SUBMITTAL DATA

FOR: Approval

FISEN ORDER NO : 2770F **DATE :** 7/21/2016

PROJECT NAME : DuPont 306

BASE UNITS BY : York

QTY	TAG(S)	FISEN JOB NO.	BASE MODEL NO.
1	CH-1	2770F	YCAL0046EE46XEBSDTX

This cover sheet is provided for the JCI sales representative as a summary of modifications and customizations to be performed by Fisen Corporation on JCI base equipment. Details listed above are provided for reference only. Details of the modifications performed are listed in the attached submittals in the sections titled *Construction Details*.

☐ Approved No Exceptions

☐ Approved As Noted

☐ Revise and Resubmit

APPROVED

AS NOTED

Approval Signature:_____ Date:_____

Note: Shipping dates are subject to production loading at time of project release, availability of material and receipt of signed paperwork. Fisen products are provided as submitted subject to Fisen's final engineering requirements and the actual unmodified base unit. Fisen Corporation is committed to continuous product improvement and component type, location, and style are subject to change based upon component fit and availability. Final drawings, IOMs and actual component cut sheets are available at the time of unit shipment.

YORK®
A JOHNSON CONTROLS COMPANY

Air Cooled Scroll Chiller Performance Specification

Unit Tag	Qty	Model No.	Capacity (Tons)	Volts/Ph/Hz	Refrigerant
CH-1	1	YCAL0046EE46	39.32	460/3/60	R410A

Pin:

BASE MODEL	POWER	CONTROLS	COMP PIPING	EVAPORATOR	COND	CABINET	WARR
YCAL0046EE46XEB	SDTX	AXXRLXXXX	45XX1XXXX	XXXSXXX	XXX	1XXXXXN	FXXXJB
5 10 15		20 25	30 35	40	45	50	55 60

Evaporator Data		Condenser Data		Performance Data	
EWT (°F)	57.5	Ambient Temp Design (°F)	95.0	EER (EER)	10.1
LWT (°F)	45.0	Altitude (ft.)	0	NPLV.IP(EER)	14.7
Design Flow Rate (gpm)	80.0	Min. Ambient Temp (°F)	28.4		
Pressure Drop (ft.)	6.53	Max. Ambient Temp (°F)	113.0	**Physical Data**	
Fluid	P.G. 30.0%			Unit Rigging Wt. (lbs.)**	3354
Fouling Factor	0.00010			Unit Operating Wt. (lbs.)**	3639
Water Volume. (gal)	3.5			Skid Rigging Wt. (lbs.)**	744
Min Flow Rate(GPM)	40.0			Skid Operating Wt. (lbs.)**	1267
Max Flow Rate (GPM)	200.0				

Piping Skid Package Data			
Water Volume (gal)	61.2	Combined Water Volume(gal)	64.7*
Piping Package Pressure Drop(ft)	0.8	Combined Fluid Pressure Drop(ft)	19.4*

Electrical Data				
Circuit	1	2	3	4
Compressor RLA	21/21	20/20		
Compressor Start Current (LRA)	125/125	125/125		
Fan QTY/FLA (each)	2/3.4	2/3.4		

Single-Point				
Min. Circuit Ampacity	109			
Recommended Fuse/CB Rating	125			
Max. Inverse Time CB Rating	125			
Max. Dual Element Fuse Size (Amps)	125			
Unit Short Circuit Withstand (STD)	65[kA]			
Wire Lugs Per Phase*	1			
Wire Range (Lug Size)	4AWG - 300			
Starter Type	Across the Line			
			Operating Condition Electrical Data	
			Compressor kW	40.98
			Total Fan kW	5.600
			Total kW	46.58
			Total kW with Hydrokit Power	48.82

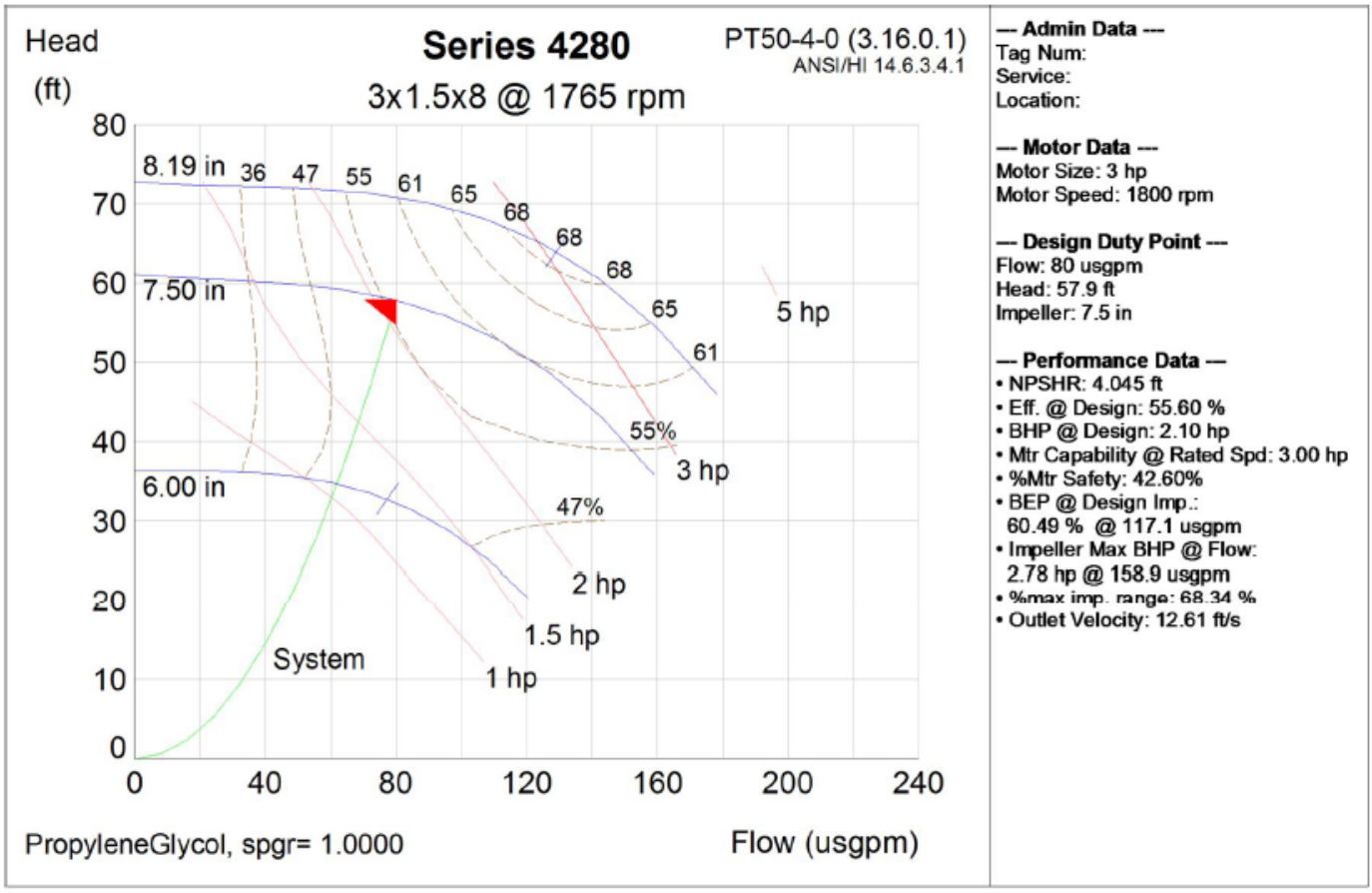
Notes:	Notes: Certified in accordance with the AHRI Air-Cooled Water-Chilling Packages Using Vapor Compression Cycle Certification Program, which is based on AHRI Standard 550/590 (I-P) and AHRI Standard 551/591 (SI). Unit containing freeze protection fluids in the condenser or in the evaporator with a leaving chilled fluid temperature above 32 DEG F [0 DEG C] is certified when rated per the Standard with water. Certified units may be found in the AHRI Directory at www.ahridirectory.org. Auxiliary components included in total KW - Oil heaters, Chiller controls. Auxiliary power is already included in the compressor and fan power *Use Copper Conductors only *Does not include field piping between standalone skid and chiller. **Weights are an approximation and subject to a ±10% deviation. A strainer, preferably 40 mesh, must be installed in the cooler inlet just ahead of the cooler. This is important to protect the cooler from the entrance of large particles which could cause damage to the evaporator. *Installing contractor responsible for providing and installing all chiller isolation. Represented weights are approximations and must be field verified at the time of installation.*

Part Load Rating Data				
Stage	Ambient (°F)	Capacity (Tons)	Compressor kW	Unit Efficiency
1	95.0	39.32	46.58	10.13
2	83.0	31.45	30.81	12.25
3	69.4	22.51	17.76	15.21
4	55.0	11.67	7.949	17.62

SOUND POWER LEVELS (In Accordance with ARI 370)										
Load %	Ambient (°F)	63	125	250	500	1K	2K	4K	8K	LWA
1	95.0	90	89	89	89	87	84	80	76	92
2	83.0	90	89	89	89	87	84	80	75	91
3	69.4	87	86	86	86	84	81	77	73	89
4	55.0	84	83	83	83	81	78	74	70	85

Performance at AHRI Conditions					
Evaporator Data		**Condenser Data**		**Performance Data**	
EWT (°F)	54.0	Ambient Temp Design (°F)	95.0	EER(EER)	10.2
LWT (°F)	44.0	Altitude (ft.)	0	IPLV.IP (EER)	14.7
Design Flow Rate (gpm)	94.37			Capacity(Tons)	39.3
Pressure Drop (ft.)	5.13				
Fluid	Water				
Fouling Factor	0.00010				
Water Volume. (gal)	3.5				

Hydro Kit Data					
Flow	80 UGPM	Impeller Diameter	7.5 in	Efficiency	56%
Head	57.9 H2O	Fluid	Water	Pump Quantity	2
Hydro Kit Performance Data					
Pump Motor Size	3 hp	Pump Motor BHP	2.1	Chiller Evaporator PD	6.5
Pump Motor Speed	1800 RPM	Pump Type	Dual	Hydro-Kit PD	12.1
				Stand AloneSkid PD	0.8
				Head Safety Factor	9.3
				Available Head	29.2



Fisen Provided Features

- Pipe Package
  - Allen Bradley Variable Frequency Drive(s) without Bypass
    - No Controls or Programming
    - In Line Disconnect Switch
  - Pump Differential Pressure Gauges
  - Evaporator Leaving Thermometer
  - Evaporator Leaving Pressure Gauge
  - Evaporator Entering Thermometer
  - Evaporator Leaving Pressure Gauge
- Stand Alone Skid Package
  - Single Entering and Leaving Fluid Connection
  - ANSI/AWWA C-606 Piping
  - Air Separator
    - Manual Air Vent
  - Pressurized Expansion Tank
  - Fill Station
  - 30 Gallon Glycol Makeup Unit
  - ¾" Elastomeric Insulation
- Field Installed Items(*Fisen Provided)
  - Flow Switch
  - Vibration Isolation *Must be sized for revised weights.*
- Testing Package
  - Quality Assurance Inspection
  - Electrical Controls Run Test
  - Hydronic Pressure Test
  - Limited Warranty on Fisen Provided Parts

Testing and Warranty Features

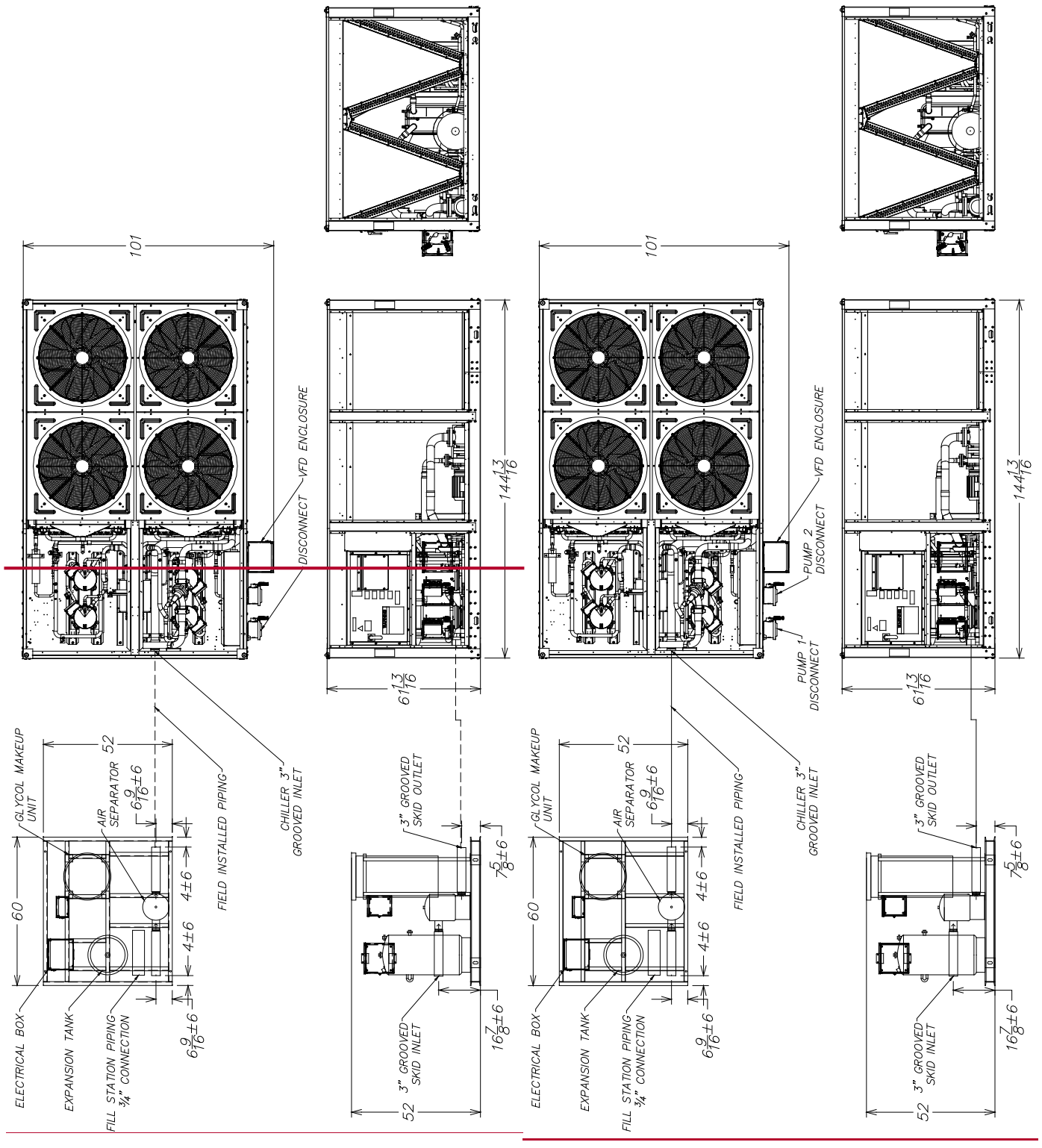
Electrical Controls Run Test
Modified electrical sub-systems shall be run tested prior to shipment. Electrical verification of all control components, and validation and verification of the sequence of operation shall be performed. Component test measurements and conditions shall be recorded and compared to engineering design data. Test logs shall be available for customer inspection upon request.

Hydronic Pressure Test
Factory installed hydronic system shall be pressure test for leaks prior to shipment. Pressure shall be held for a minimum of 4 hours. Mechanical components, e.g. valves, automatic air vents, etc , shall be tested in place when appropriate. Component test measurements and conditions shall be recorded and compared to engineering design data. Test logs shall be available for customer inspection upon request.

Quality Assurance Inspection
Fisen installed and modified components shall be inspected for compliance against the submittal documents prior to shipment. Submitted dimensions, component compatibility, and documentation shall be visually verified by the project manager prior to the unit being released to shipping for delivery to the customer. Items validated during this inspection include but are not limited to: unit voltage, unit refrigerant, unit mounted disconnect requirements, gas and power connection locations, supply and return duct connection locations, horizontal or vertical airflow, safety labels and warnings, regulatory labeling, presence of ship with materials, correct literature included with unit for shipping, and general compliance of unit against submitted data. A log of this inspection shall be available for customer inspection upon request.

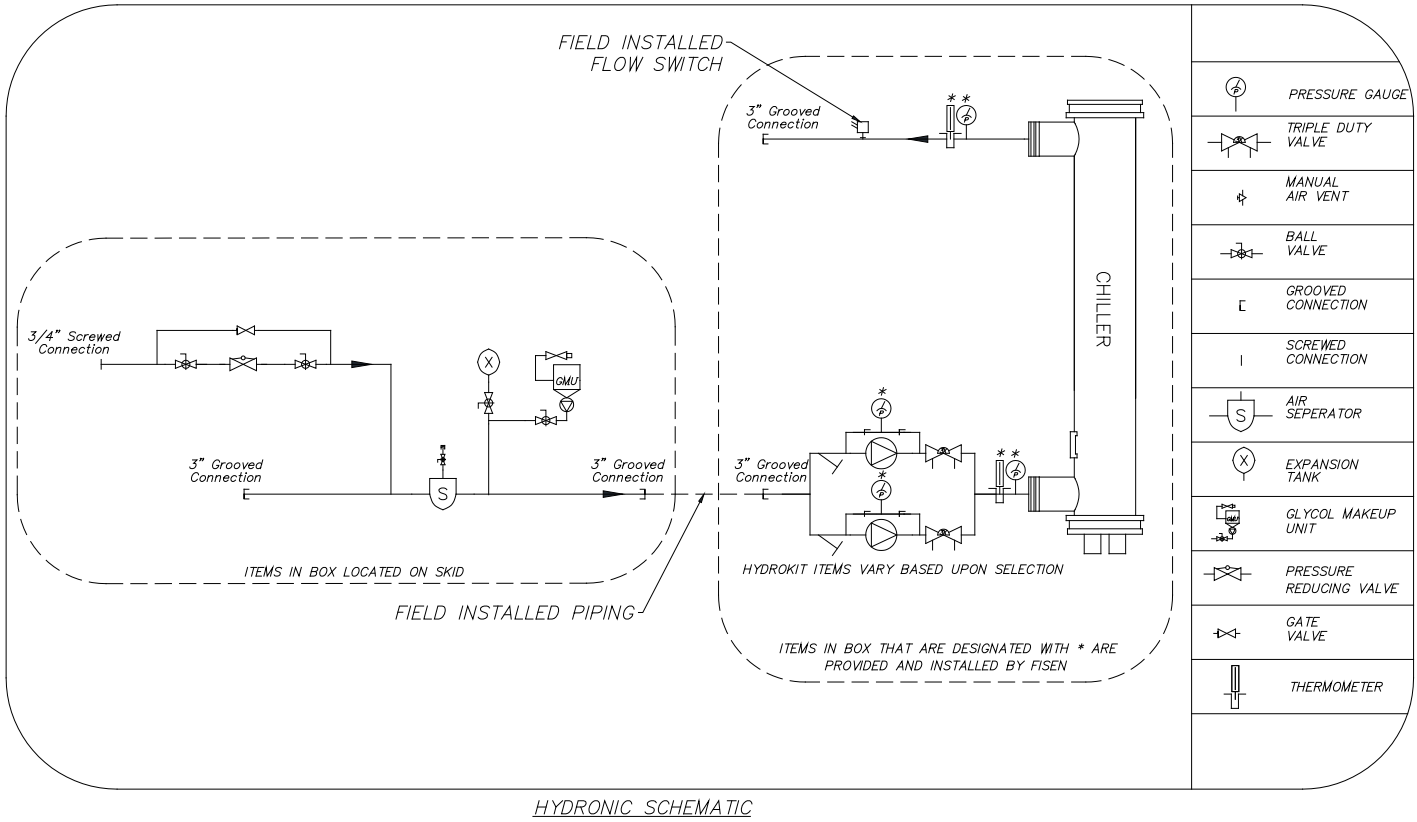
Limited Warranty on Fisen Provided Parts from Ship Date
Fisen shall provide a limited warranty for all Fisen provided parts for 18 months from shipment date or 12 months from start-up, whichever occurs first. Part warranty provides for replacement parts on a standard shipping cycle, express shipping and overnight freight are not included. Any parts replaced under warranty must be returned to Fisen. Failure to return failed parts within 72 hours of receipt of replacement parts may result in being charged for the replacement parts. Expendable parts, parts damaged through incidental damages, damage due to rigging or shipping are not covered under this warranty. Parts warranty is limited to actual part failure and specifically excludes labor. This exclusion refers to, but is not limited to: troubleshooting time, travel time to and from job site, lifting and rigging labor, and miscellaneous administrative labor codes. A detailed warranty letter is available from Fisen field support upon request.

Unit Drawings



Sequence of Operation
Sequence of Operation All controls and programming required for proper operation shall be provided by others.

Hydronic Flow Diagram



HYDRONIC SCHEMATIC

Construction Details
Pumping Package - Pump Variable Frequency Drive without Bypass - The hydro kit shall be equipped with a variable frequency drive for each pump. The AC Drive and all associated optional equipment is UL listed according to Power Conversation Equipment UL 508C and CSA certified. The AC Drive is designed, constructed and tested in accordance with NEMA ICS, NFPA, and IEC standards. The Drive converts incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. DC link reactors are provided on both the positive and negative rails of the DC bus equal to 3% impedance to minimize power line harmonics. Full load amp ratings meet or exceed NEC Table 430-150. The Drive provides full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting. **Pumping Package - Pump Controls and Programming By Others -** The provided pumps and pump variable frequency drives are provided without controls or programming. All controls and programming required for proper primary/stand-by operation of the pumps shall be provided by others. **Pump Differential Pressure Gauge Assembly –** The installed pumps shall be equipped with a factory installed differential pressure gauge assembly. The assembly shall consist of 1 differential pressure gauge, two isolation valves, 1 equalizing valve, and interconnecting piping. The gauge shall be capable of reading the pump differential pressure. Interconnecting piping on the isolation valves shall be a minimum of 1/4" and will typically be soft copper though other materials may be used. The pressure gauge shall be a 4-1/2" gauge with a 1/4" connection size. Gauge units of measure shall be in psi unless specifically stated otherwise. The wetted parts are bronze tube and socket. Freeze protection of the gauge assembly and associated piping is the responsibility of the installing contractor, unless a freeze protection / heat trace package has been specifically identified elsewhere in this document. Some applications, particularly those subject to severe pressure fluctuations, pulsations, or line shock, require the installation of field provided and installed snubbers or dampeners. If excessive pulsations are present snubbers or orifice pulsation dampeners are recommended. **Pump (s) Non-Fused Disconnect Switch (s) - 3R Type –** The unit shall be equipped with a non-fused disconnect. This disconnect may be used as a means for disconnecting a load from its supply, or for opening and closing a circuit. The switch shall be manufactured in accordance with UL98, Standard for Safety, Enclosed and Dead Front, Switches. UL Listed under File E2875, or E154828, NEMA Standards Publication KS1, Enclosed Switches, Federal Specifications WS-865c for Type HD, CSA Certified – C22.2 No.4, and be NOM Certified. The switch shall be constructed with the following features: visible blades for positive blade position, a handle indication for switch position, a quick-make, quick-break spring driven operating mechanism, and multiple padlock provisions in the OFF position. The disconnect shall be NEMA 3R rated and fabricated from galvanneal steel. **Power Wiring Installation Single Point Power - Chiller** – Existing wiring and conduit shall be reused when reasonably feasible. Typically the existing power wiring is run in black nylon flexible conduit. This flexible conduit, when reused shall be routed and terminated to maintain a weather resistant installation. Any new installed power wiring for the pumping package shall be accomplished using EMT conduit on the main wiring runs with a NMFC run of less than 6' length at the pump connection. EMT conduit shall be installed with weather resistant fittings approved for use in a rain prone environment. Power wiring shall be color coded to assist in the identification of specific phases and type of wiring. In some cases the wiring insulation shall be black with colored tape applied near the ends of the wire for use in this identification. This wiring style is typically applied to wiring between the chiller control/power panel, and 1 or more of the following components: pumps, variable frequency drives, transformers, heaters, lights, and other components operating at unit line voltage. Unless otherwise noted in this document, power connection location shall be as indicated in the appropriate technical guide for the chiller. **See chiller specification for single point connection details.** **Pumping Skid -** The pumping package skid shall be fabricated as shown in the drawings accompanying this submittal to include a stable platform for the hydronic system pumping and piping package. **Pumping Skid – Base – Structural Steel -** The pumping skid shall be engineered and fabricated using structural steel base with a minimum of 4" high main beams and 4" cross members. Plates, when present, shall be a minimum of 3/16" plate steel and welded to the frame for a secure anchoring of equipment. The frame shall be primed and painted. Lifting lugs shall be provided for rigging the unit into place on the job site. Lifting lugs shall be welded or bolted to the structural steel base depending on specific design requirements. Additional holes shall be provided for the installation of field provided and installed isolators. Refer to rigging and weight diagram for details on hole location.

Construction Details

Pumping Skid – Lifting Lugs – The pump package skid shall incorporate lifting lugs to rig, position, and set skid in place on the job site. Lugs are located and provided as shown in the accompanying rigging diagram. Lugs are designed to accept a "corky" style lifting device commonly used in container rigging. The holes are designed to accept a 1.7x3.0 inch "corky". The pump skid must be rigged using all provided lifting lugs and only rigged dry and empty.

Pumping Skid – Base – Finish – Painted - The pumping skid base shall be primed with an exterior grade corrosion inhibiting primer following preparation for finish. Preparation includes wash down of all surfaces with a paint-prep solution, removal of weld slag, and sanding of any fine surface corrosion that may be present when materials are delivered from the mill. After primer has dried and cured, the steel base shall be painted a neutral color similar machine dark grey, champagne brown, or black. Slight variations in dye lots may change final appearance of the pumping skid color. The underside of the pumping skid is provided primed and painted in a similar fashion to the top side. The pumping skid base is provided uninsulated.

Piping Package - A Fisen installed piping package shall be provided for the unit. Piping shall be as indicated on the enclosed drawings. No components not specifically identified in this document or upon the enclosed Fisen drawings shall be included. Construction and material for piping shall be as indicated below.

Piping Package – Pipe and Fittings Construction - Fisen will provide at our option one or a mixture of the following:

1. Schedule 40 black steel pipe, welded and 150 pound flanges.
2. Type L hard drawn copper with wrought copper fittings or copper grooved mechanical couplings and standard copper grooved fittings.

Piping Package – Single Entering / Leaving Fluid Connection – The unit shall be equipped with a single entering fluid connection and a single leaving fluid connection. The connection type shall be as indicated on the included submittal drawings elsewhere in this document. When unit is assembled using C-606 style grooved fittings and couplings and the connection type is shown as flanged, the unit shall ship with flange adapters. These items ship loose and require field installation. The flange adapters are not typically listed in the field installed items section.

Piping Package - Air Separator with Manual Air Vent - The package shall be equipped with an air separator with a manual air vent. ASME air separators are designed according to the ASME CODE Section VIII. Div 1. Intended for use in hydraulic / chilled water systems. The air separator shall have a maximum working pressure of at least 125psi and a maximum working temperature of 375ºF. Construction shall be of carbon steel. These air separators are intended for removal of entrapped air in hydronic and plumbing systems.

Air Separator Air Vent – Brass Isolation Ball Valve – The unit shall utilize a two piece body, full port, blowout proof stem PTFE seat ball valves as isolation valves on components indicated on the hydronic diagram in this document. Valves under 2" shall have a 600 PSI working pressure and valves 2-1/2" to 4" shall have a 400 PSI

Air Separator – Drain Plug – The air separator shall be equipped with a port in the bottom of the tank for the draining of the system fluid. The port ships with a plug or in the case of an insulated vessel, a nipple and cap. The cap or plug is provided uninsulated in all circumstances. If a nipple is installed it shall be insulated if the vessel is provided insulated. The cap, plug, and nipple assembly shall be schedule 40 black pipe.

Piping Package – Liquid in Glass Thermometer – The package shall be equipped with 9" liquid in glass thermometers in the locations shown in the hydronic schematic. The thermometers are installed in temperature wells and packed with thermal conductive compound. The thermometer is a liquid in glass design and features a cast aluminum case to provide weather tight sealing. The thermometer shall have +/- 1.0% full scale accuracy IAW ASME B40.3 Grade A

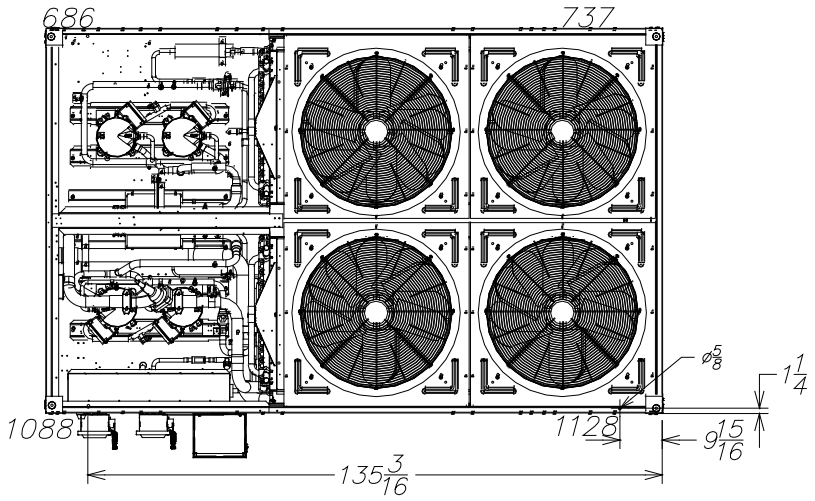
Piping Package – Thermo Well – The skid shall be equipped with brass thermo wells for use with standard thermistors, temperature sensors and thermometers. The brass well is compatible with noncorrosive liquids and have a maximum withstand temperature of 400ºF and a static pressure of 1000 psi.

Piping Package – Pressure Gauge – The pipes leaving and entering the heat exchanger shall be equipped with a pressure gauge. The gauge shall be capable of reading the system pressure. The pressure gauge shall be a 4-1/2" gauge with a 1/4" connection size. Gauge units of measure shall be in psi unless specifically stated otherwise. The wetted parts are bronze tube and socket. Freeze protection of the gauge assembly and associated piping is the responsibility of the installing contractor, unless a freeze protection / heat trace package has been specifically identified elsewhere in this document. Some applications, particularly those subject to severe pressure fluctuations, pulsations, or line shock, require the installation of field provided and installed snubbers or dampeners. If excessive pulsations are present snubbers or orifice pulsation dampeners are recommended.

Piping Package - Expansion Tank - The piping package shall be equipped with a thermal expansion tank. The tank shall be constructed in accordance with ASME Code section VIII, Div.1 and bear a UM stamp. The maximum working pressure of the tank shall be at least 150 psi and the maximum operating temperature shall be 240ºF. Construction is

Construction Details
based upon a two shell or two shell and body design depending upon total capacity. A removable butyl bladder is used to isolate water from the tank to mitigate corrosion. The tank utilizes a carbon steel water connection and is equipped with a protective nipple for the air valve. The tank ships precharged to 12 psi. The installing contractor must charge to specific job site conditions at the time of system startup. **Pump Package – Expansion Tank – Brass Isolation Ball Valve -** The unit shall utilize a two piece body, full port, blowout proof stem PTFE seat ball valves as isolation valves on components indicated on the hydronic diagram in this document. Valves under 2" shall have a 600 PSI working pressure and valves 2-1/2" to 4" shall have a 400 PSI working pressure. Valve connections may be threaded or sweat depending upon system requirements. **Piping Package – 30 Gallon Glycol Make-up Unit -** Pumping package shall be equipped with a glycol makeup unit. Glycol Make-up Unit (GMU) shall be a packaged, automatic glycol solution make up unit. The unit shall have a 30 gallon mixing tank capacity configured in a space saving design to minimize floor space requirement. The package shall monitor and maintain the minimum system pressure at all times. The pressurization assembly shall consist of a pressurization pump with pressure controls, a PRV, and a pressure gauge to continuously monitor PRV outlet pressure. The pressurization assembly shall be mounted on the translucent polyethylene solution container, complete with cover. Discharge pressure shall be factory preset to 12 psig and adjustable from 10-60 psi. **Piping Package – Pipe and Fittings Insulation – 3/4" Elastomeric -** All non-economizing chilled water piping, fittings and hydronic specialties are provided with 3/4" elastomeric insulation. Insulation shall be UV resistant without the application of covering paint. Depending upon material availability at the time of fabrication, standard elastomeric insulation may be provided and coated with an ultraviolet resistant finish. Components and piping provided on the base unit shall retain factory provided insulation type and size unless specifically noted elsewhere in this document. Insulation is installed using a contact adhesive. As a contact adhesive, in all cases, both surfaces to be joined are coated with adhesive. For application to large, flat or curved metal surfaces such as ducts, very large pipes, tanks and vessels, full adhesive coverage is used. For application as pipe insulation and fitting covers, only the seams and joints are adhered with contact adhesive.

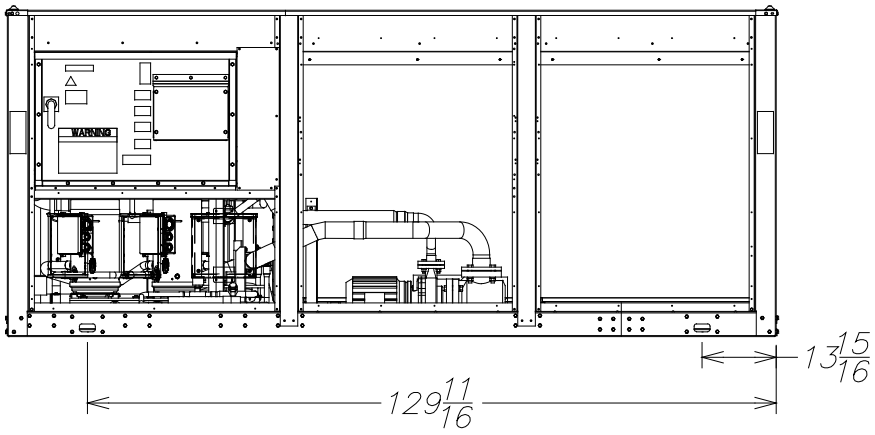
Rigging and Weight Distribution (Unit)



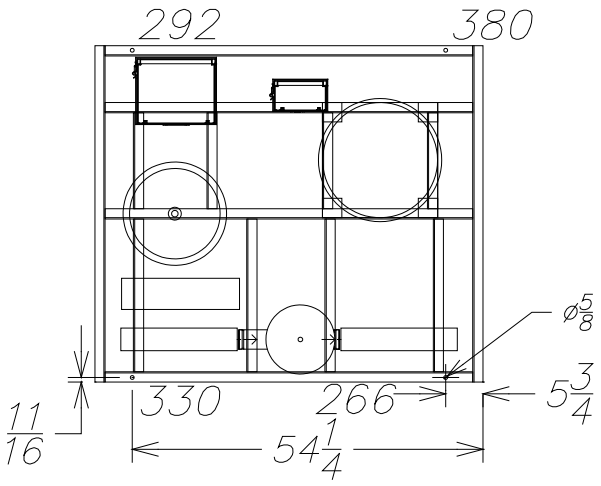
Item	X-Loc	Y-Loc	Weight
Base Unit			3573
Electrical Package			60
Hardware, Brackets, and Connectors			6

Total Approximate Weight (Operating): 3639 lbs

Weights shown represent approximate weights and have ± 10% accuracy



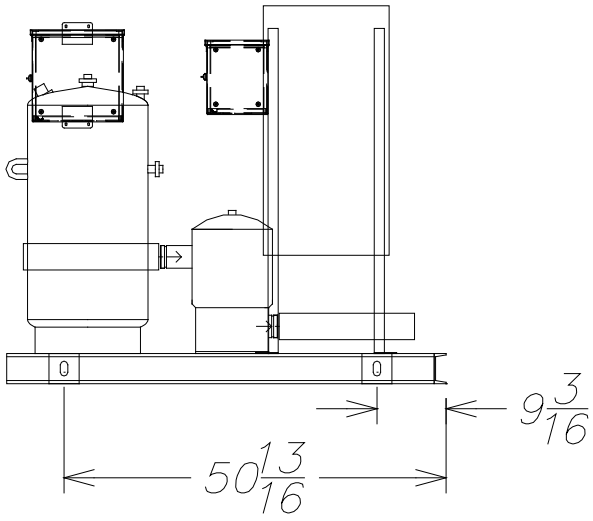
Rigging and Weight Distribution (Skid)



Item	X-Loc	Y-Loc	Weight
Standalone Skid			1200
Hardware, Brackets, and Connectors			67

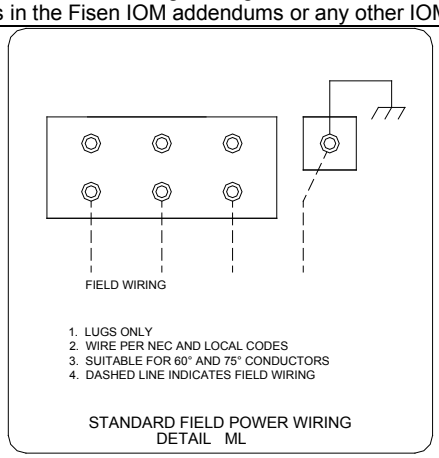
Total Approximate Weight (Operating): 1267 lbs

Weights shown represent approximate weights and have ± 10% accuracy

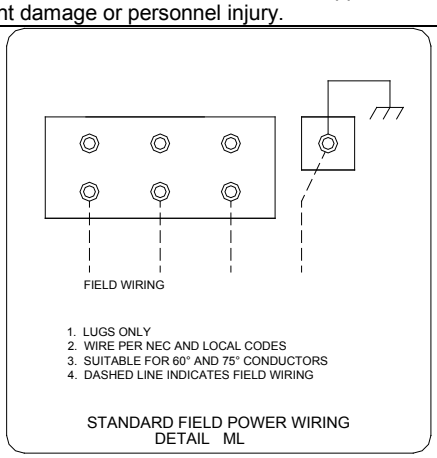


Field Connections

Field connections are detailed in the JCI IOM or Technical Guide other than those listed in this document. Refer to the JCI provided documents for detailed instructions on high voltage electrical connections. Failure to follow the instructions in that document as supplemented by the instructions in the Fisen IOM addendums or any other IOMs may result in equipment damage or personnel injury.



460/3/60 on Chiller



120/1/60 [redacted] On Standalone Skid for Glycol Makeup Unit (FLA 8.6A)

Electrical Connections

Air Cooled Scroll Liquid Chiller -YORK YCAL R410A 50Hz & 60Hz

1. GENERAL

1.01. GENERAL REQUIREMENTS

The requirements of this Section shall conform to the general provisions of the Contract, including General and Supplementary Conditions, Conditions of the Contract, and Contract Drawings.

1.02. SCOPE

Provide Microprocessor controlled, multiple scroll compressor, air-cooled, liquid chillers of the scheduled capacities as shown and indicated on the Drawings, including but not limited to:

1. Chiller package
2. Charge of refrigerant and oil
3. Electrical power and control connections
4. Chilled liquid connections
5. Manufacturer start-up

1.03. QUALITY ASSURANCE

A. Products shall be Designed, Tested, Rated and Certified in accordance with, and Installed in compliance with applicable sections of the following Standards and Codes:

1. AHRI 550/590 – Water Chilling Packages Using the Vapor Compression Cycle
2. AHRI 370 – Sound Rating of Large Outdoor Refrigerating and Air-Conditioning Equipment
3. ANSI/ASHRAE 15 – Safety Code for Mechanical Refrigeration
4. ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings
5. ANSI/NFPA 70 – National Electrical Code (N.E.C.)
6. ASME Boiler and Pressure Vessel Code, Section VIII, Division 1
7. OSHA – Occupational Safety and Health Act
8. Manufactured in facility registered to ISO 9001
9. Conform to Intertek Testing Services for construction of chillers and provide ETL/cETL Listed Mark

B. Factory Run Test: Chiller shall be pressure-tested, evacuated and fully charged with refrigerant and oil, and shall be factory operational run tested with water flowing through the vessel.

C. Chiller manufacturer shall have a factory trained and supported service organization.

D. Warranty: Manufacturer shall Warrant all equipment and material of its manufacture against defects in workmanship and material for a period of eighteen (18) months from date of shipment or twelve (12) months from date of start-up, whichever occurs first.

1.04. DELIVERY AND HANDLING

A. Unit shall be delivered to job site fully assembled with all interconnecting refrigerant piping and internal wiring ready for field installation and charged with refrigerant and oil by the Manufacturer.

B. Unit shall be stored and handled per Manufacturer's instructions.

C. Protect the chiller and its accessories from the weather and dirt exposure during shipment.

D. During shipment, provide protective covering over vulnerable components. Fit nozzles and open ends with plastic enclosures.

2. PRODUCTS

2.01. CHILLER MATERIALS AND COMPONENTS

A. General: Install and commission, as shown on the schedules and plans, factory assembled, charged, and tested air cooled scroll compressor chiller(s) as specified herein. Chiller shall be designed, selected, and constructed using a refrigerant with Flammability rating of "1", as defined by ANSI/ASHRAE STANDARD - 34 Number Designation and Safety Classification of Refrigerants. Chiller shall include, but is not limited to: a complete system with a single refrigerant circuit 35 tons (123kW) and below, and not less than two refrigerant circuits above 35 tons (123kW), scroll compressors, direct expansion type evaporator, air-cooled condenser, refrigerant, lubrication system, interconnecting wiring, safety and operating controls including capacity controller, control center, motor starting components, and special features as specified herein or required for safe, automatic operation.

B. Cabinet: External structural members shall be constructed of heavy guage, galvanized steel coated with baked on powder paint which, when subject to ASTM B117, 1000 hour, 5% salt spray test, yields minimum ASTM 1654 rating of "6".

C. Wire Panels (full unit): Heavy gauge, welded wire-mesh, coated to resist corrosion, to protect condenser coils from incidental damage and restrict unauthorized access to internal components. Factory installed.

2.02. COMPRESSORS

A. Compressors: Shall be hermetic, scroll-type, including:

1. Compliant design for axial and radial sealing.
2. Refrigerant flow through the compressor with 100% suction cooled motor.
3. Large suction side free volume and oil sump to provide liquid handling capability.
4. Compressor crankcase heaters to provide extra liquid migration protection.
5. Annular discharge check valve and reverse vent assembly to provide low-pressure drop, silent shutdown and reverse rotation protection.
6. Initial oil charge.
7. Oil level sight glass.
8. Vibration isolator mouonts for compressors.
9. Brazed-type connections for fully hermetic refrigerant circuits.

2.03. REFRIGERANT CIRCUIT COMPONENTS

Each refrigerant circuit shall include: liquid line shutoff valve with charging port, low side pressure relief device, filter-drier, solenoid valve, sight glass with moisture indicator, thermostatic expansion valves, and flexible, closed-cell foam insulated suction line and suction pressure transducer.

2.04. HEAT EXCHANGERS

A. Evaporator:

1. Evaporator shall be brazed-plate stainless steel construction, single or dual circuit heat exchangers capable of refrigerant working pressure of 650 PSIG (4482 kPa) and liquid side pressure of 150 psig (1034 kPa)
2. Brazed plate heat exchangers shall be UL listed.
3. Exterior surfaces shall be covered with 3.4" (19mm), flexible, closed cell insulation, thermal conductivity of 0.26k ([BTU/HR-Ft² - °F]/in.) maximum.
4. Cooler shall have a factory installed thermostatically controlled heater to protect to -20°F (-29°C) ambient in off-cycle.

5. Installing contractor must include accommodations in the chilled water piping to allow proper drainage and venting of the heat exchanger. A strainer with a mesh size between .5 and 1.5 mm is recommended upstream of the heat exchanger to prevent clogging.

B. Air-cooled Condenser:

1. Coils: Internally enhanced, seamless copper tubes, mechanically expanded into aluminum alloy fins with full height collars. Subcooling coil an integral part of condenser. Design working pressure shall be 450 PSIG (31 bar).

2. Fans shall be dynamically and statically balanced, direct drive, corrosion resistant glass fiber reinforced composite blades molded into a low noise, full-airfoil cross section, providing vertical air discharge and low sound. Each fan in its own compartment to prevent crossflow during fan cycling. Guards of heavy gauge, PVC (polyvinylchloride) coated steel.

3. Fan Motors: High efficiency, direct drive, 6 pole, 3 phase, insulation class "F", current protected, Totally Enclosed Air-Over (TEAO) , rigid mounted, with double sealed, permanently lubricated, ball bearings.

2.05. CONTROLS

A. General: Automatic start, stop, operating, and protection sequences across the range of scheduled conditions and transients.

B. Microprocessor Enclosure: Rain and dust tight NEMA 3R/12 (IP55) powder painted steel cabinet and gasket sealed door.

C. Microprocessor Control Center:

1. Automatic control of compressor start/stop, anti-coincidence and anti-recycle timers, automatic pumpdown at system shutdown, condenser fans, evaporator pump, evaporator heater, unit alarm contacts, and chiller operation from 0°F to 125°F (-18°C to 52°C) ambient. Automatic reset to normal chiller operation after power failure.

2. Software stored in non-volatile memory, with programmed setpoints retained in lithium battery backed real-time-clock (RTC) memory for minimum 5 years.

3. Forty character liquid crystal display, descriptions in English (or Spanish, French, Italian, or German), numeric data in English (or Metric) units. Sealed keypad with sections for Setpoints, Display/Print, Entry, Unit Options & clock, and On/Off Switch.

4. Programmable Setpoints (within Manufacturer limits): display language; chilled liquid temperature setpoint and range, remote reset temperature range, daily schedule/holiday for start/stop, manual override for servicing, low and high ambient cutouts, low liquid temperature cutout, low suction pressure cutout, high discharge pressure cutout, anti-recycle timer (compressor start cycle time), and anti-coincident timer (delay compressor starts).

5. Display Data: Return and leaving liquid temperatures, low leaving liquid temperature cutout setting, low ambient temperature cutout setting, outdoor air temperature, English or metric data, suction pressure cutout setting, each system suction pressure (optional on YCAL0014-0060 models), discharge pressure (optional), liquid temperature reset via a YORK ISN DDC or Building Automation System (by others) via a 4-20milliamp or 0-10 VDC input with optional BAS interface, anti-recycle timer status for each compressor, anti-coincident system start timer condition, compressor run status, no cooling load condition, day, date and time, daily start/stop times, holiday status, automatic or manual system lead/lag control, lead system definition, compressor starts/operating hours (each), status of hot gas valves, evaporator heater and fan operation, run permissive status, number of compressors running, liquid solenoid valve status, load & unload timer status, water pump status.

6. System Safeties: Shall cause individual compressor systems to perform auto shut down; manual reset required after the third trip in 90 minutes. System Safeties include: high discharge pressure, low suction pressure, high pressure switch, and motor protector. Compressor motor protector shall protect against damage due to high input current or thermal overload of windings.

7. Unit Safeties: Shall be automatic reset and cause compressors to shut down if low ambient, low leaving chilled liquid temperature, under voltage, and flow switch operation. Contractor shall provide flow switch and wiring per chiller manufacturer requirements.

8. Alarm Contacts: Low ambient, low leaving chilled liquid temperature, low voltage, low battery, and (per compressor circuit): high discharge pressure, and low suction pressure.

D. Manufacturer shall provide any controls not listed above, necessary for automatic chiller operation. Mechanical Contractor shall provide field control wiring necessary to interface sensors to the chiller control system.

2.06. POWER CONNECTION AND DISTRIBUTION

A. Power Panels:

1. NEMA 3R/12 (IP55) rain/dust tight, powder painted steel cabinets with gasket sealed outer doors. Provide main power connection(s), control power connections, compressor and fan motor start contactors, current overloads, and factory wiring.

2. Power supply shall enter unit at a single location, be 3 phase of scheduled voltage, and connect to individual terminal blocks per compressor. Separate disconnecting means and/or external branch circuit protection (by Contractor) required per applicable local or national codes.

B. Exposed compressor, control and fan motor power wiring shall be routed through liquid tight conduit.

2.07. ACCESSORIES AND OPTIONS

Some accessories and options supersede standard product features. Your Johnson Controls representative will be pleased to provide assistance.

A. Microprocessor controlled, Factory installed Across-the-Line type compressor motor starters as standard.

B. Outdoor Ambient Temperature Control

1. High Ambient Control (Factory Mounted): Permits unit operation above 115°F ambient.

2. Low Ambient Control (Factory mounted):Permits unit operation to 0°F ambient. Standard unit controls to

C. Power Supply Connections:

1. Single point terminal Block with Circuit Breaker and lockable external handle (in compliance with Article 44014 of N.E.C.) can be supplied to isolate power voltage for servicing. Incoming power wiring must comply with the National Electric Code and/or local codes.

D. Control Power Transformer: Converts unit power voltage to 120-1-60 (500 VA capacity). Factory-mounting includes primary and secondary wiring between the transformer and the control panel.

E. Pressure Transducers and Readout Capability:

1. Discharge Pressure Transducers: Permits unit to sense and display discharge pressure.

F. Protective Chiller Panels (Factory or Field Mounted)

1. Wire Panels (full unit): Heavy gauge, welded wire- mesh, coated to resist corrosion, to protect con- denser coils from incidental damage and restrict unauthorized access to internal components.

G. Flow Switch (Field-mounted): Vapor proof SPDT, NEMA 3R switch, 150 PSIG (10.3 bar), -20°F to 250°F (-28.9°C to 121.1°C).

H. Hot Gas By-Pass: Permits continuous, stable operation at capacities below the minimum step of unloading to as low as 5% capacity (depending on both the unit & operating conditions) by introducing an artificial load on the evaporator. Hot gas by-pass is installed on only one refrigerant circuit.

I. Low Temperature Process Brine: Leaving chilled liquid setpoint range 20o F to 50o F.

J. Low speed, reduce noise fans (Factory-mounted).

K. Vibration Isolation (Field installed):

1. Elastomeric Isolators.

L. Building Automation System (EMS) Reset Interface: Chiller to accept 4 to 20mA, 0 to 10 VDC, input to reset the leaving chilled liquid temperature.

M. Hydronic Kit

1. The Hydro Kit shall be integrated to the chiller without increasing overall chiller dimension.
2. Hydronic kit shall be factory installed within the framework of the chiller, lowering additional installation costs and decreasing floor space occupied by mechanical equipment.
3. Dual pump arranged in a lead/lag configuration shall be provided for stand-by operation.
4. The hydronic kit shall include features such as:
    a. Factory-installed Y strainer with a drain port.
    b. Factory-installed butterfly shut off valve for servicing pumps.
    c. Factory-installed Armstrong 4392 pump.
    d. ¼" NPT fitting for field provided venting device.
    e. ¼" NPT fitting for factory-installed thermal dispersion flow switch.
    f. Flow Trex Combination Valve, including shut off valve, check valve and balancing capability.
5. The unit with the hydronic kit shall have single point power, reducing installation time and cost.
6. The hydronic kit shall have remote on/off control through the chiller micropanel.
7. Hydronic kit piping and components shall be heated and insulated for freeze protection.

3. EXECUTION

3.01. INSTALLATION

A. General: Rig and Install in full accordance with Manufacturer's requirements, Project drawings, and Contract documents.

B. Location: Locate chiller as indicated on drawings, including cleaning and service maintenance clearance per Manufacturer instructions. Adjust and level chiller on support structure. If equipment provided exceeds height of scheduled chiller, installing contractor is responsible for additional costs associated with extending the height of parapet or screening walls/enclosures.

C. Components: Installing Contractor shall provide and install all auxiliary devices and accessories for fully operational chiller.

D. Electrical: Coordinate electrical requirements and connections for all power feeds with Electrical Contractor (Division 16).

E. Controls: Coordinate all control requirements and connections with Controls Contractor.

F. Finish: Installing Contractor shall paint damaged and abraded factory finish with touch-up paint matching factory finish.

ARMSTRONG

SERIES 4280 | END SUCTION MOTOR MOUNTED CLOSED-COUPLED | 3 × 1.5 × 8 | SUBMITTAL

File No: 42.60
Date: DECEMBER 4, 2014
Supersedes: 42.60
Date: SEPTEMBER 10, 2012

Job: Dupont Experimental Station Bldg 306 Representative: _____

_____ Order no: _____ Date: _____

Engineer: DEDC Submitted by: _____ Date: _____

Contractor: _____ Approved by: _____ Date: _____

PUMP DESIGN DATA

No. of pumps: 2 Tag: P-1, P-2

Capacity: 80 USgpm (L/s) Head: 30 External ft (m)

Liquid: Water 30% PG Viscosity: _____

Temperature: 45 °F (°C) Specific gravity: _____

Suction: 3"(75mm) Flanged

Discharge: 1.5"(38mm) Flanged

MOTOR DESIGN DATA

HP: 3 RPM: 1800 Frame size: _____ Enclosure: _____

Volts: 460 Hertz: 60 Hz Phase: 3

Efficiency: ☐ Energy EFF 12.11 ☐ NEMA premium 12.12

MATERIALS OF CONSTRUCTION

ANSI FLANGE RATING	ANSI 125	ANSI 250
Construction	☐ BF	☐ DBF
Casing	Cast iron	Ductile iron
Adapter	Cast iron	Ductile iron

Impeller: Bronze
Gasket: Confined non-asbestos fiber
Shaft: Carbon steel
Shaft sleeve: Bronze

MAXIMUM PUMP OPERATING CONDITIONS

ANSI 125

175 psig at 150°F (12 bars at 65°C)

140 psig at 250°F (10 bars at 121°C)

ANSI 250

300 psig at 150°F (20 bars at 65°C)

250 psig at 250°F (17 bars at 121°C)

- Tolerance of ±0.125" (±3 mm) should be used
- See performance curves on page 3
- For exact installation, data please write factory for certified dimensions
- Pump equipped with casing drain plug and ¼" NPT suction and discharge gauge ports

MECHANICAL SEAL DATA

Seal type: 2A
Secondary seal: EPDM
Spring: Stainless steel
Stationary seat: Silicone carbide
Rotating hardware: Stainless steel

OPTIONAL EQUIPMENT

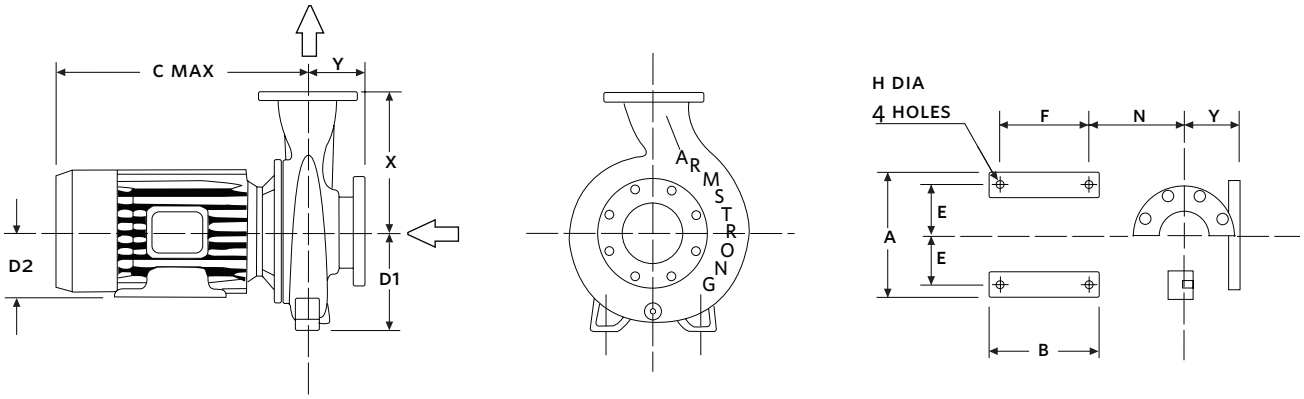
FLUID TYPE	ALL GLYCOLS > 30% WT CONC		ALL OTHER NON-POTABLE FLUIDS		POTABLE (DRINKING) WATER	
Temperature	up to 200°F (93°C)	over 200°F (93°C)	up to 200°F (93°C)	over 200°F (93°C)	up to 200°F (93°C)	over 200°F (93°C)
Rotating face	Silicone carbide		Resin bonded carbon	Antimony loaded carbon	Resin bonded carbon	
Seat elastomer	EPDM (L-cup)	EPDM (O-ring)	EPDM (L-cup)	EPDM (O-ring)	EPDM (L-cup)	EPDM (O-ring)
Material code	SCSC L EPSS 2A	SCSC O EPSS 2A	C-SC L EPSS 2A	ACSC O EPSS 2A	C-SC L EPSS 2A	C-SC O EPSS 2A

MOTOR	HP @ RPM (ODP & TEFC)			MAX. DIMENSIONS INCHES (mm)										ASSEMBLY WEIGHT*	
						C MAX								lbs (kgs)	
FRAME	3600	1800	1200	A	B	ODP	TEFC	D1	D2	E	F	H	N	ODP	TEFC
143JM	—	1	—	7.00 (178)	5.00 (127)	13.00 (330)	15.00 (381)	5.63 (143)	3.50 (89)	2.75 (70)	4.00 (102)	0.35 (9)	6.63 (168)	116 (52.7)	119 (54.0)
145JM	—	1.5 & 2	1	7.00 (178)	6.00 (152)	14.00 (356)	16.00 (406)	5.63 (143)	3.50 (89)	2.75 (70)	5.00 (127)	0.35 (9)	6.63 (168)	123 (55.8)	129 (58.5)
182JM	—	3	—	9.00 (229)	5.75 (146)	15.00 (381)	17.00 (432)	5.63 (143)	4.50 (114)	3.75 (95)	4.50 (114)	0.41 (10)	7.38 (187)	126 (57.1)	170 (77.1)
184JM	7.5	5	—	9.00 (229)	6.75 (172)	16.00 (406)	18.00 (457)	5.63 (143)	4.50 (114)	3.75 (95)	5.50 (140)	0.41 (10)	7.38 (187)	139 (63.0)	220 (99.8)
213JP	10	—	—	10.50 (267)	7.00 (178)	21.00 (533)	23.00 (584)	5.63 (143)	5.25 (133)	4.25 (108)	5.50 (140)	0.41 (10)	12.13 (308)	202 (91.6)	244 (110.7)
215JP	15	—	—	10.50 (267)	8.50 (216)	23.00 (584)	25.00 (635)	5.63 (143)	5.25 (133)	4.25 (108)	7.00 (178)	0.41 (10)	12.13 (308)	207 (93.9)	332 (150.6)
254JM	20	—	—	12.38 (314)	10.50 (267)	22.00 (559)	24.00 (610)	5.63 (143)	6.25 (159)	5.00 (127)	8.25 (210)	0.53 (13)	9.75 (248)	275 (124.7)	380 (172.4)
256JM	25	—	—	12.38 (314)	12.25 (311)	24.00 (610)	26.00 (660)	5.63 (143)	6.25 (159)	5.00 (127)	10.00 (254)	0.53 (13)	9.75 (248)	339 (153.8)	465 (210.9)
284JM	30	—	—	13.88 (353)	12.25 (311)	24.00 (610)	26.00 (660)	5.63 (143)	7.00 (178)	5.50 (140)	9.50 (241)	0.53 (13)	9.75 (248)	436 (197.8)	495 (224.5)

PUMP DIMENSIONS
inches (mm)

X	Y
8.50 (216)	4.00 (102)

*Assembly weight combines pump and motor.



LISTEN.
THINK.
SOLVE.SM

PowerFlex® 4M

TECHNICAL DATA

ADJUSTABLE FREQUENCY AC DRIVES

ALLEN-BRADLEY • ROCKWELL SOFTWARE

Rockwell Automation

Product Overview

Providing users with powerful motor speed control in a compact, space saving design, the Allen-Bradley® PowerFlex® 4M AC drive is the smallest and most cost effective member of the PowerFlex® family of drives. Ideal for machine level speed control, the PowerFlex 4M drive provides the application versatility to meet the demands of global OEMs and end users who require space savings and easy-to-use AC drives that provide application flexibility, feed-through wiring and ease-of-programming. The PowerFlex 4M AC drive is available in three frame sizes (A, B and C) and power ratings from 0.2 to 11 kW (0.25 to 15 Hp) and in voltage classes of 120, 240 and 480 volts.

Table of Contents

Reference Materials

For additional PowerFlex 4M data and general drive information, refer to the following publications:

Title	Publication	Available Online at . . .
PowerFlex 4M User Manual	22F-UM001...	**www.rockwellautomation.com/literature**
Wiring and Grounding Guidelines for PWM AC Drives	DRIVES-IN001...	
Preventive Maintenance of Industrial Control and Drive System Equipment	DRIVES-TD001...	
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control	SGI-1.1	

For other information, contact Allen-Bradley Drives Technical Support:

Title	Online at . . .
Allen-Bradley Drives Technical Support	**www.ab.com/support/abdrives**

Start Up, Programming and Operation

- An **integral keypad** provides out of the box operation using the local potentiometer and control keys.
- The 12 most common application parameters are contained in the **Basic Program Group**, making programming fast and easy.
- The **programming keys** have the same function as all other PowerFlex drives, so if you can program one PowerFlex drive, you can program them all.
- **4 digit display** with 10 additional LED indicators provides an intuitive display of drive status and information.
- Integral **RS-485 communications** can be used for programming from a PC. It can also be used in a multi-drop network configuration. A serial converter module provides connectivity to any controller with a DF1 port.
- A **NEMA/UL Type 4X** remote and **NEMA/UL Type 1 hand-held LCD keypad** provide additional programming and control flexibility, both featuring the popular CopyCat function.

Packaging and Mounting

- Installation can be a virtual snap using the **DIN rail mounting** feature on A and B frame drives. Panel mounting is also available, providing added flexibility.
- **Zero Stacking**™ is allowable for ambient temperatures up to 40°C, saving valuable panel space. 50°C ambient temperatures are permitted with minimal spacing between drives.
- Integral filtering is available on all 240V single phase and 480V three phase ratings, providing a cost-effective means of meeting EN61800-3. External filters for all PowerFlex 4M drive ratings are also available.

Optimized Performance

- **Removable MOV** to ground ensures reliable operation with ungrounded or resistive distribution systems.
- A **relay pre-charge** limits inrush current.
- **Integral brake transistor**, available on Frame C drives, provides dynamic braking capability with simple low cost brake resistors.
- DIP switch settable **24V DC sink or source control** for control wiring flexibility.
- 150% overload for 60 seconds or 200% overload for 3 seconds provides **robust overload protection**.
- Adjustable PWM frequency up to 10 kHz ensures quiet operation.
- Volts per Hertz Control Performance.
- Drive automatically provides auto boost (IR compensation) and slip compensation.
- Provides excellent speed regulation and high levels of torque across the entire speed range of the drive, and improved speed regulation even as loading increases.

Communications

- A **Serial Converter Module** provides connectivity to any controller that has the ability to initiate DFI messaging.
  - 22-SCM-232 – RS232/DF1 to RS 485/DSI
  - Bluetooth® - Wireless/DF1 to RS 485/DSI
- **Integral RS485/DSI communications** enable the drives to be used in a multi-drop network configuration.
- Integral communication cards such as **DeviceNet™** , **EtherNet/IP™** , **PROFIBUS™ DP**, **LonWorks®**, **BACnet®** and, **ControlNet™** can improve machine performance. These cards are optional and *can only be used with an external DSI communications kit*.
- The DSI Wireless Interface Module (WIM) provides a wireless communication interface between a Pocket PC, laptop computer or desktop computer equipped with Bluetooth® wireless technology, and any Allen-Bradley® product supporting the DSI™ protocol.
- RS485/DSI = Modbus RTU*
  - Directly compatible with PanelView products using RTU master capability
  - Direct compatibility with MicroLogix RTU master capability
  - Compatible with SLC-500 and ControlLogix, using 3rd-party scanners with RTU Master capability

Feed-through Wiring Design

- Feed through wiring for simple retrofitting into applications requiring variable speed motor control.
- Feed-through wiring design provides simple variable speed motor control with minimal installation and retrofitting time.

PC Programming Software

- Through the use of a Serial Converter Module and DriveExplorer™ or DriveTools™ SP software, programming can be greatly simplified.

DriveExplorer Software

- View and modify drive and adapter parameters in a method similar to the file management capability of Microsoft Windows Explorer.
- Operate the drive via an on-screen Control Bar, which is a tool that allows you to start, stop, and change the speed reference of the drive.
- Save, restore and print parameter information.
- Compare current parameters with factory defaults or previously saved parameter values.
- Edit, upload and download parameters.

DriveTools SP Software

- Online and offline programming capability
- In-grid and dialog-based parameter editing
- Immediate visual indication of drive and communication status when viewing online drive
- Integrated HTML Help architecture

Catalog Number Explanation

Position

1-3	4	5	6-8	9	10	11	12	13-14
22F	–	D	018	N	1	0	4	AA
a		b	c	d	e	f	g	h

a

Drive	
Code	Type
22F	PowerFlex 4M

b

Voltage Rating		
Code	Voltage	Ph.
V	120V ac	1
A	240V ac	1
B	240V ac	3
D	480V ac	3

c1

Rating		
100…120V ac, Single-Phase Input		
Code	Amps	kW (Hp)
1P6	1.6	0.2 (0.25)
2P5	2.5	0.4 (0.5)
4P5	4.5	0.75 (1.0)
6P0	6.0	1.1 (1.5)

c2

Rating		
200…240V ac, Single-Phase Input		
Code	Amps	kW (Hp)
1P6	1.6	0.2 (0.25)
2P5	2.5	0.4 (0.5)
4P2	4.2	0.75 (1.0)
8P0	8.0	1.5 (2.0)
011	11	2.2 (3.0)

c3

Rating		
200-240V ac, Three-Phase Input		
Code	Amps	kW (Hp)
1P6	1.6	0.2 (0.25)
2P5	2.5	0.4 (0.5)
4P2	4.2	0.75 (1.0)
8P0	8.0	1.5 (2.0)
012	12.0	2.2 (3.0)
017	17.5	3.7 (5.0)
025	25.0	5.5 (7.5)
033	33.0	7.5 (10.0)

c4

Rating		
380…480V ac, Three-Phase Input		
Code	Amps	kW (Hp)
1P5	1.5	0.4 (0.5)
2P5	2.5	0.75 (1.0)
4P2	4.2	1.5 (2.0)
6P0	6.0	2.2 (3.0)
8P7	8.7	3.7 (5.0)
013	13.0	5.5 (7.5)
018	18.0	7.5 (10.0)
024	24.0	10.0 (15.0)

d

Enclosure	
Code	Enclosure
N	Panel Mount - IP20 (NEMA/UL Type Open)

e

HIM	
Code	Interface Module
1	Fixed Keypad

f

Emission Class	
Code	EMC Filter
0	No Filter
1	Filter

g

Brake	
Code	Description
3	No Brake IGBT
4	Standard

h

Reserved	
Code	Description
AA through ZZ	Reserved

Product Selection

120V ac, Single-Phase Drives (50/60 Hz)

Drive Ratings				IP20, NEMA/UL Open Type
		Output Current		
kW	Hp	A	Frame Size	Cat. No.
0.2	0.25	1.6	A	22F-V1P6N103
0.4	0.5	2.5	A	22F-V2P5N103
0.75	1	4.5	B	22F-V4P5N103
1.1	1.5	6	B	22F-V6P0N103

240V ac, Single-Phase Drives (50/60 Hz)

Drive Ratings				IP20, NEMA/UL Open Type	w/Integral "S Type" EMC Filter ❄
		Output Current			
kW	Hp	A	Frame Size	Cat. No.	Cat. No.
0.2	0.25	1.6	A	22F-A1P6N103	22F-A1P6N113
0.4	0.5	2.5	A	22F-A2P5N103	22F-A2P5N113
0.75	1	4.2	A	22F-A4P2N103	22F-A4P2N113
1.5	2	8	B	22F-A8P0N103	22F-A8P0N113
2.2	3	11	B	22F-A011N103	22F-A011N113

❄ This filter is suitable for use with a cable length of up to 5 meters for class A environments and up to 1 meter for class B environments.

240V ac, Three-Phase Drives (50/60 Hz)

Drive Ratings				IP20, NEMA/UL Open Type
		Output Current		
kW	Hp	A	Frame Size	Cat. No.
0.2	0.25	1.6	A	22F-B1P6N103
0.4	0.5	2.5	A	22F-B2P5N103
0.75	1	4.2	A	22F-B4P2N103
1.5	2	8	A	22F-B8P0N103
2.2	3	12	B	22F-B012N103
3.7	5	17.5	B	22F-B017N103
w/Brake				
5.5	7.5	25	C	22F-B025N104
7.5	10	33	C	22F-B033N104

480V ac, Three-Phase Drives (50/60 Hz)

Drive Ratings				IP20, NEMA/UL Open Type	w/Integral "S Type" EMC Filter ❄
		Output Current			
kW	Hp	A	Frame Size	Cat. No.	Cat. No.
0.4	0.5	1.5	A	22F-D1P5N103	22F-D1P5N113
0.75	1	2.5	A	22F-D2P5N103	22F-D2P5N113
1.5	2	4.2	B	22F-D4P2N103	22F-D4P2N113
2.2	3	6	B	22F-D6P0N103	22F-D6P0N113
3.7	5	8.7	B	22F-D8P7N103	22F-D8P7N113
w/Brake					
5.5	7.5	13	C	22F-D013N104	22F-D013N114
7.5	10	18	C	22F-D018N104	22F-D018N114
11	15	24	C	22F-D024N104	22F-D024N114

❄ This filter is suitable for use with a cable length of up to 10 meters for Class A environments.

User Installed Options

Human Interface Module Option Kits and Accessories

Description	Cat. No.
Remote (Panel Mount) LCD Display, Digital Speed Control, CopyCat Capable. IP66 (NEMA/UL Type 4X/12) Indoor Use Only. Includes 2.0 meter cable.	22-HIM-C2S ∗
Remote Handheld, LCD Display, Full Numeric Keypad, Digital Speed Control, CopyCat Capable. IP30 (NEMA/UL Type 1). Includes 1.0 meter cable. Panel mount with optional Bezel Kit.	22-HIM-A3
Remote Handheld, Wireless Interface Module with Bluetooth® Technology. IP30 (NEMA/UL Type 1). Panel Mount with optional Bezel Kit.	22-WIM-N1
Remote (Panel Mount), Wireless Interface Module with Bluetooth Technology. IP66 (NEMA/UL Type 4X/12) Indoor Use Only.	22-WIM-N4S
Bezel Kit. Panel Mount for LCD Display, Remote Handheld Unit. IP30 (NEMA/UL Type 1). Includes a 22-RJ45CBL-C20 cable.	22-HIM-B1
DSI HIM Cable (DSI HIM to RJ45 cable)	
1.0 Meter (3.3 Feet)	22-HIM-H10
2.9 Meter (9.51 Feet)	22-HIM-H30

∗ The 22-HIM-C2S is smaller than the 22-HIM-C2 and cannot be used as a direct replacement.

PC Programming Software

Description	
DriveTools™ SP Software ✦	See publication 9303-PL002… for ordering/pricing information.
DriveExplorer™ Software (Lite/Full) ✦❖	
Pocket DriveExplorer™ Software	

✦ Set-up wizards are available for use with DriveTools SP and DriveExplorer (Lite/Full) only.

❖ DriveExplorer Lite is available for free download at: http://www.ab.com/drives/driveexplorer/free_download.html.

Communication Option Kits

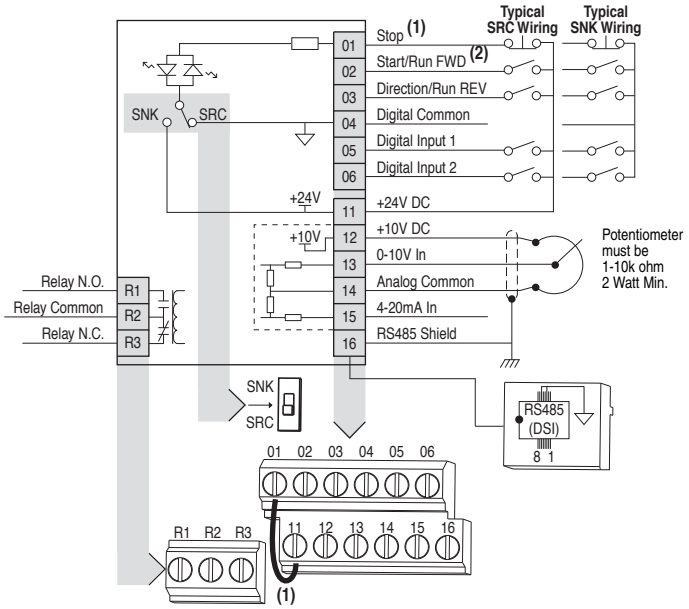
Description	Cat. No.
Serial Converter Module (RS485 to RS232) Provides serial communication via DF1 protocol for use with DriveExplorer and DriveExecutive™ software. Includes DSI to RS232 serial converter, 1203-SFC serial cable, 22-RJ45CBL-C20 cable, and DriveExplorer Lite CD.	22-SCM-232
Serial Cable 2.0 meter with a locking low profile connector. Connects the serial converter to a 9-pin sub-miniature D female computer connector.	1203-SFC
Serial Null Modem Adapter Use when connecting the serial converter to DriveExplorer on a handheld PC.	1203-SNM
Universal Serial Bus™ (USB) Converter includes 2m USB, 20-HIM-H10 & 22-HIM-H10 Cables	1203-USB
DSI Cable 2.0 meter RJ45 to RJ45 cable, male to male connectors.	22-RJ45CBL-C20
Splitter Cable RJ45 one to two port splitter cable.	AK-U0-RJ45-SC1
Terminating Resistors 120 Ohm resistor embedded in an RJ45 connector (2 pieces).	AK-U0-RJ45-TR1
Terminal Block RJ45 two position terminal block (6 pieces) with two 120 Ohm terminating resistors (loose).	AK-U0-RJ45-TB2P
DSI External Communications Kit External mounting kit for 22-COMM Communication Adapters.	22-XCOMM-DC-BASE
External Comms Power Supply Optional 100…240V ac Power Supply for External DSI Communications Kit.	20-XCOMM-AC-PS1
BACnet® MS/TP RS485 Communication Adapter ‡	22-COMM-B
ControlNet™ Communication Adapter ‡	22-COMM-C
DeviceNet™ Communication Adapter ‡	22-COMM-D
EtherNet/IP™ Communication Adapter ‡	22-COMM-E
PROFIBUS™ DP Communication Adapter ‡	22-COMM-P
Compact I/O Module (3 Channel)	1769-SM2

‡ PowerFlex 4M drives require External DSI Communication Kits. Communication Adapters cannot be drive mounted.

Installation Considerations

Control Wiring

- The control logic is 24V DC and can be set for either Sink or Source control via a DIP switch setting.
- Control terminal screws are sized for a conventional blade screw driver.
- I/O Terminals 1, 2 and 3 are dedicated for Stop, Start and Reverse operation respectively. These I/O Terminals can be programmed for 2- or 3-Wire operation to meet application requirements.
- I/O Terminals 4 and 5 are programmable and provide added flexibility. Programmable functions include:
  - Local Control
  - Preset Frequencies
  - Jog
  - RS485 Control
  - Second Accel/Decel
  - Auxiliary Fault
  - Clear Fault
- Speed can be controlled via a 0-10V input or 4-20 mA input. Both are electrically isolated from the drive.
- One form C relay can be programmed to provide the status of a wide variety of drive conditions. The drive is shipped with a jumper installed between I/O Terminals 01 and 11 to allow out of box operation from the keypad.



No.	Signal	Default	Description	Param.
R1	Relay N.O.	Fault	Normally open contact for output relay.	t221
R2	Relay Common	–	Common for output relay.	
R3	Relay N.C.	Fault	Normally closed contact for output relay.	t221
Sink/Source DIP Switch		Source (SRC)	Inputs can be wired as Sink (SNK) or Source (SRC) via DIP Switch setting.	
01	Stop (1)	Coast	The factory installed jumper or a normally closed input must be present for the drive to start.	P106 (1)
02	Start/Run FWD	Not Active	Command comes from the integral keypad by default. To disable reverse operation, see A095 [Reverse Disable].	P106, P107
03	Direction/Run REV	Not Active		P106, P107, A434
04	Digital Common	–	For digital inputs. Electronically isolated with digital inputs from analog I/O.	
05	Digital Input 1	Preset Freq	Program with t201 [Digital In1 Sel].	t201
06	Digital Input 2	Preset Freq	Program with t202 [Digital In2 Sel].	t202
11	+24V DC	–	Drive supplied power for digital inputs. Maximum output current is 100mA.	
12	+10V DC	–	Drive supplied power for 0-10V external potentiometer. Maximum output current is 15mA.	P108
13	0-10V In (3)	Not Active	For external 0-10V input supply (input impedance = 100k ohm) or potentiometer wiper.	P108
14	Analog Common	–	For 0-10V In or 4-20mA In. Electronically isolated with analog inputs from digital I/O.	
15	4-20mA In (3)	Not Active	For external 4-20mA input supply (input impedance = 250 ohm).	P108
16	RS485 (DSI) Shield	–	Terminal should be connected to safety ground - PE when using the RS485 (DSI) communications port.	

(3) Only one analog frequency source may be connected at a time. If more than one reference is connected at the same time, an undetermined frequency reference will result.

Specifications

Drive Ratings									
Catalog Number	Output Ratings		Input Ratings			Branch Circuit Protection			
	kW (HP)	Amps	Voltage Range	kVA	Amps	Fuses	140M Motor Protectors[2] [3]	Contactors	Min. Enclosure Volume[4] (in.^{3})
100 - 120V AC (±10%) – 1-Phase Input, 0 - 230V 3-Phase Output									
22F-V1P6N103	0.2 (0.25)	1.6	90-126	0.8	6.4	10	140M-C2E-C10	100-C09	1655
22F-V2P5N103	0.4 (0.5)	2.5	90-126	1.1	9.0	15	140M-C2E-C16	100-C12	1655
22F-V4P5N103	0.75 (1.0)	4.5	90-126	2.2	18.0	30	140M-D8E-C20	100-C23	1655
22F-V6P0N103	1.1 (1.5)	6.0	90-126	2.9	24.0	40	140M-F8E-C32	100-C30	1655
200 - 240V AC (±10%) – 1-Phase Input, 0 - 230V 3-Phase Output									
22F-A1P6N103	0.2 (0.25)	1.6	180-265	0.7	5.3	10	140M-C2E-B63	100-C09	1655
22F-A2P5N103	0.4 (0.5)	2.5	180-265	1.6	6.5	10	140M-C2E-C10	100-C09	1655
22F-A4P2N103	0.75 (1.0)	4.2	180-265	2.0	8.2	15	140M-C2E-C16	100-C12	1655
22F-A8P0N103	1.5 (2.0)	8.0	180-265	5.4	22.3	35	140M-D8E-C25	100-C23	1655
22F-A011N103	2.2 (3.0)	11.0	180-265	5.9	24.3	40	140M-F8E-C32	100-C30	1655
200 - 240V AC (±10%) – 1-Phase Input, 0 - 230V 3-Phase Output, with Filter									
22F-A1P6N113	0.2 (0.25)	1.6	180-265	1.3	5.3	10	140M-C2E-B63	100-C09	1655
22F-A2P5N113	0.4 (0.5)	2.5	180-265	1.6	6.5	10	140M-C2E-C10	100-C09	1655
22F-A4P2N113	0.75 (1.0)	4.2	180-265	2.0	8.2	15	140M-C2E-C16	100-C12	1655
22F-A8P0N113	1.5 (2.0)	8.0	180-265	5.4	22.3	35	140M-D8E-C25	100-C23	1655
22F-A011N113	2.2 (3.0)	11.0	180-265	5.9	24.3	40	140M-F8E-C32	100-C30	1655
200 - 240V AC (±10%) – 3-Phase Input, 0 - 230V 3-Phase Output									
22F-B1P6N103	0.2 (0.25)	1.6	180-265	0.8	1.9	3	140M-C2E-B25	100-C09	1655
22F-B2P5N103	0.4 (0.5)	2.5	180-265	1.2	2.7	6	140M-C2E-B40	100-C09	1655
22F-B4P2N103	0.75 (1.0)	4.2	180-265	2.1	4.9	10	140M-C2E-B63	100-C09	1655
22F-B8P0N103	1.5 (2.0)	8.0	180-265	4.0	9.5	15	140M-C2E-C16	100-C12	1655
22F-B012N103	2.2 (3.0)	12.0	180-265	6.3	15.0	25	140M-C2E-C20	100-C23	1655
22F-B017N103	3.7 (5.0)	17.5	180-265	8.8	21.1	35	140M-F8E-C25	100-C23	1655
22F-B025N104[1]	5.5 (7.5)	25.0	180-265	11.4	27.2	45	140M-F8E-C32	100-C37	3441
22F-B033N104[1]	7.5 (10.0)	33.0	180-265	16.1	38.5	60	140M-F8E-C45	100-C60	3441
380 - 480V AC (±10%) – 3-Phase Input, 0 - 460V 3-Phase Output									
22F-D1P5N103	0.4 (0.5)	1.5	340-528	1.5	1.8	3	140M-C2E-B25	100-C09	1655
22F-D2P5N103	0.75 (1.0)	2.5	340-528	3.0	3.5	6	140M-C2E-B40	100-C09	1655
22F-D4P2N103	1.5 (2.0)	4.2	340-528	5.0	6.0	10	140M-C2E-C10	100-C09	1655
22F-D6P0N103	2.2 (3.0)	6.0	340-528	5.2	6.2	10	140M-C2E-C10	100-C09	1655
22F-D8P7N103	3.7 (5.0)	8.7	340-528	7.0	8.3	15	140M-C2E-C16	100-C12	1655
22F-D013N104[1]	5.5 (7.5)	13.0	340-528	12.9	15.4	25	140M-D8E-C20	100-C23	3441
22F-D018N104[1]	7.5 (10.0)	18.0	340-528	16.3	19.5	30	140M-F8E-C25	100-C23	3441
22F-D024N104[1]	11.0 (15.0)	24.0	340-528	21.7	26.1	40	140M-F8E-C32	100-C30	3441
380 - 480V AC (±10%) – 3-Phase Input, 0 - 460V 3-Phase Output, with Filter									
22F-D1P5N113	0.4 (0.5)	1.5	340-528	1.5	1.8	3	140M-C2E-B25	100-C09	1655
22F-D2P5N113	0.75 (1.0)	2.5	340-528	3.0	3.5	6	140M-C2E-B40	100-C09	1655
22F-D4P2N113	1.5 (2.0)	4.2	340-528	5.0	6.0	10	140M-C2E-C10	100-C09	1655
22F-D6P0N113	2.2 (3.0)	6.0	340-528	5.2	6.2	10	140M-C2E-C10	100-C09	1655
22F-D8P7N113	3.7 (5.0)	8.7	340-528	7.0	8.3	15	140M-C2E-C16	100-C12	1655
22F-D013N114[1]	5.5 (7.5)	13.0	340-528	12.9	15.4	25	140M-D8E-C20	100-C23	3441
22F-D018N114[1]	7.5 (10.0)	18.0	340-528	16.3	19.5	30	140M-F8E-C25	100-C23	3441
22F-D024N114[1]	11.0 (15.0)	24.0	340-528	21.7	26.1	40	140M-F8E-C32	100-C30	3441

(1) Catalog suffix ending with '4', such as N104 and N114, indicate that an internal brake IGBT is supplied.

(2) The AIC ratings of the Bulletin 140M Motor Protector Circuit Breakers may vary. See Bulletin 140M Motor Protection Circuit Breakers Application Ratings.

(3) Manual Self-Protected (Type E) Combination Motor Controller, UL listed for 208 Wye or Delta, 240 Wye or Delta, 480Y/277 or 600Y/347. Not UL listed for use on 480V or 600V Delta/Delta, corner ground, or high-resistance ground systems.

(4) When using a Manual Self-Protected (Type E) Combination Motor Controller, the drive must be installed in a ventilated or non-ventilated enclosure with the minimum volume specified in this column. Application specific thermal considerations may require a larger enclosure.

Input/Output Ratings	Approvals
Output Frequency: 0-400 Hz (Programmable) *Efficiency:* 97.5% (Typical)	UL508C CSA 22.2 EMC Directive 89/336 LV: EN 50178, EN 60204 EMC: EN 61800-3, EN 50081-1, EN 50082-2

Digital Control Inputs (Input Current = 6mA)		Analog Control Inputs
SRC (Source) Mode: 18-24V = ON 0-6V = OFF	SNK (Sink) Mode: 0-6V = ON 18-24V = OFF	*4-20mA Analog:* 250 ohm input impedance *0-10V DC Analog:* 100k ohm input impedance *External Pot:* 1-10k ohms, 2 Watt minimum

Control Output (Programmable Output, form C relay)

Resistive Rating: 3.0A at 30V DC, 125V AC and 240V AC *Inductive Rating:* 0.5A at 30V DC, 125V AC, and 240V AC

Recommended Fuses and Circuit Breakers

Fuse: UL Class J, RK1, T or Type BS88; 600V (550V) or equivalent. *Circuit Breakers:* HMCP or Bulletin 140M or equivalent.

Protective Features

Motor Protection: I^2t overload protection - 150% for 60 Secs, 200% for 3 Secs (Provides Class 10 protection)

Overcurrent: 200% hardware limit, 300% instantaneous fault

Over Voltage: 100-120V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 150V AC incoming line)
200-240V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 290V AC incoming line)
380-460V AC Input – Trip occurs at 810V DC bus voltage (equivalent to 575V AC incoming line)

Under Voltage: 100-120V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 75V AC incoming line)
200-240V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 150V AC incoming line)
380-480V AC Input – Trip occurs at 390V DC bus voltage (equivalent to 275V AC incoming line)

Control Ride Through: Minimum ride through is 0.5 Secs - typical value 2 Secs

Faultless Power Ride Through: 100 milliseconds

Dynamic Braking

Internal brake IGBT included with power ratings 5.5 kW (7.5 HP) and 7.5 kW (10.0 HP) for 240V, 3-phase drives and 5.5 kW (7.5 HP), 7.5 kW (10.0 HP) and 11.0 kW (15.0 HP) for 480V, 3-phase drives. See the PowerFlex 4M *User Manual* for ordering information.

Category	Specification	
Environment	Altitude:	1000 m (3300 ft) max. without derating
	Maximum Surrounding Air Temperature without derating:	
	IP20:	–10 to 50° C (14 to 122° F)
	IP20 zero stacking:	–10 to 40° C (14 to 104° F)
	Cooling Method	
	Convection:	120V, 1-Phase, 0.75 kW (1 HP) and below 240V, 1-Phase, 0.4 kW (0.5 HP) and below 240V, 3-Phase, 0.75 kW (1 HP) and below 480V, 3-Phase, 0.75 kW (1 HP) and below
	Fan:	All other drive ratings.
	Storage Temperature:	–40 to 85 degrees C (–40 to 185 degrees F)
	Atmosphere:	**Important:** Drive **must not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.
	Relative Humidity:	0 to 95% non-condensing
	Shock (operating):	15G peak for 11ms duration (±1.0ms)
	Vibration (operating):	1G peak, 5 to 2000 Hz
Control	Carrier Frequency	2-10 kHz. Drive rating based on 4 kHz.
	Frequency Accuracy	
	Digital Input:	Within ±0.05% of set output frequency.
	Analog Input:	Within 0.5% of maximum output frequency.
	Speed Regulation - Open Loop with Slip Compensation:	±2% of base speed across a 40:1 speed range.
	Stop Modes:	Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S Curve.
	Acceleration/Deceleration:	Two independently programmable acceleration and deceleration times. Each time may be programmed from 0 - 600 seconds in 0.1 second increments.
	Intermittent Overload:	150% Overload capability for up to 1 minute 200% Overload capability for up to 3 seconds
	Electronic Motor Overload Protection	Provides class 10 motor overload protection according to NEC article 430 and motor over-temperature protection according to NEC article 430.126 (A) (2). UL 508C File 29572.

Parameter Cross Reference - by Name

Parameter Name	Number	Group
Accel Time 1	P109	Basic Program
Accel Time 2	A401	Advanced Program
Analog In 0-10V	d020	Display
Analog In 4-20mA	d021	Display
Anlg In 0-10V Hi	t212	Terminal Block
Anlg In 0-10V Lo	t211	Terminal Block
Anlg In4-20mA Hi	t214	Terminal Block
Anlg In4-20mA Lo	t213	Terminal Block
Auto Rstrt Delay	A452	Advanced Program
Auto Rstrt Tries	A451	Advanced Program
Boost Select	A453	Advanced Program
Bus Reg Mode	A441	Advanced Program
Comm Data Rate	C302	Communications
Comm Format	C306	Communications
Comm Loss Action	C304	Communications
Comm Loss Time	C305	Communications
Comm Node Addr	C303	Communications
Comm Status	d015	Display
Comm Write Mode	C307	Communications
Commanded Freq	d002	Display
Compensation	A436	Advanced Program
Contrl In Status	d013	Display
Control Source	d012	Display
Control SW Ver	d016	Display
Current Limit	A441	Advanced Program
DB Duty Cycle	A428	Advanced Program
DB Resistor Sel	A427	Advanced Program
DC Brake Level	A425	Advanced Program
DC Brake Time	A424	Advanced Program
DC Bus Voltage	d005	Display
Decel Time 1	P110	Basic Program
Decel Time 2	A402	Advanced Program
Dig In Status	d014	Display
Digital In1 Sel	t201	Terminal Block
Digital In2 Sel	t202	Terminal Block
Drive Status	d006	Display
Drive Temp	d022	Display
Drive Type	d017	Display
Elapsed Run Time	d018	Display
Fault 1 Code	d007	Display
Fault 2 Code	d008	Display
Fault 3 Code	d009	Display

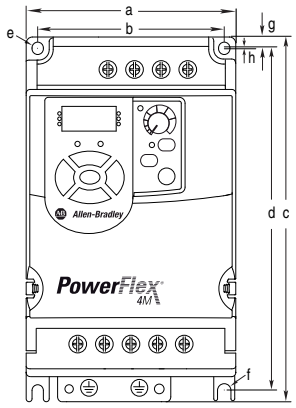
Parameter Name	Number	Group
Fault Clear	A450	Advanced Program
Flying Start En	A435	Advanced Program
Internal Freq	A409	Advanced Program
Jog Accel/Decel	A405	Advanced Program
Jog Frequency	A404	Advanced Program
Language	C301	Communications
Maximum Freq	P105	Basic Program
Maximum Voltage	A457	Advanced Program
Minimum Freq	P104	Basic Program
Motor NP FLA	A461	Advanced Program
Motor NP Hertz	P102	Basic Program
Motor NP Volts	P101	Basic Program
Motor OL Current	P103	Basic Program
Motor OL Ret	P111	Basic Program
Motor OL Select	A444	Advanced Program
Output Current	d003	Display
Output Freq	d001	Display
Output Voltage	d004	Display
Preset Freq 0	A410	Advanced Program
Preset Freq 1	A411	Advanced Program
Preset Freq 2	A412	Advanced Program
Preset Freq 3	A413	Advanced Program
Process Display	d010	Display
Process Factor	A440	Advanced Program
Process Time Hi	A439	Advanced Program
Process Time Lo	A438	Advanced Program
Program Lock	A458	Advanced Program
PWM Frequency	A446	Advanced Program
Relay Out Level	t222	Terminal Block
Relay Out Sel	t221	Terminal Block
Reset To Defalts	P112	Basic Program
Reverse Disable	A434	Advanced Program
S Curve %	A403	Advanced Program
Skip Freq Band	A419	Advanced Program
Skip Frequency	A418	Advanced Program
Slip Hertz @ FLA	A437	Advanced Program
Speed Reference	P108	Basic Program
Start At PowerUp	A433	Advanced Program
Start Source	P106	Basic Program
Stop Mode	P107	Basic Program
SW Current Trip	A448	Advanced Program
Testpoint Data	d019	Display
Testpoint Sel	A459	Advanced Program

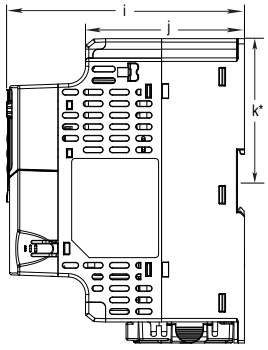
Product Dimensions

PowerFlex 4M Panel Mount Drives – Ratings are in kW and (HP)

Frame	120V AC – 1-Phase	240V AC – 1-Phase	240V AC – 3-Phase	480V AC – 3-Phase
A	0.2 (0.25) 0.4 (0.5)	0.2 (0.25) 0.4 (0.5) 0.75 (1.0)	0.2 (0.25) 0.4 (0.5) 0.75 (1.0) 1.5 (2.0)	0.4 (0.5) 0.75 (1.0) 1.5 (2.0)
B	0.75 (1.0) 1.1 (1.5)	1.5 (2.0) 2.2 (3.0)	2.2 (3.0) 3.7 (5.0)	2.2 (3.0) 3.7 (5.0)
C	—	—	5.5 (7.5) 7.5 (10.0)	5.5 (7.5) 7.5 (10.0) 11.0 (15.0)

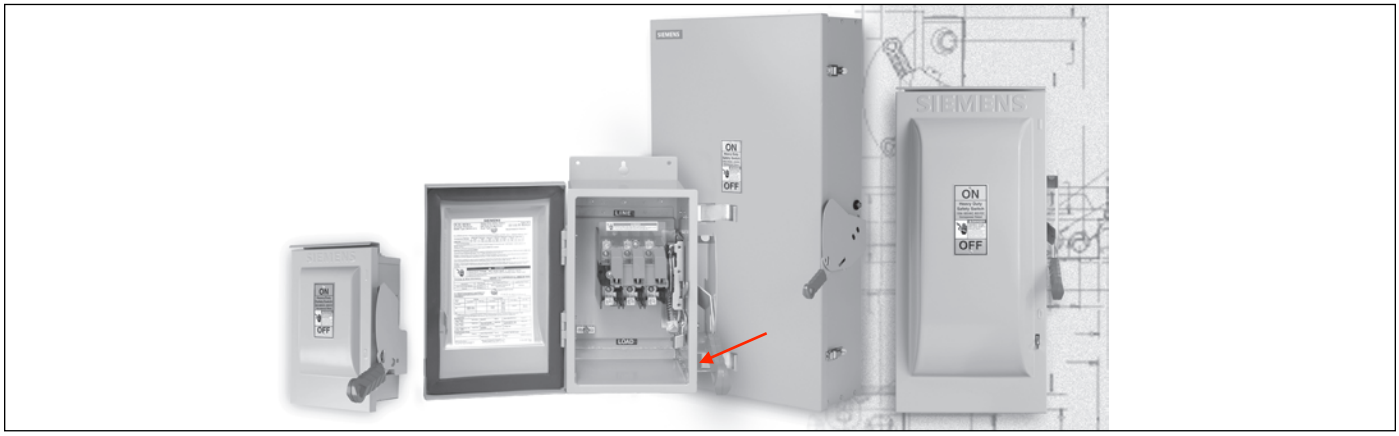
PowerFlex 4M Panel Mount Drives
– Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).





Note:
DIN rail mounting is not applicable to Frame C.

Frame	a	b	c	d	e	f	g	h	i	j	k	Shipping Weight
A	72.0 (2.83)	59.0 (2.32)	174.0 (6.85)	151.6 (5.97)	∅ 5.4 (0.21)	∅ 5.4 (0.21)	5.2 (0.20)	—	136.0 (5.35)	90.9 (3.58)	81.3 (3.20)	1.6 (3.5)
B	100 (3.94)	89.0 (3.50)	174.0 (6.85)	163.5 (6.44)	∅ 5.4 (0.21)	∅ 5.4 (0.21)	5.2 (0.20)	0.5 (0.02)	136.0 (5.35)	90.9 (3.58)	81.3 (3.20)	2.1 (4.6)
C	130.0 (5.12)	116.0 (4.57)	260.0 (10.24)	247.5 (9.74)	∅ 5.5 (0.22)	∅ 5.5 (0.22)	6.0 (0.24)	1.0 (0.04)	180.0 (7.09)	128.7 (5.07)	—	4.8 (10.6)



System	Ampere Rating	Indoor - Type 1 Catalog Number	Ship. Wgt.	List Price $	Outdoor - Type 3R Catalog Number	Ship. Wgt.	List Price $	Horsepower Ratings 240 Volt 1-Phase	240 Volt 3-Phase	480 Volt 1-Phase	480 Volt 3-Phase	600 Volt 1-Phase	600 Volt 3-Phase	250V DC	600V DC

600 Volt Non-Fusible④

2-Pole ③ — 480 Volt AC / 600 Volt AC / 600 Volt DC

Ampere Rating	Indoor - Type 1 Catalog Number	Ship. Wgt.	List Price $	Outdoor - Type 3R Catalog Number	Ship. Wgt.	List Price $	240 Volt 1-Phase	240 Volt 3-Phase	480 Volt 1-Phase	480 Volt 3-Phase	600 Volt 1-Phase	600 Volt 3-Phase	250V DC	600V DC
30	HNF261	12		HNF261R	13		—	—	7 1/2	—	10	—	5	15
60	HNF262	19		HNF262R	20		—	—	20	—	25	—	10	30
100	HNF263	24		HNF263R	25		—	—	30	—	40	—	20	50
400	HNF265■	109		HNF265R	113		15	—	50	—	50	—	40	50
600	HNF266■	111		HNF266R■	115		15	—	50	—	50	—	50	50

3-Pole — 480 Volt AC / 600 Volt AC / 250 Volt DC

Ampere Rating	Indoor - Type 1 Catalog Number	Ship. Wgt.	List Price $	Outdoor - Type 3R Catalog Number	Ship. Wgt.	List Price $	240 Volt 1-Phase	240 Volt 3-Phase	480 Volt 1-Phase	480 Volt 3-Phase	600 Volt 1-Phase	600 Volt 3-Phase	250V DC	600V DC
30	HNF361	12		HNF361R	13		5	10	7 1/2	20	10	30	5	—
30	—	—	—	HNF361RL⑥	19		5	10	7 1/2	20	10	30	5	—
60	HNF362H②	11		HNF362RH②	11		10	20	20	50	20	40	10	—
60	HNF362①⑦	18		HNF362R①⑦	19		10	20	20	50	25	60	10	30⑦
60	—	—	—	HNF362RL⑥⑦	24		10	20	20	50	25	60	10	30⑦
100	HNF363①⑦	23		HNF363R①⑦	24		15	40	30	75	40	100	20	50⑦
200	HNF364①	46		HNF364R①	47		15	60	50	125	50	150	40	50
400	HNF365	114		HNF365R	118		15	125	50	250	50	350	50	—
600	HNF366	116		HNF366R	120		15	200	50	400	50	500	50	—
800	HNF367	295		HNF367R	295		15	250	50	500	50	500	50	—
1200	HNF368	305		HNF368R	307		15	250	50	500	50	500	50	—

600 Volt Non-Fusible④

2-Pole ③ — 480 Volt AC / 600 Volt AC / 600 Volt DC

Ampere Rating	Type 4 / 4X Stainless ⑧ Catalog Number	Ship. Wgt.	List Price $	Type 12 Industrial ⑤ Catalog Number	Ship. Wgt.	List Price $	240 Volt 1-Phase	240 Volt 3-Phase	480 Volt 1-Phase	480 Volt 3-Phase	600 Volt 1-Phase	600 Volt 3-Phase	250V DC	600V DC
30	HNF261S	13		HNF261J	13		—	—	7 1/2	—	10	—	5	15
60	HNF262S	20		HNF262J	20		—	—	20	—	25	—	10	30
100	HNF263S■	25		HNF263J■	25		—	—	30	—	40	—	20	50
400	HNF265S■	113		HNF265J■	114		15	—	50	—	—	—	40	50
600	HNF266S■	115		HNF266J■	120		15	—	50	—	—	—	50	50

3-Pole — 480 Volt AC / 600 Volt AC / 250 Volt DC

Ampere Rating	Type 4 / 4X Stainless ⑧ Catalog Number	Ship. Wgt.	List Price $	Type 12 Industrial ⑤ Catalog Number	Ship. Wgt.	List Price $	240 Volt 1-Phase	240 Volt 3-Phase	480 Volt 1-Phase	480 Volt 3-Phase	600 Volt 1-Phase	600 Volt 3-Phase	250V DC	600V DC
30	HNF361S	13		HNF361J	13		5	10	7 1/2	20	10	30	5	—
60	HNF362SH②	15		HNF362JH②	14		10	20	20	50	20	40	10	—
60	HNF362S①⑦	19		HNF362J①⑦	19		10	20	20	50	25	60	10	30⑦
100	HNF363S①⑦	24		HNF363J①⑦	24		15	40	30	75	40	100	20	50⑦
200	HNF364S①	47		HNF364J①	47		15	60	50	125	50	150	40	50
400	HNF365S	118		HNF365J	119		15	125	50	250	50	350	50	50
600	HNF366S	120		HNF366J	120		15	200	50	400	50	500	50	50
800	HNF367S	295		HNF367J■	295		15	250	50	500	50	500	50	50
1200	HNF368S	310		HNF368J	310		15	250	50	500	50	500	50	50

■ Built to order. Allow 2–3 weeks for delivery.
① Also rated 600V DC.
② Compact switch (11.1"H, 6.6"W box less cover and handle). Short circuit withstand rating—100,000 RMS sym. amps.
③ Use 3-Pole switch for 200A application.
④ Suitable for use as service entrance equipment except for 1200 when used on a 480 or 600V grounded wye system.
⑤ Also rated type 3S / 3R.
⑥ Indicates oversized enclosure (30A switch in a 60A enclosure or a 60A switch in a 100A enclosure.
⑦ 600V DC and 600V DC horsepower rating shown requires (2) poles to be connected in series.
⑧ 304 grade stainless steel. For switches with enclosures constructed from 316 grade stainless steel see page 18/9.

ARMSTRONG®

FILE NO:	37.620
DATE:	Sept. 5, 2003
SUPERSEDES:	37.62
DATE:	Aug. 1, 2000

Vortex Air Separators - Models VA / VAS: 2" to 3"

SUBMITTAL

JOB: _____ REPRESENTATIVE: _____

_____ ORDER NO: _____ DATE: _____

ENGINEER: _____ SUBMITTED BY: _____ DATE: _____

CONTRACTOR: _____ APPROVED BY: _____ DATE: _____

MODEL NO. ORDERED: _____ QTY.: _____

TAG NO.: _____

ASME CONSTRUCTION: ☐ YES ☐ NO

TECHNICAL DATA

Max. Working Temperature	350°F (176°C)
Max. Working Pressure	160 psi (1105 kPa)
Connection Type	Threaded NPT

MATERIALS OF CONSTRUCTION

Shell	Cast Iron
Strainer	Stainless Steel Mesh (1/4" x 3/4")
Gasket	Non-Asbestos

TYPICAL SPECIFICATION

ASME Coded Units

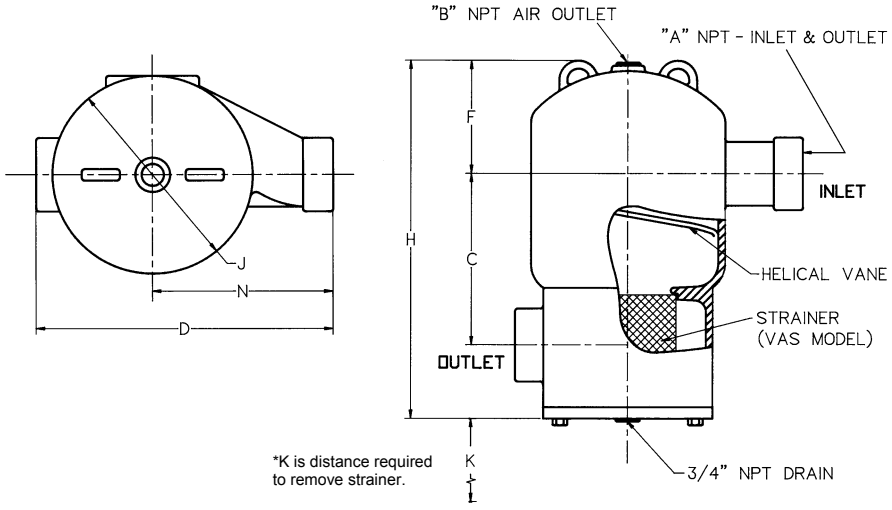
Furnish & install an Armstrong Vortex® Air Separator, Model ___ VA or Model ___ VAS (with strainer) with NPT tangential connections as shown on plans. The unit shall be designed and built in accordance with the latest revisions of ASME Pressure Vessel Code, Section VIII, Division 1. A blowdown connection is provided for routine cleaning of the unit.

Non-ASME Coded Units

Furnish & install an Armstrong Vortexâ Air Separator, Model ___ VA or Model ___ VAS (with strainer) with NPT tangential connections as shown on plans. The unit is considered as "part of the piping" and no Code Inspection applies. A blowdown connection is provided for routine cleaning of the unit.

MODEL		DIMENSIONS inches (mm)									FLOW RATE in USgpm (L/s) for LINE VELOCITY ft/s (m/s)			WEIGHT lbs. (kg)		STRAINER SCREEN FREE AREA
LESS STRAINER	WITH STRAINER	A	B	C	D	F	H	J	K	N	4 (1.22)	6 (1.83)	8 (2.44)	VA	VAS	Sq. in. (Sq. cm)
VA-2	VAS-2	2.00 (51)	0.75 (19)	7.50 (191)	12.75 (324)	4.75 (121)	15.75 (400)	8.63 (219)	7.00 (178)	7.75 (197)	42 (2.6)	63 (4.0)	84 (5.3)	70 (32)	70 (32)	40 (258)
VA-2-1/2	VAS-2-1/2	2.50 (64)	0.75 (19)	9.25 (235)	15.50 (394)	6.15 (156)	19.00 (483)	10.70 (272)	7.88 (200)	9.50 (241)	60 (3.8)	90 (5.7)	120 (7.6)	100 (45)	100 (45)	67 (432)
VA-3	VAS-3	3.00 (76)	0.75 (19)	9.25 (235)	15.50 (394)	6.15 (156)	19.00 (483)	10.70 (272)	7.88 (200)	9.50 (241)	93 (5.9)	140 (8.8)	185 (11.7)	100 (45)	100 (45)	67 (432)

Note: Dimension "K" applies to only VAS Models.



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U.S.A. 14120-6594
Tel: (716) 693-8813
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23 Bertrand Avenue
Toronto, Ontario
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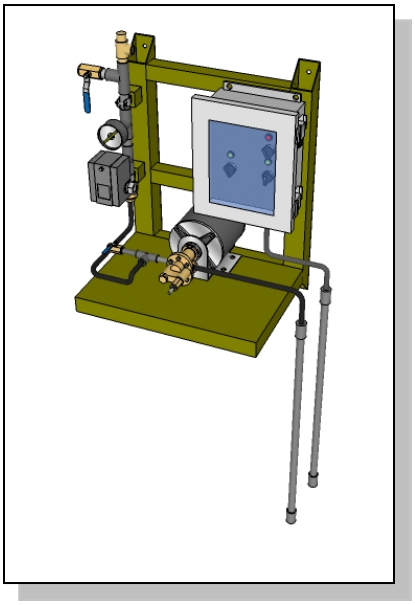
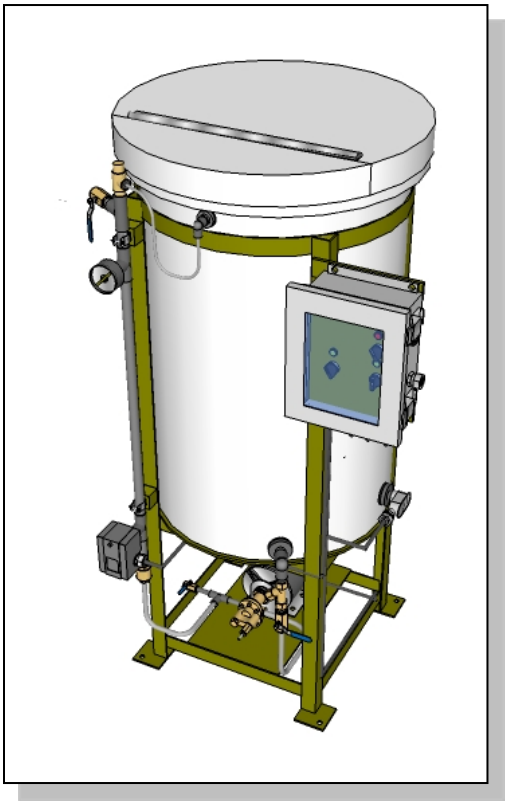
Industrial Gly-Pack Feed Systems
Operations & Maintenance Manual





Record Your Model, Serial Number and
Other Information on the back of this document.

Manufacturing: Bypass & Filter Feeders, Glycol Feed Packages, Separators & Separator Systems, Tanks, Tank Stands, Chemical Batch Mixers, Corrosion Coupon Racks, Packaged Feed Systems and Custom Systems

P.O. Box 8697, Brea, CA 92822-5697 ♦ Phone: 714) 257-9165
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***** WARNING – BEFORE YOU GET STARTED *****

1) All fasteners & fittings should be inspected and secured before operation as they may be loosened in transit
2) Personnel safety practices should apply at all times
3) Safety glasses or face shields and gloves should be worn
4) Do not service glycol feed package with out disconnecting power
5) Close isolation valve and release pressure before servicing any components on the system
6) All liquids in system should be drained before servicing

1.0 INTRODUCTION Thank you for choosing General Treatment Products Industrial "Gly-Pack" Glycol Feed Package. This industrial, automated package comes complete and ready to install. In this document we explain the basics for locating, installing, adjusting and operating this glycol fed system. For further information, please contact us at customerservice@gtpcompany.com or call us at the phone number on the cover.

2.0 WARRANTY General Treatment Products Gly-Pack Feed Systems are guaranteed for two years from date of shipment against manufacturing defects in material and workmanship that develop in the service for which they are designed. We will repair or replace a defective part of this system when returned to our factory with freight prepaid; providing that the part is found to be defective upon inspection. We assume no liability for labor and/or other expenses in making repairs or adjustments.

3.0 UNPACKING **Upon receipt of order, inspect package thoroughly**. In the event there was damage incurred in transit you must notify the freight company within 3-5 days of receipt of order. Once system is inspected for damage and received in good condition, and store indoors in safe place until installing. Damaged incurred before installation is not covered under warranty.

3.1 PRODUCT/ORDER VERIFICATION

MODEL				
GP	55	-E4	-1	-HM

OPTIONS	
-HM	High Temperature Discharge Manifold
-DGL	Digital Glycol Control Panel
-SC	Surge Suppression Chamber
-AL	Audible Alarm & Silence Switch
-DC	Remote Dry Contact on Low Level
-MX	Mixer & Control Switch
-HL	High Level Indicator

Note: See pricing for complete options list

PRESSURE RANGE	CUT-IN	CUT-OUT	PSID
1	10-45 (20*)	20-50 (40*)	10-30 (20*)
2	40-80 (60*)	65-100 (90*)	20-40 (30*)
3	3-10 (8*)	9-30 (15*)	6-20 (7*)
CST	Custom (See back of manual and inside of pressure switch cover to verify).		

PUMP	
D	Dual Pump System
E	Standard Model
H	High Temp Model
4	1.3GPM at 100PSI gear pump
5	3.0GPM at 100PSI gear pump

SIZE (GALLONS)	
15	15 gallon PE tank and hinged cover
30	30 gallon PE tank and hinged cover
55	55 gallon PE tank and hinged cover
100	100 gallon PE tank and hinged cover

BASE MODEL	
GP	Glycol industrial package, tank, hinge lid, stand, low level, pressure switch, pump, pressure gauge and pressure relief.
GX	Glycol industrial wall mount package, low level wand, pressure switch, pump, pressure gauge and pressure relief.
GDW	Glycol industrial double wall tank package, low level wand, pressure switch, pump, pressure gauge and pressure relief.

Note: Not all options and sizes available on all systems. See pricing for standard models.

4.0 LOCATION AND EVIROMENT Although the control panel is rated for outdoor use the gear pump, pressure switch and power cord should not be exposed to direct elements. In most cases, there will not be a dry indoor location that is convenient to install the glycol feed system. Some shelter, awning or shed needs to be installed to validate warranty.

5.0 INSTALLATION Once location is decided on, system need to be securely mounted to concrete base. **Be sure that mounting pad and anchoring bolts comply with local building codes.**

Glycol feed packages come standard with an 8FT power cord. Power supply with no less than 15 amps should be within 8FT of glycol feed package. **Extension cords should not be used at anytime.** Systems can be hardwired, if need. Have only an experienced electrician hardwire system. Wiring diagrams are provided in section 9.0.

5.1 CONNECTING TO THE SYSTEM Glycol feed package should be installed within 10 to 30 feet of system. If system is to close, it is difficult to set low pressure systems. If system is to far, pump outputs will very based on pipe size, elbows and other fittings.

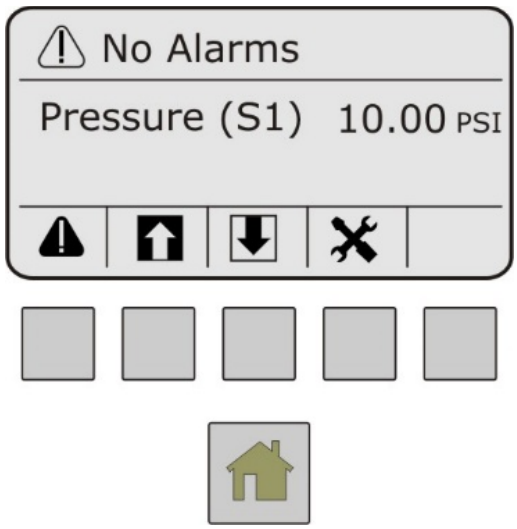
Glycol feed package is supplied with ½" isolation valve and should be connected to system using a minimum pipe size of ½". **DO NOT INSTALL CHECK VALVES OR PRESSURE REDUCING VALVES BETWEEN GLYCOL FEED PACKAGE AND SYSTEM.** The installation of check valve or pressure reducing valves will cause problems with reading system pressure accurately.

5.2 ADJUSTING THE PRESSURE RELIEF VALVE Turning the pressure valve counter-clockwise will decrease the system pressure relief setting and turning the valve handle clockwise will increase the pressure setting. If an engineer or system designer has not set the system pressure relief for you, you should have the glycol system setting above 3% to 5% higher than the main system pressure relief valve. That way in the case of system over pressure, the contents of the system will not over flow the glycol package.

5.3 ADJUSTING THE PUMP INTERNAL PRESSURE RELIEF (Bronze gear pumps only) Turning the set screw and lock nut counter-clockwise will decrease the pump internal pressure relief setting and turning it clockwise will increase the internal pressure relief setting. This feature is a pump standard, and on our system is only needed when setting the pump in low pressure systems. Over adjustment may cause harm to the operations of the pump. It's normally best to leave this alone. If you have a pump that is not performing, give us a call and well be glad to help.

5.4 SETTING THE PRESSURE SWITCH GTP Glycol Feed Packages, when specified, can be factory pre-set to your system requirements. When requested, your factory settings will be listed on label on back of instruction manual and on packing slip. If you are setting the pressure switch on site, please follow the steps below.
STEP 1) close isolation valve and open pressure relief valve.
STEP 2) Start systems in manual and adjust pressure relief valve to cut-in pressure desired. (This should be the low pressure setting)
STEP 3) Turn large nut on pressure switch out (counter-clockwise) until pressure switch is off.
STEP 4) now, turn same nut on pressure switch in (clockwise) until pressure switch is on.
STEP 5) Adjust pressure relief valve to cut-out pressure determined. (This will be the high pressure setting)
STEP 6) If pressure switch has not turned off, turn small nut (counter-clockwise) until pressure switch turns off.
STEP 7) If pressure turn off before you could set it, turn small nut clockwise 2 or 3 revolutions and repeat STEP 6.
STEP 8) Test setting by adjusting pressure relief valve in and out of range before returning system to automatic position.

5.3 SETTING THE DIGITAL CONTROLLER
GTP Economy Digital Glycol Feed Controller is a back lit custom LCD and should not be exposed to direct sunlight. The screen and key image to the right is the home screen. Understanding the Icon based menus will allow you to navigate the system. The buttons below the screen execute the symbols along the lower portion of the screen.



The symbols across the bottom of the screen are:
Alarms Inputs Outputs Maintenance

Other icon's include:
Back One Calibration Cancel Check
Enter Scroll Left Scroll Down Scroll Up
Value Down Value Up

Main/Home Screen Menus

Alarms	Inputs	Outputs	Maintenance
Shows Alarms	Pressure (S1)	Glycol Pump (R1)	Global Settings
	Unassigned (S2)	Mixer Timer (R2)	Security Settings
	Low Level (D1)	Alarms (R3)	Display Settings
	Flow Meter (D2)		File Utilities
			Controller Details

5.3A ADJUSTING INPUTS: This is to maintain the pressure sensor, changing the settings for the low level switch or adding the setting for a output flow meter. Press the button below the input icon. The input menu will have all available inputs. Pressure sensor input (S1), Low Level sensor input (D1) and optional flowmeter input (D2).

5.3a1 PRESSURE SENSOR INPUT (S1) MENU: (maintenance) Sensor input menu includes alarms for low and high pressure and allows you to change values such as name and pressure units.

Prompt	**Response/Value:**
LoLo Alarm	0.00
Low Alarm	0.00
Hi Alarm	100.00
HiHi Alarm	100.00
Deadband	0.50
Cable/Length	3FT
Gauge Wire	22GA/.35MM2
Units	PSI
Sensor Slope	2.0
Sensor Offset	0.0
Low Range	0.0
Hi Range	100.0
Name	Pressure
Type	Generic

5.3a2 2 POINT CALIBRATION MENU: The glycol feed package is factory calibrated, to recalibrate the pressure sensor, always best to do a 2 point. Calibrating to two points allow the sensor to be accurate at low range and at the high range. While the glycol feed system is in the hand mode, get the system to recirculate glycol at a moderately low pressure. Go to the pressure input and press the calibration button under the sensor maintenance menu. Scroll down to the two point calibration and press the enter key. Use these next few steps to recalibrate the system:

Prompt:	**Response:**
Ok to disable controls?	Y
First buffer value	(enter the current low pressure of the system)
Please remove sensor	(do not remove sensor)
Stabilization	(will take a few moments)
Second buffer value	(increase system pressure and let it stabilize and enter the value)
Place sensor in second value	(do not remove sensor)
Stabilization	(will take a few moments)

Next the controller will show the gain and offset, press "Y" to accept and return to the home screen. If the controller fails to calibrate, please contact the factory for assistance.

5.3a3 LOW LEVEL INPUT MENU (D1): (maintenance) Low level input ment lets you adjust and change settings such as change switch logic and name.

Prompt	**Response/Value:**
Open Message	LowLevel
Closed Message	Level
Interlock	When Open
Alarm	When Open
Name	Levelswtch
Type	DI State

5.3a4 OPTIONAL FLOW METER INPUT (D2): (🔧 maintenance) Optional flow meter input allows you to track and monitor your glycol usage, change your volume units and change the flow meter name and type. Flow meter can be added to the front display, contact factory for assistance.

Prompt	**Response/Value:**
Totalizer Alarm	0g
Reset Flow Total	
Volume/Contact	1gal
Flow Units	Gallons
Name	Flowmeter
Type	Contacting FM

5.3B ⬇ ADJUSTING OUTPUTS: Adjusting the outputs includes changing the set points and monitoring/changing the alarm relay. Setting the cut in (set point) and the cut out (deadband) is available in the R1 (relay 1) menu. From the home screen press the output menu. Enter the R1 menu and press maintenance button.

5.3b1 GLYCOL FEED OUTPUT (R1) MENU: (🔧 maintenance)

Prompt:	**Response/Value:**
HOA Setting	(current) ** Make sure the relay is in auto by pressing enter
Set Point	20.00 PSI
Dead Band	10.00 PSI
Output Time Limit	20:00:00 (HH:MM:SS)
Reset Time Limit	
Interlock Channels	(none)
Activate With Channels	(none)
Hand Time Limit	00:10:00 (HH:MM:SS)
Input	Pressure S1
Direction	Force Higher
Name	Glycol
Mode	On/Off

When changing any of the values, scroll down to the setting you with to change, press enter ↵ and use the arrows to change the setting. Press the check mark ✓ to accept the new setting. Contact factory for assistance with making changes or calibrating your controller.

6.0 PRESSURE AND TEMPERATURE LIMITATIONS: Industrial Glycol Feeders maximum operating perimeters are 150PSI @ 85F. High Temp designated glycol feeders have a maximum rating of 150PSI @ 150F. Some optional fittings, as noted in descriptions, may change limitations, contact factory for assistance.

MATERIAL	MAXIMUM SHORT TERM TEMPERATURE	MAXIMUM OPERATING TEMPERATURE	MAXIMUM OPERATING PRESSURE
Polyethylene (PE)	160°F/69°C	85°F/36°C	N/A
Polyvinylchloride (PVC)	140°F/60°C	85°F/36°C	100PSI/6.9BAR
Chlorinated Polyvinylchloride (CPVC)	180°F/77°C	120°F/49°C	100PSI/6.9BAR
Polypropylene (PP)	180°F/77°C	100°F/49°C	100PSI/6.9BAR
Carbon Steel (CS)	200°F/93°C	200°F/93°C	150PSI/10.3BAR
Cast Iron (CI)	200°F/93°C	200°F/93°C	150PSI/10.3BAR
Brass (BR)	200°F/93°C	200°F/93°C	150PSI/10.3BAR
Stainless Steel (SS)	200°F/93°C	200°F/93°C	150PSI/10.3BAR

Note: Minimum Fluid Temperature is 50°F/10°C.

7.0 ROUTINE MAINTENANCE Routine maintenance in this section is referred to as checking a system once a month until a maintenance schedule can be determined. All fasteners should be check for proper operations. Maintenance and care will depend upon the usage and environment in which the glycol feed package is subject to. The following is the suggested regular maintenance checks required to keep the glycol feed system operating properly.

7.1 TANK AND PLUMBING Periodically check piping, hoses and tank fittings for leaks. Y-strainers and check valves need to be free from debris. Tank should be checked for signs of bulging and cracking.

7.2 GEAR PUMP The pump should be inspected for proper operation and output. Unusual noises and leaks need to be corrected immediately. Pump assembly and disassembly should only be done by qualified personnel. Wear items, like seal, carbon bearings and gears need to be inspected and replaced when needed. Contact us for assembly and disassembly.

Carbon bearing pumps do not need lubrication. Check the motor for lubrication instructions. Our standard motor does not need lubrication, but some custom motors do. Be sure to check lubrication instructions in pump manual. DO NOT OVER LUBRICATE. Oil is conductive and can cause harm or electric shock.

7.3 PRESSURE SWITCH The only wear item is the contacts. Make sure there are no shorts or wire connections problems.

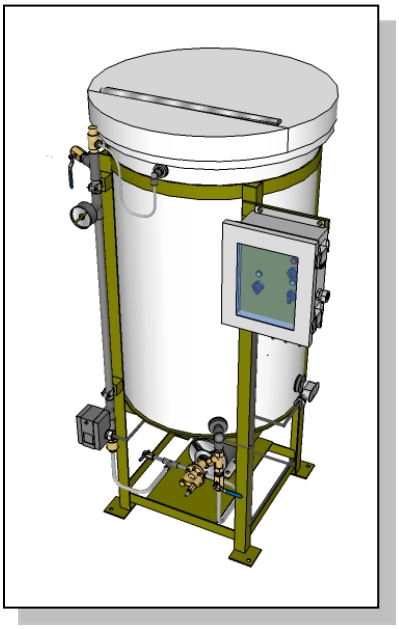
7.4 PRESSURE RELIEF VALVE Pressure relief valves need to be free from debris. Disassembling and checking the seating surface for tears and abrasion is all that needed. Improper seating of diaphragm and seal can cause valve leaks.

8.0 PARTS LISTING In the following diagrams, the systems are shown with tables itemizing parts that may be replaced in the field. If further breakdown is needed, consult manufacturer's operations manual or call us for assistance.

8.1 GLYCOL SYSTEM OVERVIEW

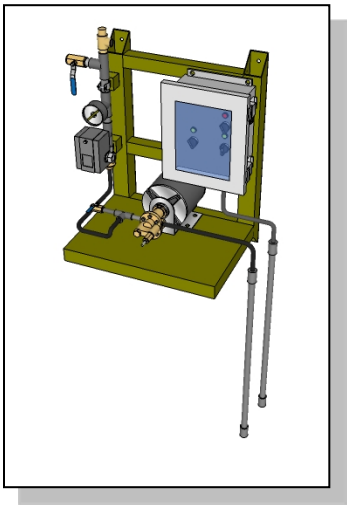
PART	GP__E	GP__H	30	55	100
TANK & COVER	P30C-H	C30C-H	X		
	P55C-H	C55C-H		X	
	P100C-H	C100C-H			X
STAND	TS30B	Included in tank above.	X		
	TS55B			X	
	TS100B				X
DISC. MANIFOLD	0122001	0122010	X		
	0122002	0122011		X	
	0122003	0122012			X
SUCT. MANIFOLD	0122020	0122025	X	X	X
PUMP, 1/3HP	GP1.3E		X	X	X
PUMP, 1/2HP	GP3.0E		X	X	X
SUCT. HOSE	0122030		X	X	X
DISC. HOSE	0122035		X	X	X
RELIEF HOSE	0122040		X	X	X
CONTROL PANEL	CPE		X	X	X
RELIEF ADAPTR	0122050	N/A	X	X	X
PRESSURE SWITCH	PS-1		X	X	X
	PS-2		X	X	X
	PS-3		X	X	X
BALL VALVE	BV05P	BV05B	X	X	X
Y-STRAINER	YS05B		X	X	X
CHECK VALVE	CV05C		X	X	X
RELIEF VALVE	RV05B		x	x	X

Dual models use similar items.



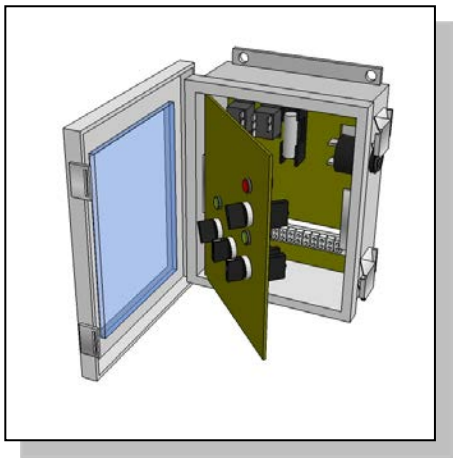
PART	GP__X
FRAME	MBGX
DISC. MANIFOLD	0122005
SUCT. MANIFOLD	0122021
PUMP, 1/3HP	GP1.3E
PUMP, 1/2HP	GP3.0E
CONTROL PANEL	CPE
RELIEF ADAPTR	0122050
PRESSURE SWITCH	PS-1
BALL VALVE	BV05P
Y-STRAINER	YS05B
CHECK VALVE	CV05B
RELIEF VALVE	RV05B

Dual models use similar items.

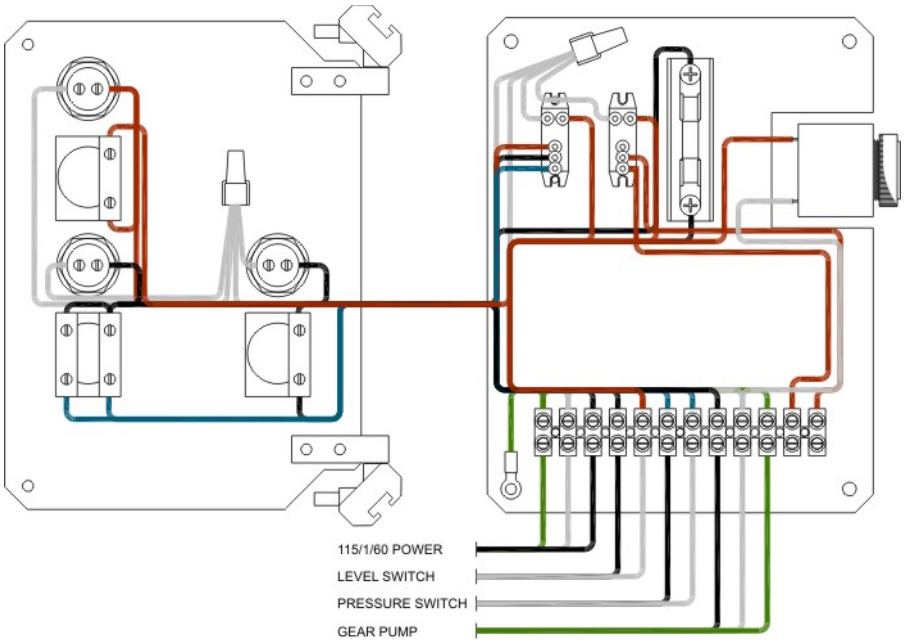


8.2 CONTROL PANEL

PART	INDUSTRIAL
ENCLOSURE	NE-P
POWER SWITCH	SW-2P
PUMP SWITCH	SW-3P
GREEN LIGHT	LGT-G
RED LIGHT	LGT-R
RELAY	RL-1
FUSE	FS-1



9.0 WIRING The following wiring diagram is for standard model with audible alarm and dry contact. Custom model may follow similar diagrams, but can be different. If you need assistance, contact us and have model number and serial number information ready.



Note: All standard and optional feature diagrams are available through our website, www.gtpcompany.com or you can e-mail us at literature@gtpcompany.com.

9.1 WIRING The following wiring diagram is for economy digital model with audible alarm, motor starter and dry contact. Custom model may follow similar diagrams, but can be different. If you need assistance, contact us and have model number and serial number information ready.

Inputs:

Sensor:
Red = TB2 #6
Black = TB2 #4
Shield = TB1 #3
Green = TB1 #7
White = TB1 #11

Low Level:
Black = TB2 #8
Red = TB2 #9

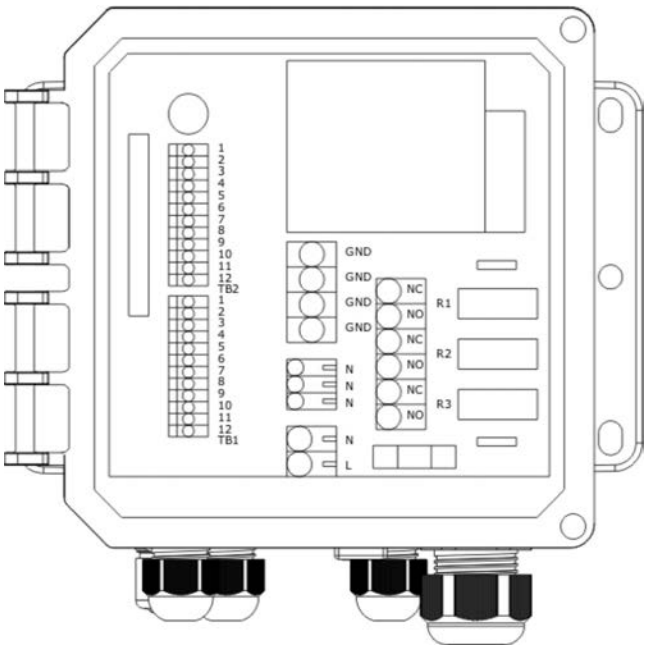
Flow Meter: (optional)
White = TB2 #4
Red = TB2 #5
Blue = Not used

Outputs:

Glycol Pump:
White = Neutral
Black = R1 NO

Mixer: (optional)
White = Neutral
Black = R2 NO

Alarm:
White = Neutral
Black = R3 NO



10.0 TROUBLE SHOOTING

PROBLEM	POSSIBLE CAUSE / ACTION
Low flow rate	Piping / equipment is dirty or fouled
	Discharge is restricted or undersized
	Gears are worn
Pump runs, but no fluid	Suction piping is restricted or plugged
	Pump suction valve is closed
	Pump is rotating in the wrong direction
Pressure is low	Line is restricted
	Gears are worn
Excessive noise while pump is in operation	Pump head and gear may be misaligned
	Pump mounting hardware is loose
	System pressure is excessive
Pump does not shut off at low level	Float switch is faulty, defective or damaged
	Low level relay is faulty, defective or damaged
	Wiring is incorrect or shorted
System does not relieve pressure properly	Pressure relief valve is clogged
	Pressure relief valve is set improperly
Pump cycles on and off repetitively	Piping leak on discharge side
	Pressure settings are not adequate for system size pressure

If you are still having trouble, contact us at technical@gtpcompany.com, or you can call us at the number on the front of the Instruction manual.

Class 150 Bronze Globe Valves

Union Bonnet • Integral Seat • Renewable Seat Disc

150 PSI/10.3 Bar Saturated Steam to 366° F/185° C
300 PSI/20.7 Bar Non-Shock Cold Working Pressure

T-235-Y
Threaded

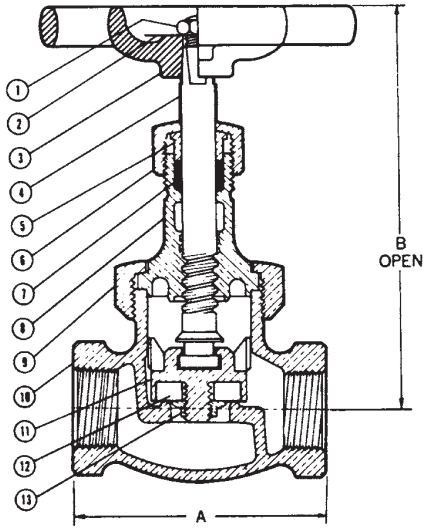
Dezincification Resistant

S-235-Y
Solder

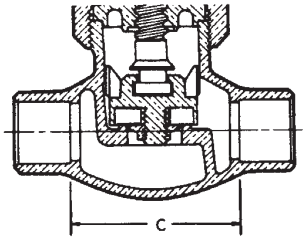
CONFORMS TO MSS SP-80

MATERIAL LIST

	PART	SPECIFICATION
1.	Handwheel Nut	300 Series Stainless Steel
2.	Identification Plate	Aluminum
3.	Handwheel	Malleable Iron ASTM A 47
4.	Stem	Silicon Bronze ASTM B 371 Alloy C69400/C69430
5.	Packing Gland	Bronze ASTM B 62 or ASTM B 584 Alloy C84400 or Brass ASTM B 16
6.	Packing Nut	Bronze ASTM B 62 or ASTM B 584 Alloy C84400 or Brass ASTM B 16
7.	Packing	Aramid Fibers with Graphite
8.	Bonnet	Bronze ASTM B 62
9.	Union Nut	Bronze ASTM B 62
10.	Body	Bronze ASTM B 62
11.	Disc Holder	Bronze ASTM B 62
12.	Disc	Steam (PTFE) (Y)
13.	Disc Nut	Bronze ASTM B 62/ASTM B 98 Alloy C65100 w/SS Washer



T-235-Y
NPT x NPT



S-235-Y
C x C

DIMENSIONS—WEIGHTS—QUANTITIES

Size		Dimensions A		B		C		T-235-Y		S-235-Y		Master Ctn. Qty.	
In.	mm.	In.	mm.	In.	mm.	In.	mm.	Lbs.	Kg.	Lbs.	Kg.	T-235-Y	S-235-Y
1⅛	6	2.31	59	3.88	99	2.00	51	1.21	0.55	1.06	0.48	50	50
†¼	8	2.31	59	3.88	99	1.88	48	1.19	0.54	1.05	0.48	50	50
†⅜	10	2.38	60	3.88	99	1.75	45	1.17	0.53	1.03	0.47	50	50
½	15	2.69	68	4.63	118	1.88	48	1.60	0.73	1.38	0.62	40	50
¾	20	3.19	81	5.38	137	2.31	59	2.34	1.06	2.21	1.00	20	20
1	25	3.75	95	6.00	153	2.88	73	3.56	1.61	3.35	1.52	10	20
1¼	32	4.25	108	6.56	167	3.13	79	5.76	2.61	4.93	2.23	10	10
1½	40	4.75	121	7.38	187	3.75	95	7.59	3.44	7.17	3.25	6	10
2	50	5.75	146	8.31	211	4.50	114	12.56	5.70	11.02	5.00	4	4
2½	65	6.63	168	10.19	259	5.38	137	17.44	7.91	17.16	7.79	2	2
3	80	7.75	197	11.13	283	6.50	165	23.87	10.83	22.82	10.35	2	2

† No packing gland, packing only in these sizes.

FREEZING WEATHER PRECAUTION: Subsequent to testing a piping system, valves should be left in an open position to allow complete drainage.

◆For detailed Operating Pressure, refer to Pressure Temperature Chart on page 113.

Brass Ball Valves

Two-Piece Body • Full Port • Blowout-Proof Stem • PTFE Seats

¼"-2" 600 PSI/41.4 Bar Non-Shock Cold Working Pressure
2½"-4" 400 PSI/27.6 Bar Non-Shock Cold Working Pressure

CSA CERTIFIED TO ASME B16.44
AND CR91-002 (THREADED ¼"-4") • UL LISTED (THREADED ¼"-4")
• IAPMO LISTED TO NSF/ANSI 61-8
• FM APPROVED (THREADED ¼"-2")

CSA (¼" - 4"):
- CR91-002: ½ psig, 2 psig, and 5 psig (these are specific approved categories)
- ASME B13.44: 125 psig (maximum)
- Temperature is -4° F to 194° F

FM (1/4" - 2"):
- 175wwp (both SFP600A and TFP600A)

UL, Gas and Oil (¼" - 4"):
- YQNZ, Compressed Gas Shutoff Valves: 250 psi
- YRBX, Flammable Liquid Shutoff Valves: 250 psi
- YRPV, Gas Shutoff Valves: 250 psi
- YSDT, LP-Gas Shutoff Valves: 250 psi
- MHKZ, Manual Valves: 250 psi

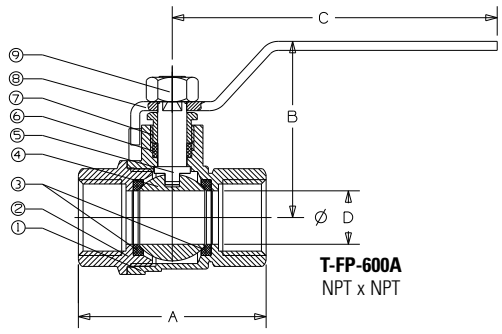
T-FP-600A
Threaded

S-FP-600A
Solder

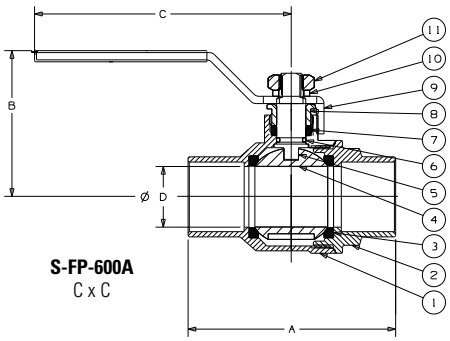
MATERIAL LIST

PART		SPECIFICATION
1.	Body	Forged Brass[2] CU > 57%
2.	End Cap	Forged Brass[2] CU > 57%
3.	Ball Seat	PTFE
4.	Ball	Brass, Chrome Plated
5.	Stem	Brass
6.	O-Ring (Stem Seal)*	Fluorocarbon (FKM)
7.	Stem Packing	PTFE
8.	Packing Nut	Brass
9.	Lever Handle[1]	Steel, Plated
10.	Lock Washer*	Stainless Steel
11.	Handle Nut[1]	Stainless Steel

Note: * Parts 6 and 10 are applicable of S-FP-600A only.
[1] Due to Standard Approvals, Lever Handles and Nuts are not interchangeable between Solder and Threaded. There are no handle options at this time.
[2] For Material Certification, contact NIBCO Technical Services.



T-FP-600A
NPT x NPT



S-FP-600A
C x C

DIMENSIONS—WEIGHTS—QUANTITIES

Size		Dimensions T-FP-600A A		S-FP-600A A		T-FP-600A B		S-FP-600A B		T-FP-600A C		S-FP-600A C		Port D		T-FP-600A		S-FP-600A		T-FP-600A	S-FP-600N
In.	mm.	In.	mm.	In.	mm.	In.	mm.	In.	mm.	In.	mm.	In.	mm.	In.	mm.	Lbs.	Kg.	Lbs.	Kg.	Ctn. Qty.	Ctn. Qty.
¼	8	1.76	45	—	—	1.73	44	—	—	3.54	90	—	—	.39	10	.33	.15	—	—	18	—
⅜	10	1.76	45	1.75	44	1.73	44	1.58	40	3.54	90	3.78	96	.39	10	.30	.14	.38	.17	18	18
½	15	2.05	52	2.01	51	1.92	49	1.78	45	3.54	90	3.78	96	.59	15	.44	.20	.40	.18	18	18
¾	20	2.36	60	2.74	70	2.09	53	2.13	54	3.78	96	3.98	101	.75	19	.66	.30	.67	.30	12	12
1	25	2.76	70	3.35	85	2.56	65	2.52	64	4.53	115	4.41	112	.98	25	1.10	.50	1.12	.51	6	6
1¼	32	3.31	84	3.78	96	2.95	75	2.65	67	4.53	115	5.04	128	1.26	32	1.57	.71	1.49	.67	4	4
1½	40	3.66	93	4.42	112	3.35	85	3.12	79	5.51	140	6.22	158	1.57	40	2.40	1.09	2.38	1.08	2	2
2	50	4.18	106	5.34	136	3.68	93	3.41	87	5.51	140	6.22	158	1.97	50	3.37	1.53	3.62	1.64	2	2
2½	65	5.38	137	6.28	160	4.76	121	4.76	121	8.66	220	8.66	220	2.56	65	7.60	3.45	6.36	2.88	3	3
3	75	6.04	153	7.15	182	5.08	129	5.08	129	8.66	220	8.66	220	2.95	75	9.36	4.24	8.32	3.77	2	2
4	100	7.39	188	—	—	5.87	149	—	—	9.61	244	—	—	3.89	99	16.85	7.64	—	—	1	—

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Patterson™

AUTOMATIC FAST FILL VALVES

Models 10F & 11F

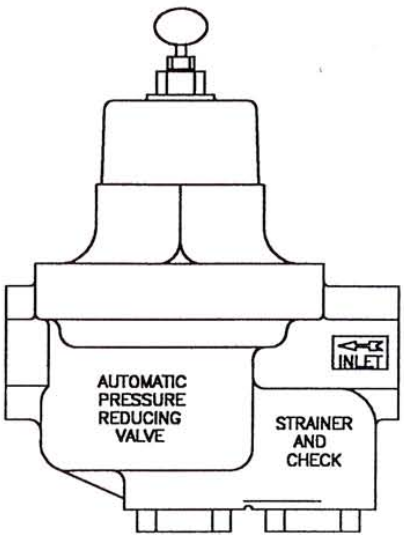
AUTOMATIC FAST FILL VALVES

The Patterson Automatic Fill Valves are low pressure reducing valves designed to maintain proper water pressure in closed loop heating systems or any closed piping system.

Standard factory setting is 12 PSIG delivery pressure with incoming pressure of 45 PSIG. The adjusting screw permits field adjustments from 2 PSIG (min) to 25 PSIG (max) pressures.

All Fast Fill Valves feature a clean able strainer, removable seat, brass working parts, heat resistant seat and diaphragm and a built in check valve.

The thumb screw adjustment feature in all Fast Fill Valves allow for fast filling and positive purging of air from hot water systems without a separate by pass line. Turning the thumbscrew clockwise overrides the operating setting and opens the valve for system filling. Turning the thumbscrew counterclockwise closes the valve and restores the valve to factory setting.



Model	Part Number	Size Conn.	Built In Check	Material Body	Wt. Lb.	Height	Width
10F	418-2	1/2"	Yes	Bronze	3	6 1/2"	4 1/2"
11F	418-3	3/4"	Yes	Bronze	4	6 3/4"	5"

Job Name: _____

Location: _____

Engineer: _____

Contractor: _____

Representative: _____

Model No: _____

Notes: _____

NIBCO
AHEAD OF THE FLOW®

www.nibco.com
Revised 9/12/2011

Brass Ball Valves

Two-Piece Body • Full Port • Blowout-Proof Stem • PTFE Seats

¼"-2" 600 PSI/41.4 Bar Non-Shock Cold Working Pressure
2½"-4" 400 PSI/27.6 Bar Non-Shock Cold Working Pressure

CSA CERTIFIED TO ASME B16.44
AND CR91-002 (THREADED ¼"-4") • UL LISTED (THREADED ¼"-4")
• IAPMO LISTED TO NSF/ANSI 61-8
• FM APPROVED (THREADED ¼"-2")

CSA (¼" - 4"):
- CR91-002: ½ psig, 2 psig, and 5 psig (these are specific approved categories)
- ASME B13.44: 125 psig (maximum)
- Temperature is -4° F to 194° F

FM (1/4" - 2"):
- 175wwp (both SFP600A and TFP600A)

UL, Gas and Oil (¼" - 4"):
- YQNZ, Compressed Gas Shutoff Valves: 250 psi
- YRBX, Flammable Liquid Shutoff Valves: 250 psi
- YRPV, Gas Shutoff Valves: 250 psi
- YSDT, LP-Gas Shutoff Valves: 250 psi
- MHKZ, Manual Valves: 250 psi

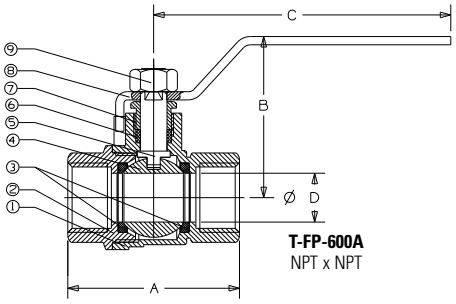
T-FP-600A
Threaded

S-FP-600A
Solder

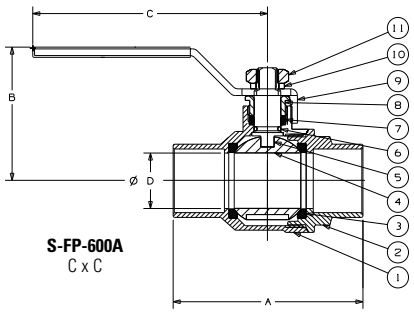
MATERIAL LIST

PART		SPECIFICATION
1.	Body	Forged Brass[2] CU > 57%
2.	End Cap	Forged Brass[2] CU > 57%
3.	Ball Seat	PTFE
4.	Ball	Brass, Chrome Plated
5.	Stem	Brass
6.	O-Ring (Stem Seal)*	Fluorocarbon (FKM)
7.	Stem Packing	PTFE
8.	Packing Nut	Brass
9.	Lever Handle[1]	Steel, Plated
10.	Lock Washer*	Stainless Steel
11.	Handle Nut[1]	Stainless Steel

Note: * Parts 6 and 10 are applicable of S-FP-600A only.
[1] Due to Standard Approvals, Lever Handles and Nuts are not interchangeable between Solder and Threaded. There are no handle options at this time.
[2] For Material Certification, contact NIBCO Technical Services.



T-FP-600A
NPT x NPT



S-FP-600A
C x C

DIMENSIONS—WEIGHTS—QUANTITIES

Size		Dimensions T-FP-600A A		Dimensions S-FP-600A A		Dimensions T-FP-600A B		Dimensions S-FP-600A B		Dimensions T-FP-600A C		Dimensions S-FP-600A C		Port D		T-FP-600A		S-FP-600A		T-FP-600A	S-FP-600N
In.	mm.	In.	mm.	In.	mm.	In.	mm.	In.	mm.	In.	mm.	In.	mm.	In.	mm.	Lbs.	Kg.	Lbs.	Kg.	Ctn. Qty.	Ctn. Qty.
¼	8	1.76	45	—	—	1.73	44	—	—	3.54	90	—	—	.39	10	.33	.15	—	—	18	—
⅜	10	1.76	45	1.75	44	1.73	44	1.58	40	3.54	90	3.78	96	.39	10	.30	.14	.38	.17	18	18
½	15	2.05	52	2.01	51	1.92	49	1.78	45	3.54	90	3.78	96	.59	15	.44	.20	.40	.18	18	18
¾	20	2.36	60	2.74	70	2.09	53	2.13	54	3.78	96	3.98	101	.75	19	.66	.30	.67	.30	12	12
1	25	2.76	70	3.35	85	2.56	65	2.52	64	4.53	115	4.41	112	.98	25	1.10	.50	1.12	.51	6	6
1¼	32	3.31	84	3.78	96	2.95	75	2.65	67	4.53	115	5.04	128	1.26	32	1.57	.71	1.49	.67	4	4
1½	40	3.66	93	4.42	112	3.35	85	3.12	79	5.51	140	6.22	158	1.57	40	2.40	1.09	2.38	1.08	2	2
2	50	4.18	106	5.34	136	3.68	93	3.41	87	5.51	140	6.22	158	1.97	50	3.37	1.53	3.62	1.64	2	2
2½	65	5.38	137	6.28	160	4.76	121	4.76	121	8.66	220	8.66	220	2.56	65	7.60	3.45	6.36	2.88	3	3
3	75	6.04	153	7.15	182	5.08	129	5.08	129	8.66	220	8.66	220	2.95	75	9.36	4.24	8.32	3.77	2	2
4	100	7.39	188	—	—	5.87	149	—	—	9.61	244	—	—	3.89	99	16.85	7.64	—	—	1	—

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Class 150 Bronze Globe Valves

Union Bonnet • Integral Seat • Renewable Seat Disc

150 PSI/10.3 Bar Saturated Steam to 366° F/185° C
300 PSI/20.7 Bar Non-Shock Cold Working Pressure

T-235-Y
Threaded

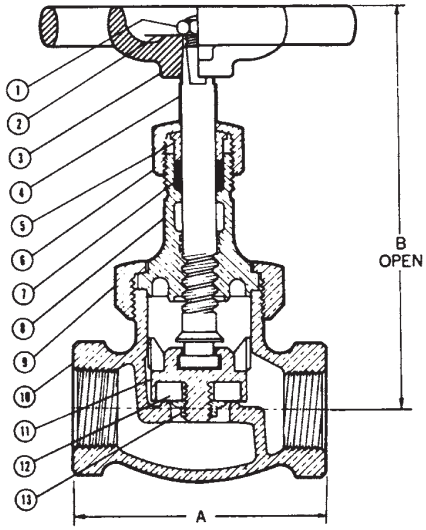
Dezincification Resistant

S-235-Y
Solder

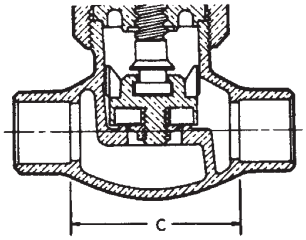
CONFORMS TO MSS SP-80

MATERIAL LIST

	PART	SPECIFICATION
1.	Handwheel Nut	300 Series Stainless Steel
2.	Identification Plate	Aluminum
3.	Handwheel	Malleable Iron ASTM A 47
4.	Stem	Silicon Bronze ASTM B 371 Alloy C69400/C69430
5.	Packing Gland	Bronze ASTM B 62 or ASTM B 584 Alloy C84400 or Brass ASTM B 16
6.	Packing Nut	Bronze ASTM B 62 or ASTM B 584 Alloy C84400 or Brass ASTM B 16
7.	Packing	Aramid Fibers with Graphite
8.	Bonnet	Bronze ASTM B 62
9.	Union Nut	Bronze ASTM B 62
10.	Body	Bronze ASTM B 62
11.	Disc Holder	Bronze ASTM B 62
12.	Disc	Steam (PTFE) (Y)
13.	Disc Nut	Bronze ASTM B 62/ASTM B 98 Alloy C65100 w/SS Washer



T-235-Y
NPT x NPT



S-235-Y
C x C

DIMENSIONS—WEIGHTS—QUANTITIES

Size		Dimensions A		B		C		T-235-Y		S-235-Y		Master Ctn. Qty.	
In.	mm.	In.	mm.	In.	mm.	In.	mm.	Lbs.	Kg.	Lbs.	Kg.	T-235-Y	S-235-Y
†⅛	6	2.31	59	3.88	99	2.00	51	1.21	0.55	1.06	0.48	50	50
†¼	8	2.31	59	3.88	99	1.88	48	1.19	0.54	1.05	0.48	50	50
†⅜	10	2.38	60	3.88	99	1.75	45	1.17	0.53	1.03	0.47	50	50
½	15	2.69	68	4.63	118	1.88	48	1.60	0.73	1.38	0.62	40	50
¾	20	3.19	81	5.38	137	2.31	59	2.34	1.06	2.21	1.00	20	20
1	25	3.75	95	6.00	153	2.88	73	3.56	1.61	3.35	1.52	10	20
1¼	32	4.25	108	6.56	167	3.13	79	5.76	2.61	4.93	2.23	10	10
1½	40	4.75	121	7.38	187	3.75	95	7.59	3.44	7.17	3.25	6	10
2	50	5.75	146	8.31	211	4.50	114	12.56	5.70	11.02	5.00	4	4
2½	65	6.63	168	10.19	259	5.38	137	17.44	7.91	17.16	7.79	2	2
3	80	7.75	197	11.13	283	6.50	165	23.87	10.83	22.82	10.35	2	2

† No packing gland, packing only in these sizes.

FREEZING WEATHER PRECAUTION: Subsequent to testing a piping system, valves should be left in an open position to allow complete drainage.

◆For detailed Operating Pressure, refer to Pressure Temperature Chart on page 113.

600CB

Cast Aluminum Case

600CB shown

- **3½" & 4½" Dial Sizes**
- **±1.0% Accuracy**
- **Cast Aluminum Case**
- **Adjustable Pointer**

The **600CB** Trerice Contractor Gauge is among the most frequently specified HVACR gauges within the construction industry. This gauge offers high reliability at a moderate price. The 600CB is furnished with a cast aluminum case and an adjustable pointer.

- Optional features and case style variations available: Please consult the Options & Accessories Section for details.
- For correct use and application of all pressure gauges, please refer to: Pressure Gauge Standard ASME B40.100.

Specifications

Model	**600CB**
Dial Sizes	3½", 4½"
Wetted Parts	3½" Dial Size: Bronze tube, brass socket 4½" Dial Size: Brass tube & socket
Movement	Brass
Connection	Lower male, ¼ NPT
Case	Cast aluminum, black finished, stem-mounted flangeless
Ring	3½" Dial Size: Friction type, steel, black finished 4½" Dial Size: Friction type, 304 stainless steel
Window	Clear glass
Pointer	Adjustable, black finished
Dial Face	Aluminum, white background with black graduations and markings
Accuracy	±1.0% Full Scale, ASME B40.100 Grade 1A
Maximum Temperature	**250°F (121°C)**
Approximate Shipping Weight	3½" Dial Size: 0.7 lbs [0.32 kg] 4½" Dial Size: 1.1 lbs [0.50 kg]

HOW TO ORDER

Sample Order Number: **600CB 35 02 L A 090**

Model	Dial Size	Connection Size	Connection Location	Units of Measure	Range Code
600CB	**35** 3½" **45** 4½"	**02** ¼ NPT	**L** Lower	**A** psi **B** kPa **C** kg/cm² **D** psi/kPa **E** psi & kg/cm²	See Standard Ranges

12950 W. Eight Mile Road • Oak Park, MI 48237-3288 • TEL:248/399-8000 • FAX: 248/399-7246 • www.TRERICE.com

Adjustable Angle

7" • 9" • 12" Scale Sizes

INDUSTRIAL THERMOMETERS

BX91403 shown

- 7", 9", 12" Scale
- ± 1 Scale Division Accuracy
- Cast Aluminum Case
- Adjustable Angle Stem

Recognized globally as the Trerice **"BX" Industrial Thermometer**, this is an instrument of extreme accuracy and rugged dependability. Available in scale sizes of 7" (AX9), 9" (BX9), & 12" (CX9), with a durable cast aluminum case, this universally adjustable, liquid-in-glass thermometer is the most widely specified instrument of its kind.

- Optional features available: Please consult the Options & Accessories Section for details.

Thermowell

- For applications where the process media may be corrosive or contained under pressure, the use of a thermowell is required to prevent damage to the thermometer and facilitate its removal from the process.

(Refer to page 152)

Specifications

Models	Scale Sizes
AX9	7"
BX9	9"
CX9	12"

Adjustable Angle

Fill Type	Spirit: Blue colored, organic
Case	Cast Aluminum, blue epoxy finish
Stem	Aluminum, brass, 304 stainless steel or air-duct style available
Connection	Standard: 1¼-18 UNEF-2A coupling nut Air-Duct: Reversible mounting flange with 3 bolt holes
Window	Ultraviolet protective acrylic on ranges to 300° F Glass on ranges over 300° F
Tube	Lens front, magnifying type
Scale	Aluminum, white background with black graduations and markings
Top Plate	ABS
Accuracy	±1 scale division
Approximate Shipping Weight	AX9: 1.5 lbs [0.68 kg] BX9: 1.6 lbs [0.73 kg] CX9: 2.0 lbs [0.91 kg]

HOW TO ORDER

Sample Order Number: **BX9 1 403 07**

Model	Stem (Material)	Stem (Length)	Specific Range
AX9 7" Adjustable **BX9** 9" Adjustable **CX9** 12" Adjustable	**1** Aluminum (standard) **2** Brass **3** 304 SS **9** Air-Duct (Aluminum)*	**403** 3½" **406** 6" **408** 8" **006** 6" Air-Duct	See Standard Ranges

* Not for use with Thermowells

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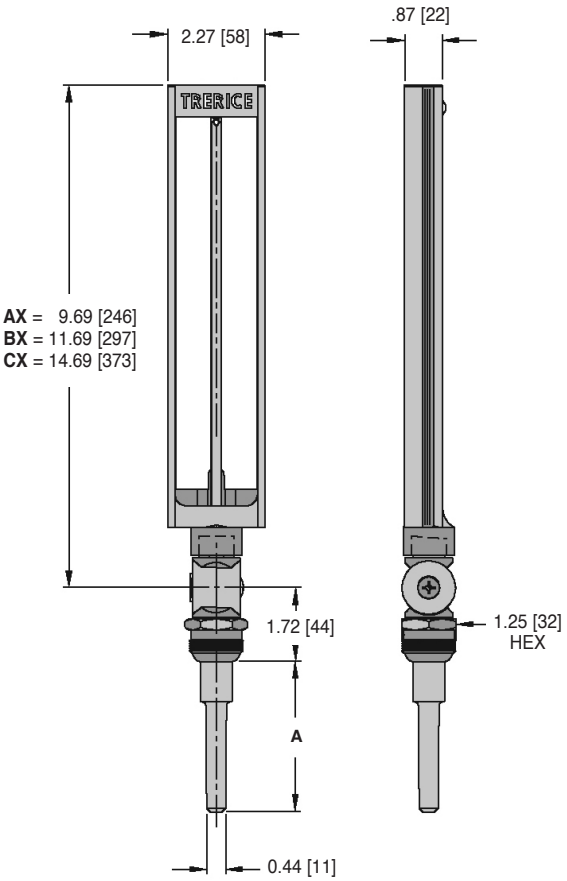
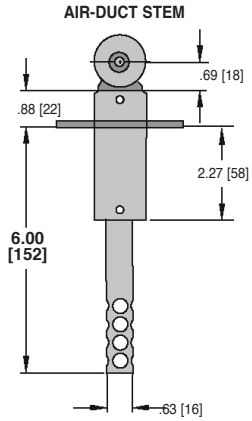
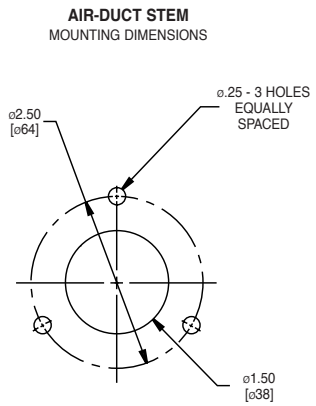
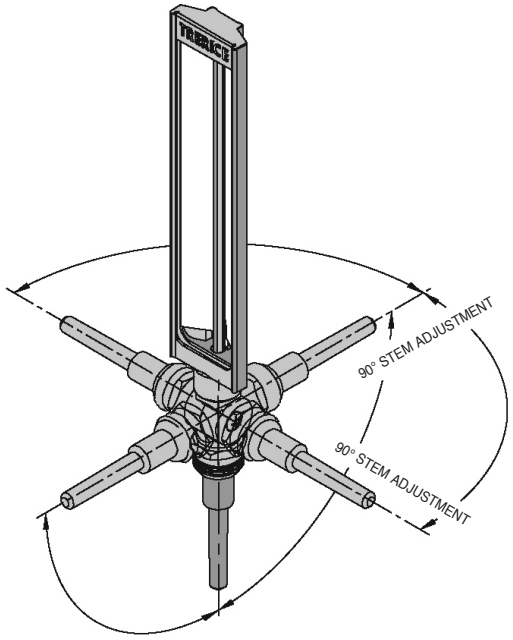
Adjustable Angle

All dimensions are nominal.
Dimensions in [ ] are in millimeters.









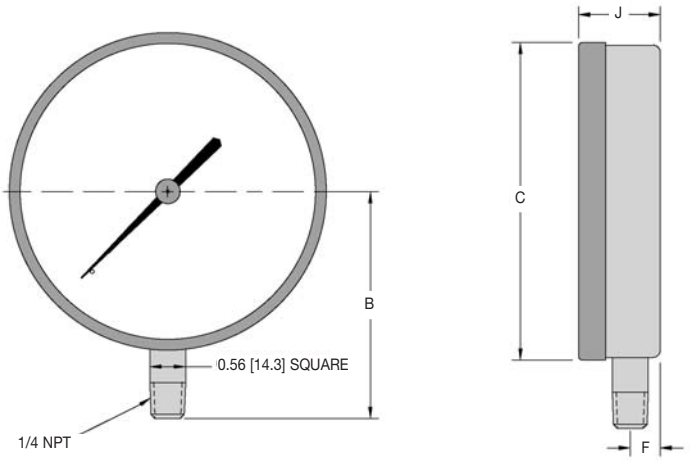
(A) Stem Length	Dimension
3 1/2"	3.50 [88.9]
6"	6.00 [152.4]
8"	8.00 [203.2]

Standard Ranges

Fahrenheit Scale		Celsius Scale		Dual Scale		Fahrenheit		Celsius	
Range Code	Range	Range Code	Range	Range Code	Range	Figure Intervals	Minor Divisions	Figure Intervals	Minor Divisions
01	–40° to 110°F	17	–40° to 40°C	41	–40° to 110°F & –40° to 40°C	10°	2°	5°	1°
02	0° to 100°F	24	–18° to 38°C	42	0° to 100°F & –18° to 38°C	5°	1°	5°	0.5°
03	30° to 130°F	25	0° to 55°C	43	30° to 130°F & 0° to 55°C	5°	1°	5°	1°
04	0° to 160°F	26	–18° to 70°C	44	0° to 160°F & –18° to 70°C	10°	2°	5°	1°
06	30° to 180°F	27	0° to 83°C	46	30° to 180°F & 0° to 83°C	10°	2°	5°	1°
07	30° to 240°F	19	0° to 115°C	47	30° to 240°F & 0° to 115°C	10°	2°	5°	1°
08	30° to 300°F	20	0° to 150°C	48	30° to 300°F & 0° to 150°C	10°	2°	10°	2°
09	50° to 400°F	28	10° to 205°C	49	50° to 400°F & 10° to 205°C	25°	5°	10°	2°
15	50° to 500°F	31	10° to 260°C	55	50° to 500°F & 10° to 260°C	25°	5°	10°	2°

Dual scale figure intervals may differ

All dimensions are nominal. Dimensions in [ ] are in millimeters.



Dial Size	B	C	F	J
3½"	3.06 [77.8]	3.88 [98.6]	0.44 [11.2]	1.22 [31]
4½"	3.54 [89.9]	4.96 [126]	0.47 [11.9]	1.28 [32.5]

Standard Ranges

psi Ranges (A)				kPa Ranges (B)				kg/cm² Ranges (C)			
Range Code	Specific Range (psi)	Figure Intervals	Minor Divisions	Range Code	Specific Range	Figure Intervals	Minor Divisions	Range Code	Specific Range	Figure Intervals	Minor Divisions
010	30" Hg to 0	5	0.2	010	–100 to 0 kPa	10	1	010	76 cm Hg to 0	10	0.5
020	30" Hg to 15 psi	5/5	0.5/0.2	020	–100 to 100 kPa	20	2	020	76 cm Hg to 1 kg/cm²	20/0.2	1/.02
030	30" Hg to 30 psi	10/5	1/0.5	030	–100 to 200 kPa	50	2	030	76 cm Hg to 2 kg/cm²	20/0.5	2/.02
040	30" Hg to 60 psi	10/10	1/1	040	–100 to 400 kPa	50	5	040	76 cm Hg to 4 kg/cm²	25/0.5	5/.05
050	30" Hg to 100 psi	30/10	2/1	050	–100 to 700 kPa	100	5	050	76 cm Hg to 7 kg/cm²	76/1	5/0.1
060	30" Hg to 150 psi	30/20	5/2	060	–100 to 1000 kPa	100	10	060	76 cm Hg to 10 kg/cm²	76/1	15/0.1
070	30" Hg to 300 psi	30/50	5/2	070	–100 to 2000 kPa	200	20	070	76 cm Hg to 21 kg/cm²	76/2	19/0.2
080	0 to 15 psi	3	0.1	080	0 to 100 kPa	10	1	080	0 to 1 kg/cm²	0.1	0.01
090	0 to 30 psi	5	0.2	090	0 to 200 kPa	20	2	090	0 to 2 kg/cm²	0.2	0.02
100	0 to 60 psi	10	0.5	100	0 to 400 kPa	50	5	100	0 to 4.2 kg/cm²	0.5	0.05
110	0 to 100 psi	10	1	110	0 to 700 kPa	100	5	110	0 to 7 kg/cm²	1	0.05
120	0 to 160 psi	20	1	120	0 to 1200 kPa	200	10	120	0 to 11 kg/cm²	1	0.1
130	0 to 200 psi	20	2	130	0 to 1500 kPa	300	10	130	0 to 14 kg/cm²	2	0.1
140	0 to 300 psi	50	2	140	0 to 2000 kPa	200	20	140	0 to 21 kg/cm²	3	0.2
150	0 to 400 psi	50	5	150	0 to 3000 kPa	300	20	150	0 to 28 kg/cm²	4	0.2
160	0 to 600 psi	50	5	160	0 to 4000 kPa	500	50	160	0 to 42 kg/cm²	6	0.5
180	0 to 1000 psi	100	10	180	0 to 7000 kPa	1000	50	180	0 to 70 kg/cm²	10	0.5

For dual scale ranges, specify the appropriate ***Units of Measure: D*** *(psi/kPa) or* ***E*** *(psi & kg/cm²) followed by the equivalent* ***A*** *(psi)* ***Range Code****. Other pressure ranges are also available including: Altitude, Ammonia, Refrigerant and Receiver. Consult Special Application Ranges section or factory for availability.*

Johnson Controls	LIMITED WARRANTY ENGINEERED SYSTEMS EQUIPMENT	
SERVICE POLICY	Supersedes: 50.05-NM2 (1008)	Form 50.05-NM2 (309)

POLICY STATEMENT

Johnson Controls, Inc. (JCI) warrants all new Engineered Systems Equipment and materials, or installation or start-up services performed by JCI in connection therewith, against defects in workmanship and material for a period of eighteen (18) months from date of shipment or twelve (12) months from date of start-up, whichever occurs first. This warranty does not extend to products used for rental chiller duty. Subject to the exclusions listed below, JCI, at its option, will repair or replace, FOB point of shipment, such JCI products or components as it finds defective.

Except for reciprocating replacement compressors, which JCI warrants for a period of twelve (12) months from date of shipment, JCI reconditioned or replacement materials, or installation or start-up services performed by JCI in connection therewith, warrants against defects in workmanship and material for a period of ninety (90) days from date of shipment. Subject to the exclusions listed below, JCI, at its option, will repair or replace, FOB point of shipment, such JCI products or components as it finds defective.

Exclusions:

Unless specifically agreed to in the contract documents, this warranty does not include the following costs and expenses:

1. Labor to remove or reinstall any equipment, materials, or components.
2. Shipping, handling, or transportation charges.
3. Cost of refrigerant.
4. Cost of rental chillers or other temporary cooling equipment.

No warranty repairs or replacements will be made until payment for all equipment, materials, or components has been received by JCI.

ALL WARRANTIES ARE VOID IF:

1. Equipment is used with refrigerants, oil, or antifreeze agents other than those authorized by JCI.
2. Equipment is used with any material or any equipment such as evaporators, tubing, other low side equipment, or refrigerant controls not approved by JCI.
3. Equipment has been damaged by freezing because it is not properly protected during cold weather, or damaged by fire or any other conditions not" ordinarily encountered.
4. Equipment is not installed, operated, maintained and serviced in accordance with instructions issued by JCI.
5. Equipment is damaged due to dirt, air, moisture, or other foreign matter entering the refrigerant system.
6. Equipment is not properly stored, protected, or inspected by the customer during the period from date of shipment to date of initial start-up.
7. Equipment is damaged due to acts of god, abuse, neglect, sabotage, or acts of terrorists.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES AND LIABILITIES, EXPRESS OR IMPLIED IN LAW OR IN FACT, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE WARRANTIES CONTAINED HEREIN SET FORTH BUYER'S SOLE AND EXCLUSIVE REMEDY IN THE EVENT OF A DEFECT IN WORKMANSHIP OR MATERIALS. IN NO EVENT SHALL JCI'S LIABILITY FOR DIRECT OR COMPENSATORY DAMAGES EXCEED THE PAYMENTS RECEIVED BY JCI FROM BUYER FOR THE MATERIALS OR EQUIPMENT INVOLVED. NOR SHALL JCI BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES. THESE LIMITATIONS ON LIABILITY AND DAMAGES SHALL APPLY UNDER ALL THEORIES OF LIABILITY OR CAUSES OF ACTION, INCLUDING, BUT NOT LIMITED TO, CONTRACT, WARRANTY, TORT (INCLUDING NEGLIGENCE) OR STRICT LIABILITY. THE ABOVE LIMITATIONS SHALL INURE TO THE BENEFIT OF JCI'S SUPPLIERS AND SUBCONTRACTORS.

Johnson Controls

P.O. Box 423, Milwaukee, WI 53203
www.johnsoncontrols.com

Printed in USA 50.05-NM2 (309)
Replaces: 50.05-NM2 (1008)

18 months (1 Year) Labor Only Warranty
FOR THE ENTIRE UNIT
YORK INTERNATIONAL CORPORATION
ENGINEERED SYSTEMS

PRODUCT TYPE: Air Cooled Scroll Chillers
YORK CONTRACT NO.:
UNIT MODEL NUMBER: YCAL0046EE
UNIT SERIAL NUMBER:
UNIT TAG ID: CH-1
UNIT LOCATION:

COMPRESSOR SERIAL NUMBER(S):

PROJECT NAME:
Installation
Address:

,

Shipping Date

The term of this agreement is 18 months (1 Year), commencing _____ and expires _____.

LIMITED WARRANTY

WHEN PROPERLY ENDORSED, THIS PROTECTION PLAN BETWEEN YORK INTERNATIONAL CORPORATION (YORK) AND CUSTOMER, WARRANTS, TO THE CUSTOMER NAMED HEREIN, *** UNASSIGNED *** FOR THE . IT DOES NOT COVER REFRIGERANT COST, FREIGHT CHARGES, OR ANY OTHER COSTS.

THIS WARRANTY EXCLUDES IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND WE DO NOT ASSUME, OR AUTHORIZE ANY OTHER PERSON TO ASSUME OTHER WARRANTIES FOR US. THIS WARRANTY IS OFFERED AS AN EXTENSION TO THE STANDARD LIMITED WARRANTY (FORM 50.05-NM2) AND IS SUBJECT TO THE SAME LIMITATIONS AND EXCLUSIONS, EXCEPT WHERE NOTED.

THIS PROTECTION PLAN DOES NOT COVER FAILURE OR DAMAGE RESULTING FROM FIRE, FLOOD, ABUSE, OR ACT OF GOD. ALSO EXCLUDED ARE DAMAGES OR FAILURES CAUSED BY INSTALLATION, OPERATION, OR MAINTENANCE CONTRARY TO YORK RECOMMENDATIONS, OR THOSE OF THE MANUFACTURER IF OTHER THAN YORK. IN NO EVENT SHALL YORK BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL, OR INDIRECT DAMAGE, LOSS, OR INJURY. WARRANTY FOR EXCHANGE OR PARTS PROCUREMENT SERVICE SHALL BE AVAILABLE THROUGH THE SERVICER LISTED HEREIN DURING NORMAL WORKING HOURS.

DISTRICT SERVICE OFFICE: _____

OFFERED BY: _____ (York Selling Representative Print/Sign) _____ (Date)

APPROVED BY: _____ (York Area Service Manager Print/Sign) _____ (Date)

ACCEPTED BY: _____ (Customer Signature) _____ (Date)

(Manufacturer's Use Only)

AUTHORIZED BY: _____ (Manager, Warranty Administration) 2016-05-06 (Date)

Product Code Ref: 8123

66 MONTHS (5 YEARS)PARTS & LABOR WARRANTY
FOR THE COMPRESSOR
YORK INTERNATIONAL CORPORATION
ENGINEERED SYSTEMS

PRODUCT TYPE: AIR COOLED SCROLL CHILLERS
YORK CONTRACT NO.:
UNIT MODEL NUMBER: YCAL0046EE
UNIT SERIAL NUMBER:
UNIT TAG ID: CH-1
UNIT LOCATION:

COMPRESSOR SERIAL NUMBER(S):

PROJECT NAME:
INSTALLATION ADDRESS:
,

Shipping Date

The term of this agreement is 66 months (5 Years), commencing _____ and expires _____.

LIMITED WARRANTY

WHEN PROPERLY ENDORSED, THIS PROTECTION PLAN BETWEEN YORK INTERNATIONAL CORPORATION (YORK) AND CUSTOMER, WARRANTS, TO THE CUSTOMER NAMED HEREIN, FOR THE . IT DOES NOT COVER REFRIGERANT COST, FREIGHT CHARGES, OR ANY OTHER COSTS.

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DISTRICT SERVICE OFFICE: _____

OFFERED BY: _____ (York Selling Representative Print/Sign) _____ (Date)

APPROVED BY: _____ (York Area Service Manager Print/Sign) _____ (Date)

ACCEPTED BY: _____ (Customer Signature) _____ (Date)

(Manufacturer's Use Only)

AUTHORIZED BY: _____ (Manager, Warranty Administration) 2016-05-06 (Date)

Product Code Ref: 8521