharge Control	
S1	On	S1	On	S1	On
S2	Off	S2	Off	S2	Off
S3	Off	S3	Off	S3	On
Space Heating		Space Heating		Space Heating	
S1	Off	S1	Off	S1	Off
S2	On	S2	On	S2	On
S3	Off	S3	Off	S3	On

To test all furnace modules during startup, perform the following:

- Discharge Control: Disconnect one wire to the discharge air sensor to simulate a call for maximum heat output.
- Space Control: Set the Thermostat dipswitches to discharge control.

Once high and low fire gas pressure adjustments have been made, configure wiring and dipswitches to their original state.

*NOTE: All dip switch settings specific for each unit are displayed on the electrical schematic. Red dip switches located on the modulating furnaces power-vent blower speed controller are de-activated and should not be adjusted.

FVFAB Settings

The FVFAB has a user interface for choosing the number of stages in the furnace and the input control type. Number of stages can be selected from 1 to 4. Type of control input can be either 0-10 VDC, 2-10 VDC, 0-20 mA or 4-20 mA.

High Altitude Orifice Sizing

The burner orifices should be sized per the table below depending on fuel type, furnace size and altitude. Standard orifice sizes are for sea level. The unit should either be ordered with the altitude specific orifices or the parts should be ordered through CaptiveAire.

Natural Gas High ALT Conversion						
High ALT for 400,000BTU			High ATL for 300,000 to 75,000BTU			
Altitude	Input Rate	Drill Size	Input Rate	Input Rate	Input Rate	Drill Size
0 - 1999ft	400000	#41	300,000	200,000	150,000	#3/32
2000-2999ft	384000	#42	288000	192000	144000	2.35mm
3000-3999ft	368640	2.35mm	276480	184320	138240	2.3mm
4000-4999ft	353894	2.3mm	265421	176947	132710	#43
5000-5999ft	339739	#43	254804	169869	127402	2.25mm
6000-6999ft	326149	2.25mm	244612	163075	122306	#44
7000-8000ft	313103	#44	234827	156552	117414	2.15mm

LP Gas High ALT Conversion						
High ALT for 400,000BTU			High ATL for 300,000 to 75,000BTU			
Altitude	Input Rate	Drill Size	Input Rate	Input Rate	Input Rate	Drill Size
0 - 1999ft	400000	1.45mm	300,000	200,000	150,000	#54
2000-2999ft	384000	#54	288000	192000	144000	#54
3000-3999ft	368640	#54	276480	184320	138240	#55
4000-4999ft	353894	#54	265421	176947	132710	#55
5000-5999ft	339739	#54	254804	169869	127402	#55
6000-6999ft	326149	#55	244612	163075	122306	#55
7000-8000ft	313103	#55	234827	156552	117414	#56

Orifice Part Numbers		
Size	Part#	AX#
#41	BG100-41	A0023045
#42	BG100-42	A0023050
2.35mm	BG101-19	A0023053
2.3mm	BG101-05	A0023051
#43	BG100-43	A0023047
2.25mm	BG101-20	A0023054
#44	BG100-44	A0023046
#3/32	BG100-3/32	A0023044
2.15mm	BG101-21	A0023055
1.45mm	BG101-16	A0023052
#54	BG100-54	A0023048
#55	BG100-55	A0023049
#56	BG100-56	A0023057

Orifice Qty. Per Furnace	
Size	Qty
150,000 BTU	6
200,000 BTU	8
300,000 BTU	12
400,000 BTU	15

Troubleshooting

The following tables list causes and corrective actions for possible problems with in-direct heater units. Review these lists prior to consulting manufacturer.

Airflow Troubleshooting Chart

Problem	Potential Cause	Corrective Action
Fan Inoperative	Blown fuse or open circuit breaker	Replace fuse or reset circuit breaker and check amps
	Disconnect switch in "Off" position	Turn to "On" position
	Motor wired incorrectly	Check motor wiring to wiring diagram located on fan motor
	Broken fan belt	Replace belt
	Motor starter overloaded	Reset starter and check amps
	Remote panel set to "Blower Off"	Set Remote Panel to "Blower On"
Motor Overload	Fan rotating in the wrong direction	Be sure fan is rotating in the direction shown on rotation label
	Fan speed is too high	Reduce fan RPM
	Motor wired incorrectly	Check motor wiring to wiring diagram located on fan motor
	Overload in starter set too low	Set overload to motor FLA value
	Motor HP too low	Determine if HP is sufficient for job
	Duct static pressure lower than design	Reduce fan RPM
Insufficient Airflow	Fan rotating in the wrong direction	Be sure fan is rotating in the direction shown on rotation label
	Poor outlet conditions	There should be a straight clear duct at the outlet
	Intake damper not fully open	Inspect damper linkage and replace damper motor if needed
	Duct static pressure higher than design	Improve ductwork to eliminate or reduce duct losses
	Blower speed too low	Increase fan RPM. Do not overload motor
	Supply grills or registers closed	Open and adjust
	Dirty or clogged filters	Clean and/or replace
	Belt slippage	Adjust belt tension
Excessive Airflow	Blower speed too high	Reduce fan RPM
	Filters not installed	Install filters
	Duct static pressure lower than design	Reduce fan RPM
Excessive Vibration and Noise	Misaligned pulleys	Align pulleys
	Damaged or unbalanced wheel	Replace wheel
	Fan is operating in the unstable region of the fan curve	Refer to performance curve for fan
	Bearings need lubrication or replacement	Lubricate or replace
	Fan speed is too high	Reduce fan RPM
	Belts too loose, worn or oily	Inspect and replace if needed

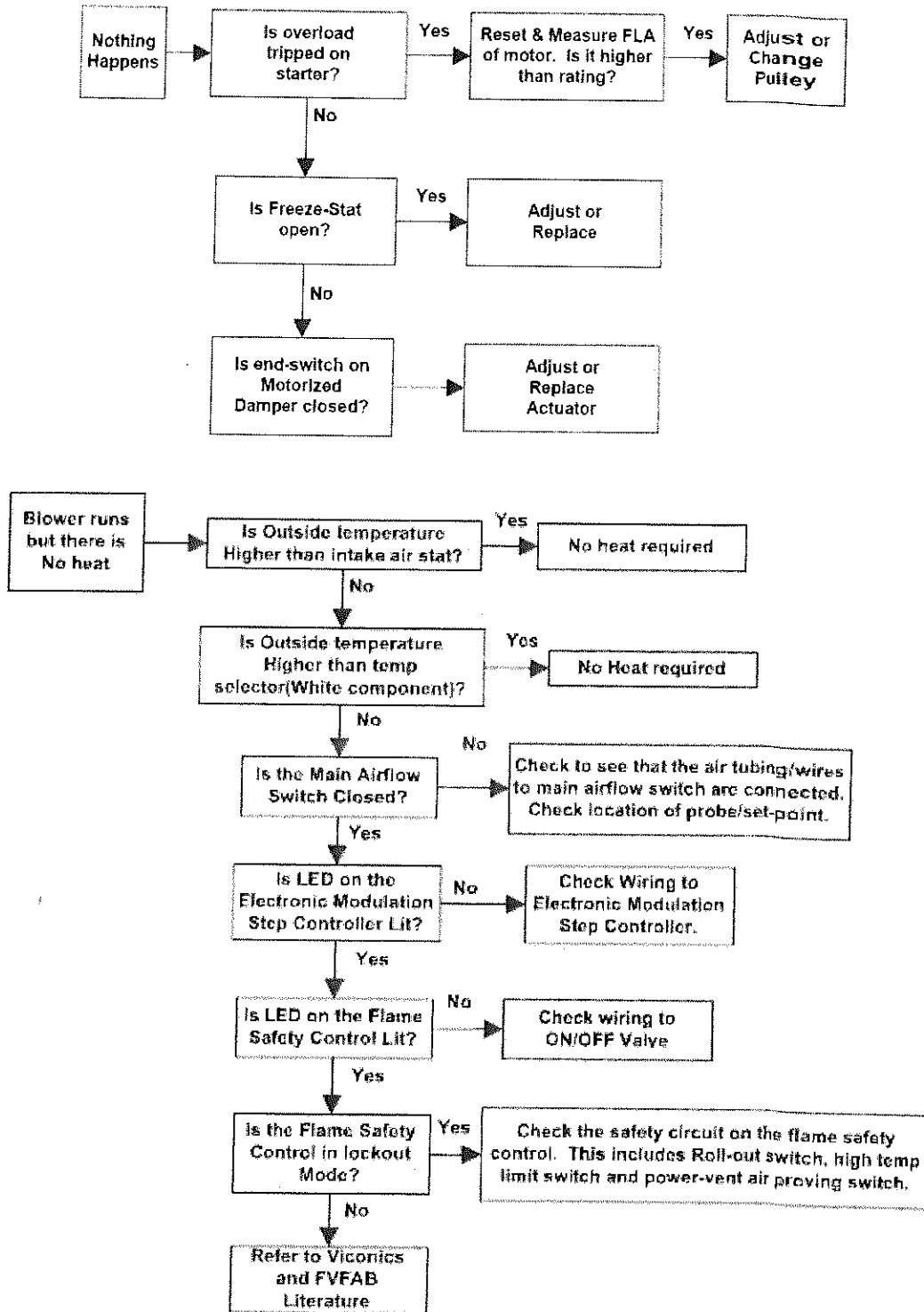
Furnace Troubleshooting Chart

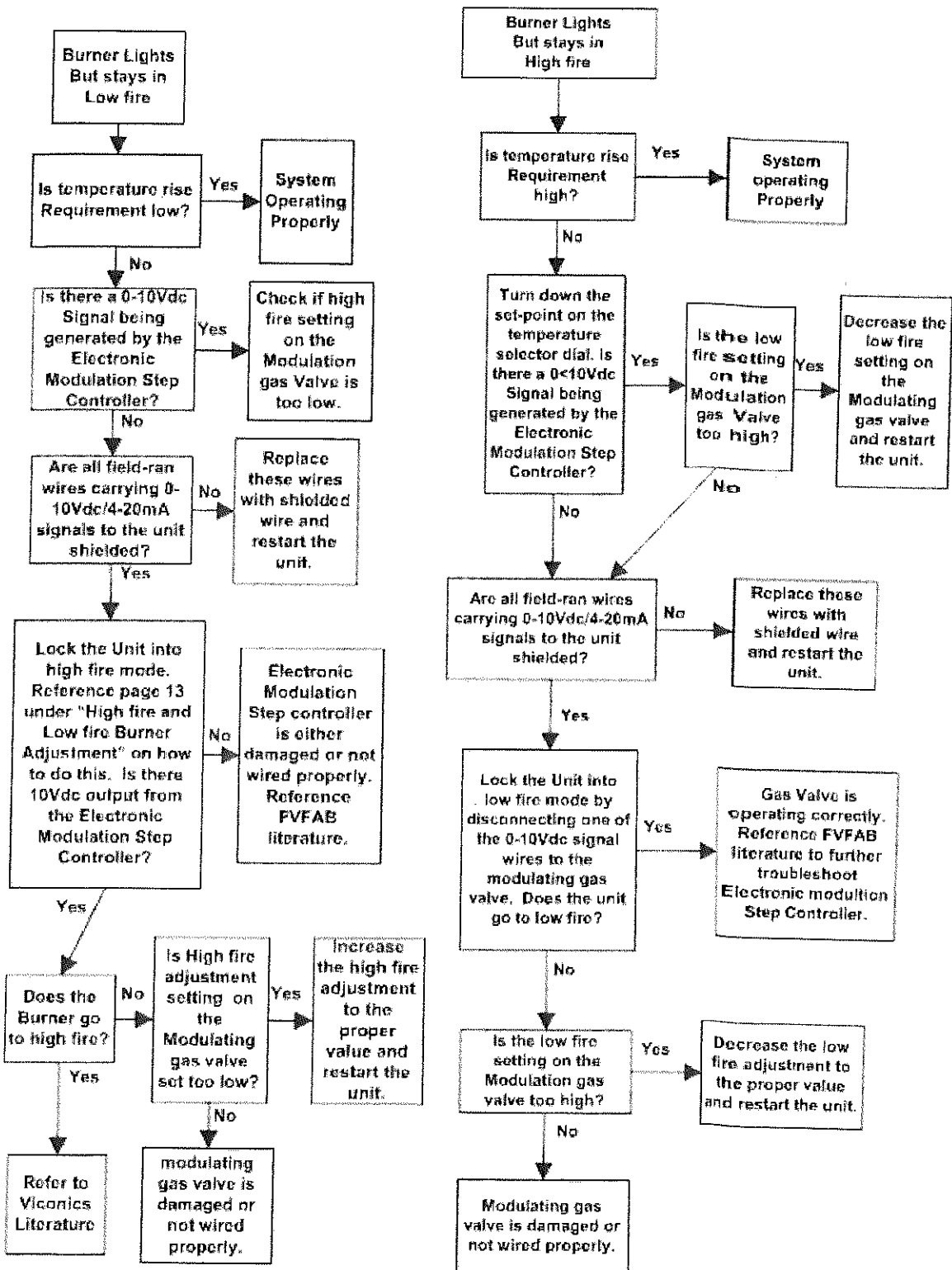
Problem	Potential Cause	Corrective Action
Furnace Does Not Light/Stay Lit	Main gas is off	Open main gas valve
	Air in gas line	Purge gas line
	Dirt in burner orifices	Clean orifices with compressed air
	Gas pressure out of range	Adjust to proper gas pressure
	ON/OFF Gas valve is off	Turn ON/OFF Gas valve on
	Spark Igniter Rod out of position	Relocate Spark Igniter Rod to proper area
	Excessive drafts	Re-direct draft away from unit
	Safety device has cut power	Check limits and airflow switch
	Dirty flame sensor	Clean flame sensor
	Remote panel in "Vent" mode	Change to "Heat" mode
	No spark at igniter	Check wiring, sensor, and ignition controller
	Defective valve	Replace ON/OFF or Modulator Gas Valve
	Loose valve wiring	Check wiring to valve
	Defective flame sensor	Replace flame sensor
	Shut off valve closed	Open shut off valve
	Defective Flame Safety Controller	Replace Flame Safety Controller
	Unit cycling on high limit	Increase airflow through furnace and check gas pressure
Not Enough Heat	Main gas pressure too low	Increase main gas pressure – do not exceed 14 in. w.c. inlet pressure
	Unit locked into low fire	Check wiring
	Too much airflow	Decrease airflow if possible
	Furnace undersized	Check design conditions
	Gas controls not wired properly	Check wiring
Too Much Heat	Thermostat setting too low	Increase thermostat setting
	Thermostat malfunction	Check/replace thermostat
	Defective modulating gas valve	Check/replace modulating valve
	Thermostat setting too high	Decrease thermostat setting
	Unit locked into high fire	Check Modulation Valve Settings/12Vdc source
	Thermostat wired incorrectly	Check the mostat wiring
Lifting Flames or Flashback	Too much primary air	Reduce primary air
	Manifold pressure set too high	Reduce manifold pressure
	Dirty orifice	Check and clean orifice
Yellow Tipping	Orifice too large	Check orifice size
	Insufficient primary air	Increase primary air
	Misaligned orifice	Check manifold alignment
Floating Flames or Flame Rollout	Insufficient primary air	Increase primary air
	Orifice too large	Check orifice size
	Manifold pressure too high	Decrease manifold pressure
	Blocked vent	Check venting system
	Misaligned orifice	Check manifold alignment

Remote Panel Troubleshooting Chart

Light Indication	Condition	Possible Cause	
No Lights	Power not available to Remote Panel	Bad voltage to unit	
		Main disconnect in "OFF" Position	
		Circuit breaker tripped	
POWER Light Only	Proper unit Off Operation	Bad main transformer	
		No problem	
	No power to motor starter	Blower On/Blower Off Switch in "Blower Off" Position	
		Improper damper function	
		Low Temperature Thermostat Timed Out (Option)	
	Improper Airflow		Insufficient Airflow
			Bad airflow switch
			Problem with air probes
			Problem with airflow tubing
			Broken Belt
POWER Light and BLOWER ON Light	Proper Ventilation Operation	No Problem	
		Heat/Vent Switch in "Vent" Position	
	No Power to Flame Safety Controller	Gas Pressure Switch Tripped (option)	
		High Temperature Limit Thermostat Tripped	
CLOGGED FILTER Light On (Optional)	Filters Clogged	Filters Dirty or Need Replacement	
LOW TEMP Light On (Optional)	Freeze-stat has shut blower down	Discharge Temperature Too Cold Heating System is not Functioning	
POWER Light and BLOWER ON Light and HEAT ON Light	Proper Heating Operation	No Problem	

Troubleshooting Flow-charts





MAINTENANCE

To guarantee trouble free operation of this heater, the manufacturer suggests following these guidelines. Most problems associated with fan failures are directly related to poor service and maintenance.

Please record any maintenance or service performed on this fan in the documentation section located at the end of this manual.

WARNING: DO NOT ATTEMPT MAINTENANCE ON THE HEATER UNTIL THE ELECTRICAL SUPPLY HAS BEEN COMPLETELY DISCONNECTED AND THE MAIN GAS SUPPLY VALVE HAS BEEN TURNED OFF.

General Maintenance

1. Fan inlet and approaches to ventilator should be kept clean and free from any obstruction.
2. Motors are normally permanently lubricated. Check bearings periodically. If they have grease fittings lubricate each season. Use caution when lubricating bearings, wipe the fittings clean, the unit should be rotated by hand while lubricating. **Caution: Use care when touching the exterior of an operating motor. Motors normally run hot and may be hot enough to be painful or cause injury.**
3. All fasteners should be checked for tightness each time maintenance checks are performed prior to restarting unit.
4. Blowers require very little attention when moving clean air. Occasionally oil and dust may accumulate causing imbalance. If the fan is installed in a corrosive or dirty atmosphere, periodically inspect and clean the wheel, inlet and other moving parts to ensure smooth and safe operation.
5. Before each heating season, verify that the drain on the bottom of each common flue box of every furnace in the unit is clear.

Re-Setting of the Unit

If the flame safety control is locked out (Spark igniter fails or no gas supply), reset the unit by:

1. Turn OFF Power to the unit.
2. Turn Power to the unit back ON.

Emergency shutdown of unit

To shut down the unit in the event of an emergency do the following:

1. Turn power OFF to the unit from main building disconnect.
2. Turn the external disconnect switch to the OFF position.
3. CLOSE the inlet gas valve located on the heater.

Prolonged shutdown of the unit

For prolonged shutdown the following steps should be done:

1. Turn the external disconnect switch to the OFF position.
2. CLOSE the inlet gas valve located on the heater.

To re-start the unit the following steps should be done:

1. Turn the external disconnect switch to the ON position.
2. OPEN the inlet gas valve located on the heater.

2 weeks after startup

1. Belt tension should be checked after the first 2 weeks of fan operation. Belts tend to stretch and settle into pulleys after an initial start-up sequence. **Do not tension belts by changing the setting of the motor pulley**, this will change the fan speed and may damage the motor. To re-tension belts, turn the power to the fan motor OFF. Loosen the fasteners that hold the blower scroll plate to the blower. Rotate the motor to the left or right to **adjust** the belt tension. Belt tension should be adjusted to allow 1/64" of deflection per inch of **belt span**. Exercise extreme care when adjusting V-belts as not to misalign pulleys. Any misalignment will cause a sharp reduction in belt life and produce squeaky noises. Over-tightening will cause excessive belt and bearing wear as well as noise. Too little tension will cause slippage **at startup** and uneven wear. **Whenever belts are removed or installed, never force belts over pulleys without loosening motor first to relieve belt tension.** When replacing belts, use the same type as supplied by the manufacturer. On units shipped with double groove pulleys, **matched belts** should always be used.
2. All fasteners should be checked for tightness each time maintenance checks are performed prior to restarting unit.

Every 3 months

1. Belt tension should be checked quarterly. See instructions in the previous maintenance section. Over-tightening will cause excessive bearing wear and noise. Too little tension will cause slippage at startup and uneven wear.
2. Filters need to be cleaned and/or replaced quarterly, and more often in severe conditions. Washable filters can be washed in warm soapy water. When re-installing filters, be sure to install with the **airflow in the correct direction** as indicated on the filter.

Filter Quantity Chart

Intake	16" x 20"	20" x 25"
Size 1 Sloped	3	
Size 2 Sloped		3
Size 3 Sloped	6	
Size 4 Sloped	10	
Size 5 Sloped		8
Size 1 V-Bank		3
Size 2 V-Bank	8	
Size 3 V-Bank		8
Size 4 V-Bank	15	
Size 5 V-Bank		12

Optional Mixing Box Filters

Diagonal Filters

Unit Size	Filter Quantity	Filter Size
1	4	10 x 16
2	2	20 x 25
3	4	15 X 20
4	4	18 X 25
5	9	14.5 x 19

Vertical Filters

Unit Size	Filter Quantity	Filter Size
1	1	10 x 16
2	1	16 x 25
3	2	15 x 15
4	2	16 x 20
5	3	14.5 x 19

Yearly

1. Before each heating season, verify that the drain on the bottom of each common flue box of every furnace in the unit is clear.
2. Inspect bearings for wear and deterioration. Replace if necessary.
3. Inspect belt wear and replace torn or worn belts.
4. Inspect bolts and set screws for tightness. Tighten as necessary.
5. Inspect motor for cleanliness. Clean exterior surfaces only. Remove dust and grease from the motor housing to ensure proper motor cooling. Remove dirt and grease from the wheel and housing to prevent imbalance and damage.
6. The heat exchanger should be checked for cracks. The heat exchanger should be replaced immediately if cracks are detected.
7. Inspect the combustion blower motor for cleanliness. Clean exterior surfaces of the combustion blower motor only. Removing excess dust and grease guarantees proper motor cooling.
8. Before each heating season, examine the burner and gas orifices. Inspect burner ports for foreign debris, heat exchanger, and spark igniter for cleanliness.

Start-Up and Maintenance Documentation

START-UP AND MEASUREMENTS SHOULD BE PERFORMED AFTER THE SYSTEM HAS BEEN AIR BALANCED AND WITH THE HEAT ON (Warranty will be void without completion of this form)

Job Information

Job Name	
Address	
City	
State	
Zip	
Phone Number	
Fax Number	
Contact	
Purchase Date	

Service Company	
Address	
City	
State	
Zip	
Phone Number	
Fax Number	
Contact	
Start-Up Date	

Heater Information

Refer to the start-up procedure in this manual to complete this section.

Name Plate and Unit Information	
Model Number	
Serial Number	
Motor Volts	
Motor Hertz	
Motor Phase	
Motor FLA	
Motor HP	
Blower Pulley	
Motor Pulley	
Belt Number	
Gas Type	
Min. Btu/Hr	
Max. Btu/Hr	

Field Measured Information	
Motor Voltage	
Motor Amperage**	
RPM	
Gas Type	
High Fire Inlet Gas Pressure	in. w.c.
Low Fire Manifold Gas Pressure	in. w.c.
High Fire Manifold Gas Pressure	in. w.c.
Thermostat Set-Point	
Temperature Control	Discharge
	Space

Airflow Direction	Correct
	Incorrect

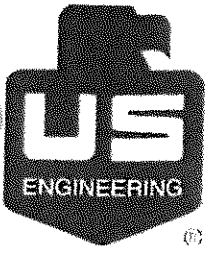
**If measured amps exceed the FLA rating on the nameplate, fan RPM must be reduced to decrease the measured amps below the nameplate FLA rating.

Maintenance Record

Date	Service Performed

Factory Service Department

Phone: 1-866-784-6900
Fax: 1-919-554-9374



Packaged, Outdoor,
Heating and Cooling MAU
Submittal Information:
MAU-1

**BEATTIE
ELEMENTARY
SCHOOL**

3000 MEADOWLARK AVE
FORT COLLINS CO 80526



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
---	---	--

Date: 4/11/2014	Reference Number: 0044
------------------------	-------------------------------

Transmitted To: Chris Mallory US Engineering Co. P.O. Box 905 Loveland, CO 80539	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
--	--

Qty	Submittal Package No	Description	Due Date	Package Action
4/11/2014013 - 237433 - 0		Make-Up Air Unit		Make Corrections Noted

Transmitted For	Delivered Via	Tracking Number
For Your Use and Corrections	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
001		Makeup Air Units - Product Data	237433		
002		Makeup Air Units - Shop Drawings	237433		

Cc: Company Name	Contact Name	Copies	Notes
FCI Constructors, Inc. - Longmont	File	1	

Remarks

Notes: 1. MAKEUP AIR UNIT (Make Corrections Noted)

1. Provide 2" pleated filters rather than washable filters.
2. This unit has been submitted with a factory control panel, controls are by TCC. Coordinate with specification section 230993. MAU shall be provided with remote BAS control input for heating capacity control to meet the sequence of operation.
3. Provide internal fan vibration isolation, factory disconnect switch, airflow proving switch, manual blower switch.

Signature	Signed Date
------------------	--------------------

TRANSMITTAL



Belford Watkins Group
Architects

Date: 4.10.14

Project: Beattie Elementary

To: Rob Price/DJ Anderson

From: Patti Watkins

We are transmitting the following submittals with the comments listed below:

ARCHITECTURE

INTERIORS

PLANNING

NET: No Exception Taken **MCN: Make Corrections Noted** **RX: Rejected**
RR: Revise and Resubmit **SSI: Submit Specified Item**
CMT: See Comment Below

237433 Make Up Air Unit

Copies	Section	Item	Manufacturer	NET	MCN	RR	RX	SSI	CMT
1	237433	Product Data, shop drawings	Captive Aire		x				1

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures, there from. The Contractor remains responsible for details and accuracy, for conforming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

Notes: 1. MAKEUP AIR UNIT (Make Corrections Noted)

1. Provide 2" pleated filters rather than washable filters.
2. This unit has been submitted with a factory control panel, controls are by TCC. Coordinate with specification section 230993. MAU shall be provided with remote BAS control input for heating capacity control to meet the sequence of operation.
3. Provide internal fan vibration isolation, factory disconnect switch, airflow proving switch, manual blower switch.



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
---	---	--

Date: 3/28/2014	Reference Number: 0021
------------------------	-------------------------------

Transmitted To: Don Watkins Belford Watkins Group P.O. Box 1306 Fort Collins, CO 80521 Tel: 970-212-1243	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001 N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
---	---

Qty	Submittal Package No	Description	Due Date	Package Action
1	013 - 237433 - 0	Make-Up Air Unit	4/11/2014	

Transmitted For	Delivered Via	Tracking Number
Review & Approval	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
		Makeup Air Units - Product Data	237433		
		Makeup Air Units - Shop Drawings	237433		

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

_____ Signature	_____ Signed Date	
Prolog Manager	Printed on: 3/28/2014 FCI PM Data	Page 1



4001 N. Valley Drive
 Longmont, CO 80504
 Phone: 970-535-4867
 Fax: 970-535-4867

DATE: 03/28/2014

SPECIFICATION SECTION(S): 237433
 SCOPE OF WORK: HVAC - Make-Up Air Unit

PROJECT: Poudre School District – Beattie Elementary School

PROJECT #: 30-13-038

ARCHITECT/DESIGNER: Belford Watkins Group, LLC.
 425 West Mulberry Ave., Suite 207
 P.O. Box 1306
 Fort Collins, CO 80521

PHONE: 970-407-0070

GENERAL CONTRACTOR: FCI CONSTRUCTORS, INC.
 4001 N. Valley Drive
 Longmont, CO 80504

PHONE: 970-535-4725
 FAX: 970-535-4867

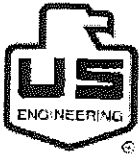
SUBMITTED BY: U.S. Engineering
 PO Box 905
 Loveland, CO 80539

PHONE: 970-669-1666
 FAX:

CONTRACTORS STAMP:

ARCHITECT/ENGINEER STAMP

FCI CONSTRUCTORS, INC.	
Review of this submittal is subject to the provisions of the Contract Drawings and Specifications. This action is for general concurrence only.	
<input checked="" type="checkbox"/>	Reviewed
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmit with Corrections
<input type="checkbox"/>	DISAPPROVED RESUBMIT
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmittal not Required.
Submittal Reviewed By: DA	Date: 03/28/2014
Submittal No: 013	Spec. Section: 237433



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 80539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-023

Date: 3/18/2014

Revision #: _____

Discipline: Tinner

Project : Beattie Elementary

Project #: 1202

Supplier : Air Purification

Spec Sect: 23 74 33

Submitted Items:			
Page Number	Paragraph Number	Description	Manufacturer
23 74 33-2	2	Make-Up Air Unit MAU-1 and Curb	CaptiveAire Lead Time-35 business days

Target Dates:				
Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
3/11/14	3/18/14	3/28/14		

GC/Arch/Engineer Stamp Area:

Signed: *Chris Mallory*
Chris Mallory

U.S. Engineering

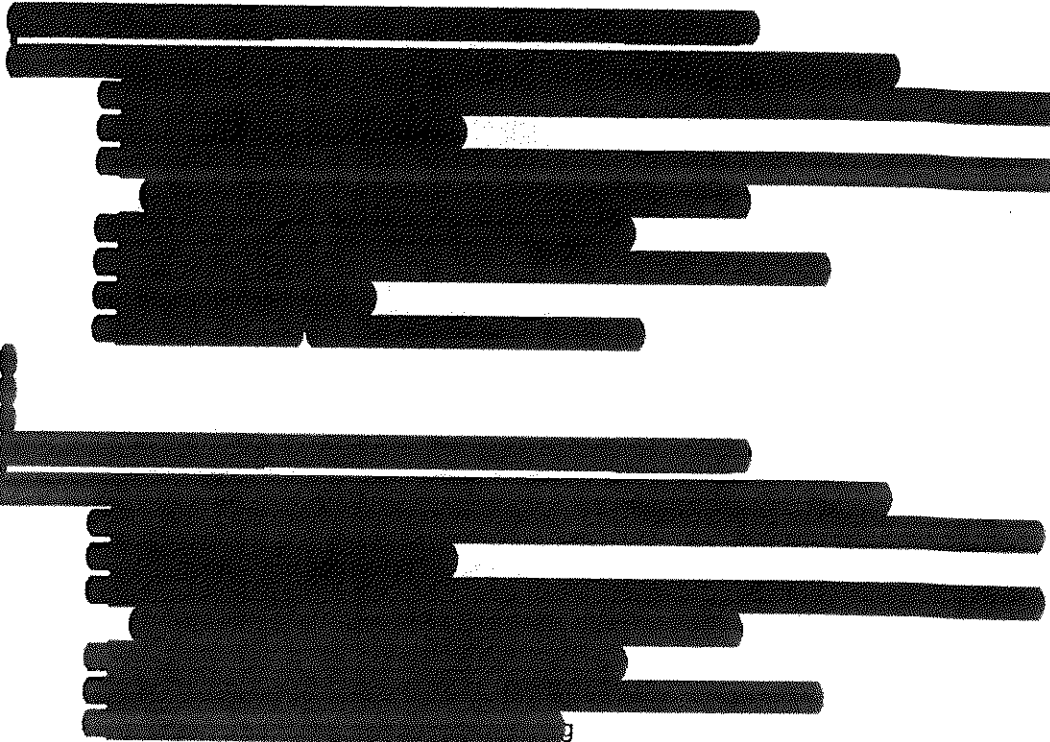


Air Purification Company

1861 West 64th Lane, Denver, Colorado 80221

Phone: 303.428.2800 • Fax: 303.428.2700

Kitchen Equipment



INDIRECT FIRED MAKE-UP AIR UNIT – CAPTIVE AIRE, A1 Model (KMUA-1)

1 – A1-IBT-300-150-G10 Indirect Bent Tube Gas Fired Heater with 10" Blower, 2 Furnaces, Electronic Full Modulation, Constant 80% Efficiency, and 12:1 Max Turndown for NG. Stainless Steel Burners and Heat Exchangers

- Supply Fan: 1,960 cfm @ 0.50" sp with 1 HP-208/3/60-ODP Motor
- Configuration: Down Discharger, Airflow Right to Left
- EZ V-Bank Metal Mesh Filters
- Screened Intake for Outdoor Installation
- 50-90°F Discharge Temp Control
- Motorized Backdraft Damper
- Separate 120v Electrical Connection (*120v must be run by electrician from building panel to mua switch*)
- Gas Pressure Gauges
- Discharge Firestat for Heaters set to 240°F
- Clogged Filter Switch
- Rails and Curb as detailed on submittal drawing

(Continued on Next Page)

REV	DESCRIPTION	DATE
1	REVISED	3/4/2014

REVISIONS



GENERAL OFFICE

Beattie Elementary
Greeley, CO

DATE: 3/4/2014
DWG: BDP-42
SCALE: 3/4" = 1'-0"
MASTER DRAWING

SHEET NO. 2

EXHAUST FAN INFORMATION - JOB# 1362507

FAN NO.	TAG	FAN UNIT MODEL #	CFM	ESP	RPM	HP	#	VOL. FLA	WEIGHT	CLS-BDNCS
1	REF-1	REAFPA	2439	0.600	1240	0.720	3	408	2.7	137

FAN NO.	TAG	FAN UNIT MODEL #	SECTOR	CFM	ESP	RPM	HP	#	VOL. FLA	WEIGHT	CLS-BDNCS
2	KMA-1	AI-181-200-150-100-010	G10	AI-181-200-150-100	1500	1023	1.020	3	200	3.5	171

FAN NO.	TAG	ACTUAL BRGTS	TEMP. RISE	REQUIREMENT	GAS TYPE
1	KMA-1	YES	4193K	192749	SI 469 F

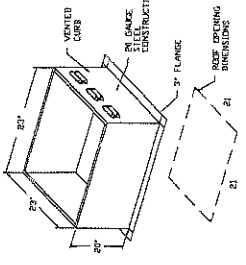
- FAN OPTIONS**
- 1 - Extra Set of Brkts
 - 1 - Exhaust Fan Wheel Access Port
 - 1 - 1/2" Dia. Screen
 - 1 - 1/2" Dia. Screen
 - 1 - Fan Base Grate Seal - Fan Grate Brkts
 - 1 - Special support for 1/2" Inlet Pressure
 - 1 - Motorized Recirculator Bumper for all Housing
 - 1 - Special Interlock Connection with and vertical panel for Standing Power - No. 100 or 1/2" Inlet Pressure must be selected. Do not provide supply.
 - 1 - Inlet Pressure Gauge, 0-25"
 - 1 - Nonfield Pressure Gauge, 0 to 10" w.c. 2 Pressure
 - 1 - Extra Set of Brkts
 - 1 - Discharge Pressure Set to 249"
 - 1 - Dropped filter switch with no venturi pump

FAN ACCESSORIES

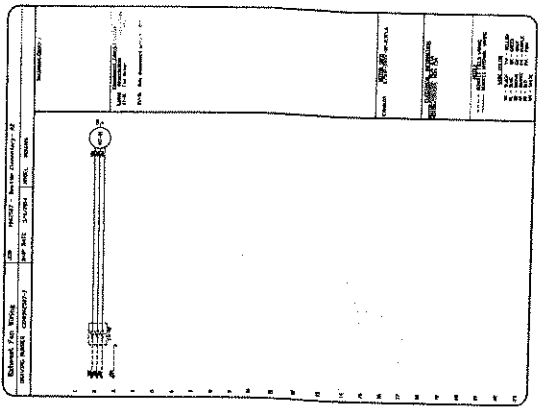
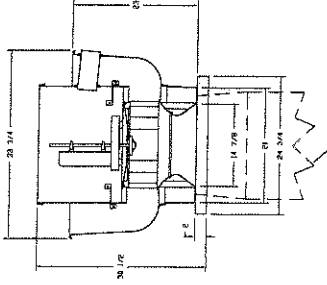
FAN UNIT NO.	EXHAUST CUP	EXHAUST RAMPER	EXHAUST MOUNT	EXHAUST CONSOLE	EXHAUST VALVE	EXHAUST PANEL
1	REF-1	YES	NO	NO	NO	NO
2	KMA-1	YES	NO	NO	NO	NO

CURB ASSEMBLIES

NO.	DN	WT	HT	ITCN	SIZE
1	FAN	58 LBS	23.000"	23.000"	23.000" x 23.000" x 23.000"
2	FAN	10 LBS	10.000"	10.000"	10.000" x 10.000" x 10.000"
3	FAN	50 LBS	24.000"	24.000"	24.000" x 24.000" x 15.000"



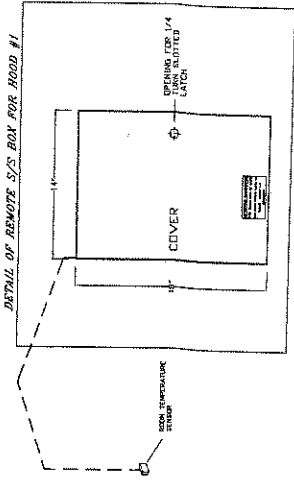
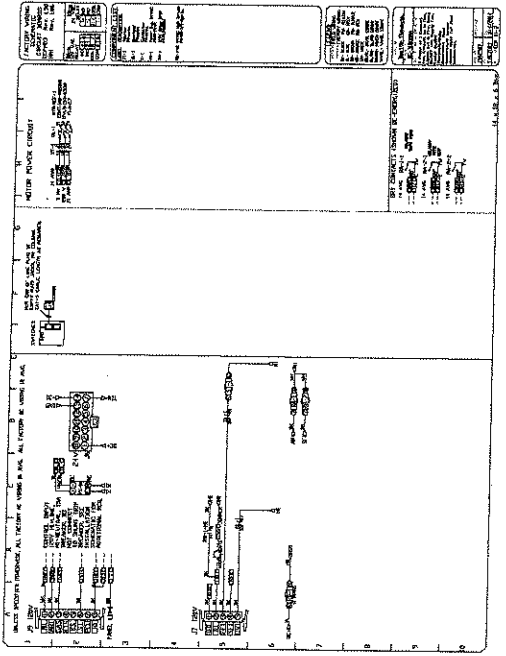
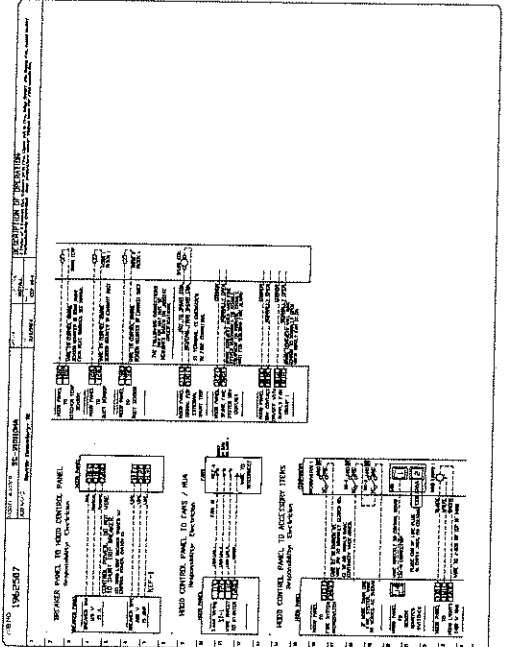
- FEATURES**
- ROT MOUNTED FANS
 - HIGH SPEED AIR CONFIDENT
 - 1/2" DIA. AIR INLET
 - 1/2" DIA. AIR OUTLET
 - MANIFOLD SUPPORT
 - HIGH SPEED OPERATION (NOT APPLICABLE)
 - SPECIAL CONSTRUCTION TESTING
- NORMAL TEMPERATURE TEST** - CONTINUOUSLY WHILE OPERATING AT 100% CAPACITY. NORMAL TEMPERATURE AND VIBRATION SHALL BE WITHIN THE FAN WHEN VOLTAGE CORRECTED TO 100%.
- ABNORMAL FLAG-UP TEST** - CONTACT FAN MUST BE OPERATIONAL CONTINUOUSLY AT 100% CAPACITY FOR A PERIOD OF 24 HOURS. VOLTAGE CORRECTED TO 100%. VIBRATION SHALL BE WITHIN THE FAN WHEN VOLTAGE CORRECTED TO 100%.
- CEILING**
- FAN SET IN BELL
 - ACCESS PORT
 - 1/2" DIA. AIR INLET
 - 1/2" DIA. AIR OUTLET
 - FAN BASE GRATE SEAL - FOR WEARAGE BRKTS

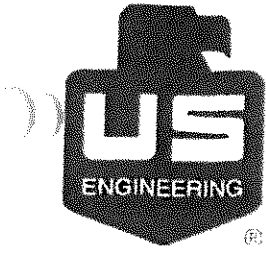


ELECTRICAL PACKAGES - J0411822807

NO.	TAG	PACKAGE #	LOCATION	SWITCHES	QUANTITY	OPTION
1		EC-210104	Wall Mount in SS Box	1 1/2" x 1/2" x 1/2" (1) Fan	1	Smart Control: Thermoelectric Control or Relay Drift/Off with Supply

FANS CONTROLLED	
TYPE	# HP, VOL, FLA
Exhaust	3 @ 275 208 27

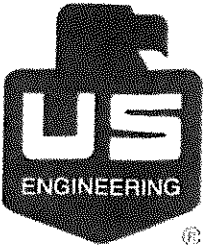




Tab-11
Specification Section: 23 82 16
Air Coils:
C-1 (Daikin)
C-3 (Daikin)
C-4 (Daikin)
C-5 (Daikin)

**BEATTIE
ELEMENTARY
SCHOOL**

3000 MEADOWLARK AVE
FORT COLLINS, CO 80526



Air Coils (Daikin) O&M
and Warranty
Information:

- C-1
- C-3
- C-4
- C-5

**BEATTIE
ELEMENTARY
SCHOOL**

3930 MEADOWLARK AVE
FORT COLLINS CO 80526

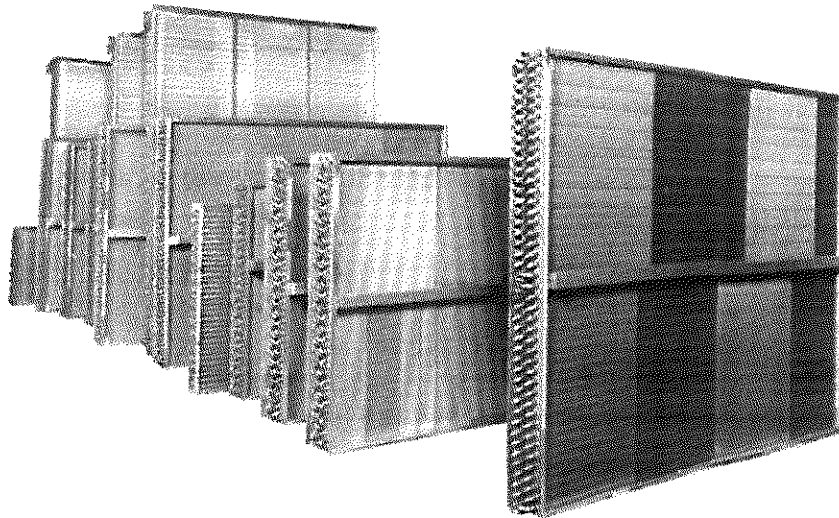
McQuay Water Cooling, Heating, and High Capacity Booster Coils

Group: Applied Air

Part Number: IM 900

Date: February 2008

Types HI-F5, E-F5



Contents

Introduction	3	Operation and Maintenance	5
General Information	3	Operation	5
Hazard Identification Information	3	Initial Start-Up	5
Receiving Instructions	3	General	5
Coil Types	3	Maintenance	5
Standard Fluid Coils	3	General	5
Nomenclature	3	Blowing-Out Coils	6
Installation	4	Freeze Protection Fittings	6
Mounting	4	Flushing Coils	7
Installation	4		

General Information

These are general guidelines for the installation, operation and maintenance of McQuay water heating and high capacity booster coils. They may have to be tailored to meet the specific requirements of any one job. An experienced installation company or fully trained personnel should perform the installation and maintenance of any coil.

Hazard Identification Information

⚠ DANGER
Dangers indicate a hazardous situation which will result in death or serious injury if not avoided.

⚠ WARNING
Warnings indicate potentially hazardous situations, which can result in property damage, severe personal injury, or death if not avoided.

⚠ CAUTION
Cautions indicate potentially hazardous situations, which can result in personal injury or equipment damage if not avoided.

Receiving Instructions

- 1 All McQuay fluid coils are factory tested at 315 psig minimum air pressure while submersed in water, inspected, and carefully packaged.
- 2 Damage to the coils can occur after they have left the factory. Therefore, the coils should be inspected for shipping damage upon receipt. The freight bill should also be checked against items received for complete delivery.

- 3 Damaged and/or missing items should be noted on the carrier's freight bill and signed by the driver.
- 4 For additional assistance, contact your local McQuay sales representative.

Coil Types

Standard Fluid Coils

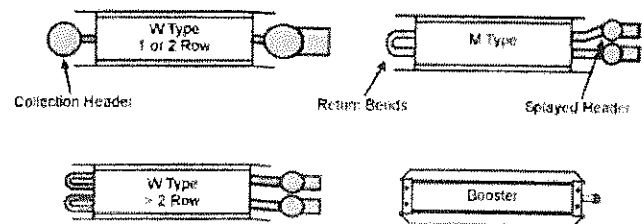
McQuay fluid coils are specifically designed for your particular application. Flexibility is built into our manufacturing processes, offering variations in fin type, fin density, circuitry arrangement, coil casing, and materials of construction.

Standard fluid type "W" coils utilize a collection header for one and two row applications and return bends for applications that require three or more rows.

Type "M" coils are used for one and two row applications that require same end connections. For type "M" coils, the supply and return headers are offset or "splayed." This orientation allows for the supply and return headers to be placed side by side.

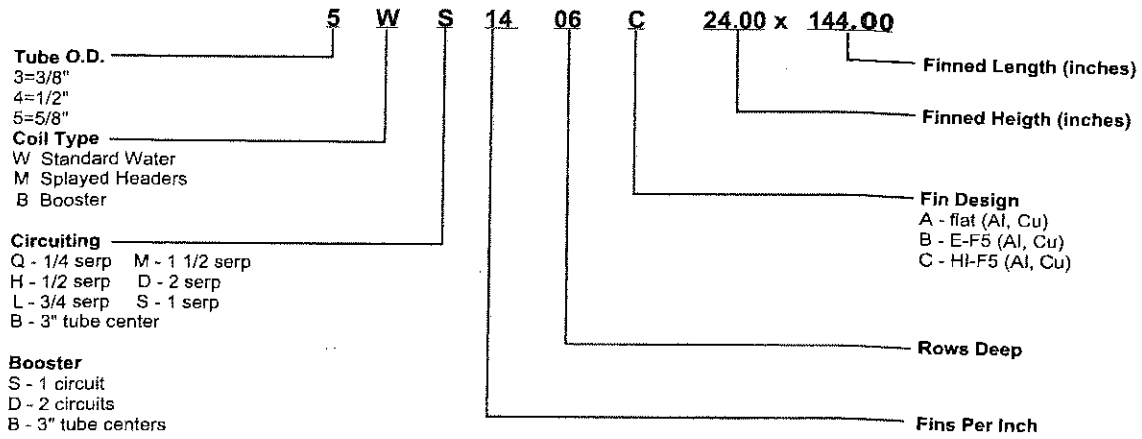
Booster coils, type "B," are also available for one and two row applications.

Figure 1: Coil Types



Introduction


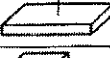
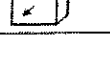
Nomenclature

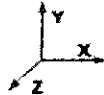


Mounting

All McQuay water and glycol coils are designed to be fully drainable when properly mounted. Vertical air-flow is not recommended for dehumidifying coils.

Figure 2: Coil Mounts

	Horizontal Air Flow Horizontal Tubes	Level with the y-axis and x-axis.
	Vertical Air Flow Horizontal Tubes	Level with the z-axis and x-axis.
	Horizontal Air Flow Vertical Tubes	Level with the y-axis and x-axis.



Installation

CAUTION

Sharp edges on sheet metal and fasteners can cause personal injury. This equipment must be installed, operated, and serviced only by an experienced installation company and fully trained personnel.

Protective equipment such as safety glasses, steel toe boots and gloves are recommended during the installation and routine maintenance of the coil.

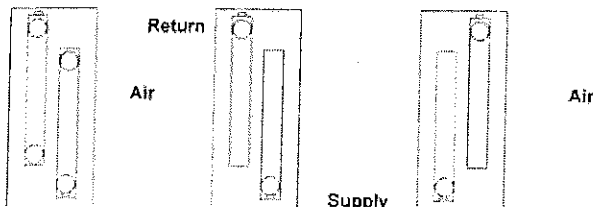
CAUTION

Failure to properly install the coil can result in irreparable damage to the coil as well as other components in the system.

If you are unsure about any portion of the installation, contact your local steam specialist for assistance.

- Carefully remove the coil from the shipping package to avoid damage to the finned surface area. Damaged fins can be straightened using an appropriate fin comb.
- McQuay recommends cleaning the coil with a commercially available coil cleaner prior to installation. Refer to "Maintenance" on page 5 for cleaning recommendations.
- Check the coil hand designation to insure that it matches the system. Water and glycol coils are generally plumbed with the supply connection located on the bottom of the leaving air-side of the coil and the return connection at the top of the entering air-side of the coil. This arrangement (Figure 2) provides counter flow heat exchange and positive coil drainage. If a universal coil is supplied, cap off the two unused connections.

Figure 3: Supply and Return Locations



- Standard coils must be mounted level to insure proper drainage. Refer to "Mounting" on page 4 for leveling requirements.
- Proper clearance should be maintained between the coil and other structures such as the fan, filter racks, transition areas, etc.
- Once installed, the coil should be pressurized to 100 psig with dry nitrogen or other suitable gas. The coil should be left pressurized for a minimum of 10 minutes. If the coil holds the pressure, the hook-up can be considered leak free. If the pressure drops by 5 psig or less, re-pressurize the coil and wait another 10 minutes. If the pressure drops again, there is more than likely one or more small leaks which should be located and repaired. Pressure losses greater than 5 psig would indicate a larger leak that should be isolated and repaired. If the coil itself is found to be leaking, contact your local McQuay sales representative.

Note: Unauthorized repair to the coil may void the coil's warranty (see McQuay's warranty policy on back cover).

- All field brazing and welding should be performed using high quality materials and an inert gas purge (like nitrogen) to reduce oxidation of the internal surface of the coil.
- All field piping must be self-supporting. System piping should be flexible enough to allow for thermal expansion and contraction of the coil. Typical piping diagrams are represented in Figure 4 and Figure 5.

Figure 4: Horizontal Air Flow

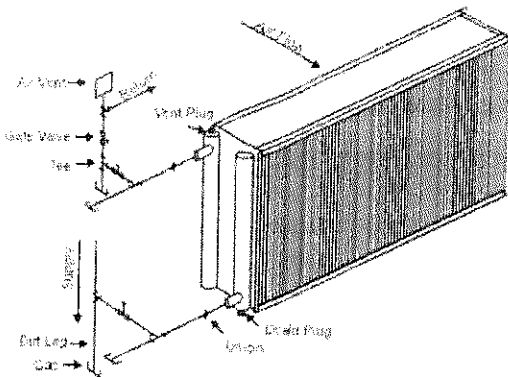
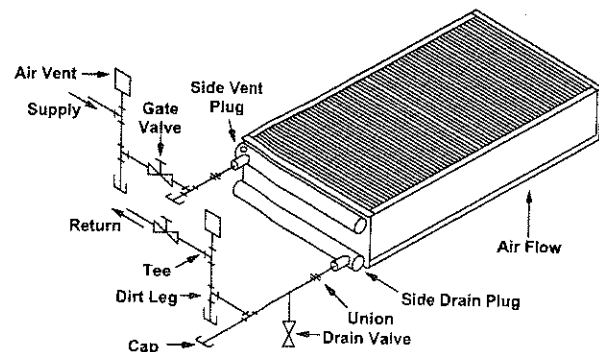


Figure 5: Vertical Air Flow



Operation and Maintenance

Operation

Initial Start-Up

- 1 Open all air vents to eliminate air in the coil circuitry and headers.
- 2 Verify that all vents and drains are unobstructed and can discharge a stream of water.
- 3 Fill the coil with water and then close all vents.
- 4 Perform an initial hydrostatic leak test of all brazed, threaded or flanged joints, valves, and interconnecting piping. Recheck the coil level and correct if necessary. When the setup is found to be leak free, discharge and discard initial water charge. It is important that all grease, oil, flux and sealing compounds found present during installation be removed.

General

- 1 Proper air distribution is vital to coil performance. Airflow anywhere on the coil face should not vary by more than 20%.
- 2 The drain pan and associated piping (drain line and trap) should be installed so that there is no standing water in the drain pan and that no blow-through occurs.
- 3 Working pressure rating is 250 psig @ 300°F (standard)
- 4 Fluid and air velocities should be maintained within McQuay's recommended values and for ARI certification.

Table 1: Fluid Velocities

Fluid Velocity	
Water	1 to 8 fps
Glycol	1 to 6 fps

Maintenance

DANGER

Follow the manufacturer's guidelines for lockout/tagout and disconnect all power to the unit before performing maintenance. Contact with high voltage power will cause electrical shock, resulting in severe personal injury or death.

WARNING

Moving parts, high pressure, and/or high temperature fluids can cause serious personal injury.

General

- 1 Filters should be inspected on a regular basis and changed as needed. Maintaining clean filters is a cost effective way to help maintain maximum coil performance and service life.
- 2 Periodic inspection of the coil for signs of corrosion and/or leaks is recommended. Repair and replacement of the coil

and the connecting piping, valves, etc., should be performed as needed by a qualified individual.

- 3 Should the coil surface need cleaning, caution should be exercised in selecting the cleaning solution as well as the cleaning equipment. Improper selection can result in damage to the coil and/or health hazards.
- 4 Suggested cleaning instructions:
 - a When handling strong chemicals, be sure to wear chemical impervious gloves, apron and splash goggles.
 - b Acti-Brite (AB-1) is the recommended cleaning solution. For more information, contact your local McQuay Parts Distributor.
 - c Determine required dilution for the specific application. It is recommended to start with a dilution ratio of 10:1 and increase concentration until the desired results are achieved.
 - d As with mixing all acids, place the desired amount of water into the tank and then add the chemicals.
 - e Turn off fans and allow hot coils to cool before applying.
 - f Using plain water, wet both the coil as well as the area surrounding the equipment. Wetting the coil with water aids in product penetration and performance.

CAUTION

Carefully read and follow the manufacturer's recommendations before using any cleaning fluid.

- g Apply properly diluted product to coil surface. Whenever possible, apply solution from the outlet side of the coil. Allow solution to remain on surface, normally 5-10 minutes. Do not allow solution to dry on the coil.

Note: In extreme cases, application may have to be repeated to achieve desired results.

- h If foaming does not occur, check for extreme grease buildup which will slow the cleaning process. Foaming may not occur if coil is coated or painted.
 - i Rinse coils, tools, and surrounding area thoroughly after the coil cleaning.
- 5 Clean the coil from the leaving airside so that foreign material will be washed out of the coil rather than pushed further in.
 - 6 Maintain the circulated fluid free of sediment, corrosive products, and biological contaminants. Periodic testing of the fluid followed by any necessary corrective measures, along with maintaining adequate fluid velocities and proper filtering of the fluid, will help to satisfy this goal.
 - 7 If automatic air vents are not utilized, periodic venting of the coil is recommended to remove accumulated air.

Blowing-Out Coils

- 1 Isolate the coil from the rest of the system by closing the valves on both the supply and return lines (see gate valves in Figure 5 and Figure 6).
- 2 Drain the coil by opening all drain valves and/or the drain plug. Remove the vent plug to aid the draining process.
- 3 Once the coil has been fully drained, the blower compressed air can be hooked-up. Caps installed in the piping on straight runs going to the supply and return connections are ideal points to hook-up the blower. The air vent and drain plug are not suitable locations for hooking up the blower.

⚠ DANGER

The blower operator must take precautions to insure that water does not come into contact with any of the electrical components of the blower. Failure to do so will result in damage to the equipment and serious injury.

- 4 Close the vent or drain plug on the header that the blower is connected and open the drain valve or cap on the other header.
- 5 Operate the blower for 45 minutes and then check the coil to see if it is dry. A mirror placed in the discharge will become fogged if moisture is present. Repeat this procedure until the coil is dry.
- 6 Let the coil stand for several minutes then blow it out again. If water comes out, repeat the blowout operation.
- 7 Leave all plugs out and drains open until the threat of freezing has passed.

Figure 6: Horizontal Air Flow

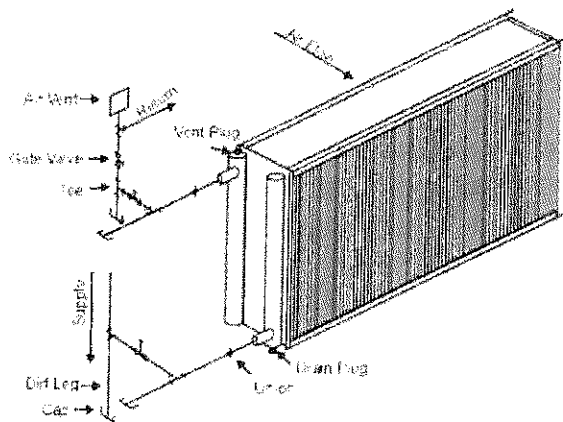
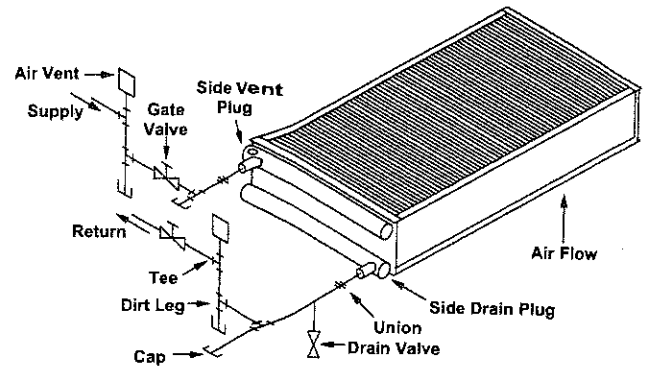


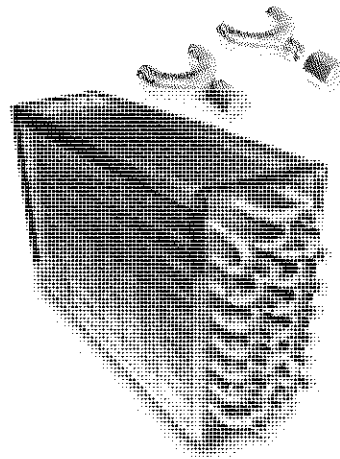
Figure 7: Vertical Air Flow



Freeze Protection Fittings

During the winter, chilled water coils need to be protected against freezing. Factory installed and tested freeze protection fittings are brazed onto water and steam coil headers, return bends and tube stubs (as necessary) as part of the factory assembly process. Freeze relief caps are then screwed onto each fitting. All coils are leak tested at 315 psi air pressure before shipping. The relief caps are designed to burst at 650 psig, relieving pressure before coil damage occurs. When freeze damage occurs, simply unscrew the ruptured relief caps and screw in replacement caps.

Figure 8: Freeze Protection Fittings



Operation and Maintenance

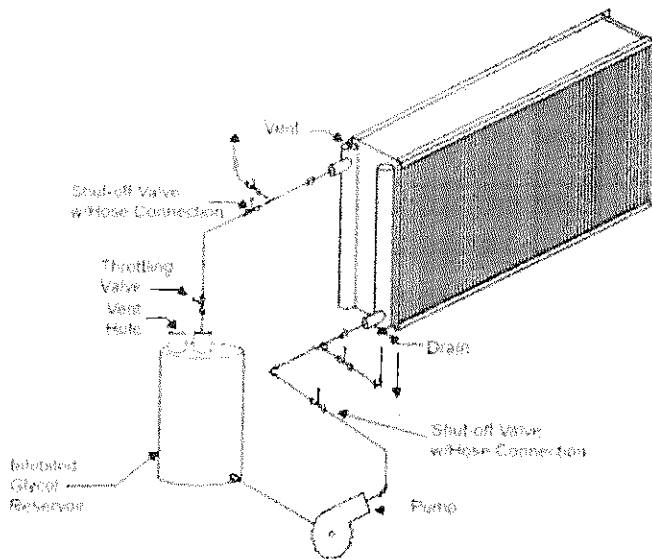
Flushing Coils

- 1 McQuay recommends the use of inhibited glycol designed for HVAC applications for corrosion protection. The use of uninhibited glycol has produced formicary corrosion in copper tubing. The complete filling of water coils with an inhibited glycol solution for freeze protection can be expensive. In some instances, it is more cost effective to flush the coils with an appropriate concentration of inhibited glycol solution. Residual fluid can be left in the coil without the threat of freeze damage provided the correct concentration of inhibited glycol was used. The recovered fluid can then be used to flush other coils. Select an inhibited glycol solution that will protect the coil from the lowest possible temperatures that can occur at the particular coil's locality.
- 2 Estimate the volume of the coil in gallons. For 5/8" tubes (1.5" face tube spacing) (finned height in inches) x (finned length in inches) x (# of rows) x 0.0011 = gallons.
- 3 Isolate the coil from the rest of the system by closing the valves on both the supply and return lines (gate valves in Figure 5 and Figure 6).
- 4 Drain the coil by opening all drain valves and/or the drain plug. Remove the vent plug to aid the draining process.

- 5 Close the drain valve(s) and drain plug.
- 6 Connect the flushing system to the coil. A typical system is shown in Figure 9.
- 7 With the throttling valve closed, start the pump and operate until the air is vented from the coil. After venting, close the air vent.
- 8 Open the throttling valve about halfway and circulate the fluid through the coil for 15 minutes. Check the strength of the fluid. A hydrometer or test kit from the fluid manufacturer is suitable for this application.
- 9 Adjust the solution strength as needed and circulate the fluid for another 15 minutes.
- 10 Repeat steps 8 and 9 until the desired concentration is reached.
- 11 Shut the pump down and drain the inhibited glycol from the coil.
- 12 The recaptured fluid can be used to flush other coils.

Note: Follow the manufactures' recommendations before utilizing any glycol based antifreeze solution. Additional fluid will be required for the pump, connected piping, and fluid reservoir. Formulae are for estimation purposes only.

Figure 9: Flushing System



McQuay Training and Development

Now that you have made an investment in modern, efficient McQuay equipment, its care should be a high priority. For training information on all McQuay HVAC products, please visit us at www.mcquay.com and click on training, or call 540-248-9646 and ask for the Training Department.

Warranty

All McQuay equipment is sold pursuant to its standard terms and conditions of sale, including Limited Product Warranty. Consult your local McQuay Representative for warranty details. Refer to Form 933-43285Y. To find your local McQuay Representative, go to www.mcquay.com.

This document contains the most current product information as of this printing. For the most up-to-date product information, please go to www.mcquay.com.





**DAIKIN APPLIED AMERICAS INC.
LIMITED PRODUCT WARRANTY
(North America)**

Daikin Applied Americas Inc. dba Daikin Applied ("Company") warrants to contractor, purchaser and any owner of the product (collectively "Owner") that Company, at its option, will repair or replace defective parts in the event any product manufactured by Company, including products sold under the brand name Daikin and used in the United States or Canada, proves defective in material or workmanship within twelve (12) months from initial startup or eighteen (18) months from the date shipped by Company, whichever occurs first. Authorized replaced parts are warranted for the duration of the original warranty. All shipments of such parts will be made FOB factory, freight prepaid and allowed. Company reserves the right to select carrier and method of shipment.

In addition, labor to repair or replace warranty parts is provided during Company normal working hours on products with rotary screw compressors, centrifugal compressors and on absorption chillers. Warranty labor is not provided for any other products.

Company's liability to Owner under this warranty shall not exceed the lesser of the cost of correcting defects in the products sold or the original purchase price of the products.

PRODUCT STARTUP ON ABSORPTION, CENTRIFUGAL AND SCREW COMPRESSOR PRODUCTS IS MANDATORY and must be performed by a Daikin Applied or a Company authorized service representative.

It is Owner's responsibility to complete and return the Registration and Startup Forms accompanying the product to Company within ten (10) days of original startup. If this is not done, the ship date and the startup date will be deemed the same for warranty period determination, and this warranty shall expire twelve (12) months from that date.

EXCEPTIONS

1. If free warranty labor is available as set forth above, such free labor does not include diagnostic visits, inspections, travel time and related expenses, or unusual access time or costs required by product location.
2. Refrigerants, fluids, oils and expendable items such as filters are not covered by this warranty.
3. This warranty shall not apply to products or parts which (a) have been opened, disassembled, repaired, or altered by anyone other than Company or its authorized service representative; or (b) have been subjected to misuse, negligence, accidents, damage, or abnormal use or service; or (c) have been operated, installed, or startup has been provided in a manner contrary to Company's printed instructions, or (d) were manufactured or furnished by others and which are not an integral part of a product manufactured by Company; (e) have been exposed to contaminants, or corrosive agents, chemicals, or minerals, from the water supply source, or (f) have not been fully paid for by Owner.

ASSISTANCE

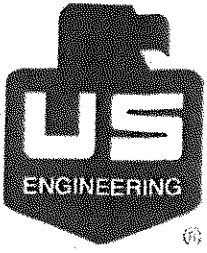
To obtain assistance or information regarding this warranty, please contact your local sales representative or a Daikin Applied office.

SOLE REMEDY

THIS WARRANTY CONSTITUTES THE OWNER'S SOLE REMEDY. IT IS GIVEN IN LIEU OF ALL OTHER WARRANTIES. THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT AND UNDER NO CIRCUMSTANCE SHALL COMPANY BE LIABLE FOR INCIDENTAL, INDIRECT, SPECIAL, CONTINGENT OR CONSEQUENTIAL DAMAGES, WHETHER THE THEORY BE BREACH OF THIS OR ANY OTHER WARRANTY, NEGLIGENCE OR STRICT LIABILITY IN TORT.

No person (including any agent, sales representative, dealer or distributor) has the authority to expand the Company's obligation beyond the terms of this express warranty or to state that the performance of the product is other than that published by Company.

For additional consideration, Company will provide an extended warranty(ies) on certain products or components thereof. The terms of the extended warranty(ies) are shown on a separate extended warranty statement.



Air Coils Submittal
Information:

- C-1
- C-3
- C-4
- C-5

**BEATTIE
ELEMENTARY
SCHOOL**

3000 MEADOWLARK AVE
FORT COLLINS CO 80526



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary
3000 Meadowlark Avenue
Fort Collins, CO 80526

Project # 30-13-038
Tel: Fax:

FCI Constructors, Inc. - Longmont

Date: 5/13/2014

Reference Number: 0083

Transmitted To: Chris Mallory
US Engineering Co.
P.O. Box 905
Loveland, CO 80539

Transmitted By: DJ Anderson
FCI Constructors, Inc. - Longmont
4001 N. Valley Drive
Longmont, CO 80504
Tel: 970-535-4725
Fax: 970-535-4867

Qty	Submittal Package No	Description	Due Date	Package Action
1	015R - 238216 - 1	Air Coils		Make Corrections Noted

Transmitted For	Delivered Via	Tracking Number
For Your Use and Corrections	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
-------	-----	-------------	--------------	-------------	-------------

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

Signature

Signed Date

TRANSMITTAL



Belford Watkins Group
Architects

Date: 4.22.14

Project: Beattie Elementary

To: Rob Price/DJ Anderson

From: Patti Watkins

We are transmitting the following submittals with the comments listed below:

ARCHITECTURE

INTERIORS

PLANNING

NET: No Exception Taken
RR: Revise and Resubmit
CMT: See Comment Below

MCN: Make Corrections Noted
SSI: Submit Specified Item

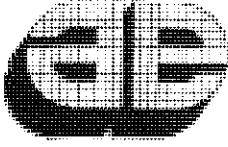
RX: Rejected

238216 Air Coils

Copies	Section	Item	Manufacturer	NET	MCN	RR	RX	SSI	CMT
1	237433	Product Data	Daikin						1

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures, there from. The Contractor remains responsible for details and accuracy, for conforming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

Notes: 1. See AE comments



AE Associates, Inc.

ENGINEERING SUCCESSFUL BUILDING ENVIRONMENTS

5587 W. 19th Street
Greeley, Colorado 80634
Phone 970.330.5587
Fax 970.330.3040

SUBMITTAL REVIEW COMMENTS

Date:	April 8, 2014	Specification Section:	Varies
Project:	Beattie Elementary School	Submittal Description:	Cooling Tower, MAU, VAV's, Air Coils
Project Location:	Fort Collins, Colorado	Date Received:	March 28, 2014
AEAI Project #	2013952.00	# Copies Received:	1 (via e-mail)
Mech. Contractor:	US Engineering	# Copies Returned:	1 (via e-mail)

Submittal Status: *Make Corrections Noted*

No Exception Taken	<input type="checkbox"/>	Make Corrections Noted	<input checked="" type="checkbox"/> *
Rejected	<input type="checkbox"/>	(* Resubmission not required)	
Submit Specified Item	<input type="checkbox"/>	Revise and Resubmit	<input type="checkbox"/>

CHECKING IS ONLY FOR GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE INFORMATION GIVEN IN THE CONTRACT DOCUMENTS. ANY ACTION SHOWN IS SUBJECT TO THE REQUIREMENTS OF THE PLANS AND SPECIFICATIONS. CONTRACTOR IS RESPONSIBLE FOR DIMENSIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE. FABRICATION PROCESSES AND TECHNIQUES OF CONSTRUCTION, COORDINATION OF HIS WORK WITH THAT OF ALL OTHER TRADES AND THE SATISFACTORY PERFORMANCE OF HIS WORK.

AE ASSOCIATES, INC.
CONSULTING ENGINEERS

Date: April 8, 2014 By: Alicia Thorpe, PE

This comment form is considered part of the referenced submittal review. All comments contained within shall be considered part of the submittal review for all copies of the submittal as if the comments were written on the submittal.

SUBMITTAL COMMENTS

AIR COILS (*Make Corrections Noted*)

- Contractor to verify right hand or left hand coil configuration based on field conditions.

END OF COMMENTS



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
---	--	--

Date: 4/18/2014	Reference Number: 0058
------------------------	-------------------------------

Transmitted To: Don Watkins Belford Watkins Group P.O. Box 1306 Fort Collins, CO 80521 Tel: 970-212-1243	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001 N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
---	---

Qty	Submittal Package No	Description	Due Date	Package Action
1	015R - 238216 - 1	Air Coils	5/2/2014	Revise & Resubmit

Transmitted For	Delivered Via	Tracking Number
Resubmittal and Approval	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

_____ Signature	_____ Signed Date
Prolog Manager Printed on: 4/18/2014 FCI PM Data	Page 1



4001 N. Valley Drive
Longmont, CO 80504
Phone: 970-535-4867
Fax: 970-535-4867

DATE: 4/18/2014

SPECIFICATION SECTION(S): 238216
SCOPE OF WORK: HVAC - Air Coils

PROJECT: Poudre School District – Beattie Elementary School

PROJECT #: 30-13-038

ARCHITECT/DESIGNER: Belford Watkins Group, LLC.
425 West Mulberry Ave., Suite 207
P.O. Box 1306
Fort Collins, CO 80521

PHONE: 970-407-0070

GENERAL CONTRACTOR: FCI CONSTRUCTORS, INC.
4001 N. Valley Drive
Longmont, CO 80504

PHONE: 970-535-4725
FAX: 970-535-4867

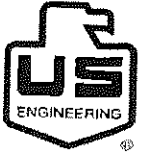
SUBMITTED BY: U.S. Engineering
PO Box 905
Loveland, CO 80539

PHONE: 970-669-1666
FAX:

CONTRACTORS STAMP:

ARCHITECT/ENGINEER STAMP

FCI CONSTRUCTORS, INC.	
Review of this submittal is subject to the provisions of the Contract Drawings and Specifications. This action is for general concurrence only.	
<input checked="" type="checkbox"/>	Reviewed
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmit with Corrections
<input type="checkbox"/>	DISAPPROVED RESUBMIT
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmittal not Required.
Submittal Reviewed By: DA	Date: 4/18/2014
Submittal No: 015R	Spec. Section: 238216



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 80539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-024

Date: 4/17/2014

Revision #: 1

Discipline: Piping

Project : Beattie Elementary

Project #: 1202

Supplier : Long and Associates

Spec Sect: 23 82 16

Submitted Items:

Page Number	Paragraph Number	Description	Manufacturer
238216-1	2	Revised Air Coils	Daikin

Target Dates:

Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
	4/17/14	5/1/14	5/1/14	5/29/14

GC/Arch/Engineer Stamp Area:

U.S. Engineering

Signed:

Chris Mallory



1610 W. Evans Ave.
Englewood, CO 80110
303.975.2116 tel
303-922-0469 fax
tcowan@long.com

BUILDING ENVIRONMENTS

*Technology for
Better Buildings*

EQUIPMENT SUBMITTAL

PROJECT	PSD Beattie Elem School
ARCHITECT	
ENGINEER	AE Associates
CONTRACTOR	US Engineering
ITEM	Cooling Coils
MANUFACTURER	Daikin Applies
SUBMITTED BY	LONG Building Environments

Equipment will not be released for production until formal approval is received.

DATE: April 15, 2014

Modified the coils overall length to meet the 56.75" length required in the field. The submittal and performance have been revised to reflect the reduction in size.

Record Purpose Comments:

Took a look at the latest schedule and capacity and we can meet capacity with 12 FPI in place of the original 14FPI selection and also reduce overall APD. We modified the GPM to 18.9 per recommendations from the engineer.



SUBMITTAL DATA

for

PSD BEATTIE ES RECORD PURPOSE

Sold to

US Engineering Co

Prepared for

Chris Mallory

Prepared by

John Stumpf / LONG

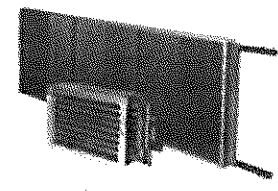
4/15/2014

Table of Contents

Technical Data Sheet for C-1, C-2, C-3, C-4 Rev-2..... 4
CW Same end RH_Drawing for C-1, C-2, C-3, C-4 Rev-... .. 5
Specification for C-1, C-2, C-3, C-4 Rev-2 7

Job Information **Technical Data Sheet**

Job Name: BEATTIE ELEMENTARY
Date: 4/15/2014
Submitted By: Matt Bylsma; John Stumpf
Software Version: 04.60 **Coil DLL Version:** 04.60
Unit Tag: C-1, C-2, C-3, C-4



Model Number	Application	Total Capacity Btu/hr	Air Flow CFM	Face Velocity ft/min	Fin Length in
5WH1206B	Chilled water coil	86647	7300	586.9	49.75

Coil
Model Number: 5WH1206B
Application: Chilled water coil
Type: Cooling - Standard
Crating: Standard Crate

Physical

Depth	Height	Length	Shipping Weight	Overall Weight
10.00 in	38.00 in	59.50 in	462 lb	451 lb

Tube Diameter	Fin	Material	Tube	Case
0.625 in	0.0075 in Aluminum		0.020 in Copper nominal	Galvanized steel

Geometry					
Fin Design	Fins per Inch	Number of Rows	Fin Height	Fin Length	Tube Spacing
Corrugated	12	6	36 in	49.75 in	1.50 X 1.299

Connection			Flange Dimensions		
Type	Size	Hand	Length	Header	Side
Carbon Steel (threaded)	1.500 in	Right Hand	3.00 in	1.00 in	1.00 in

Performance

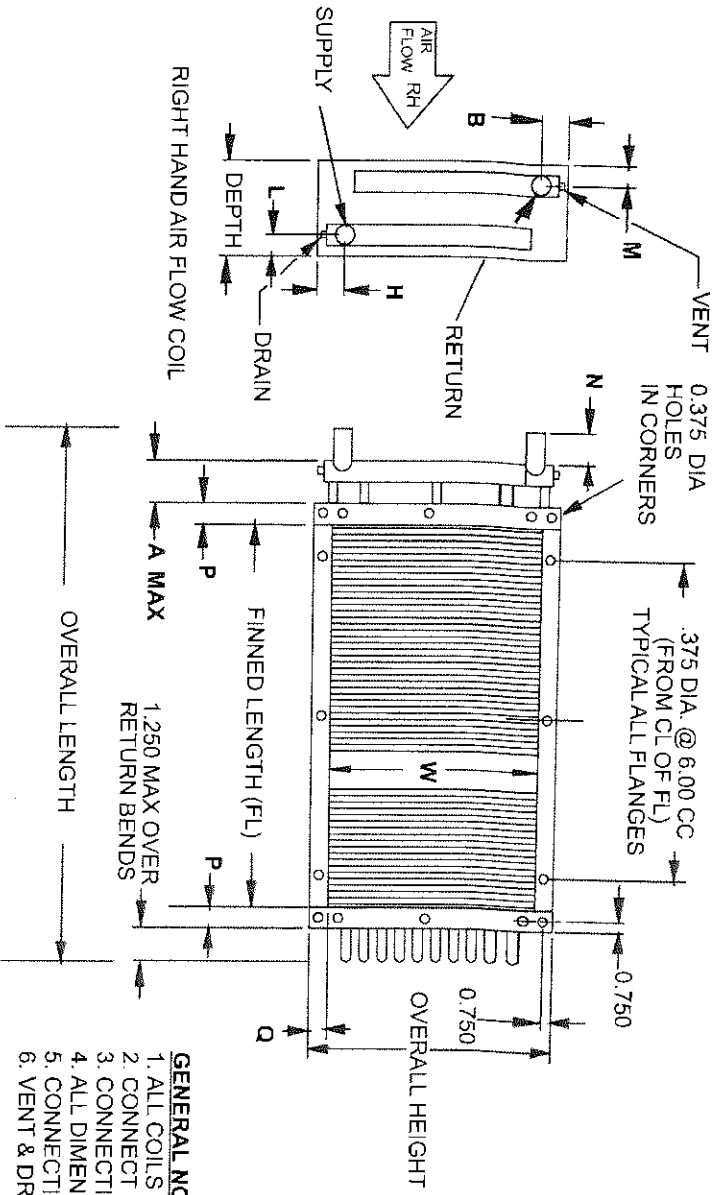
Airflow CFM	Airflow Direction	Altitude ft	Face Area ft ²	Face Velocity ft/min
7300	Horizontal	5000	12.4	586.9

Capacity		Air Temperature				Air Pressure Drop
Total Btu/hr	Sensible Btu/hr	Entering		Leaving		inH ₂ O
		Dry Bulb °F	Wet Bulb °F	Dry Bulb °F	Wet Bulb °F	
86647	86647	80.0	61.0	66.9	56.6	0.76

Fluid							
Entering Temp °F	Leaving Temp °F	Type	Glycol Concentration %	Flow Rate gpm	Velocity ft/s	Pressure Drop ft H ₂ O	Volume gal
62.0	71.5	Propylene	25.0	18.9	1.7	6.8	10.00

Chilled Water Fouling Factor: 0.0000

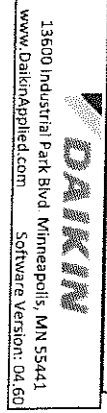
Options
Coil Options: Brass Turbospirals
Protective Coatings: None



- GENERAL NOTES:**
1. ALL COILS DRAINABLE
 2. CONNECT COILS FOR COUNTERFLOW
 3. CONNECTIONS ARE PIPE, NPT (EXT)
 4. ALL DIMENSIONS IN INCHES (MM)
 5. CONNECTION LOCATION ± 0.125
 6. VENT & DRAIN, $\frac{1}{4}$ NPT

Dimensions																
Coil Model	Coil Airflow	Rows	Fin Height (in)	Fin Length (in)	Overall Height (in)	Overall Length (in)	Conn Size (in)	A (in)	B (in)	H (in)	L (in)	M (in)	N (in)	P (in)	Q (in)	Depth (in)
SWH1206B	Horizontal	6	36	49.75	38.00	59.50	1.500	3.500	1.800	1.800	1.75	1.75	3.00	1.00	1.00	10.00

Product Drawing
 Unit Tag: C-1, C-2, C-3, C-4 Rev-2
 Project Name: BEATTIE ELEMENTARY
 Apr. 15, 2014
 Ver/Rev: Sheet: 1 of 1
 Sales Office: Long Building Technologies
 Sales Engineer:
 Scale: NTS
 Tolerance: +/- 0.25"
 Dwg Units: (in)



No change to this drawing may be made unless approved in writing by Daikin Applied. Purchaser must determine that the equipment is fit and sufficient for the job specifications.

Inh Number: R3000F

BEATTIE ENGINEERING

Date: 1/15/2014

Prepared Date: 1/15/2014

www.DaikinApplied.com

CW Same end RH_Drawing for C-1, C-2, C-3, C-4 Rev-2

PART 1: GENERAL

1.01 SECTION INCLUDES

- A. Water Cooling Coils.
 - 1. SWH Coil Types.

1.02 SUBMITTALS

- A. Shop Drawings: Indicate coil fin height & length AND overall height, length and depth, connection sizes & location, flange mounting dimensions, and direction of airflow.
- B. Product Data.
 - 1. Certification - Acceptable coils are to be certified in accordance with ARI Standard 410 and bear the ARI label. Coils exceeding the scope of the manufacturer's certification and/or the range of ARI's standard rating conditions will be considered provided the manufacturer is a current member of the ARI Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with ARI Standard 410. Manufacturer must be ISO 9002 certified.
 - 2. Identify fin, tube & casing material type and thickness.
 - 3. Show coil weight (shipping & operating).
 - 4. State air and water flow amounts with its associated pressure drops.
 - 5. Indicate entering & leaving air and water temperatures.

1.03 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing water cooling and heating coils specified in this section must show a minimum five years experience and issues complete catalog data.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site.
- B. Accept products on site on factory-installed shipping skids. Inspect for damage.
- C. Store in a clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Daikin Applied.

2.02 GENERAL DESCRIPTION

- A. Furnish as shown on plans and as described in the specification, Daikin Applied Water Cooling and/or Heating Coils.
- B. Coils to have extended surface, staggered tube, and plate fin design.

2.03 HEADERS

- A. Made of seamless copper tubing to assure compatibility with primary surface.
- B. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements.
- C. Vent and drain plugs shall be provided on the coil header. For certain replacement air handler (Vision/Skyline & some LSL models) coils the plugs will be provided on the coil connections. For replacement air handler (LSL/LHD) heating coils that are uncased, vent and drain plugs will not be provided.

2.04 CONNECTIONS

- A. Coil connection should be compatible with the piping to the coil to minimize chance of "galvanic action/electrolysis".

- B. Connections shall be a diameter adequate for specified gpm flow.
 - 1. The connections are located to permit right hand mounting of the coil and assure equal pressure through all the circuits.
- C. Connection and material type.
 - 1. Connection material to be carbon steel pipe. Connection type to be threaded.
- D. Coils are circuited to provide maximum mean effective temperature difference for heat transfer rates.
- E. Coils, greater than 2 rows, must be arranged for counter flow.

2.05 TESTING AND PRESSURE RATINGS

- A. Completed coils are tested at a minimum of 315 PSIG air pressure while submerged in warm water.
- B. Hydronic tests alone are not acceptable.
- C. Standard coil construction is rated for 250 PSIG working pressure at 300 degrees F.

2.06 CAPACITY

- A. Coil capacity shall be as outline on the project schedule and confirmed with computer generated output.
- B. Application.
 - 1. Cooling.
- C. Fluid Type.
 - 1. Propylene Glycol.

2.07 PRIMARY SURFACE

- A. Tubes to be 5/8" O.D., staggered in direction of airflow, and must be on 1 1/2" tube centers. [Note: 5WB coil is on 3.00" tube centers].
- B. Wall thickness to be .020" nominal copper and water pressure drop of coil selection adjusted to wall thickness specified.
- C. Tubes to be mechanically expanded in to fin collars to provide a continuous primary to secondary compression bond over entire coil length, assuring maximum heat transfer.
- D. Coil Tube Type.
 - 1. Standard smooth bore with internal brass spring turbospirals.

2.08 SECONDARY SURFACE

- A. Plate style fins shall be corrugated for high capacity and structural strength.
 - 1. Fin thickness shall be .0075" aluminum.
- B. The fins to have collars to determine fin spacing per inch and support the heat transfer bond to primary surface. Tubing should not be visible between the fins.
 - 1. Fin Style to be a New Ripple fin type.

2.09 COIL TYPE & SERPENTINE

- A. 5WH - Half Serpentine.
- B. Coils available from 12" to 54" fin height on 1.5" tube centers and on 3" increments.
- C. All water cooling and heating coils with standard .020" nominal copper tubing available from 12" to 216" fin length in two decimal point increments. For other tube material types the maximum tube length is 180".

2.10 CASINGS

- A. Casing Style
 - 1. Contractor Coil with flanged casing.
- B. Casing Material.
 - 1. Galvanized Steel.

2.11 PROTECTIVE COATINGS

- A. None, specified coil and casing material only.

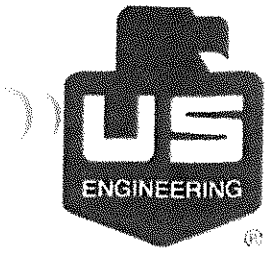
2.12 PACKAGING

- A. Coil(s) to be fully crated in a wood enclosure with protective cardboard covering the finned area.

PART 3: EXECUTION

3.01 INSTALLATION

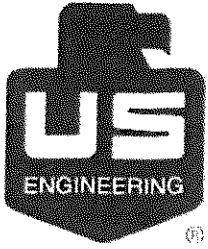
- A. Install in accordance with manufacturer's recommendations.



Tab-12
Contract Print M-0.2 Schedule
Air Separator:
AS-1 (Rolairtrol)

**BEATTIE
ELEMENTARY
SCHOOL**

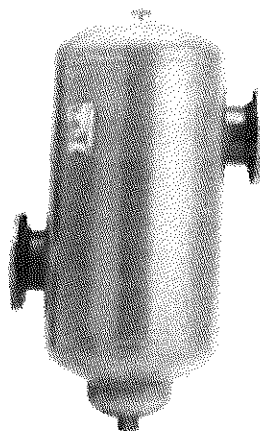
JUDY MEADOWLARK AVE
FORT COLLINS CO 80526



Air Separator
(Rolairtrol) O&M and
Warranty Information:
AS-1

**BEATTIE
ELEMENTARY
SCHOOL**

3000 MEADOWLARK AVE
FORT COLLINS CO 80526



MODEL NO.	SCREEN
SRS-3	A01950
SRS-4	A01951
SRS-5	A01952
SRS-6	A01953
SRS-8	A01954
SRS-10	A01955
SRS-12	A01956

SEDIMENT REMOVAL SEPARATORS

When ordering parts for the following products,
please contact our factory in Buffalo, NY at (716) 897-2800.

Separator Parts

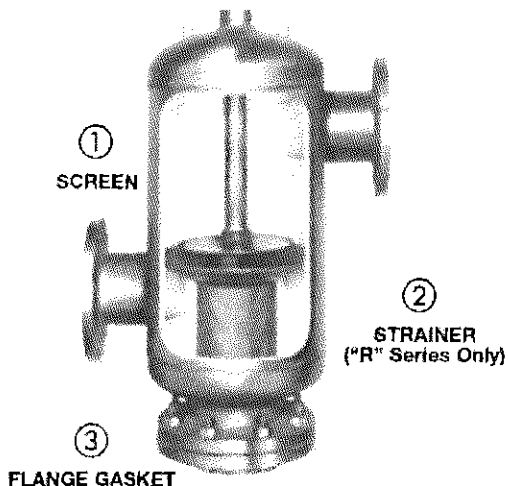
Rolairtrol and Sediment Removal Separators
Replacement Parts



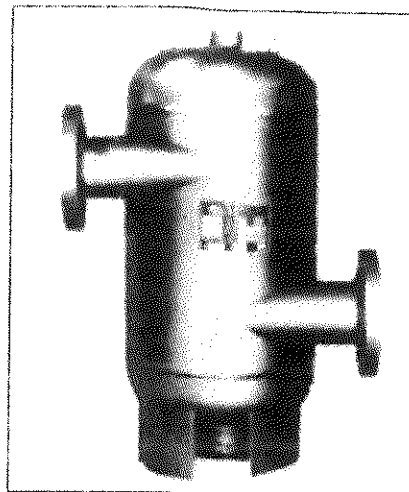
Bell & Gossett

a xylem brand

ROLAIRTROL® AIR SEPARATORS



**"R" SERIES
WITH STRAINER**



"RL" WITHOUT STRAINER

MODEL NO.	SCREEN 1	STRAINER 2	FLANGE GASKET 3	MODEL NO.	SCREEN 1	STRAINER 2	FLANGE GASKET 3
R-2 RL-2	T85167	T85733 NONE	J94032 NONE	R-6 (G) RL-6 (G)	A01953	A01963 NONE	V35000 NONE
R-2 1/2 RL-2 1/2	T85170	T85733 NONE	J94034 NONE	R-8 (G) RL-8 (G)	A01954	A01964 NONE	V36400 NONE
R-3 (G) RL-3 (G)	A01950	A01960 NONE	V29400 NONE	R-10 RL-10	A01955	A01965 NONE	G85250 NONE
R-4 (G) RL-4 (G)	A01951	A01961 NONE	V33001 NONE	R-12 RL-12	A01956	A01966 NONE	G87000 NONE
R-5 (G) RL-5 (G)	A01952	A01962 NONE	V33001 NONE	SIZE 14 & LARGER	CONTACT FACTORY		

ROLAIRTROL AIR SEPARATORS MANUFACTURED PRIOR TO APRIL, 1974

Old style strainers are no longer available. Current style strainers may be altered to fit old style models by reducing the strainer length as follows:

MOODEL NO.	1961 THRU JULY, 1971	AUGUST, 1971 THRU MARCH, 1974	MODEL NO.	1961 THRU JULY, 1971	AUGUST, 1971 THRU MARCH, 1974
R-2 B-2 1/2	CONSULT FACTORY	USE CURRENT STRAINER*	R-6 R-8	2 3/8" 2"	2 7/8" 2 1/2"
R-3	1 1/8"	1 1/8"	R-10	3 1/2"	5 3/8"
R-4	1 1/8"	1 3/8"	R-12	N/A	7 1/2"
R-5	2 1/4"	2 1/4"			

*If replacing a cone-shaped strainer, you must also order an adaptor bracket. For the 2", order a T85734 bracket, for the 2 1/2", order a T85737 bracket.

- Factory recommended spare parts.

N/A = Not Available.

xylem
Let's Solve Water

Xylem Inc.
8200 N. Austin Avenue
Morton Grove, Illinois 60053
Phone: (847) 966-3700
Fax: (847) 965-8379
www.bellgossett.com

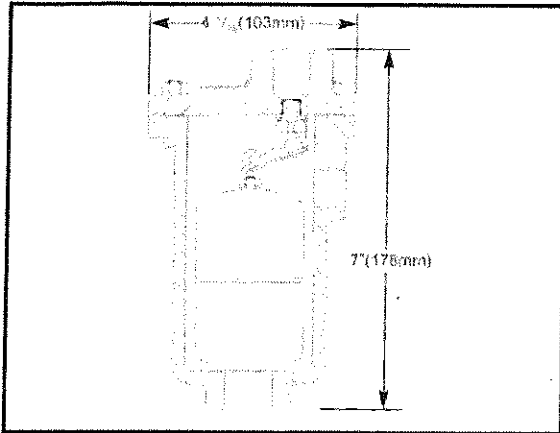
Bell & Gossett is a trademark of Xylem Inc. or one of its subsidiaries.
© 2013 Xylem Inc. HS-60-PL December 2000



SUBMITTAL

HS-103(C)

JOB: UNIT TAG: ENGINEER: CONTRACTOR:	REPRESENTATIVE: ORDER NO.: SUBMITTED BY: APPROVED BY:	DATE: DATE: DATE:
---	--	--



Hoffman Specialty Model 792 High Pressure Water Main Vent Valve

Materials of Construction	
Part	Specifications
Body	Cast Iron
Cover	Cast Iron
Float	Stainless Steel
Seat	Stainless Steel
Pin	Stainless Steel

Capacities	
Water Pressure psig (bar)	Air Discharge to Atmosphere cu. ft./min. (S(m ³ /min))
100 (6.9)	10 (.28)
150 (10.3)	15 (.42)
200 (13.8)	20 (.57)
250 (17.3)	25 (.70)

RATINGS

Model	NPT Bottom Inlet Size in.	NPT Side Inlet Size in.	NPT Outlet Size in.	Maximum Operating Pressure psig (bar)	Maximum Hydrostatic Pressure psig (bar)	Maximum Operating Temperature °F (°C)
792	3/4	1/2	1/2	250 (17.3)	350 (24.2)	300 (149)

SCHEDULE

MODEL NUMBER	PART NUMBER	TAGGING INFORMATION	QTY.
792	401494		

ITT
 8200 N. Austin Avenue
 Morton Grove, IL 60053
 Phone (847)966-3700
 Facsimile (847)966-9052
www.hoffmanspecialty.com



TERMS AND CONDITIONS OF SALE

FLOWTRONEX PSI LLC, a Division of Xylem Inc.

(DBA Flowtronex, Water Equipment Technologies, A-C Fire Pump, Bell & Gossett, and/or Goulds Water Technology)

1. Agreement, Integration and Conflict of Terms. These terms and conditions, together with any special conditions expressly incorporated thereto in the quotation or sales form, are to govern any sale by Flowtronex PSI LLC. (d/b/a Flowtronex, Water Equipment Technology, A/C Firepumps, Bell & Gossett, and/or Goulds), a division of Xylem Inc. ("Seller"). This writing is an offer or counteroffer by Seller to sell the goods and/or services set forth on the quotation or sales form subject to these terms and conditions and is expressly made conditional on Buyer's assent to these terms and conditions. Acceptance by Buyer is expressly limited to these terms and conditions. Any additional or different terms and conditions contained in Buyer's purchase order or other communication shall not be effective or binding upon Seller unless specifically agreed to in writing by Seller; Seller hereby objects to any such conditions, and the failure of Seller to object to specific provisions contained in any purchase order or other communication from Buyer shall not be construed as a waiver of these terms and conditions nor an acceptance of any such provisions. Neither Seller's commencement of performance nor delivery shall be deemed or construed as acceptance of Buyer's additional or different terms and conditions.

Buyer agrees that these terms and conditions, together with any accompanying quotation and any special conditions or limited process guarantees or documents referred to or included within the quotation and expressly made a part of this agreement, (e.g., drawings, illustrations, specifications, or diagrams), is the complete and final agreement between the parties ("Agreement"). This Agreement supersedes all prior negotiations, representations, or agreements, either written or oral, between the parties and, further, can only be altered, modified or amended with the express written consent of Seller.

2. Quotation, Withdrawal, Expiration. Quotes are valid for thirty (30) calendar days from the date of issuance. Seller reserves the right to cancel or withdraw the quotation at any time with or without notice or cause prior to acceptance by Buyer. There is no Agreement if any conditions specified within the quotation or sales form are not completed by Buyer to Seller's satisfaction within thirty (30) calendar days of Seller's acknowledgement in writing of an order. Seller nevertheless reserves its right to accept any contractual documents received from Buyer after this 30-day period.

3. Prices. Prices apply to the specific quantities stated on the quotation or sales form. Unless otherwise agreed to in writing by Seller, all prices are F.O.B. Seller's plant, and do not include transportation costs or charges relating to transportation, which costs and charges shall be solely the responsibility of Buyer. Prices include standard packing according to Seller's specifications. All costs and taxes for special packing requested by Buyer, including packing for exports, shall be paid by Buyer as an additional charge. Prices are subject to change without notice.

4. Taxes. The price for the goods does not include any applicable sales, use, excise, GST, VAT, or similar tax. Buyer shall have the responsibility for the payment of such taxes if applicable.

5. Payment Terms. Seller reserves the right to require payment in advance or C.O.D. and otherwise modify credit terms should Buyer's credit standing not meet Seller's acceptance. Unless different payment terms are expressly set forth in the quotation or sales form or order acknowledgment or Sales Policy Manual, goods will be invoiced upon shipment. Payment in full is due within thirty (30) days from the invoice date. In the event payment is not made when due, Buyer agrees to pay Seller a service or finance charge of the lesser of (i) one and one-half percent (1.5%) per month (18% per annum), or (ii) the highest rate permitted by applicable law, on the unpaid balance of the invoice from and after the invoice due date. Buyer is responsible for all costs and expenses associated with any checks returned due to insufficient

TERMS AND CONDITIONS OF SALE
FLOWTRONEX PSI LLC

funds. All credit sales are subject to prior approval of Seller's credit department. Export shipments will require payment prior to shipment or an appropriate Letter of Credit. If, during the performance of the contract with Buyer, the financial responsibility or condition of Buyer is such that Seller in good faith deems itself insecure, or if Buyer becomes insolvent, or if a material change in the ownership of Buyer occurs, or if Buyer fails to make any payments in accordance with the terms of its contract with Seller, then, in any such event, Seller is not obligated to continue performance under the contract and may stop goods in transit and defer or decline to make delivery of goods, except upon receipt of satisfactory security or cash payments in advance, or Seller may terminate the order upon written notice to Buyer without further obligation to Buyer whatsoever. If Buyer fails to make payments or fails to furnish security satisfactory to Seller, then Seller shall also have the right to enforce payment to the full contract price of the work completed and in process. Upon default by Buyer in payment when due, Buyer shall immediately pay to Seller the entire unpaid amounts for any and all shipments made to Buyer irrespective of the terms of said shipment and whether said shipments are made pursuant to this Agreement or any other contract of sale between Seller and Buyer, and Seller may withhold all subsequent shipments until the full amount is settled. Acceptance by Seller of less than full payment shall not be a waiver of any of its rights hereunder.

Buyer shall not assign or transfer this Agreement or any interest in it, or monies payable under it, without the written consent of Seller and any assignment made without such consent shall be null and void.

6. Delivery, Risk of Loss. Delivery dates are estimates, and time is not of the essence. All shipments will be made F.O.B. Seller's plant unless otherwise specified. Seller shall not be responsible to Buyer for any loss, whether direct, indirect, incidental or consequential in nature, including without limitation loss of profits, arising out of or relating to any failure of the goods to be delivered by the specified delivery date. In the absence of specific instructions, Seller will select the carrier. Upon delivery to the common carrier, title and the risk of loss for the material shall pass to Buyer. Buyer shall reimburse Seller for the additional cost of its performance resulting from inaccurate or lack of delivery instructions, or by any act or omission on Buyer's part. Any such additional cost may include, but is not limited to, storage, insurance, protection, re-inspection and delivery expenses. Buyer further agrees that any payment due on delivery shall be made on delivery into storage as though goods had been delivered in accordance with the order.

7. Warranty. For goods sold by Seller to Buyer that are used by Buyer for personal, family or household purposes, Seller warrants the goods to Buyer on the terms of Seller's limited warranty available on Seller's website. For goods sold by Seller to Buyer for any other purpose, Seller warrants that the goods sold to Buyer hereunder (with the exception of membranes, seals, gaskets, elastomer materials, coatings and other "wear parts" or consumables all of which are not warranted except as otherwise provided in the quotation or sales form) will be (i) be built in accordance with the specifications referred to in the quotation or sales form, if such specifications are expressly made a part of this Agreement, and (ii) free from defects in material and workmanship for a period of one (1) year from the date of installation or eighteen (18) months from the date of shipment (which date of shipment shall not be greater than thirty (30) days after receipt of notice that the goods are ready to ship), whichever shall occur first (the "Warranty").

Seller shall, at its option and at no cost to Buyer, either repair or replace any product which fails to conform with the Warranty; provided, however, that under either option, Seller shall not be obligated to remove the defective product or install the replaced or repaired product and Buyer shall be responsible for all other costs, including, but not limited to, service costs, shipping fees and expenses. Seller shall have complete discretion as to the method or means of repair or replacement. Buyer's failure to comply with Seller's repair or replacement directions shall constitute a waiver of its rights and render all warranties void. Any parts repaired or replaced under the Warranty are warranted only for the balance of the warranty period on the parts that were repaired or replaced. The Warranty is conditioned on Buyer giving written notice to Seller of any defects in material or workmanship

of warranted goods within ten (10) days of the date when any defects are first manifest.

Seller shall have no warranty obligations to Buyer with respect to any product or parts of a product that: (a) have been repaired by third parties other than Seller or without Seller's written approval; (b) have been subject to misuse, misapplication, neglect, alteration, accident, or physical damage; (c) have been used in a manner contrary to Seller's instructions for installation, operation and maintenance; (d) have been damaged from ordinary wear and tear, corrosion, or chemical attack; (e) have been damaged due to abnormal conditions, vibration, failure to properly prime, or operation without flow; (f) have been damaged due to a defective power supply or improper electrical protection; or (g) have been damaged resulting from the use of accessory equipment not sold by Seller or not approved by Seller in connection with products supplied by Seller hereunder. In any case of products not manufactured by Seller, there is no warranty from Seller; however, Seller will extend to Buyer any warranty received from Seller's supplier of such products.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ANY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES, GUARANTEES, CONDITIONS OR TERMS OF WHATEVER NATURE RELATING TO THE GOODS PROVIDED HEREUNDER, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY EXPRESSLY DISCLAIMED AND EXCLUDED. BUYER'S EXCLUSIVE REMEDY AND SELLER'S AGGREGATE LIABILITY FOR BREACH OF ANY OF THE FOREGOING WARRANTIES ARE LIMITED TO REPAIRING OR REPLACING THE PRODUCT AND SHALL IN ALL CASES BE LIMITED TO THE AMOUNT PAID BY THE BUYER HEREUNDER. IN NO EVENT IS SELLER LIABLE FOR ANY OTHER FORM OF DAMAGES, WHETHER DIRECT, INDIRECT, LIQUIDATED, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR SPECIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY OR LOSS OF REPUTATION.

8. Inspection. Buyer shall have the right to inspect the goods upon their receipt. When delivery is to Buyer's site or to a project site ("Site"), Buyer shall notify Seller in writing of any nonconformity of the goods with this Agreement within three (3) days from receipt by Buyer. For all other deliveries, Buyer shall notify Seller in writing of any nonconformity with this Agreement within fourteen (14) days from receipt by Buyer. Failure to give such applicable notice shall constitute a waiver of Buyer's right to inspect and/or reject the goods for nonconformity and shall be equivalent to an irrevocable acceptance of the goods by Buyer. Claims for loss of or damage to goods in transit must be made to the carrier, and not to Seller.

9. Seller's Limitation of Liability. IN NO EVENT SHALL SELLER'S LIABILITY UNDER THIS AGREEMENT EXCEED THE AMOUNT PAID BY BUYER UNDER THIS AGREEMENT. SELLER SHALL HAVE NO LIABILITY FOR LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY, LOSS OF REPUTATION, INDIRECT, CONSEQUENTIAL, INCIDENTAL, PUNITIVE OR EXEMPLARY DAMAGES.

10. Force Majeure. Seller may cancel or suspend this Agreement and Seller shall have no liability for any failure to deliver or perform, or for any delay in delivering or performing any obligations, due to acts or omissions of Buyer and/or its contractors, or due to circumstances beyond its reasonable control, including but not limited to acts of God, fire, flood or other natural disasters, war and civil disturbance, riot, acts of governments, terrorism, disease, currency restrictions, labor shortages or disputes, unavailability of materials, fuel, power, energy or transportation facilities, failures of suppliers or subcontractors to effect deliveries, in which case the time for performance shall be extended in an amount equal to the excused period, provided that Seller shall have, as soon as reasonably practicable after it has actual knowledge of the beginning of any excusable delay, notified Buyer of such delay, of the

**TERMS AND CONDITIONS OF SALE
FLOWTRONEX PSI LLC**

Page 2 of 3

reason therefor and of the probable duration and consequence thereof. Seller shall use its best efforts to eliminate the cause of the delay, interruption or cessation and to resume performance of its obligations hereunder with the least possible delay.

11. Cancellation. Except as otherwise provided in this Agreement, no order may be cancelled unless requested in writing by either party and accepted in writing by the other. In the event of a cancellation by Buyer, Buyer shall, within thirty (30) days of such cancellation, pay Seller a cancellation fee, which shall include all costs and expenses incurred by Seller prior to the receipt of the request for cancellation including, but not limited to, all commitments to its suppliers, subcontractors and others, all labor and overhead expended by Seller, plus a reasonable charge for profit.

Notwithstanding anything to the contrary herein, in the event of the commencement by or against Buyer of any voluntary or involuntary proceedings in bankruptcy or insolvency, or in the event Buyer shall be adjusted bankrupt, make a general assignment for the benefit of its creditors, or if a receiver shall be appointed on account of Buyer's insolvency, or if Buyer fails to make payment when due under this Agreement, or in the event Buyer does not correct or, if immediate correction is not possible, commence and diligently continue action to correct any default of Buyer to comply with any of the provisions or requirements of this Agreement within ten (10) calendar days after being notified in writing of such default by Seller, Seller may, by written notice to Buyer, without prejudice to any other rights or remedies which Seller may have, terminate its further performance of this Agreement. In the event of such termination, Seller shall be entitled to receive payment as if Buyer has cancelled the Agreement as per the preceding paragraph. Seller may nevertheless elect to complete its performance of this Agreement by any means it chooses. Buyer agrees to be responsible for any additional costs incurred by Seller in so doing.

Upon termination of this Agreement, the rights, obligations and liabilities of the parties which shall have arisen or been incurred under this Agreement prior to its termination shall survive such termination.

12. Drawings. All drawings are the property of Seller. Seller does not supply detailed or shop working drawings of the goods; however, Seller will supply necessary installation drawings. The drawings and bulletin illustrations submitted with Seller's quotation show general type, arrangement and approximate dimensions of the goods to be furnished for Buyer's information only and Seller makes no representation or warranty regarding their accuracy. Unless expressly stated to the contrary within the quotation or sales form, all drawings, illustrations, specifications or diagrams form no part of this Agreement. Seller reserves the right to alter such details in design or arrangement of its goods which, in its judgment, constitute an improvement in construction, application or operation. All engineering information necessary for installation of the goods shall be forwarded by Seller to upon Buyer's acceptance of this Agreement. After Buyer's acceptance of this Agreement, any changes in the type of goods, the arrangement of the goods, or application of the goods requested by Buyer will be made at Buyer's expense. Instructions necessary for installation, operating and maintenance will be supplied when the goods are shipped.

13. Proprietary Information, Injunction. Seller's designs, illustrations, drawings, specifications, technical data, catalogues, "know-how", economic or other business or manufacturing information (collectively "Proprietary Information") disclosed to Buyer shall be deemed proprietary and confidential to Seller. Buyer agrees not to disclose, use, or reproduce any Proprietary Information without first having obtained Seller's express written consent. Buyer's agreement to refrain from disclosing, using or reproducing Proprietary Information shall survive completion of the work under this Agreement. Buyer acknowledges that its improper disclosure of Proprietary Information to any third party will result in Seller's suffering irreparable harm. Seller may seek injunctive or equitable relief to prevent Buyer's unauthorized disclosure.

14. Installation and Start-up. Unless otherwise agreed to in writing by Seller, installation shall be the sole responsibility of Buyer. Where start-up service is required with respect to the goods purchased

hereunder, it must be performed by Seller's authorized personnel or agents; otherwise, the Warranty is void. In the event Buyer has engaged Seller to provide an engineer for start-up supervision, such engineer will function in a supervisory capacity only and Seller shall have no responsibility for the quality of workmanship of the installation. In any event, Buyer understands and agrees that it shall furnish, at Buyer's expense, all necessary foundations, supplies, labor and facilities that might be required to install and operate the goods.

15. Specifications. Changes in specifications requested by Buyer are subject to approval in writing by Seller. In the event such changes are approved, the price for the goods and the delivery schedule shall be changed to reflect such changes.

16. Buyer Warranty. Buyer warrants the accuracy of any and all information relating to the details of its operating conditions, including temperatures, pressures, and where applicable, the nature of all hazardous materials. Seller can justifiably rely upon the accuracy of Buyer's information in its performance. Should Buyer's information prove inaccurate, Buyer agrees to reimburse Seller for any losses, liabilities, damages and expenses that Seller may have incurred as a result of any inaccurate information provided by Buyer to Seller.

17. Minimum Order. Seller reserves the right to refuse to process any order that does not meet quantity requirements that Seller may establish for any given product or group of products.

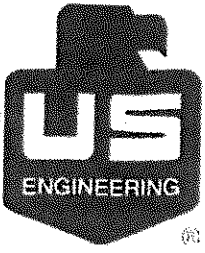
18. Quality Levels. Prices are based on quality levels commensurate with normal processing. If a different quality level is required, Buyer must specify its requirements, as approved in writing by Seller, and pay any additional costs that may be applicable.

19. GOVERNING LAW. THE TERMS OF THIS AGREEMENT AND ALL RIGHTS AND OBLIGATIONS HEREUNDER SHALL BE GOVERNED BY THE LAWS OF THE STATE OF SELLER'S OFFICE TO WHICH THIS ORDER HAS BEEN SUBMITTED (WITHOUT REFERENCE TO PRINCIPLES OF CONFLICTS OF LAWS). THE RIGHTS AND OBLIGATIONS OF THE PARTIES HEREUNDER SHALL NOT BE GOVERNED BY THE 1980 U.N. CONVENTION ON CONTRACTS FOR THE INTERNATIONAL SALE OF GOODS.

20. Titles. The section titles are for reference only, and shall not limit or restrict the interpretation or construction of this Agreement.

21. Waiver. Seller's failure to insist, in any one or more instances, upon Buyer's performance of this Agreement, or to exercise any rights conferred, shall not constitute a waiver or relinquishment of any such right or right to insist upon Buyer's performance in any other regard.

22. Severability. The partial or complete invalidity of any one or more provisions of this Agreement shall not affect the validity or continuing force and effect of any other provision.



Air Separator Submittal
Information:
AS-1

**BEATTIE
ELEMENTARY
SCHOOL**

3000 MCARDOW LARK AVE
FORT COLLINS CO 80526



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
---	---	--

Date: 4/18/2014	Reference Number: 0067
------------------------	-------------------------------

Transmitted To: Chris Mallory US Engineering Co. P.O. Box 905 Loveland, CO 80539	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
--	--

Qty	Submittal Package No	Description	Due Date	Package Action
1	031 - 236500 - 0	Air Seperator & Expansion Tank		

Transmitted For	Delivered Via	Tracking Number
For your use and files.	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action
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Cc: Company Name	Contact Name	Copies	Notes
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Remarks

_____ Signature	_____ Signed Date
Prolog Manager	Printed on: 4/18/2014 FCI PM Data
	Page 1

TRANSMITTAL



Belford Watkins Group
Architects

Date: 4.18.14

Project: Beattie Elementary

To: Rob Price/DJ Anderson

From: Patti Watkins

We are transmitting the following submittals with the comments listed below:

ARCHITECTURE

INTERIORS

PLANNING

NET: No Exception Taken

MCN: Make Corrections Noted

RX: Rejected

RR: Revise and Resubmit

SSI: Submit Specified Item

CMT: See Comment Below

236500 Air Separator and Expansion Tank

Copies	Section	Item	Manufacturer	NET	MCN	RR	RX	SSI	CMT
1	236500	Product Data		x					1

Review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures, there from. The Contractor remains responsible for details and accuracy, for conforming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

Notes AIR SEPARATOR, AUTOMATIC AIR VENT AND EXPANSION TANK (No Exception Taken)



Submittal Transmittal

Detailed, Grouped by Each Number includes Sub Section

Beattie Elementary 3000 Meadowlark Avenue Fort Collins, CO 80526	Project # 30-13-038 Tel: Fax:	FCI Constructors, Inc. - Longmont
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Date: 4/8/2014	Reference Number: 0040
-----------------------	-------------------------------

Transmitted To: Don Watkins Belford Watkins Group P.O. Box 1306 Fort Collins, CO 80521 Tel: 970-212-1243	Transmitted By: DJ Anderson FCI Constructors, Inc. - Longmont 4001 N. Valley Drive Longmont, CO 80504 Tel: 970-535-4725 Fax: 970-535-4867
---	---

Qty	Submittal Package No	Description	Due Date	Package Action
1	031 - 236500 - 0	Air Separator & Expansion Tank	4/22/2014	

Transmitted For	Delivered Via	Tracking Number
Review & Approval	Email	

Items	Qty	Description	Spec Section	Sub Section	Item Action

Cc:	Company Name	Contact Name	Copies	Notes
	FCI Constructors, Inc. - Longmont	File	1	

Remarks

Air Separator & Expansion Tank are being submitted per M-0.2 Schedule.

_____ Signature	_____ Signed Date
Prolog Manager Printed on: 4/8/2014 FCI PM Data	Page 1



4001 N. Valley Drive
 Longmont, CO 80504
 Phone: 970-535-4867
 Fax: 970-535-4867

DATE: 4/8/2014

SPECIFICATION SECTION(S): 236500 & M-0.2
 SCOPE OF WORK: HVAC - Air Seperator & Expansion Tank

PROJECT: Poudre School District – Beattie Elementary School

PROJECT #: 30-13-038

ARCHITECT/DESIGNER: Belford Watkins Group, LLC.
 425 West Mulberry Ave., Suite 207
 P.O. Box 1306
 Fort Collins, CO 80521

 PHONE: 970-407-0070

GENERAL CONTRACTOR: FCI CONSTRUCTORS, INC.
 4001 N. Valley Drive
 Longmont, CO 80504

 PHONE: 970-535-4725
 FAX: 970-535-4867

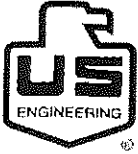
SUBMITTED BY: U.S. Engineering
 PO Box 905
 Loveland, CO 80539

 PHONE: 970-669-1666
 FAX:

CONTRACTORS STAMP:

ARCHITECT/ENGINEER STAMP

FCI CONSTRUCTORS, INC.	
Review of this submittal is subject to the provisions of the Contract Drawings and Specifications. This action is for general concurrence only.	
<input checked="" type="checkbox"/>	Reviewed
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmit with Corrections
<input type="checkbox"/>	DISAPPROVED RESUBMIT
<input type="checkbox"/>	Reviewed with Notations Indicated - Resubmittal not Required.
Submittal Reviewed By: DA	Date: 4/8/2014
Submittal No: 031	Spec. Section: 236500



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 80539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-028

Date: 3/28/2014

Revision #: _____

Discipline: Piping

Project: Beattie Elementary

Project #: 1202

Supplier: Wholesale Specialties

Spec Sect: Plan And Schedule

Submitted Items:

Page Number	Paragraph Number	Description	Manufacturer
M-0.2	Schedule	Air Seperator	Bell & Gossett

Target Dates:

Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
4/17/14	4/24/14	5/22/14	5/29/14	6/12/14

GC/Arch/Engineer Stamp Area:

Signed:

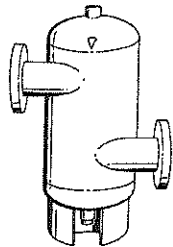
U.S. Engineering

Chris Mallory



SUBMITTAL
A-326.8D

JOB: Beattie Elementary	REPRESENTATIVE: MCNEVIN CO	
UNIT TAG:	ORDER NO.:	DATE: 3/10/2014
ENGINEER: AE Associates	SUBMITTED BY: Wholesale Specialties	DATE:
CONTRACTOR: U.S. Engineering	APPROVED BY:	DATE:



ROLAIRTROL®

Air Separator

Flanged Less Strainer
Air Control and Elimination

Plans call for an AMTROL - Model 3-AS(L) Tangential Air Separator. Architect please verify Bell & Gossett - Rolairtrol 5363-03F-12-003 is an acceptable alternate.

DESCRIPTION

The Rolairtrol Air Separator is an ASME vessel designed with tangential openings to create a low velocity vortex where air is separated and removed from the circulating water.

CONSTRUCTION MATERIALS

- Designed and constructed per ASME Section VIII, Division 1
- Shell: Carbon Steel

MAXIMUM WORKING PRESSURE

125 PSIG (862 kPa)

MAXIMUM OPERATING TEMPERATURE

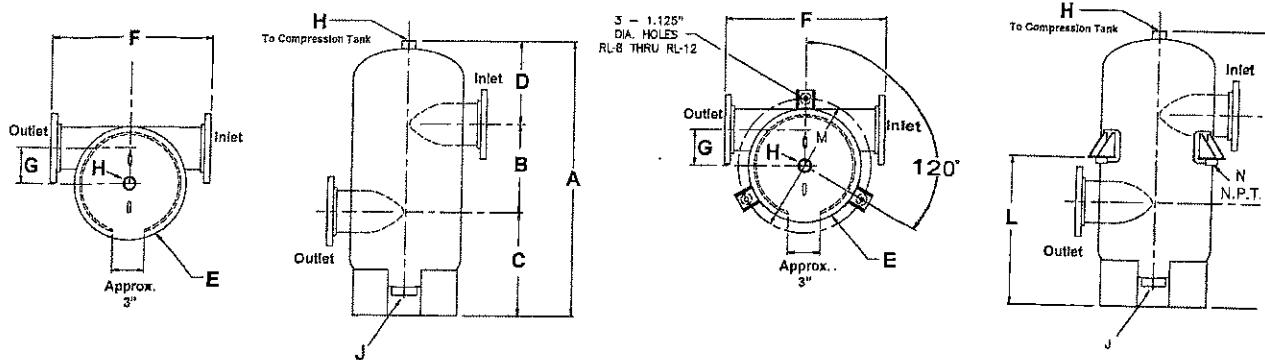
350°F (177°C)

Consult factory for higher working pressures and temperatures.

PART NUMBER	MODEL NUMBER	Capacity GPM (m³/hr)	Flanged Tangential Opening in. (mm)	TAGGING INFORMATION	QUANTITY
5363-03F-12-003	RL-3F	190 (43.2)	3 (76.2)	AS-1	1
5363-04F-12-003	RL-4F	300 (68.1)	4 (101.6)		
5363-05F-12-003	RL-5F	530 (120.4)	5 (127.0)		
5363-06F-12-003	RL-6F	850 (193.0)	6 (150.0)		
5363-08F-12-004	RL-8F	1,900 (431.5)	8 (203.2)		
5363-10F-12-003	RL-10F	3,600 (817.6)	10 (254.0)		
5363-12F-12-003	RL-12F	4,800 (1090.1)	12 (300.0)		
5363-03F-12-004	RL-3FB	190 (43.2)	3 (76.2)		
5363-04F-12-004	RL-4FB	300 (68.1)	4 (101.6)		
5363-05F-12-004	RL-5FB	530 (120.4)	5 (127.0)		
5363-06F-12-004	RL-6FB	850 (193.0)	6 (150.0)		
5363-08F-12-005	RL-8FB	1,900 (431.5)	8 (203.2)		
5363-10F-12-004	RL-10FB	3,600 (817.6)	10 (254.0)		

ROLAIRTROL - Flanged Less Strainer

**A-3
F**



DIMENSIONS in Inches (mm) AND WEIGHTS in Lbs (kg.)

MODEL NUMBER	A	B	C	D	E	F	G	H	J	L*	M*	N*	Cv	Approx. Volume in Gallons (Ltr.)	Approx. Shpg. Wt. in Lbs. (Kg)	Flood Wt. Less Bracket in Lbs. (Kg)	L
RL-3F (B)	26-7/8 (683)	8 (203)	10-13/16 (275)	8-1/16 (205)	10-3/4 (273)	22-3/4 (578)	3-5/8 (92)	1-1/4 (32)	2 (51)	13-3/8 (340)	14 (356)	2 (51)	215	7 (26)	115 (52)	173 (79)	
RL-4F (B)	31-7/16 (799)	10 (254)	11-15/16 (303)	9-1/2 (241)	12-3/4 (324)	20-1/2 (521)	4-1/8 (105)	1-1/2 (38)	2 (51)	15-3/8 (391)	16 (406)	2 (51)	370	13 (49)	155 (70)	263 (119)	
RL-5F (B)	37 (940)	12 (305)	14-1/16 (357)	10-15/16 (278)	16 (406)	23-3/4 (603)	5-1/4 (133)	1-1/2 (38)	2 (51)	18-1/2 (470)	19-3/8 (492)	2 (51)	580	25 (95)	205 (93)	414 (188)	
RL-6F (B)	44-1/16 (1119)	14 (356)	16-13/16 (427)	13-1/4 (337)	18 (457)	25-3/4 (654)	5-11/16 (144)	1-1/2 (38)	2 (51)	22-1/8 (562)	21-1/4 (540)	2 (51)	850	34 (129)	280 (127)	564 (256)	
RL-8F (B)	54 (1372)	18 (457)	19-7/16 (494)	16-9/16 (421)	24 (610)	31-3/4 (806)	7-11/16 (195)	2 (51)	2 (51)	26 (660)	29-1/2 (749)	2 (51)	1,445	90 (341)	420 (190)	1,171 (531)	
RL-10F (B)	64-11/16 (1643)	22 (559)	22-5/8 (575)	20-1/16 (510)	30 (762)	37-3/4 (959)	9-5/8 (244)	2 (51)	2 (51)	31-5/8 (803)	35-1/2 (902)	2 (51)	2,340	150 (568)	800 (363)	2,052 (930)	
RL-12F (B)	75-3/8 (1915)	27 (586)	25-3/4 (654)	22-5/8 (575)	36 (914)	46-3/4 (1187)	11-5/8 (295)	2 (51)	2 (51)	37-5/8 (956)	41-1/2 (1054)	2 (51)	3,300	291 (1,101)	1,110 (503)	3,538 (1,605)	

*Indicates measurements for models that have optional support brackets

†Bracket weight should be added to flood weight and approximate shipping weight for models that are being supplied with optional support brackets.

Important Note: Dimensions not to be used for construction.

IMPORTANT NOTES:

1. Consult IOM A85524 for safety and service instructions.
2. Lifting lugs are for the transportation and installation of the empty vessel, and are not to be used for complete or partial support of the flood vessel.
3. The RL skirt can support flooded vessel weight.
4. Welding to the pressure vessel boundary will void the ASME stamp.
5. Standard Rolairtrol design up to 12" can be hung from the nozzles using hangers. Optional, factory welded, support brackets are available for an cost.

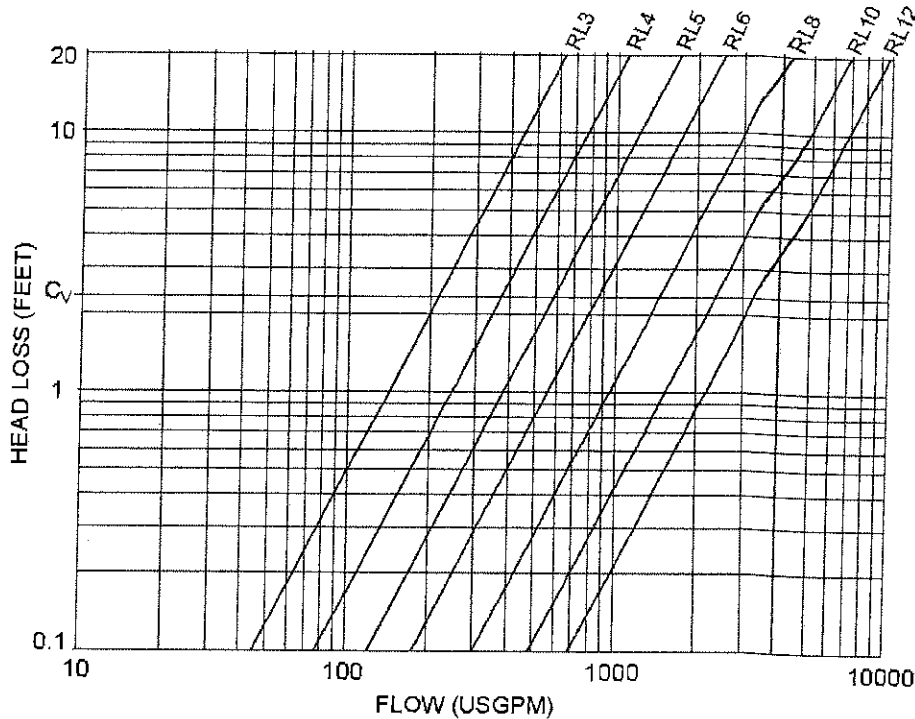
ROLAIRTROL - Flanged Less Strainer

A-326.8D

Page 3

Rolairtrol® Air Separator Performance Coverage Chart

RL MODELS (WITHOUT STRAINERS)



Note: Pressure drops for a range of flow are indicated on this chart. Users should select Rolairtrol using B&G published capacity guidance, and ASHRAE pipe sizing recommendations for optimal performance.

TYPICAL ROLAIRTROL SPECIFICATIONS

Furnish and install, as shown on plans, a centrifugal type air separator. The unit shall have _____" inlet and outlet flanged connections tangential to the vessel shell. The unit shall have the capability to direct accumulated air to the compression tank (air control system) or air vent (air elimination system) via an NPT vent connection at top of unit.

Vessel shell diameter to be three times the nominal inlet/outlet pipe diameter, with a minimum vessel volume for sufficient velocity reduction.

A blowdown connection shall be provided to facilitate routine cleaning. Specify B&G Model MBV-1 Rolairtrol accessory with appropriate fittings for manual blowdown.

The air separator must be designed, constructed and stamped for 125 psig @ 375°F (862 kPa @ 191°C) in accordance with Section VIII, Division I of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors. The air separator(s) shall be painted with one shop coat of light gray air dry enamel.

Each air separator shall be Bell & Gossett Model No. _____
 Rolairtrol Air Separator for _____ GPM (_____ m³), Shell
 Dia. _____" (_____ mm) and Min. Vessel Volume _____
 Gal (_____ liters).

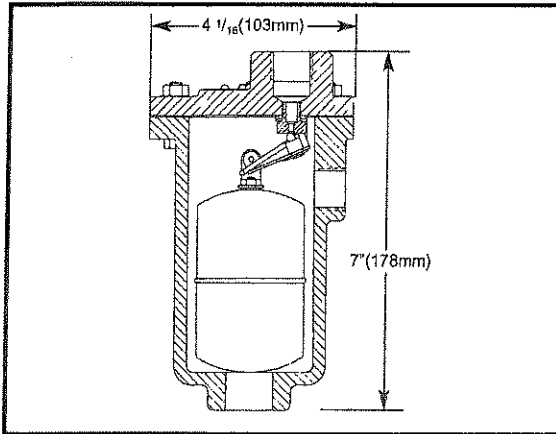
Refer to submittal A-329 for information on the MBV-1 manual blowdown valve.

Xylem Inc.



SUBMITTAL
HS-103(C)

JOB: Beattie Elementary		REPRESENTATIVE: MCNEVIN CO	
UNIT TAG:	ORDER NO.	DATE: 3/10/2014	
ENGINEER: AE Associates	SUBMITTED BY: Wholesale Specialties	DATE:	
CONTRACTOR: U.S. Engineering	APPROVED BY:	DATE:	



Hoffman Specialty Model 792 High Pressure Water Main Vent Valve

Materials of Construction	
Part	Specifications
Body	Cast Iron
Cover	Cast Iron
Float	Stainless Steel
Seat	Stainless Steel
Pin	Stainless Steel

Capacities	
Water Pressure psig (bar)	Air Discharge to Atmosphere cu. ft./min. (S(m ³ /min))
100 (6.9)	10 (.28)
150 (10.3)	15 (.42)
200 (13.8)	20 (.57)
250 (17.3)	25 (.70)

RATINGS

Model	NPT Bottom Inlet Size in.	NPT Side Inlet Size in.	NPT Outlet Size in.	Maximum Operating Pressure psig (bar)	Maximum Hydrostatic Pressure psig (bar)	Maximum Operating Temperature °F (°C)
792	3/4	1/2	1/2	250 (17.3)	350 (24.2)	300 (149)

SCHEDULE

MODEL NUMBER	PART NUMBER	TAGGING INFORMATION	QTY.
792	401494	AS-1	1

Xylem Inc.
8200 N. Austin Avenue



U.S. ENGINEERING

P.O. Box 905
Loveland, Colorado 80539
Phone - 970-669-1666

SUBMITTAL COVER SHEET

Submittal #: 1202-029

Date: 3/28/2014

Revision #: _____

Discipline: Piping

Project : Beattie Elementary

Project #: 1202

Supplier : Wholesale

Spec Sect: Plan And Schedule

Submitted Items:

Page Number	Paragraph Number	Description	Manufacturer
M-0.2	Schedule	Expansion Tank	Bell & Gossett

Target Dates:

Due From Supplier	Submit to GC	Due Back from GC	Return to Supplier and Release	Items Due on Site
4/17/14	4/24/14	5/22/14	5/29/14	6/12/14

GC/Arch/Engineer Stamp Area:

U.S. Engineering

Signed:

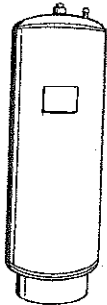
Chris Mallory



M-0.2 Schedule calls for AMTROL, Model AX-15V.
 Architect please confirm this is an acceptable alternate.

SUBMITTAL
A-346G

JOB: Beattie Elementary	REPRESENTATIVE: MCNEVIN CO
UNIT TAG:	ORDER NO.:
ENGINEER: AE Associates	SUBMITTED BY: Wholesale Specialties
CONTRACTOR: U.S. Engineering	APPROVED BY:
	DATE: 3/10/2014
	DATE:
	DATE:



Series "D" (ASME) Pressurized Expansion Tanks Vertical

Not For Potable Water Systems

DESCRIPTION

Series "D" expansion tanks are ASME rated precharged diaphragm-type pressure vessels. The Series "D" tank is designed to absorb the expansion forces of heating/cooling system water while maintaining proper system pressurization under varying operating conditions. The heavy duty diaphragm separates system water from the tank air charge thereby eliminating waterlogging problems.

CONSTRUCTION

Shell: Carbon Steel
 Diaphragm: Heavy Duty Butyl Rubber
 System Connection: Forged Steel
 Designed and Constructed per ASME Section VIII, Division 1

PERFORMANCE LIMITATIONS

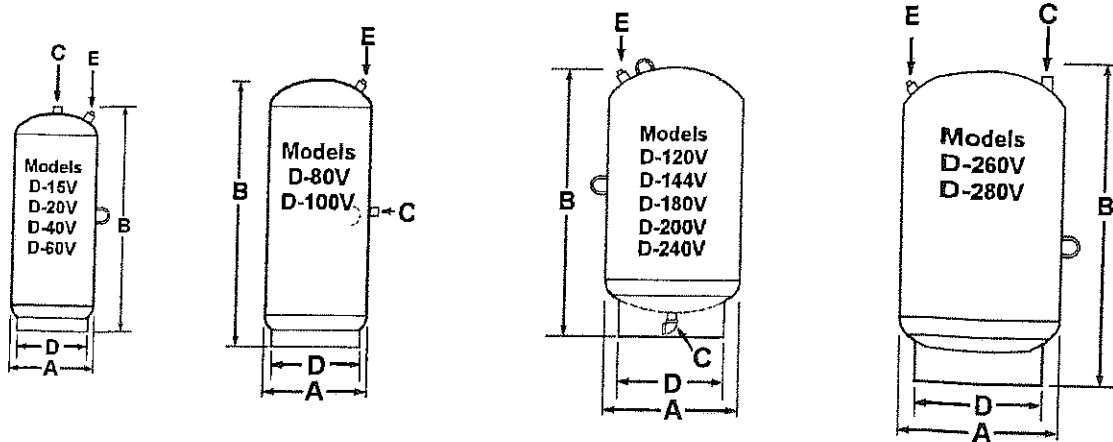
Maximum Design Pressure: 125 PSI (862kPa)
 Design Temperature: 240°F (115°C)

SCHEDULE

PART NUMBER		MODEL NO.	VOLUME GALLONS (LITERS)		TAGGING INFORMATION	QUANTITY
PRESSURIZED EXPANSION TANKS	WITH SEISMIC RESTRAINTS		TANK	ACCEPTANCE		
116491	116942	D-15V	8.0 (30.3)	2.4 (9.1)	ET-1	1
116492	116943	D-20V	10.9 (41.3)	2.4 (9.1)		
116493	116944	D-40V	21.7 (82.1)	11.3 (42.8)		
116525	116945	D-60V	33.6 (127.2)	11.3 (42.8)		
116526	116946	D-80V	44.4 (168.1)	22.6 (85.5)		
116527	116947	D-100V	55.7 (211.8)	22.6 (85.5)		
116528	116948	D-120V	68.0 (257.4)	34.0 (128.7)		
116529	116949	D-144V	77.0 (291.5)	34.0 (128.7)		
116530	116950	D-180V	90.0 (340.7)	34.0 (128.7)		
116531	116951	D-200V	110.0 (416.4)	34.0 (128.7)		
116532	116952	D-240V	132.0 (500)	46.0 (174.1)		
116780	116953	D-260V	159.0 (600)	56.0 (212.0)		
			211.0			

ASME EXPANSION TANKS - PRESSURIZED

A-346G



NOTE:Tanks are factory pre-charged at 12 psi (83 kPa)
Sight glass and seismic restraints available.
Tanks can also be installed in the horizontal position.

DIMENSIONS AND WEIGHTS

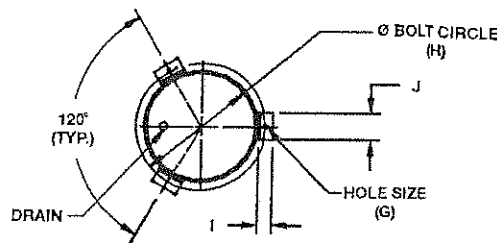
MODEL NUMBER	DIMENSIONS IN INCHES (MM)						APPROX. SHPG. WT. LBS. (Kg)	APPROX. WT* 100% FULL LBS. (Kg)
	A	B	SYSTEM CONNECTION C	SKIRT O.D. D	CHARGING VALVE E	SKIRT THICKNESS		
D-15V**	12 (305)	19-1/2 (495)	1/2 NPTM	10-3/4 (273)	.302"-32 NC	3/16 (5)	43 (20)	110 (50)
D-20V**	12 (305)	26-1/2 (673)	1/2 NPTM	10-3/4 (273)	.302"-32 NC	3/16 (5)	45 (21)	136 (62)
D-40V	16-1/4 (413)	29-1/2 (749)	1/2 NPTM	12-3/4 (324)	.302"-32 NC	3/16 (5)	90 (41)	271 (123)
D-60V	16-1/4 (413)	45-1/8 (1146)	1/2 NPTM	12-3/4 (324)	.302"-32 NC	3/16 (5)	110 (50)	390 (177)
D-80V	16-1/4 (413)	56 (1422)	1/2 NPTM	12-3/4 (324)	.302"-32 NC	3/16 (5)	146 (66)	517 (234)
D-100V	16-1/4 (413)	69 (1753)	1/2 NPTM	12-3/4 (324)	.302"-32 NC	3/16 (5)	167 (76)	632 (287)
D-120V	24 (610)	43-7/8 (1114)	1 NPTF	16 (406)	.302"-32 NC	1/4 (6)	224 (102)	791 (359)
D-144V	24 (610)	48-3/4 (1238)	1 NPTF	16 (406)	.302"-32 NC	1/4 (6)	244 (111)	887 (402)
D-180V	24 (610)	58-1/8 (1426)	1 NPTF	16 (406)	.302"-32 NC	1/4 (6)	266 (121)	977 (443)
D-200V	24 (610)	62-5/8 (1591)	1 NPTF	16 (406)	.302"-32 NC	1/4 (6)	296 (134)	1214 (551)
D-240V	30 (762)	53-1/2 (1357)	1 NPTF	24 (610)	.302"-32 NC	3/16 (5)	427 (194)	1529 (693)
D-260V	30 (762)	60-1/2 (1537)	1-1/4 NPTM	24 (610)	.302"-32 NC	3/16 (5)	476 (216)	1803 (818)
D-280V	30 (762)	78-1/4 (1989)	1-1/4 NPTM	24 (610)	.302"-32 NC	3/16 (5)	745 (338)	2506 (1137)

Dimensions are subject to change. Not to be used for construction purposes unless certified.

*Approximate weight 100% full occurs if diaphragm fails. **No Lifting Ring

**SEISMIC RESTRAINTS
DIMENSIONS IN INCHES (MM)**

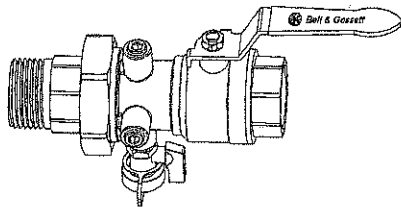
TANK DIAMETER A	G	H	I	J
12 (305)	9/16 (14)	12-3/4 (324)	2 (51)	2 (51)
16-1/4 (413)	9/16 (14)	14-3/4 (375)	2 (51)	2 (51)
24 (610)	9/16 (14)	18 (457)	2 (51)	2 (51)
30 (762)	7/8 (22)	28 (711)	3 (76)	3 (76)





SUBMITTAL
A-615A

JOB: Beattie Elementary	REPRESENTATIVE: MCNEVIN CO	
UNIT TAG:	ORDER NO.	DATE: 3/10/2014
ENGINEER: AE Associates	SUBMITTED BY: Wholesale Specialties	DATE:
CONTRACTOR: U.S. Engineering	APPROVED BY:	DATE:



TPV - Tank Purge Valve for Non-Potable Water

DESCRIPTION

The Bell & Gossett TPV is a combination full port shut-off valve and drain valve used to connect the system to the tank. This valve allows the tank to be drained for easy servicing or tank replacement without having to drain the system. These valves are furnished standard with a drain valve with a standard 5/8" hose connection.

CONSTRUCTION

- Body: Brass
- Ball: Chrome Plated
- Ball Seal: Teflon®
- Stem: Explosion Proof
- O-Rings: EPDM
- Taps: 3 Total - 1/4" NPT
 - 1 - Drain Valve
 - 2 - Plugged

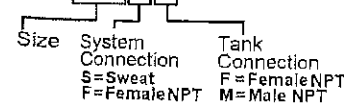
MAXIMUM WORKING PRESSURE

400 psig (2,758 kPa)

MAXIMUM OPERATING TEMPERATURE

-4°F (-20°C) to 250°F (121°C)

TPV-1/2SF



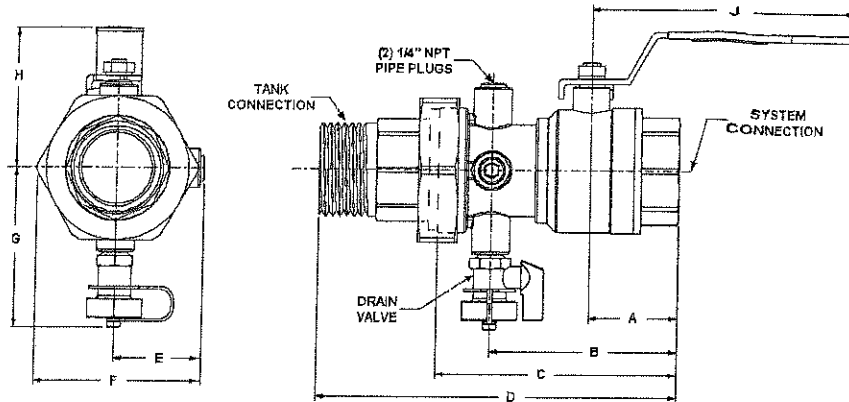
SCHEDULE

MODEL NUMBER	PART NUMBER	SYSTEM CONNECTION	TANK CONNECTION	TAGGING INFORMATION	QUANTITY
TPV-1/2SF	113226	1/2" Female SWT	1/2" Female NPT		
TPV-1/2FF	113227	1/2" Female NPT	1/2" Female NPT	ET-1	1
TPV-1/2SM	113228	1/2" Female SWT	1/2" Male NPT		
TPV-1/2FM	113229	1/2" Female NPT	1/2" Male NPT		
TPV-3/4SF	113230	3/4" Female SWT	3/4" Female NPT		
TPV-3/4FF	113231	3/4" Female NPT	3/4" Female NPT		
TPV-3/4SM	113232	3/4" Female SWT	3/4" Male NPT		
TPV-3/4FM	113233	3/4" Female NPT	3/4" Male NPT		
TPV-1SF	113234	1" Female SWT	1" Female NPT		
TPV-1FF	113235	1" Female NPT	1" Female NPT		
TPV-1SM	113236	1" Female SWT	1" Male NPT		
TPV-1FM	113237	1" Female NPT	1" Male NPT		
TPV-1½SF	113238	1½" Female SWT	1½" Female NPT		
TPV-1½FF	113239	1½" Female NPT	1½" Female NPT		
TPV-1½SM	113240	1½" Female SWT	1½" Male NPT		
TPV-1½FM	113241	1½" Female NPT	1½" Male NPT		
TPV-1¾SM	113242	1¾" Female SWT	1¾" Male NPT		
TPV-1¾FM	113243	1¾" Female NPT	1¾" Male NPT		
TPV-2SM	113244	2" Female SWT	2" Male NPT		
TPV-2FM	113245	2" Female NPT	2" Male NPT		

*Teflon® is a registered trademark of E.I. DuPont de Nemours and Company.

TPV

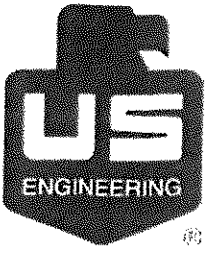
A-615A
Page 2



Model Number	System Connection	Tank Connection	DIMENSIONS* INCH (mm)									Approx. Weight Lbs.
			A	B	C	D	E	F	G	H	J	
TPV-1/2SF	1/2" Female SWT	1/2" Female NPT	1.67 (42.4)	2.25 (57.2)	3.15 (80.0)	3.82 (97.0)	0.84 (21.3)	1.60 (40.6)	2.36 (59.9)	1.75 (44.5)	3.34 (84.8)	1.0 (0.5)
TPV-1/2FF	1/2" Female NPT	1/2" Female NPT	1.19 (30.2)	2.00 (50.8)	2.90 (73.7)	3.56 (90.4)	0.84 (21.3)	1.60 (40.6)	2.36 (59.9)	1.75 (44.5)	3.34 (84.8)	1.0 (0.5)
TPV-1/2SM	1/2" Female SWT	1/2" Male NPT	1.29 (32.8)	2.25 (57.2)	3.15 (80.0)	4.73 (120.1)	0.84 (21.3)	1.60 (40.6)	2.36 (59.9)	1.75 (44.5)	3.34 (84.8)	1.0 (0.5)
TPV-1/2FM	1/2" Female NPT	1/2" Male NPT	1.06 (26.9)	2.00 (50.8)	2.90 (73.7)	4.47 (113.5)	0.84 (21.3)	1.60 (40.6)	2.36 (59.9)	1.75 (44.5)	3.34 (84.8)	1.0 (0.5)
TPV-3/4SF	3/4" Female SWT	3/4" Female NPT	1.67 (42.4)	2.85 (72.4)	3.72 (94.5)	4.53 (115.1)	1.06 (26.9)	1.95 (49.5)	2.66 (67.6)	1.89 (48.0)	3.50 (88.9)	1.24 (0.6)
TPV-3/4FF	3/4" Female NPT	3/4" Female NPT	1.19 (30.2)	2.50 (63.5)	3.26 (82.8)	4.06 (103.1)	1.06 (26.9)	1.95 (49.5)	2.66 (67.6)	1.89 (48.0)	3.50 (88.9)	1.24 (0.6)
TPV-3/4SM	3/4" Female SWT	3/4" Male NPT	1.67 (42.4)	2.85 (72.4)	3.72 (94.5)	5.50 (140.0)	1.06 (26.9)	1.95 (49.5)	2.66 (67.6)	1.89 (48.0)	3.50 (88.9)	1.25 (0.6)
TPV-3/4FM	3/4" Female NPT	3/4" Male NPT	1.19 (30.2)	2.50 (63.5)	3.26 (82.8)	5.03 (127.8)	1.06 (26.9)	1.95 (49.5)	2.66 (67.6)	1.89 (48.0)	3.50 (88.9)	1.25 (0.6)
TPV-1SF	1" Female SWT	1" Female NPT	1.95 (49.5)	3.18 (80.8)	4.14 (105.2)	5.05 (128.3)	1.23 (31.2)	2.06 (52.3)	2.71 (68.8)	2.00 (50.8)	4.00 (101.6)	1.71 (0.8)
TPV-1FF	1" Female NPT	1" Female NPT	1.45 (36.8)	2.63 (66.8)	3.60 (91.4)	4.50 (114.3)	1.23 (31.2)	2.06 (52.3)	2.71 (68.8)	2.00 (50.8)	4.00 (101.6)	1.71 (0.8)
TPV-1SM	1" Female SWT	1" Male NPT	1.95 (49.5)	3.18 (80.8)	4.14 (105.2)	6.16 (156.5)	1.23 (31.2)	2.06 (52.3)	2.71 (68.8)	2.00 (50.8)	4.00 (101.6)	1.75 (0.8)
TPV-1FM	1" Female NPT	1" Male NPT	1.45 (36.8)	2.63 (66.8)	3.60 (91.4)	5.60 (142.2)	1.23 (31.2)	2.06 (52.3)	2.71 (68.8)	2.00 (50.8)	4.00 (101.6)	1.75 (0.8)
TPV-1 1/4SF	1 1/4" Female SWT	1 1/4" Female NPT	2.13 (54.1)	3.94 (100.1)	5.14 (130.6)	6.10 (154.9)	1.34 (34.0)	2.71 (68.8)	2.96 (75.2)	2.45 (62.2)	4.50 (114.3)	3.15 (1.5)
TPV-1 1/4FF	1 1/4" Female NPT	1 1/4" Female NPT	1.55 (39.4)	3.37 (85.6)	4.55 (115.6)	5.50 (139.7)	1.34 (34.0)	2.71 (68.8)	2.96 (75.2)	2.45 (62.2)	4.50 (114.3)	3.15 (1.5)
TPV-1 1/4SM	1 1/4" Female SWT	1 1/4" Male NPT	2.13 (54.1)	3.94 (100.1)	5.14 (130.6)	7.11 (180.6)	1.34 (34.0)	2.71 (68.8)	2.96 (75.2)	2.45 (62.2)	4.50 (114.3)	3.19 (1.5)
TPV-1 1/4FM	1 1/4" Female NPT	1 1/4" Male NPT	1.55 (39.4)	3.37 (85.6)	4.55 (115.6)	6.52 (165.6)	1.34 (34.0)	2.71 (68.8)	2.96 (75.2)	2.45 (62.2)	4.50 (114.3)	3.19 (1.5)
TPV-1 1/2SM	1 1/2" Female SWT	1 1/2" Male NPT	2.54 (64.5)	4.66 (118.4)	5.90 (149.9)	8.32 (211.3)	1.85 (47.0)	3.25 (82.6)	3.38 (85.9)	3.00 (76.2)	5.30 (134.6)	5.50 (2.5)
TPV-1 1/2FM	1 1/2" Female NPT	1 1/2" Male NPT	1.91 (48.5)	3.97 (100.8)	5.12 (130.1)	7.64 (194.1)	1.85 (47.0)	3.25 (82.6)	3.38 (85.9)	3.00 (76.2)	5.30 (134.6)	5.50 (2.5)
TPV-2SM	2" Female SWT	2" Male NPT	2.89 (72.4)	4.57 (116.1)	6.80 (172.7)	9.80 (248.9)	2.00 (50.8)	4.00 (101.6)	3.52 (89.4)	3.33 (84.6)	6.12 (155.5)	8.00 (3.63)
TPV-2FM	2" Female NPT	2" Male NPT	2.06 (52.3)	4.65 (118.1)	5.85 (148.6)	8.87 (225.3)	2.00 (50.8)	4.00 (101.6)	3.52 (89.4)	3.33 (84.6)	6.12 (155.5)	8.00 (3.63)

*All dimensions +/- 0.125 (3.2 mm) tolerance. Dimensions are subject to change. Not to be used for construction purposes unless certified.

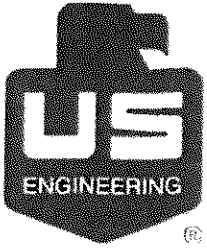




Tab-13
Contract Print M-0.2 Schedule
Expansion Tank:
ET-1 (Bell & Gossett)

**BEATTIE
ELEMENTARY
SCHOOL**

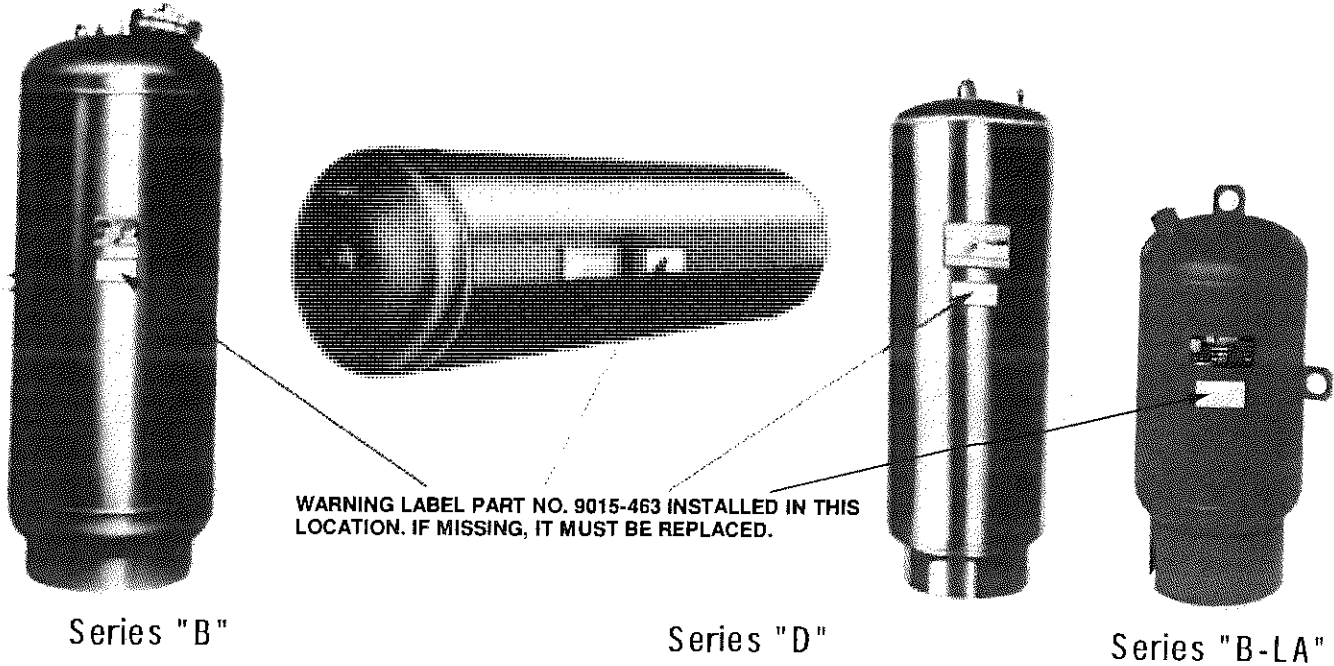
3000 MEADOWLARK AVE
FORT COLLINS CO 80526



Expansion Tank (Bell
& Gossett) O&M and
Warranty Information:
ET-1

**BEATTIE
ELEMENTARY
SCHOOL**

1600 MEADOWLARK AVE
FORT COLLINS, CO 80526




Pressurized Expansion Tanks (ASME)

Installation, Operation, & Service Instructions

INSTALLER: PLEASE LEAVE THIS MANUAL FOR THE OWNER'S USE.

SAFETY INSTRUCTIONS

This safety alert symbol will be used in this manual to draw attention to safety related instructions. When used, the safety alert symbol means **ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED! FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN A SAFETY HAZARD.**

 **WARNING: Explosion Hazard**
 Failure to follow instructions in the accompanying product manual can cause rupture or explosion, possibly causing serious or fatal injury, leaking or flooding and/or property damage.

DESCRIPTION


Precharged Expansion Tanks contain either a bladder or a diaphragm to separate the air charge from the system water. Tanks are designed to absorb the expansion forces of heating/cooling system water while maintaining proper system pressurization under varying operating conditions.

NOT FOR USE IN DOMESTIC (POTABLE) WATER SYSTEMS

DANGER: Series "B", "D", & "B-LA" are for use in closed loop systems only. Domestic, potable or fresh water can cause serious corrosion in a tank. This can result in leakage and a potential explosion. Do not use for domestic, potable or fresh water. Failure to follow this instruction will result in serious personal injury or death and property damage.

OPERATIONAL LIMITS

Maximum Operating Pressure: 125 psi (or as stamped on nameplate)
 Maximum Operating Temperature: 240°F
 Minimum Operating Temperature: 35°F (non-glycol application)
 18°F (glycol application)

 **WARNING:** Carefully read the Instruction Manual to avoid serious personal injury and property hazards and to ensure safe use and proper care of this product.


POINT OF CONNECTION


A. General

The Series B and Series D tanks work equally well when installed in the vertical or horizontal position. When Series B tank is installed horizontally, the system connection must be located below the centerline of the tank. The Series B-LA tanks must be installed in vertical position. They cannot be installed in the horizontal position.

The pressurized expansion tank-to-system piping differs from the "standard" compression tank piping in several major aspects:

1. Air from the system must be purged to the atmosphere and not allowed to enter the tank.
2. Tank-to-system piping must not be pitched-up to the tank.
3. Shut-off and drain valves or tank purge valve B&G TPV must be installed in the tank-to-system piping in order to properly check and recharge the tank air after the system has been filled with water.
4. Airtrol Tank Fitting (ATF or ATFL) is not required.


 **WARNING:** This product must be installed by a qualified professional. Failure to follow the instruction in accompanying manual may cause a rupture or explosion which may result in serious injury or death and property damage.

 **WARNING: CALIFORNIA PROPOSITION 65 WARNING!** This product contains a chemical known by the State of California to cause cancer and to cause birth defects or other reproductive harm. (California Installer/Contractor - California law requires that this notice be given to consumer/end user of this product.


B. Piping

Typical tank-to-system and air vent piping are illustrated by Figures 1 thru 6. Some general notes regarding this piping are listed below:

1. The connection point from tank-to-system represents the point of no pressure change. This means that the expansion tank must be connected as close as possible to the suction side of the system circulating pump for proper system operation.

 **CAUTION:** Pump cavitation and unbalanced circuits can result from improper tank location. Connect tank as close to suction side of system circulating pump as possible. Failure to follow this instruction could result in property damage and/or moderate personal injury.


2. The branch piping to the tank must be attached to the main to minimize the possibility of air and debris entering the tank piping. If connected to the horizontal main, do not use top (12 o'clock) and bottom (6 o'clock) positions. Side connections are the proper positions. If connection must be made at the bottom, a dirt trap leg with a flushing drain valve, such as shown in Figure 4, should be installed.


 **CAUTION:** A blocked connection to the expansion tank will cause system to become overpressurized resulting in periodic discharge of system relief valve. This periodic discharge will require that fresh water be added to the system to maintain pressure. The resulting addition of fresh water will cause corrosion in system components. The use of a bottom connection to the main requires the use of dirt trap leg with a flushing drain valve. Failure to follow these instructions could result in property damage and/or moderate personal injury.

3. Table A shows the recommended pipe sizes. Note that the MBH column represents the output of the heat generator (firing rate, etc.). The pipe sizes are selected for very low pressure loss in the tank-to-system piping to accommodate system operating pressures within 10% of the relief valve setting. However, if the actual system operating pressure is less than 80% of the relief valve setting, the tabulated pipe size above 1" may be reduced by one size.


Pipe sizes 1" or less must not be changed due to the greater possibility of fouling in the smaller pipes.

4. In order to change the tank air charge pressure it is necessary to isolate the tank circuit from the main system piping. A high quality, gate type or TPV, lock-shield valve must be used for this purpose. The lock-shield for the valve stem will eliminate tampering of this normally open valve during normal system operation.

 **WARNING:** System overpressurization will result if expansion tank isolation valve is not kept open during normal operation. Provisions must be made to lock this valve open during normal system operation. Failure to follow these instructions could result in serious personal injury or death and property damage.

 **WARNING:** Do not locate this product where leaking or flood could cause damage to the surrounding property. A drip pan connected to an adequate drain must be installed if leaking or flooding could cause property damage. Failure to follow this instruction could result in property damage.

5. In addition to the lock-shield valve above TPV or a drain valve, automatic air vent and a pressure gauge must be installed in the piping. The drain valve is used for flushing (item 2 above) and to drain the water out of the tank for proper air charging.
6. Tank sizing calculations are based on minimum temperature rise of the air in the tank. For this reason, an anti-thermosiphon loop must be formed in the tank-to-system piping to minimize the effects of gravity (thermal) circulation into the tank. A drop leg from 12" to 20" long is usually sufficient. It is also suggested that this piping and tank not be insulated (heating systems only).

 **CAUTION:** Lack of or improperly sized air vent will cause system circulation problems. An automatic air vent must be installed in the line to the expansion tank and at air separating devices as shown in Figures 1 thru 6. These must be sized to vent off any accumulated air. Failure to follow these instructions could result in property damage and/or moderate personal injury.

7. Allow an overhead clearance for the Series B of at least 36" to remove the bladder through the flanged opening in case replacement is required. For bladder replacement of the Series B-LA tanks, the tank must be removed from the system.

INSTALLATION

1. Note location of system connection, air charge valve and drain connection on tank.
2. Remove the plug or pipe cap from the system connection.
3. Remove the 1/2" NPT plug covering the air charge valve.
4. Before making any connection to the tank, check the tank and air charge (use an accurate pressure gauge). The air pressure must be equal to the minimum system pressure at the tank location.
5. After making sure the air charge is correct, replace the 1/2" plug over the air valve.
6. The tank may now be piped to the system (use the suggested tank piping diagram on page 4 and 5).
7. Using table A, select appropriate pipe size. Connection to each tank must have a lock shield gate valve or TPV and union to allow isolation and removal if required. Make up and fill valves, whether manual or automatic, should be tied into the connecting line. This will ensure that pump operation will not affect valve operation.

OPERATING INSTRUCTIONS

1. Check the expansion tank pre-charge before the system is filled with water. The charge is 12 psig unless noted otherwise on the tank label. Check to make sure this is the correct precharge pressure specified for the system. Precharge should match system fill pressure at point of tank installation. If increasing precharge, the tank must be connected immediately to the system. The tank should not be isolated at this condition. Failure to do so could result in damage to the bladder and void all warranties.
2. If the tank pre-charge pressure needs to be changed on a dry system follow the following procedure:
 - a. Check the expansion tank air pressures at the precharge connection with an accurate tire type pressure gauge. The pre-charge connection is the same kind of connection found on automobile tires.
 - b. If the pressure is low, charge the tank with nitrogen gas or with oil-free compressed air. Check the pressure frequently during this process as you would when filling a tire with air.

⚠ DANGER: Excessive pressure can cause tank to explode. Exercise care when filling a tank with air so the pressure does not exceed that required or does not exceed the working pressure of the tank as stamped on the nameplate. Failure to follow these instructions will result in serious personal injury or death and property damage.

3. If, after the system has been filled with water and operating, it is found that the expansion tank pre-charge must be changed use the following procedure:
 - a. Turn off the heat source and allow the system water to cool to ambient temperature.

IMPORTANT: Expansion tank cannot be properly air charged other than at ambient temperature.

- b. Close the lock-shield valve in the tank-to-system piping.
- c. Open the drain valve or TPV to empty the water from the tank.
- d. Check the tank air pressure at the pre-charge connection with an accurate tire type air gauge.
- e. Refer to 2b above.
- f. Close the drain valve, open the lock-shield valve and turn on the heat source.
- g. Relock the lock-shield valve.

SERVICE INSTRUCTIONS

1. Check the expansion tank periodically for signs of external leakage or corrosion, if found, the tank must be replaced.

⚠ DANGER: Signs of leakage or corrosion are indications the tank may explode. Periodically check the expansion tank for signs of external leakage or corrosion. If found, the tank must be replaced. Failure to follow these instructions will result in serious personal injury or death and property damage.

2. If the tank fails to hold the pre-charge pressure it could be the result of one of the following.
 - a. Leakage of air valve. Do not depend on the valve cap to seal leak.
 1. Refer to items 3a thru 3d under operating instructions to prepare the tank so that the air valve core can be changed.

⚠ WARNING: Improper use of air charging valve during venting of air pressure from tank will create a hazardous condition due to the escape of high velocity gas and/or liquid. Depress the center valve core stem, as with a tire valve, to slowly vent off gas pressure. Do not remove the valve core until pressure in the expansion tank has reached zero. Failure to follow these instructions could result in serious personal injury or death and property damage.

2. If only gas escapes, **unscrew** the air valve core and replace with a tire type/Schrader valve core. If liquid escaped refer to 2b below.
3. Refer to 3e thru 3g under operating instruction to complete the service procedure.

- b. The bladder or diaphragm is leaking as indicated by liquid on the gas side or the inability of the tank to maintain its gas cushion. If the tank is a diaphragm type, the tank must be replaced. Diaphragm tanks can be identified by the model numbers beginning with a "D" and the absence of a large flanged opening to remove the bladder. If the tank is a bladder type, the bladder can be replaced as follows:
 1. Refer to items 3a thru 3c under operating instructions to prepare the system for replacement of the bladder.

⚠ WARNING: Residual system pressure is a serious hazard when attempting to replace tank bladder. Make sure that all fluid has stopped draining from the drain valve and the system pressure is zero. If leaking continues from the drain valve, the lock-shield isolation valve must be replaced before proceeding. Failure to follow these instructions could result in serious personal injury or death and property damage.

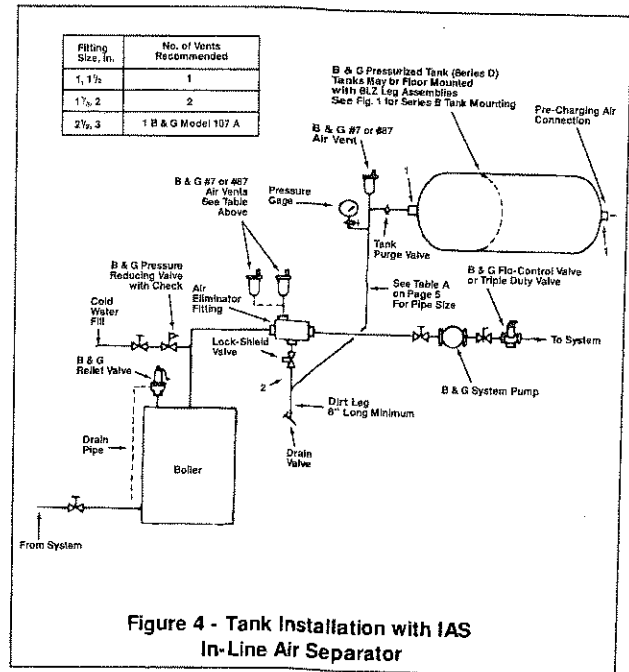
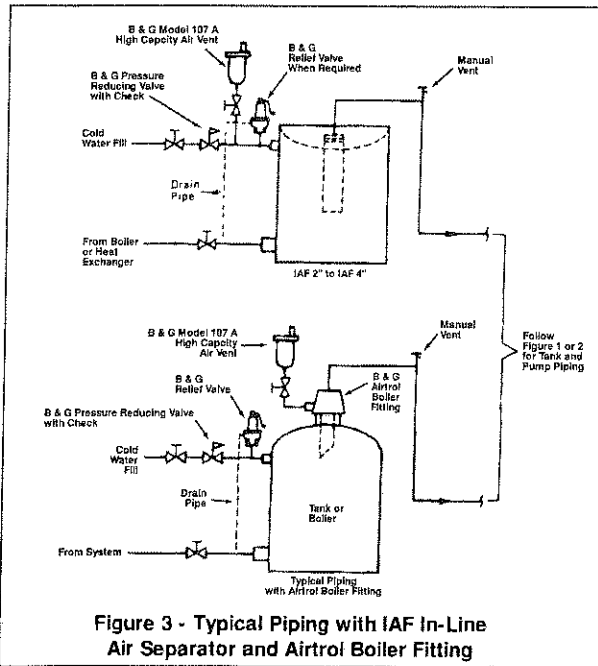
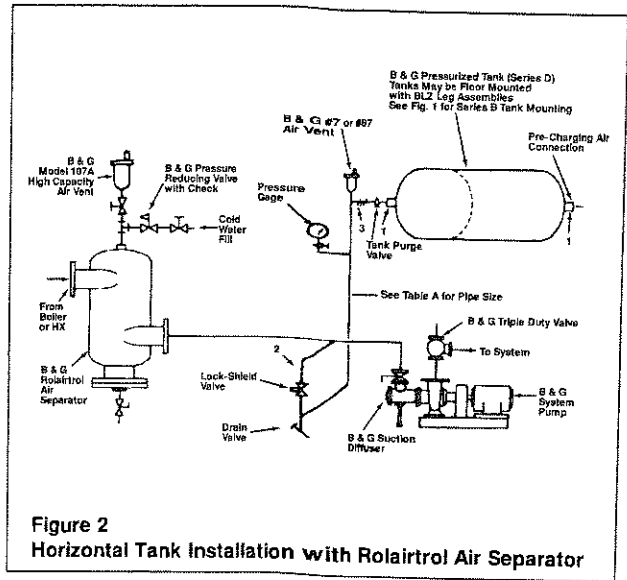
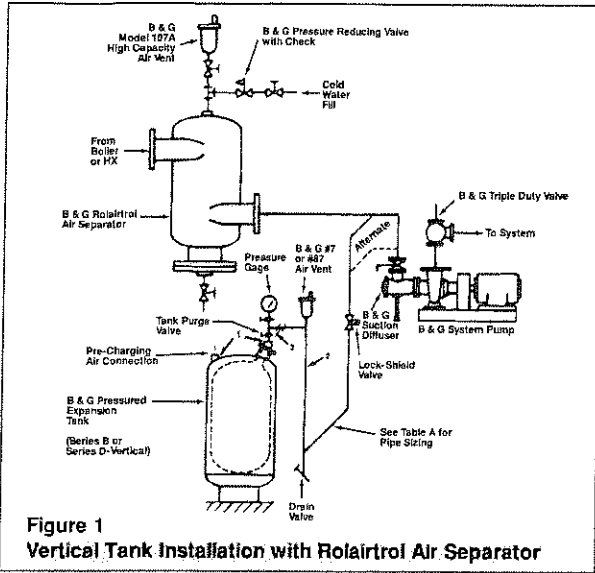
2. Depress the center valve core stem on the air side of the tank, as with a tire valve, to slowly vent off the air or gas charge.

⚠ WARNING: Removing the bladder housing cover with an air charge or pressure still in the tank can cause the cover to be blown off. Make sure that all gas charge pressure and system pressure is removed from the tank before loosening or removing cover bolts. Failure to follow these instructions could result in serious personal injury or death and property damage.

3. Remove the bolts from the flanged cover to gain access to the bladder. Series B-LA tanks must be disconnected from the system. Remove the bottom drain plug to drain fluid.
4. Pull the bladder from the tank through the flanged opening.
5. Make sure all flange surfaces are clean and free of corrosion so that the new bladder will seal properly. If corroded, the tank must be replaced.
6. Install the new bladder in the tank by stuffing through the flange opening in the reverse manner that the old bladder was removed. The Partial Acceptance tank has a support pipe, which the bladder will fit around. Insert the new bladder into bottom of the tank. To make system connection, align elbow with hole in skirt.
7. Replace the flanged cover and tighten the bolts in a crisscross pattern. Take care not to exceed the allowable torque of the bolts. Screw in drain plug.
8. Refer to item 3e thru 3g under operating instructions to place the system back in operation.
9. Check for gas leaks around the flange connection. If leaks are found, lightly tighten bolts in a criss-cross pattern, again being careful not to exceed the allowable torque of the bolts. If leaking continues, the expansion tank will have to be replaced.

FIGURE NOTES

1. Tank connection locations may vary depending on the type of tank to be installed.
2. Provide an anti-thermosyphon loop with a minimum drop of 12" to prevent gravity heating of the tank.
3. Figures 1 and 2 show where a tee would be located if multiple expansion tanks are installed.



PIPING DIAGRAMS

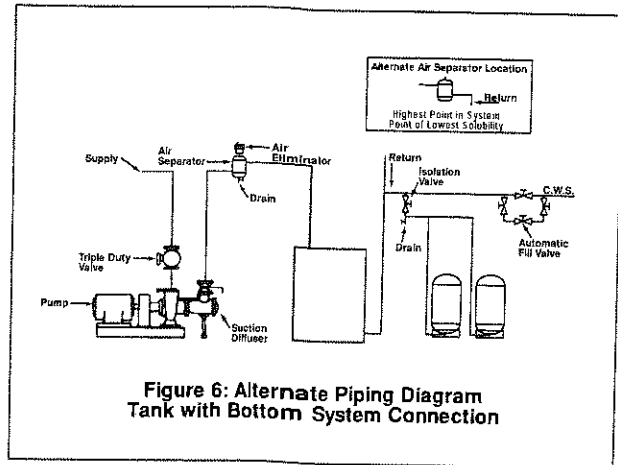
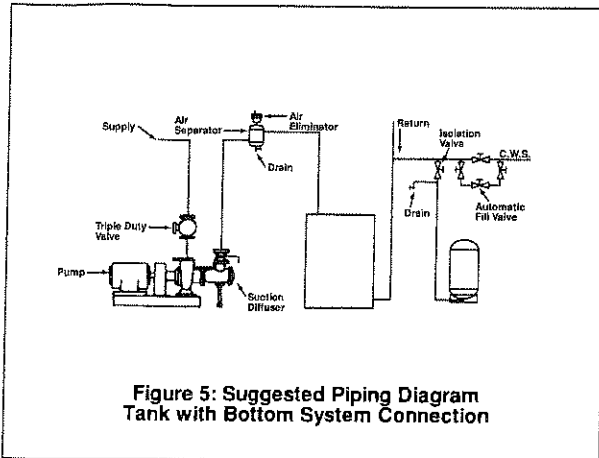


TABLE A - MINIMUM PIPE SIZE FROM TANK TO SYSTEM (IN INCHES)

MBH	EQUIVALENT LENGTH UP TO 10'					EQUIVALENT LENGTH 11' TO 30'					EQUIVALENT LENGTH 31' TO 100'				
	MAX. AVERAGE DESIGN TEMP. °F.					MAX. AVERAGE DESIGN TEMP. °F.					MAX. AVERAGE DESIGN TEMP. °F.				
	100	150	200	250	300	100	150	200	250	300	100	150	200	250	300
1,000	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	3/4	3/4	3/4	1
2,000	1/2	1/2	1/2	1/2	3/4	1/2	3/4	3/4	3/4	1	3/4	3/4	1	1	1 1/4
3,000	1/2	1/2	3/4	3/4	3/4	3/4	3/4	1	1	1	3/4	1	1	1 1/4	1 1/4
4,000	1/2	3/4	3/4	3/4	1	3/4	1	1	1	1 1/4	1	1	1 1/4	1 1/4	1 1/4
5,000	1/2	3/4	3/4	1	1	3/4	1	1	1 1/4	1 1/4	1	1 1/4	1 1/4	1 1/4	1 1/4
6,000	1/2	3/4	1	1	1	3/4	1	1 1/4	1 1/4	1 1/4	1	1 1/4	1 1/4	1 1/2	1 1/2
7,000	3/4	1	1	1	1 1/4	1	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/2	2
8,000	3/4	1	1	1	1 1/4	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/4	1 1/4	1 1/2	1 1/2	2
9,000	3/4	1	1	1 1/4	1 1/4	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/4	1 1/4	1 1/2	2	2
10,000	3/4	1	1	1 1/4	1 1/4	1	1 1/4	1 1/4	1 1/2	1 1/2	1 1/4	1 1/2	2	2	2
12,000	1	1	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	2	1 1/4	1 1/2	2	2	2
14,000	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/4	1 1/4	1 1/2	2	2	1 1/4	2	2	2	2 1/2
16,000	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/4	1 1/2	1 1/2	2	2	1 1/2	2	2	2 1/2	2 1/2
18,000	1	1 1/4	1 1/4	1 1/2	1 1/2	1 1/4	1 1/2	2	2	2	1 1/2	2	2	2 1/2	2 1/2
20,000	1	1 1/4	1 1/4	1 1/2	1 1/2	1 1/4	1 1/2	2	2	2	1 1/2	2	2 1/2	2 1/2	2 1/2



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ITT
8200 N. Austin Avenue
Morton Grove, IL 60053
Phone: (847) 966-3700
Fax: (847) 966-9052
<http://www.bellgossett.com>