

Greenfield Compressor Package



- » Compressor: Sulzer C5T223.13-LC
- » Working Pressure: 2500 PSI
- » Air Flow: 244 CFM @ 2500 PSI
- » Motor: 200 HP TEFC, 460 volts, 60 Hz, 230 Amps
- » PLC Controls and safety shutdown
- » Automatic condensate drain system & reservoir
- » Sound level: 72 dBA @ 3'
- » Dimensions: 21'5" x 7'6" x 13' Tall
- » Weight: 21,000 lbs



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IG0344

IG0345

**CT Operation
and
Maintenance
Instruction
Manual**

GreenField Compression, Inc

909 N. Bowser Rd.
Richardson, Texas
Tel: (972) 889-2400
Fax: (972) 234-4829

CT Operation and Maintenance Instruction Manual

Compressor Type: C5T223.13-LC
Station Serial Number: IG0344 & IG0345
Prime Mover: 200 HP Electric Motor
Compressor Block Serial Number: 700550 & 700551

Customer: US Filter/Zimpro
301 West Military Road
Rothschild, WI 54474
Order Number: 004319
Order Date: 03/19/2004

These instructions are an important element in the continued **safety** of the operating personnel and equipment. It is in everyone's interest to have all staff that may be exposed to the process air compressor read this manual thoroughly.

This manual and all spare parts should be readily available at the site installation for reference.



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1.0 Safety



The preceding picture point refers to potential dangers to body and life and must be respected, accordingly. The different picture points appear in the Instruction Manual, where appropriate, with the corresponding advice signal.

- Each person that is involved with erection, dismantling, reassembly, commissioning and maintenance (inspection, service, and overhaul) of the system, must have read and understood this complete Manual. GreenField recommends that the user confirm, in writing, the responsible personnel's understanding of this material.
- The system is provided exclusively for the compression of the intended gas. Any other use of the system is considered unauthorized, and voids all warranties, guarantees, and raises serious safety issues. The manufacturer is not responsible for damage resulting from such inappropriate use. The risk shall be borne by the user.
- Appropriate use is not restricted to usage, but also includes the erection, dismantling, reassembly, commissioning, operation and maintenance procedures issued by the manufacturer.
- The system can only be operated, serviced and overhauled by authorized, skilled and trained personnel. These personnel must have been specifically instructed on the dangers, which could occur with this system.
- The responsibility during erection, dismantling, reassembly, commissioning, operation and maintenance must be clearly defined, so that no safety issues occur.
- Any work, which might impact the safety of the system, must be avoided.
- The user must operate the system only in a perfect state.
- The user must identify any modification to the system, which could impact safety
- Any alterations and modifications performed without approval, which would compromise the safety of the installation and operational system are not allowed.
- Any work performed on the compressor, must only be performed when the compressor is at a standstill, and the appropriate Lockout/Tagout procedures followed.
- Before starting work on the compressor, the compressor drive must be secured against unintentional start.
- Equipment guards may only be removed after the compressor is stopped and secured.
- The complete system (compressor, piping, gas storage, dispenser, etc.) can remain under gas pressure when idle. Before starting work on the system, this pressure must be released and, if necessary, purged with an inert gas.
- Before re-commissioning after an overhaul, care must be taken to insure that all safety protection has been provided.
- After erection or overhaul, the existing protection devices must be tested.
- For the operation of the system, the local (state, city, county, etc.) safety instructions and rules for prevention of accidents must be followed.



- During operation, high temperatures develop on cylinders, piping and accessories, which may lead to severe burns. Before starting work on the compressor, be sure that components have cooled.

1.1 Special Areas

When installing the equipment, special attention must be paid to the classification of areas, according to the standards and codes or recommended practices, and special environments specified by the authorities having jurisdiction over the installation area.

1.1.1 Protection Methods for Electrical Instruments

There are two main types of protection used by GreenField for hazardous areas:

- Intrinsic safety
- Explosion-proof Equipment Enclosures

a) Intrinsically Safe Circuit

An intrinsically safe circuit is the only one, which operates by limiting the electrical energy available to the circuitry and equipment to levels that are too low to ignite the most easily ignitable mixture of gas and air that is likely to occur. Two mechanisms of ignition are taken into account, namely, electrical sparks and electrically heated surfaces.

Intrinsic safety is essentially a low power technique, limited to approximately 2-3 watts and, therefore, well suited to industrial instrumentation. It is not suitable for power equipment such as electric motors or solenoid valves, but it may be used to make these types of control circuits safe.

b) Explosion-proof Equipment Enclosures

Explosion proof or flameproof means that the enclosure must be strong enough to withstand any internal pressures caused by an explosion and be tight enough to prevent flames from escaping the enclosure. Explosion-proof does not mean that the equipment has to be gas tight.

Explosion-proof instruments are always installed where high power transfer is unavoidable. Equipment requiring this type of power includes electric motors, motor starters and certain types of controls.

1.2 Work Safety Notices

The safety of the compressor is assured when handled and operated according to the data given in the order confirmation and the operating instructions.

- The entire system must be laid out in conformance to regulations as well as the manufacturer's data provided for the system.
- Prior to checks, maintenance and repair work, the operator/technician must ensure that the compressor cannot be started accidentally. Furthermore, it is highly recommended that a lockout/tagout procedure be instituted prior to performing any maintenance. The following are general guidelines and do not constitute a complete lockout/tagout procedure.



- Isolate all electrical power, i.e., lockout the main disconnect switch and remove related fuses, etc. Some components may receive power from multiple sources. Insure that all sources of power are disconnected or turned off.
- Isolate all potential sources of energy. Gas stored under pressure must also be vented.
- Isolate all sources of gas pressure by isolating the suction and discharge side of the compressor.

The following work must only be done after venting the compressor and isolating the discharge side:

- Adding or draining lubricating oil
- Maintenance checks on any pressurized components
- Service or repair works regarding replacement of components

A blow down recovery system has been installed to assure trouble-free operation.



1.3 LUBRICANTS

ATTENTION! For oil lubricated CNG compressors, observe the lubricants chart for air. For compressors designed for the compression of helium or argon or other gases, observe the lubricants chart for special gases. INDUSTRIAL GAS applications recommended oil is synthetic.

1.3.1 SAFETY INSTRUCTIONS

The danger information on the manufacturer's safety data page for the lubricant is important for the safe use of lubricants.

Observe the instructions relating to skin tolerability, environmental soundness, and behavior in the case of a fire and waste disposal. Used oil can contain gas. If this is a combustible gas (e.g. H₂, C₂H₄, etc.,) the flashing point of the used oil can be far below the value specified in the technical product sheet.

1.3.2 USE OF SYNTHETIC OIL - PREFERRED

Due to excellent lubrication properties and favorable viscosity/temperature behavior, we recommend the use of selected synthetic oils. Factory fill consists of ISO 150 mineral oil.



Polyglycol oils are hygroscopic, i.e. they easily intermix with water, therefore, avoid contact with the atmosphere, as much as possible. These oils are only suitable for dry gases!

Based on positive experience to date, the following are recommended:

Manufacturer	Normal Type	Warm Weather Type
GreenField	110-3605	
AGIP	DICREA S 150	
BP		*Energyn GCS 180
CALTEX /TEXACO	SYNLUBE 140	
CASTROL		*AIRCOL PG 185
ELF	PRIMERIA LPG 150	
EXXON		*Exxcolub LG 185



MOBIL	GAS COMPRESSOR OIL	
UCON	LB-400-X	*Compressor Lubricant R-1

ATTENTION! *When frequently operating at cooling air temperatures of above 86 °F, we strongly recommend the use one of the above qualities.

Other synthetic oils:

Manufacturer	Normal Type	Warm Weather Type
MOBIL	RARUS 829	
ESSO	COMPRESSOR OIL RS 100	

To use lubricants, which are not contained in the above list, please contact Technical Support. We may require technical specification (technical data sheet) in order to be able to assess the quality of the lubricant.

GreenField declines any liability for the quality and the properties of the lubricants referenced.

1.3.3 USE OF MINERAL OIL

REQUIREMENTS

Use lightly doped refined mineral oil containing agents to enhance resistance against ageing, corrosion as well as to reduce wear.

Viscosity:	According to ISO classification ISO VG 100 i.e. 90-100 cSt (mm ² /S) at 104 °F (corresponds to 55-70 cSt or 7-9°E at 122 °F)
Viscosity Index:	Minimum: 80
Flash Point:	Minimum: 392°F
Solidification or Pour Point:	Maximum: -18°F



The oil qualities in question should contain only small quantities of additives with dispergent or none at all, because of the demulsifying ability to condensation water.

The following is a list of suppliers offering the corresponding oil quality (in alphabetical order):

Manufacturer	Normal Type	Warm Weather Type
AGIP	Dicrea 100	* Dicrea 150
ASEOL	Plus 16-130	* Plus 16-140
BP	Energol RC 100	* Energol RC 150
CALTEX	RPM Compressor Oil 100	* RPM Compressor Oil 150
CASTROL	Aircol PD 100	* Aircol PD 150
ELF	Dacnis P 100	* Dacnis P 150
ESSO	Nuto 100	* Nuto 150
SHELL	Corena P 100	* Corena P 150
TEXACO	Compressor Oil EP VDL 100	* Compressor Oil EP VDL 150
VALVOLINE	Compressor Oil 100	* Compressor Oil 150



WINTERSHALL

Wiolan CD 100

* Wiolan CD 150



When frequently operating at cooling air temperatures of above 86°F, we strongly recommend the use of one of the above oil qualities.

To use lubricants which are not contained in the above list, please contact Technical Support. We may require technical specification (technical data sheet) in order to be able to assess the quality of the lubricant used.

1.3.4 CHANGING FROM MINERAL OIL TO SYNTHETIC OIL

Mineral oil and synthetic oil must not be blended! Follow this method when changing over.

1. Depressurize and flush the compressor (see also to the corresponding reference in the instruction manual)*.
2. Drain the mineral oil when warm.
3. Fill with synthetic oil up to the minimal oil mark plus 2 liters (note reference in the instruction manual for the minimum oil level).
4. Remove gas lines, cylinder heads and valves.
5. Let the compressor run for approximately 20 minutes and check the oil rise in the cylinders (refer to the corresponding point in the instruction manual).
6. Flush compressor (refer to the pertinent instruction manual)*.
7. Switch off the compressor and drain the oil mix.
8. Clean drive housing and change oil filter (if installed).
9. Reinstall valves, cylinder heads and gas lines.
10. Fill with synthetic oil up to the maximum oil level.
11. Start compressor according to instructions (not with air, knowing that the majority of the synthetic oils are hygroscopic, i.e. then intermix with water).

* only if possible.

1.4 PRESSURES AND TEMPERATURES

1.4.1 PRESSURES

The regular observation of suction and interstage pressures is very important.

Detecting valve problems at an early stage can prevent overloading of another stage and, subsequently reduce possible damage to valve inner parts to an absolute minimum.

The Compressor Data Sheet of this manual shows "Interstage Pressures" giving the appropriate figures for compressing natural gas at the mentioned conditions.

It is recommended at commissioning to mark the appropriate interstage pressures on the appropriate manometers (gauges), thus enabling a quick reference and proper judgement of requested interstage pressure checks.

Deviations of suction and interstage pressures and their possible consequences as well as proposed actions can be found in the section on Troubleshooting.

1.4.2 TEMPERATURES



The actual temperatures achieved by the compressor can give important hints of the condition of the machine. It is important to distinguish between the following two temperatures:

- Ambient temperature
- Gas temperature inlet/outlet

Temperatures are different for compressing natural gas and other gases.

Ambient Temperature

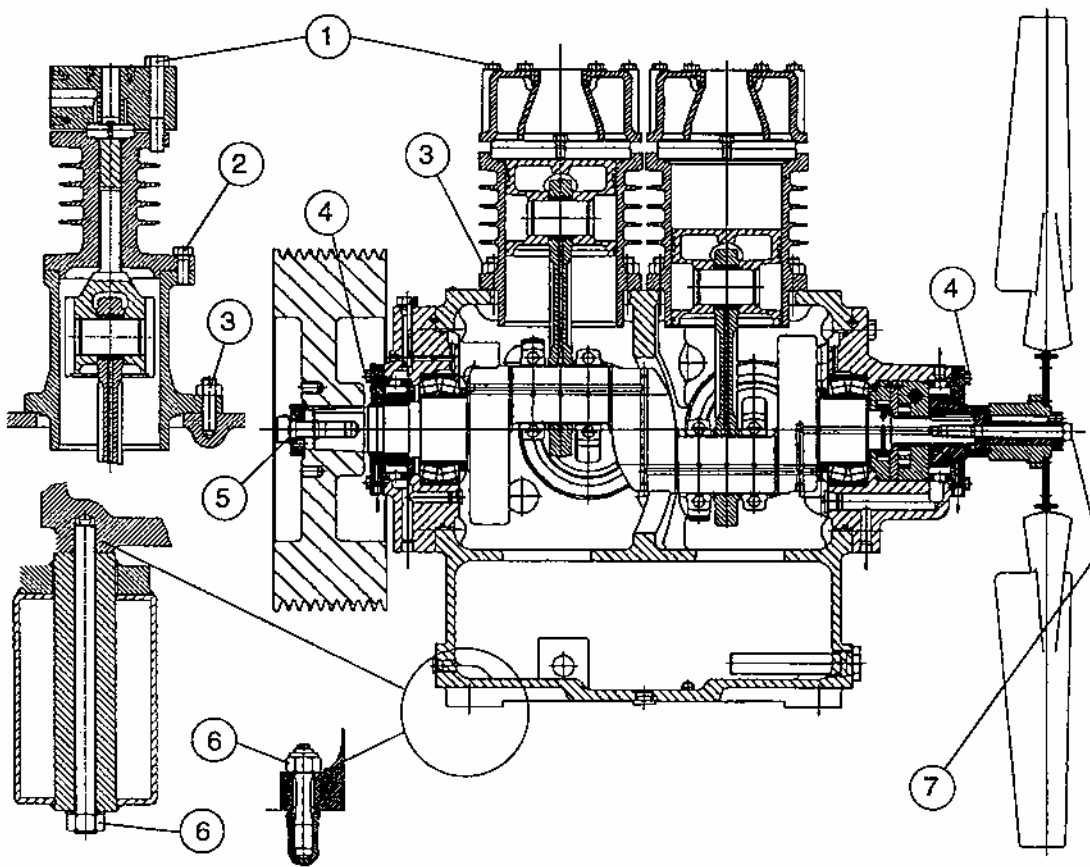
The maximum allowable ambient temperature is 115 °F. When exceeding this temperature, please contact CSS at once.

Operating the compressor at ambient temperatures between 110-115 °F should be regarded as *operation under difficult conditions*. Under these conditions, the service intervals should be doubled.

Gas Temperature Inlet/Outlet

Gas temperatures provide great information regarding possible valve difficulties and the benefit of observation should not be underestimated. The gas temperature curves provided in this manual have a measurement basis, which you will find below.

1.5 TIGHTENING PRESCRIPTION FOR SCREWS AND NUTS





Point	Description	Torque
1a	Cylinder head screws cylinder Ø170-225mm	120 Nm, 12 kpm, 88.5 ft-lbs
1b	Cylinder head screws cylinder Ø43-155mm	220 Nm, 22 kpm, 162 ft-lbs
1c	Cylinder head screws cylinder Ø30-37mm	200 Nm, 20 kpm, 148 ft-lbs
2	Steeple cylinder / guiding cylinder	300 Nm, 30 kpm, 221 ft-lbs
3	Guide cylinder / crankcase	500 Nm, 50 kpm, 369 ft-lbs
4	Crankshaft bearing covers	60 Nm, 6 kpm, 44 ft-lbs
5	Flywheel attachment bolts	1000 Nm, 100 kpm, 738 ft-lbs
6	Crankcase anchor bolts	1000 Nm, 100 kpm, 738 ft-lbs
7	Fan attachment bolt	300 Nm, 30 kpm, 221 ft-lbs



**As a rule, treat all screws $\geq$ M12 with a lubricant admitted for the individual application.
NEVER FASTEN SCREWS WITHOUT THIS LUBRICANT!**

- 1) Use grease Molykote G-n as standard
- 2) Oil or grease should be used only in special cases

Clean contact surface of the parts to be joined. Grease the glide surface of the screw (thread including head and nut contact surface) with the specified lubricant. Tighten the screw at least twice by applying the specified tightening torque according to the table. Use exclusively approved torque wrenches.

1.6 TOOLS

Tools are divided into two groups:

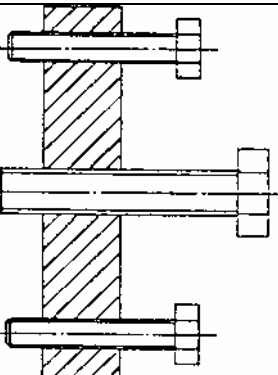
Group 1

Tools are for the normal overhaul of the compressor that are furnished with compressor.

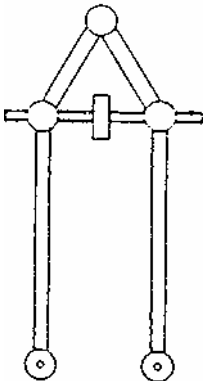
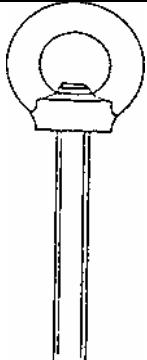
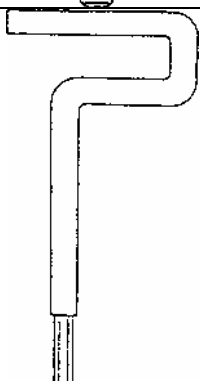
Group 2

Tools for larger repair work. Group 2 tools are available from our stock and can be ordered via Spare Parts Department.

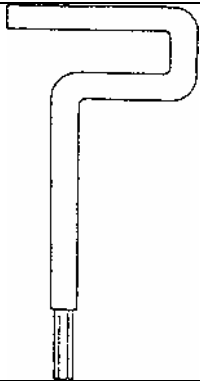
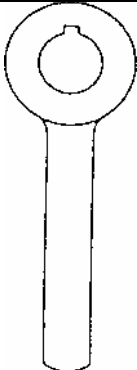
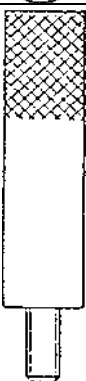
Please see enclosure for Tools List.

Item	Appearance	Description and Use	Order No	Group	CU	CU-P	CT	CT-P
1		Extractor with bolt to remove flywheel	M 10558 M 10559	1 1		√	√	√



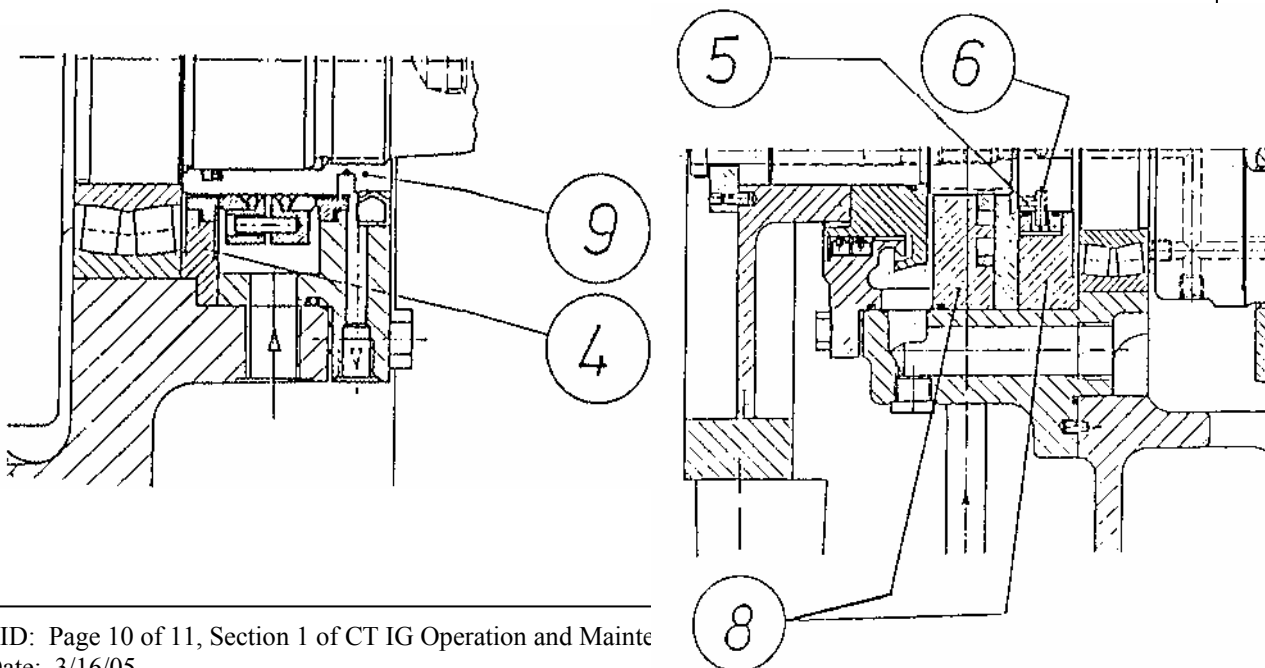
Item	Appearance	Description and Use	Order No	Group	CU	CU-P	CT	CT-P
2		Spanner to remove oil- level sight glass	M 10542	1		√	√	√
3		Fork wrench for gas pipes [90mm]	M 10551	1			√	√
4		Extracting screws to remove rings behind mechanical seals	M 9545	1		√		√
5		Hexagonal spanner to remove the safety thread pin of the oil distributing rings	M 10541	2	√	√	√	√

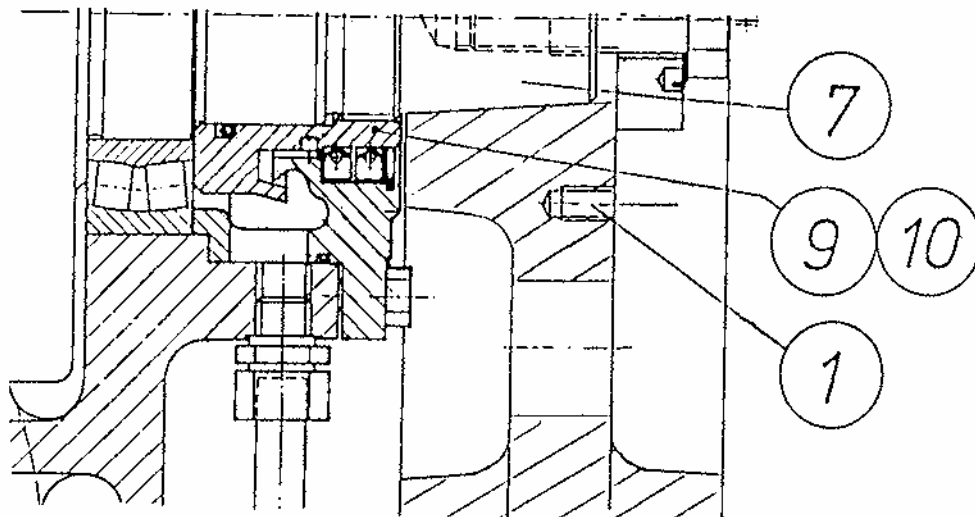


Item	Appearance	Description and Use	Order No	Group	CU	CU-P	CT	CT-P
6		Hexagonal spanner to remove the driver screw of the oil distributing rings	M 10540	2	√	√	√	√
7		Key wrench to hold crankshaft while tightening and loosening the seal jacket	M 10548 M 10549	2 2	√	√	√	√
8		Extracting screw to remove the oil pump and the distance piece on the non-driving side	M 10550	2	√	√	√	√
9		Special 4-key wrench to remove the crankshaft seal jacket	M 10543 M 10544 M 10545 M 10546	2 2 2 2	√	√	√	√



Item	Appearance	Description and Use	Order No	Group	CU	CU-P	CT	CT-P
10		Hexagonal bolt (14mm AF x 50mm LG.) to remove the center connecting rod of each crank	M 10556	2	√	√		
11		Hexagonal bolt (14mm AF x 235mm LG.) to remove the center connecting rod of each crank	M 10557	2	√	√		

TOOL NUMBERS AND LOCATION OF USE



1.7 HIGH PRESSURE CONNECTIONS

The tube fittings provided are specially designed for high-pressure applications. Do not mix or interchange parts of the tube fittings (ferrules, nuts, etc.) from different manufacturers. Observe the safety precautions according to manufacturer's recommendations.



GreenField

IG Station Manual

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2.0 System Description

2.1 Not Applicable

2.2 Station Description

Each compressor unit usually consists of a compressor and control panel. The compressor control panel is normally installed near the compressor outside of the classified area. In the event of a compressor malfunction, one of the red lights on the control panel will illuminate. This light will require investigation and possibly a manual reset prior to the compressor restarting. Details about the compressor and other main equipment can be found in section. 2.3.

2.3 Equipment Description & Maintenance

2.3.1 Compression Module

The GreenField compressor package is a compact module including the skid frame, compressor, motor, blowdown tank, equipment and accessories, completely assembled on the common skid. Protective enclosures (both acoustic and non acoustic) are available as an option. Other optional equipment such as a Oil Removal System, Emergency Shut Down system, and others may also be included on or off the skid.

2.3.2 Compressor

The compressor is a reciprocating, multi-stage, single-acting, air-cooled, oil lubricated compressor of trunk-piston design with various piston configurations. It is designed to compress different gases in a periodic or continuous operation and is equipped with all the instruments for safe automatic operation.

The airflow required for cooling the entire compressor is generated by crankshaft driven fan. A crankshaft driven oil pump generates the oil flow required for the lubrication of its moving parts. The crankshaft of the compressor, where all the necessary operating motions are concentrated, is driven by an electric motor through a set of anti-static v-belts. The drivers are suitable for v-belt drive arrangement and are mounted on a sliding or pivoting motor base to enable tension adjustments.

The entire compressor is protected against over pressurization by a safety relief valve system, which vents to the suction line and/or to the atmosphere.

2.3.3 Not Applicable

2.3.4 Not Applicable

2.3.5 Blowdown System (Optional)

The blowdown system includes a tank designed with enough volume to guarantee the expansion of the compressed gas inside the compression system at each shutdown of the compressors without gas venting. The blowdown tank is installed at the compressor suction side and also functions as a condensate tank for the separator filters.

During operation, the entire volume of each stage consisting of cylinder, piping, separator, cooler, etc. is under a specified pressure (see Figure 1). Upon shut off, the contained compressed gas of each stage is expanded to a common pressure, as the blowdown valves are opened. Depending on the installation, the available volume for individual gas compressor models can be different (e.g. non-return device, automatic shut off valves, pressure regulating valve on suction side close to suction inlet).



The blowdown pressure will in many cases be above the set pressure of the pressure switch in the suction line. Therefore, the pressure switch has to be bypassed at start-up and during condensate draining cycle. See Figure 2 for the settle pressure diagram.

At start-up, the additional volume will be consumed and the correct interstage pressures will be established.

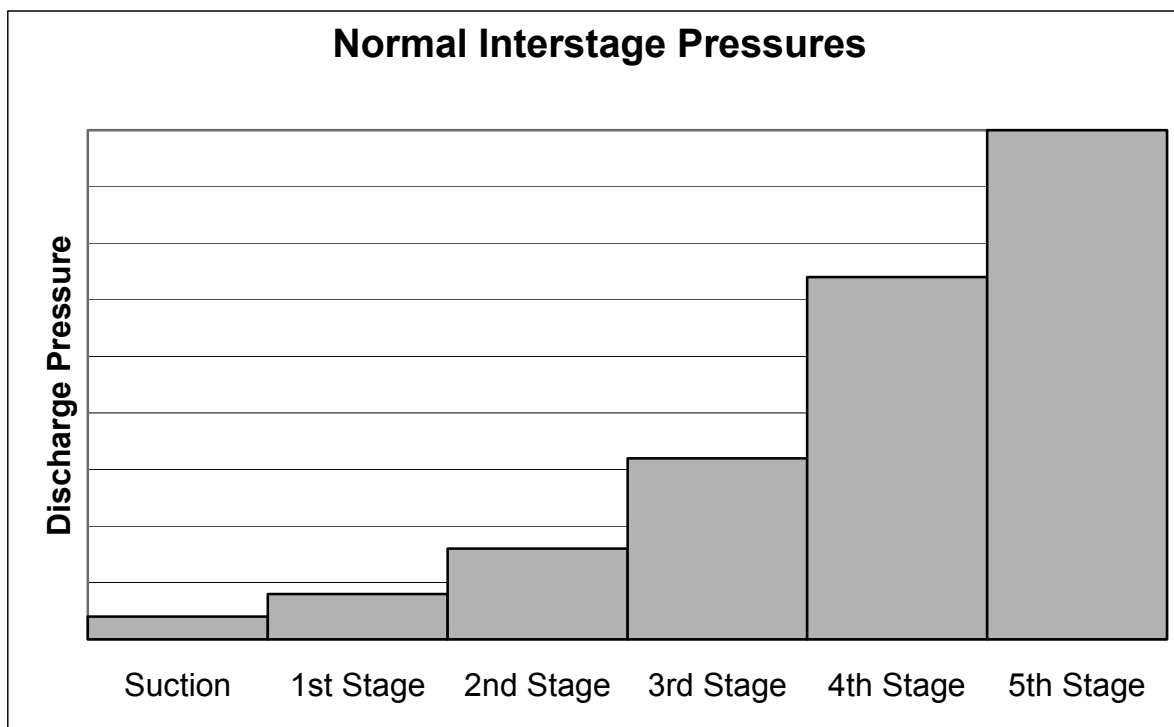


Figure 1 - Interstage Pressures

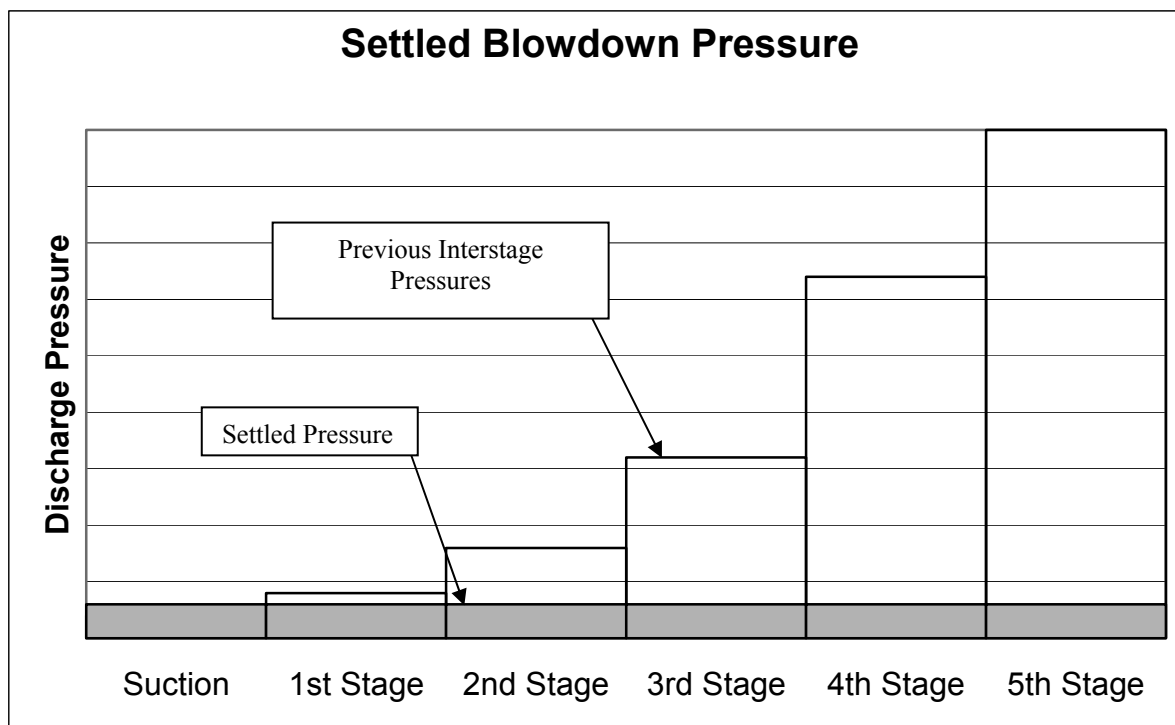


Figure 2 - Blowdown Pressure

2.3.6 Suction Filter

An inlet filter is installed in the suction line of the compressor to prevent dirt from entering the compressor and affecting its internal parts. The filter cartridge has to be inspected, cleaned or changed periodically according to the maintenance schedule.

2.3.7 Separator/Buffer Filters

Separator filters are installed, depending on the gas compressor model, and placed before and/or after the gas cooler to receive the condensate from the compression process. The compressor discharge has a coalescing filter that drains with an automatic condensate draining system. These filters also serve to buffer the operation of the compressor valves.



If the unit is supplied with a manual condensate system, it is imperative that these be checked on regular bases. Should a large quantity of condensate or oil overflow the separators and reach the next stage of compression the results can be catastrophic.

2.3.8 Heat Exchangers

The compressor is provided with an air/gas cooler and consists of two machined headers which themselves consist of sections which relate to the stages of the compressor. The gas pass between the headers through bent finned tubes creating 3-5 pass system depending on cooling requirements. The cooling fan is mounted on the compressor crankshaft. The oil cooler is mounted on the heat exchanger and shares the same cooling air.

**2.3.9 Not Applicable****2.3.10 Not Applicable****2.3.11 Not Applicable****2.3.12 Control Panel**

Both the motor control center and the system monitoring/control are concentrated in a single unit managed by a Programmable Logic Controller or PLC. From this unit, the following sub-systems can be distinguished:

- Control and monitoring of compressor status
- Solenoid valves and field instruments
- Main Drive Motor starter & Fan Motor Starter

By monitoring the input states of the field instruments, the PLC produces the outputs to control the automatic operation of the compressor.

The emergency shutdown system, when operated, interrupts the power supply to the PLC outputs (and therefore the compressor skid and the power supply to both dispensers). Upon actuation, all the electrical outputs to the equipment in the hazardous area are de-energized. If a complete power shunt to the compressor is required (input signals as well), contact GreenField Customer Service for assistance in installing a shunt trip system.

A touch screen terminal, status indicators and switches are placed on the front of the control panel.

2.3.13 Main Drive

The compressor is driven by a V-belt arrangement. Belts are direct from the motor sheave (DriveR) to the compressor flywheel (DriveN).

Indirect V-Belt Drive

In order to gain maximum use of the belts, it is most important to pay careful attention to their tensioning.

The grooves of the flywheel and the pulley must be in line and free of rust and dirt. To fit the belts onto the wheels, reduce the shaft distances to a minimum (using the motor base adjustment screws) and slide the belts over by hand.



Do not attempt to install belts by “rolling” them onto the sheaves. Doing so damages the belts and reduces their lifespan.

The belt tension is checked by measuring the amount of force required to deflect a belt the distance “F” shown in Figure 1.

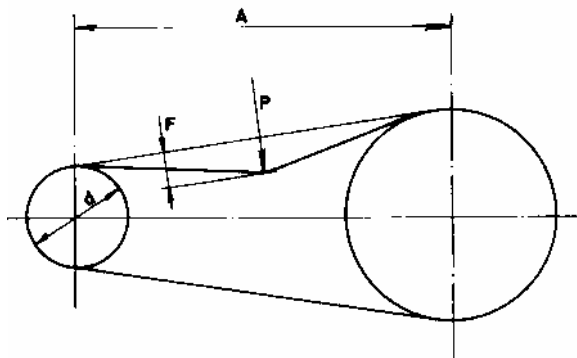


Figure 1 Belt Tensioning Diagram

Diameter “d” of Sheave

6.0 to 6.8 in

7.4 to 9.4 in

11.0 in

Force P per belt

6.6 to 9.6 lbf

7.4 to 11.0 lbf

8.2 to 12.5 lbf

Hereby the deflection “F” is 1/16” per 1 inch of the shaft distance “A”,
e.g., A = 25.5 inches: therefore $F = 25.5 \times 1/16 = 1.60$ ”

New belts should be tightened to the upper limit of the force value “P”. After the first 20 service hours with new belts, the tensioning must be re-checked. 80% of the possible elongation occurs during this period. After this run-in period, belt tension must be checked every 1500 hours.

V-Belt Tension Gauge P/N 701496 is available through GreenField Customer Service. The setting (Force P) should be 24.6 to 37.5 lbs for three band belts (3 belts in one).

Electric Motor

The motor must be greased periodically according to maintenance requirements. Refer to the motor documentation in the Section 12, manufactures literature section

2.3.14 Automatic Condensate Drain System/Captive Unloading System

These three systems are comprised of the same components. The systems are defined by the different methods in which these common components are operated. Each system is described below.

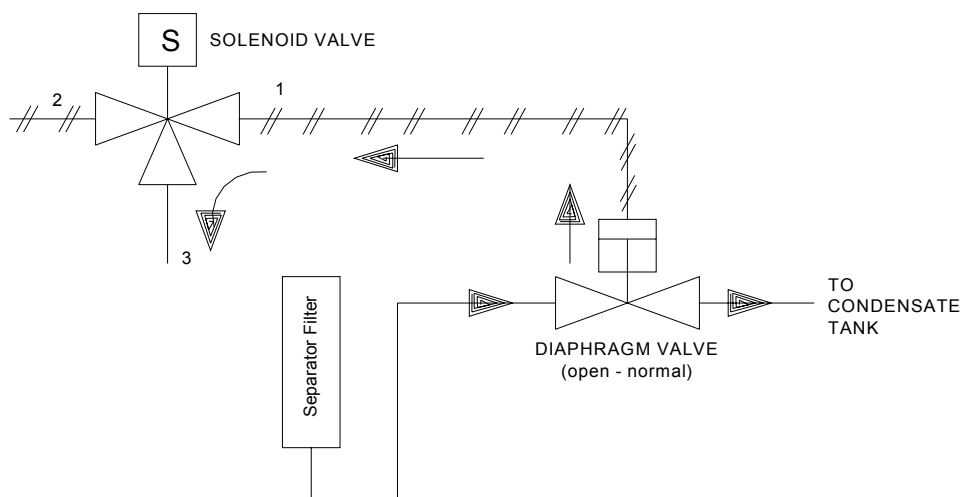
2.3.14.1 Automatic Condensate Drain System

Pneumatic valves, operated by three-way solenoid valves, control the blowdown system. Depending on the gas, and on the compressor operating conditions, the valves are installed in the suction &/or discharge of some stages to drain gas condensate and oil aerosols.

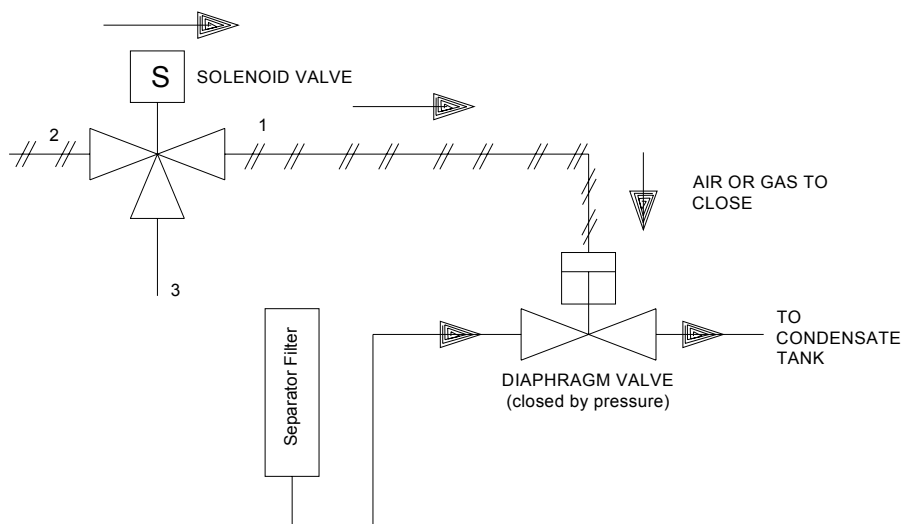
The PLC controls the drain system by a timer set for the interval between the condensate drain periods. Normally, the draining of the condensate has to be set at least once every 20 minutes. The duration that the valves remain open are controlled by a zero gas loss system in which a pressure rise in the blow down tank will close the blow down valve.

The solenoid valve functions are “normally closed”, which means in case of power failure, the system vents and the pneumatic valves open, causing the condensate to drain into the suction tank. The following description details the system in the energized and de-energized state.

- a) De-Energized System (Valve Open)

**DE-ENERGIZED**

- As the solenoid is de-energized, the control air/gas returning from pneumatic valve travels from port 1 to port 3 in the solenoid valve and goes to vent. Consequently, the actuated valve open, draining the condensate.
- The flow from port 2 to port 1 in the solenoid valve is prevented as this path is closed.

b) Energized System (Valve Closed)**ENERGIZED**

- As the solenoid is energized, the control air/gas flows to the diaphragm valves from port 2 to port 1 in the solenoid valve. Consequently, the pneumatic valve closes.
- The flow from port 1 to port 3 in the solenoid is prevented as this path is closed.

**2.3.14.2 Captive Unloading System**

The same system described above has an important function to unload the compressor at each compressor stop. During the compressor shutdown phase, the amount of compressed gas at each stage is decompressed to the suction side by the blowdown valve. This causes the pressure settling effect as described in Section 2.3.5. This system also serves to prevent a fully loaded start of the compressor. A full load start occurs when all the compression cylinders contain the operating pressure when the main drive motor starts. This puts unnecessary strain on the drive train components and the compressor system. All the gas is held “captive” in the suction side tank to prevent any environmental release under normal operating conditions.

2.3.15 Pressure Relief Devices (Safety Relief Valves)

Safety valves are protective devices preventing a dangerous overpressure. They are not control devices and should never be used as such. Care should be taken for their good condition, correct setting and maintenance. The safety valves are set on the test bench so that they activate when the safe operating pressure is exceeded.

When a safety valve has to be disassembled for inspection, cleaning, regrinding of seat or replacing of parts, it has to be reset correctly. The set pressure of safety valves is indicated in the process and instrumentation diagram. These set pressures do not, in any condition, change without GreenField's written permission.

2.3.16 Not Applicable



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3.0 INSTALLATION

3.1 TRANSPORT AND STORAGE

Prior to installation, the equipment should remain in the original packing. For detailed explanation of long-term storage, please refer to Section 8.0. The detailed transport and lifting instructions are supplied in the Outline and Installation Drawing. The compressor module skid is provided with lifting points. Before removing the compressor skid from truck or container, and before installation at the site, please read all the instructions regarding the levelling and foundation bolting.

All relevant information to install, level and grout the skid can be found in the Project Documents, in Section 14.

3.2 INSTALLATION OF THE COMPRESSOR MODULE

The compressor module, when provided with an enclosure, is weather protected, and no other roof is required over the compressor area. The compressor should be installed on the foundation with anchoring bolts. It is recommended that the system be placed on a **well-levelled and flat** reinforced concrete platform. This platform requires dimensions of at least four inches over the skid dimensions and a height of two inches in order to avoid water accumulation around the skid.

It is very important to leave a free space around the skid with concrete flooring for maintenance. A minimum clearance of 3 feet around the compressor is recommended.

Free ventilation: Because of the air cooled compressor design, consideration must be given to good ventilation. This means keeping the air inlet and air outlet of the enclosure clear of obstructions.

Special attention must be taken when compressors are being installed inside a room. Depending on the room size or ambient temperature, fresh air from outside is required for the compressor and cooler. However, it is recommended that you contact GreenField for more details before installation of the compressor.

3.3 PIPING AND TUBE CONNECTIONS

The compressor discharge line operates under high pressure and is designed with special fittings and tubes. Only qualified personnel should assemble it, carefully following the manufacturer's instructions. See Section 1.

Regarding the connections and tubing selection (i.e. wall thickness), the design pressure of the compressor discharge line must be taken into account, per Process and Instrumentation Diagram (P&ID).

3.4 ELECTRICAL CONNECTIONS

All the conduits, connection box, cables, etc., to connect the compressor skid must be selected by the area classification according to local standard codes.. GreenField documents show a typical installation to accepted National codes. It is the responsibility of the installation personnel to comply with all local codes.



Warning! After the start-up of the compressor is completed, all the conduit seals must be sealed according to national and local electric and fire codes.



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4.0 Commissioning & Start-Up

4.1 Introduction

Each compressor has been tested at the GreenField factory prior to shipment, thus warranting trouble-free service. Please ensure that all electrical connections have been carried out according to local codes, conditions and in accordance with the principle electrical diagram.

Read the instructions to be informed about safety precautions on compressor and accessories.

4.2 First Start-Up of Compressor



Only qualified technicians with experience and training should perform start-up and commissioning of a compressor. The consequences of improper start-up can be disastrous.

This procedure must be followed with new compressors, compressors being newly overhauled or repaired and after long standstills. See also Section 8.0 Packing and Storage for long-term guidelines.

Inspection of Installation:

1. Check suction piping (dirt, rust, moisture, etc.)
2. Flush and clean pipes, if necessary
3. Check installation for correct suction filter

Inspection of Compressor:

1. Take all valves out of the cylinders. Check if there is any rust or fouling on valves or in compression zones. Protect openings with rags (not required for a new compressor skid if installed within 6 weeks of factory testing).
2. Fill crankcase with oil up to the maximum mark of the oil level indicator. For quantity and quality, see Specifications and Capacities section. It is important that mechanical seal chambers be flooded with oil at initial start-up (already done during factory testing). The chambers are to be refilled, before first start-up and after they have been drained for checks/repair works, etc. Sliding surfaces between pressure ring and seal have to be oiled on replacement seals before assembly. (Not required for a new compressor skid if installed within 2 weeks of factory testing).
3. Pre-lubricate rotating parts by manually revolving the flywheel three or four times.
4. Check the direction of rotation (marked by arrow) by “bumping” the motor.
5. Check the fitting and tension of the belts on compressors with V-belt drive.
6. Only for explosive gas compressors: Purging of compressor and pipes for compressors handling flammable or explosive gases (see Section 4.3) may be required.
7. Conduct mechanical test run of approximately 5-10 minutes to blow through piping of the compressor with all the blowdown valves open.
8. Slowly increase the pressure at the discharge by closing the blowdown valve.
9. Check whether compressor runs smoothly and quietly. To determine this, listen to the crankcase (especially after service or repair works).
10. Re-tighten all nuts and bolts.

4.3 Purging of the Compressor

For certain flammable gases, purging of the compressor before and after servicing, may be required. Contact the GreenField Factory for details.



4.4 First Start-Up of the Compressor System

4.4.1 Safety Recommendations

Only trained and authorized technicians should carry out the first start-up of the system. The recommendations in this Instruction Manual are to be followed. Refer to the recommendations in Section 6.0 of this manual.

4.4.2 Conditions for First Start-Up

To carry out the first start-up, the following conditions have to be fulfilled:

- Gas, electrical power, nitrogen (for purging of the system - as necessary) must be available according to the specified parameters.
- Lubrication oil for the compressor must be available.
- Tools must be on hand.
- Spare parts must be available.
- The required licenses and permits for the operation of the system must be at hand and posted, if required.

4.4.3 Electrical Preparation for First Start-Up

4.4.3.1 Electrical Equipment

Before start-up, the electrical equipment should be checked for proper function with the control panel: These items are:

- Pressure switches - PSL, PSH
- Pressure transducers - PT
- Temperature Elements - TE
- Emergency Stop Circuit & Pushbuttons
- Solenoid valves

4.4.3.2 Grounding (Earthing)

It is very important that the following system modules are separately grounded:

- Container and especially the base frame of the system
- Storage vessel arrangement
- Compressor frame

4.4.4 System Preparation

4.4.4.1 Verify the Installation

Check that all parts of GreenField's Supply are erected according to the General Arrangement Drawings and Installation Manual. Check all the foundation bolts, tightening when required. However, do not torque the bolts such that the skid is twisted or put under stress.

4.4.4.2 Suction Line Cleanliness

Suction line has to be checked for dirt, rust, and welding slag. Also check the suction filter element.

4.4.4.3 Discharge Line Cleanliness

The piping between compressor and other equipment has to be blown out to make sure that the line inside is free of dirt, rust and metal shavings. Be extra careful to inspect the system (including the vent system) for water that could accumulate during installation (open fittings, open valves, etc).

**4.4.4.4 Instrument Set Up**

All instruments are pre-set. All set points should be checked again before start-up.

4.4.4.5 Electrical Connections

All interconnections between the Control Panel and compressor skid must be verified for proper connection and tightness (refer to Electrical Installation Drawings).

4.4.5 Compressor Preparation

The following procedures are usually done at the assembly facility and are not required at the installation site. However, they must be carried out before the first start-up:

- Wash the cylinder heads, valves, and cylinder with petroleum*.
- Remove cylinder heads and valves*.
- Check liners and valves for rust and dirt*.
- Assemble valves, cylinder heads and piping*.
- Fill the compressor crankcase with lubricating oil. (See oil recommendation in the Section Safety Instructions).
- Fill chambers of the mechanical seal with oil (see corresponding Section in the Compressor Manual).

*Must be carried out only if the compressor was delivered more than six months prior to start-up.

4.4.6 Purging the System

Since some compressed gases are flammable, it is necessary to purge the system with nitrogen. Contact the GreenField factory for details.

4.4.7 Starting the Compressor System

Before starting, open the manual isolation valve of the low bank tube. The following steps must be carried out afterwards:

1. Start the compressor for a very short time (maximum five seconds) and check the rotation. Refer to the arrow on compressor crankcase (change motor direction if necessary). If the rotation is wrong, no oil pressure will build up.
2. Start the (primary) compressor. The secondary compressor (if installed) should still be in the “off” position.
3. During compression, check the piping for leaks.

4.4.8 Verify all Safety Functions

The following checks must be carried out:

1. *Emergency Stop:* While the compressor is running, push the “Emergency Stop” button. The complete system should shut off and the storage should be isolated. The ESD Valves (Emergency Shutdown System, if installed) should close the flow from storage to the dispenser.



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5. OPERATING

5.1 COMPRESSOR OPERATING

GreenField's compressors can be used for continuous or intermittent operation.

Short operational periods (less than 15 minutes) are potentially damaging to the machine and should therefore be avoided. Very short working periods and long standstills may provoke the formation of rust in the high pressure stages, since the machine will not reach its operation temperature in such a short time.

To prevent any formation of rust in the compressor, a period of non-use for more than one week should be avoided. By starting up once a week, the mechanical seal chambers will be flooded with oil and therefore a better tightness to atmosphere is obtained. A weekly start-up is essential to prevent any harm to the mechanical seal. If a compressor must be left idle for a long period, it must be preserved in a described method as per section 8.0 (Packing and Storage).

The GreenField compressor is a rugged machine, however a minimum of care, checks and controls are necessary.

The recommended checks and controls are detailed in the Compressor Description and Maintenance section 6.0, and must, under all circumstances, be adhered to.

Any kind of contamination either in the process gas or in the ambient air may be damaging to the compressor and can diminish running life of individual components or the compressor considerably.

Refer to the explanations concerning the functioning of the automatic condensate draining system in Section 2.0. The mentioned condensate draining intervals are standard figures and should be checked and adjusted to the respective local conditions. Non-functioning of the condensate draining system can create great damages to the compressor.

5.2 COMPRESSOR STATION OPERATING

5.2.1 ATTENDANT DAILY REQUIREMENTS

Please report any concerns outlined in this section to your local Service Technician.

Daily or Once Per Shift:

1. Circle the compressor station once per day when the compressor is running and not running. Report any observed conditions that are abnormal or of concern (i.e., unusual noises, leaks, sound of gas escaping, etc.)
2. Check the compressor control panel for fault lights and/or LCD read-out.

Specific Compressor Information:

Check the compressor control panel daily for faults: Is alarm light on?

Note: A red malfunction light normally indicates a compressor problem. In this case, the system must be reset before normal operation can continue.

With the Compressor Running:

Normal indication on the Control Panel is:

White	“Power On” Light
Green	“Compressor Run” Light

With the Compressor Shutdown and Normal:

Normal indication on the Control Panel is:

White “Power On” Light
Flashing Green “Compressor Ready” Light

Any Other Light Status Indicates a Potential Problem.

The table below lists potential compressor faults and action required.

Compressor Fault	Action Required
ESD Alarm	Reset
Low Enclosure Temperature	Reset Compressor – Call for service if condition persists
High Enclosure Temperature	Reset Compressor – Call for service if condition persists
High Discharge Temperature	Reset Compressor – Call for service if condition persists
High/High Discharge Temperature	Call for Service
High Discharge Pressure	Call for Service
High Oil Temperature	Call for Service
Low Oil Temperature	Call for Service
Low Oil Pressure	Call for Service
Gas Detection (Optional)	Call for Service
Bad Pressure Signal (Discharge, Low, Mid, High Banks)	Reset Compressor

Engine Fault	Action Required
High Water Temp	Call for Service
Low Coolant Level	Top off coolant – Reset Compressor – Call for service if condition persists

Low Oil Pressure	Call for Service
Low Oil Level	Top off oil – Reset Compressor – Call for service if conditions persist
Engine Over speed	Call for service
Engine Crank Fault	Call for service
Engine Governor Fault	Call for service
High exhaust gas alarm (Optional emissions control)	Refer to manufacturer's literature in section 10
High exhaust gas shutdown (Optional emissions control)	Refer to manufacturer's literature in section 10

Each of the conditions noted above is identified on the Control Panel by a flashing red light with fault condition displayed on LCD panel.

5.2.2 Emergency Shutdown Button Information.

1. If the emergency shutdown button is pushed or activated, the compressor will not operate.
2. After determining the circumstances that caused the ESD to be activated, contact your local Service Support as above to report the incident and receive further direction.

ESD or Alarm Reset:

- ESD or Compressor alarms can be reset at the Control Panel.
- Ensure that safe resetting of the station can take place.
- Contact your local Service Technician to discuss the alarm status before resetting, if in doubt.
- Ensure that all ESD buttons are not engaged.
- Ensure Compressor stop/start switch is in start position.
- If a red light is flashing, identify fault on LCD panel.
- Depending on fault,
 1. *Push reset button on start system, or*
 2. *Contact Service Technician for keyed reset after fault correction.*
- The compressor will start if operating conditions are met.

5.2.3 NOT APPLICABLE

5.2.4 NOT APPLICABLE



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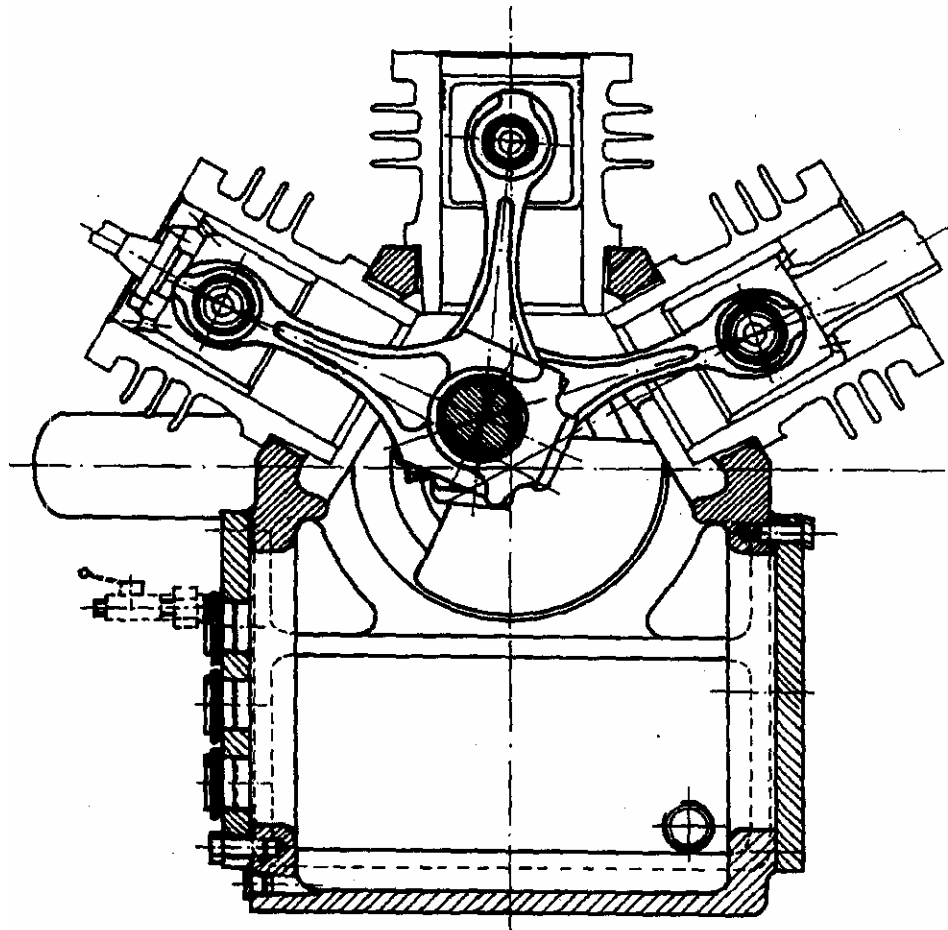
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6.0 COMPRESSOR DESCRIPTION AND MAINTENANCE

6.1 CRANK CASE

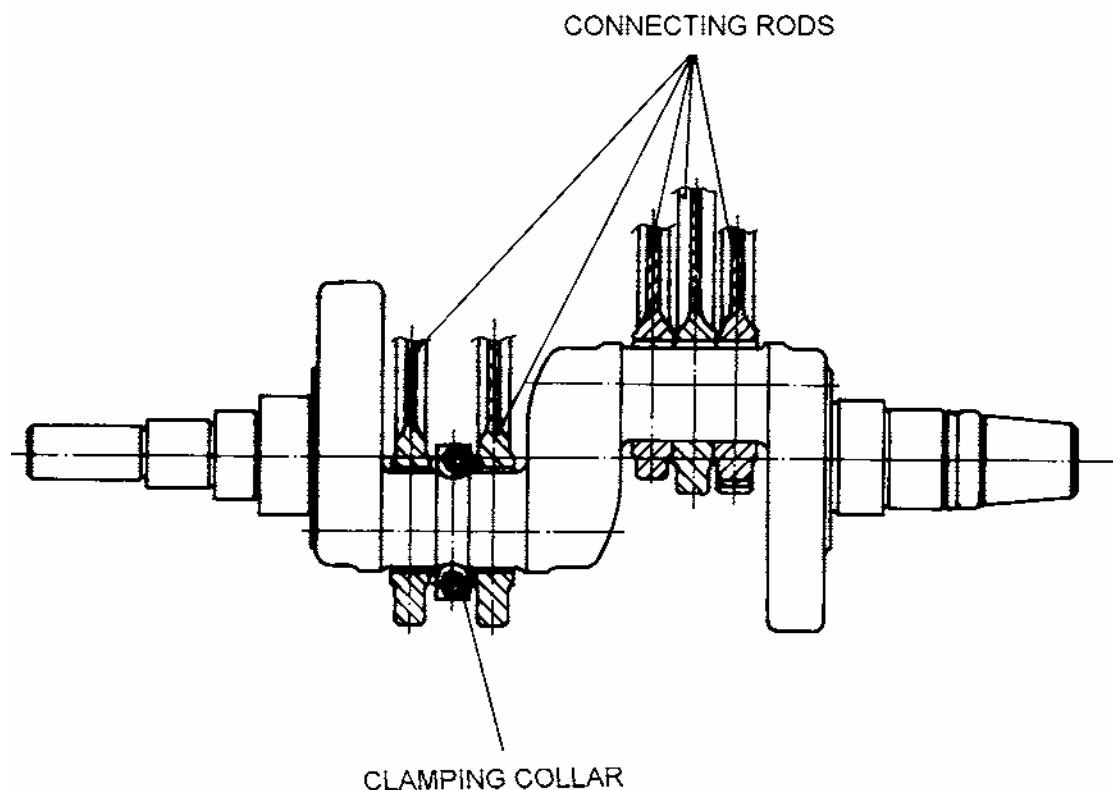
The crank case consists of an oil tight casing, which contains the oil reservoir in the bottom part and the actual moving parts, the crankshaft with its bearings and connecting rods are in the upper part.

There are two lateral crank casing covers for checking the crank pin bearings and other moving parts.



6.1.1 Crankshaft

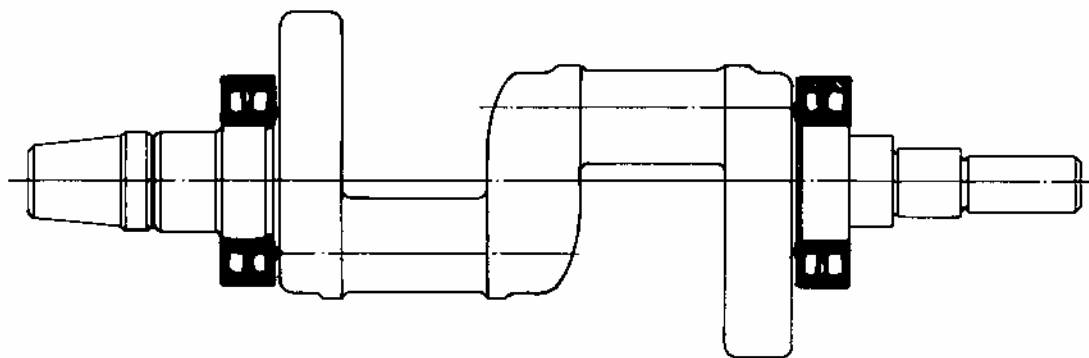
The crankshaft has two cranks and machined crank bearing surfaces for the assembly of six connecting rods. Depending on the compressor type, it may be necessary to close the oil outlets on the crank bearing surfaces (which are not covered by connecting rods) with a clamping collar.



6.1.2 CRANKSHAFT BEARINGS

The crankshaft bearings, consisting of self-aligning roller bearings, are situated on either side of the crankshaft. Before mounting, heat bearings in an oil bath, or on a stove plate, to a temperature between 100° and 120° C. The bearings do not need any service.

Exchanging the crankshaft assembly should always be done as a complete unit consisting of crankshaft, distance ring and roller bearings.



6.1.3 Crankshaft seals

6.1.3.1 Crankshaft Seals Description

The execution of the crankshaft seals for pressure tight service incorporates:

- Slide ring packing on both sides of crankshaft
- Bearing mounts

6.1.4 CONNECTING RODS

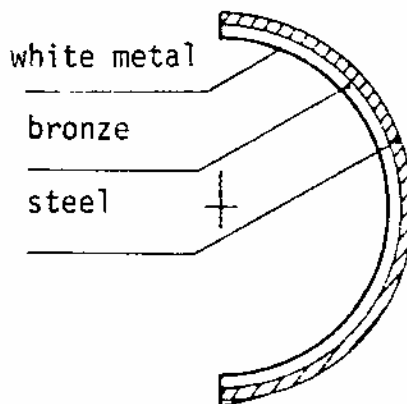
The connecting rods are of spherical cast iron. There are two parts on the crankshaft side for containment of the crank pin bearing.

Upper and lower connecting rod components and the appropriate connecting rod bolts are marked and must not be exchanged under any circumstances.

6.1.5 Crank Pin Bearing Description

One pair of bearing shells (upper shell and lower shell) form a complete crank pin bearing.

The shells are made of steel, serving as the supporting structure of the bearing surface. The bearing surface is made of a thin plating of white metal, which is sprayed on top of a bronze coating by a galvanic process.



Important Characteristics

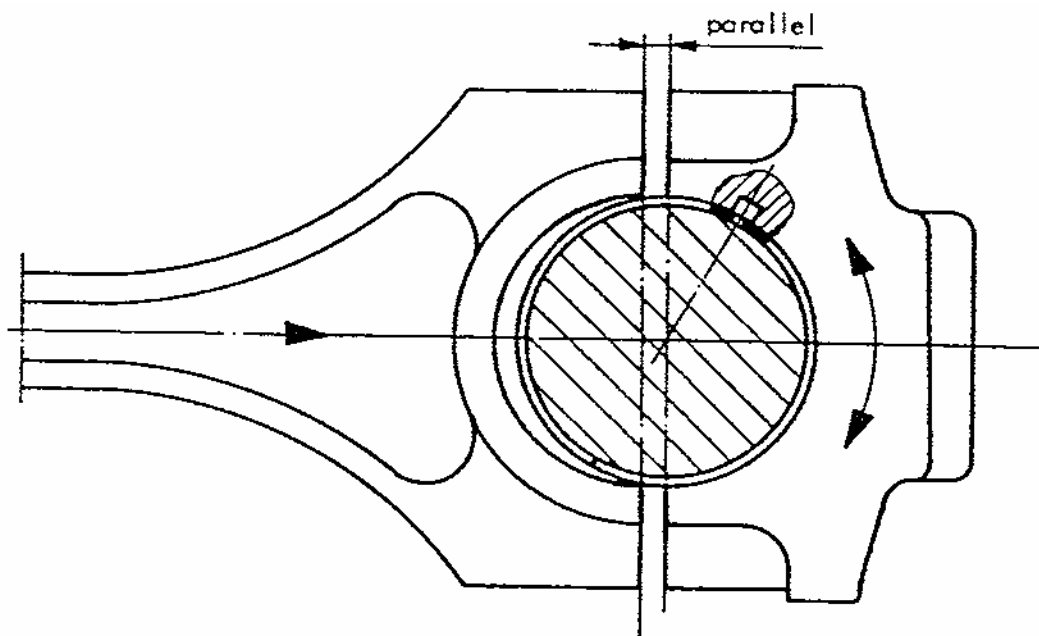
- As the white metal plating is very thin, it is not admissible to scrape the shells.
- If two shells have once been put into operation together, from then on they have to remain an inseparable pair.
- Only fit shells belonging together if they can be reused, i.e. after revision,
- Never replace only one shell of a pair. If replacement is necessary always fit a new pair of shells.

Mounting of Bearing Shells

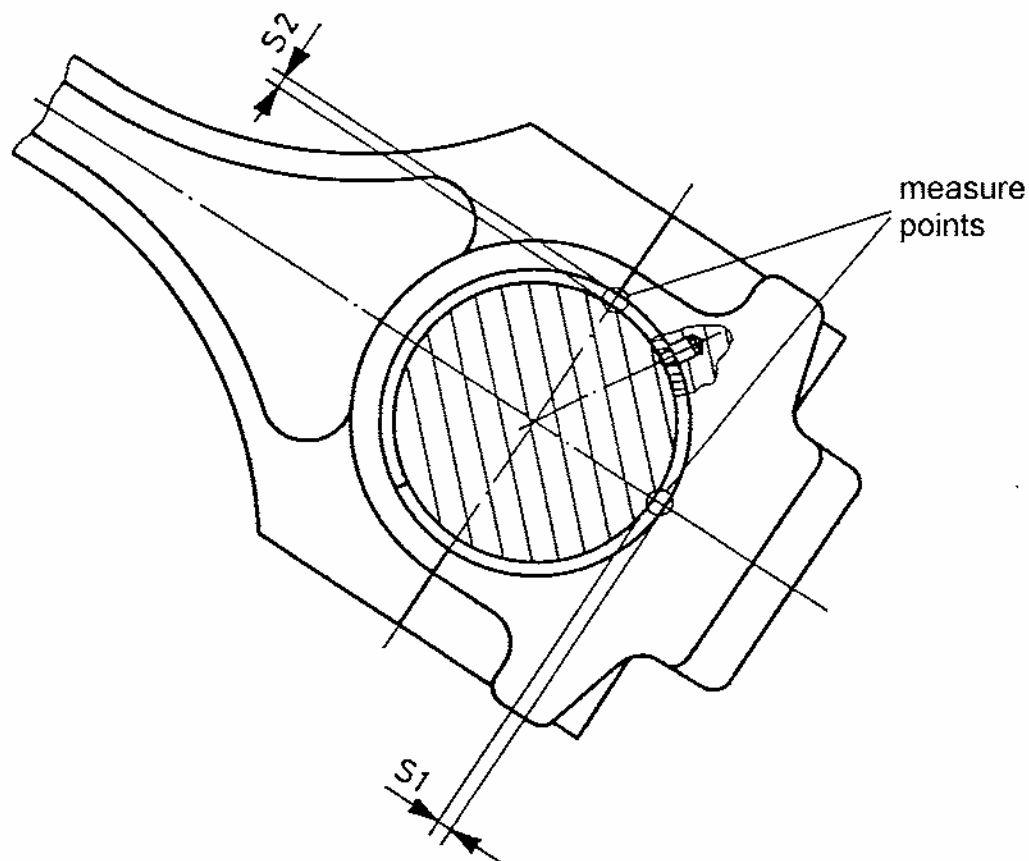
- Only fit shells in pairs.



- Check shells and bore of connecting rod for smooth surfaces and sharp or damaged edges. If necessary, rectify.
- ***Do not scrape bearing surface of shells, there is danger of damaging the white metal coating!***
- Clean outer surface of shells and bore of connecting rod.
- Place both bearing shells around the greased crank pin.
- Mount the lower connecting rod half-first so that the pin fits in the bore of the bearing shells.
- Move connecting rod with piston slowly towards the bearing shells.
- Turn the bearing shells with the connecting rod cover by hand until the connecting rod surfaces coincide.
- ***External surfaces of bearing shells and internal surface of connecting rod bore must remain dry!***
- Carefully place connecting rod on bearing shells.
- Clean thread, contact surfaces and centering part of the connecting rod and the bolts and coat them with Molycote (no equivalent allowed).
- Apply connecting rod bolts and tap them completely by hand.
- ***Connecting rod and bolts form a unit and must not be exchanged!***
- Tighten with torque wrench to 100Nm, then loosen bolts and tighten them again with the same torque. ***Always tighten connecting rod bolts alternately!***
- Check the two bolts for the same tightening torque.



Carefully determine the bearing clearance with a feeler gauge at the checkpoints indicated in figure below:
Avoid damaging the thin white metal surface with the feeler gauge!



Replacement of shells is necessary if:

- the bronze coating is visible on the bearing surface at an angle of 90° to 120° , or
- the crank pin bearing clearances exceed the max. admissible values given below

Pos.	Clearance with new bearing shells	Maximum Admissible clearance
S1	0,06 - 0,15	0,20
S2	0,06 - 0,20	0,25

6.2 LUBRICATION ARRANGEMENT

6.2.1 Description

It is unavoidable with trunk piston reciprocating compressors that the lubrication oil comes in contact with the compressed gas or the compressed air.

The purity of the compressed gas and the cleanliness of the lubrication oil in use have a great influence to proper functioning and life expectation of the compressor. This applies especially to wearing parts such as piston rings, valve inner parts, shaft seals, etc.

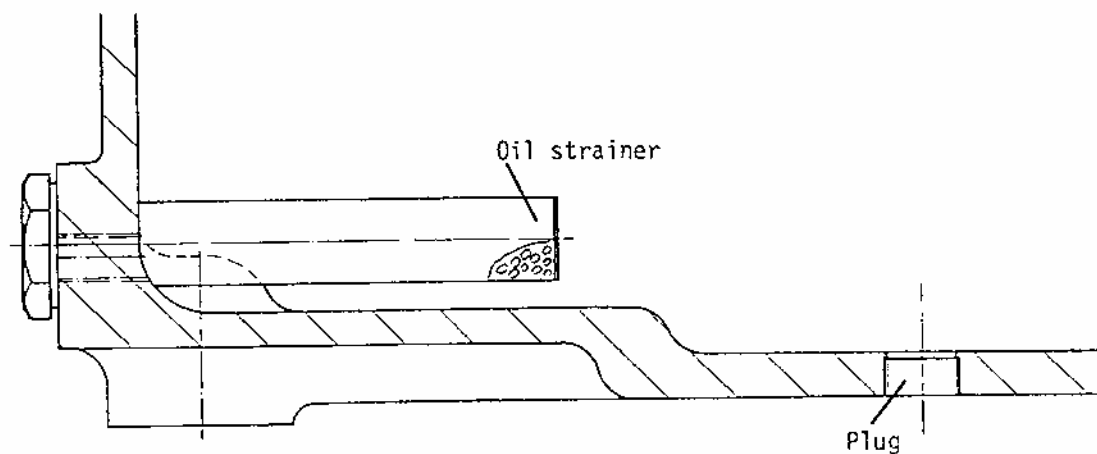
Great attention has, therefore, to be paid to the necessary procedures as laid down in the Service and Maintenance schedule.

This type of compressor is equipped with a force feed lubrication system for the crank pin bearings. The cylinders are splash lubricated by the oil which is forced out on either side of the bearings.

For details regarding the oil pipes and instrumentation, please refer to the oil system diagram.

6.2.2 Oil Strainer

The oil strainer with a mesh width of 1 mm, which is installed in the crank casing, does prevent the entry of rough residues into the oil lubrication system. It must be checked and cleaned as detailed in the Service and Maintenance schedule.

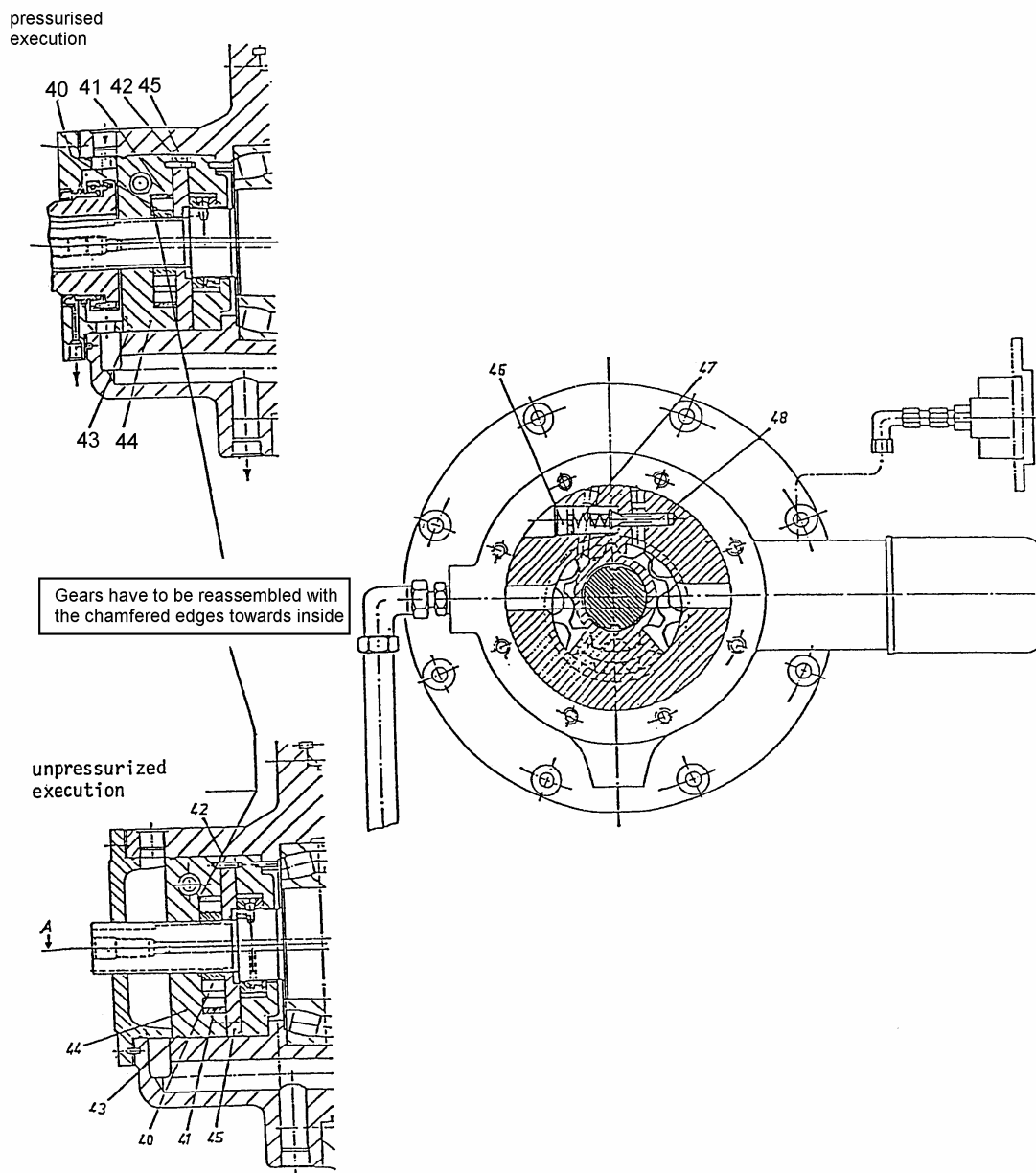


6.2.3 Oil Pump

6.2.3.1 Oil Pump Description

Oil arrives through an externally fitted pipe from the crank casing into the pump, which is an integrated part of the compressor driven by the crankshaft.

The rotating gears generate a vacuum in the intake chamber. As a result, the oil to be displaced flows into the tooth spaces, is carried around in the direction of the rotating gears and expelled into the pressure chamber. In



order to protect the lubrication pump as well as the other parts of the lubrication system against excessive pressure increase, a relief valve is mounted on the oil pump discharge.

Maintenance

The oil pump needs no special maintenance. In case the operating pressure falls below the minimum admissible value of 22 psi, check for the cause and improve (refer to section 7, Troubleshooting).

If the maximum admissible axial clearance of the gears in the pump body is exceeded (more than 0.12 mm), the entire lubrication pump has to be replaced.

6.2.3.2 Oil Pump Disassembly and AssemblyDismantling of Lubrication Pump

Prior to the dismantling of the pump, the following disassembly steps have to be carried out:

- Pressurized execution: Depressurize crankcase, then remove end cover.

Work on Lubrication Pump

- Extract the pump from shaft with extracting screws.
- Only carry out further dismantling if really necessary (i.e. when pump is fouled and blocked by dirt or rust).
- Take off pump cover Pos. 45 and extract gears Pos. 40 and 41.
- Clean all parts.
- Check condition of gears and axial clearance of gears in pump body.
- Replace O-ring Pos. 43.

Dismantling of Relief Valve

- Record the position of adjusting screw Pos.46 for set pressure adjustment at re-assembly.
- Loosen Allan-type set screw in adjusting screw Pos. 46.
- Remove adjusting screw Pos. 46 , spring Pos. 47 and valve cone Pos. 48.
- Clean all parts.
- Check condition of the valve cone and valve seat.

Assembling of Lubrication Pump

- Re-assembling of the pump has to be performed at absolute cleanliness.
- Place gears Pos. 40 and 41 in the pump body Pos. 44 with chamfered edge inside.
- Position pump cover Pos. 45 on the pump body Pos. 44 by use of the provided pins Pos. 42.
- Fix cover with screws.
- Reassemble the relief valve
- Coat O-ring Pos. 43 with oil or grease.
- Partly fill the pump with oil through suction and discharge side.
- Carefully mount pump on shaft with centring pin Pos. 42 giving the correct position.

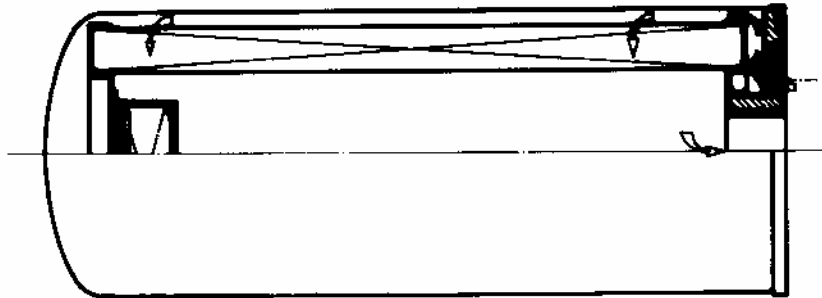


Attention! The feather-key on the crankshaft is to be positioned with key-way of pump gear. Slight knocks on pump body with a plastic hammer overcome possible tilting of pump.



Filter element

Gasket



6.2.4 OIL FILTER

Technical Data

Max. operating pressure: 362 psi
Temperature range: -40 °F to +248 °F
Fineness: 10 ppm

Materials

Housing: Steel
Gaskets: Perbunan
Filter element: Organic paper

Mounting of Filter

- Apply oil and grease onto gasket.
- Screw in filter until gasket touches sealing face of crank casing.
- Tighten filter by applying one more revolution.
- Start compressor.
- Check sealing of faces, if necessary re-tighten filter.
- Check oil level.



Attention! When exchanging filters, only use original filters with installed non-return valve.

- Strictly follow the intervals for oil change and oil-filter change.
- Change oil filter also at each oil change.
- Never reuse “cleaned oil filters”.
- Run compressor with new oil filling and new oil filter after each change of cylinders and piston rings. Oil change and oil filter change are necessary after further 100 running hours.
- Keep enough oil filters on stock.
- Use original oil filters only.



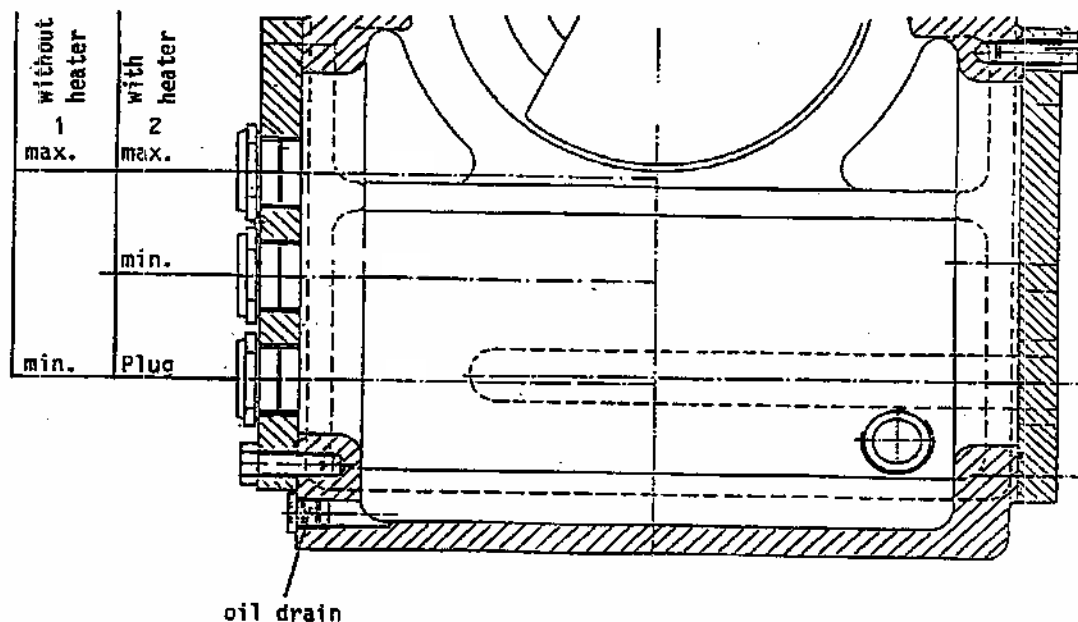
6.2.5 Oil Pressure Gauge

The pressure gauge housing is filled with glycerin to prevent the transfer of any vibrations through to the manometers in order not to destroy the index needle system. At start up in cold ambient conditions, a pressure rise above normal oil pressure is possible. Within a short operating period, the operating temperature will be reached and the expected oil pressure will arrive.

6.2.6 Oil Pressure Switch

The oil pressure switch controls the oil pressure initiated by the integral lubrication pump. The oil pressure switch has been set at the minimum allowed oil pressure. If the oil pressure fails below the set pressure, the compressor will be shut off automatically.

6.2.7 OIL LEVEL, OIL DRAINAGE, OIL SIGHT GLASS



<u>Oil content CU:</u>	Maximum oil level	10 gallons
	Minimum oil level	3 gallons/6 gallons with heater
<u>Oil content CT:</u>	Maximum oil level	21 gallons
	Minimum oil level	8 gallons/14 gallons with heater

At initial commissioning and at re-commissioning after a major repair, we recommend filling in minimum quantity of oil + 1 gallon, as the oil has to be drained after 100 hours operation. For lubricants, please refer to the recommended list of lubricants.



Use only lubricants recommended in Section 1.3.



Attention! At each oil change, the oil filter must be changed and the oil sump and the oil strainer must be cleaned.

6.2.8 Pair of Oil Distributing Rings

Oil distributing rings ensure the transport of the pressurized oil into the crankshaft. At the same time, the rings seal towards the pump, as well as the crank casing side.

Dismantling

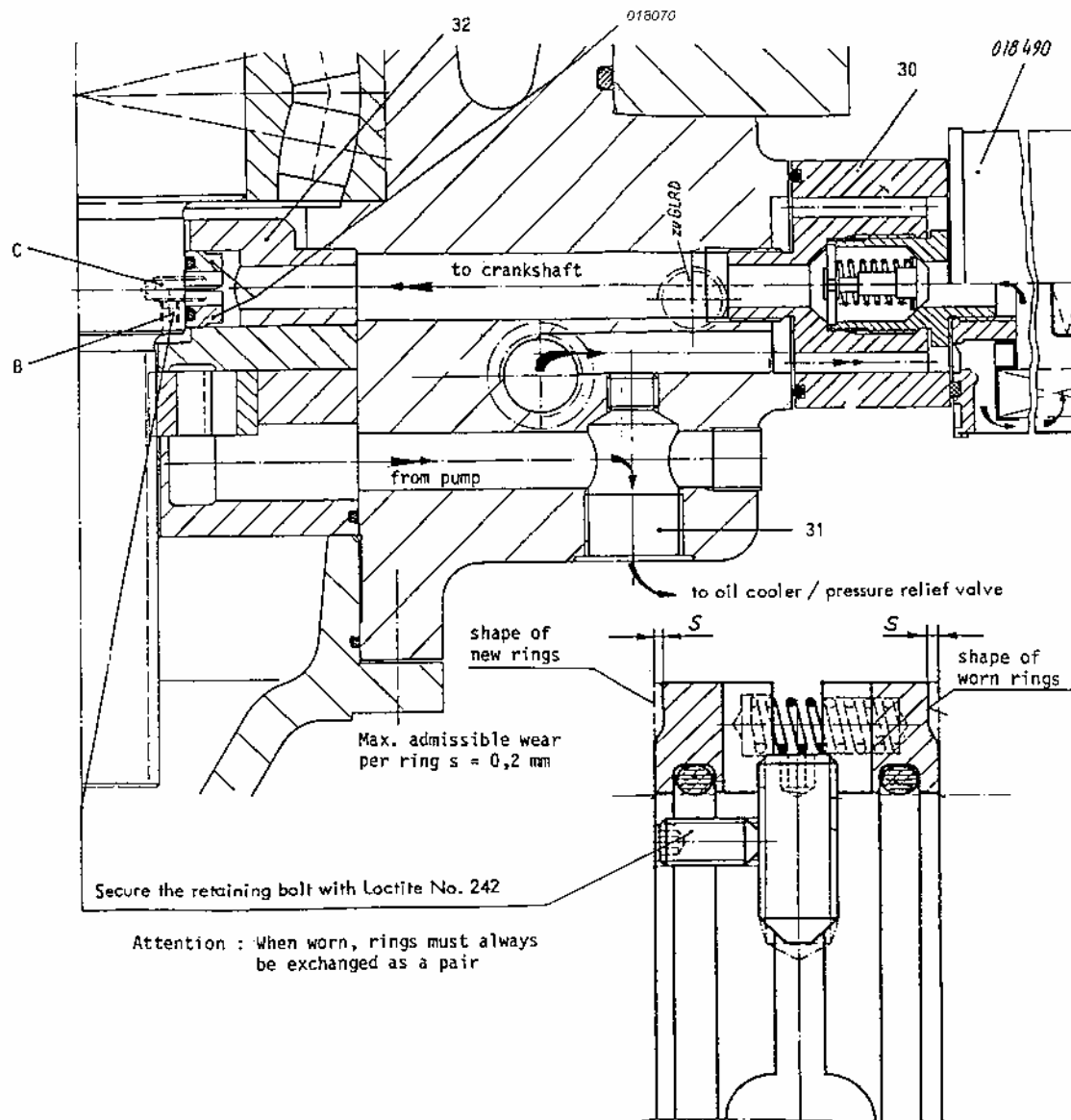
- Remove oil pump as per Section 6.2.3.2.
- Remove safety thread pin Pos. B which is secured with Loctite .
- Remove oil filter Pos. 291.
- Remove non-return valve.
- Driver screw Pos. C to be removed with special alloy key.
- Remove oil distributing ring 288 and distance piece 286 with extraction screws.
- Clean all parts.
- Check condition of seals and contact faces of each ring and measure wear.

If maximum admissible wear of 0.2 mm has been reached, exchange pair of oil distributing rings.

Assembly

The re-assembly of the oil distributing rings must be carried out under absolute cleanliness.

- Fit distance piece Pos. 286 in the housing. The locating ring ensures the correct position.
- Grease seal and contact faces of oil distributing rings Pos. 288.
- Grease O-rings.
- Mount back-ring with deep spring-holes onto shaft.
- Mount driver screw Pos. C.
- Assemble and secure safety thread pin Pos. B with Loc-tite.
- Mount springs.
- Mount front ring and apply control pressure to ensure functioning of springs and correct position.
- Mount screw plug Pos. 297 and seal with PTFE sealing band.
- Fit oil filter.
- Fit oil pump.



6.2.9 OIL REFILLING

The compressor has to be shut off for oil refilling, and the pressure in the crankcase has to be vented to atmospheric pressure. Then isolate the suction and discharge side of the compressor.

If you are sure that there is no over pressure in the crankcase, disconnect the ventilation pipe from the crankcase. The oil has to be filled through an oil filling funnel while opening the upper bleed valve to allow the existing air to escape.

If refilling of oil is necessary during operation (i.e., for continuous operation), a special device is needed and can be supplied by GreenField.

**6.2.10 OIL CONSUMPTION****6.2.10.1 Compressor Oil Consumption**

At average ambient and operating temperatures (approximately 77 °F) approximately 0.5 to 1.2 g/kWh or less than 1 ppm will be consumed.

When top value is exceeded, look for cause. Refer to Section 7, Troubleshooting.

6.2.10.2 Mechanical Seal Oil Consumption

The maximum allowable leak oil rate per seal side is approx. 6 drops/min. = approx. 0.2 l/24 hr.

When this rate is exceeded, the pressure ring, seal ring with pin and the O-rings have to be replaced. See section 6.1.3.2.

Replacement of mechanical seal, see section 6.1.3.3.

The leak oil rate can be checked in the plastic bottles situated at the base frame.

6.2.11 Oil Rise

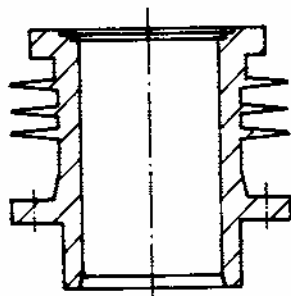
To determine in which stage the high oil consumption is (i.e., due to worn piston rings, worn cylinder), all cylinder heads and valves have to be removed. For gas compressors, isolate suction as well as discharge side and operate compressor with air for 5 – 10 minutes.

Under normal circumstances, a few drops of oil will appear on the piston head only. If oil is splashing out, except when cylindrical piston rings are used, the respective cylinder has to be removed and the cause for the splashing must be determined.

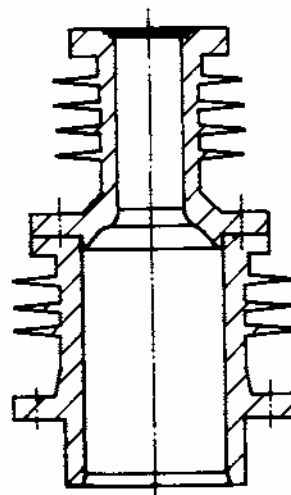
The rectangular rings have an increased oil rise during the running-in period, however, after a few operating hours, these rectangular rings will be “run-in”, and the oil rise will stabilize under operating pressure.

6.3 CYLINDER**6.3.1 CYLINDER DESCRIPTION**

The cylinders are made of grey cast iron and assembled to the crankcase with hexagonal screws. The cylinders for pistons between diameters 100 and 35 mm are made of two parts. They consist of the guiding cylinder and the compression cylinder. The cylinders for pistons above 100 mm diameter are made in one part.



CYLINDERS OF DIAMETER
105 TO 225 mm

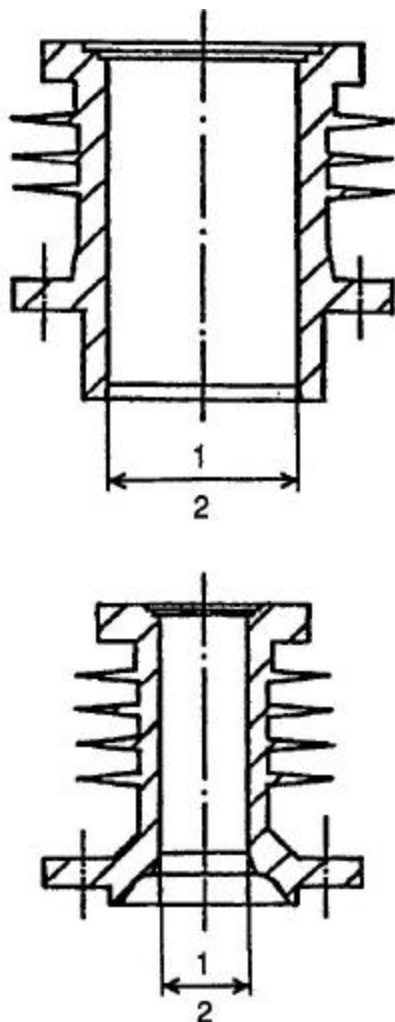


CYLINDERS OF DIAMETER
35 TO 100 mm

6.3.2 Cylinder Maintenance

When disassembling the cylinders, replace the gaskets and O-rings at the same time. In case running faces of cylinders show deep longitudinal marks, which could be the reason for an abnormal oil consumption, the cylinders should be machined, and honed, observing maximum allowable bore sizes as per enclosed tolerance table.

Tightening moments for various screws can be found in section 1.5, Tightening Prescriptions for Screws and Nuts.



CU Compressor		
New Part		Max Wear
Ø 165	+0.046 - 0.0	Ø 165.35
Ø 140	+0.040 - 0.0	Ø 140.32
Ø 125	+0.040 - 0.0	Ø 125.29
Ø 110	+0.035 - 0.0	Ø 110.26
Ø 100	+0.035 - 0.0	Ø 100.24
Ø 90	+0.035 - 0.0	Ø 90.22
Ø 80	+0.030 - 0.0	Ø 80.19
Ø 70	+0.030 - 0.0	Ø 70.17
Ø 60	+0.030 - 0.0	Ø 60.15
Ø 50	+0.025 - 0.0	Ø 50.13
Ø 45	+0.025 - 0.0	Ø 45.12
Ø 42	+0.025 - 0.0	Ø 42.11
Ø 35	+0.025 - 0.0	Ø 35.10
Ø 32	+0.025 - 0.0	Ø 32.09
Ø 28	+0.025 - 0.0	Ø 28.08
Ø 25	+0.025 - 0.0	Ø 25.07
Ø 20	+0.025 - 0.0	Ø 20.06

CT Compressor		
New Part		Max Wear
Ø 225	+0.046 - 0.0	Ø 225.40
Ø 200	+0.046 - 0.0	Ø 200.40
Ø 170	+0.040 - 0.0	Ø 170.35
Ø 160	+0.040 - 0.0	Ø 160.32
Ø 155	+0.040 - 0.0	Ø 155.30
Ø 150	+0.040 - 0.0	Ø 150.30
Ø 140	+0.040 - 0.0	Ø 140.30
Ø 130	+0.040 - 0.0	Ø 130.26
Ø 125	+0.040 - 0.0	Ø 125.25
Ø 105	+0.035 - 0.0	Ø 105.21
Ø 100	+0.035 - 0.0	Ø 100.20
Ø 90	+0.035 - 0.0	Ø 90.18
Ø 75	+0.030 - 0.0	Ø 75.15
Ø 65	+0.030 - 0.0	Ø 65.13
Ø 58	+0.030 - 0.0	Ø 58.12
Ø 55	+0.030 - 0.0	Ø 55.11
Ø 50	+0.025 - 0.0	Ø 50.10
Ø 43	+0.025 - 0.0	Ø 43.10
Ø 40	+0.025 - 0.0	Ø 40.10
Ø 35	+0.025 - 0.0	Ø 35.10
Ø 32	+0.025 - 0.0	Ø 32.10
Ø 30	+0.025 - 0.0	Ø 30.10



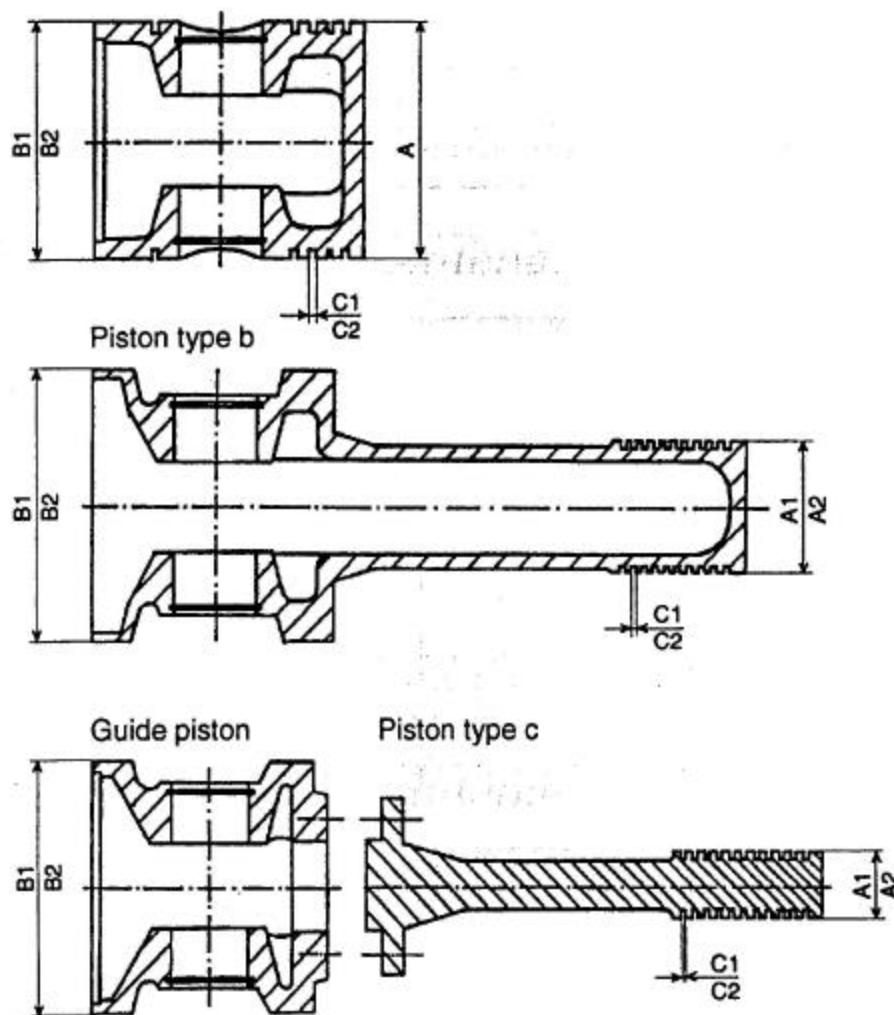
6.4 PISTONS AND PISTON PINS

Depending on the piston diameter, there are three different piston types as shown below.

The piston pins are made of hardened steel. Pistons showing heavy longitudinal marks (seizing marks) or having deflected ring grooves, must be replaced. Fine or slight marks may be removed with polishing cloth. The piston pin must be free of any marks (for maximum allowable wear, please refer to Specification table enclosure).

When fitting or removing piston pins, the pistons must be heated in an oil bath or a stove to about 176 °F, after having removed the Seeger circlips. In this hot condition, the piston must be suitably placed so that the piston pin can be removed or fitted by light blows with a piece of hard wood.

Adjusting of bores is easily achieved by an assembly pin with a diameter of 0.2 – 0.3 mm smaller than the bore.





Under no circumstances should the piston be clamped between jaws during assembly.

CU Piston Type A					
A		B		C	
1	2	1	2	1	2
165	164.3	165	164.45	3.5	3.58
140	139.3	140	139.5	3.5	3.58
125	124.3	125.	124.55	3.5	3.58
110	109.4	110	109.6	3	3.08

CU Piston Type B					
A		B		C	
1	2	1	2	1	2
100	99.6	125	124.74	3	3.08
90	89.62			3	3.08
80	79.64			3	3.08
70	69.66			3	3.08
65	64.67			3	3.08
60	59.68			2.5	2.58
50	49.7			2.5	2.58
45	44.72			2	2.05
42	41.74			2.5	2.58
35	34.82			2.5	2.55
32	31.82			2.5	2.55
28	27.82			2	2.05
25	24.82			2	2.05
20	19.84			1.5	1.55

CT Piston Type A					
A		B		C	
1	2	1	2	1	2
225	224.3	225	224.5	5.028	5.08
200	199.4	200	199.5	4.028	4.08
170	169.4	170	169.6	4.028	4.08
160	159.4	160	159.6	3.528	3.58
155	154.4	155	154.6	3.528	3.58
150	149.4	150	149.6	3.528	3.58

CT Piston Type B					
A		B		C	
1	2	1	2	1	2
140	139.65	170	169.6	3.522	3.58

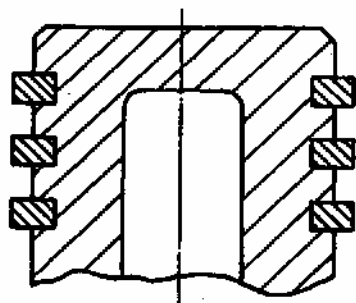
CT Piston Type B					
A		B		C	
1	2	1	2	1	2
130	129.65	170	169.6	3.522	3.58
125	124.65	170	169.6	3.016	3.08
105	104.65	170	169.6	3.016	3.08
100	99.65	170	169.6	3.016	3.08
90	89.65	170	169.6	3.016	3.08
75	74.65	170	169.6	2.516	2.58
65	64.65	170	169.6	2.516	2.58
58	57.65	170	169.6	2.516	2.58
55	54.65	170	169.6	2.516	2.58
50	49.65	170	169.6	2.516	2.58
43	42.65	170	169.6	2.516	2.58
40	39.65	170	169.6	2.516	2.58
35	34.65	170	169.6	2.016	2.08
32	31.65	170	169.6	2.516	2.58
30	29.65	170	169.6	2.516	2.58

1. Dimension of new part
2. Max allowable wear

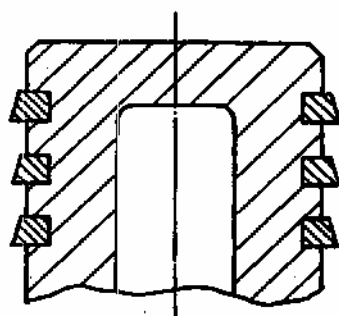
6.5 PISTON RINGS

The pistons rings, of special cast iron, have a conical contact surface, except for diameters 20 and 25 mm. The piston rings act as oil scrapper rings, as well.

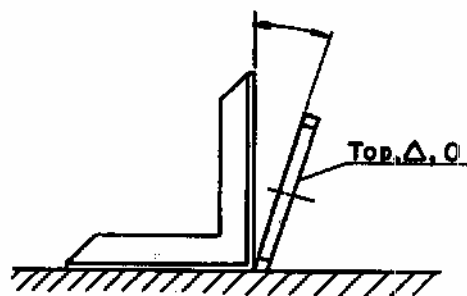
The upper side marked with either top, Δ , or O has to be turned towards the cylinder head.



PISTON RINGS OF DIAMETERS
20 and 25



PISTON RINGS OF DIAMETERS
28 to 165



Before mounting new rings slightly deburr edge of new piston rings with fine emery cloth.

Great care has to be taken for fitting rings. Please follow procedure as follows. Special attention has to be paid to the fitting of the cylinders because damaging of rings and cylinders will result in additional problems.

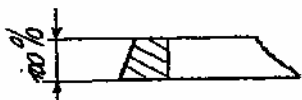
New conical shaped rings should, after a few running hours, only show running in marks at the bottom.

Prior to re-assembly, after checks or revisions, the old piston rings must be checked for wear and, if necessary, be replaced. At the same time butt clearance has to be checked, as this has direct influence on the oil consumption.

Attention! Prior to fitting new rings, butt clearance off new rings must be checked in the corresponding cylinder.

Judgement of Piston Ring Condition

Criteria 1 - "Ring Height"

<i>Ring Condition</i>	<i>Sketch</i>	<i>Surface</i>	<i>Disposition</i>
New		-----	Useable
Worn 50%		Smooth	Useable
		Light Scratches	
		Heavy Scratches	Replace
Worn 100%		Smooth	Check Radial Thickness by Sheet 484 525/76
		Light Scratches	
		Heavy Scratches	Replace

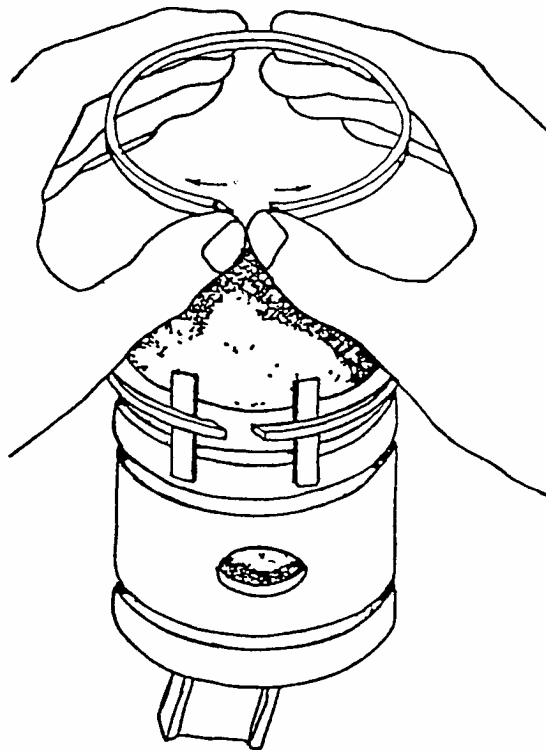
Criteria 2 - "Radial Thickness"

Valid for Beveled rings work > 100% of ring height and for rectangular rings.

Surface Condition	Used radial thickness See sheet 484 525/76	Disposition
Smooth/Light Scratches	Within limit	Useable
	Limit Exceeded	Replace
Heavy Scratches		Replace

Mounting of Piston Rings

For the mounting of self-adjusting piston rings of special cast iron, special piston ring tools should be used. If not available, rings can be fitted using fingers or some flat steel shims, spaced evenly around the perimeter of the piston. The shims must be long enough to span all grooves, thus preventing the rings from snapping into every groove.



Mounting with shims resp. by hand



Mounting with piston ring pliers

For fitting, the ring ends must be spread apart carefully. Shift the joints of the different rings so that no lining-up occurs, the best offset being 90 degrees.

Deformed piston rings will show irregular traces after a few service hours.



Attention! To prevent any possibility of damaging cylinder wall surface during running-in period, edges of piston rings must be smoothed with fine emery cloth or “sharpening stone”.

RUNNING-IN PROCEDURE FOR CYLINDERS AND PISTON RINGS

Application

For newly installed or repaired compressors, in which cylinders and/or piston rings have been replaced.

Applicable for all compressors with ambient suction pressures.

Running-in Procedure

- Run the compressor 2.5 hours unloaded (cylinder heads and valves removed). The cylinders can be covered with plastic covers.

-

Check Oil Rise

- Mount valves, cylinders and pressure lines 1st stage and run the compressor for 0.5 hrs with air (blowing out).
- Repeat this procedure up to the last stage.
- Run the compressor under pressure as described below.
- Install inlet filter (10 µm)
- Run the compressor in four stages with final pressure (manual valve), 1 hour per stage. For example, 725 psi / 1450 psi / 2900 psi.



Attention! It is dangerous and not permitted, to run the compressor with air in a closed circuit.
(Explosive oil-/air mixture)

6.6 SUCTION AND DISCHARGE VALVE

The proper functioning of valves is essential for compressor performance. The designed valve lift has been based on calculation and experience and under no circumstances be changed without permission from the manufacturer.

Valve failures can be classified as follows

1. Wear and fatigue.
2. Abnormal mechanical action.
3. Wear or damage due to foreign materials.

For acceptable performance of valves, it is vital to:

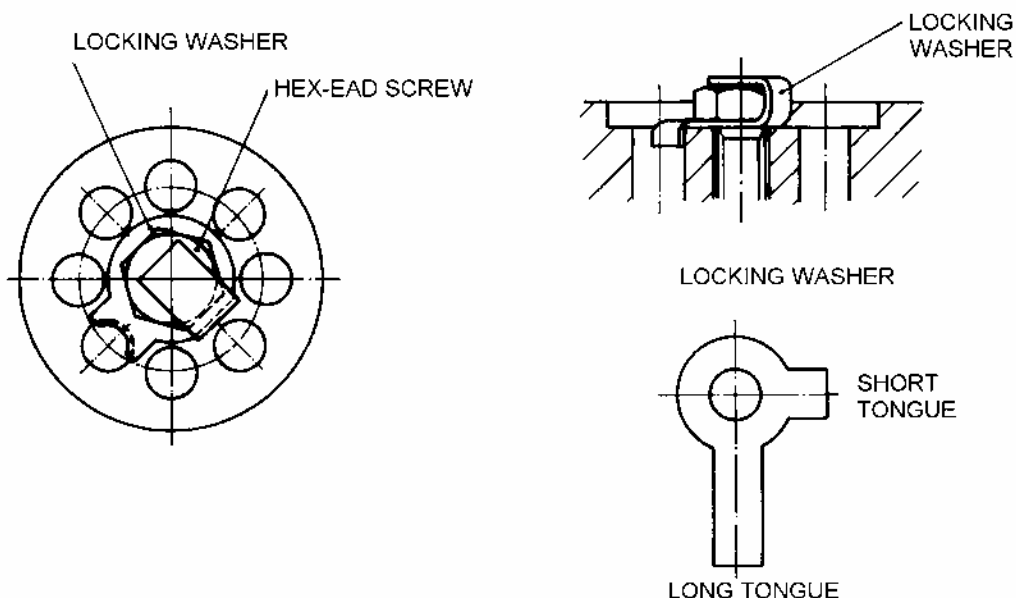
1. Eliminate liquid carry-over (ensure and test proper functioning of condensate draining system).
2. Eliminate dirty gas and watch cleanliness during maintenance and repair.
3. Ensure proper lubrication.
4. Keep systematic records of valve failures.
- 5.

Important hints for reconditioning of valves

- Clean with safety solvent using a soft wire brush on all non-seat parts.
- Use a bristle brush on valves and seating surfaces.
- Avoid scratching, nicking or dropping any parts.
- Replace valve parts such as springs, valve plates when inspection shows they are worn. Do not wait till they break.
- Do not put new valve parts on worn seats.
- Resurface seat if worthwhile by grinding and lapping using fine grinding paste.
- Do not alter the valve lift.
- Clean thoroughly with safety solvent before re-assembly.
- Oil well all parts for re-assembly.
- Do not apply too much force with tightening screw.
- Secure hex-head screw with locking washer.
- Record observed damages of exchanged parts.

Fitting and locking of valve screw

- The two parts of the valve are held together by a hex-head screw, which itself is secured by a locking washer. The locking washer serves at the same time as a valve sealing.
- While assembling, the hex-head screw must be strongly tightened by hand with the help of a suitable spanner but without any elongation.
- The one tongue of the locking washer must be bent downwards into one of the above indicated valve-openings.
- The other tongue must be bent upwards along a hexagon and, if still long enough, over the screw head.
- Whether the short or the long tongue is bent into the valve-opening depends on the dimension of the valve.



6.7 CHECKING AND MAINTENANCE

6.7.1 SAFETY PRECAUTIONS FOR MAINTENANCE



Safety should always be paramount in operation and maintenance.

The following are basic rules:

- 1) Before attempting any maintenance, be certain the compressor cannot be started accidentally.
- 2) Tag the switch and then pull the fuses or disconnect.
- 3) Blow down the condensate receiver and all intercoolers and aftercoolers.
- 4) Isolate the compressor.
- 5) Tag the shut-off valve.
- 6) Be certain there is no pressure in the machine before opening.
- 7) On a reciprocating unit, loosen (do not remove) all nuts on a cylinder head.
- 8) Pry it loose so that any trapped gas may escape.
- 9) Always use a safety solvent for cleaning compressor parts and dry them thoroughly before replacing.
- 10) If a safety valve blows during operation, stop the unit immediately and determine the cause. An intercooler safety valve will blow when there is unusual leakage in the higher-pressure stage.
- 11) Any blowing safety valve indicates trouble somewhere.
- 12) The following work must only be done after decompressing the compressor and isolating suction and discharge side:
 - a) purging of compressor
 - b) refilling or draining of lubricating oil
 - c) any checks on pressurized parts

d) any service or repair work or exchange of parts.

- 13) When draining liquid from condensate collector tank, draining valve is to be opened carefully as collector tank may be under pressure.
- 14) Any inspection, service or repair work must be carried out by experienced personnel.
- 15) Read the instruction manual.

6.7.2 Checking and Maintenance Plan

The intervals for control and overhaul work given in this instruction manual, are based on experiences over years and proved to be adequate. They are valid in the assumption that installation, function and operation of the compressor are correct as well as a clean gas is present, as per our general conditions of supply and our operating instructions. Adaptations to the life duration of wear parts can become necessary due to the operating conditions/manner/ambient conditions, etc. depending on the experiences of the user.

CU/CT COMPRESSOR - CHECKING & MAINTENANCE PLAN						
Recommended Checks	20 Hours	Weekly	100 Hours	Every 3000 Hours or Once/Year	10000 Hours	20000 Hours
Tighten all cylinder head screws (machine in standstill condition, still warm)	x					
Check/re-tighten V-belts	x					
Log running hours		x				
Drain reservoirs		x				
Check oil level		x				
Check oil consumption		x				
Check leak rate of crankshaft seals		x				
Check oil contamination		x				
Check suction and interstage pressures and temperatures		x				
Check condensate draining system		x				
Exchange motion work oil			x	x	x	x
Exchange oil filter and clean discharge check valve			x	x	x	x
Clean motion work oil strainer			x	x	x	x
Check for contamination in diaphragm valves			x	x	x	x
Check oil rise in cylinders			x	x	x	x
Clean/exchange the suction filter element as required				x	x	x
Check of all flexible hoses for signs of deterioration and/or damage and replace if necessary				x	x	x



COMPRESSOR DESCRIPTION AND MAINTENANCE

SECTION 6

CU/CT COMPRESSOR - CHECKING & MAINTENANCE PLAN

Recommended Checks	20 Hours	Weekly	100 Hours	Every 3000 Hours or Once/Year	10000 Hours	20000 Hours
Check the functioning and tightness of the relief and diaphragm valves				X	X	X
Check the suction and discharge valves of all stages, and if necessary, replace inner parts				X	X	X
Check the condensate collecting tank for contamination				X	X	X
Cleaning of V-belts, grooves of flywheel and motor pulley				X	X	X
Check condition of V-belts, as well as V-belt tension				X	X	X
Replace separator filter elements in third and fourth stage				X	X	X
Grease/lubricate motor bearings				X	X	X
Complete revision of compressor					X	X
Check cylinders, pistons, piston rings and crank pin bearings for wear and replace if necessary					X	X
Replace piston pins and piston pin bearings					X	X
Replace slide ring packing and shaft sealing					X	X
Replace inner parts of diaphragm valves, as well as diaphragm valve plates and o-rings					X	X
Replace set of V-belts					X	X
Replace all synthetic flexible hoses of pressure gauges, drain lines, etc.					X	X
Check, repair and set, if necessary, all electrical instruments including pressure switch, temperature switch, etc.					X	X
Check and set, if necessary, all safety valves					X	X
Check wear on oil pump						X
Replace crankshaft main bearings						X
After re-commissioning, start again with checks and work follow procedures as per new unit				X	X	X



7. TROUBLESHOOTING

POINT	FAILURES	POSSIBLE CAUSES	REMEDY
1	Interstage pressures too high	damaged pressure gauge	replace pressure gauge
		damaged suction valve in following stage	replace valve
		too high suction pressure	set correct suction pressure
		blow down check valve leaking	replace check valve
2	Interstage pressure too low	damaged pressure gauge	replace pressure gauge
		damaged discharge valve of the respective stage or of the previous stage	replace valve
		blowdown valve not fully closed or leaking	replace valve, check actuator
		leaking safety valve	replace valve
		too low suction pressure	set correct suction pressure
		low ambient pressure (e.g. high altitudes)	recalculate intermediate pressures
		clogged suction filter	clean or replace filter element
		mechanical seal is leaky	replace mechanical seal or parts
		leaking safety valve	check and repair safety valve
3	Last stage discharge pressure too low	gas supply pressure too low	check inlet gas pressure
		blowdown valve leaking	replace valve
		safety valve leakage	check, replace seal (if necessary)
		discharge piping leakage	check, re-tighten pipe connections, etc.
		damage pressure gauge	replace pressure gauge
4	Capacity flow too low	damaged valve first stage	replace valve
		too low suction pressure	set correct suction pressure
		low ambient pressure (e.g. high altitudes)	recalculate flow
		clogged suction filter	clean or replace filter element
		leakage in fittings or gaskets	clean or grind safety valve seat
		leaking safety valves	replace seal (if necessary)
		leakage in piping	search for leak (use leak detection fluid), re-tighten pipe connections
		worn piston rings	replace piston rings
		mechanical seals leaky	replace mechanical seal or parts
		low speed	check and set design speed
5	Blow off of safety valve	closed or clogged shut off and non-return device in discharge piping of	check discharge system



POINT	FAILURES	POSSIBLE CAUSES	REMEDY
		compressor	
		• pressure too high	• see point 1
		• damaged seat of safety valve or wrong setting	• dismantle, clean and grind safety valve seat, set safety valve to correct pressure
		• clogged discharge piping or filters	• check and clean discharge piping & filter elements
		• clogged gas cooler	• check and clean (if necessary)
		• compressor stage valves leaking	• check and clean (if necessary)
6	Blow off last stage safety valve	• Discharge pressure switch/transducer damaged	• check set points and calibration
7	Compression temperature too high	• damaged suction or discharge valve	• replace valves
		• too high ambient temperature	• check temperature, improve ventilation (if installed in restricted area)
		• clogged air flow through finned gas cooler	• clean finned gas cooler externally
		• insufficient intermediate cooling (damaged fan, wrong flow direction of cooling air, fouled cooler)	• check fan and direction check cooler
		• damaged part inside compressor (seizure of piston, corroded cylinder)	• dismantle compressor
8	Oil consumption too high	• piston rings are worn	• replace piston rings
		• oil content over maximum oil level	• check the oil amount in the crankcase
		• cylinder bore, piston diameter or piston ring grooves are not of maximum allowable tolerance due to wear	• replace worn parts
9	Oil leaking from crankcase	• damaged gasket	• replace gasket
		• clogged venting device causing too high pressure in motion work	• check and clean venting device
		• piston rings worn causing over pressure	• replace piston rings
		• worn or damaged crankshaft seals	• replace crankshaft seals or parts
		• not tightened screws	• re-tighten screws, use correct tightening torque
		• clogged crankcase vent line	• check and clean if necessary
10	Malfunctioning of blowdown valve	• no power to 3-way control	• check PLC output and wiring



POINT	FAILURES	POSSIBLE CAUSES	REMEDY
		solenoid	
11	Noisy or hot crankshaft operation	insufficient lubrication	check oil level, check oil pressure, check functioning of oil pump
		damaged bearings, too much axial clearance of crankshaft, contamination in bearings	check bearings for possible exaggerated clearance
12	Compressor knocks (to be stopped immediately)	too much clearance in the bearing of crankshaft, crank pin or piston pin	check clearance and dismantle (if necessary)
13	Oil pressure incorrect	too little oil	refill oil
		defective or clogged oil pump	dismantle and clean
		wrong direction of compressor	correct direction
		defective pressure gauge	replace pressure gauge
		defective pressure regulator	adjust or replace
14	Oil pressure too low	damaged pressure gauge	replace pressure gauge
		suction strainer clogged	clean suction strainer
		oil filter clogged	replace oil filter
		lubrication pump worn	replace pump
		relief valve defective or out of set	check valve spring or set of
		oil viscosity too low	use oil according to manual section 1.3
		oil level too low	check and replace oil
		pressure switch/transducer malfunction	- replace pressure switch/transducer - check PLC control functions
15	Oil pressure too high	cold oil when starting up	continue running the compressor and check after 10 minutes if reached the correct set.
		oil viscosity too high	use oil according to manual section 1.3
		oil relief valve defective or out of set	check valve spring or set it
16	Lubrication pump blocked, seized	pump fouled	dismantle and clean
		pump corroded during standstill period	dismantle and lean, replace pump (if necessary)
		gears moved wrongly	replace pump



POINT	FAILURES	POSSIBLE CAUSES	REMEDY
17	Condensate tank level high	condensate drain solenoid valve out of order	clean or replace (if necessary)
		level control malfunction	- check switches - check PLC control functions
18	Condensate tank level low	condensate drain solenoid valve out of order	clean or replace (if necessary)
		level control malfunction	- check switches - check PLC control functions
19	Motor high temperature or overload	Compressor requires too much power	check compressor
		motor winding problems	check motor
		control system malfunction	check PLC control functions
20	Enclosure temperature high	cooler air intake blocked	clean air intake
		heater controls defective	check heater controls
		enclosure temperature sensor defective	repair or replace sensor
		cooler fan defective	repair or replace fan
21	Enclosure temperature low	enclosure temperature sensor defective	repair or replace sensor
		too low outside temperature	add heat
22	Discharge pressure high	closed discharge valve	open discharge valve
		external reason	see pertinent Manual
23	Oil temperature high	cooler air intake blocked	clean air intake
		oil heater controls defective	check heater controls
		cooler fan defective	repair or replace fan
24	Oil temperature low	oil heater defective	repair or replace oil heater
		oil heater controls defective	check heater controls
25	Condensate tank fail to (de)pressurize	clogged drain line	clean drain line
26	PLC fault	no power	- check incoming power - check fuse and replace (if necessary)
		program not operational	check battery and replace (if necessary). Ready light off indicates PLC logic problem. Call service or replace PLC
27	Engine High Water Temp	fouled radiator	clean radiator
		faulty thermostat	replace
		faulty water pump	replace
28	Engine Low Oil Pressure	low oil level	check level and fill
		lubrication pump worn	replace pump



POINT	FAILURES	POSSIBLE CAUSES	REMEDY
		oil filter clogged	replace filter
29	Engine over speed	governor out of adjustment	refer to manufacturer literature in section 10.
30	Engine will not start	air pressure too low	- check air compressor - check air receiver SRV
		air starter faulty	contact engine manufacturer
		engine ignition system faulty	contact engine manufacturer
		clogged air filter	replace



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IG Station Manual

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8.0 PACKING AND STORAGE

8.1 GENERAL

This section provides details regarding shipping and storage of packaged GreenField compressors.

8.2 Specification for Handling During Transport and Site Storage

During transport and site storage, the system should be protected against:

- Mechanical damage
- Penetration of water, sand, dust, etc.
- High temperature differences
- Continuous high vibrations
- Water flooding

8.3 Extended Storage Prior to Installation

It may be possible to extend the storage life of the compressor by following these procedures and repeating the checks and inspections every two months.

Check stored units for following points:

- Lack of Tectyl protection
- Lack of painting
- Possible corrosion

Thus for 6 months storage, the packing should be inspected and refreshed at four months from shipment and again at six months.

8.4 Storage in Installed Conditions Prior to First Start-Up

We recommend storing the goods as long as possible in their original packaging prior to installation. In case a long standstill period is necessary between installation and first start-up, we recommend proceeding as follows:

Connect and supply power to the following items if present:

- Electric motor space heater
- Motor Control Center (Control Panel) space heater

Protect all open lines (suction/discharge/vents etc.) against entering of:

- Water
- Sand, dust, etc.

Protect all bright external parts with Tectyl 511-M (or equivalent).



Check installed units every 3 months for following points:

Check outside surfaces for:

- lack of Tectyl protection
- lack of painting
- possible corrosion

1. Remove cylinder heads and valves and check cylinder parts and bores for condense water/possible corrosion etc. Turn crankshaft manually to check cylinder bores.
2. Remove crankcase cover and check crankcase with flashlight for possible condensate and corrosion.
3. Disconnect flexible hoses from separators and drain possible condensate water.
4. Repaint all parts with Tectyl 873 (or equivalent) (inside) and Tectyl 511-M (or equivalent) (outside) where required.
5. Clean outside of unit from sand/dust/dirt, etc. and renew painting if necessary.
6. Enter carried out checks in individual compressor logbook.

All checks and works to be done under clean conditions by experienced and well-trained personnel. Units with extended storage in installed conditions as per above-mentioned points have to be checked by Greenfield personnel prior to first start-up.

8.5 Extended Storage in Installed Conditions Prior to First Start-Up

Follow procedure as per section 8.4 accordingly.

Follow respective paragraphs in Instruction Manual.

8.6 Extended Shutdown Periods After First Start-Up

Procedure for longer shutdown periods after first start-up is described below. To prevent oxidation during long standstill periods of components of the compressor package, run the machine every week for at least 30 minutes.

If it is not possible to operate the compressor, we recommend the following:

8.6.1 Drying of Compressor

- Run the compressor under load for at least 30 minutes
- Run the compressor unloaded for 10 minutes

Unloaded description:

- no back pressure (disconnect discharge line)
- drain (diaphragm) valves all open (disconnect wiring of the magnetic valve so that valve is closed but not under tension)
- Rotate the flywheel of the compressor two to three revolutions every three weeks

After this procedure, the compressor can be left idle for two months. Repeat this procedure every two months for longer standstill periods.



8.7 Part Disassembly

If compressor cannot be dried as described above, it should be partly disassembled by removing the following parts:

- Interstage piping
- Cylinder heads
- Combined concentric suction and discharge valves

All parts should be well oiled for preservation. Cylinder walls to be oiled as well. All opening should be plugged to prevent ingress of moisture and dust.

This procedure is recommended for standstill after installation of longer than three months.

8.8 Nitrogen Purge

The most effective and reliable way to preserve the compression system is by purging the entire gas flow stream with dry nitrogen. Suction and discharge lines must be plugged and a supply of approximately one to three psig should be applied to the complete system.

Capacity of the dry nitrogen source must be sufficient to meet the demands of the entire system including any leakage.



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IG Station Manual

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9.0 IDENTIFICATION

9.1 IDENTIFICATION DATA

Customer/Project Name	US Filter
Package SN/Compressor SN	IG0344/700550 & IG0345/700551
Type of machine	C5T223.13-LC
Number of cylinders	6
Number of stages	5
Year of construction	2004

9.1.1 Gas and Operating Data

Gas composition by weight	Nitrogen	75.47%
	Oxygen	23.20%
	Argon	1.28%
	Carbon Dioxide	0.046%

Relative humidity variable

Operating Conditions	Guarantee	Max
Capacity supplied, dry at 70 °F and 14.17 psig	244 SCFM	
Suction pressure	0 PSIG	2 PSIG
Suction temperature	32°F	
Final pressure	2500 PSIG	
Shaft power	188 HP	
Min. required motor power	200 HP	
Compressor RPM	1045 RPM	
Tolerance: - suction capacity (SCFM) $\pm 5\%$ - specific power (kWh/Nm³) $\pm 5\%$		

**9.1.2 Guarantee**

Stage
Number of cylinders x mm
Suction pressure psig
Discharge pressure psig
Suction temperature °F
Final temperature,
Adiabatic °F

Suction	1st	2nd	3rd	4th	5th
	2x225	1x170	1x100	1x58	1x35
0	-0.1	30.7	119	379	1069
	33.4	123	382	1076	2500
	62	87	87	87	77
	232	241	237	226	194

9.1.3 Cooling

Medium	Air
Quantity	16900 CFM
Cooling air temperature	ambient °F

9.1.4 Lubrication

Viscosity	ISO VG 150
Oil contents	~ 21 Gallons
Oil consumption	~ 170 g/h
Operating pressure of the lubrication system	min. 36 psig
Oil temperature min./max.	+41/ +194 °F



ATTENTION! For lubricant recommendation see Section 6.2

9.1.5 Conditions for Installation

Height above sea level	unknown
Expected ambient temperature min./max.	+40 / +86 °F
Admissible ambient temperature min./max.	+23 / +113 °F
Installation in the open air / in a building	with enclosure

**APPLICATION AND STIPULATED USE:**

This compressor is exclusively for the compression of the gas mentioned in this operating manual. Please refer to the section on “Technical Data” for the exact gas specification.

Every use over and above this is considered not stipulated. The manufacturer is not liable for damages resulting thereof; the user bears all risks.

9.1.6 Prime Mover

See Prime Mover data, Section 10.

9.1.7 Weight of Individual Compressor Components

Drive without flywheel	~ 4000 lb
Bearing lid on the oil pump side	~ 250 lb
Crank shaft with bearings	~ 500 lb
Flywheel	~ 1000 lb
Cooler	~ 1300 lb
Belt guard	~ 60 lb
Surge Tank	~ 2500 lb

05	GreenField Compressors	Operator : Jacot	Date : 21.12.04	Page : 1
et 0	=====	Client GFC Inc	Ord. I0246	
dp 1	SIZING CALCULATION ____		Type C5T223.13 LC	
lu 0	Flywheel side (1.Crank)	K	CONSTRUCTION - DATA	
dm 0	4 2	Angles Misancell.	Case 1045 0	
ab 0	S1 S1	Cyl Crnk	Speed 1/min 1045.	
bl 0		1 180 0 c-m 4.4m/s	Stroke 125 mm	
be 1	1	2 90 0 pBlow	VBlow Liter 4885.	
we 0	() S1 () S1	3 0 0 1.5 bara	Nr.of cranks 6	
pu 0		4 180 180 p crankcas	Nr.of stages 5	
sa 0	S1 S1	5 90 180 1.0 bara	Conn.rod mm 320.	
	---5 ---3	6 0 180 Freq. 60Hz	Motor kW 140.	

	(Cr.No) STAGE	(i) 1 (3) 2 (1) 3 (6) 4 (4) 5		
	- Cylinder SIZE	225B/1 170/1 100/1 58/1 35A/1		
	mm Piston diam.	225.0 170.0 100.0 58.0 35.0		
	cm2 Piston area T	397.6 227.0 78.5 26.4 9.6		
	% Clearance T	10.0 3.7 6.3 8.3 15.5		
	% Vol.corr. T	12.8 10.5 10.1 9.0 7.8		
	% Vol. eff. T	73.7 85.0 82.6 82.7 81.7		
mmm/s	V-Strok,c S T	1.40 44.7 1.40 35.2 1.40 35.6 1.40 29.1 1.50 27.9		
mmm/s	V-Strok,c D T	1.40 32.6 1.50 36.3 1.60 36.2 1.00 29.5 1.20 23.7		
kN	GASLoad T,BDC	9.17 0.00 19.32 4.82 20.72 6.45 19.60 6.90 16.62 7.10		
kN	GASLoadSV T,B	16.32 0.00 23.40 4.82 24.86 6.45 23.52 6.90 18.28 7.10		
kN	PIN sv C. T.	10.99 -8.91 21.91 -5.77 22.76 -5.63 22.46 -2.48 19.39 -0.55		
degr	Rodrevers op	126.3 44.8 42.2 27.6 12.3		

Nr.	Form Vol.% dry Nr. Form Vol.% dry	Nr. Vol.% dry	GAS+OPERATING DATA	
0	Luft 99.70 100.0		Gas Air	
20	H2O 0.30		Speed1045. Hum% 50.	
			Molw 28.96 td 10.	
			kapp0 1.40 tAmb 0.	
			gamn 1.293 pb s 20.	
			MSB-Wasserkuehler	
%/-	dp Intst rato	5.71 3.32 3.19 3.05 0.96 2.97 0.60 2.77 0.27 2.32		
bar a	ps 1.000	0.995 3.117 9.208 27.111 74.741		
bar a	pd 173.300	3.300 9.506 27.372 75.188 173.760		
bar e	psv (actual)	4.100 10.306 31.647 89.026 190.036		
grd C	ts 0.000	0.0 10.0 10.0 10.0 10.0		
grd C	td ad.	111.3 116.0 113.9 107.6 89.8		
grd C	td eff.approx	133.0 133.5 130.9 119.7 99.4		
m3/kg	vs 0.78473	0.78891 0.26079 0.08806 0.02976 0.01075		
m3/kg	vd	0.33504 0.11793 0.04090 0.01488 0.00641		
-/-	zeta s/zeta d	1.000/1.001 0.999/1.002 0.997/1.007 0.992/1.023 0.989/1.068		
kg/s	Mass flow T	0.1617 0.1611 0.1604 0.1597 0.1591		
kg/s	m-byp a/Stage	0.0000 0.0000 0.0000 0.0000 0.0000		
kg/s	Leckage/Stage	0.000630 0.000544 0.000557 0.000555 0.000559		
%	Rel.Hum. suct	50.0 76.7 100.0 100.0 100.0		
kg/h	G Cond.disch.	0.00 0.60 0.31 0.10 0.03		
-kJkg	k/di ad Hexch	1.40 -102.8 1.40 -108.4 1.42 -108.4 1.47 -107.7 1.63 -97.3		
kW	P isentrop	21.31 19.35 18.76 17.21 13.91		
bar e	p Desg.Auxil.	25.00 35.00 85.00 190.00 385.00		
kW	Valve loss	2.59 2.08 2.11 1.41 1.11		

kg/h	G (Act) D dry	570.83	PERFORMANCE D.	G (Nom.) D dry 570.83 553
m3/h	Vn(Act) D dry	441.60	% vMargin 0.00	Vn(Nom.) D dry 441.60 428
kg/h	G (Act) S wet	582.19	% etvDact 72.0	Vs(Nom.) m3/h 448.77 435
kg/h	G (Act) D wet	570.85	% eta iso 52.0	P iso (Nom.) kW 64.27
kg/h	Wa(Act) S/D 1.1/	0.02	% eta isn 73.3	P isn (Nom.) kW 90.54
%	Rel.Hum D	100.00		kW P Fan(8.4)+mec.drive 21.36
m3/h	VwCyl 0.0 Cyl+Oilc	0.00	(Nom.)	kW P valve loss(Nom.) 9.30
m3/h	VwOilc 0.0 VwHexch	0.00	G32.0 kN	kW P mis 2.3/P Auxil.(2.14)
grd C	t in/out 7.2/ 7.2	n1030 1/min	kW P Shaft (Nom.)	~~123.53~~ 124

Mengenreserve 3%

No negative tolerance verlangt G= **526** kg/h oder G= **1159** lbs/hr / Vn= **406** Nm3/h (bei 0°C und 1,013 bara) oder Vs= **436** Sm3/h (bei 20°C und 1,013 bara)/ V= **413** m3/h eff.

04|GreenField Compressors| Operator : Jacot Date : 21.12.04 Page : 1
 et 0 |=====| |Client GFC Inc |Ord. I0246
 dp 1 |SIZING CALCULATION ____| |Type C5T223.13 LC
 lu 0 |Flywheel side (1.Crank)|K |CONSTRUCTION - DATA
 dm 0 | 4 2 |Angles |Misancell.|Case 570 40
 ab 0 | |S1 |S1 |Cyl Crnk| |Speed 1/min 570.
 bl 0 | 1 1 | |1 180 0|c-m 2.4m/s|Stroke 125 mm
 be 1 | ()S1 ()S1 | |2 90 0|pBlow |VBlow Liter 4886.
 we 0 | | | |3 0 0| 1.5 bara|Nr.of cranks 6
 pu 0 | |S1 |S1 |4 180 180|p crankcas|Nr.of stages 5
 sa 0 | ---5 ---3 |5 90 180| 1.0 bara|Conn.rod mm 320.
 | | | |6 0 180|Freq. 60Hz|Motor kW 65.

	(Cr.No)	STAGE	(i)	1	(3)	2	(1)	3	(6)	4	(4)	5
- Cylinder SIZE	225B/1		170/1		100/1		58/1		35A/1			
mm Piston diam.	225.0		170.0		100.0		58.0		35.0			
cm2 Piston area T	397.6		227.0		78.5		26.4		9.6			
% Clearance T	10.0		3.7		6.3		8.3		15.5			
% Vol.corr. T	10.5		8.9		8.7		8.1		6.9			
% Vol. eff. T	76.4		86.8		84.0		83.4		82.3			
mm/s V-Strok,c S T	1.40	24.4	1.40	19.2	1.40	19.4	1.40	15.9	1.50	15.2		
mm/s V-Strok,c D T	1.40	17.8	1.50	19.8	1.60	19.7	1.00	16.1	1.20	12.9		
kN GASLoad T,BDC	8.78	0.00	18.67	4.90	20.46	6.40	19.58	6.86	16.59	7.12		
kN GASLoadSV T,B	15.93	0.00	22.76	4.90	24.55	6.40	23.49	6.86	18.25	7.12		
kN PIN sv C. T.	14.04	-2.39	22.66	1.74	24.22	2.83	23.43	4.12	18.78	4.90		
degr Rodrevers op	59.8		0.0		0.0		0.0		0.0			

Nr.	Form	Vol.%	dry	Nr.	Form	Vol.%	dry	Nr.	Vol.%	dry	GAS+OPERATING DATA
0	Luft	96.32	100.0								Gas Air
20	H2O	3.68									Speed 570. Hum% 50.
											Molw 28.96 td 50.
											kapp0 1.40 tAmb 40.
											gamn 1.293 pb s 20.
											MSB-Wasserkuehler
%/- dp Intst rato	1.57	3.21	0.87	2.92	0.25	2.96	0.15	2.78	0.07	2.31	
bar a ps 1.000	0.999		3.156		9.146		26.977		74.975		
bar a pd 173.300	3.206		9.225		27.045		75.091		173.418		
bar e psv (actual)	4.006		10.025		31.254		88.910		189.660		
grd C ts 40.000	40.0		50.0		50.0		50.0		50.0		
grd C td ad.	161.6		163.9		166.4		160.3		139.4		
grd C td eff.approx	160.7		163.7		163.7		155.8		136.1		
m3/kg vs 0.91153	0.91278		0.29798		0.10191		0.03446		0.01249		
m3/kg vd	0.39517		0.13828		0.04732		0.01708		0.00737		
-/- zeta s/zeta d	1.000/1.001		1.000/1.003		0.999/1.009		1.000/1.029		1.008/1.079		
kg/s Mass flow T	0.0791		0.0785		0.0769		0.0759		0.0753		
kg/s m-byp a/Stage	0.0000		0.0000		0.0000		0.0000		0.0000		
kg/s Leckage/Stage	0.000545		0.000476		0.000482		0.000479		0.000482		
% Rel.Hum. suct	50.0		94.2		100.0		100.0		100.0		
kg/h G Cond.disch.	0.00		4.21		1.55		0.50		0.16		
-kJkg k/di ad Hexch	1.39	-116.1	1.40	-119.2	1.41	-122.1	1.46	-119.8	1.59	-104.1	
kW P isentrop	11.32		10.21		10.09		9.34		7.49		
bar e p Desg.Auxil.	25.00		35.00		85.00		190.00		385.00		
kW Valve loss	0.37		0.30		0.30		0.20		0.15		

										3%
kg/h G (Act) D dry	269.16		PERFORMANCE D.	G (Nom.) D dry	269.16		261			
m3/h Vn(Act) D dry	208.22		% vMargin 0.00	Vn(Nom.) D dry	208.22		201			
kg/h G (Act) S wet	284.63		% etvDact 73.9	Vs(Nom.) m3/h	251.18		243			
kg/h G (Act) D wet	269.28		% eta iso 62.2	P iso (Nom.) kW	35.97					
kg/h Wa(Act) S/D 6.6/	0.12		% eta isn 83.7	P isn (Nom.) kW	48.46					
% Rel.Hum D	100.00			kW P Fan(1.4)+mec.drive	7.18					
m3/h VwCyl 0.0 Cyl+Oilc	0.00		(Nom.)	kW P valve loss(Nom.)	1.31					
m3/h VwOilc 0.0 VwHexch	0.00		G32.0 kN	kW P mis 0.9/P Auxil.(	0.32)					
grd C t in/out	7.2/ 7.2		n1030 1/min	kW P Shaft (Nom.)	57.87		57.9			

Mengenreserve 3%

No negative tolerance verlangt G= **248** kg/h oder G= **546** lbs/hr / Vn= **191** Nm3/h (bei 0°C und 1,013 bara) oder Vs= **205** Sm3/h (bei 20°C und 1,013 bara)/ V= **231** m3/h eff.

03 GreenField Compressors Operator : Jacot Date : 21.12.04 Page : 1																
===== Client GFC Inc Ord. I0246																
et 0	SIZING CALCULATION				Type C5T223.13 LC											
dp 1	Flywheel side	(1.Crank) K		CONSTRUCTION - DATA												
lu 0	4	2	Angles	Misancell.	Case 570 0											
dm 0	S1	S1	Cyl Crnk	Speed 1/min	570.											
ab 0			1 180 0 c-m 2.4m/s Stroke 125 mm													
bl 0	1	1	2 90 0 pBlow							VBlow Liter	4934.					
be 1	S1	S1	3 0 0 1.5 bara Nr.of cranks	6												
we 0			4 180 180 p crankcas Nr.of stages	5												
pu 0	S1	S1	5 90 180 1.0 bara Conn.rod mm	320.												
sa 0	---5	---3	6 0 180 Freq. 60Hz Motor kW	67.												
----- ----- ----- ----- ----- ----- ----- ----- ----- -----																
	(Cr.No) STAGE	(i) 1	(3) 2	(1) 3	(6) 4	(4) 5										
- Cylinder SIZE	225B/1	170/1	100/1	58/1	35A/1											
mm Piston diam.	225.0	170.0	100.0	58.0	35.0											
cm2 Piston area T	397.6	227.0	78.5	26.4	9.6											
% Clearance T	10.0	3.7	6.3	8.3	15.5											
% Vol.corr. T	10.6	9.1	8.8	8.1	6.9											
% Vol. eff. T	76.2	86.6	84.0	83.7	82.8											
mm/s V-Strok,c S T	1.40 24.4	1.40 19.2	1.40 19.4	1.40 15.9	1.50 15.2											
mm/s V-Strok,c D T	1.40 17.8	1.50 19.8	1.60 19.7	1.00 16.1	1.20 12.9											
kN GASLoad T,BDC	8.86 0.00	19.17 4.93	20.94 6.56	19.78 7.02	16.59 7.19											
kN GASLoadSV T,B	16.02 0.00	23.25 4.93	25.12 6.56	23.73 7.02	18.25 7.19											
kN PIN sv C. T.	14.15 -2.39	23.15 1.78	24.82 2.99	23.74 4.25	18.86 4.93											
degr Rodrevers op	59.7	0.0	0.0	0.0	0.0											
----- ----- ----- ----- ----- ----- ----- ----- ----- -----																
Nr.	Form Vol.% dry	Nr. Form Vol.% dry	Nr. Vol.% dry	GAS+OPERATING DATA												
0 Luft 99.70	100.0			Gas Air												
20 H2O 0.30				Speed 570. Hum% 50.												
				Molw 28.96 td 10.												
				kapp0 1.40 tAmb 0.												
				gamn 1.293 pb s 20.												
				MSB-Wasserkuehler												
%/- dp Intst rato	1.81 3.23	0.98 2.98	0.29 2.96	0.18 2.75	0.08 2.29											
bar a ps 1.000	0.998	3.170	9.351	27.576	75.721											
bar a pd 173.300	3.228	9.443	27.656	75.859	173.442											
bar e psv (actual)	4.028	10.243	31.987	89.831	189.686											
grd C ts 0.000	0.0	10.0	10.0	10.0	10.0											
grd C td ad.	108.5	113.4	113.3	106.7	88.2											
grd C td eff.approx	115.0	118.7	117.2	108.8	90.2											
m3/kg vs 0.78473	0.78598	0.25644	0.08671	0.02926	0.01061											
m3/kg vd	0.34005	0.11792	0.04043	0.01472	0.00639											
-/- zeta s/zeta d	1.000/1.001	0.999/1.002	0.997/1.007	0.992/1.023	0.989/1.068											
kg/s Mass flow T	0.0916	0.0910	0.0903	0.0897	0.0891											
kg/s m-byp a/Stage	0.0000	0.0000	0.0000	0.0000	0.0000											
kg/s Leckage/Stage	0.000632	0.000553	0.000566	0.000564	0.000567											
% Rel.Hum. suct	50.0	78.0	100.0	100.0	100.0											
kg/h G Cond.disch.	0.00	0.34	0.17	0.06	0.02											
-kJkg k/di ad Hexch	1.40 -99.9	1.40 -105.8	1.42 -107.9	1.47 -106.9	1.63 -95.5											
kW P isentrop	11.43	10.48	10.34	9.47	7.55											
bar e p Desg.Auxil.	25.00	35.00	85.00	190.00	385.00											
kW Valve loss	0.43	0.35	0.35	0.23	0.18											
----- ----- ----- ----- ----- ----- ----- ----- ----- -----																
kg/h G (Act) D dry	318.76	PERFORMANCE D.	G (Nom.) D dry	318.76	309											
m3/h Vn(Act) D dry	246.59	% vMargin 0.00	Vn(Nom.) D dry	246.59	239											
kg/h G (Act) S wet	329.77	% etvDact 73.7	Vs(Nom.) m3/h	250.60	243											
kg/h G (Act) D wet	318.77	% eta iso 60.9	P iso (Nom.) kW	35.89												
kg/h Wa(Act) S/D 0.6/	0.01	% eta isn 83.6	P isn (Nom.) kW	49.28												
% Rel.Hum D	100.00		kW P Fan(1.4)+mec.drive	7.18												
m3/h VwCyl 0.0 Cyl+Oilc	0.00	(Nom.)	kW P valve loss(Nom.)	1.54												
m3/h VwOilc 0.0 VwHexch	0.00	G32.0 kN	kW P mis 1.0/P Auxil.(	0.37)												
grd C t in/out	7.2/ 7.2	n1030 1/min	kW P Shaft (Nom.)	58.95	59											

Mengenreserve 3%

No negative tolerance verlangt G= 293 kg/h oder G= 647 lbs/hr / Vn= 227 Nm3/h (bei 0°C und 1,013 bara) oder Vs= 243 Sm3/h (bei 20°C und 1,013 bara)/ V= 230 m3/h eff.

06	GreenField Compressors	Operator : Jacot	Date : 21.12.04	Page : 1
et 0	=====	Client GFC Inc	Ord. I0246	
dp 1	SIZING CALCULATION ____		Type C5T223.13 LC	
lu 0	Flywheel side (1.Crank)	K	CONSTRUCTION - DATA	
dm 0	4 2	Angles Misancell.	Case 1045 40	
ab 0	S1 S1	Cyl Crnk	Speed 1/min 1045.	
bl 0		1 180 0 c-m 4.4m/s	Stroke 125 mm	
be 1	1	2 90 0 pBlow	VBlow Liter 4848.	
we 0	() S1 () S1	3 0 0 1.5 bara	Nr.of cranks 6	
pu 0		4 180 180 p crankcas	Nr.of stages 5	
sa 0	S1 S1	5 90 180 1.0 bara	Conn.rod mm 320.	
	---5 ---3	6 0 180 Freq. 60Hz	Motor kW 136.	

	(Cr.No) STAGE	(i) 1 (3) 2 (1) 3 (6) 4 (4) 5		
	- Cylinder SIZE	225B/1 170/1 100/1 58/1 35A/1		
	mm Piston diam.	225.0 170.0 100.0 58.0 35.0		
	cm2 Piston area T	397.6 227.0 78.5 26.4 9.6		
	% Clearance T	10.0 3.7 6.3 8.3 15.5		
	% Vol.corr. T	12.3 10.1 9.9 8.9 7.6		
	% Vol. eff. T	74.2 85.5 82.8 82.6 81.4		
mmm/s	V-Strok,c S T	1.40 44.7 1.40 35.2 1.40 35.6 1.40 29.1 1.50 27.9		
mmm/s	V-Strok,c D T	1.40 32.6 1.50 36.3 1.60 36.2 1.00 29.5 1.20 23.7		
kN	GASLoad T,BDC	9.05 0.00 18.84 4.80 20.30 6.31 19.45 6.77 16.61 7.05		
kN	GASLoadSV T,B	16.21 0.00 22.92 4.80 24.36 6.31 23.34 6.77 18.28 7.05		
kN	PIN sv C. T.	10.99 -8.91 21.50 -5.81 22.19 -5.74 22.10 -2.53 19.14 -0.47		
degr	Rodrevers op	126.8 45.2 43.2 28.3 11.9		

Nr.	Form Vol.% dry Nr. Form Vol.% dry	Nr. Vol.% dry	GAS+OPERATING DATA	
0	Luft 96.32 100.0		Gas Air	
20	H2O 3.68		Speed1045. Hum% 50.	
			Molw 28.96 td 50.	
			kapp0 1.40 tAmb 40.	
			gamn 1.293 pb s 20.	
			MSB-Wasserkuehler	
%/-	dp Intst rato	5.00 3.29 2.83 2.99 0.84 2.97 0.51 2.80 0.22 2.34		
bar a	ps 1.000	0.995 3.112 9.035 26.622 74.229		
bar a	pd 173.300	3.272 9.294 26.846 74.607 173.686		
bar e	psv (actual)	4.072 10.094 31.015 88.329 189.954		
grd C	ts 40.000	40.0 50.0 50.0 50.0 50.0		
grd C	td ad.	164.5 166.5 167.0 161.2 140.7		
grd C	td eff.approx	179.2 179.2 179.0 169.0 147.4		
m3/kg	vs 0.91153	0.91571 0.30218 0.10317 0.03492 0.01261		
m3/kg	vd	0.38978 0.13808 0.04773 0.01722 0.00739		
-/-	zeta s/zeta d	1.000/1.001 1.000/1.003 0.999/1.009 1.000/1.029 1.008/1.079		
kg/s	Mass flow T	0.1403 0.1398 0.1372 0.1360 0.1352		
kg/s	m-byp a/Stage	0.0000 0.0000 0.0000 0.0000 0.0000		
kg/s	Leckage/Stage	0.000543 0.000469 0.000476 0.000473 0.000477		
%	Rel.Hum. suct	50.0 92.9 100.0 100.0 100.0		
kg/h	G Cond.disch.	0.00 7.45 2.80 0.91 0.29		
-kJkg	k/di ad Hexch	1.39 -119.1 1.40 -121.9 1.41 -122.7 1.46 -120.6 1.59 -105.6		
kW	P isentrop	21.09 18.87 18.35 17.01 13.78		
bar e	p Desg.Auxil.	25.00 35.00 85.00 190.00 385.00		
kW	Valve loss	2.24 1.80 1.80 1.19 0.94		

kg/h	G (Act) D dry	484.51	PERFORMANCE D. G (Nom.) D dry	~~484.51~~ 469
m3/h	Vn(Act) D dry	374.82	% vMargin 0.00 Vn(Nom.) D dry	~~374.82~~ 363
kg/h	G (Act) S wet	505.16	% etvDact 72.5 Vs(Nom.) m3/h	~~452.14~~ 438
kg/h	G (Act) D wet	484.72	% eta iso 53.7 P iso (Nom.) kW	64.75
kg/h	Wa(Act) S/D 11.7/	0.21	% eta isn 73.9 P isn (Nom.) kW	89.11
%	Rel.Hum D	100.00	kW P Fan(8.4)+mec.drive	21.36
m3/h	VwCyl 0.0 Cyl+Oilc	0.00	(Nom.) kW P valve loss(Nom.)	7.97
m3/h	VwOilc 0.0 VwHexch	0.00	G32.0 kN kW P mis 2.2/P Auxil.(	1.86)
grd C	t in/out	7.2/ 7.2	n1030 1/min kW P Shaft (Nom.)	~~120.64~~ 121

Mengenreserve 3%

No negative tolerance verlangt G= **446** kg/h oder G= **984** lbs/hr / Vn= **345** Nm3/h (bei 0°C und 1,013 bara) oder Vs= **370** Sm3/h (bei 20°C und 1,013 bara)/ V= **416** m3/h eff.



GreenField

IG Station Manual

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10. PRIME MOVER

This section provides information that pertains to the particular type of Prime Mover provided for your system.



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INSTALLATION AND MAINTENANCE MANUAL FOR NEMA LOW VOLTAGE ELECTRIC MOTORS



***T**he electric motor is the item of equipment most widely used by man in his pursuit of progress, as virtually all machines and many renowned inventions depend upon it.*

By virtue of the prominent role the electric motor plays in the comfort and welfare of mankind, it must be regarded and treated as a prime power unit embodying features that merit special attention, including its installation and maintenance.

This means that the electric motor should receive proper attention.

Its installation and routine maintenance require specific care to ensure perfect operation and longer life of the unit.

THE WEG ELECTRIC MOTOR INSTALLATION AND MAINTENANCE MANUAL provides the necessary information to properly install, maintain and preserve the most important component of all equipment:

THE ELECTRIC MOTOR!

WEG





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1. Introduction



This manual covers all the three-phase and single-phase asynchronous squirrel-cage induction motors, from 140T to 580T frame sizes.

The motors described in this manual are subject to continuous improvement and all information is subject to change without notice.

For further details, please consult WEG.

2. Basic Instructions

2.1 Safety Instructions

All personnel involved with electrical installations, either handling, lifting, operation and maintenance, should be well-informed and up-to-date concerning the safety standards and principles that govern the work and carefully follow them.

Before work commences, it is the responsibility of the person in charge to ascertain that these have been duly complied with and to alert his personnel of the inherent hazards of the job in hand.

It is recommended that these tasks be undertaken only by qualified personnel and they should be instructed to:

- avoid contact with energized circuits or rotating parts,
- avoid by-passing or rendering inoperative any safeguards or protective devices,
- avoid extended exposure in close proximity to machinery with high noise levels,
- use proper care and procedures in handling, lifting, installing, operating and maintaining the equipment, and
- follow consistently any instructions and product documentation supplied when they do such work.

Before initiating maintenance procedures, be sure that all power sources are disconnected from the motor and accessories to avoid electric shock.

Fire fighting equipment and notices concerning first aid should not be lacking at the job site; these should be visible and accessible at all times.

2.2 Delivery

Prior to shipment, motors are factory-tested and balanced. They are packed in boxes or bolted to a wooden base.

Upon receipt, we recommend careful handling and a physical examination for damage which may have occurred during transportation.

In the event of damage and in order to guaranty insurance coverage, both the nearest WEG sales office and the carrier should be notified without delay.

2.3 Storage

Motors should be raised by their eyebolts and never by their shafts. It is important that high rating three-phase motors be raised by their eyebolts. Raising and lowering must be steady and joltless, otherwise bearings may be harmed.

When motors are not immediately installed, they should be stored in their normal upright position in a dry even temperature place, free of dust, gases and corrosive atmosphere.

Other objects should not be placed on or against them.

Motors stored over long periods are subject to loss of insulation resistance and oxidation of bearings.

Bearings and lubricant deserve special attention during prolonged periods of storage. Depending on the length and conditions of storage it may be necessary to regrease or change rusted bearings. The weight of the rotor in an inactive motor tends to expel grease from between the

bearing surfaces thereby removing the protective film that impedes metal-to-metal contact.

As a preventive measure against the formation of corrosion by contact, motors should not be stored near machines which cause vibrations, and every 3 month their shafts should be rotated manually.

Insulation resistance fluctuates widely with temperature and humidity variations and the cleanliness of components. When a motor is not immediately put into service it should be protected against moist, high temperatures and impurities, thus avoiding damage to insulation resistance.

If the motor has been in storage more than six month or has been subjected to adverse moisture conditions, it is best to check the insulation resistance of the stator winding with a megohmmeter.

If the resistance is lower than ten megohms the windings should be dried in one of the two following ways:

- 1) Bake in oven at temperatures not exceeding 194 degrees F until insulation resistance becomes constant.
- 2) With rotor locked, apply low voltage and gradually increase current through windings until temperature measured with thermometer reaches 194 degrees F. Do not exceed this temperature.

If the motor is stored for an extensive period, the rotor must be periodically rotated.

Should the ambient conditions be very humid, a periodical inspection is recommended during storage. It is difficult to prescribe rules for the true insulation resistance value of a machine as resistance varies according to the type, size and rated voltage and the state of the insulation material used, method of construction and the machine's insulation antecedents. A lot of experience is necessary in order to decide when a machine is ready or not to be put into service. Periodical records are useful in making this decision.

The following guidelines show the approximate values that can be expected of a clean and dry motor, at 40°C test voltage in applied during one minute.

Insulation resistance R_m is obtained by the formula:

$$R_m = V_n + 1$$

Where: R_m - minimum recommended insulation resistance in M W with winding at 40°C

V_n - rated machine voltage in kV

In case the test is carried out at a temperature other than 40°C, the value must be corrected to 40°C using an approximated curve of insulation resistance v.s temperature of the winding with the aid of Figure 2.1; it's possible verify that resistance practically doubles every 10°C that insulating temperature is lowered.

Example:

Ambient temperature = 50°C

Motor winding resistance at 50°C = 1.02 M W

Correction to 40°C

$$R_{40^{\circ}\text{C}} = R_{50^{\circ}\text{C}} \times K_{50^{\circ}\text{C}}$$

$$R_{40^{\circ}\text{C}} = 1.02 \times 1.3$$

$$R_{40^{\circ}\text{C}} = 1.326 \text{ M W}$$

The minimum resistance Rm will be:

$$R_m = V_n + 1$$

$$R_m = 0.440 + 1$$

$$R_m = 1.440 \text{ M W}$$

On new motors, lower values are often attained due to solvents present in the insulating varnishes that later evaporate during normal operation. This does not necessarily mean that the motor is not operational, since insulation resistance will increase after a period of service.

On motors which have been in service for a period of time much larger values are often attained. A comparison of the values recorded in previous tests on the same motor under similar load, temperature and humidity conditions, serves as a better indication of insulation condition than that of the value derived from a single test. Any substantial or sudden reduction is suspect and the cause determined and corrective action taken.

Insulation resistance is usually measured with a MEGGER.

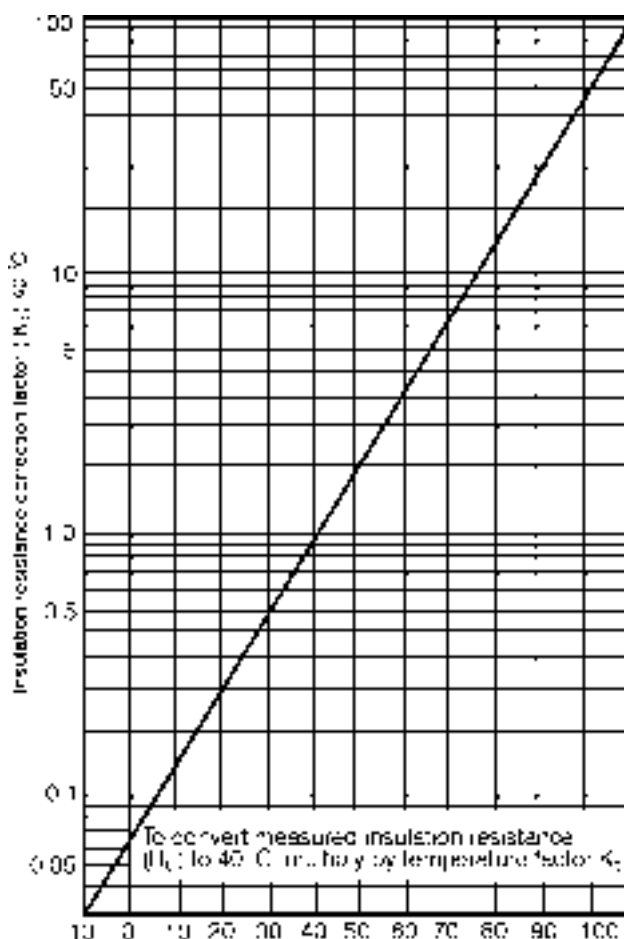
In the event that insulation resistance is inferior to the values derived from the above formula, motors should be subjected to a drying process.

This operation should be carried out with maximum care, and only by qualified personnel. The rate of temperature rise should not exceed 5°C per hour and the temperature of the winding should not exceed 105°C. An overly high final temperature as well as a fast temperature increase rate can each generate vapour harmful to the insulation.

Temperature should be accurately controlled during the drying process and the insulation resistance measured at regular intervals.

During the early stages of the drying process, insulation resistance will decrease as a result of the temperature increase, but the resistance will increase again when the insulation becomes dryer. The drying process should be extended until successive measurements of insulation resistance indicate that a constant value above the minimum acceptable value has been attained. It is extremely important that the interior of the motor be well ventilated during the drying operation to ensure that the dampness is really removed.

Heat for drying can be obtained from outside sources (an oven),



energization of the space heater (optional), or introducing a current through the actual winding of the motor being dried.

Winding Temperature (°C)

$$R_{40^{\circ}\text{C}} = R_t \times K_{t40^{\circ}\text{C}}$$

Figure 2.1.

3. Installation

Electric machines should be installed in order to allow an easy access for inspection and maintenance. Should the surrounding atmosphere be humid, corrosive or contain flammable substances or particles, it is essential to ensure an adequate degree of protection.

The installation of motors in environments where there are vapours, gases or dusts, flammable or combustible materials, subject to fire or explosion, should be undertaken according to appropriate and governing codes, such as NEC Art. 500 (National Electrical Code) and UL-674 (Underwriters Laboratories, Inc.) Standards.

Under no circumstances can motors be enclosed in boxes or covered with materials which may impede or reduce the free circulation of ventilating air. Machines fitted with external ventilation should be at least 50cm from the wall to permit the passage of air. The opening for the entry and exit of air flow should never be obstructed or reduced by conductors, pipes or other objects. The place of installation should allow for air renewal at a rate of 700 cubic feet per minute for each 75 HP motor capacity.

3.1 Mechanical Aspects

3.1.1 Foundation

The motor base must be levelled and as far as possible free of vibrations. A concrete foundation is recommended for motors over 100 HP. The choice of base will depend upon the nature of the soil at the place of erection or of the floor capacity in the case of buildings.

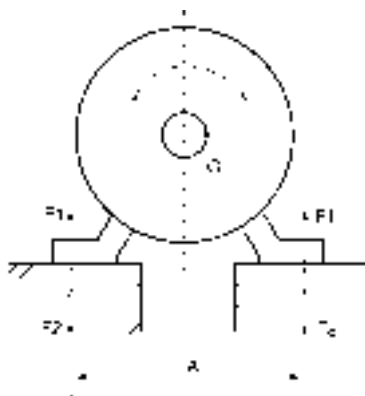
When dimensioning the motor base, keep in mind that the motor may occasionally be run at a torque above that of the rated full load torque.

Based upon Figure 3.1, foundation stresses can be calculated by using the following formula:

$$F1 = 0.2247 (0.009 \times g \times G - 213 \text{ Tmax}/A)$$

$$F2 = 0.2247 (0.009 \times g \times G + 213 \text{ Tmax}/A)$$

Figure 3.1 - Base stresses



- F1 and F2 - Lateral stress (Lb)
- g - Force of gravity (32.18 ft/s²)
- G - Weight of motor (Lb)
- Tmax - Maximum torque (Lb . Ft)
- A - Obtained from the dimensional drawing of the motor (in)

Sunken bolts or metallic base plates should be used to secure the motor to the base.

3.1.2 Types of Bases

a) Slide Rails

When motor drive is by pulleys the motor should be mounted on slide rails and the lower part of the belt should be pulling. The rail nearest the drive pulley is positioned in such a manner that the adjusting bolt be between the motor and the driven machine. The other rail should be positioned with the bolt in the opposite position, as shown in Figure 3.2.

The motor is bolted to the rails and set on the base. The drive pulley is aligned such that its center is on a plane with the center of the driven pulley and the motor shaft and that of the machine be parallel.

The belt should not be overly stretched, see Figure 3.11. After the alignment, the rails are fixed.

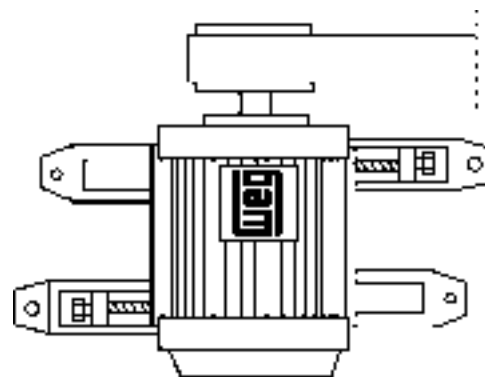


Figure 3.2 - Positioning of slide rails for motor alignment

b) Foundation Studs

Very often, particularly when drive is by flexible coupling the motor is anchored directly to the base with foundation studs.

It is recommended that shim plates of approximately 0.8 inches be used between the foundation studs and the feet of the motor for replacement purposes. These shim plates are useful when exchanging one motor for another of larger shaft height due to variations allowed by standard tolerances.

Foundation studs should neither be painted nor rusted as both interfere with to the adherence of the concrete, and bring about loosening.

After accurate alignment and levelling of the motor, the foundation studs are cemented and their screws tightened to secure the motor.

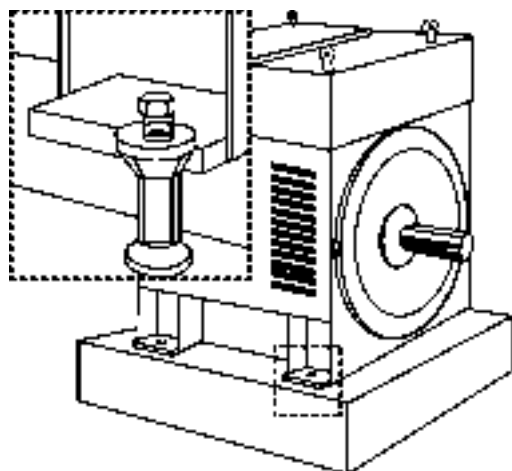


Figure 3.3 - Motor mounted on a concrete base with foundation studs

3.1.3 Alignment

The electric motor should be accurately aligned with the driven machine, particularly in cases of direct coupling. An incorrect alignment can cause bearing failure vibrations and even shaft rupture.

The best way to ensure correct alignment is to use dial gauges placed on each coupling half, one reading radially and the other axially - Figure 3.5.



Figure 3.5 - Alignment with dial gauges

Thus, simultaneous readings are possible and allow for checking for any parallel (Figure 3.6a) and concentricity deviations (Figure 3.6b) by rotating the shafts one turn.

Gauge readings should not exceed 0.02 inches. If the installer is sufficiently skilled, he can obtain alignment with feeler gauges and a steel ruler, providing that the couplings are perfect and centered -

Figure 3.6c.

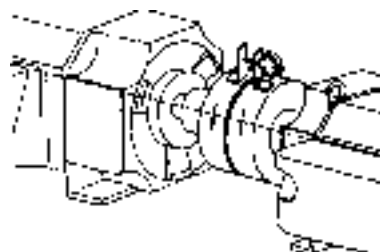


Figure 3.6a - Deviation from parallel

Figure 3.6b - Deviation from concentricity

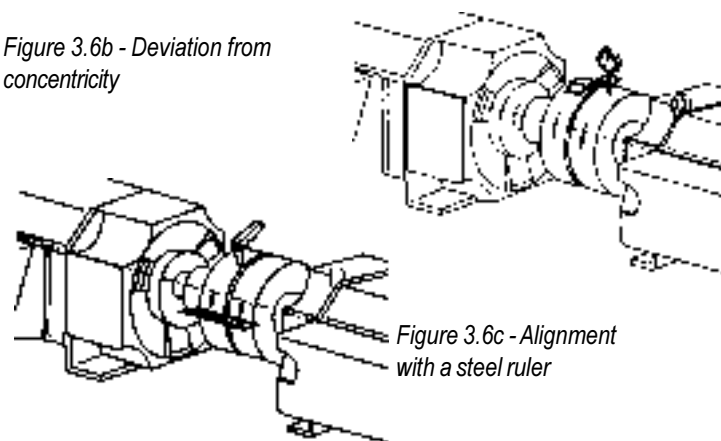


Figure 3.6c - Alignment with a steel ruler

3.1.4 Coupling

a) Direct Coupling

Direct coupling is always preferable due to its lower cost, space economy, no belt slippage and lower accident risk. In the case of speed ratio drives, it is also common to use a direct coupling with a reducer (gear box).

CAUTION: Carefully align the shaft ends using, whenever feasible, a flexible coupling.

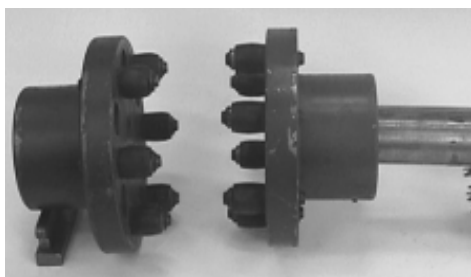


Figure 3.7 - A type of direct coupling

b) Gear Coupling

Poorly aligned gear couplings are the cause of jerking motions which bring about the vibration of the actual drive and vibrations within the motor.

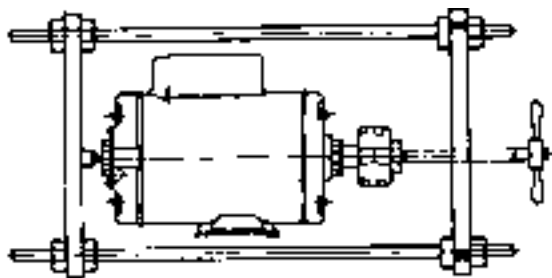
Therefore, due care must be given to perfect shaft alignment: exactly parallel in the case of straight gears, and at the correct angle for bevel or helical gears. Perfect gear engagement can be checked by the insertion of a strip of paper on which the teeth marks will be traced after a single rotation.

c) Belt and Pulley Coupling

Belt coupling is most commonly used when a speed ratio is required.

Assembly of Pulleys: To assemble pulleys on shaft ends with a keyway and threaded end holes the pulley should be inserted halfway up the keyway merely by manual pressure.

On shafts without threaded end holes the heating of the pulley to about 80°C is recommended, or alternatively, the devices illustrated



in Figure 3.8 may be employed.

Figure 3.8 - Pulley mounting device

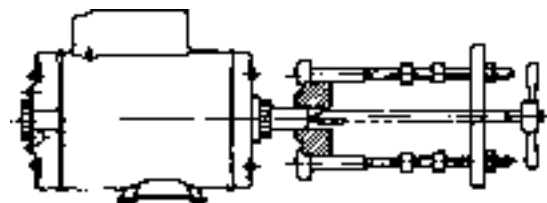


Figure 3.8a - Pulley extractor

Hammers should be avoided during the fitting of pulleys and bearings. The fitting of bearings with the aid of hammers leaves blemishes on the bearing races. These initially small flaws increase with usage and can develop to a stage that completely impairs the bearing.

The correct positioning of a pulley is shown in Figure 3.9.

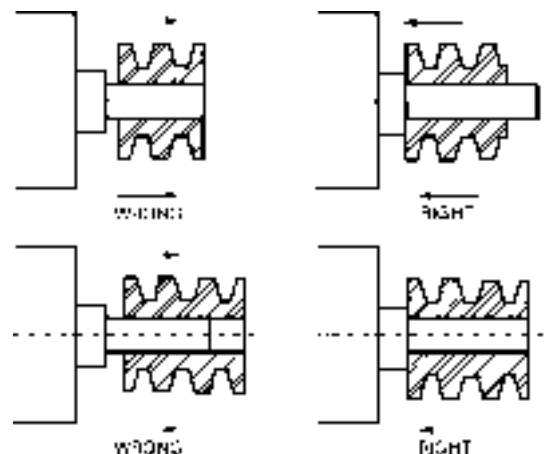


Figure 3.9 - Correct positioning of pulley on the shaft

RUNNING: To avoid needless radial stresses on the bearings it is imperative that shafts are parallel and the pulleys perfectly aligned. (Figure 3.10).

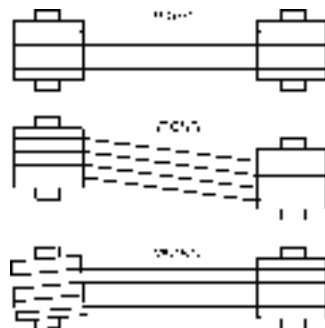
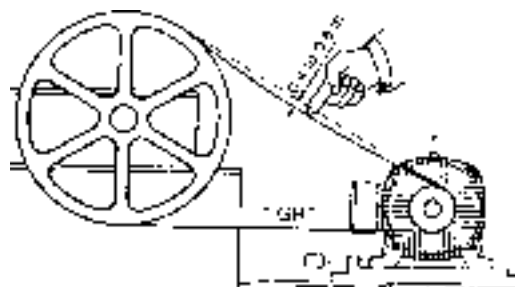


Figure 3.10 - Correct pulley alignment

Laterally misaligned pulleys, when running, transmit alternating knocks to the rotor and can damage the bearing housing. Belt slippage can be avoided by applying a resin (rosin for example). Belt tension should be sufficient to avoid slippage during operation

(Figure 3.11).

Pulleys that are too small should be avoided; these cause shaft flexion because belt traction increases in proportion to a decrease in the pulley size. Table 1 determines minimum pulley diameters, and Tables 2 and 3 refer to the maximum stresses acceptable on motor bearings up to frame 580. Beyond frame size 600, an

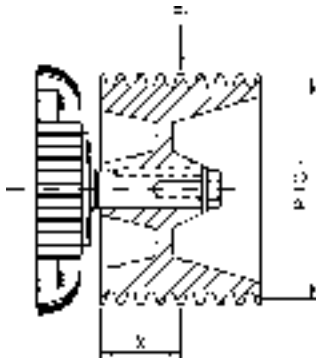


analysis should be requested from the WEG engineering.

Figure 3.11 - Belt tensions

Table 1 - Minimum pitch diameter of pulleys

Frame	Ball bearings						
	Bearing	Size X Inches					
		0.79	1.57	2.36	3.15	3.94	4.72
140	6205-Z	1.7	1.85	2			
W 180	6206-Z	3.03	3.23	3.46			
180	6307-Z	1.69	1.81	1.93			
W 210	6308-Z		2.86	3.00	3.16		
210	6308-Z		2.90	3.06	3.22		
W 250	6309 C3		4.37	4.54	4.72	4.92	
250	6309 C3		4.41	4.59	4.77	4.97	
280	6311 C3			5.08	5.19	5.47	5.65
320	6312 C3			7.44	7.76	7.94	8.18
360	6314 C3			8.73	9.00	9.28	9.57



A technical cross-sectional drawing of a ball bearing. The drawing shows the outer ring, inner ring, balls, and cage. Dimensions are labeled: 'd' for the outer diameter, 'D' for the inner diameter, 'B' for the bearing width, and 'x' for the distance from the inner ring to the balls. The balls are shown in cross-section, and the cage is depicted as a series of curved lines holding the balls in place.

Frame	Poles	Bearing	Ball Bearing				Bearing	Roller Bearing					
			Size X Inches					Size X Inches					
			1.97	3.15	4.33	5.51		1.97	3.15	4.33	5.51	6.69	8.27
400	II	6314 C3	7.3	7.62	7.94	8.24		-	-	-	-	-	-
	IV-VI-VII	6314 C3					NU 316	4.13	4.31	4.49	4.67	4.85	-
440	II	6314 C3	11.75	12.16	12.61	13.08		-	-	-	-	-	-
	IV-VI-VIII	6319 C3					NU 319	4.02	4.17	4.32	4.47	4.62	4.82
500	II	6314 C3	23.54	24.34	25.12	25.87		-	-	-	-	-	-
	IV-VI-VIII	6319 C3					NU 319	6.52	6.73	6.95	7.17	7.39	7.67
5008	II	6314 C3	44.66	45.79	46.98	48.23		-	-	-	-	-	-
	IV-VI-VIII	6322 C3					NU 322	8.73	8.95	9.96	11.34	12.87	14.82
580	II	6314 C3	57	58	59	60		-	-	-	-	-	-
	IV-VI-VIII	6322 C3					NU 322	10.72	10.91	11.11	11.31	11.50	11.76

- Important:
- 1) Peripheral speeds for solid grey cast iron pulleys FC 200 is $V = 115 \text{ ft/s}$
 - 2) Use steel pulleys when peripheral speed is higher than 115 ft/s
 - 3) V-belt speed should not exceed 115 ft/s .

Table 2 - Maximum acceptable radial load (Lbf)

Nema 56 Motors				
Frame	Radial Force (Lbf)			
	Poles	Distance X		
		1	1,18	2
56A	II	88	-	59
	IV	88	-	59
56B	II	88	-	59
	IV	86	-	59
56D	II	127	-	70
	IV	141	-	70

Saw Arbor Motors				
80 LMS	II	-	355	-
80 MMS	II	-	359	-
80 SMS	II	-	357	-
90 LMS	II	-	427	-
	IV	-	555	-

Table 3 - Maximum acceptable axial load (Lbf)

IP55 Totally Enclosed Motors - 60Hz Position / Construction Form																
F R A M E																
	II	IV	VI	VIII	II	IV	VI	VIII	II	IV	VI	VIII	II	IV	VI	VIII
140	103	141	167	187	112	152	185	207	99	132	158	178	105	143	174	198
W 180	108	145	180	202	154	209	255	286	94	130	165	183	141	194	240	269
180	149	207	249	286	269	370	443	500	136	189	229	266	253	352	421	480
W 210	196	264	326	368	329	447	544	610	176	238	297	339	310	421	518	582
210	189	257	315	357	324	443	533	599	160	220	275	310	295	405	493	553
W 250	282	372	443	485	471	620	734	811	240	317	394	414	430	564	685	743
250	273	368	436	485	463	615	727	813	220	310	379	421	410	557	672	749
280	355	480	551	624	621	826	959	1,082	275	388	427	502	540	736	838	961
320	374	498	588	668	703	930	1,091	1,232	266	366	432	511	597	793	937	1,078
360	890	1,181	1,144	1,323	890	1,181	1,375	1,552	745	985	1,144	1,323	745	985	1,144	1,323
400	877	1,148	1,347	1,521	877	1,148	1,347	1,521	705	890	1,060	1,241	705	890	1,060	1,241
440	842	1,303	1,563	1,821	842	1,303	1,563	1,821	568	884	1,109	1,488	568	884	1,109	1,488
500	769	1,250	1,481	1,728	769	1,250	1,481	1,728	355	721	844	1,190	355	721	844	1,109
5008	791	1624	1909	2137	791	1624	1909	2137	728	1548	1808	2029	728	1548	1808	2029
580	679	1,406	1,649	1,865	679	1,406	1,649	1,865	033	474	549	597	033	474	549	597

Open Motors - NEMA 56 Frames - 60Hz Position / Construction Form								
F R A M E								
	II	IV	II	IV	II	IV	II	IV
56 A	68	90	83	112	63	85	79	108
56 B	66	90	81	110	63	83	77	105
56 D	63	88	105	145	59	81	101	138

The maximum radial load for each frame are determined, by graphs.

INSTRUCTIONS ON HOW TO USE THE GRAPHS

- 1 - Maximum radial load on shaft.
- 2 - Maximum radial load on bearings.

Where: X - Half of pulley width (inches)

Fr - Maximum radial load in relation to the diameter and pulley width.

Example:

Verify whether a 2HP motor, 11 Pole, 60Hz withstands a radial load of 110Lb, considering a pulley width of 4 inches.

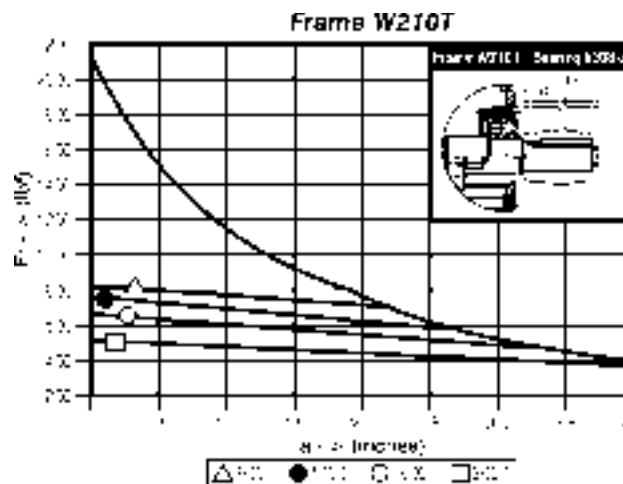
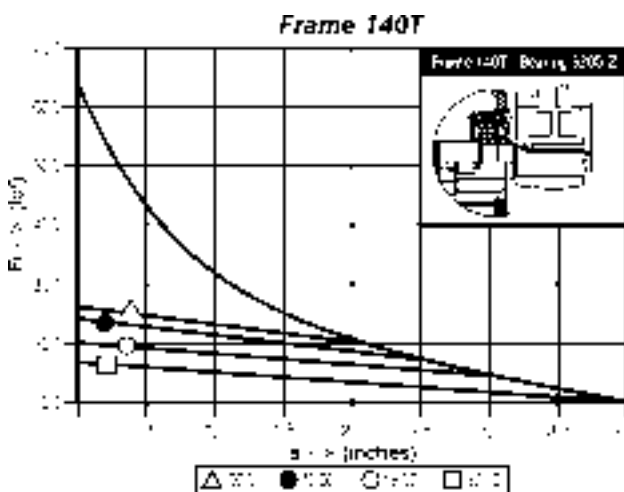
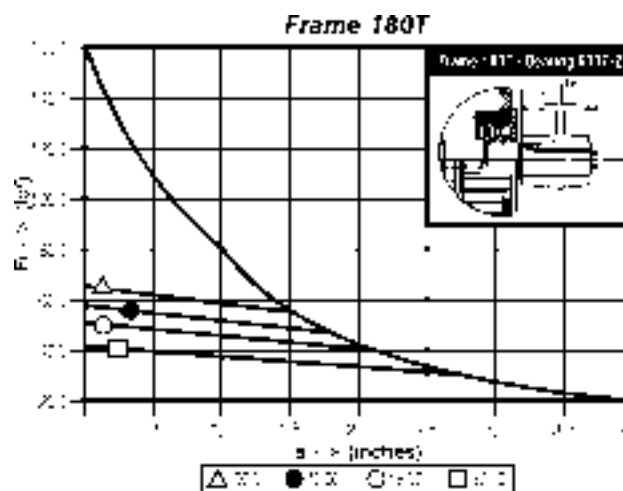
Frame : 145T

Fr : 110Lb

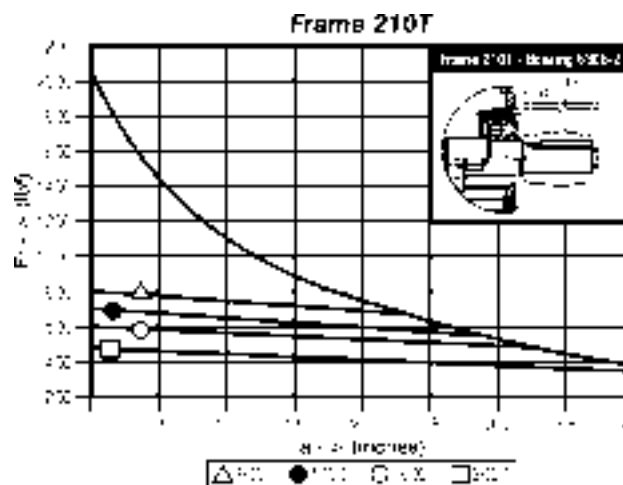
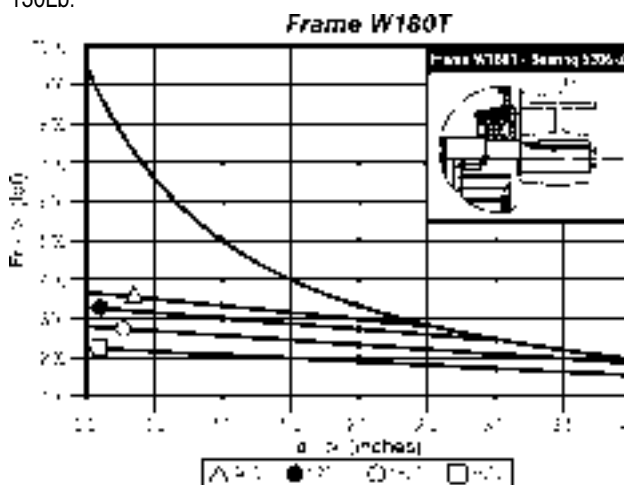
X : 2 inches

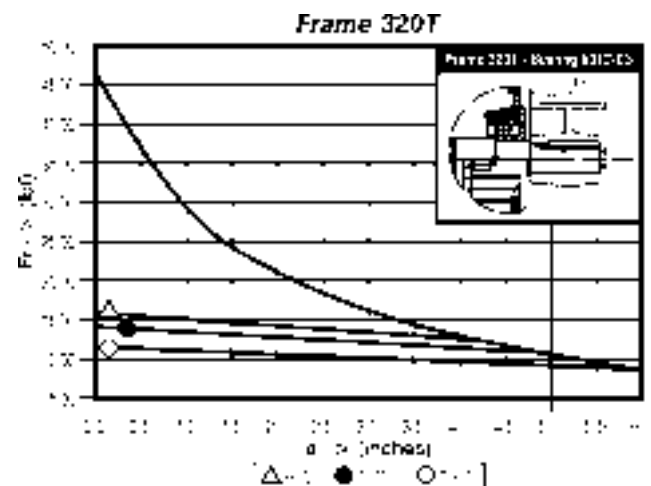
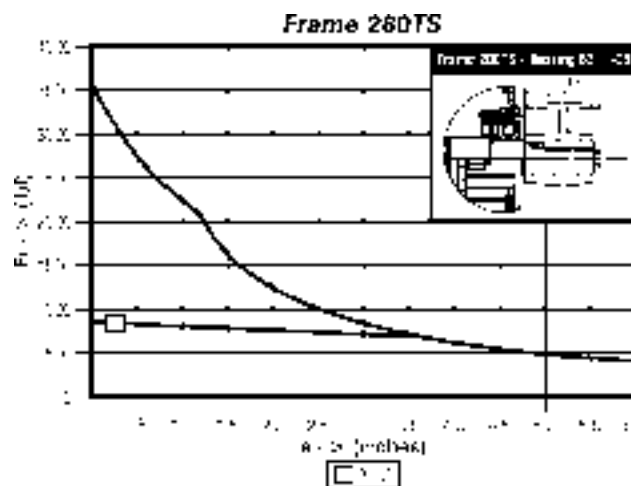
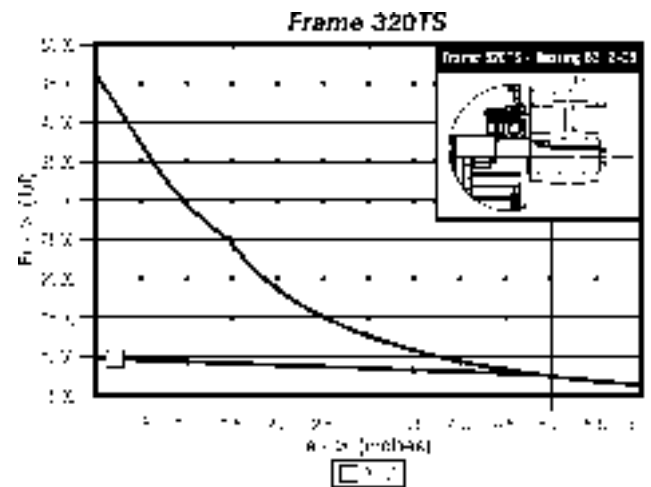
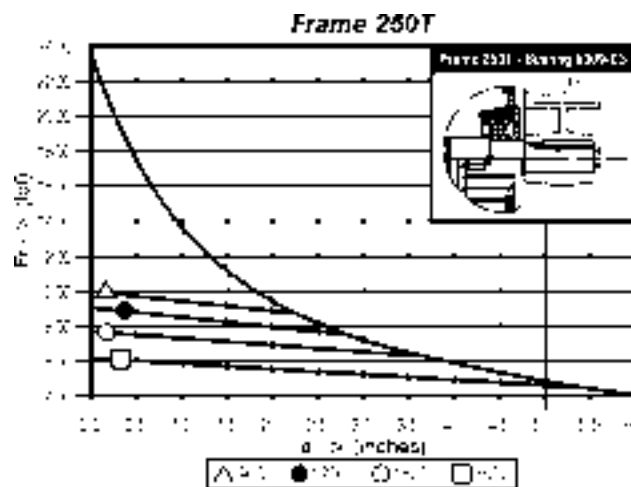
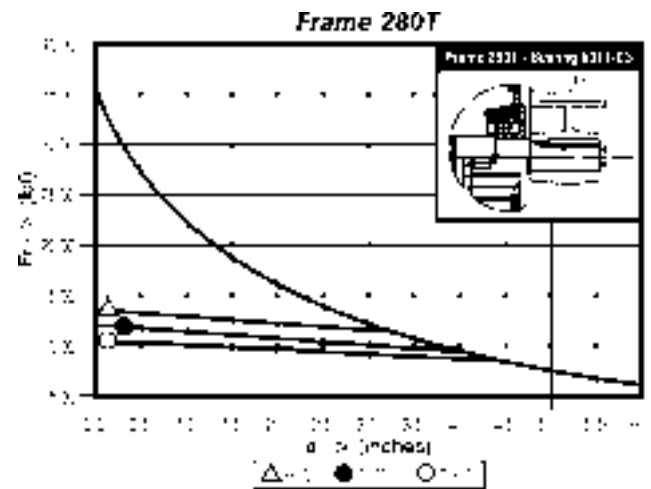
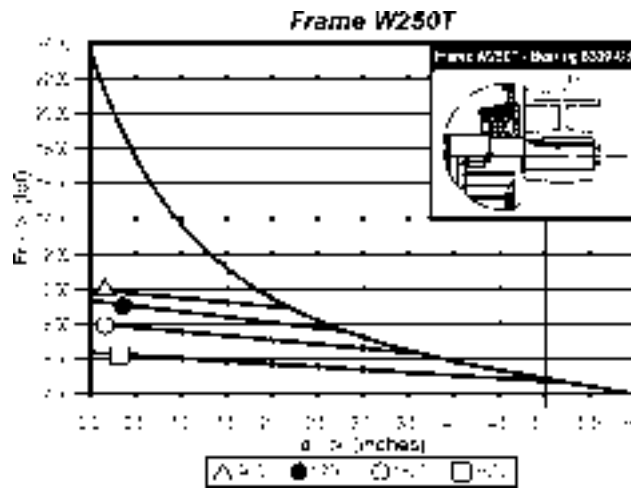
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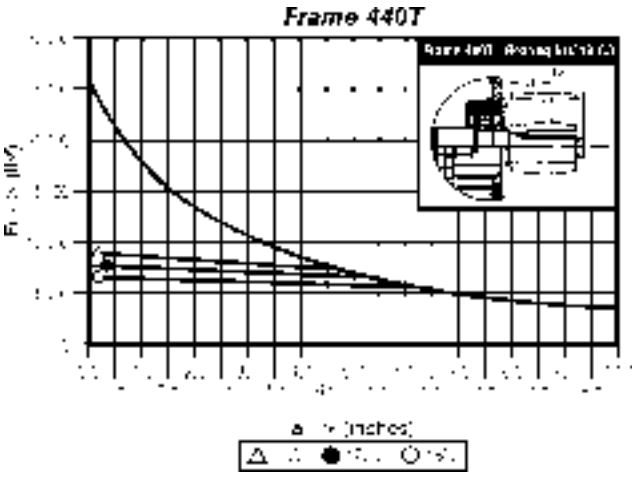
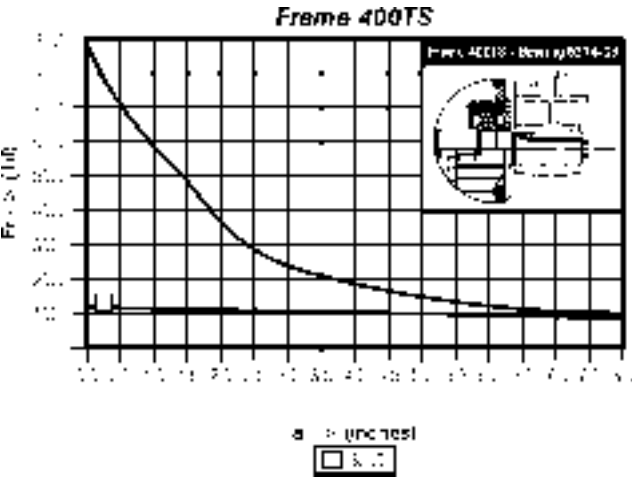
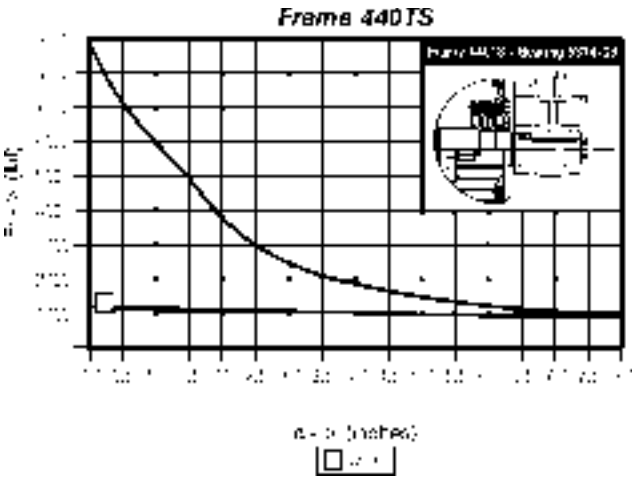
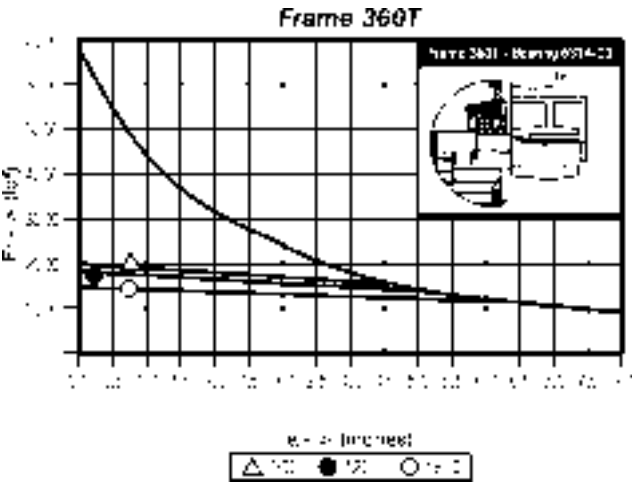
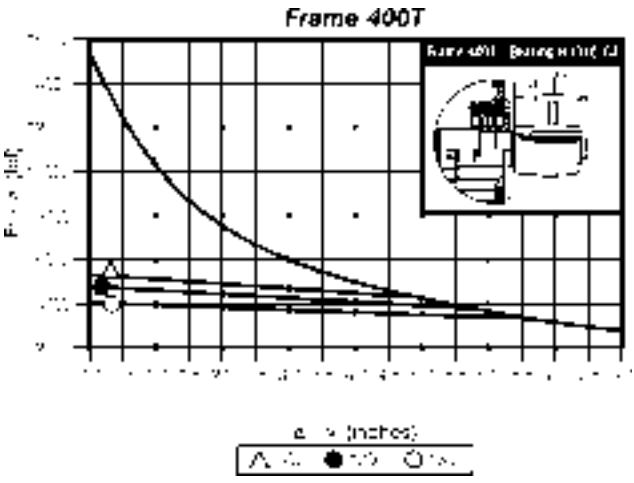
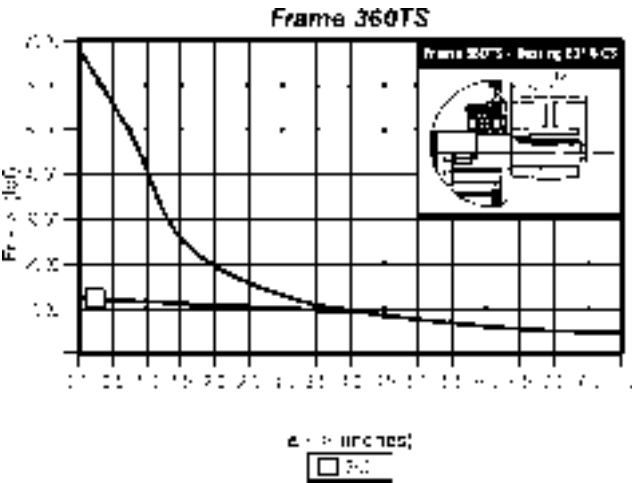
2 - Find out line N = 3600 for bearing

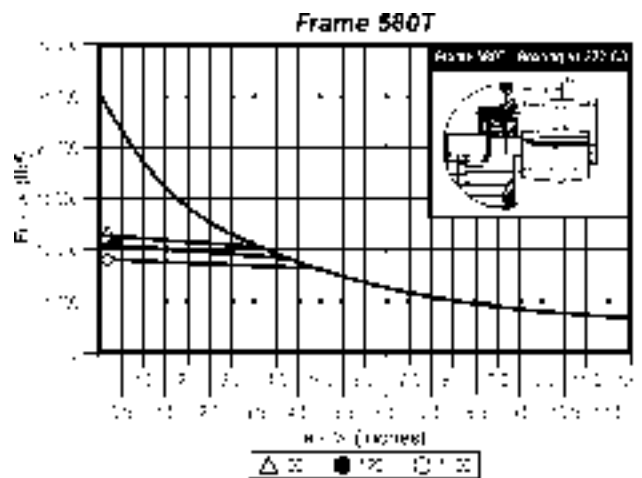
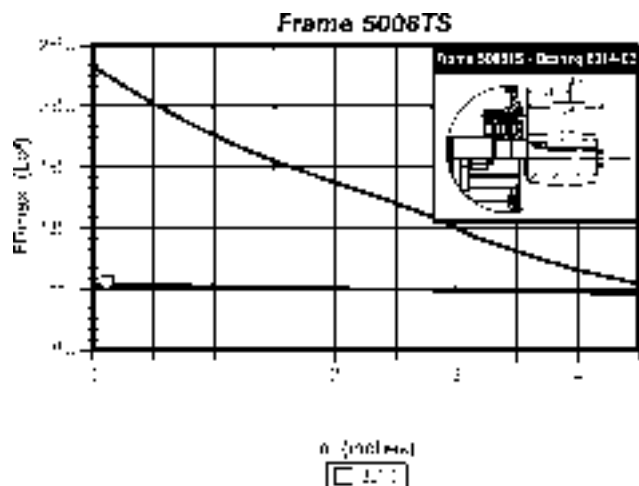
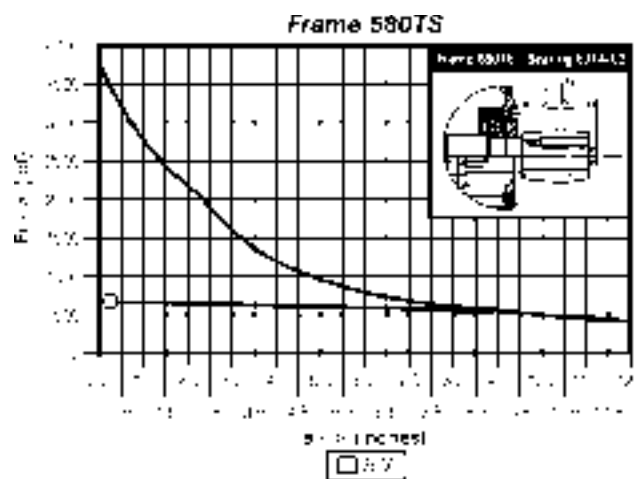
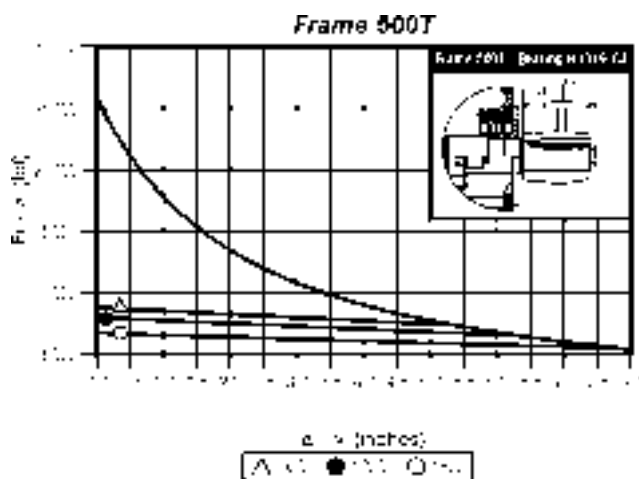
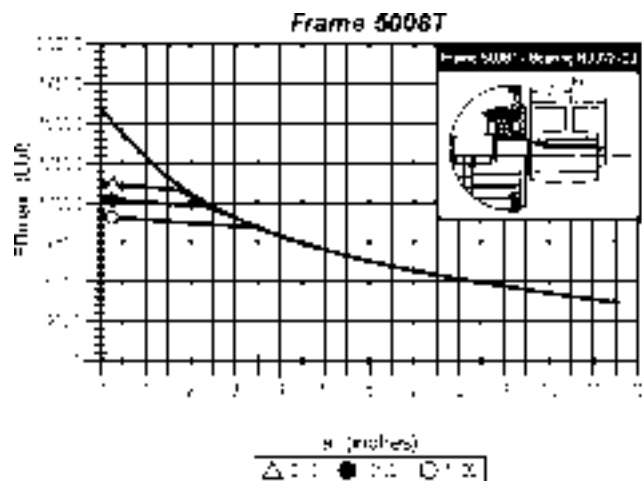
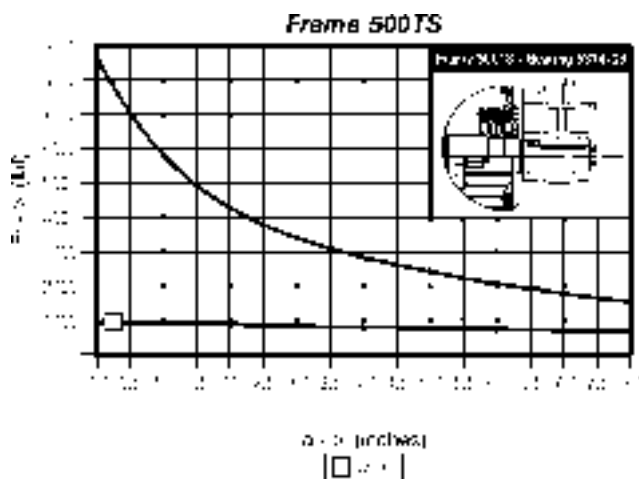


Based on the above, this bearing withstands a radial load of 130Lb.









Note: For frames 600 and above, consult your engineering representative.



3.2 Electrical Aspects

3.2.1 Feed System

Proper electric power supply is very important. The choice of motor feed conductors, whether branch or distribution circuits, should be based on the rated current of the motors as per NFPA-70 Standard article 430.

Tables 4, 5 and 6 show minimum conductor gauges sized according to maximum current capacity and maximum voltage drop in relation to the distance from the distribution center to the motor, and to the type of installation (Overhead or in ducts).

To determine the conductor gauge proceed as follows:

a) Determine the current by multiplying the current indicated on the motor nameplate by 1.25 and then locate the resulting value on the corresponding table.

If the conductor feeds more than one motor, the value to be sought on the table should be equal 1.25 times the rated current of the largest motor plus the rated current of the other motors.

In the case of variable speed motors, the highest value among the rated currents should be considered.

When motor operation is intermittent, the conductors should have a current carrying capacity equal or greater, to the product of the motor rated current times the running cycle factor shown on Table 7.

Table 7 - Running cycle factor

Duty Classification	Motor short time rating			
	5min	15min	30 at 60min	Continuous
Short (operating valves, activating contacts etc)	1.10	1.20	1.50	-
Intermittent (passenger or freight elevators, tools, pumps, rolling bridges etc)	0.85	0.85	0.90	1.40
Cyclic (rolling mills, mining machines etc)	0.85	0.90	0.95	1.40
Variable	1.10	1.20	1.50	2.00

b) Locate the rated voltage of the motor and the feed network distance in the upper part of the corresponding table. The point of intersection of the distance column and the line referring to current will indicate the minimum required gauge of the conductor.

Example:

Size the conductors for a 15 HP, three-phase, 230V, 42A, motor located 200 feet from the main supply with cables laid in conduits.

a) Current to be located: $1.25 \times 42A = 52.5A$

b) Closest value on table 6: 55A

c) Minimum gauge: 6 AWG

3.2.2 Starting of Electric Motor

Induction motors can be started by the following methods:

Direct Starting

Whenever possible a three-phase motor with a squirrel cage rotor should be started directly at full supply voltage by means of a contactor (Connection diagram a). This method is called Direct-on-Line (DoL) starting.

Table 4 - Wire and cable gauges for single-phase motor installation (voltage drop < 5%) (in conduits)

Supply Voltage	Distance of motor from distribution centre (feet)													
115	34	51	69	85	102	137	171	205	240	273	308	342	428	514
230	69	102	138	170	204	274	342	410	480	546	616	684	856	1028
460	138	204	276	340	408	548	684	820	960	1092	1232	1368	1712	2056
575	170	250	338	420	501	670	840	1010	1181	1342	1515	1680	2105	2530
Current (A)	Cable gauge (conductor)													
5	14	14	14	14	14	14	14	12	12	12	12	10	10	8
10	14	14	14	14	12	12	10	10	10	8	8	8	6	6
15	12	12	12	12	12	10	8	8	6	6	6	6	4	2
20	12	12	12	10	10	8	8	6	6	6	4	4	4	2
30	10	10	10	8	8	6	6	6	4	4	2	2	2	1/0
40	8	8	8	8	6	6	4	4	2	2	2	2	1/0	2/0
55	6	6	6	6	6	4	4	2	2	1/0	1/0	1/0	1/0	2/0
70	4	4	4	4	4	2	2	2	1/0	1/0	2/0	2/0	2/0	2/0
95	2	2	2	2	2	2	1/0	1/0	1/0	2/0	3/0	3/0	4/0	250M

Table 5 - Wire and cable gauges for three-phase motor installation - aerial conductors with 25cm spacing (voltage drop < 5%)

Supply Voltage	Distance of motor from distribution centre (feet)													
115	51	69	85	102	137	171	205	240	273	308	342	428	514	685
230	102	138	170	204	274	342	410	480	546	616	684	856	1028	1370
460	204	276	340	408	547	684	820	960	1092	1232	1368	1712	2056	2740
575	250	338	420	501	670	840	1010	1181	1342	1515	1680	2105	2530	3350
Current (A)	Cable gauge (conductor)													
15	14	14	14	12	12	10	10	10	8	8	8	6	6	4
20	14	14	12	12	10	10	8	8	8	6	6	4	4	2
30	14	12	10	8	8	8	6	6	4	4	4	2	2	1/0
40	12	10	10	8	8	6	4	4	4	2	2	2	1/0	2/0
55	10	10	8	8	6	4	4	2	2	2	1/0	2/0	3/0	--
70	8	8	6	6	4	2	2	2	1/0	1/0	2/0	3/0	--	--
100	6	6	4	4	2	2	1/0	2/0	3/0	4/0	4/0	--	--	--
130	4	4	4	2	1/0	1/0	2/0	4/0	--	--	--	--	--	--
175	2	2	2	1/0	2/0	3/0	--	--	--	--	--	--	--	--
225	1/0	1/0	1/0	2/0	3/0	--	--	--	--	--	--	--	--	--
275	2/0	2/0	2/0	4/0	--	--	--	--	--	--	--	--	--	--
320	3/0	3/0	3/0	4/0	--	--	--	--	--	--	--	--	--	--

Table 6 - Wire and cable gauges for three-phase motor installation (voltage drop < 5%) (in conduits)

Supply Voltage	Distance of motor from distribution centre (feet)											
115	85	102	120	137	171	205	240	273	308	342	428	514
230	170	204	240	274	342	410	480	546	616	684	856	1028
460	340	408	480	548	684	820	960	1092	1232	1368	1712	2056
575	420	501	590	670	840	1010	1181	1342	1515	1680	2105	2530
Current (A)	Cable gauge (conductor)											
15	12	12	12	10	10	8	8	8	6	6	6	4
20	12	10	10	10	8	8	6	6	6	6	4	4
30	10	8	8	8	6	6	6	4	4	4	2	2
40	8	8	6	6	6	4	4	4	2	2	2	1/0
55	6	6	6	4	4	4	2	2	2	1/0	1/0	1/0
70	4	4	4	4	2	2	2	1/0	1/0	1/0	2/0	2/0
95	2	2	2	2	2	1/0	1/0	1/0	1/0	2/0	3/0	4/0
125	1/0	1/0	1/0	1/0	1/0	1/0	2/0	2/0	3/0	3/0	4/0	250M
145	2/0	2/0	2/0	2/0	2/0	2/0	2/0	3/0	3/0	4/0	250M	300M
165	3/0	3/0	3/0	3/0	3/0	3/0	3/0	3/0	4/0	4/0	250M	350M
195	4/0	4/0	4/0	4/0	4/0	4/0	4/0	4/0	250M	250M	300M	350M
215	250M	250M	250M	250M	250M	250M	250M	250M	250M	300M	350M	400M
240	300M	300M	300M	300M	300M	300M	300M	300M	300M	300M	400M	500M
265	350M	350M	350M	350M	350M	350M	350M	350M	350M	350M	500M	500M
280	400M	400M	400M	400M	400M	400M	400M	400M	400M	400M	400M	--
320	500M	500M	500M	500M	500M	500M	500M	500M	500M	500M	500M	--

Note: The above indicated values are orientative. For guaranteed values, contact the Local Power Company.



There are DOL starter assemblies available combining a three-pole contactor, a bimetal relay (overload protection device), and a fuse (short circuit protection on branch circuit).

DOL starting is the simplest method, only feasible however, when the locked rotor current (LRC) does not influence the main electric supply lines.

Initial locked rotor current (LRC) in induction motors reach values six to eight times the value of the full load current. During starting by the DOL method, starting current can reach these high levels. The main electrical supply should be rated sufficiently, such that during the starting cycle no supply disturbance to others on the power network is caused by the voltage drop in the main supply.

This can be achieved under one of the following situations:

- The rated main supply current is high enough for the locked rotor current not to be proportionally high;
- Motor locked rotor current is low with no effect on the networks.
- The motor is started under no-load conditions with a short starting cycle and, consequently, a low locked rotor current with a transient voltage drop tolerable to other consumers.

Starting with a compensating switch (auto-transformer starting)

Should direct on line starting not be possible, either due to restrictions imposed by the power supply authority or due to the installation itself, reduced voltage indirect starting methods can be employed to lower the locked rotor current. The single line connection diagram (C) shows the basic components of a compensating switch featuring a transformer (usually an auto-transformer) with a series of taps corresponding to the different values of the reduced voltage. Only three terminals of the motor are connected to the switch, the other being interconnected as per diagram, for the indicated voltage.

Star-Delta starting

It is fundamental to star-delta starting that the three-phase motor has the necessary numbers of leads for both connections:

6 leads for Y/ Δ
or 12 leads for YY/ $\Delta\Delta$

All the connections for the various voltages are made through terminals in the terminal box in accordance with the wiring diagram that accompanies the motor. This diagram may be shown on the nameplate or in the terminal box.

The star-delta connection is usually used only in low-voltage motors due to normally available control and protection devices. In this method of starting the locked rotor current is approximately 30% of the original LRC. The locked rotor torque is reduced proportionally as well. For this reason, it is very important before deciding to use star-delta starting to verify if the reduced locked rotor torque in "STAR" connection is enough to accelerate the load.

3.2.3 Motor Protection

Motor circuits have, in principle, two types of protection: motor overload, locked rotor and protection of branch circuit from short circuits. Motors in continuous use should be protected from overloading by means of a device incorporated into the motor, or by an independent device, usually a fixed or adjustable thermal

relay equal or less than to the value derived from multiplying the rated feed current at full load by:

- 1.25 for motors with a service factor equal or superior to 1.15 or;
- 1.15 for motors with service factor equal to 1.0.

Some motors are optionally fitted with overheating protective detectors (in the event of overload, locked rotor, low voltage, inadequate motor ventilation) such as a thermostat (thermal probe), thermistor (PTC), RTD type resistance which dispense with independent devices.

THERMOSTAT (THERMAL PROBE): bimetallic thermal detectors with normally closed silver contacts. These open at pre-determined temperatures. Thermostats are series connected directly to the contactor coil circuit by two conductors.

THERMISTORS: Semi-conductor heat detectors positive temperature coefficient (PTC) that sharply change their resistance upon reaching a set temperature. Thermistors, depending upon the type, are series or parallel-connected to a control unit that cuts out the motor feed, or actuates an alarm system, in response to the thermistors reaction.

Resistance temperature detectors (RTD) - PT 100

The resistance type heat detector (RTD) is a resistance element usually manufactured of copper or platinum.

The RTD operates on the principle that the electrical resistance of a metallic conductor varies linearly with the temperature. The detector terminals are connected to a control panel, usually fitted with a temperature gauge, a test resistance and a terminal changeover switch.

Subject to the desired degree of safety and the client's specification, three (one per phase) or six (two per phase) protective devices can be fitted to a motor for the alarm stems, circuit breaker or combined alarm and circuit breaker, with two leads from the terminal box to the alarm or circuit breaker system and four for the combined system (alarm and circuit breaker).

Table 9 compares the two methods of protection.

3.3 Start-up

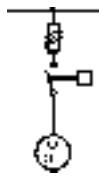
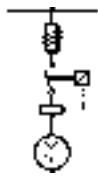
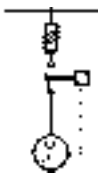
3.3.1 Preliminary Inspection

Before starting a motor for the first time, it will be necessary to:

- Remove all locking devices and blocks used in transit and check that the motor rotates freely;
- Check that the motor is firmly secured and that coupling elements are correctly mounted and aligned.;
- Ascertain that voltage and frequency correspond to those indicated on the nameplate. Motor performance will be satisfactory with main supply voltage fluctuation within ten per cent of the value indicated on the nameplate or a frequency fluctuation within five per cent or, yet, with a combined voltage and frequency variance within ten per cent;

Table 9 - Comparison between motor protection system

- d) Check that connections are in accordance with the connection diagram shown on the nameplate and be sure that all terminal screws and nuts are tight;
- e) Check the motor for proper grounding. Providing that there are no specifications calling for ground-insulated installation, the motor must be grounded in accordance with prevalent standard for grounding electrical machines. The screw identified by the symbol  should be used for this purpose. This screw is generally to be found in the terminal box or on one foot of the frame;
- f) Check that motor leads connecting with the mains, as well as the control wires and the overload protection device, are in accordance with Nema Standards;
- g) If the motor has been stored in a damp place, or has been stopped for some time, measure the insulating resistance as recommended under the item covering storage instructions;
- h) Start the motor uncoupled to ascertain that it is turning in the desired direction. To reverse the rotation of a three-phase motor, invert two terminal leads of the mains supply. High voltage motors bearing an arrow on the frame indicating rotation direction can only turn in the direction shown;

Causes of overheating	Current-based protection		Protection with probe thermistor in motor
	Fuse only	Fuse and thermal protector	
			
1. Overload with 1.2 times rated current			
2. Duty cycles S1 to S8 IEC 34, EB 120			
3. Brakings, reversals and frequent starts			
4. Operating with more than 15 starts p/hour			
5. Locked rotor			
6. Fault on one phase			
7. Excessive voltage fluctuation			
8. Frequency fluctuation on main supply			
9. Excessive ambient temperature			
10. External heating caused by bearings, belts, pulleys etc.			
11. Obstructed ventilation			

Caption:  unprotected

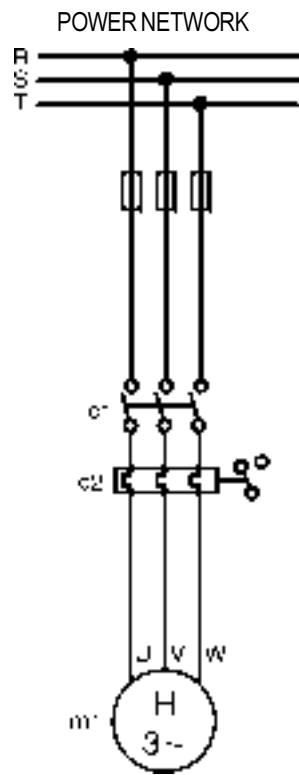
 partially protected

 totally protected

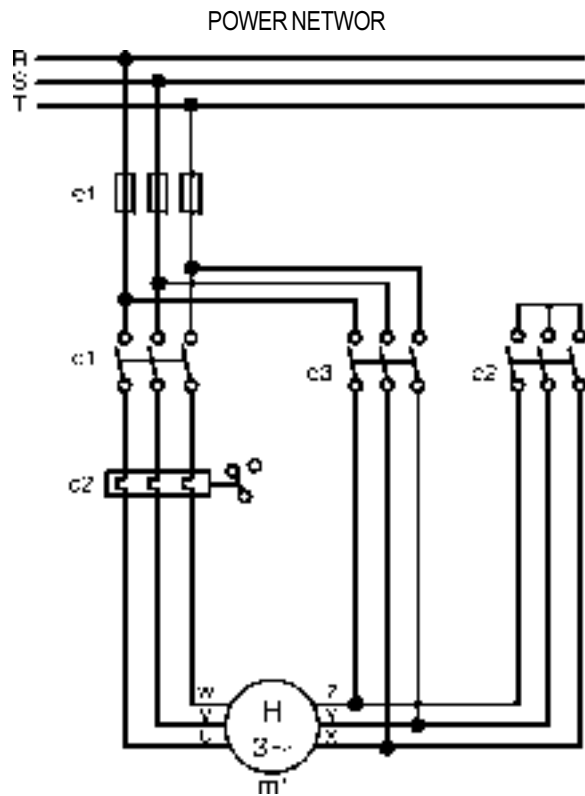


CONNECTION DIAGRAMS

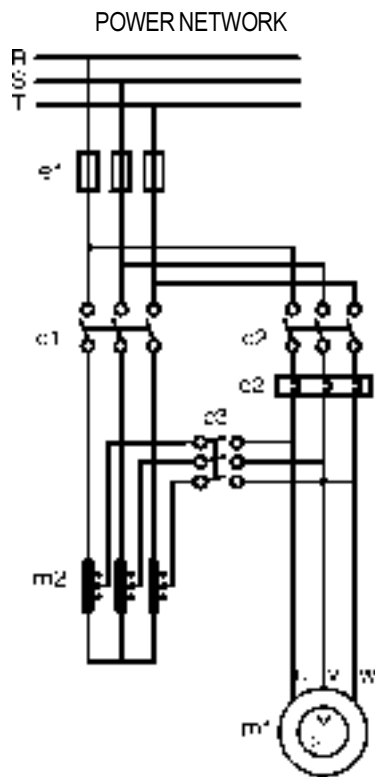
a) Direct starting



b) Star-Delta starting



c) Auto-transformer starting



3.3.2 The First Start-up

Three-Phase Motor with Cage Rotor

After careful examination of the motor, follow the normal sequence of starting operations listed in the control instructions for the initial start-up.

3.3.3 Operation

Drive the motor coupled to the load for a period of at least one hour while watching for abnormal noises or signs of overheating. Compare the line current with the value shown on the nameplate. Under continuous running conditions without load fluctuations this should not exceed the rated current times the service factor, also shown on the nameplate.

All measuring and control instruments and apparatus should be continuously checked for anomalies, and any irregularities corrected.

3.3.4 Stopping

Warning:

To touch any moving part of a running motor, even though disconnected, is a danger to life and limb.

- a) Three-phase motor with cage rotor:
Open the stator circuit switch. With the motor at a complete stop, reset the auto-transformer, if any, to the "start" position;



Table 11 - Bearing specifications by type of motor

NEMA Frames	Mounting	Bearings	
		Front (D.E.)	Rear (O.D.E.)
Open drip proof motors			
B48 and C48	ALL FORMS	6203 Z	6202 Z
56 and A56		6203 Z	6202 Z
B56 and C56		6203 Z	6202 Z
D56 and F56H/G56H		6204 Z	6202 Z / 6203 Z
Totally enclosed fan cooled motors			
143 T	ALL FORMS	6205 ZZ	6204 ZZ
145 T		6205 ZZ	6204 ZZ
182 T		6307 ZZ	6206 ZZ
184 T		6307 ZZ	6206 ZZ
W 182 T		6206 ZZ	6205 ZZ
W 184 T		6206 ZZ	6205 ZZ
213 T		6308 ZZ	6207 ZZ
215 T		6308 ZZ	6207 ZZ
W 213 T		6308 ZZ	6207 ZZ
W 215 T		6308 ZZ	6207 ZZ
254 T		6309-C3	6209 Z-C3
256 T		6309-C3	6209 Z-C3
W 254 T		6309-C3	6209 Z-C3
W 256 T		6309-C3	6209 Z-C3
284 T and TS		6311-C3	6211 Z-C3
286 T and TS		6311-C3	6211 Z-C3
324 T and TS		6312-C3	6212 Z-C3
326 T and TS		6312-C3	6212 Z-C3
364 T and TS		6314-C3	6314-C3
365 T and TS		6314-C3	6314-C3
404 T		NU 316-C3	6314-C3
404 TS		6314-C3	6314-C3
405 T		NU 316-C3	6314-C3
405 TS		6314-C3	6414-C3
444 T		NU 319-C3	6316-C3
444 TS		6314-C3	6314-C3
445 T		NU 319-C3	6316-C3
445 TS		6314-C3	6314-C3
447 T		NU 319-C3	6316-C3
447 TS		6314-C3	6314-C3
449 T		NU 322-C3	6319-C3
449 TS		6314-C3	6314-C3
504 T		NU 319-C3	6316-C3
504 TS		6314-C3	6314-C3
505 T		NU 319-C3	6316-C3
505 TS		6314-C3	6314-C3
5008 T		NU 322-C3	6319-C3
5008TS		6314-C3	6314-C3
586 T		NU 322-C3	6319-C3
586 TS		6314-C3	6314-C3
587 T		NU 322-C3	6319-C3
587 TS		6314-C3	6314-C3
Saw Arbor motor frame	Mounting	Bearings	
		Front (D.E.)	Rear (O.D.E.)
80 S MS	B3	6307 ZZ	6207 ZZ
80 M MS		6307 ZZ	6207 ZZ
80 L MS		6307 ZZ	6207 ZZ
90 L MS		6308 ZZ	6208 ZZ

ODP Motors Nema-T frames	Mounting	Bearings	
		Front (D.E.)	Rear (O.D.E.)
E143/5T	HORIZONTAL MOUNTING ONLY	6205 ZZ	6204 ZZ
F143/5T		6205 ZZ	6204 ZZ
182 T		6206 ZZ	6205 ZZ
184 T		6202 ZZ	6205 ZZ
213/5T		6208 ZZ	6206 ZZ
254 T		6309 Z-C3	6209 Z-C3
256 T		6309 Z-C3	6209 Z-C3
284 T		6311 Z-C3	6211 Z-C3
284 TS		6311 Z-C3	6211 Z-C3
286 T		6311 Z-C3	6211 Z-C3
286 TS		6311 Z-C3	6211 Z-C3
324 T		6312 Z-C3	6212 Z-C3
324 TS		6312 Z-C3	6212 Z-C3
326 T		6312 Z-C3	6212 Z-C3
326 TS		6312 Z-C3	6212 Z-C3
364 T		6314 C3	6314 C3
364 TS		6314 C3	6314 C3
365 T		6314 C3	6314 C3
365 TS		6314 C3	6314 C3
404 T		NU 316 C3	6314 C3
404 TS		6314 C3	6314 C3
405 T		NU 316 C3	6314 C3
405 TS		6314 C3	6314 C3
444 T		NU 319 C3	6316 C3
444 TS		6314 C3	6314 C3
445 T		NU 319 C3	6316 C3
445 TS		6314 C3	6314 C3

IEC frame	Mounting	Bearings	
		Front (D.E.)	Rear (O.D.E.)
Totally enclosed fan cooled motors			
63	B3	6201 ZZ	6201 ZZ
71		6203 ZZ	6202 ZZ
80		6204 ZZ	6203 ZZ
90 S - L		6205 ZZ	6204 ZZ
100 L		6206 ZZ	6205 ZZ
112 M		6307 ZZ	6206 ZZ
132 S - M		6308 ZZ	6207 ZZ
160 M - L		6309-C3	6209 Z-C3
180 M - L		6311-C3	6211 Z-C3
200 M - L		6312-C3	6212 Z-C3
225 S/M		6314-C3	6314-C3
250 S/M		6314-C3	6314-C3
280 S/M		6314-C3	6314-C3
		6316-C3	6316-C3
315 S/M		6314-C3	6314-C3
		6319-C3	6316-C3
355 M/L		6314-C3	6314-C3
		NU 322-C3	6319-C3

Table 12 - Bearing lubrication intervals and amount of grease

1 - SINGLE-ROW FIXED BALL BEARINGS

Bearings		Lubrication intervals (running hours)												Amount of grease (oz)
		II Pole		IV Pole		VI Pole		VIII Pole		X Pole		XII Pole		
		60Hz 3600 rpm	50Hz 3000 rpm	60Hz 1800 rpm	50Hz 1500 rpm	60Hz 1200 rpm	50Hz 1000 rpm	60Hz 900 rpm	50Hz 750 rpm	60Hz 720 rpm	50Hz 600 rpm	60Hz 600 rpm	50Hz 500 rpm	
Characteristics Ref.	6200	12500	13800											0,07
	6201	11700	13000	16600	18400									0,07
	6202	10500	11900	15400	17100	19500								0,07
	6203	9800	11200	14500	16200	18500								0,11
	6204	8700	10100	13300	14800	17100	19100				> 20000			0,14
	6205	8000	9400	12600	14100	16200	18200	19300						0,14
	6206	7300	8700	12000	13400	15400	17200	18300						0,18
	6207	6600	8100	11400	12700	14500	16300	17300	19200					0,25
	6208	5900	7400	10800	12000	13700	15300	16300	18200					0,29
	6209	5300	6900	10400	11600	13400	15000	16000	17800					0,29
	6210	4900	6400	9700	11000	12900	14600	15600	17300					0,32
	6211	4300	5900	9500	10900	12700	14400	15300	17000					0,39
	6212	3800	5400	9300	10300	12400	14300	15200	16500					0,46
	6213	3100	4900	8900	10100	12200	14000	14800	16100					0,50
	6214	1100	2000	4100	5000	5900	6500	6900	7600					0,54
	6215	1000	1800	4400	5000	5600	6300	6700	7600					0,61
	6216	700	1600	4100	4700	5700	6500	6800	7500					0,68

63	6304	8700	10100	13300	14800	17100	19100							0,14
	6305	8000	9400	12600	14100	16200	18200	19300						0,21
	6306	7300	8700	12000	13400	15400	17200	18300			> 20000			0,25
	6307	6600	8100	11400	12700	14500	16300	17300	19200					0,32
	6308	5900	7400	10800	12000	13700	15300	16300	18200	18600				0,39
	6309	5300	6900	10400	11600	13400	15000	16000	17800	18200	19900			0,46
	6310	4900	6400	9700	11000	12900	14600	19500	17300	17700	19500	19500		0,54
	6311	4300	5900	9500	10900	12700	14400	15300	17000	17400	19000	19000		0,64
	6312	3800	5400	9300	10300	12400	14300	15200	16500	16800	18200	18200		0,75
	6313	3100	4900	8900	10100	12200	14000	14800	16100	16400	17900	17900	19700	0,86
	6314	1100	2000	4100	5000	5900	6500	6900	7600	7700	8600	8600	9600	0,96
	6315	1000	1800	4400	5000	5600	6300	6700	7600	7900	8900	8900	9900	1,07
	6316	700	1600	4100	4700	5700	6500	6800	7500	7700	8500	8500	9500	1,22
	6317	800	1300	3900	4700	5600	6300	6700	7400	7500	8300	8300	9300	1,32
	6318	-	1000	3800	4600	5500	6200	6600	7200	7400	8200	8200	9100	1,47
	6319	-	800	3700	4500	5400	6100	6500	7100	7300	8000	8000	8900	1,61
	6320	-	-	3600	4300	5300	6000	6300	7000	7100	7900	7900	8800	1,82
	6321	-	-	3400	4200	5100	5800	6200	6800	7000	7800	7800	8700	2,00
	6322	-	-	3100	4000	5000	5700	6100	6700	6900	7700	7700	8600	2,14

- 1) Lubrication periodicity valid for NLG 1 and lithium based bearing lubricant.
2) Bearings for motors of X and XII poles - Lubrication Intervals > 20,000.



Table 13 - Bearing lubrication intervals and amount of grease

2 - CYLINDRICAL ROLLER BEARINGS

Bearings		Lubrication intervals (running hours)												
		II Pole		IV Pole		VI Pole		VIII Pole		X Pole		XII Pole		Amount of grease (oz)
		60Hz 3600 rpm	50Hz 3000 rpm	60Hz 1800 rpm	50Hz 1500 rpm	60Hz 1200 rpm	50Hz 1000 rpm	60Hz 900 rpm	50Hz 750 rpm	60Hz 720 rpm	50Hz 600 rpm	60Hz 600 rpm	50Hz 500 rpm	
Characteristics Ref.														
N U 3 S E R I E S	NU309	2800	4000	8300	9500	10700	11800	12500	14100	14500	16300	16300	18200	0,46
	NU310	2400	3600	7900	9100	10300	11400	12200	13700	14000	15800	15800	17700	0,54
	NU311	2000	3200	7400	8700	10000	11000	11800	13300	13600	15400	15400	17200	0,64
	NU312	1600	2700	6900	8300	9600	10700	11400	12800	13200	14900	14900	16800	0,75
	NU313	1500	2500	6600	8100	9400	10500	11200	12700	13000	14700	14700	16500	0,86
	NU314	700	1100	3100	3900	4600	5200	5500	6200	6400	7200	7200	8100	0,96
	NU315	-	900	2900	3800	4500	5100	5500	6200	6300	7100	7100	7900	1,07
	NU316	-	800	2800	3600	4400	5000	5400	6100	6200	7000	7000	7800	1,22
	NU317	-	600	2600	3500	4300	4900	5300	6000	6100	6900	6900	7700	1,32
	NU318	-	-	2100	3300	4300	4900	5300	5900	6000	6700	6700	7500	1,47
	NU319	-	-	2300	3200	4100	4700	5100	5800	6000	6700	6700	7500	1,61
	NU320	-	-	2000	3000	4000	4700	5000	5700	5900	6600	6600	7300	1,82
NU321	-	-	1900	2800	4000	4600	4900	5600	5700	6500	6500	7200	2,00	
NU322	-	-	1900	2600	3900	4400	4800	5500	5600	6400	6400	7100	2,14	

1) Lubrication periodicity valid for NLG 1 and 2 lithium based bearing lubricant.



4. Maintenance

A well-designed maintenance program for electric motors can be summed up as: periodical inspection of insulation levels, temperature rise, wear, bearing lubrication and the occasional checking of fan air flow.

Inspection cycles depend upon the type of motor and the conditions under which it operates.

4.1 Cleanliness

Motors should be kept clean, free of dust, debris and oil. Soft brushes or clean cotton rags should be used for cleaning. A jet of compressed air should be used to remove non-abrasive dust from the fan cover and any accumulated grime from the fan and cooling fins.

Oil or damp impregnated impurities can be removed with rags soaked in a suitable solvent.

Terminal boxes fitted to motors with IP55 protection should be cleaned; their terminals should be free of oxidation, in perfect mechanical condition, and all unused space dust-free.

Motors with IPW 55 protection are recommended for use under unfavourable ambient conditions.

4.2 Lubrication

Proper lubrication extends bearing life.

Lubrication Maintenance Includes:

- Attention to the overall state of the bearings;
- Cleaning and lubrication;
- Critical inspection of the bearings.

Motor noise should be measured at regular intervals of one to four months. A well-tuned ear is perfectly capable of distinguishing unusual noises, even with rudimentary tools such as a screw driver, etc., without recourse to sophisticated listening aids or stethoscopes that are available on the market.

A uniform hum is a sign that a bearing is running perfectly. Bearing temperature control is also part of routine maintenance. The temperature of bearings lubricated as recommended under item 4.2.2 should not exceed 70°C.

Constant temperature control is possible with the aid of external thermometers or by embedded thermal elements. WEG motors are normally equipped with grease lubricated ball or roller bearings. Bearings should be lubricated to avoid metallic contact of the moving parts, and also for protection against corrosion and wear. Lubricant properties deteriorate in the course of time and mechanical operation: furthermore, all lubricants are subject to contamination under working conditions.

For this reason lubricants must be renewed and any lubricant consumed needs replacing from time to time.

4.2.1 Periodical Lubrication

WEG motors are supplied with sufficient grease for a long running

period. Lubrication intervals, the amount of grease and the type of bearing used in frames 140T to 580T are to be found in Tables 11, 12 and 13.

Lubrication intervals depend upon the size of the motor, speed, working conditions and the type of grease used.

4.2.2 Quality and Quantity of Grease

Correct lubrication is important!

Grease must be applied correctly and in sufficient quantity as both insufficient or excessive greasing are harmful.

Excessive greasing causes overheating brought about by the greater resistance encountered by the rotating parts and, in particular, by the compacting of the lubricant and its eventual loss of lubricating qualities.

This can cause seepage with the grease penetrating the motor and dripping on the coils.

A lithium based grease is commonly used for the lubrication of electric motor bearings as it has good mechanical stability, is insoluble in water and has a drip point of approximately 200°C.

This grease should never be mixed with sodium or calcium based greases.

GREASES FOR MOTOR BEARINGS

For operating temperatures from - 20 to 130°C			
Frame	Supplier	Grease	Temperature range
143T-215T	Shell	Alvania R3	-20 to 130°C
254T to 586/7	Esso	Unirex N2	-30 to 165°C
Substitutes			
Supplier		Grease	Temperature Range
Mobil		Mobilith SHC100	-40 to 177°C
ESSO		Beacon 2	-20 to 130°C
Atlantic		Litholine 2	-20 to 130°C
Texaco		Multifak 2	-20 to 130°C
Molikote		BG 20	-45 to 180°C
Inisilikon		L5012	-20 to 200°C

Note: When changing lubricant, please follow manufacturers instructions

4.2.3 Lubricating Instructions

a) Frame 140T to 210T motors

Frame 140T to 210T size motors are not fitted with grease nipples. Lubrication is carried out during periodical overhauls when the motor is taken apart.

Cleaning and Lubrication of Bearings

With the motor dismantled and without extracting the bearings from the shaft, all existing grease should be removed and the bearings cleaned with Diesel oil, kerosene or other solvent, until thoroughly clean.

Refill the spaces between the balls or rollers and the bearing cages with grease immediately after washing. Never rotate bearings in their dry state after washing.

For inspection purposes apply a few drops of machine oil. During these operations maximum care and cleanliness is recommended to avoid the penetration of any impurities or dust that could harm the bearings. Clean all external parts prior to reassembly.

b) Frame 360T to 580T Motors

Motors above 360T frame size are fitted with regreaseable bearing system.

The lubrication system from this frame size upwards was designed to allow the removal of all grease from the bearing races through a bleeder outlet which at the same time impedes the entry of dust or other contaminants harmful to the bearing.

This outlet also prevents injury to the bearings from the well-known problem of over-greasing.

It is advisable to lubricate while the motor is running, to allow the renewal of grease in the bearing case.

Should this procedure not be possible because of rotating parts in the proximity of the nipple (pulleys, coupling sleeves, etc.) that are hazardous to the operator the following procedure should be followed:

- Inject about half the estimated amount of grease and run the motor at full speed for approximately a minute; switch off the motor and inject the remaining grease.

The injection of all the grease with the motor at rest could cause penetration of a portion of the lubricant through the internal seal of the bearing case and hence into the motor.

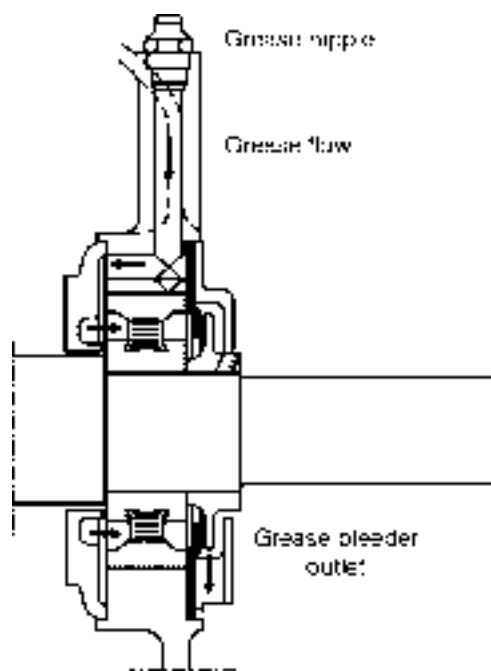


Figure 4.1 - Bearings and lubrication system

Nipples must be clean prior to introduction of grease to avoid entry of any alien bodies into the bearing.

For lubricating use only a manual grease gun.

Bearing Lubrication Steps

1. Cleanse the area around the grease nipples with clean cotton fabric.
2. With the motor running, add grease with a manual grease gun until the lubricant commences to be expelled from the bleeder outlet, or until the quantity of grease recommended in Tables 12 or 13 has been applied.
3. Allow the motor to run long enough to eject all excess grease.

4.2.4 Replacement of Bearings

The opening of a motor to replace a bearing should only be carried out by qualified personnel.

Damage to the core after the removal of the bearing cover can be avoided by filling the gap between the rotor and the stator with stiff paper of a proper thickness.

Providing suitable tooling is employed, disassembly of a bearing is not difficult.

The extractor grips should be applied to the sidewall of the inner ring to be stripped, or to an adjacent part.

To ensure perfect functioning and to prevent injury to the bearing parts, it is essential that the assembly be undertaken under conditions of complete cleanliness and by competent personnel. New bearings should not be removed from their packages until the moment of assembly.

Prior to fitting a new bearing, ascertain that the shaft has no rough edges or signs of hammering.

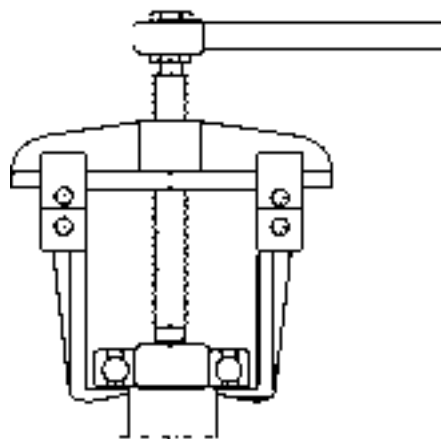


Figure 4.2 - A bearing extractor

During assembly bearings cannot be subjected to direct blows.

The aid used to press or strike the bearing should be applied to the inner ring.

4.3 Air Gap Checking (Large Rating Open Motors)

Upon the completion of any work on the bearings check the gap measurement between the stator and the rotor using the appropriate gages.

The gap variation at any two vertically opposite points must be less than 10% of the average gap measurement.

4.4 Explosion Proof Motor Repair Steps

4.4.1 Objective

In view of the heavy liability associated with burning of motors of this type, this product has been designed and manufactured to high technical standards, under rigid controls. In addition, in many areas it is required that explosion proof motors ONLY be repaired by licensed personnel or in licensed facilities authorized to do this type of work.

The following general procedures, safeguards, and guidelines must be followed in order to ensure repaired explosion proof motors operate as intended.

4.4.2 Repair Procedure and Precautions

Dismantle the damaged motor with appropriate tools without hammering and/or pitting machined surfaces such as enclosure joints, fastening holes, and all joints in general.

The position of the fan cover should be suitably marked prior to removal so as to facilitate reassembly later on.

Examine the motor's general condition and, if necessary, disassemble all parts and clean them with kerosene. Under no circumstances should scrapers, emery papers or tools be used that could affect the dimensions of any part during cleaning.

Protect all machined parts against oxidation by applying a coating of vaseline or oil immediately after cleaning.

STRIPPING OF WINDINGS

This step requires great care to avoid knocking and/or denting of enclosure joints and, when removing the sealing compound from the terminal box, damage or cracking of the frame.

IMPREGNATION

Protect all frame threads by inserting corresponding bolts, and the joint between terminal box and frame, by coating it with a non-adhesive varnish (ISO 287 - ISOLASIL).

Protective varnish on machined parts should be removed soon after treating with impregnating varnish. This operation should be carried out manually without using tools.

ASSEMBLY

Inspect all parts for defects, such as cracks, joint incrustations, damaged threads and other potential problems.

Assemble using a rubber headed mallet and a bronze bushing after ascertaining that all parts are perfectly fitted.

Bolts should be positioned with corresponding spring washers and evenly tightened.

TESTING

Rotate the shaft by hand while examining for any drag problems on covers or fastening rings.

Carry out running tests as for standard motors.

MOUNTING THE TERMINAL BOX

Prior to fitting the terminal box all cable outlets on the frame should be sealed with a sealing compound (1st layer) and an Epoxy resin (ISO 340) mixed with ground quartz (2nd layer) in the following proportions:

340A resin	50 parts
340B resin	50 parts
Ground quartz	100 parts

Drying time for this mixture is two hours during which the frame should not be handled and cable outlets should be upwards.

When dry, see that the outlets and areas around the cables are perfectly sealed.

Mount the terminal box and paint the motor.

4.4.3 Miscellaneous Recommendations

- Any damaged parts (cracks, pittings in machined surfaces, defective threads) must be replaced and under no circumstances should attempts be made to recover them.
- Upon reassembling explosion proof motors IPW55 the substitution of all seals is mandatory.
- Should any doubts arise, consult WEG.

5. Malfunctioning

Most malfunctions affecting the normal running of electric motors can be prevented by maintenance and the appropriate precautions. While ventilation, cleanliness and careful maintenance are the main factors ensuring long motor life, a further essential factor is the prompt attention to any malfunctioning as signalled by vibrations, shaft knock, declining insulation resistance, smoke or fire, sparking or unusual slip ring or brush wear, sudden changes of bearing temperatures.

When failures of an electric or mechanical nature arise, the first step to be taken is to stop the motor and subsequent examination of all mechanical and electrical parts of the installation.

In the event of fire, the installation should be isolated from the mains supply, which is normally done by turning off the respective switches.

In the event of fire within the motor itself, steps should be taken to restrain and suffocate it by covering the ventilation vents.

To extinguish a fire, dry chemical or CO₂ extinguishers should be used - never water.

5.1 Standard Three-Phase Motor Failures

Owing to the widespread usage of asynchronous three-phase motors in industry which are more often repaired in the plant workshops, there follows a summary of possible failures and their probable causes, detection and repairs.

Motors are generally designed to Class B or F insulation and for ambient temperatures up to 40°C.

Most winding defects arise when temperature limits, due to current overload, are surpassed throughout the winding or even in only portions thereof. These defects are identified by the darkening or carbonizing of wire insulation.

5.1.1 Short Circuits Between Turns

A short circuit between turns can be a consequent of two coinciding insulation defects, or the result of defects arising simultaneously on two adjacent wires. As wires are randomly tested, even the best quality wires can have weak spots. Weak spots can, on occasion, tolerate a voltage surge of 30% at the time of testing for shorting between turns, and later fail due to humidity, dust or vibration. Depending on the intensity of the short, a magnetic hum becomes audible.

In some cases, the three-phase current imbalance can be so insignificant that the motor protective device fails to react. A short circuit between turns, and phases to ground due to insulation failure is rare, and even so, it nearly always occurs during the early stages of operation.

5.1.2 Winding Failures

a) One burnt winding phase

This failure arises when a motor runs wired in delta and current fails in one main conductor.

Current rises from 2 to 2.5 times in the remaining winding with a

simultaneous marked fall in speed. If the motor stops, the current will increase from 3.5 to 4 times its rated value.

In most instances, this defect is due to the absence of a protective switch, or else the switch has been set too high.

b) Two burnt winding phases

This failure arises when current fails in one main conductor and the motor winding is star-connected. One of the winding phases remains currentless while the others absorb the full voltage and carry an excessive current.

The slip almost doubles.

c) Three burnt winding phases

Probable cause 1

Motor only protected by fuses; an overload on the motor will be the cause of the trouble.

Consequently, progressive carbonizing of the wires and insulation culminate in a short circuit between turns, or a short against the frame occurs.

A protective switch placed before the motor would easily solve this problem.

Probable cause 2

Motor incorrectly connected. For example: A motor with windings designed for 230/400V is connected through a star-delta switch to 400V connection.

The absorbed current will be so high that the winding will burn out in a few seconds if the fuses or a wrongly set protective switch fail to react promptly.

Probable cause 3

The star-delta switch is not commutated and the motor continues to run for a time connected to the star under overload conditions. As it only develops 1/3 of its torque, the motor cannot reach rated speed. The increased slip results in higher ohmic losses arising from the Joule effect. As the stator current, consistent with the load, may not exceed the rated value for the delta connection, the protective switch will not react.

Consequent to increased winding and rotor losses the motor will overheat and the winding burn out.

Probable cause 4

Failures from this cause arise from thermal overload, due to too many starts under intermittent operation or to an overly long starting cycle. The perfect functioning of motor operating under these conditions is only assured when the following values are heeded:

- number of starts per hour;
- starting with or without load;
- mechanical brake or current inversion;
- acceleration of rotating masses connected to motor shaft
- load torque vs. speed during acceleration and braking.

The continuous effort exerted by the rotor during intermittent starting brings about heavier losses which provoke overheating.

Under certain circumstances with the motor idle there is a possibility that the stator winding is subjected to damage as a result of the

heating of the motor. In such a case, a slip ring motor is recommended as a large portion of the heat (due to rotor losses) is dissipated in the rheostat.

5.1.3 Rotor Failures

If a motor running under load conditions produces a noise of varying intensity and decreasing frequency while the load is increased, the reason, in most cases, will be an unsymmetrical rotor winding.

In squirrel-cage motors the cause will nearly always be a break in one or more of the rotor bars; simultaneously, periodical stator current fluctuations may be recorded. As a rule, this defect appears only in molded or die cast aluminum cages.

Failures due to spot heating in one or another of the bars in the rotor stack are identified by the blue coloration at the affected points. Should there be failures in various contiguous bars, vibrations and shuddering can occur as if due to an unbalance, and are often interpreted as such. When the rotor stack acquires a blue or violet coloration, it is a sign of overloading.

This can be caused by overly high slip, by too many starts or overlong starting cycles. This failure can also arise from insufficient main voltage.

5.1.4 Bearing Failures

Bearing damage is a result of overloading brought about by an overly taut belt or axial impacts and stresses.

Underestimating the distance between the drive pulley and the driven pulley is a common occurrence.

The arc of contact of the belt on the drive pulley thus becomes inadmissibly small and thereby belt tension is insufficient for torque transmission.

In spite of this it is quite usual to increase belt tension in order to attain sufficient drive.

Admittably, this is feasible with the latest belt types reinforced by synthetic materials.

However, this practice fails to consider the load on the bearing and the result is bearing failure within a short time.

Additionally there is the possibility of the shaft being subjected to unacceptably high loads when the motor is fitted with a pulley that is too wide.

5.1.5 Shaft Fractures

Although bearings traditionally constitute the weaker part, and the shafts are designed with wide safety margins, it is not beyond the realm of possibility that a shaft may fracture by fatigue from bending stress brought about by excessive belt tension.

In most cases, fractures occur right behind the drive end bearing.

As a consequence of alternating bending stress induced by a rotating shaft, fractures travel inwards from the outside of the shaft until the point of rupture is reached when resistance of the remaining shaft cross-section no longer suffices.

Avoid additional drilling the shaft (fastening screw holes) as such operations tend to cause stress concentration.

5.1.6 Unbalanced V-Belt Drives

The substitution of only one of a number of other parallel belts on a drive is frequently the cause of shaft fractures, as well as being malpractice.

Any used, and consequently stretched belts retained on the drive, especially those closest to the motor, while new and unstretched belts are placed on the same drive turning farther from the bearing, can augment shaft stress.

5.1.7 Damage Arising from Poorly Fitted Transmission Parts or Improper Motor Alignment

Damage to bearing and fracture in shafts often ensue from inadequate fitting of pulleys, couplings or pinions. These parts "knock" when rotating. The defect is recognized by the scratches that appear on the shaft or the eventual scalelike flaking of the shaft end.

Keyways with edges pitted by loosely fitted keys can also bring about shaft failures.

Poorly aligned couplings cause knocks and radial and axial shaking to shaft and bearings.

Within a short while these malpractices cause the deterioration of the bearings and the enlargement of the bearing cover bracket located on the drive end side.

Shaft fracture can occur in more serious cases.



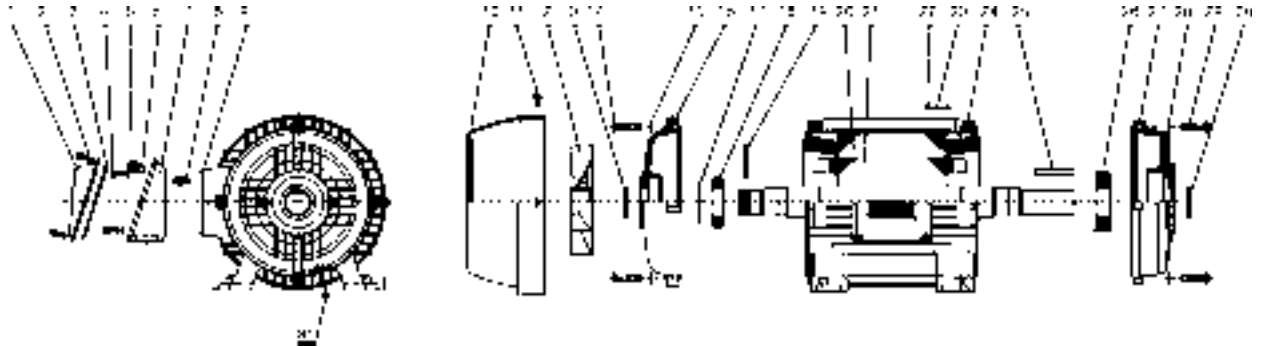
5.2 Troubleshooting chart

FAILURE	PROBABLE CAUSE	CORRECTIVE MEASURES
Motor fails to start	1. No voltage supply 2. Low voltage supply 3. Wrong control connections 4. Loose connection at some terminal lug 5. Overload	• Check feed connections to control system and from this to motor. • Check voltage supply and ascertain that voltage remains within 10% of the rated voltage shown on the motor nameplate. • Compare connections with the wiring diagram on the motor nameplate. • Tighten all connections. • Try to start motor under no-load conditions. If it starts, there may be an overload condition or a blocking of the starting mechanism. Reduce load to rated load level and increase torque.
High noise level	1. Unbalance 2. Distorted shaft 3. Incorrect alignment 4. Uneven air gap 5. Dirt in the air gap 6. Extraneous matter stuck between fan and motor casing 7. Loose motor foundation 8. Worn bearings	• Vibrations can be eliminated by balancing rotor. If load is coupled directly to motor shaft, the load can be unbalanced. • Shaft key bent; check rotor balance and eccentricity. • Check motor alignment with machine running. • Check shaft for warping or bearing wear. • Dismantle motor and remove dirt or dust with jet of dry air. • Dismantle motor and clean. Remove trash or debris from motor vicinity. • Tighten all foundation studs. If necessary, realign motor. • Check lubrication. Replace bearing if noise is excessive and continuous.
Overheating of bearings	1. Excessive grease 2. Excessive axial or radial strain on belt 3. Deformed shaft 4. Rough bearing surface 5. Loose or poorly fitted motor end shields 6. Lack of grease 7. Hardened grease cause locking of balls 8. Foreign material in grease	• Remove grease bleeder plug and run motor until excess grease is expelled. • Reduce belt tension. • Have shaft straightened and check rotor balance. • Replace bearings before they damage shaft. • Check end shields for close fit and tightness around circumference. • Add grease to bearing. • Replace bearings. • Flush out housings and relubricate.
Intense bearing vibration	1. Unbalanced rotor 2. Dirty or worn bearing 3. Bearing rings too tight on shaft and/or bearing housing 4. Extraneous solid particles in bearing	• Balance rotor statically and dynamically. • If bearing rings are in perfect condition, clean and relubricate the bearing, otherwise, replace bearing. • Before altering shaft or housing dimensions, it is advisable to ascertain that bearing dimensions correspond to manufacturer's specifications. • Take bearing apart and clean. Reassemble only if rotating and support surfaces are unharmed.
Overheating of motor	1. Obstructed cooling system 2. Overload 3. Incorrect voltages and frequencies 4. Frequent inversions 5. Rotor dragging on stator 6. Unbalanced electrical load (burnt fuse, incorrect control)	• Clean and dry motor; inspect air vents and windings periodically. • Check application, measuring voltage and current under normal running conditions. • Compare values on motor nameplate with those of mains supply. Also check voltage at motor terminals under full load. • Exchange motor for another that meets needs. • Check bearing wear and shaft curvature. • Check for unbalanced voltages or operation under single-phase condition.

6. Spare Parts and Component Terminology

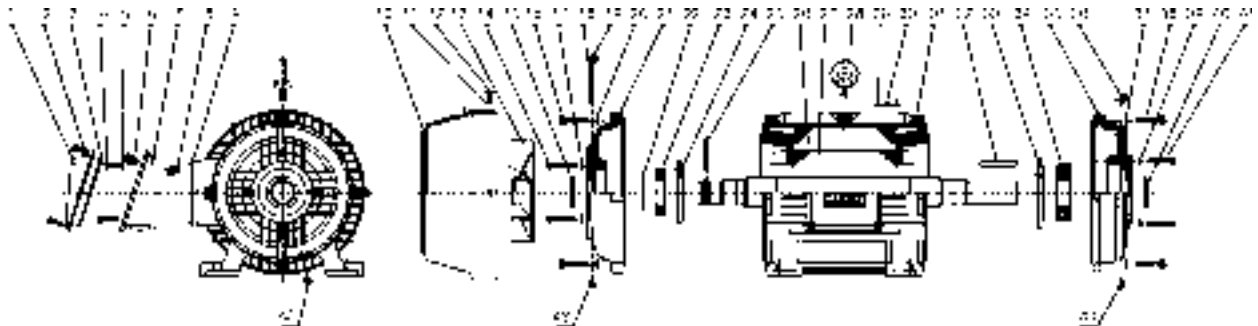


THREE-PHASE MOTORS IP55 NEMA - Frames 140T - W180T - 180T - 210T and W210T



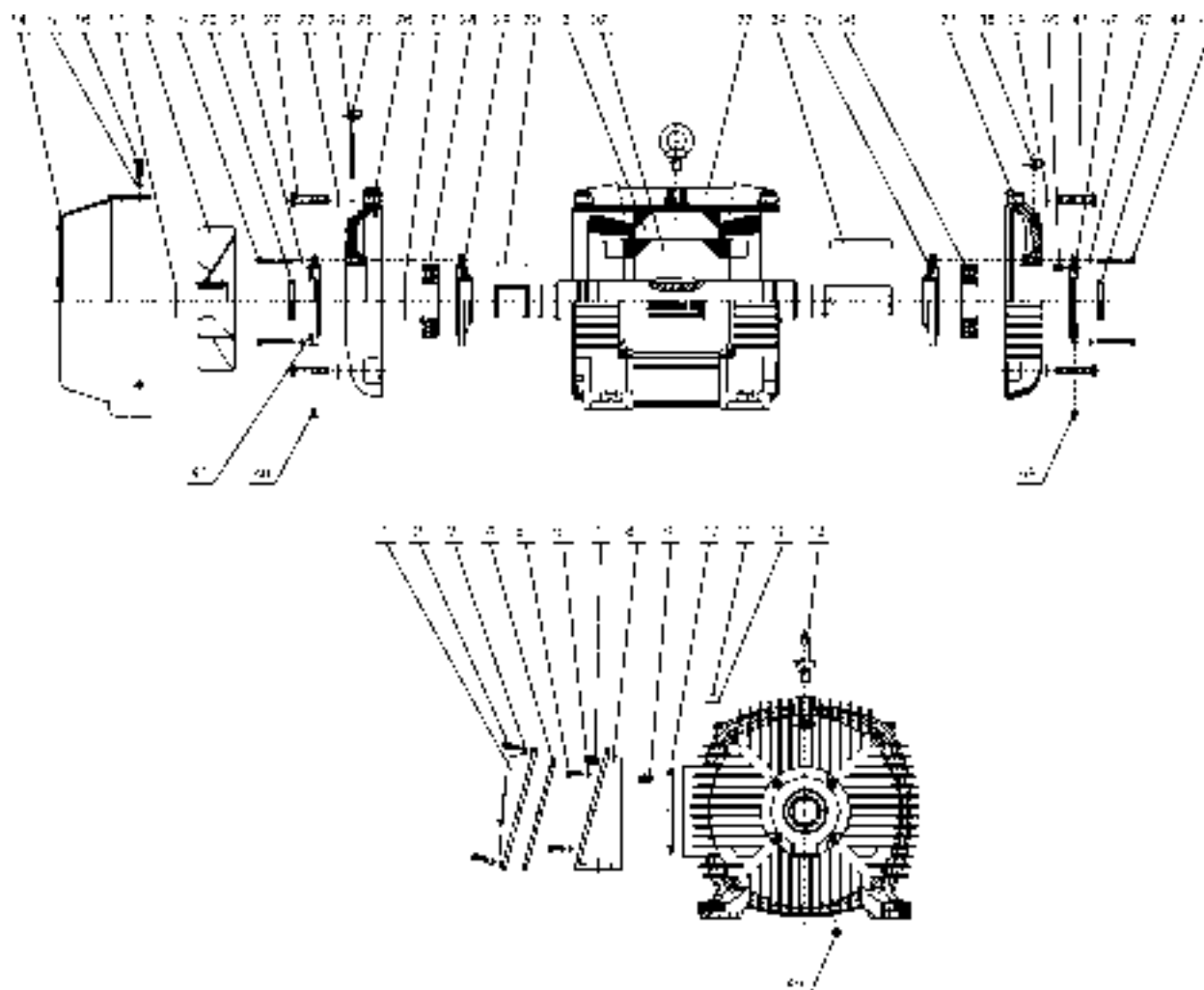
Part Nr.	Description	Part Nr.	Description	Part Nr.	Description
1	Terminal box cover	13	V'Ring	25	Shaft key
2	Terminal box cover fixing bolt	14	Non-drive end endshield fixing bolt	26	Drive end bearing
3	Terminal box cover gasket	15	Non-drive end endshield washer	27	Drive endshield
4	Terminal box fixing bolt	16	Non-drive endshield	28	Drive endshield washer
5	Terminal box fixing washer	17	Spring washer	29	Drive end endshield fixing bolt
6	Terminal box grounding lug	18	Non-drive bearing	33	V'Ring
7	Terminal box	19	Fan fixing pin	31	Drain plug
8	Frame grounding lug	20	Wound stator		
9	Terminal box o'ring gasket	21	Rotor / shaft assembly		
10	Fan cover	22	Nameplate fixing rivet		
11	Fan cover fixing bolt	23	Nameplate		
12	Fan	24	Frame		

THREE-PHASE MOTORS IP55 NEMA - Frames 250T - W250T - 280T and 320T



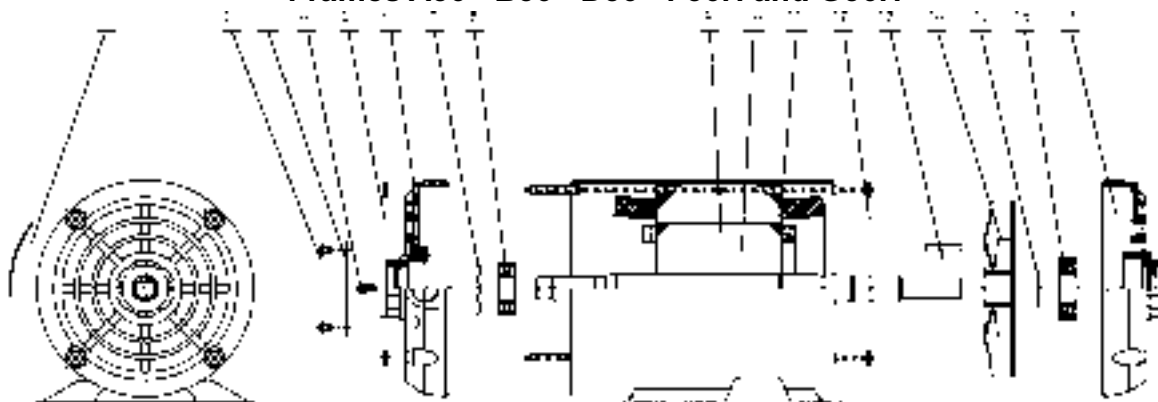
Part Nr.	Description	Part Nr.	Description	Part Nr.	Description
1	Terminal box cover	16	Non-drive end endshield fixing bolt	30	Nameplate
2	Terminal box cover fixing bolt	17	Non-drive end bearing cap washer	31	Frame
3	Terminal box cover gasket	18	Non-drive end grease nipple	32	Shaft key
4	Terminal box fixing bolt	19	Non-drive end grease nipple cover	33	Drive end bearing cap
5	Terminal box fixing washer	20	Non-drive end endshield washer	34	Drive end bearing
6	Terminal box grounding lug	21	Non-drive endshield	35	Drive andshield
7	Terminal box	22	Spring washer	36	Drive end grease nipple cover
8	Frame grounding lug	23	Non-drive end bearing	37	Drive endshield washer
9	Terminal box o'ring gasket	24	Non-drive end bearing cap	38	Drive end endshield fixing bolt
10	Fan cover	25	Fan fixing pin	39	Drive end bearing cap washer
11	Fan cover washer	26	Wound stator	40	V'Ring
12	Fan cover fixing bolt	27	Rotor and shaft	41	Drive end bearing cap fixing bolt
13	Fan	28	Eyebolt	42	Drain plug
14	Non-drive end bearing cap bolt	29	Nameplate fixing rivet	43	Non-drive and grease relief
15	V'Ring			44	Drive end grease relief

THREE-PHASE MOTORS IP55 NEMA T - Frames 360T - 400T - 440T - 500T and 580T



Part Nr.	Description	Part Nr.	Description	Part Nr.	Description
1	Terminal box cover	18	Fan	34	Shaft key
2	Terminal box cover fixing bolt	19	Non-drive end bearing cap bolt	35	Internal drive end bearing cap
3	Terminal box cover washer	20	V'Ring	36	Drive end bearing
4	Terminal box cover gasket	21	Non-drive end bearing cap washer	37	Drive endshield
5	Terminal box fixing bolt	22	Non-drive end endshield fixing bolt	38	Drive end grease nipple cover
6	Terminal box fixing washer	23	Non-drive end endshield washer	39	Drive endshield washer
7	Terminal box grounding lug	24	Non-drive end grease nipple	40	Pre-load spring
8	Terminal box	25	Non-drive end grease nipple cover	41	Drive end endshield fixing bolt
9	Frame grounding lug	26	Non-drive endshield	42	External drive end bearing cap
10	Terminal box o'ring gasket	27	Bearing cap	43	Drive end bearing cap washer
11	Nameplate fixing rivet	28	Non-drive bearing	44	V'Ring
12	Nameplate	29	Internal non-drive end bearing cap	45	Drive end bearing cap fixing bolt
13	Eyebolt	30	Fan fixing key	46	Drain plug
14	Fan cover	31	Wound stator	47	External non-drive end bearing cap
15	Fan cover washer	32	Rotor / shaft assembly	48	Non drive end grease relief
16	Fan cover fixing bolt	33	Frame	49	Non-drive end grease relief
17	Fan fixing ring				

THREE-PHASE MOTORS NEMA 56 - Frames A56 - B56 - D56 - F56H and G56H

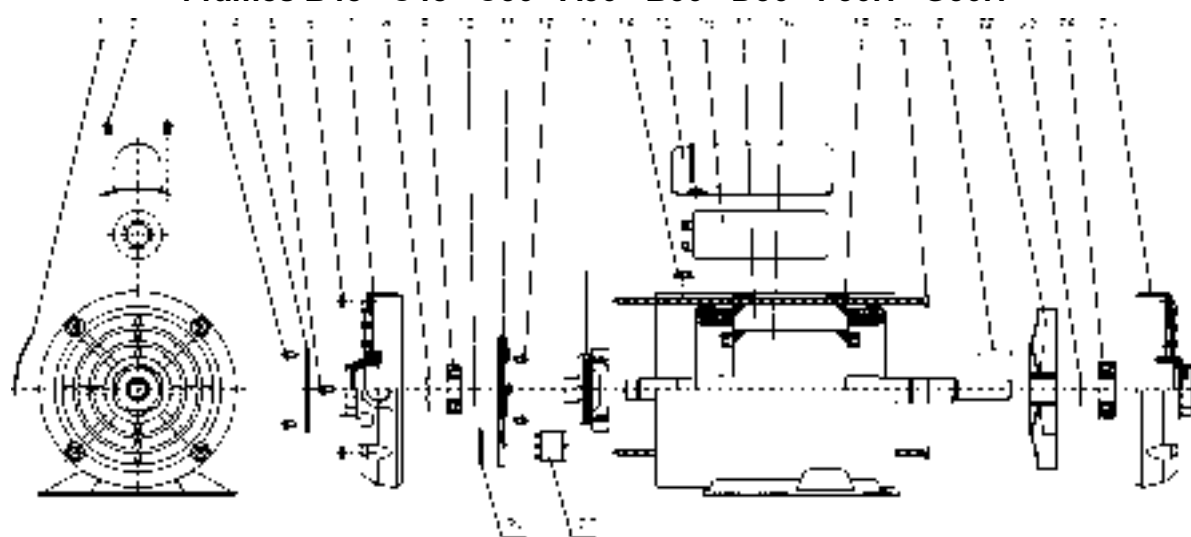


Part Nr.	Description
1	Sticker
2	Terminal box cover fixing bolt
3	Terminal box cover
4	Grounding lug
5	Through bolt fastening nut
6	Non-drive endshield
7	Spring washer

Part Nr.	Description
8	Non-drive end bearing
9	Wound stator
10	Rotor / shaft assembly
11	Frame
12	Through bolt
13	Shaft key

Part Nr.	Description
14	Fan
15	Drive end bearing fastening washer
16	Drive end bearing
17	Drive endshield

SINGLE-PHASE MOTORS NEMA 56 - Frames B48 - C48 - C56 - A56 - B56 - D56 - F56H - G56H



Part Nr.	Description
1	Sticker
2	Capacitor cover fixing bolt
3	Terminal box cover fixing bolt
4	Terminal box cover
5	Grounding lug
6	Through bolt fastening nut
7	Non-drive endshield
8	Spring washer
9	Non-drive end bearing
10	Non-drive end bearing fastening washer
11	Stationary switch

Part Nr.	Description
12	Stationary switch fastening bolt
13	Centrifugal switch
14	Rubber ring for lead passing hole to capacitor
15	Capacitor cover
16	Capacitor
17	Wound stator
18	Rotor / shaft assembly
19	Frame
20	Through bolt
21	Shaft key
22	Fan

Part Nr.	Description
23	Drive end bearing fastening washer
24	Drive end bearing
25	Drive endshield
26	Overload thermal protector fixing ring
27	Overload thermal protector

Note: For F56H and G56H frame motors: 1)

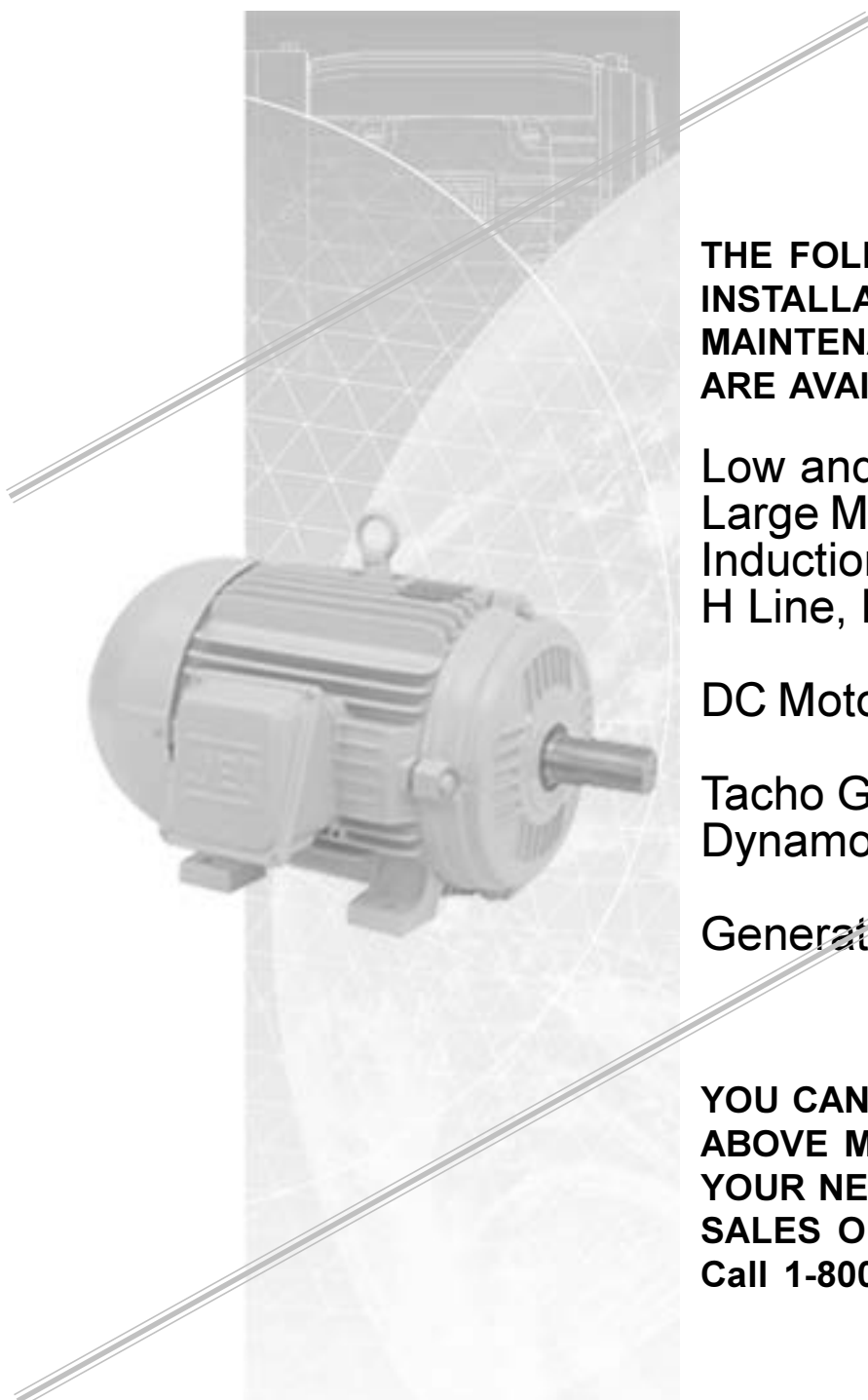
Part nr. 2 = 3 pieces; 2) Part nr. 15 and 16 = 2 pieces



NOTES:

Lined area for notes, consisting of multiple horizontal lines.

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Section 8: Manufacture's Literature

Tag No.	Manufacturer	Manufacturer PN	GreenField PN	Page
F-89,90	Universal Silencer	CCS 4"	110-1386	2
	Universal Silencer	81-1063	110-1387	3
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PI-20	WIKA	232.53/Silicone Filled	106341	20
PI-25	WIKA	232.53/Silicone Filled	100042	20
PI-33	WIKA	232.53/Silicone Filled	700701	20
C-7	GreenField	108-171	108-171	22
RTD-8,9,10,11,16,17,21,22,26,27,34,35	Smart Sensors	1250-RP-14-M-2.5-R-240-MT-1-AP	702816	26
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PSV-29	Mercer	91-16C53P13C1	705426	31
PSV-37	Mercer	91-11C53P14C1	705427	31
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	Parker/Finite	100WS15-70	705304	19
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PT-77	Rosemount	2088G2S22A1KB	705429	46
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VC-38	Parker Instrumentation	16LO-C16L-1-SS	702562	80
VC-43-49	Parker Instrumentation	8L-C8L-1-V-SS	701647	80
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SV-56	Versa	CGS-3232-NB1-XX-A120	705540	92



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Universal Silencer's cartridge filters and filter-silencers offer high-performance filtration and silencing in a convenient, economical cartridge configuration. Choose from four standard models for pipe sizes ranging from ½ in. to 16 in. and for flow capacities ranging from 15 to 7700 CFM. Three types of filter element media - pleated paper, pleated felt, or wire mesh - are available to suit your application.

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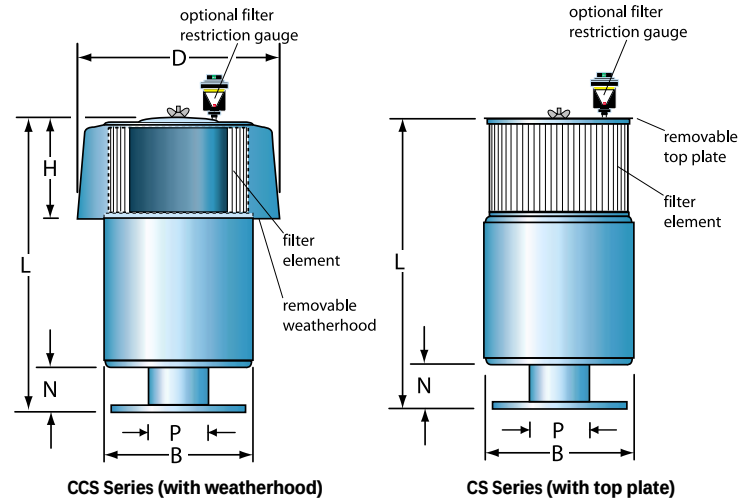
Noise Control and Air Filtration

SPECIFICATIONS

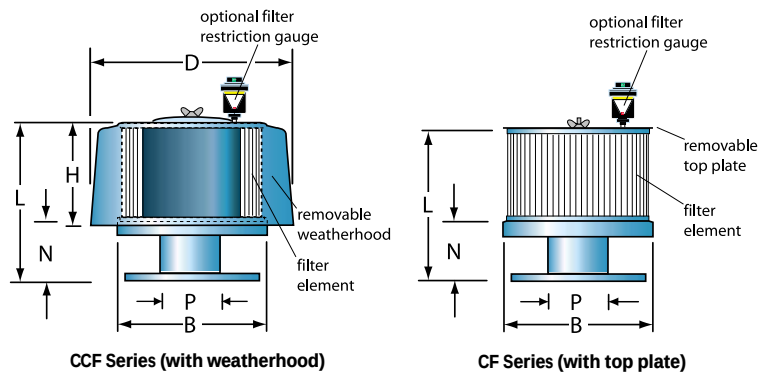
CCS and CS Filter-Silencers

Noise Attenuation, CCS and CS Filter-Silencers

Octave Band Center Frequency, Hz	63	125	250	500	1 k	2 k	4 k	8 k
Attenuation, dB	5	8	10	12	14	14	14	14



CCF and CF Filters



DIMENSIONS AND WEIGHTS

P (size)	Rated Flow Capacity				N				L				Approximate Weight with Paper Elements			
	(CFM)	D	H	B	CCF	CCS	CF	CS	CCF	CCS	CF	CS	CCF	CCS	CF	CS
½	15	8.00	3.13	6.00	Use	-	Use	-	Use	6.50	Use	6.50	Use	7	Use	7
¾	22	8.00	3.13	6.00	CCS	-	CS	-	CCS	6.50	CS	6.50	CCS	7	CS	7
1	35	8.00	3.13	6.00	Series.	-	Series.	-	Series.	6.50	Series.	6.50	Series.	7	Series.	7
1¼	60	9.00	3.50	6.50	-	-	-	-	3.50	7.88	3.50	7.88	9	10	5	9
1½	75	9.00	3.50	6.50	-	-	-	-	3.50	7.88	3.50	7.88	9	10	5	9
2	120	9.00	3.50	6.50	-	-	-	-	3.50	7.88	3.50	7.88	8	10	5	8
2½	190	13.44	6.75	10.00	1.00	1.00	1.00	1.00	7.50	17.69	7.13	17.31	11	19	10	18
3	275	13.44	6.75	10.00	1.00	1.00	1.00	1.00	7.50	17.69	7.13	17.31	10	18	9	17
3½	375	13.44	6.75	10.00	1.13	1.13	1.13	1.13	7.63	17.69	7.25	17.31	13	2012	19	
4 (NPT)	500	13.44	6.75	10.00	1.13	1.13	1.13	1.13	7.63	17.69	7.25	17.31	12	19	11	18
4 (flanged)	500	13.44	6.75	10.00	4.00	3.00	4.00	3.00	10.50	19.63	10.13	19.25	14	21	13	20
5 (NPT)	750	13.44	6.75	10.00	1.81	1.81	1.81	1.81	8.38	18.25	8.00	17.88	12	19	11	18
5 (flanged)	750	13.44	6.75	10.00	4.00	3.00	4.00	3.00	10.50	19.56	10.13	19.13	16	23	15	22
6	1100	18.00	9.50	14.00	4.00	3.00	4.00	3.00	13.31	25.25	12.75	24.75	31	43	23	35
8	2200	18.00	18.00	14.00	4.00	3.00	4.00	3.00	21.88	33.88	21.38	33.38	43	56	30	43
10	3000	24.00	11.50	18.00	4.00	3.00	4.00	3.00	15.38	29.25	14.19	28.13	52	83	41	67
12	4300	24.00	11.50	18.00	4.00	3.00	4.00	3.00	15.38	29.25	14.19	28.13	64	91	48	75
14	5900	30.00	15.44	24.00	4.00	3.00	4.00	3.00	19.38	36.25	18.25	35.06	97	143	75	121
16	7700	30.00	15.44	24.00	4.00	3.00	4.00	3.00	19.38	36.25	18.25	35.06	101	145	79	123

- All models have a 1/8-in. FNPT tap for installation of a gauge or manometer to monitor pressure drop.
- Sizes 1/2 in. through 3 1/2 in. are standard with female pipe thread connection (FNPT).
- Sizes 4 in. and 5 in. are available with female threads or flanges. Please specify "threaded" or "flanged" when you order 4 in. and 5 in. sizes.
- Sizes 6 in. through 16 in. are standard with 150# ANSI drilled plate flanges.
- Rated capacity is based upon exit velocity of approximately 5500 ft/min. If pressure drop allowance permits, capacity may be increased by as much as 50%.

PRESSURE DROP, CLEAN, ALL MODELS

Percentage of Rated Flow	50	75	100	125	150
Pressure Drop, Inches H ₂ O	0.7	1.6	2.8	4.4	6.3

FILTER ELEMENTS

Three types of filter elements are available for Universal's cartridge filters and filter-silencers. The pleated paper elements provide the highest efficiency and are considered standard. Pleated felt and wire mesh elements are available for less demanding service, with respect to efficiency. The three types of elements are completely interchangeable and will fit the CCS, CS, CF, or CCF filter housings.

SERVICE INTERVALS: Paper and felt elements are typically cleaned or replaced when the air flow resistance has increased by 4 inches of water over the initial clean resistance. The maximum restriction recommended across the filter elements is 20 inches of water, but this value may be greater than the equipment can tolerate for best efficiency. The wire mesh elements should be cleaned when they are visibly dirty and re-treated with Universal Oil-Free Adhesive or motor oil. Resistance is typically not a good indicator for cleaning wire mesh elements; a periodic cleaning schedule is recommended.



Pleated Paper Element

SPECIFICATIONS:

- High-quality industrial grade filter paper—pleated and oven-cured during production.
- Oven-cured plastisol end caps with molded sealing beads (larger elements for pipe sizes (P) 10 in., 12 in., 14 in., and 16 in. have metal end caps and closed-cell rubber gaskets).
- Media efficiency: 99.5% on 2 microns; 97% on 1 micron.
- Maximum operating temperature: 200° F for units with ½ in. through 16 in. pipe sizes.

SERVICE INSTRUCTIONS:

Because of the low cost of the paper element, it is generally treated as a consumable and replaced when dirty. However, depending upon customer preference, the paper element may be cleaned with compressed air and reused.

Compressed Air Cleaning:

Carefully direct compressed air (100 PSI maximum) through the dry element, opposite the normal direction of flow. After cleaning, inspect carefully for holes or cracks. If damaged, replace element.



Pleated Felt Element

SPECIFICATIONS:

- Durable polyester felt media — pleated.
- Oven-cured plastisol end caps with molded sealing beads (larger elements for pipe sizes (P) 10 in., 12 in., 14 in., and 16 in. have metal end caps with closed cell rubber gaskets).
- Media efficiency: 99% on 10 microns.
- Maximum operating temperature: 200° F for units with ½ in. through 8 in. pipe sizes. 250° F for units with 10 in. through 16 in. pipe sizes using elements with metal end caps.

SERVICE INSTRUCTIONS:

Pleated felt elements may be cleaned with compressed air (as described for paper elements) or water and reused.

Water Cleaning:

Rap gently to dislodge accumulated dirt, soak thoroughly approximately 15 minutes in warm water and mild detergent. Rinse thoroughly under low-pressure water. Air dry— do not dry with compressed air. After cleaning, inspect carefully for holes or cracks. If damaged, replace element.



Wire Mesh Element

SPECIFICATIONS:

- Galvanized wire-mesh media—corrugated construction.
- Larger elements for pipe sizes (P) 6 in., 8 in., 10 in., 12 in., 14 in., and 16 in. have metal end caps.
- For best efficiency, wire mesh elements must be treated with oil or oil-free adhesive.
- May be cleaned and reused indefinitely.
- Wire mesh elements are considered “roughing” filters and are not recommended for applications that require efficient filtration of fine particles.
- Approximate efficiency: 93% on 10 microns. Efficiency will vary with element oil or adhesive coverage.
- Maximum operating temperature: 200° F for ½ in. through 16 in. with oil-free adhesive (the flash point for oil-free adhesive is 235° F). 300° F for ½ in. through 16 in. without oil-free adhesive. Filter efficiency is much lower without oil-free adhesive on the filter. Higher temperatures can be used with uncoated ½ in. through 5 in. filter elements without end caps.

SERVICE INSTRUCTIONS:

New elements are delivered pre-treated with Universal Silencer's oil-free adhesive. See the back page for details. For best efficiency, wire mesh elements must be re-treated after each cleaning. Spray the element on both sides with Universal Oil-Free Adhesive, P/N 81-0323, following the directions on the container. For oil treatment, dip the element in SAE 30-50 motor oil and drain thoroughly before using.

To clean wire mesh elements, wash in solvent or warm water and detergent in a container large enough for complete immersion of element. Rinse completely, drain, and either air dry or use compressed air. After cleaning and drying, re-treat the element with oil-free adhesive or oil as described.

P (nom.)	Replacement Element Part No.		
	Paper	Felt	Wire
1½	81-0470	81-1202	81-1035
3¼	81-0470	81-1202	81-1035
1	81-0470	81-1202	81-1035
1¼	81-0471	81-1203	81-1036
1½	81-0471	81-1203	81-1036
2	81-0471	81-1203	81-1036
2½	81-1063, 81-0472 (old)	81-1205, 81-1204 (old)	81-1038, 81-1037 (old)
3	81-1063, 81-0472 (old)	81-1205, 81-1204 (old)	81-1038, 81-1037 (old)
3½	81-1063	81-1205	81-1038
4	81-1063	81-1205	81-1038
5	81-1063, 81-0474 (old)	81-1205, 81-1206 (old)	81-1038, 81-1039 (old)
6	81-0475	81-1207	81-1040
8	(2) 81-0475	(2) 81-1207	(2) 81-1040, (1) 81-1199 (old)
10	81-1163	81-1209	81-1200
12	81-1163	81-1209	81-1200
14	81-1164	81-1210	81-1201
16	81-1164	81-1210	81-1201

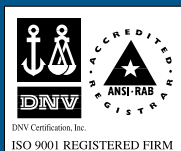
UNIVERSAL SILENCER



Our corporate headquarters are located in Stoughton, Wisconsin, just southeast of Madison, the state capital. This new building houses administration, sales, and engineering departments.



Manufacturing facilities are in Muscoda (above), 75 miles west of Stoughton, and Montello (below), 70 miles north.



Our products have been used to protect, quiet, and optimize the performance of industrial equipment for 40 years. We maintain a fully equipped testing facility to qualify filters and silencers. We are an ISO 9001 registered firm and ASME Code certified.

*Keeping
industrial equipment
clean and quiet.*

UNIVERSAL

TM

Cartridge Air Filters and Filter-Silencers

AIR FILTER RESTRICTION GAUGE

Universal's Filter Restriction Gauge provides a convenient, accurate means of monitoring filter pressure drop as the filter element becomes increasingly loaded with dirt. Cartridge filters and filter-silencers are standard with threaded connections for direct mounting of the gauge. See product bulletin 81-1234 for a complete description.



OIL-FREE ADHESIVE FOR WIRE MESH ELEMENTS

This is an oil-free product developed for use on viscous impingement filters. It is a substitute for applications that do not permit oil wetting of the filter elements, such as oil-free compressors. Universal oil-free filter adhesive is available in 16-ounce aerosol spray cans, packaged 6 cans per case. Order by part number 81-0323.



Contact us for more information about our complete line of industrial silencers, air filters, and filter-silencers:

- Air filters and filter-silencers, catalog 241-A
- CB compact blower silencers, catalog 255-A
- CBF/CBFI compact blower filter-silencers, catalog 261-A
- Air filter restriction gauge, catalog 81-1234
- Reciprocating engine silencers and filters, catalog 246-A
- Rotary positive blower silencers, catalog 244-D
- Absorptive silencers, catalog 245-B
- Vent and blowdown silencers, catalog 243-C
- Compressor silencers and filters, information provided by application
- Vacuum pump separator silencers, catalog 222-B
- Industrial fan silencers, catalog 249-A, 249-D
- Steam ejectors, pressure reduction valves, and other special applications
- Gas turbine silencers and filters, catalog B-249-A
- Acousti-Tube® Silencers, catalog 260
- Acousti-Tube® Silencer Series, technical bulletin 94-1315
- StrataClean™ barrier air filter systems, catalog 268
- StrataClean™ Pulse air filter systems, catalog 269

UNIVERSAL SILENCER

A FLEETGUARD/NELSON COMPANY
P. O. Box 411, Stoughton, Wisconsin 53589
608-873-4272 Fax 608-873-4298

Internet E-mail: US@universal-silencer.com

On the Web: www.universal-silencer.com

AIR FILTRATION PRODUCTS

Air Filter Restriction Gauge 81-1234

For cartridge and panel filter housings

CBF, CBFI, CCF, CF, CCS, CS, FH, FSH, FRH, FCRH, FASH, FMH, ILF, ILFS, RF, RFY, RFS, RFSY

Saves energy, labor, material

- Accurate monitoring ensures that filter elements are replaced and serviced only when necessary.

Easy to check filter life

- Convenient monitoring saves maintenance time.
- The gauge is easy to read, even at a distance.

Universal's air filter restriction gauge provides a convenient, inexpensive means of monitoring filter element restriction and remaining life of the filter element.

The yellow indicator in the filter restriction gauge drops progressively as the filter element is loaded with dirt. When the indicator reaches the mark recommended by the equipment manufacturer, it's time to change or service the filter.

The gauge measures up to 20 inches of water and allows you to determine the condition of the filter element even after the equipment is shut down. After the element has been replaced, just push the reset button on the top of the gauge to reset it to the original clean-filter position.

The manufacturer of the equipment in which the filter is installed can recommend the maximum pressure drop at which the filter should be serviced. The maximum restriction recommended across Universal Silencer's filter elements is 20 inches of water, but this value may be greater than the equipment can tolerate for best efficiency. Thus, the filter element should be serviced or replaced at either the manufacturer's recommendation or 20 inches of water, whichever is smaller.

The restriction gauge is equipped with a 1/8" male NPT and may be threaded directly into a 1/8" female NPT fitting.

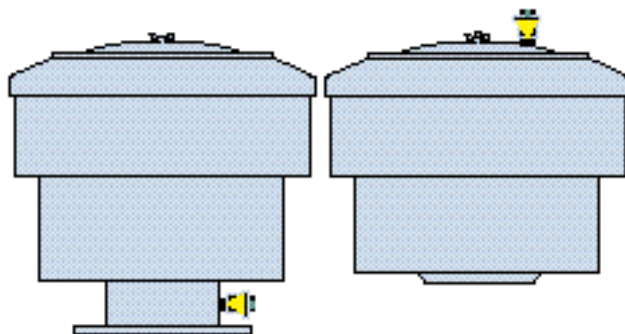
If the gauge is to be installed in a 1/4" female fitting, a 1/4" x 1/8" NPT adapter is required.

Order part number 81-1234.

608.873.4272

Internet E-mail: US@universal-silencer.com

On the Web: www.universal-silencer.com



NOZZLE MOUNT

WEATHERHOOD MOUNT

Mount the gauge in the nozzle with a 1/4" x 1/8" NPT adapter, as shown at left, or mount it on the weatherhood in the 1/8" FNPT opening, as shown on the right.



UNIVERSAL SILENCER

A FLEETGUARD/NELSON COMPANY

Noise Control and Air Filtration

UNIVERSAL SILENCER



Our corporate headquarters are located in Stoughton, Wisconsin, just southeast of Madison, the state capital. This new building houses administration, sales, and engineering departments. Manufacturing facilities are in Muscoda, 75 miles west of Stoughton, and Montello, 70 miles north.



Our products have been used to protect, quiet, and optimize the performance of industrial equipment for almost 40 years. We maintain a fully equipped facility for testing filters and silencers under actual operating conditions. We are an ISO 9001 registered firm and ASME Code certified.

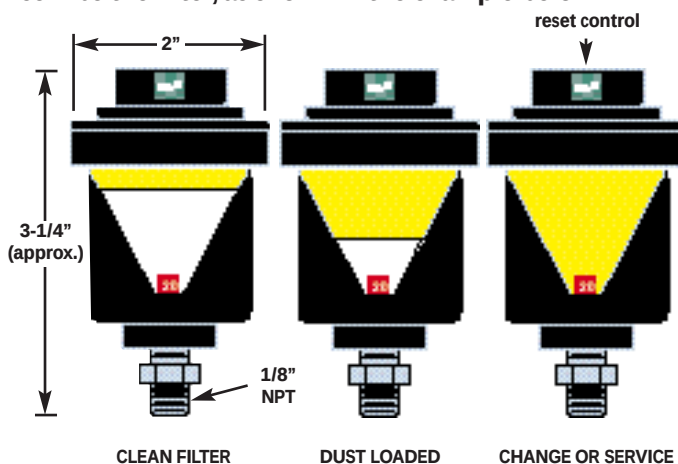
*Keeping
industrial equipment
clean and quiet.*



AIR FILTRATION

Filter Gauge 81-1234

The yellow indicator in the filter restriction gauge drops progressively as the filter element is loaded with dirt. When the indicator reaches the mark recommended by the equipment manufacturer, it's time to change or service the filter, as shown in the example below.



Contact us for more information about our complete line of industrial silencers and air filter/filter silencers:

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- Cartridge air filters and filter silencers, catalog 242-B
- CB compact blower silencers, catalog 255-A
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- Vent silencers, catalog 243-B
- Vent silencer specification sheet, form 88-0063
- Reciprocating engines, catalog 246-A
- Rotary positive blowers, catalog 244-D
- Axial fans, catalog 249-D
- Compressors, information provided by application
- Vacuum pumps, catalog 222-B
- Industrial fans, catalog 249-A
- Steam ejectors, pressure reduction valves, and other special applications

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International H-Series

Compressed Air & Gas Filters

- Coalescing, Particulate & Hydrocarbon Adsorption
- Flows from 10 to 1600 SCFM; 17 to 2822 m³/hr
- 1/4" to 3" NPT, BSPF & BSPT Ports

Bulletin 1300 - 993C/USA



Finite[®]

focus



quality



service



innovation



Finite® Filter focuses on what matters most—quality, service, innovation, and YOU - our customer. So when your compressed air or gas system challenges you, give the experts at Finite a call!
1-800-521-4357



Product rejects?
Lost production time?
Increased maintenance expense?

The real problem? ... dirty compressed air and gas

Why filter compressed air and gas?

Submicronic contaminants in compressed air systems plug orifices of sensitive pneumatic instrumentation, wear out seals, erode system components, reduce the absorptive capacity of desiccant air/gas dehydrators, foul heat transfer surfaces, reduce air tool efficiency, and damage finished products. The results include: product rejects, lost production time and increased maintenance expense. For example, trace amounts of submicronic oil can cause serious fish eye

blemishing in automotive finishing operations. Water left in air lines can freeze during exposure to cold, blocking flow or rupturing pipes.

Compressor lubricant not captured in a coalescing filter will eventually collect in pneumatic components, causing premature component repair or replacement. Environmental concerns will be raised if oily, compressed air is continually discharged into the atmosphere through a pneumatic muffler.



The real solution? ...**Finite's** International H-Series

Finite Filter's International H-Series is the right solution for most compressed air/gas applications. The International H-Series housings are available with oil removal (coalescing), particulate and oil vapor removal elements.

This world class, world quality product can greatly improve your compressed air and gas systems.

Finite's H-Series Offers...

- Coalescing, particulate and adsorption filter elements
- Optional indicators, gauges and drains
- Temperatures to 450° F
- Connection sizes from 1/4" to 3" NPT, BSPF & BSPT
- Flows from 10 to 1600 SCFM (17-2822 m³/hr)
- Pressures to 500 PSIG

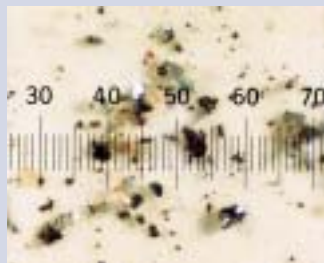
oil



water



solids



Actual pictomicrograph of particulate contaminants
(Magnified 100x Scale: 1 division = 20 microns (mm))

three contamination threats

The contaminants of greatest concern in precision compressed air systems are water, oil and solids. Water vapor is present in all compressed air; it becomes greatly concentrated by the compression process. While air dryer systems can be used effectively to remove water from compressed air, they will not remove the second major liquid contaminant – oil. Most oil comes from compressor lubrication carry-

over, but even the air produced by oil-free compressors has hydrocarbon contamination brought into the system through the intake.

The third contaminant found in compressed air is solid matter including rust and scale. Solid particulates, combined with aerosols of water and oil, can clog and shorten the life of air system components and can foul processes.



Typical Applications

(See Pages 4-5 for application drawings)

Coalescing (Oil Removal)

- Air dryer prefilter
- Paint spray booths
- Breathing air
- Tool protection
- Air valve protection
- Air cylinder protection
- Compressed air system protection

Adsorber (Vapor Removal)

- Odor removal
- Breathing air
- Food packaging machines
- High purity laboratory gases
- Hydrocarbon vapor removal

Interceptor (Particulate Removal)

- Desiccant dryer afterfilter
- Prefilter for coalescer
- Systems with high concentrations of solid contaminant
- Particulate protection for non-lubricated systems



Easy as...

Steps to
clean, dry
compressed air!

Step 1

Determine your application, media grade, media type and end seals.
Pages 6-7

Step 2

Choose your housing and replacement elements.
Pages 8-9

Step 3

Choose your accessories. Find out what's standard or choose what's best for your application.
Page 9

Step 4

How to Order. Build your own part number here!
Page 10

Does one of these applications describe your system?

From aeration in pharmaceutical and chemical processes to pneumatic power systems, the possibilities for applications are endless. Finite has some suggested applications that may fit your needs. Let one of Finite's application engineers find a system that is right for you.

quality.

International Standard ISO8573-1 is fast becoming the industry standard method for specifying compressed air cleanliness. The following diagrams describe various systems in terms of their corresponding ISO classification.

International ISO Standards

Notification as specified in ISO8573 - 1

Class	Solid		Water		Oil
	Maximum particle size* (mm)	Maximum Concentration** ppm(mg/m³)	Maximum Pressure Dewpoint °F (°C)		Maximum Concentration** ppm(mg/m³)
1	0.1	0.1 (.08)	-94 (-70)		0.01 (.008)
2	1	1 (.8)	-40 (-20)		0.1 (.08)
3	5	5 (4.2)	-4 (-20)		1 (.83)
4	15	8 (6.7)	37 (+3)		5 (4.2)
5	40	10 (8.3)	45 (+7)		25 (21)
6	-	-	50 (+10)		-

* Particle size is based on a filtration ratio ≥ 20 . The minimum accuracy of the measuring method used is 20% of the limiting value of the class.

** At 14.7 psi (1 bar) absolute pressure, +70°F (+20°C) and a relative humidity of 60%. It should be noted that at pressures above atmospheric, the contaminant concentration is higher.

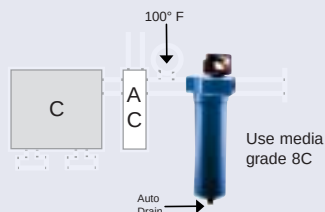
Notes:

1. The quality of the air delivered by non-lubricated compressors is influenced by the quality of the intake air and the compressor design.

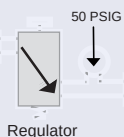
2. The minimum accuracy of the measuring method used is 20% of the limiting value of the class.

ISO Class 2 3

Compressor Room (Source)
Air Preparation Equipment:



Point-Of-Use
Air Preparation Equipment:

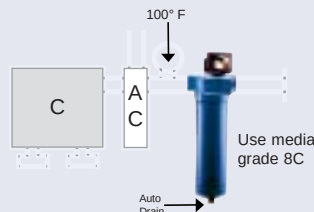


Any compressor with aftercooler. Air intended for use with lubricated air tools, air motors, cylinders, shot blasting, non-frictional valves.

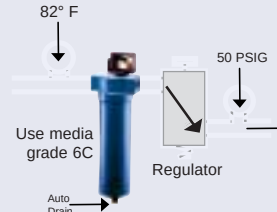
OTHER SPECS MET: Compressed Air & Gas Institute:
CGA – G7.1 (Grades A & Ba1),

ISO Class 1 1

Compressor Room (Source)
Air Preparation Equipment:



Point-Of-Use Air Preparation Equipment:

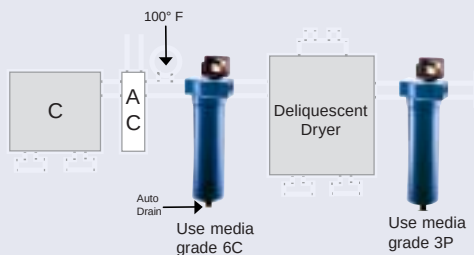


Any compressor with aftercooler and 2-stage coalescing. Air intended for use with lubricated control valves, cylinders and parts blow-down, etc.

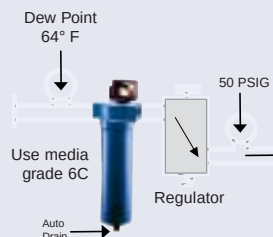
OTHER SPECS MET: Mil. Std. 282 H.E.P.A. U.S.P.H.S. 3A
Accepted particles for milk

ISO Class 1 1

Compressor Room (Source)
Air Preparation Equipment:



Point-Of-Use
Air Preparation Equipment:

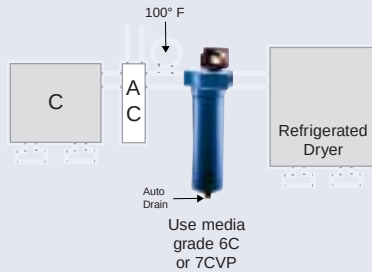


Any compressor with aftercooler, 2-stage coalescing and deliquescent dryer. Air intended for use with general pneumatic systems, body shop spray painting and components sensitive to high moisture content.

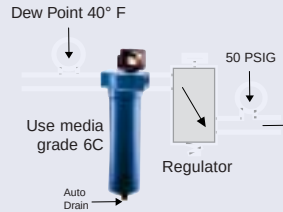
OTHER SPECS MET: Compressed Air & Gas Institute:
CGA – G7.1 (Grades C)

ISO Class 141

Compressor Room (Source) Air Preparation Equipment:



Point-Of-Use Air Preparation Equipment:

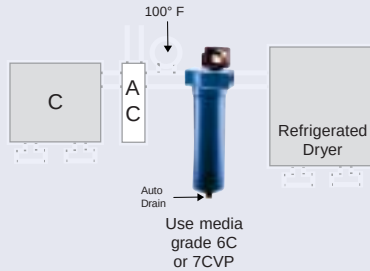


Any compressor with aftercooler, 2-stage coalescing and refrigerated dryer. Air intended for use with air-gauging, air conveyors, spray-painting, food processing, instrumentation, blow molding, cosmetics, film processing, bottling, pharmaceuticals, dairy, breweries, medical, robotics and close tolerance valves.

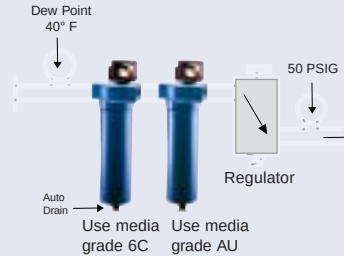
SPECS MET: CGA – G7.1 (Grade D & E) ISAS7.3 Fed. Std. 209 (Class 100)

ISO Class 141

Compressor Room (Source) Air Preparation Equipment:



Point-Of-Use Air Preparation Equipment:

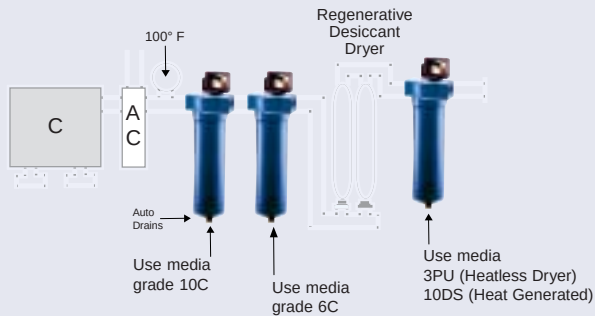


Any compressor with aftercooler, 2-stage coalescing, refrigerated dryer and carbon absorber. Air intended for use as industrial breathing air and decompression chambers. CAUTION: Always use high temperature synthetic lubricants and monitor (alarm for carbon monoxide concentrations exceeding 20ppm). This system will not eliminate toxic gases!

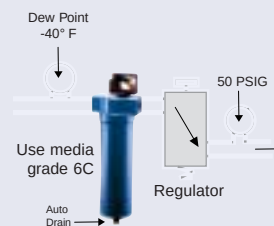
OTHER SPECS MET: O.S.H.A. 29CFR 1910.134

ISO Class 121

Compressor Room (Source) Air Preparation Equipment:



Point-Of-Use Air Preparation Equipment:



Any compressor with aftercooler, two-stage and double coalescing and a regenerative-type desiccant dryer. Air intended for use in applications involving rapid expansion of compressed air, critical instrumentation, high purity gases, computer chip drying, etc. CAUTION: This air is too dry for respiratory use.

SPECS MET: CGA – G7.1 (Grade F),

Step 1

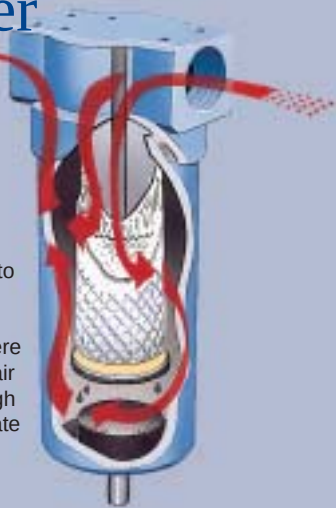
Determine your application, media grade, media type and end seals.

Find your (or similar) application in the chart below, from the basic application circuits on the previous page, or consult a **Finite®** application engineer. Determine media grade, media type, and end seal required. If your application requires a coalescing element, use the information listed below. For other media types, please see the following page.

Coalescing (Liquid and Particulate Removal) Filter Media

How does a coalescer work?

This filter housing cutaway depicts the coalescing process. Air enters the housing and flows through the filter media passing from the inside element surface to the outside. Coalesced liquid, water and oil, collects in the bowl where it is drained and clean air exits the housing through the outlet port. Particulate contaminants are captured and held in the media.



Coalescing elements are wrapped in color netting corresponding to media grades below, or will have the media grade printed on the element.

Media Grade
Media Type
End Seal

4

APPLICATIONS: Very high-efficiency coalescer; for elevated pressures up to **500 PSIG** (34 bar) or when removing aerosols from lighter weight gases. Protection of pneumatic systems and critical modulating systems such as flow and temperature controllers.

STANDARD

6

APPLICATIONS: General air coalescing applications when total removal of liquid aerosols and suspended fines is required in all pressure ranges. Protection of air dryers, air gauging, air logic, modulating systems, critical air conveying, most breathing air systems, etc.

7CVP

APPLICATIONS: High efficiency and very low pressure drop, even when wetted by oil and water, makes this pleated coalescing media an excellent choice for medium efficiency applications. Large surface area means long life and a high tolerance for heavy liquid aerosol contamination. Prefilter for refrigerated air dryer.

8

APPLICATIONS: Good air coalescing efficiency in combination with high flow rate and long element life. Protection of noncritical circuit components such as valves, cylinders, etc. Prefilter for refrigerated air dryer.

10

APPLICATIONS: Precoalescer or prefilter for Grade 6 to remove gross amounts of water and oil, or tenacious aerosols which are difficult to remove. Upgrading existing particulate equipment to coalescing without increase in pressure drop.

Choose your media type



C: Micro-glass coalescer



Q: Micro-glass coalescer with built-in pleated prefilter



7CVP: Micro-glass pleated coalescer



D: High temperature micro-glass coalescer up to 450° F (232° C)

Media Specifications

Grade Designation	Coalescing Efficiency .3 to .6 Micron Particles	Maximum Oil Carryover ¹ PPM w/w	Micron Rating	Pressure Drop (PSID) @ Rated Flow ²	
				Media Dry	Media Wet With 10-20 wt. oil
4	99.995%	.003	.01	1.25	3-4
6	99.97%	.008	.01	1.0	2-3
7	99.5%	.09	.5	.25	.5 - .7
8	98.5%	.2	.5	.5	1-1.5
10	95%	.85	.7	.5	.5

¹Tested per ADF-400 at 40 ppm inlet.

²Add dry + wet for total pressure drop.

Coalescer End Seals:

Blank: No end seals - Elements are self-sealing.

Standard on filters with 1/4" to 1" connection sizes.

U: Molded urethane, Standard on all filters with 1 1/4" to 3" connection sizes.

S: Molded silicone rubber end seals used for high-temperature elements up to **450°F** (232°C).

V: Fluorocarbon gasket bonded to metal end cap. Optional seal used for high temperature **450°F** (232°C) elements. Available on 1 1/4" NPT and larger. Standard on all 7CVP media.

Water Separator Filter Media

100WS

APPLICATIONS: Reduction and elimination of excess liquids in gas streams. Excellent prefiltration for coalescing grades 6 and 10 when extreme quantities of liquid contaminants are present.

Grade Designation	Filter Efficiency Rating	Pressure Drop (PSID) @ Rated Flow Media Dry
100WS	100mm	<.25

Water Separator End Seals:

Blank: Fluorocarbon gasket bonded to metal end cap. Standard on filters with 1 1/4" to 3" connection sizes.

U: Molded urethane. Standard on all filters with 1/4" to 1" connection sizes.

media type



100WS: Rolled Stainless Steel Mesh

Interceptor (Particulate Removal) Filter Media

3P U

APPLICATIONS: Particulate removal where very high dirt-holding capacity is required. Safety afterfilter for desiccant dryer, pore matched prefilter for coalescer or as general use for final instrument air protection.

Media Specifications

Grade Designation	Filter Efficiency Rating	Pressure Drop (PSID) @ Rated Flow Media Dry
3P	3mm	.25

media type



3P: Pleated Cellulose

Interceptor End Seals: **U** = Molded urethane. Standard on all 3P pleated cellulose filter elements.

Adsorption (Vapor Removal) Filter Media

A U

APPLICATIONS: Polishing gas stream of final trace amounts of hydrocarbon contaminants, usually .5 to 2 ppm inlet concentrations. Preparation for breathing air; hydrocarbon vapor removal.

Media Specifications

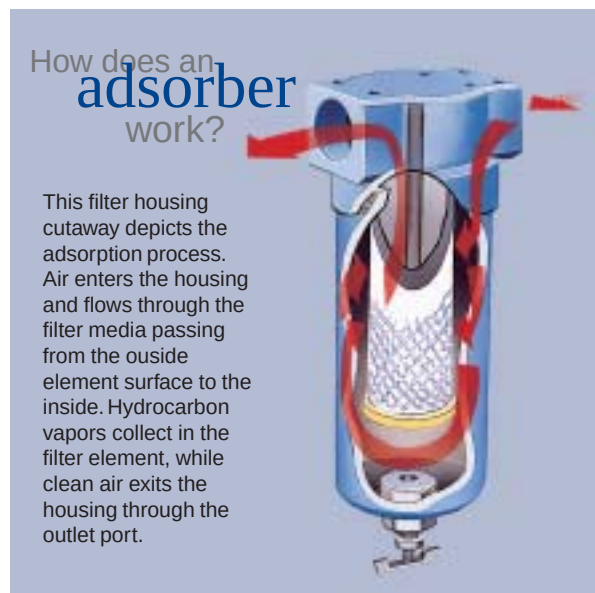
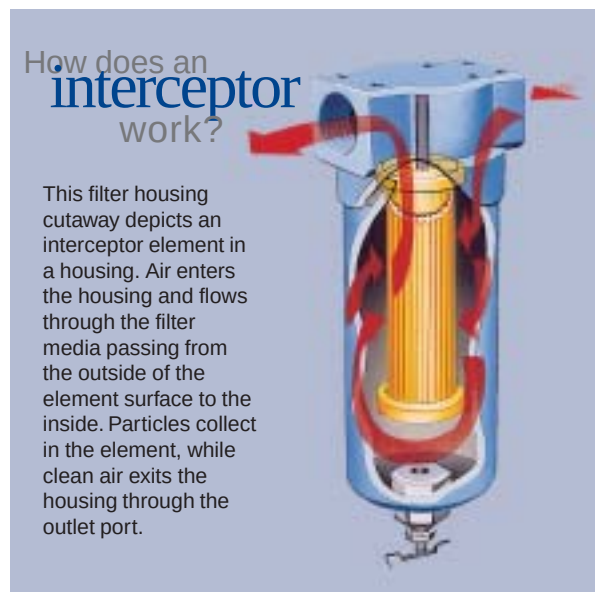
Grade Designation	Oil Vapor Removal Efficiency	Pressure Drop (PSID) @ Rated Flow Media Dry
A	99%+	1

media type



A: Activated Carbon

Adsorber End Seals: **U** = Molded urethane. Standard on all activated carbon filter elements.



Step 2

Determine your Housing.

Find desired flow rate under appropriate media grade column. For pressures other than 100 PSIG or temperatures other than 70°F, please see Alternate Housing Selection Chart, Step 2a, on following page.

☐ = Insert Port Type. See page 11 for options. For example: Insert "N" for an NPT Port.

Housing Selection Chart

Housing Assembly	Port Size	Rated Flows: SCFM @ 100 PSIG (m³/hr @ 7 bar) + 10%							
		For other pressures, please see Step 2a on following page							
		4 Coalescer	STANDARD 6 Coalescer	7CVP Coalescer	8 Coalescer	10 Coalescer	3PU Interceptor	100WS Water Separator	A Adsorber
H ☐ 1S	1/4"	11 (19)	15 (26)	N/A	20 (34)	25 (43)	25 (43)	50 (85)	15 (26)
H ☐ 15S	3/8"	15 (26)	20 (34)	N/A	27 (46)	33 (56)	33 (56)	66 (112)	20 (34)
H ☐ 2S	1/2"	19 (32)	25 (43)	N/A	34 (58)	42 (71)	42 (71)	83 (141)	25 (43)
H ☐ 1L	1/4"	23 (39)	30 (51)	N/A	41 (68)	50 (85)	50 (85)	50 (85)	30 (51)
H ☐ 15L	3/8"	30 (51)	40 (68)	N/A	55 (94)	66 (112)	66 (112)	66 (112)	40 (68)
H ☐ 2L	1/2"	38 (65)	50 (85)	N/A	68 (116)	83 (141)	83 (141)	83 (141)	50 (85)
H ☐ 3S	3/4"	61 (104)	80 (136)	N/A	109 (185)	133 (226)	133 (226)	133 (226)	80 (136)
H ☐ 4S	1"	76 (129)	100 (170)	N/A	136 (231)	166 (282)	166 (282)	232 (394)	100 (170)
H ☐ 4L	1"	106 (180)	140 (238)	N/A	191 (325)	232 (394)	232 (394)	232 (394)	140 (238)
H ☐ 5S	1 1/4"	190 (323)	250 (425)	415 (706)	330 (461)	415 (706)	415 (706)	415 (706)	250 (425)
H ☐ 6S	1 1/2"	260 (442)	350 (595)	600 (1020)	465 (791)	600 (1020)	600 (1020)	600 (1020)	350 (595)
H ☐ 8E	2"	260 (442)	350 (595)	600 (1020)	465 (791)	600 (1020)	600 (1020)	600 (1020)	350 (595)
H ☐ 8S	2"	340 (578)	450 (765)	750 (1275)	600 (1020)	750 (1275)	750 (1275)	750 (1275)	450 (765)
H ☐ 8L	2"	470 (799)	625 (1063)	1035 (1760)	830 (1411)	1035 (1760)	1035 (1760)	1035 (1760)	625 (1063)
H ☐ 0L	2 1/2"	600 (1020)	800 (1360)	1330 (2261)	1060 (1802)	1330 (2261)	1330 (2261)	1330 (2261)	800 (1360)
H ☐ 12L	3"	750 (1275)	1000 (1700)	1660 (2822)	1330 (2261)	1660 (2822)	1660 (2822)	1660 (2822)	1000 (1700)

Replacement Element Part Numbers

Housing Assembly	Media Type							
	(* Insert selected grade 4, 6, 8, 10)							
	Coalescer	Coalescer w/ inner retainer	High Temperature	Coalescer w/ built-in prefilter	7CVP Pleated Coalescer	3PU Interceptor	100WS Water Separator	AU Adsorber
H ☐ 1S	*C10-025	*IU10-025	*DS10-025	*QU10-025	N/A	3PU10-025	100WSU10-025	AU10-025
H ☐ 15S	*C10-025	*IU10-025	*DS10-025	*QU10-025	N/A	3PU10-025	100WSU10-025	AU10-025
H ☐ 2S	*C10-025	*IU10-025	*DS10-025	*QU10-025	N/A	3PU10-025	100WSU10-025	AU10-025
H ☐ 1L	*C10-050	*IU10-050	*DS10-050	*QU10-050	N/A	3PU10-050	100WSU10-025	AU10-050
H ☐ 15L	*C10-050	*IU10-050	*DS10-050	*QU10-050	N/A	3PU10-050	100WSU10-025	AU10-050
H ☐ 2L	*C10-050	*IU10-050	*DS15-060	*QU10-050	N/A	3PU10-050	100WSU10-025	AU10-050
H ☐ 3S	*C15-060	*IU15-060	*DS15-060	*QU15-060	N/A	3PU15-060	100WSU15-060	AU15-060
H ☐ 4S	*C15-060	*IU15-060	*DS15-095	*QU15-060	N/A	3PU15-060	100WSU15-060	AU15-060
H ☐ 4L	*C15-095	*IU15-095	*DV25-130	*QU15-095	N/A	3PU15-095	100WSU15-060	AU15-095
H ☐ 5S	*CU25-130	*CU25-130	*DV25-130	*QU25-130	7CVP25-130	3PU25-130	100WS25-130	AU25-130
H ☐ 6S	*CU25-130	*CU25-130	*DV25-130	*QU25-130	7CVP25-130	3PU25-130	100WS25-130	AU25-130
H ☐ 8E	*CU25-130	*CU25-130	*DV25-130	*QU25-130	7CVP25-130	3PU25-130	100WS25-130	AU25-130
H ☐ 8S	*CU25-187	*CU25-187	*DV25-187	*QU25-187	7CVP25-187	3PU25-187	100WS25-187	AU25-187
H ☐ 8L	*CU25-235	*CU25-235	*DV25-235	*QU25-235	7CVP25-235	3PU25-235	100WS25-235	AU25-235
H ☐ 0L	*CU35-280	*CU35-280	*DV35-280	*QU35-280	7CVP35-280	3PU35-280	100WS35-280	AU35-280
H ☐ 12L	*CU35-280	*CU35-280	*DV35-280	*QU35-280	7CVP35-280	3PU35-280	100WS35-280	AU35-280

Step 2a

Alternate Housing Selection Chart

for applications with pressures other than 100 PSIG and 70°F (standard conditions)

Converting Actual Application Conditions to Standardized Conditions

Because the required size of a filter is affected not only by flow, but also by operating pressure and operating temperature, it is necessary to convert those actual conditions to standardized conditions (100 PSIG and 70°F.) The calculated adjusted flow rate can then be used to choose the appropriate filter in the chart on page eight. When using the chart, choose the closest flow rate from the appropriate media grade column.

Equation:

$$\begin{matrix} \text{Flow} \\ \text{Actual} \\ \text{System} \\ \text{Flow Rate} \\ \text{(SCFM)} \end{matrix} \times \begin{matrix} \text{Pressure} \\ (100 \text{ PSIG} + 14.7 \text{ PSIG}) \\ (System \text{ Pressure (PSIG)} + 14.7 \text{ PSIG}) \end{matrix} \times \begin{matrix} \text{Temperature} \\ (System \text{ Temp } ^\circ\text{F} + 460^\circ\text{F}) \\ (70^\circ\text{F} + 460^\circ\text{F}) \end{matrix} \times \begin{matrix} \text{Specific Gravity} \\ \sqrt{\text{specific gravity}} \end{matrix} = \begin{matrix} \text{Adjusted Flow Rate} \\ \text{Adjusted Flow Rate} \\ \text{(At 100 PSIG and} \\ \text{70}^\circ\text{F)} \end{matrix}$$

Example: For grade 6C filter, with an actual flow rate of 60 SCFM, an actual pressure of 50 PSIG and an actual temperature of 175°F, the equation would go as follows:

system pressure = 50

system temperature = 175

$$\frac{(100\text{PSIG} + 14.7 \text{ PSIG})}{(50 \text{ PSIG} + 14.7 \text{ PSIG})}$$

$$\frac{(175 ^\circ\text{F} + 460^\circ\text{F})}{(70^\circ\text{F} + 460^\circ\text{F})}$$

$$\frac{(114.7)}{(64.7)} = 1.77$$

$$\frac{(635)}{(530)} = 1.19$$

Note: Take the square root of your specific gravity. If this is for a compressed air application, skip this step because the specific gravity of air equals one. Please consult **Finite**® if you do not know your specific gravity.

Now go to the chart on page 8, look down the media grade 6 column for a flow of 126.4 SCFM, you will see the correct housing is the HN4L.

$$60 \text{ SCFM} \times 1.77 \times 1.19 \times 1 = 126.4 \text{ SCFM}$$

Pre-Installed Accessory Options

Step 3

Choose your accessories.

Consult **Finite**® when choosing pre-installed accessories for special gases.

Accessory Designator	Auto Drain	DPI Indicator	DPG Gauge	High Temp	DP Ports	Fluorocarbon O-Rings	No Accessories	Pressure/Temp		Pressure/Temp	
								PSIG	Degrees°F	bar	Degrees°C
A								250	175°	17	79°
D								250	175°	17	79°
G								500	175°	34	79°
J								250	450°	17	232°
N								500	175°	34	79°
P								250	175°	17	79°
V								500	175°	34	79°
W								250	175°	17	79°
X								250	175°	17	79°
Y								250	175°	17	79°

Pre-installed Accessories



Other Compatible Accessories



	DPI Indicator	AD-12 Automatic Drain Valve (Internal)	DPG-15 Differential Pressure Gauge	TV-50 Timed Drain Valve	ZLD-10 Zero Loss Drain	VS-50 Visual Sump Drain (not shown: Standard Bowl Guard)	MS-50 Metal Sump Drain (External)
Designator	D, W	A, W, X, Y	G, Y				
Temp. °F/°C	175°/79°	175°/79°	175°/79°	210°/99°	175°/79°	125°/52°	175°/79°
Pressure PSIG/Bar	250/17	250/17	500/34	300/20	250/17	150/10	250/17
Port Size (NPT)	N/A	N/A	N/A	1/2" NPT	1/2" NPT	1/2" NPT	1/2" NPT

How to Order

Use the steps below to build your own part number.

For any permutation not mentioned below, please consult factory at 1-800-521-4357.

Step 2 or 2a				Step 1			Step 3
H Series Name	N Port Type	1 2 Port (Connection) Size	L Bowl	6 Element Grade	C Element Type	U End Seal	G Accessory Designator for preinstalled accessories
N - NPT F - BSPF S - SAE* T - BSPT *SAE-32 2" connection only		1 - 1/4" 15 - 3/8" 2 - 1/2" 3 - 3/4" 4 - 1" 5 - 1 1/4" 6 - 1 1/2" 8 - 2" 0 - 2 1/2" 12 - 3"	S - Standard L - Long E - Economy (short bowl)* *Short bowl is only available on 2" connection size Note: Bowl length is determined by the flow rate required. See page 8, Housing Selection Chart, for flow rates.	4 6 8 10	C Q D 7CVP I 3P 100WS A	Blank = No end seal, Standard on 1/4" to 1" connection sizes U = Urethane, Standard on 1 1/4" to 3" connection sizes S = Molded Silicone Rubber V = Fluorocarbon, Available 1 1/4" to 3" connections only U = Urethane, Standard all connection sizes S = Molded Silicone Rubber V = Fluorocarbon, Available 1 1/4" to 3" connections only S = Molded Silicone Rubber, Standard on all connection sizes V = Fluorocarbon, Available 1 1/4" to 3" connection sizes only Blank = Fluorocarbon, Standard on all 7CVP elements; elements available 1 1/4" to 3" connections only U = Urethane, Standard on 1/4" to 1" connection sizes U = Urethane, Standard on all connection sizes S = Molded Silicone Rubber V = Fluorocarbon, Available 1 1/4" to 3" connections only U = Urethane, Standard on 1/4" to 1" connection sizes Blank = Fluorocarbon, Standard on 100WS elements 1 1/4" to 3" connections only U = Urethane, Standard on all connection sizes S = Molded Silicone Rubber	A - Auto Drain D - DPI Indicator G - DPG Gauge (Standard on 3/4" & up) J - High Temperature (450°F) N - No Accessories P - 1/8" Differential (3/4" & up) Sensing Ports V - Fluorocarbon Seals W - A + D X - A + P Y - A + G Note: For max. pressures and temperatures related to Accessories , please see chart on previous page.

Examples on How to Order

Example 1:

HN12L-6CUY

What am I ordering?

An H-Series, with a 3" NPT connection, long bowl, standard grade 6 coalescing element, with an urethane end seal, an auto drain and a standard DPG gauge.

Example 2:

HN15L-8CA

What am I ordering?

An H-Series, with a 3/8" NPT connection, long bowl, grade 8 coalescing element, without end seals and an auto drain.

Example 3:

HN8S-7CVP G

What am I ordering?

An H-Series, with a 2" NPT connection, standard bowl, a 7CVP coalescing element, with the standard fluorocarbon end seals and standard DPG gauge.

Example 4:

HN8E-10DVJ

What am I ordering?

An H-Series, with a 2" NPT connection, economy short bowl, grade 10 high-temp coalescing element, with the standard fluorocarbon end seals and "J" as an accessory. This high temperature option converts all materials to be capable of handling temperatures of 450°F.

Example 5:

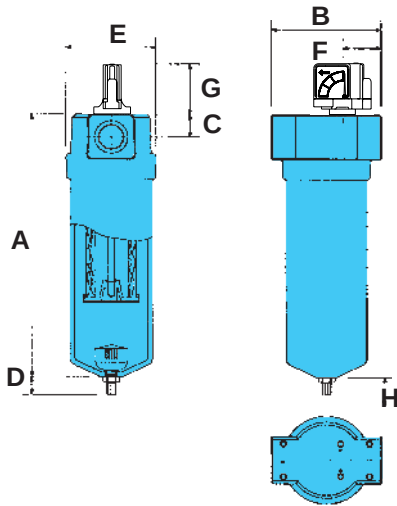
HN2S-AUN

What am I ordering?

An H-Series, with a 1/2" NPT connection, short bowl, adsorber element, with the standard urethane end seals and no accessories.

Drawings, Dimensions & Specifications

1/4" to 1" Housings



Specifications

Max. Pressure: **500 PSIG** (34 bar)
 Safety Factor: Max. operating to burst 4:1
 Max Temp.: **175°F** (79°C) with option to **450°F** (232°C)
 Seals: Nitrile Std./Fluorocarbon optional
 Materials: Aluminum - 380 Die cast heads;
 6061 Drawn bowls
 Coatings: Chromated heads and bowls;
 Powder painted exterior
 Design: In-line threaded bowl to head

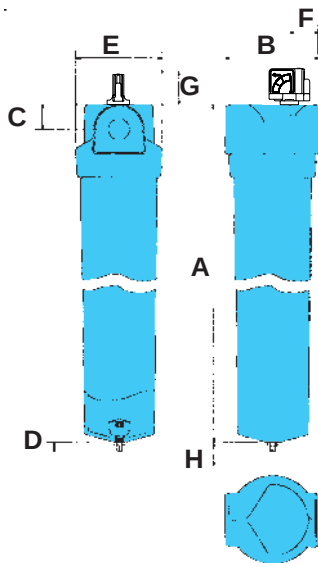
Note: Manual Drain Port is 1/8" FNPT when tee valve is removed from drain bushing.

Model	A	B	C	D	E	F	G	H*	Sump (ml)	Weight
H□1S	7.21 (183)	3.12 (79)	.53 (13)	.79 (20)	2.98 (76)	1.56 (39.5)	2.6 (66)	2.99 (76)	150	1.49 (.68)
H□15S	7.21 (183)	3.12 (79)	.53 (13)	.79 (20)	2.98 (76)	1.56 (39.5)	2.6 (66)	2.99 (76)	150	1.47 (.66)
H□2S	7.21 (183)	3.12 (79)	.53 (13)	.79 (20)	2.98 (76)	1.56 (39.5)	2.6 (66)	2.99 (76)	150	1.44 (.65)
H□1L	9.69 (246)	3.12 (79)	.53 (13)	.79 (20)	2.98 (76)	1.56 (39.5)	2.6 (66)	5.51 (140)	140	1.89 (.86)
H□15L	9.69 (246)	3.12 (79)	.53 (13)	.79 (20)	2.98 (76)	1.56 (39.5)	2.6 (66)	5.51 (140)	140	1.87 (.85)
H□2L	9.69 (246)	3.12 (79)	.53 (13)	.79 (20)	2.98 (76)	1.56 (39.5)	2.6 (66)	5.51 (140)	140	1.85 (.84)
H□3S	10.75 (273)	4.65 (118)	.98 (25)	.79 (20)	3.68 (93.5)	1.73 (44)	2.6 (66)	6.5 (165)	270	3.56 (1.61)
H□4S	10.75 (273)	4.65 (118)	.98 (25)	.79 (20)	3.68 (93.5)	1.73 (44)	2.6 (66)	6.5 (165)	270	3.29 (1.49)
H□4L	14.25 (362)	4.65 (118)	.98 (25)	.79 (20)	3.68 (93.5)	1.73 (44)	2.6 (66)	10.00 (254)	270	4.11 (1.86)

Special Note: Dimensions are in **inches** (millimeters); weight is in **pounds** (kilograms).

* Clearance required to remove bowl.

1 1/4" to 3" Housings



Specifications

Max. Pressure: **500 PSIG** (34 bar)
 Safety Factor: Max. operating to burst 4:1
 Max Temp.: **175°F** (79°C) with option to **450°F** (232°C)
 Seals: Nitrile Std./Fluorocarbon optional
 Materials: Aluminum - 356 Sand cast heads;
 6061 Drawn bowls
 Coatings: Chromated heads and bowls;
 Powder painted exterior
 Design: In-line threaded bowl to head

Note: Manual Drain Port is 1/8" FNPT when tee valve is removed from drain bushing.

Model	A	B	C	D	E	F	G	H*	Sump (ml)	Weight
H□5S	18.23 (463)	6.0 (152)	1.65 (42)	.83 (21)	5.67 (144)	1.85 (47)	2.6 (66)	13.50 (343)	440	12.11 (5.49)
H□6S	18.23 (463)	6.0 (152)	1.65 (42)	.83 (21)	5.67 (144)	1.85 (47)	2.6 (66)	13.50 (343)	440	11.97 (5.43)
H□8E	18.23 (463)	6.0 (152)	1.65 (42)	.83 (21)	5.67 (144)	1.85 (47)	2.6 (66)	13.50 (343)	440	11.97 (5.43)
H□8S	24.29 (617)	6.0 (152)	1.65 (42)	.83 (21)	5.67 (144)	1.85 (47)	2.6 (66)	19.25 (489)	530	14.00 (6.35)
H□8L	29.33 (745)	6.0 (152)	1.65 (42)	.83 (21)	5.67 (144)	1.85 (47)	2.6 (66)	24.02 (610)	620	15.99 (7.25)
H□0L	35.98 (914)	8.0 (203)	2.4 (61)	.83 (21)	7.24 (184)	2.36 (60)	2.6 (66)	28.50 (724)	880	35.00 (15.87)
H□12L	35.98 (914)	8.0 (203)	2.4 (61)	.83 (21)	7.24 (184)	2.36 (60)	2.6 (66)	28.50 (724)	880	34.14 (15.48)

Special Note: Dimensions are in **inches** (millimeters); weight is in **pounds** (kilograms).

* Clearance required to remove bowl.

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Fax: (248) 628-1850
<http://www.parker.com/finitfilter>
Reprinted July 2003



Parker Hannifin Corporation
Filtration and Separation Division
500 Glaspie Street - P.O. Box 599
Oxford, MI 48371
(248) 628-6400

Bulletin Number: NP017
Date: June 2002

NOTICE OF NEW PRODUCT

Separator Elements to fit Finite J-Series High Pressure Assemblies

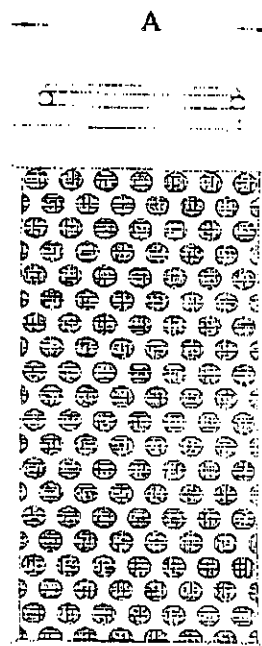
Part Number	Box Quantity	List Price
100WS11-035 x 1	1	\$ 75.00
100WS15-070 x 1	1	\$ 120.00
100WS23-130 x 1	1	\$ 300.00

Max PSIG: 1000 PSIG

Max Temp: 350°F

Materials of Construction: Stainless Steel, Galvanized Steel, PTFE-coated

DESCRIPTION: Finite's new stainless steel mesh separator elements eliminate excess liquids from compressed air and gas systems. Compressing gas can condense air vapors into liquids, potentially flooding the system and damaging critical components. This can reduce the effectiveness of coalescing filters. Our new stainless steel mesh separator elements reduce overall maintenance cost by making the entire compressed air/gas system work more efficiently. These elements have an extremely robust construction and are very tolerant of exposure to high differential pressure.



Part Number	A	B	Rated Flow (SCFM) at 4500 PSIG	Compatible Housing Number
100WS11-035 x 1*		3.46	2400	J6SH or J6NH
100WS15-070 x 1		7.25	6000	J6SH or J6NH
100WS23-130 x 1		13.25	18000	J6SH or J6NH

* Part Number 100WS11-035 x 1 has an internal captive o-ring, rather than the external captive o-ring depicted above.



Bourdon Tube Pressure Gauges

All Stainless Steel Construction

Industrial Series Liquid Fillable • Type 23X.53

Pressure Gauges

Application

Suitable for corrosive environments compatible with 316 stainless steel wetted parts, dry and liquid fillable case, where vibration and/or pressure pulsation occur in liquid or gaseous media which will not obstruct the pressure system.

Sizes (All sizes not stocked)

2", 2½" and 4" (50, 63 and 100 mm)

Accuracy

2", 2½" ± 1.5% of span

4" ± 1.0% of span (ASME B40.1 Grade 1A)

Ranges (All ranges not stocked)

Vacuum / Compound to 30"HG / 0 / 200 PSI

Pressure from 15 PSI to 15,000 PSI

or other equivalent units of pressure or vacuum

Working Range

2" & 2½" Steady: 3/4 of full scale value

Fluctuating: 2/3 of full scale value

Short time: full scale value

4" Steady: Full scale value

Fluctuating: 0.9 x full scale value

Short time: 1.3 x full scale value

Operating Temperature

Ambient: -40°F to 140°F (-40°C to 60°C) ^{Note 1}

Media: max. 212°F (+100°C)

Temperature Error

Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

Standard Features

Connection

Material: 316 stainless steel

Lower mount (LM)

Center back mount (CBM) 2½"

Lower back mount (LBM) 4"

1/4" or 1/2" NPT limited to wrench flat area

Bourdon Tube

Material: 316 stainless steel

30"Hg (Vac) to 1000 PSI C-type - 2" & 2½"

30"Hg (Vac) to 1500 PSI C-type - 4"

1500 PSI to 15,000 PSI helical type - 2" & 2½"

2000 PSI to 15,000 PSI helical type - 4"

Movement

Stainless steel

Dial

White aluminum with black lettering. 2½" with stop pin.

Pointer

Black aluminum, non-adjustable

Case

304 stainless steel with vent plug and SS crimping ring.

Welded case/socket connection



Weather Protection

Weather resistant (NEMA 3 / IP 54) - dry case

Weather tight (NEMA 4X / IP 65) - liquid-filled case

Standard Scale

PSI

PSI, PSI/BAR, PSI/KPA, PSI/KG/CM² (2½" CBM)

Window Gasket

Buna-N



Case Filling

232.53 - None

233.53 - Glycerine

Window

Polycarbonate

Acrylic (4")

ORDER OPTIONS (min. order may apply)

Custom dial layout

Steel zinc plated u-clamp bracket (field installable)

Stainless steel u-clamp bracket (field installable)

Pressure compensating membrane window for filled gauges

Stainless steel polished front flange (CBM or LBM only)

Stainless steel rear flange

316 SS threaded restrictor

Glycerine, silicone, or fluorolube case filling (**Type 233.53**) ^(Note 1)

Special connections limited to wrench flat area

Other pressure scales available:

Bar, kPa, MPa, Kg/cm² and dual scales

DIN standards

Cleaned for oxygen service

Externally adjustable red drag pointer (max. hand)

Externally adjustable red mark pointer (set pointer)

Note 1 Temperature Ranges (Liquid filled gauges)

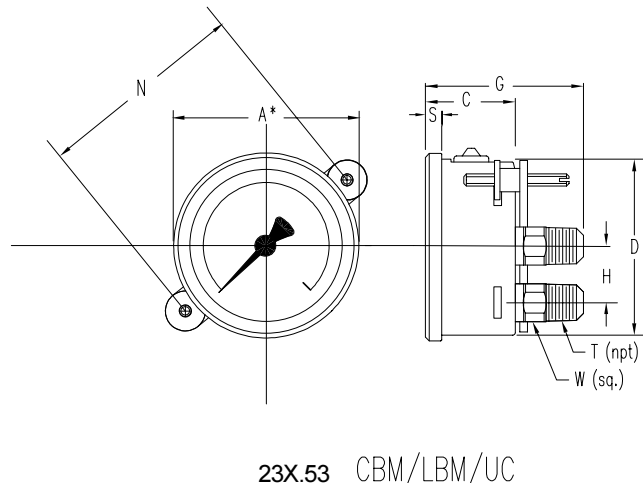
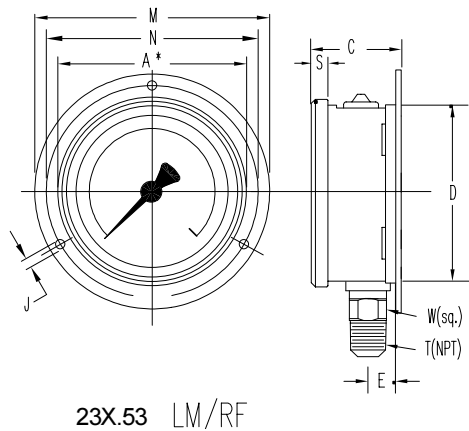
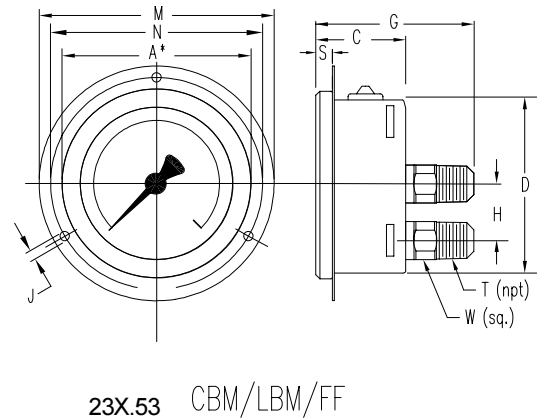
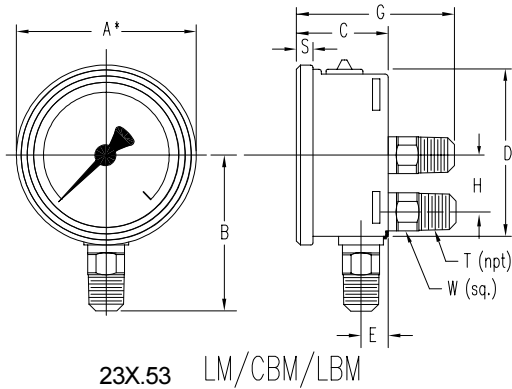
Glycerine: -4°F to 140°F (-20°C to 60°C)

Silicone: -40°F to 140°F (-40°C to 60°C)

APM 23X.53

(APM 02.13)

Dimensions:



A* NOMINAL SIZE

TYPE/SIZE	WEIGHT	KEY	A*	B	C	D	E	G	H	J	L	M	N	S	T	W
23X.53 2"	0.27 lbs. + 0.06 lbs. if filled	mm	50	48	30	50	12	53	--	3.6	6.5	71	60	5.5	--	14
		in	2	1.89	1.18	1.97	0.47	2.09		0.14	0.26	2.80	2.36	0.22	1/4"	0.55
23X.53 2.5"	0.36 lbs. + 0.08 lbs. if filled	mm	63	54	32	62	13	54	--	3.6	7.5	85	75	6.5	--	14
		in	2.5	2.13	1.26	2.44	0.51	2.13		0.14	0.30	3.35	2.95	0.26	1/4"	0.55
23X.53 4"	1.10 lbs. + 0.66 lbs. if filled	mm	100	87	48	100	15.5	79.5	30	4.8	9	132	116	8	--	22
		in	4	3.43	1.89	3.94	0.61	3.13	1.18	0.19	0.35	5.20	4.57	0.31	1/2"	0.87

NOTE: For 1/4" NPT connections on 3" and 4" gauges, reduce B* dimension by 5 mm / 0.02 in.

Panel cut-out dimensions: D + 1mm

THE MEASURE OF Total Performance™

Ordering Information:

State computer part number (if available) / type number / size / range / connection size and location / options required.

Specifications given in this price list represent the state of engineering at the time of printing. Modifications may take place and the specified materials may change without prior notice.

05/02



WIK A Instrument Corporation

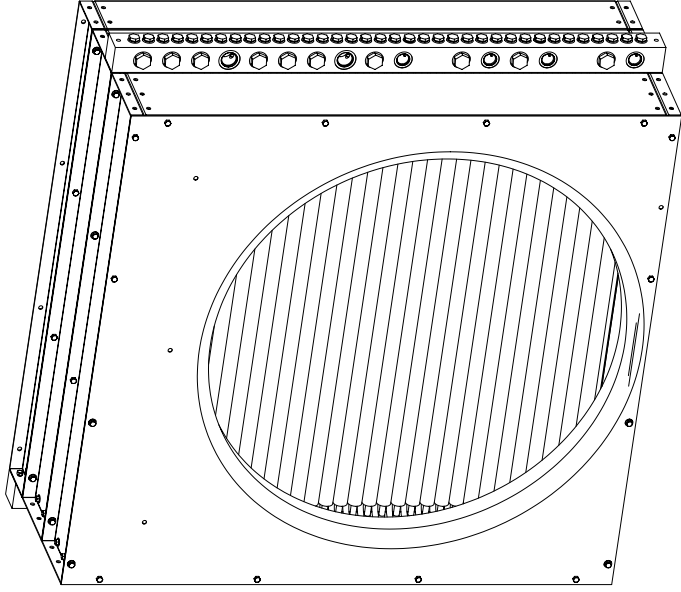
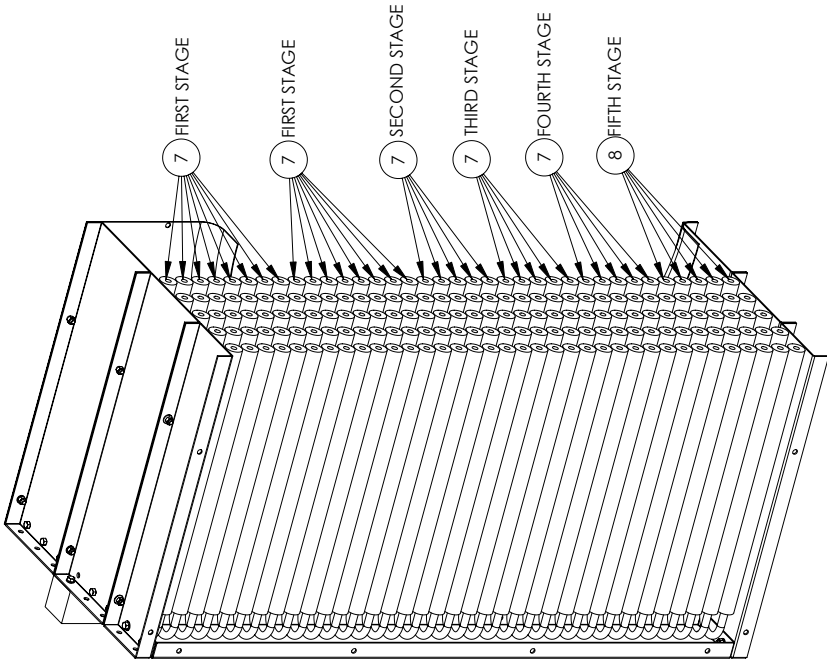
1000 Wiegand Boulevard

Lawrenceville, Georgia 30043-5868

Tel: 770-513-8200 Fax: 770-338-5118

<http://www.wika.com> e-mail: info@wika.com

ASME Section VIII, Division 1 Code Information						
	IC-1A	IC-13	IC-2	IC-3	IC-4	AC-5
Inlet Port	1-1/4" SAE	1" SAE	1" SAE	1" SAE	1" SAE	1" SAE
Outlet Port	1-1/4" SAE	1" SAE	1" SAE	1" SAE	1" SAE	1" SAE
MAWP (psig)	2,000	2,000	2,000	2,000	2,000	5,000
at deg F	450	450	450	450	450	450
MDMT	2,000	2,000	2,000	2,000	2,000	5,000
at deg F	-20	-20	-20	-20	-20	-20
Hydrotest	3,000	3,000	3,000	3,000	3,000	7,500
PWHT Required: None						
NDT Required: None						



UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES

DECIMALS TO THREE PLACES

FRACTIONS TO 1/16

ANGULAR MATCHES TO 1/8" MAX

WELDING TO BE AS SHOWN

THREE PLACE DECIMALS

MATERIAL

FINISH

DRAWN

CHECKED

ENG APPR

COMMENTS

NAME

CJ

JBR

CF

DATE

5/4/04

5/5/04

5/5/04

GreenField

9001 NEWPORT

HOUSTON, TEXAS 77061-2833

TITLE:

HEAT EXCHANGER

CT, 6 BANK, 5 STAGE

SIZE

DWG. NO.

REV

C

C000-4420-SND4008

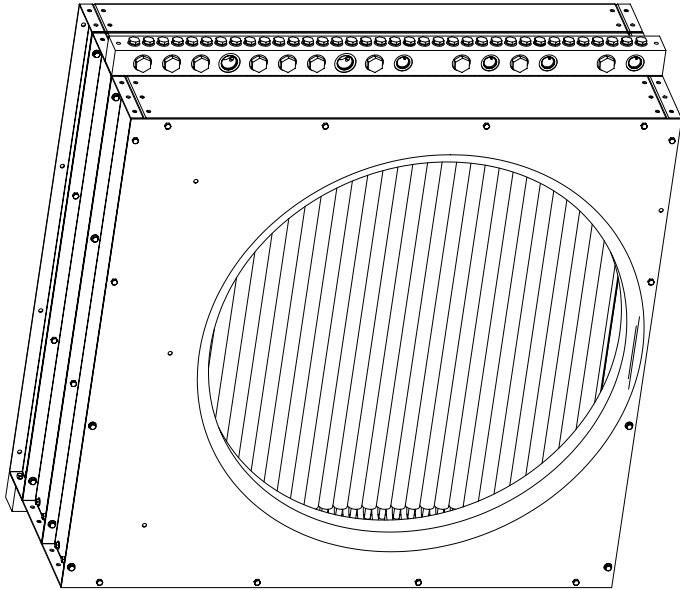
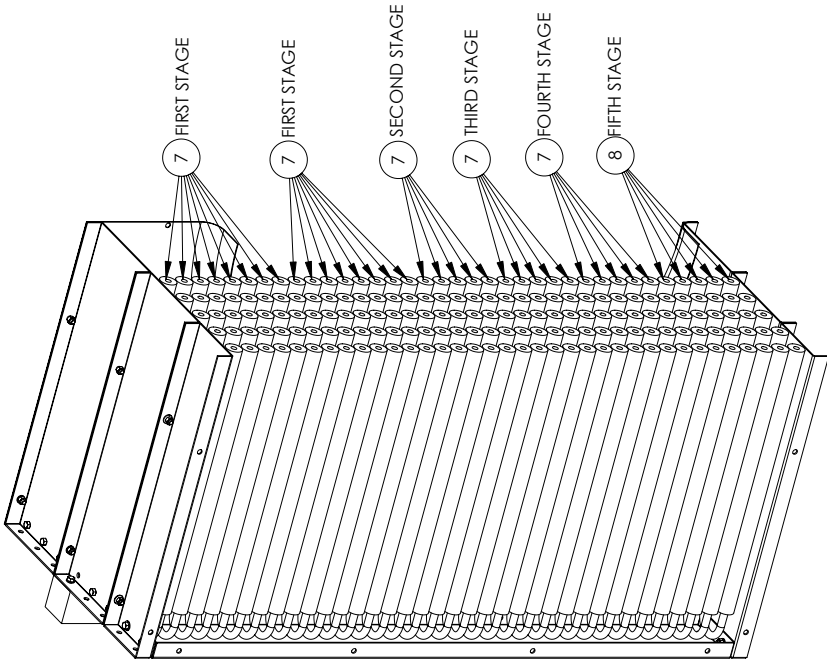
A

SCALE:

NONE

SHEET 2 OF 2

ASME Section VIII, Division 1 Code Information						
	IC-1A	IC-13	IC-2	IC-3	IC-4	AC-5
Inlet Port	1-1/4" SAE	1" SAE	1" SAE	1" SAE	1" SAE	1" SAE
Outlet Port	1-1/4" SAE	1" SAE	1" SAE	1" SAE	1" SAE	1" SAE
MAWP (psig)	2,000	2,000	2,000	2,000	2,000	5,000
at deg F	450	450	450	450	450	450
MDMT	2,000	2,000	2,000	2,000	2,000	5,000
at deg F	-20	-20	-20	-20	-20	-20
Hydrotest	3,000	3,000	3,000	3,000	3,000	7,500
PWHT Required: None						
NDT Required: None						



UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES

DECIMALS ARE TO BE EXPRESSED AS FRACTIONS

ANGULAR MEASUREMENTS ARE TO BE EXPRESSED AS DEGREES AND MINUTES

THREE PLACE DECIMALS

DRAWN

CHECKED

ENG APPR

COMMENTS

NAME

CJ

JBR

CF

DATE

5/4/04

5/5/04

5/5/04

GreenField

9001 NEWPORT

HOUSTON, TEXAS 75081-2833

TITLE:

HEAT EXCHANGER

CT, 6 BANK, 5 STAGE

SIZE

DWG. NO.

REV

C

C000-4420-SN04009

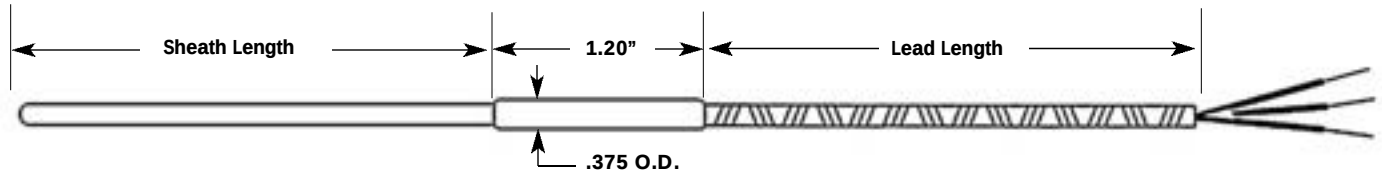
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SCALE:

NONE

SHEET 2 OF 2

TYPE 1250 SMART RTD WITH FLEXIBLE LEADS



Type	RTD Type	Diameter	Construction	Sheath Length	Sheath Material	Lead Length	Lead Insulation	Terminations	Options
1250				(Inches)	R	(Inches)			

DIAMETER CODE

18 1/8"
316 3/16"
14 1/4"
38 3/8"

CONSTRUCTION CODE

L Low Temp up to 500°F
H High Temp up to 900°F
M Mineral Insulated
DL Dual Low Temp
DH Dual High Temp
DM Dual Mineral Insulated

RTD TYPE

CODE

RP 100 ohm Platinum Temperature
Coefficient .00385 ohms/ohm/°C
RPB 100 ohm Platinum Temperature
Coefficient .003916 ohms/ohm/°C
RPD 100 ohm Platinum Temperature
Coefficient .003900 ohms/ohm/°C
RN 120 ohm Nickel (Edison #7)
Temperature Coefficient .00672
ohms/ohm/°C
RC 10 ohm Copper Temperature
Coefficient .00427 ohms/ohm/°C

SHEATH MATERIAL CODE

R 316SS
Other Sheaths Available

LEAD INSULATION CODE

MF Fiberglass multistranded 22
ga.
(use with high temperature)
MT Teflon multistranded 22 ga.
(use with low temperature)

TERMINATIONS CODE

1 Bare Ends
11 Spade Lugs
12 Three Prong Plug
13 Three Prong Jack

OPTIONS

CODE

A Armor (Stainless Steel)
AP Armor with PVC Jacket
BD45 45° Bend in Sheath
BD90 90° Bend in Sheath
BR18 ADJ Brass Comp Ftg 1/8" NPT*
BR14 ADJ Brass Comp Ftg 1/4" NPT*
BR12 ADJ Brass Comp Ftg 1/2" NPT*
BS Bell Spring Transition Relief
CG12 Weather Tight Fitting 1/2" NPT
FW 4 Wire (8 wire for dual)
GA Grade A Tolerance Per ASTM 1137
SB Stainless Steel Overbraid Leads
SS18 ADJ SS Comp Ftg 1/8" NPT*
SS14 ADJ SS Comp Ftg 1/4" NPT*
SS12 ADJ SS Comp Ftg 1/2" NPT*
ST Smooth Transition
TF Teflon Coated Sheath
TW 2 Wire (4 wire for dual)
WC Wire Clamp Bracket for Leads
WP Weld Pad 1" x 1" x 1/8" SS
*Add T after SS or BR for Teflon Ferrule

NOTE: 3 wire is standard
Grade B is standard
Tolerance per ASTM E1137
Leadwire is nickel clad copper multistrand
Color code: Platinum RTD = Red/Red/White
Nickel RTD = Red/Red/Black
Copper RTD = Red/Red/Green



M E R C E R 9 1 0 0 S E R I E S

THREADED SAFETY RELIEF VALVES



- EXTENDED SEAT LIFE • SOFT SEAT TIGHTNESS
- CRISP "POP" ACTION • FULL NOZZLE CAPACITIES
- PREMIUM CONSTRUCTION DETAILS
- **ASME CODED FOR AIR, GAS AND LIQUID.**



M E R C E R V A L V E C O . I N C

9609 N.W. 4th Street, Oklahoma City, OK 73127

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1-800-833-6402 • (405) 495-6533 • Fax (405) 495-8728

24 HOUR SERVICE AVAILABLE

MERCER 9100 SERIES

THREADED SAFETY RELIEF VALVES

INTRODUCTION

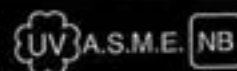
Mercer Valve 9100 Series Threaded Safety Relief Valves are the "State of the Art" in soft seat, high flow rate, pressure relieving devices. The field-proven soft seat is coupled with a new, unique disk type **PATENTED DESIGN**. Expected seat life with "Auto Seat Technology"® is hundreds of "pops". Full length guiding of "low rate" set pressure springs insures accurate, repeatable relief action. Standard, low blow downs are consistent with efficient relieving of over pressure without expensive loss of process gas.

The valve is well suited for all industrial air, gas, or, liquid relief applications, including compressors, separators,

heater treaters, scrubbers, dehydrator, free water knockouts, thermal relief, gas production units, transmission and gathering lines, meter runs, gas plants, chemical plants, refineries and other industrial applications.

All 9100 Series Threaded Valves are built in accordance with the requirements of the ASME Boiler and Pressure Vessel Code. Capacity ratings were established by testing performed at the National Board of Boiler and Pressure Vessel Inspectors, Columbus, Ohio.

SPECIFICATIONS



© 2002 Mercer Valve reserves the right to change product designs and specifications without notice.

API Orifice Letter	C	D	E	F	G	H	J	K
Orifice Diameter (in.)	0.281	0.394	0.520	0.655	0.775	1.050	1.350	1.625
Orifice Area (sq. in.)	0.062	0.122	0.212	0.337	0.472	0.865	1.430	2.074
Inlet Size Offered	½", ¾", 1"	½", ¾", 1"	¾", 1"	1½", 2"	1½", 2"	1½", 2"	2", 3"	3"
Pressure Limits (psig)	15-2999	15-2999	15-2400	15-2400	15-2000	15-2000	15-800	15-750
ASME Gas "Slope" (90%)	.93	1.83	3.18	5.06	7.08	12.98	21.51	31.12
Flow Coefficient "K" (90%) Gas	.818	.818	.818	.818	.818	.818	.818	.818
Flow Coefficient "K" (90%) Liquid	.707	.707	.707	.707	.707	.707	.707	.707

TEMPERATURE RANGES

Standard -20° F to + 400° F: Reference Seat Data Below

Extended -180° F to +550° F: Consult Factory for Material Specifications

NOTE: 1) FOR INLET AND OUTLET SIZE COMBINATIONS SEE SELECTION TABLE

2) HIGHER PRESSURE LIMITS ARE AVAILABLE FOR "C" AND "D" ORIFICE, SEE 9100 SERIES MODEL 20 LITERATURE

SEAT DATA (May vary with orifice size, consult factory)

SEAT MATERIAL	DUROMETER	TEMPERATURE		PRESSURE (psig)	
		Maximum	Minimum	Maximum	Minimum
*BUNA N	90	250	-40	1000	15
VITON®	90	275	-20	1000	15
TEFLON®	N/A	400	-420	2000	15
PEEK	N/A	500	0	3000	500
*KALREZ®	90	525	0	1000	15
*NEOPRENE	90	250	-40	1000	15
*EPDM	90	250	-60	1000	15

*SPECIAL ORDER, CONSULT FACTORY

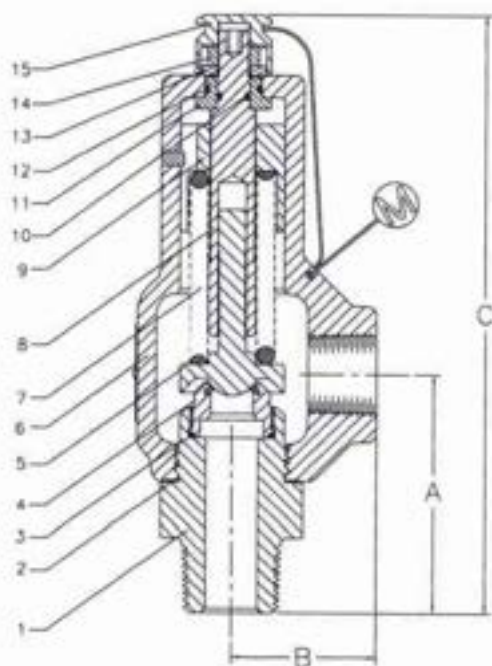
BODY BACK PRESSURE LIMITS

OUTLET SIZE	ORIFICE SIZE	MAXIMUM PRESSURE (psi)
1"	C,D,E	2000
1½", 2"	D,E,F,G	1500
2", 2½"	H	1000
3"	J,K	1000

MERCER 9100 SERIES

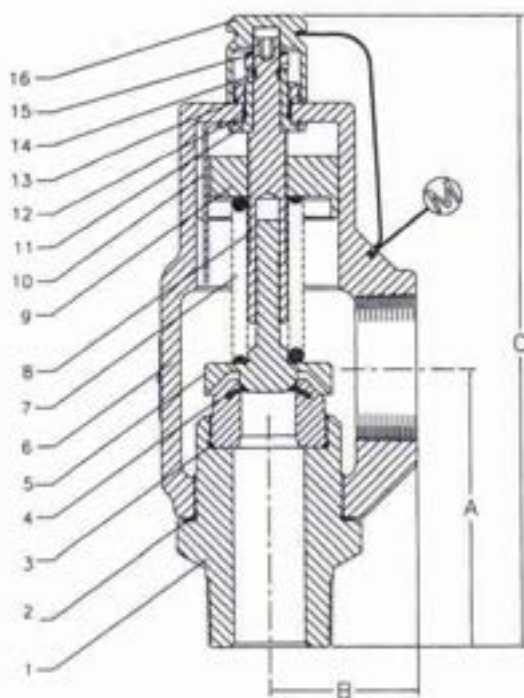
THREADED SAFETY RELIEF VALVES

BILL OF MATERIALS



"C", "D", and "E" Orifice

"C", "D", AND "E" ORIFICE				
ITEM NO.	PART NAME	"C" ORIFICE STD MTRLS "C" TRIM CODE	"D" & "E" STD MTRLS "E" TRIM CODE	"C", "D", "E" OPTIONS "U", "L", "N", OR "B" CODE
1	Inlet Base	Carbon Steel or 316 Stainless Steel	Carbon Steel or 316 Stainless Steel	Carbon Steel or 316 Stainless Steel
2	Base Seal	Carbon Steel or 316 Stainless Steel	Carbon Steel or 316 Stainless Steel	Carbon Steel or 316 Stainless Steel
3	O'Ring	Viton	Viton	Viton
4	Nozzle Subassy	17-4 Stainless Steel with Soft Seat	17-4 Stainless Steel with Soft Seat	316 Stainless Steel with Soft Seat
5	Disk Subassy	440C Stainless Steel	17-4 Stainless Steel	316 Stainless Steel
6	Body	WCB Carbon Steel or CF3M Stainless Steel	WCB Carbon Steel or CF3M Stainless Steel	WCB Carbon Steel or CF3M Stainless Steel
7	Spring	17-7 Stainless Steel	17-7 Stainless Steel	17-7 Stainless Steel or Inconel X-750 (NACE)
8	Adjustment Screw	300 Series Stainless Steel	300 Series Stainless Steel	300 Series Stainless Steel
9	Adjustment Bushing	300 Series Stainless Steel	300 Series Stainless Steel	300 Series Stainless Steel
10	O'Ring	Buna N	Buna N	Buna N
11	Center Bushing	300 Series Stainless Steel	300 Series Stainless Steel	300 Series Stainless Steel
12	O'Ring	Buna N	Buna N	Buna N
13	Washer	Carbon Steel	Carbon Steel	Carbon Steel
14	Lock Nut	Carbon Steel	Carbon Steel	Carbon Steel
15	Cap	Anodized Aluminum	Anodized Aluminum	Anodized Aluminum

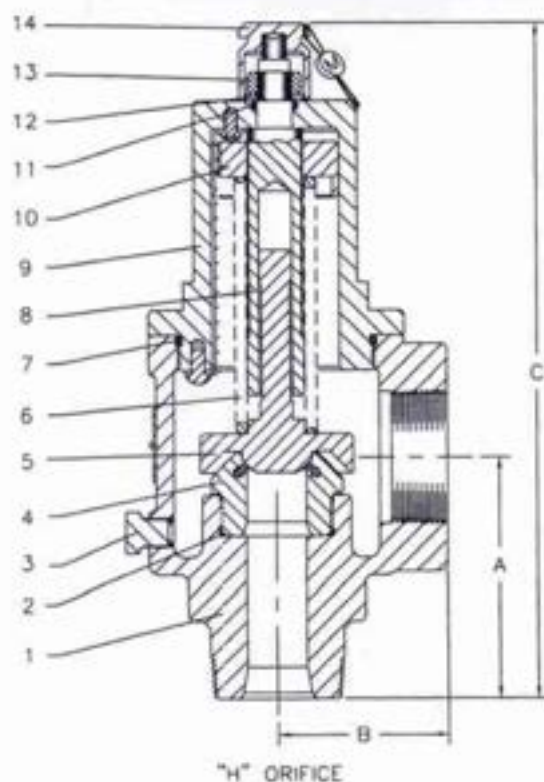


"F" and "G" Orifice

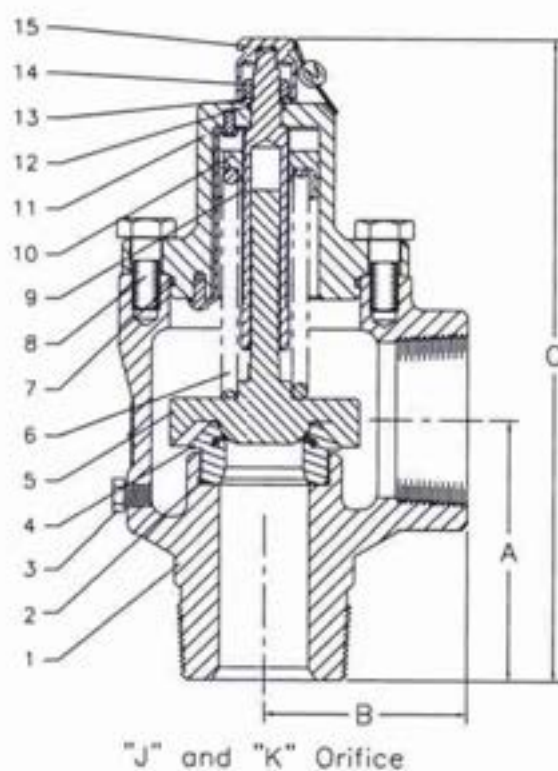
"F" AND "G" ORIFICE			
ITEM NO.	PART NAME	"F" AND "G" ORIFICE STD MTRLS "U", "L", "N", OR "B" TRIM CODE	"F" AND "G" STD MTRLS "C" TRIM CODE (High Pressure)
1	Inlet Base	Carbon Steel or 316 Stainless Steel	Carbon Steel or 316 Stainless Steel
2	Base Seal	Carbon Steel or 316 Stainless Steel	Carbon Steel or 316 Stainless Steel
3	O'Ring	Viton	Viton
4	Nozzle Subassy	316 Stainless Steel with Soft Seat	17-4 Stainless Steel with Soft Seat
5	Disk Subassy	316 Stainless Steel	440C Stainless Steel
6	Body	WCB Carbon Steel or CF3M Stainless Steel	WCB Carbon Steel or CF3M Stainless Steel
7	Spring	17-7 Stainless Steel or Inconel X-750 (NACE)	17-7 Stainless Steel
8	Adjustment Screw	300 Series Stainless Steel	300 Series Stainless Steel
9	Adjustment Bushing	300 Series Stainless Steel	300 Series Stainless Steel
10	Index Bracket	300 Series Stainless Steel	300 Series Stainless Steel
11	Center Bushing	300 Series Stainless Steel	300 Series Stainless Steel
12	O'Ring	Buna N	Buna N
13	Center Nut	Carbon Steel	Carbon Steel
14	O'Ring	Buna N	Buna N
15	Lock Nut	Carbon Steel	Anodized Aluminum
16	Cap	Anodized Aluminum	Anodized Aluminum

MERCER 9100 SERIES

THREADED SAFETY RELIEF VALVES



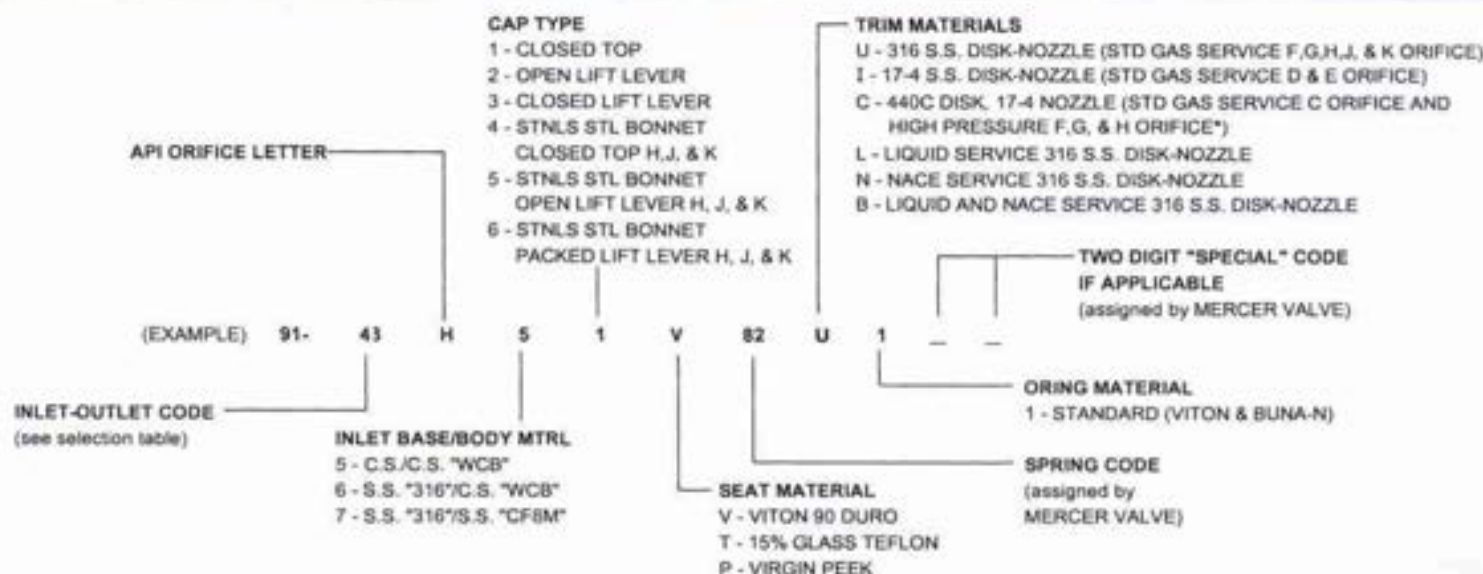
"H" ORIFICE			
ITEM NO.	PART NAME	"H" ORIFICE STD MTRLS "U", "L", "N", OR "B" TRIM CODE	"H" ORIFICE STD MTRLS "C" TRIM CODE (High Pressure)
1	Body	WCB Carbon Steel or CF3M Stainless Steel	WCB Carbon Steel or CF3M Stainless Steel
2	O'Ring	Viton	Viton
3	Drain Plug	Carbon Steel or Stainless Steel	Carbon Steel or Stainless Steel
4	Nozzle Subassy	316 Stainless Steel with Soft Seat	17-4 Stainless Steel with Soft Seat
5	Disk Subassy	316 Stainless Steel	440C Stainless Steel
6	Spring	17-7 Stainless Steel or Inconel X-750 (NACE)	17-7 Stainless Steel
7	O'Ring	Buna N	Buna N
8	Adjustment Screw	300 Series Stainless Steel	300 Series Stainless Steel
9	Bonnet Subassy	Carbon Steel or 316 Stainless Steel	Carbon Steel or 316 Stainless Steel
10	Adjustment Bushing	300 Series Stainless Steel	300 Series Stainless Steel
11	O'Ring	Buna N	Buna N
12	Washer	300 Series Stainless Steel	300 Series Stainless Steel
13	Lock Nut	18-8 Stainless Steel	18-8 Stainless Steel
14	Cap	Anodized Aluminum	Anodized Aluminum



"J" AND "K" ORIFICE			
ITEM NO.	PART NAME	"J" AND "K" STD MTRLS "U", "L", "N", OR "B" TRIM CODE	"J" AND "K" STD MTRLS "C" TRIM CODE (High Pressure)
1	Body	WCB Carbon Steel or CF3M Stainless Steel	WCB Carbon Steel or CF3M Stainless Steel
2	O'Ring	Viton	Viton
3	Drain Plug	Carbon Steel or Stainless Steel	Carbon Steel or Stainless Steel
4	Nozzle Subassy	316 Stainless Steel with Soft Seat	17-4 Stainless Steel with Soft Seat
5	Disk Subassy	316 Stainless Steel	440C Stainless Steel
6	Spring	17-7 Stainless Steel or Inconel X-750 (NACE)	17-7 Stainless Steel
7	O'Ring	Buna N	Buna N
8	Bonnet Bolt	Alloy Steel B7 or Stainless Steel B8M	Alloy Steel B7 or Stainless Steel B8M
9	Adjustment Screw	300 Series Stainless Steel	300 Series Stainless Steel
10	Adjustment Bushing	300 Series Stainless Steel	300 Series Stainless Steel
11	Bonnet Subassy	Carbon Steel or 316 Stainless Steel	Carbon Steel or 316 Stainless Steel
12	O'Ring	Buna N	Buna N
13	Washer	300 Series Stainless Steel	300 Series Stainless Steel
14	Lock Nut	18-8 Stainless Steel	18-8 Stainless Steel
15	Cap	Anodized Aluminum	Anodized Aluminum

THREADED SAFETY RELIEF VALVES

PRODUCT NUMBERING SYSTEM



*F > 1399 psi : G > 1199 psi : H > 1049 psi

STANDARD MATERIALS OR OPTIONS LISTED CONSULT FACTORY FOR OTHER MATERIALS OR OPTIONS

SELECTION TABLE

VALVE SIZE INLET X OUTLET	AVAILABLE ORIFICE SIZE	INLET- OUTLET CODE	PRESSURE LIMITS (psig)	DIMENSIONS (IN.) $\pm 1/16$ INLET X OUTLET X HT. "A" X "B" X "C"	APPROX. WEIGHT (lbs.)
1/2" FNPT X 1" FNPT	C,D	05	SEE PAGE 2	2 1/4 X 1 7/8 X 7 1/16	4.5
1/2" MNPT X 1" FNPT	C,D	06	SEE PAGE 2	3 1/4 X 1 7/8 X 8	4.5
3/4" FNPT X 1" FNPT	C,D,E	11	SEE PAGE 2	2 1/4 X 1 7/8 X 7 1/16	4.5
3/4" MNPT X 1" FNPT	C,D,E	12	SEE PAGE 2	3 1/4 X 1 7/8 X 8 1/8	4.5
1" FNPT X 1" FNPT	C,D,E	16	SEE PAGE 2	3 1/4 X 1 7/8 X 8	4.5
1" MNPT X 1" FNPT	C,D,E	17	SEE PAGE 2	3 1/4 X 1 7/8 X 8	4.5
1" FNPT X 1 1/2" FNPT	C,D,E	22	SEE PAGE 2	3 3/8 X 2 3/8 X 9	10.5
1" MNPT X 1 1/2" FNPT	C,D,E	23	SEE PAGE 2	4 1/2 X 2 3/8 X 9 5/8	11
1" FNPT X 2" FNPT	C,D,E	27	SEE PAGE 2	3 3/8 X 2 3/8 X 9	10.5
1" MNPT X 2" FNPT	C,D,E	28	SEE PAGE 2	4 1/2 X 2 3/8 X 9 5/8	11
1 1/2" FNPT X 2" FNPT	F,G	33	SEE PAGE 2	4 5/8 X 2 3/8 X 10 5/16	11.5
1 1/2" MNPT X 2" FNPT	F,G	34	SEE PAGE 2	4 7/16 X 2 3/8 X 10 1/16	11
1 1/2" FNPT X 2" FNPT	H	33	15-850	3 X 3 X 10 3/4	22
1 1/2" MNPT X 2" FNPT	H	34	15-850	4 1/4 X 3 X 12	22.5
2" FNPT X 2" FNPT	F,G	42	15-2000	4 5/8 X 2 3/8 X 10 5/16	12
2" MNPT X 2" FNPT	F,G	43	15-2000	4 7/16 X 2 3/8 X 10 1/16	12
2" FNPT X 2" FNPT	H	42	15-850	3 X 3 X 10 3/4	22
2" MNPT X 2" FNPT	H	43	15-850	4 1/4 X 3 X 12	23
2" FNPT X 2 1/2" FNPT	H	46	15-850	3 X 3 X 10 3/4	22
2" MNPT X 2 1/2" FNPT	H	47	15-850	4 1/4 X 3 X 12	23
2" FNPT X 2 1/2" FNPT	H	46	851-2000	3 X 3 X 13 1/8	28
2" MNPT X 2 1/2" FNPT	H	47	851-2000	4 1/4 X 3 X 14 1/2	29
2" FNPT X 3" FNPT	J	51	15-450	3 3/4 X 4 1/4 X 11 3/4	41
2" MNPT X 3" FNPT	J	52	15-450	5 1/2 X 4 1/4 X 13 3/8	42
2" FNPT X 3" FNPT	J	51	451-800	3 3/4 X 4 1/4 X 15 5/16	52
2" MNPT X 3" FNPT	J	52	451-800	5 1/2 X 4 1/4 X 17 1/16	53
3" MNPT X 3" FNPT	J	61	15-450	5 1/2 X 4 1/4 X 13 1/2	44
3" MNPT X 3" FNPT	J	61	451-800	5 1/2 X 4 1/4 X 17 1/4	55
3" MNPT X 3" FNPT	K	61	15-285	5 1/2 X 4 1/4 X 13 1/2	46
3" MNPT X 3" FNPT	K	61	286-750	5 1/2 X 4 1/4 X 17 1/4	57

NOTES: (1) Consult factory for other size options. (2) Weight & "C" dimension may vary with NACE option.

THREADED SAFETY RELIEF VALVES

SIZING

SAFETY RELIEF VALVE SIZING

Safety Relief Valves may be sized by using the formulas, capacity charts, Mercer supplied sizing software, or from Mercer website.

SIZING BY FORMULA: Appendix 11, Section VIII, Division I of the ASME Boiler and Pressure Vessel Code prescribes the formula for capacities of orifices. These basic formulas are:

WEIGHT FLOW (GAS)

$$W = KACP \sqrt{\frac{M}{TZ}}$$

(lb / hr)

VOLUME FLOW (GAS)

$$Q = \frac{KACP}{w \times 60} \sqrt{\frac{M}{TZ}}$$

(SCFM)

VOLUME FLOW (LIQUID)

$$Q = KAK_v \sqrt{\frac{P - P_d}{S}}$$

(GPM)

WHERE:

W=weight flow of gases in lbs/hr

Q=flow rate in SCFM for gases and GPM for liquids

A=actual flow area in square inches

P=flowing pressure (set pressure + overpressure + atmospheric pressure) in psia.

Typical overpressure is 10% or 3 psi, whichever is greater

M=molecular weight

T=absolute temperature in degrees Rankin ("F+460)

C=gas constant. This is a function of ratio of specific heats

w=density of the gas at exit conditions in lb/ft³. This is usually specified at standard conditions of 60°F and 14.7 psia. (w_{air}=0.07640 & w_{CO2}=0.04588)

Z=Compressibility Factor

K=ASME flow coefficient. (K=0.818 for gases and K=0.707 for liquids)

P_d=Pressure at discharge from valve in psia.

S=Specific Gravity of the liquid

K_v=Viscosity correction factor for liquids.

NOTE: It is the responsibility of the user to ensure pressure relief valves are properly sized and installed prior to initial operation.

Table Molecular Weight and Values of C for Gases

Gas	Mol. Wt.	Cp/Cv	C	Gas	Mol. Wt.	Cp/Cv	C
Acetylene	26	1.28	345	Hydrochloric Acid	36.5	1.40	356
Air	29	1.40	356	Hydrogen	2	1.40	356
Ammonia	17	1.33	351	Hydrogen Sulfide	34	1.32	348
Argon	40	1.66	377	Iso-butane	58	1.11	328
Benzene	78	1.10	327	Methane	16	1.30	346
Carbon Disulfide	76	1.21	338	Methyl-Alcohol	32	1.20	337
Carbon Dioxide	44	1.28	345	Methylchloride	50.5	1.20	337
Carbon Monoxide	28	1.40	356	N-Butane	58	1.11	328
Chlorine	71	1.36	352	Natural Gas (0.6)	17.4	1.27	344
Cyclohexane	84	1.08	324	Nitrogen	28	1.40	356
Ethane	30	1.22	339	Oxygen	32	1.40	356
Ethylene	28	1.20	337	Pentane	72	1.09	325
Freon 22	86	1.18	355	Propane	44	1.14	331
Helium	04	1.66	377	Sulfur Dioxide	64	1.26	342
Hexane	86	1.08	324				

AIR

10% OVERPRESSURE

NOZZLE CAPACITIES -CU. FT. PER MIN

ASME PRESSURE VESSEL CODE (UV) 90% RATING

SET	C	D	E	F	G	H	J	K
15	30	60	104	165	232	424	702	1018
20	35	69	120	191	267	489	809	1173
25	40	78	136	216	302	554	916	1329
30	44	87	152	241	338	619	1024	1484
50	65	128	222	352	494	905	1496	2169
100	116	228	397	631	883	1619	2676	3881
150	167	329	572	909	1273	2332	3856	5592
200	218	430	747	1187	1662	3046	5036	7304
250	270	530	922	1465	2052	3760	6216	9016
300	321	631	1097	1743	2441	4474	7396	10727
400	423	832	1446	2299	3220	5902	9757	14151
500	525	1034	1796	2856	3999	7329	12117	17574
750	781	1537	2671	4246	5947	10899	18018	26132
800	832	1638	2846	4524	6337	11613	19198	
1000	1037	2041	3546	5637	7895	14468		
1500	1549	3047	5296	8418	11790	21607		
1800	1856	3652	6345	10087	14127	25890		
2000	2060	4054	7045	11199	15685	28746		
2400	2470	4860	8445	13424				
2600	2674	5262						
2800	2879	5665						
2999	3083	6066						

MERCER 9100 SERIES

THREADED SAFETY RELIEF VALVES

GAS

10% OVERPRESSURE
NOZZLE CAPACITIES -CU. FT. PER MIN

NATURAL GAS SPECIFIC GRAVITY OF .6 @ 60° F
ASME PRESSURE VESSEL CODE (UV) 90% RATING

SET	C	D	E	F	G	H	J	K
15	38	75	130	206	289	529	874	1268
20	44	86	149	238	333	610	1008	1462
25	50	97	169	269	377	691	1142	1656
30	55	109	189	301	421	771	1275	1850
50	81	159	276	439	615	1127	1864	2703
100	145	284	494	786	1101	2017	3334	4836
150	208	410	712	1132	1586	2906	4805	6969
200	272	535	930	1479	2071	3796	6275	9102
250	336	661	1148	1825	2557	4686	7746	11234
300	400	786	1366	2172	3042	5575	9217	13367
400	527	1037	1802	2865	4013	7354	12158	17633
500	655	1288	2238	3558	4984	9133	15099	21899
750	973	1915	3329	5291	7411	13581	22452	32563
800	1037	2041	3547	5638	7896	14471	23923	
1000	1292	2543	4419	7024	9838	18029		
1500	1930	3797	6599	10490	14692	26924		
1800	2312	4550	7907	12569	17604	32262		
2000	2567	5052	8779	13955	19546	35820		
2400	3078	6056	10523	16728				
2600	3333	6558						
2800	3588	7059						
2999	3841	7559						

GAS

10% OVERPRESSURE
NOZZLE CAPACITIES -MILLION CU. FT. PER DAY

NATURAL GAS SPECIFIC GRAVITY OF .6 @ 60° F
ASME PRESSURE VESSEL CODE (UV) 90% RATING

SET	C	D	E	F	G	H	J	K
15	0.055	0.11	0.19	0.30	0.42	0.76	1.26	1.83
20	0.063	0.12	0.22	0.34	0.48	0.88	1.45	2.11
25	0.071	0.14	0.24	0.39	0.54	0.99	1.64	2.38
30	0.080	0.16	0.27	0.43	0.61	1.11	1.84	2.66
50	0.12	0.23	0.40	0.63	0.89	1.62	2.68	3.89
100	0.21	0.41	0.71	1.13	1.58	2.90	4.80	6.96
150	0.30	0.59	1.03	1.63	2.28	4.19	6.92	10.03
200	0.39	0.77	1.34	2.13	2.98	5.47	9.04	13.11
250	0.48	0.95	1.65	2.63	3.68	6.75	11.15	16.18
300	0.58	1.13	1.97	3.13	4.38	8.03	13.27	19.25
400	0.76	1.49	2.60	4.13	5.78	10.59	17.51	25.39
500	0.94	1.85	3.22	5.12	7.18	13.15	21.74	31.53
750	1.40	2.76	4.79	7.62	10.67	19.56	32.33	46.89
800	1.49	2.94	5.11	8.12	11.37	20.84	34.45	
1000	1.86	3.66	6.36	10.11	14.17	25.96		
1500	2.78	5.47	9.50	15.11	21.16	38.77		
1800	3.33	6.55	11.39	18.10	25.35	46.46		
2000	3.70	7.27	12.64	20.10	28.15	51.58		
2400	4.43	8.72	15.15	24.09				
2600	4.80	9.44						
2800	5.17	10.17						
2999	5.53	10.88						

THREADED SAFETY RELIEF VALVES

WATER**10% OVERPRESSURE****NOZZLE CAPACITIES - U.S. GALLONS PER MINUTE****ASME PRESSURE VESSEL CODE (UV) 90% RATING**

SET	C	D	E	F	G	H	J	K
15	7	14	24	38	54	99	163	236
20	8	16	27	43	61	111	184	267
25	9	17	30	48	67	123	203	295
30	10	19	33	52	73	133	221	320
50	12	24	42	67	94	172	285	413
100	17	34	60	95	133	244	403	584
150	21	42	73	116	163	298	493	716
200	25	49	84	134	188	345	570	826
250	28	54	94	150	210	385	637	924
300	30	60	103	164	230	422	698	1012
400	35	69	119	190	266	487	806	1169
500	39	77	134	212	297	545	901	1306
750	48	94	164	260	364	667	1103	1600
800	49	97	169	269	376	689	1139	
1000	55	109	189	300	420	771		
1500	68	133	231	368	515	944		
1800	74	146	253	403	564	1034		
2000	78	154	267	425	595	1090		
2400	86	168	293	465				
2600	89	175						
2800	92	182						
2999	96	188						

NOTE: It is the responsibility of the user to ensure pressure relief valves are properly sized and installed prior to initial operation.

OTHER INFORMATION

The quality standards and attention to detail that goes into every 9100 Series Relief Valve assures us we are delivering a premier product to satisfy the needs of the customer. The 9100 Series Threaded Relief Valve meets or exceeds API Standard 527 for seat tightness. Mercer Valve Company recommends API 520, "Part II - Installation" be used to install all 9100 Series Safety Relief Valves.

Mercer Valve Company also offers a 9100 Series Flanged Safety Relief Valve, 9500 Series Pilot Operated Safety Relief Valve, and Valve Repair services in shop or field (VR Certified).

ORDERING

For better assistance and correct valve selection please specify the following information when ordering:

1) Number of Valves	6) Back Pressure and Type	11) Cap Type
2) Valve Size Inlet X Outlet	7) Required Capacity	12) Body Material
3) Set Pressure	8) Media Name	13) Special Requirements if Needed
4) Operating Pressure	9) Media State (Vapor or Liquid)	14) Required Drawings or Certifications
5) Operating & Relieving Temp	10) Molecular Wt. and/or Specific Gr.	

9609 NW 4th Street,
Oklahoma City, OK 73127
(800) 833-6402
VISIT OUR WEBSITE AT
www.mercervalve.net



Part #MVC91THD

Revised 10/1/02



PHONE # (405) 495-6533
FAX # (405) 495-8728
24 HOUR SERVICE AVAILABLE
OR E-MAIL US AT
mvsales1@mercervalve.net



J-Series

High Pressure (to 5,000 PSIG)
Compressed Gas Filters



Finite[®]

J-Series High Pressure Filters

High Pressure Systems Need Filtration Protection

High pressure compressed gas systems pose difficult problems that require special filtration attention. Excessive amounts of liquid aerosols and solid particulate contamination are common. In addition, higher temperature levels are possible, and may cause the liquid oils to varnish. Varnishing contributes to poor component performance and wear that may lead to unscheduled maintenance. Finite's "J" Series high pressure filters are an extremely effective way to reduce or eliminate these problems.

Removing Liquid Aerosols

Finite's Grade 4 media will remove 99.995% of liquid aerosols in the .3 to .6 micron range. For most systems the Grade 4 coalescing media is recommended. But for systems with high liquid concentrations (+ 50 ppm of oil or + 25 ppm of water), pre-coalescing is required.

Pre-coalescing involves two-stage filtration. A Finite "J" Series filter with Grade 10 media is used to remove the gross aerosols. Then a second "J" Series filter with Grade 4 media is placed after the Grade 10 filter to clean up the remaining aerosols.

Filtering Solid Particulates

Particulate contamination problems are controlled and often eliminated with Finite's "3P" pleated cellulose media. The pleated element exposes a larger surface area that significantly increases element life. Finite's resin impregnated "3P" media is also water resistant giving it high performance in the presence of liquids.

Particulate filter elements like the "3P" are often used upstream of coalescing filters. By removing particulate contamination first, the life of the coalescing filter is greatly extended.

Specifications

Housing Model	J2SD	J2SL	J4SF	J4NF	J6SH	J6NH
Port Size	SAE-8 (Std.) Adapter Bushings Provided for 1/2" NPT Female		SAE-16	1" NPT	SAE-24	1½" NPT
Pressure (PSIG), Max.	5000		5000		5000	
Temp. (°F), Max.	350		350		350	
Sump Capacity	60 ml	220 ml	210 ml		637 ml	
Assembly Weight (lbs.)	9.2	13.1	22.1		52.5	
Major Materials of Construction (with coalescing element installed)	Ductile iron, fluoro-carbon seals, aluminum, fiberglass, carbon steel, epoxy, rayon.		Nodular cast iron, carbon steel, fluoro-carbon seals, fiberglass, epoxy, rayon, aluminum, engineered plastic.		Nodular cast iron, carbon steel, fluoro-carbon seals, fiberglass, epoxy, rayon, aluminum.	
Drain Port Size	SAE-6		SAE-6		SAE-6	

J-Series High Pressure Filters

Application Notes

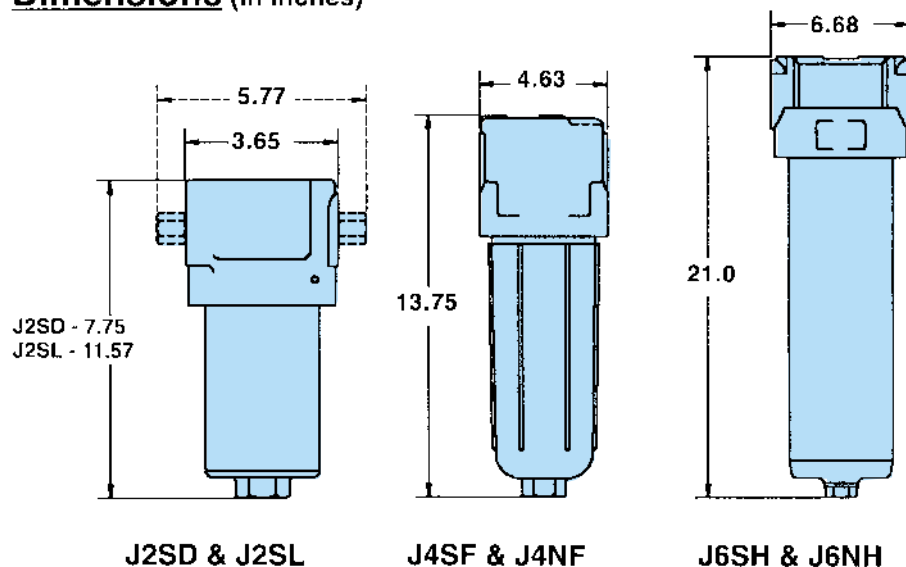
- At high pressures, excessive amounts of oil aerosols may be present. Pre-coalescing with Grade 10 may be necessary before final coalescing.
- Grade 4 (not Grade 6 as in other Finite Filter series) is used as the standard coalescer media in the "J" Series. High pressure systems reduce the effectiveness of filter media, requiring the upgrade to Grade 4 media as the standard.
- Flow Direction:
 Coalescers (Grade 10 or Grade 4) Port 1 to Port 2
 Interceptors ("3P" Particulate) Port 2 to Port 1
 Absorbers ("A" Charcoal Adsorber) Port 2 to Port 1
- Element Replacement:

	Element Differential Pressure (PSID)
Coalescers and Particulate Interceptors	10
Adsorbers	Any Increase, or after 6 months in use.
- Mount filters in a vertical position.
- Do not service these filters under pressure! The system pressure must be reduced to atmospheric levels before changing elements, draining bowls, or performing any other maintenance activity on or near these filters.

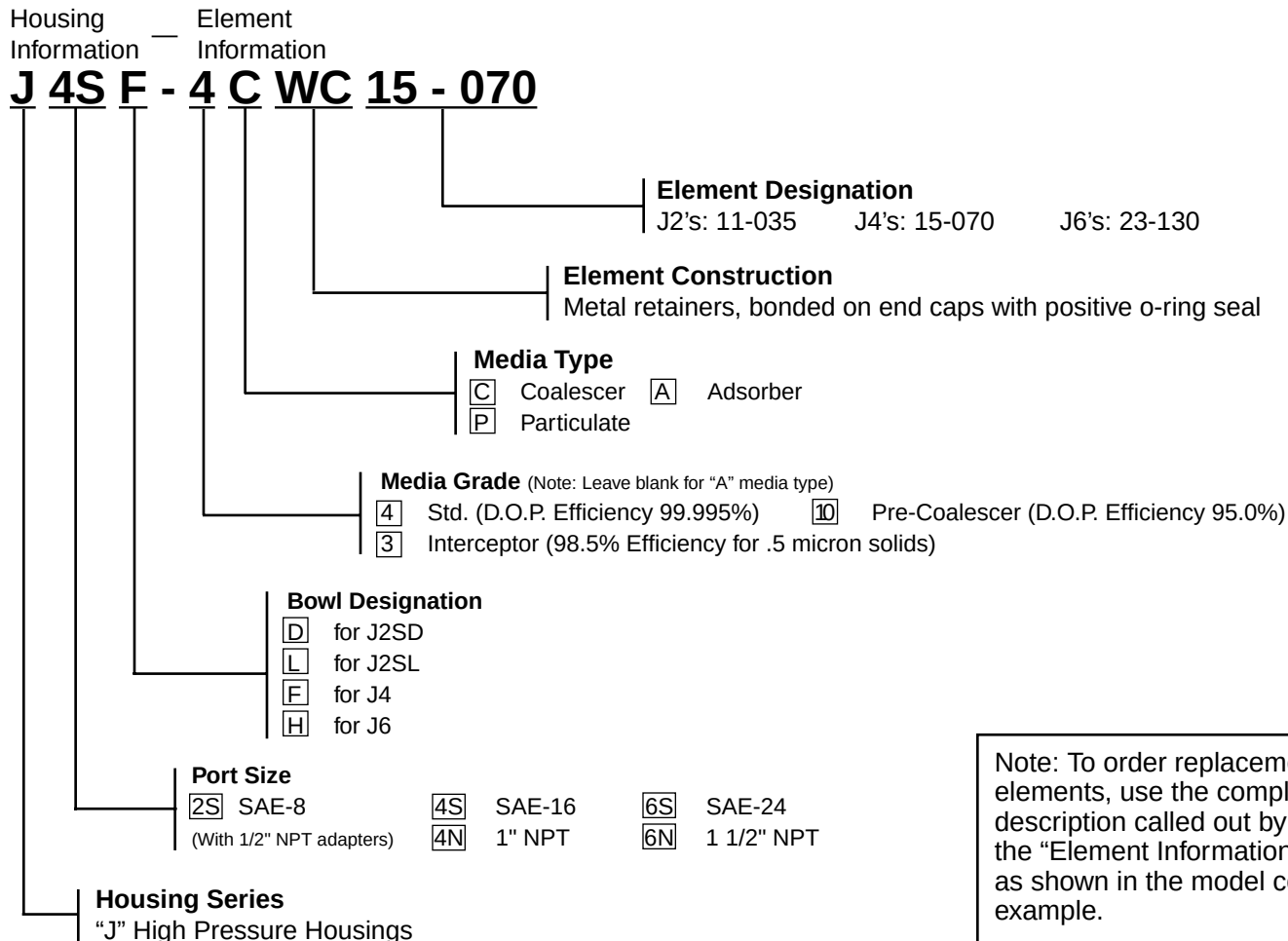
Flow Rates (SCFM @ indicated system pressures)

	Media	J2SD & J2SL	J4SF & J4NF	J6SH & J6NH
Flow @ 1500 PSIG	4C, A 10C, 3P	400 800	1000 2000	3000 6000
Flow @ 3000 PSIG	4C, A 10C, 3P	800 1600	2000 4000	6000 12,000
Flow @ 4500 PSIG	4C, A 10C, 3P	1200 2400	3000 6000	9000 18,000

Dimensions (In Inches)



How To Order



Note: To order replacement elements, use the complete description called out by the "Element Information," as shown in the model code example.

WARNING

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application including consequences of any failure, and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

Model 2088 Absolute and Gage Pressure Transmitter

***A TRADITION OF EXCELLENCE IN
PERFORMANCE FROM THE INDUSTRY
LEADERS***

- *Absolute and gage pressure ranges from 0–1.5 psi to 0–4,000 psi (0–0.1 to 0–276 bar)*
- *0.20% reference accuracy, including linearity, hysteresis, and repeatability*
- *20:1 turndown*
- *Lightweight, compact size makes for easy installation and handling*
- *0.1% High accuracy option*



Content

Specifications	page 3
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Ordering Information	page 8
Configuration Data Sheet	page 10

The Model 2088

The Rosemount® Model 2088 Smart Pressure Transmitter is an economical addition to the Rosemount pressure transmitter line of instruments. The Model 2088 is designed with reliability, long-term performance, and maintainability in mind. Model 2088 transmitters maintain a specification conformance of at least $3\sigma^{(1)}$. The rugged, reliable performance for which Rosemount transmitters are famous, coupled with Smart capabilities, make these transmitters exceptional values.

The Model 2088 is available in either gauge or absolute pressure in pressure ranges to 4,000 psi (275 bar). It utilizes a solid-state, polysilicon pressure sensor with a choice of either 316L or Hastelloy isolating diaphragms. The low oil fill of this design has very little temperature effect and outstanding accuracy.

(1) *Sigma (σ) is a statistical symbol to designate the standard deviation from the mean value of normal distribution.*

Features

The Model 2088 provides accurate, stable, and reliable pressure measurement in your most difficult applications. Its small compact design allows it to be directly connected to your process providing a quick, easy, and cost effective installation.

The Model 2088 standard process connection is $\frac{1}{2}$ inch NPT but a variety of optional connections are available. Optional connections range from multiple threaded connections to our full line of manifolds and remote diaphragm seals that provide solutions for virtually any connection.

The Model 2088 also features a fully configurable digital LCD meter that displays pressure and diagnostic information. The information displayed is directly from the microprocessor which accounts for its accuracy and reliability.

Rosemount Pressure Solutions

Model 3051S Series of Instrumentation

Scalable pressure, flow and level measurement solutions improve installation and maintenance practices. See product data sheet 00813-0100-4801.

Model 3095MV Mass Flow Transmitter

Accurately measures differential pressure, static pressure and process temperature to dynamically calculate fully compensated mass flow. See product data sheet 00813-0100-4716.

Model 305 and 306 Integral Manifolds

Factory-assembled, calibrated and seal-tested manifolds reduce on-site installation costs. See product data sheet 00813-0100-4733.

Model 1199 Diaphragm Seals

Provides reliable, remote measurements of process pressure and protects the transmitter from hot, corrosive, or viscous fluids. See product data sheet 00813-0100-4016.

Model 1195 Integral Orifice and ProPlate®/Mass ProPlate® Flowmeters

Convenient ready-to-install assembly designed for small-bore flow measurement of any clean gas, liquid, or vapor. See product data sheet 00813-0100-4686.

Annubar® Flowmeter Series

A series of highly accurate and repeatable insertion-type flowmeters available in 2-in. to 72-in. (50.8 to 1829 mm) line sizes. See product data sheet 00813-0100-4809.

Model 405P Compact Orifice

A wafer style primary element with an integral three-valve manifold. See product data sheet 00813-0100-4810.

Specifications

Functional Specifications

Service

Liquid, gas, and vapor applications

Ranges

Range	Minimum Span	URL/Max. span/ Sensor Limit
1	1.5 psi (103 mbar)	30 psi (2.1 bar)
2	7.5 psi (517 mbar)	150 psi (10.3 bar)
3	40 psi (2.8 bar)	800 psi (55.2 bar)
4	200 psi (13.8 bar)	4000 psi (275.8 bar)

Output

Code S: 4–20 mA dc

Code N: 1-5 volt dc, low power

(Outputs are directly proportional to the input pressure)

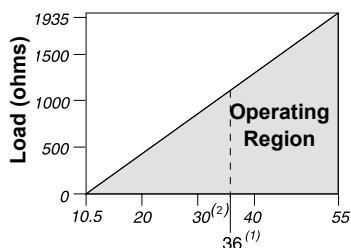
Rangedown

20 to 1

Load Limitations

Reverse polarity protection is standard. Maximum loop resistance is determined by the power supply voltage as described by the following equations:

$$\text{Max. Loop Resistance} = 43.5 (\text{Power Supply Voltage} - 10.5)$$



Power Supply Output Code S (dc Volts)

Communication requires a minimum loop resistance of 250 ohms.

(1) For hazardous location approvals, power supply must not exceed 36 V.

(2) For CENELEC Ex ia approval, the power supply must not exceed 30 V.

Power Supply

External power supply required. Transmitter operates on 10.5–36 V dc with no load (6–12V for Low Power). Reverse polarity protection is standard.

Current Draw

Output Code N: ≤ 3 mA without LCD display.

Zero Elevation and Suppression

Zero can be suppressed between atmosphere for gage transmitters or 0 psia for absolute transmitters and upper range limit, provided the calibrated span is equal to or greater than the minimum span, and the upper range value does not exceed the upper range limit. For vacuum calibrations, the compound range option is available (Option Code CR).

Compound Range Capability

Select the Compound Range (CR) option for use in negative gage pressure applications. An enhanced sensor is installed in transmitters with the CR option code.

Overpressure Limits

Range 1: 120 psig max

All other ranges: two times the URL

Time Response

Time Constant: 200 milliseconds

Dead time: < 0.1 s

Update rate: 20 times per second minimum

Temperature Limits

Process

Silicone fill sensor: -40 to 250 °F (-40 to 121 °C)

Inert fill sensor: -22 to 250 °F (-30 to 121 °C)

Process temperatures above 185 °F (85 °C) require derating the ambient limits by a 1.5:1 ratio:

Ambient:

-40 to 185 °F (-40 to 85 °C)

-4 to 175 °F (-20 to 80 °C) with LCD meter

Storage:

-50 to 230 °F (-46 to 110 °C)

-40 to 185 °F (-40 to 85 °C) with LCD meter

$$\text{Maximum Ambient Temperature in } ^\circ\text{F} : 185 - \frac{(\text{Process Temp} - 185)}{1.5}$$

$$\text{Maximum Ambient Temperature in } ^\circ\text{C} : 85 - \frac{(\text{Process Temp} - 85)}{1.5}$$

Humidity Limits

0–100% relative humidity

Volumetric Displacement

Less than 0.00042 cm^3

Turn-on Time

2.0 seconds, no warm-up required

Failure Mode

If self-diagnostics detect a sensor or microprocessor failure, the analog signal is driven either high or low to alert the user. High or low failure mode is user-selectable with a jumper on the transmitter. The values to which the transmitter drives its output in failure mode depend on whether it is factory-configured to *standard* or *NAMUR-compliant* operation. The values for each are as follows:

Standard Operation			
Output Code	Linear Output	Fail High	Fail Low
S	$3.9 \leq I \leq 20.8$	$I \geq 21.75 \text{ mA}$	$I \leq 3.75 \text{ mA}$
N	$0.97 \leq V \leq 5.2$	$V \geq 5.4 \text{ V}$	$V \leq 0.95 \text{ V}$
N with Code C2	$0.78 \leq V \leq 3.44$	$V \geq 4.0 \text{ V}$	$V \leq 0.77 \text{ V}$

Standard Operation			
NAMUR-Compliant Operation			
Output Code	Linear Output	Fail High	Fail Low
S	$3.8 \leq I \leq 20.5$	$I \geq 22.5 \text{ mA}$	$I \leq 3.6 \text{ mA}$

Transmitter Security

Activating the transmitter security function prevents changes to the transmitter configuration, including local zero and span adjustments. Security is activated by an internal switch.

Performance Specifications

(Zero-based spans, reference conditions, silicone oil fill, and 316L SST isolating diaphragm.)

Reference Accuracy

$\pm 0.20\%$ of calibrated span. Includes combined effects of linearity, hysteresis, and repeatability

Ambient Temperature Effect

Expressed as a total effect per 50°F (28°C)

Total effect includes zero and span effects.

$\pm (0.15\% \text{ URL} + 0.15\% \text{ of span})$ from -40°F to 185°F (-40°C to 85°C)

Stability

$\pm 0.10\%$ of URL for 12 months

Vibration Effect

Less than $\pm 0.1\%$ of URL when subjected to vibration of: peak to peak constant displacement of 4 mm (5–15 Hz) and constant acceleration of 2 g (15–150 Hz) and 1 g (150–2000 Hz).

Power Supply Effect

Less than 0.01% of calibrated span per volt

Mounting Position Effect

Zero shift of up to 1.2 inH₂O (0.30 kPa), which can be calibrated out. No span effect.

RFI Effect

Less than $\pm 0.25\%$ of upper range limit from 20–1000 MHz at 30 V/m with leads in conduit. Less than $\pm 0.25\%$ of upper range limit from 20–1000 MHz at 10 V/m with unshielded twisted pair (no conduit).

Transient Protection Limits

IEEE 587 Category B

6 kV Crest ($1.2 \times 50 \mu\text{s}$)

3 kV Crest ($8 \times 20 \mu\text{s}$)

6 kV Crest ($0.5 \mu\text{s}$ by 100 kHz)

IEEE 472

SWC 2.5 kV Crest, 1 MHz waveform

General Specifications

Tested to IEC 801-3

Physical Specifications

Electrical Connection

$1/2$ –14 NPT, M20 $\times$ 1.5 (CM20), PG 13.5, or

G $1/2$ female (PF $1/2$ female) conduit entry

Process Connection

$1/2$ –14 NPT female, DIN 16288 G $1/2$ male, RC $1/2$ female (PT $1/2$ female), M20 $\times$ 1.5 (CM20) male

Process Wetted Parts

Isolating Diaphragm

316L stainless steel or Hastelloy C-276

Process Connector

316L stainless steel CF-3M (Cast version of 316L SST, material per ASTM_A743) or Hastelloy C-276

Non-wetted Parts

Electronics Housing

Low-copper aluminum, NEMA 4X, IP65, IP67, CSA enclosure Type 4X

Paint

Polyurethane

Cover O-rings

Buna-N

Fill Fluid

Silicone or inert fill

Weight

Output Code S and N: Approximately 2.44 lb (1.11 kg)

Tagging

The transmitter is tagged, at no charge, in accordance with customer requirements. All tags are stainless steel. The standard tag is permanently attached to the transmitter. Tag character height is $1/8$ in. (0.318 cm). A wired tag is available upon request.

Accessory Block and Bleed Valve (S5 Option)

Model 306 Integral Manifold is pre-assembled to transmitter and leak checked.

Product Certifications

Approved Manufacturing Locations

Rosemount Inc. — Chanhassen, Minnesota, USA
Fisher-Rosemount GmbH & Co. — Wessling, Germany
Emerson Process Management
Asia Pacific Private Limited — Singapore

European Pressure Equipment Directive (PED) (97/23/EC)

Models 2088/2090 Pressure Transmitters —
Sound Engineering Practice

Ordinary Location Certification

As standard, the transmitter has been examined and tested to determine that the design meets basic electrical, mechanical, and fire protection requirements by FM, a nationally recognized testing laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

Hazardous Locations Certifications

North American Certifications

Factory Mutual (FM)

- E5** Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II, Division 1, Groups E, F, G, Class III, Division 1, indoor and outdoor (NEMA 4X) hazardous locations; factory sealed.
- I5** Intrinsically safe for use in Class I, Division 1, Groups A, B, C, D; Class II, Division 1, Groups E, F, and G; and Class III, Division 1 when connected in accordance with Rosemount drawing 02088-1018. Non-incendive for Class I, Division 2, Groups A, B, C, and D.
For input parameters see control drawing 02088-1018.

Canadian Standards Association (CSA)

- C6** Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II, Division 1, Groups E, F, G, Class III, indoor and outdoor hazardous locations. CSA enclosure Type 4X; factory sealed. Suitable for Class I, Division 2, Groups A, B, C, and D.
Intrinsically Safe for Class I, Division 1, Groups A, B, C, and D. Temp. Code T3C. Intrinsically safe when connected with approved barriers in accordance with Rosemount drawing 02088-1024.
For input parameters see control drawing 02088-1024.

European Certifications

- I1** CENELEC Intrinsic Safety
Certificate No.: BAS00ATEX1166X  II 1 G
EEx ia IIC T5 (Tamb = -55 to 40 °C)
EEx ia IIC T4 (Tamb = -55 to 70°C)
CE 1180

CENELEC I1 Input Parameters	Input Type
U _i = 30 V dc	Smart
I _i = 200 mA	Smart
P _i = 0.9 W	Smart
C _i = 0.012 µF	Smart

SPECIAL CONDITIONS FOR SAFE USE (X):

When the optional transient protection terminal block is installed, the apparatus is not capable of withstanding a 500V rms test to case. This must be taken into account on any installation in which it is used, for example by assuring that the supply to the apparatus is galvanically isolated.

- N1** CENELEC Type n
Certification No.: BAS00ATEX3167X  II 3 G
Ex nL IIC T5 (T_a = -40 °C to 70 °C)
U_i = 50 V dc max

SPECIAL CONDITIONS FOR SAFE USE (X):

When the optional transient protection terminal block is installed, the apparatus is not capable of withstanding a 500 V r.m.s. test to case. This must be taken into account on any installation in which it is used, for example, by assuring that the supply to the apparatus is galvanically isolated.

ND CENELEC Dust
 Certificate No.: BAS01ATEX1427X  II 1 D
 T105°C (T_{amb} = -20°C to 85°C)
 IP66
 1180
 V_{max} = 36 V dc

SPECIAL CONDITIONS FOR SAFE USE (X):

1. The user must ensure that the maximum rated voltage and current (36 volts, 24 milliamps, D.C.) are not exceeded. All connections to other apparatus or associated apparatus shall have control over this voltage and current equivalent to a category "ib" circuit according to EN50020.

2. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP66.

3. Unused cable entries must be filled with suitable blanking plugs which maintain the ingress protection of the enclosure to at least IP66.

4. Cable entries and blanking plugs must be suitable for the ambient range of the apparatus and capable of withstanding a 7J impact test.

5. The 2088/2090 sensor module must be securely screwed in place to maintain the ingress protection of the enclosure.

ED CENELEC Flame-Proof
 Certification No.: KEMA97ATEX2378  II 1/2 G
 EEx d IIC T6 (T_a = -20 °C to 40°C)
 T4 (T_a = -20 °C to 80 °C)
 1180
 V_{max} = 36 (with Smart output option)
 V_{max} = 14 (with low power output option)

Japanese Certifications

E4 JIS Flame-Proof
 Ex d IIC T6 (T_{amb} = 85 °C)

Certificate	Description
C14783	2088 Smart with SST wetted parts (no meter)
C14784	2088 Smart with SST wetted parts (with meter)
C15051	2088 Smart with Hast. wetted parts (no meter)
C15052	2088 Smart with Hast. wetted parts (with meter)
C15055	2088 Smart with SST CR option (no meter)
C15056	2088 Smart with Hast. CR option (no meter)
C15057	2088 Smart with SST CR option (with meter)
C15058	2088 Smart with Hast. CR option (with meter)

Combinations of Certifications

Stainless steel certification tag is provided when optional approval is specified. Once a device labeled with multiple approval types is installed, it should not be reinstalled using any other approval types. Permanently mark the approval label to distinguish it from unused approval types.

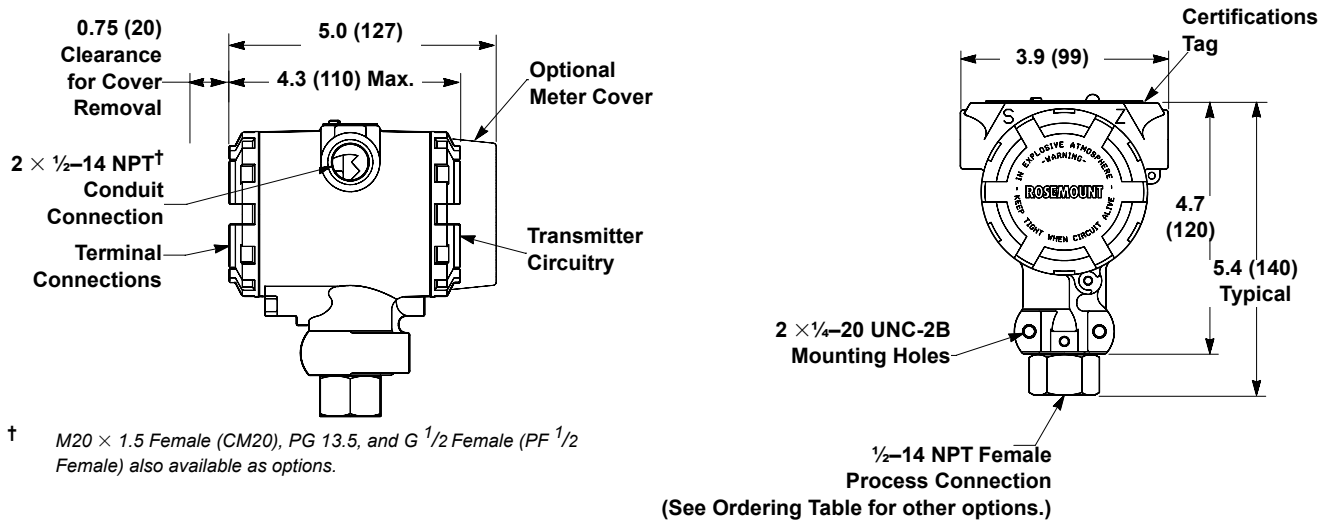
KB K5 and C6 combination

KH K5, ED and I1 combination

K5 E5 and I5 combination

Dimensional Drawings

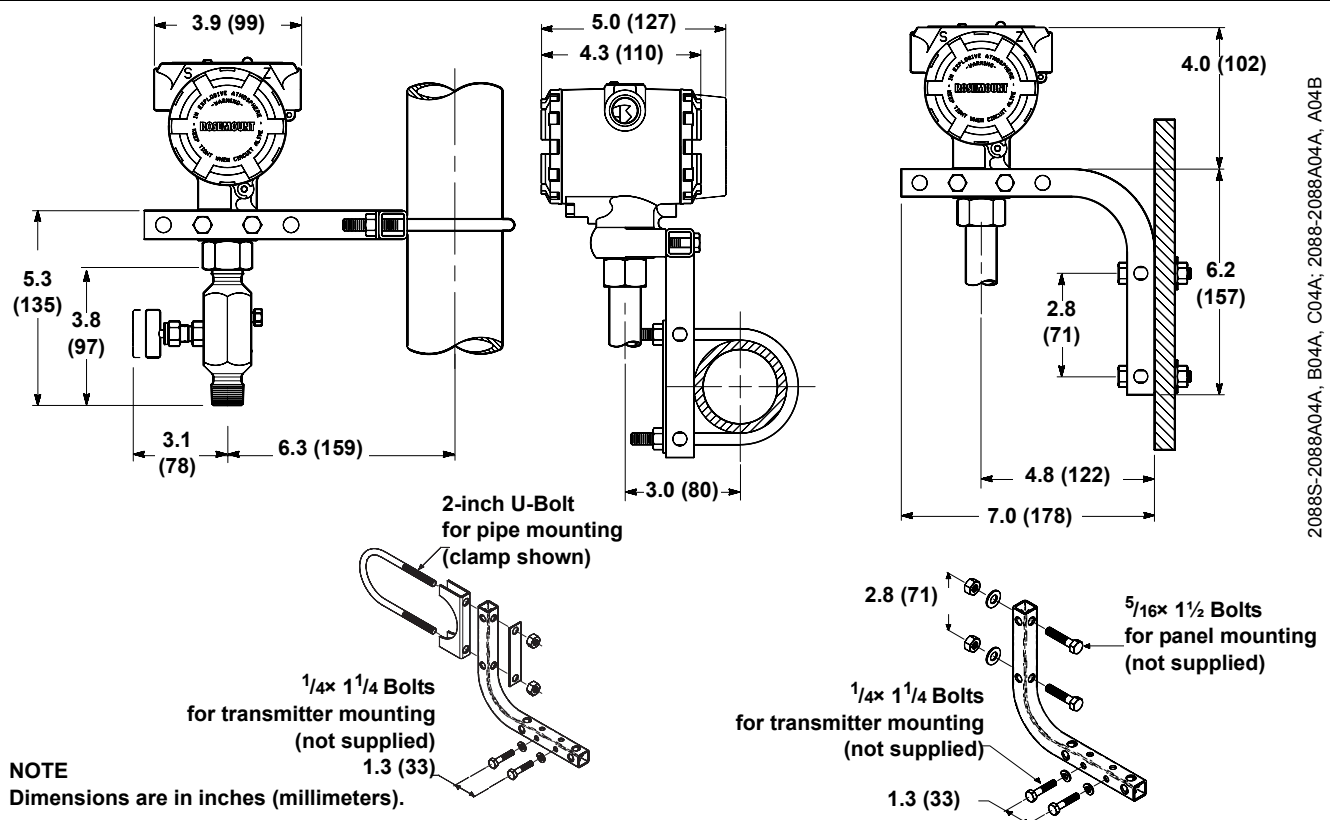
Model 2088



Mounting Configurations with Optional Mounting Brackets

Pipe Mounting

Panel Mounting



Ordering Information

Model	Product description		
2088	Pressure Transmitter		
Code	Transmitter type		
A	Absolute		
G	Gage		
Code	Range	Minimum span	URL/Max.span/Sensor limit
1	0–30 psi (0–2.1 bar)	1.5 psi (103.0 mbar)	30 psi (2.1 bar)
2	0–150 psi (0–10.3 bar)	7.5 psi (517.0 mbar)	150 psi (10.3 bar)
3	0–800 psi (0–55.2 bar)	40 psi (2.8 bar)	800 psi (55.2 bar)
4	0–4,000 psi (0–275.8 bar)	200 psi (13.8 bar)	4000 psi (275.8 bar)
Code	Output		
S	4–20 mA dc/Digital HART® Protocol		
N	1-5 V dc Low Power/ Digital HART protocol		
MATERIALS OF CONSTRUCTION			
Code	Process connection	Isolating diaphragm	Oil fill
22 ⁽¹⁾	316L SST	316L SST	Silicone
33 ⁽¹⁾	Hastelloy C-276	Hastelloy C-276	Silicone
2B ⁽¹⁾	316L SST	316L SST	Inert
Code	Process connection		
A	½–14 NPT Female		
B	DIN 16288 G ½ Male		
C ⁽²⁾	RC ½ Female (PT ½ Female)		
D ⁽²⁾	M20 × 1.5 Male (CM20 Male)		
Code	Conduit thread		
1	½–14 NPT		
2	M20 × 1.5 Female (CM20)		
3	PG 13.5		
4	G ½ Female (PF ½ Female)		
OPTIONS			
Code	Integral manifold		
S5	Assembly to Model 306 integral manifold <i>Note: Use ½ - 14 NPT Female Process Connection code A.</i>		
Code	Diaphragm seal assemblies		
S1	Attachment of one diaphragm seal		
Code	Mounting brackets		
B4	SST mounting bracket with SST Bolts		
Code	Special configuration (software)		
C4 ⁽⁴⁾	NAMUR alarm and saturation values, high alarm		
CN ⁽⁴⁾	NAMUR alarm and saturation values, low alarm		
C9 ⁽³⁾	Software configuration		
Code	Special configuration (hardware)		
C2	0.8 - 3.2 V dc output with HART protocol, Output code N only.		
CR	Compound range calibration capability		
Continued on next page			

Product Data Sheet

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Model 2088

Code	Product Certifications
Hazardous Location Certifications	
I1 ⁽⁴⁾	CENELEC Intrinsic Safety
N1 ⁽⁴⁾	CENELEC Type nL
ND ⁽⁴⁾	CENELEC Dust
C6	CSA explosion-proof, Intrinsic Safety, and Non-Incendive
K6 ⁽⁴⁾	CSA/CENELEC explosion-proof and Intrinsic Safety Approval Combination
E4 ⁽⁴⁾	JIS Flameproof <i>Note: Available with G¹/₂ Female Conduit Thread code 4, and with or without meter output codes M5 and M7.</i>
E5	FM explosion-proof
I5	FM Non-Incendive and Intrinsic Safety Approval
ED	CENELEC flame-proof
DW	NSF drinking water approval <i>Note: Requires 316 SST diaphragm Materials of Construction code 22 with ¹/₂-14 NPT Process Connection code A.</i>
K5	E5 and I5 combination
KB	K5 and C6 combination
KH ⁽⁴⁾	K5, ED, and I1 combination
Code Digital Display	
M5	LCD display, scaled 0–100%
M7	LCD display, special configuration
Code Special procedures	
P1	Hydrostatic testing
P2	Cleaning for special service
P8	0.1% accuracy to 10:1 turndown
Code Special certifications	
Q4	Calibration certificate
Code Terminal blocks	
T1	Transient protection <i>Note: Available with Hazardous Location Certifications codes E5, ED, I1, I5, N1, C6, and K5.</i>

(1) Meets NACE material recommendations.

(2) Not available with Hastelloy C-276, Materials of Construction code 33.

(3) A Configuration Data Sheet, see page 10, must be completed.

(4) Not available with low-power Output code N.

★ = Defaults

Customer _____ P.O. No. _____
 Model No. _____ Line Item _____
 SST Tag No: _____
 Software Tag: | | | | | | | |

Pressure Units: ☐ inH₂O ☐ **psi ★** ☐ Pa ☐ ftH₂O
☐ inHg ☐ bar ☐ kPa ☐ g/cm²
☐ mbar ☐ Torr ☐ mmH₂O ☐ inH₂O at 4 °C⁽¹⁾
☐ Atm ☐ kg/cm² ☐ mmHg ☐ mmH₂O at 4 °C⁽¹⁾

Range Points: 4mA (1, 0.8V) = (0) ★ 20mA (5, 3.2V) = (URL) ★⁽²⁾

Damping: ☐ 0.00 seconds ☐ 0.05 seconds ☐ 0.10 seconds ☐ 0.20 seconds
☒ **0.40 seconds★** ☐ 0.80 seconds ☐ 1.60 seconds ☐ 3.20 seconds
☐ 12.8 seconds ☐ 25.6 seconds

(1) *Not available with low power output*

(2) Default values may be different outside the U.S.A. Consult your Rosemount Sales Representative.

Descriptor:⁽¹⁾ (16 Characters)

Message:⁽¹⁾ (32 Characters)

Date:⁽¹⁾

Day/Month/Year

pan and Zero: ☒ **Enabled★** ☐ Disabled

(1) C9 Option required for configuration of this parameter.

Product Data Sheet

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Model 2088

LCD METER INFORMATION: (Software Adjustable)

Meter Display Type: ⁽¹⁾	☐ Eng. Units Only	☐ Alternate Eng. Units & % of Range★
	☐ % of Range Only	☐ Alternate Eng. Units & Custom Display ⁽²⁾
	☐ Custom Display Only ⁽²⁾	☐ Alternate % of Range & Custom Display ⁽²⁾
Custom Display Configuration:	Decimal Point Position (fixed)	
(Must be filled out if Custom Display is selected as meter type)	Indicate decimal point location	X _□ X _□ X _□ X _□ X _□
Enter Lower Range Value (Decimal point must be in the same position as specified above.)	(circle sign) + - ☐ ☐ ☐ ☐ ☐	Default is +000.00
Enter Upper Range Value (Decimal point must be in the same position as specified above.)	(circle sign) + - ☐ ☐ ☐ ☐ ☐	Default is +100.00
Custom Units	Available characters: A-z, 0-9, /, *, %, (blank)	☐ ☐ ☐ ☐ ☐ Default is %RNGE

(1) C9 Option required for configuration of this parameter.

(2) Not available with low power output.

HARDWARE SELECTABLE INFORMATION

Alarm Option:	☐ High★	☐ Low
Transmitter Security:	☐ Off★	☐ On

NOTE: Specify C4 or CN option in model structure when ordering NAMUR-compliant alarm and saturation limits.⁽¹⁾

(1) Not available with low power output.

SIGNAL SELECTION: (Software Selectable)

☐ 4–20 mA with simultaneous digital signal based on HART protocol★
☐ Burst mode of HART digital process variable ⁽¹⁾
Burst mode output options:
☐ Primary variable in engineering units ★ ⁽²⁾
☐ Primary variable in percent of range
☐ All dynamic variables in engineering units
☐ All dynamic variables in engineering units and the primary variable mA value
☐ Multidrop Communication ^{(1) (3)} Choose transmitter address (1-15) ⁽⁴⁾ : _____

(1) C9 Option required for configuration of this parameter.

(2) When Burst mode is selected, "Primary variable in engineering units" is default when no other Burst mode option is selected.

(3) This option fixes the transmitter analog output at 4mA.

(4) Default address is 1 if multidrop communication is selected.

Product Data Sheet

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November 2002

Model 2088

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120 Series

120 Series

PRESSURE, VACUUM, DIFFERENTIAL PRESSURE, TEMPERATURE

FEATURES

- Class I, Div. 1 & 2, Groups B, C, & D
Class II, Div. 1 & 2, Groups E, F, & G
Class III
- Choice of one or two SPDT,
optional DPDT output
- Dual electrical conduit openings
- Terminal block wiring
- Welded diaphragm or bellows sensor
- Cover lock
- Ultra-low pressure ranges



OVERVIEW

As safety requirements become more stringent, the determining factor in specifying an industrial pressure, differential pressure and/or temperature switch rests upon that switch protecting equipment, processes and personnel. Meeting hazardous location requirements through adherence to UL, CSA, and ATEX standards, UE's 120 Series is the choice where potentially explosive or highly corrosive atmospheres exist.

The 120 Series offers a variety of pressure, differential pressure, vacuum and temperature ranges, as well as port connections, wetted materials and sensor types. With common, flexible "platforms", models can quickly be adapted at the factory for special requirements, such as ranges, process connections and electrical ratings. Typical industries using 120 Series switches include chemical, petrochemical, refinery, oil and gas pipelines & production and pharmaceuticals.

An innovator in the application of Threshold Detection and Switching™ technology since 1931, United Electric's primary focus is the protection of equipment, processes and people.

FEATURES

- Approvals include cULus, ATEX & SAA; compliance with CE and NACE standards
- Internal adjustment or external adjustment via calibrated dials with tamper resistant cover
- Single or Dual Output
- Wide variety of sensor materials
- Optional Hastelloy®, Monel® and Tantalum sensor material for corrosive media
- Flush mount sanitary sensors
- Stainless steel, Hastelloy®, Monel® flanges conforming to ANSI standards
- Indicating Differential Pressure Module
- Most models available for immediate delivery!



SPECIFICATIONS

STORAGE TEMPERATURE	-65 to 160°F (-54 to 71°C)
AMBIENT TEMPERATURE LIMITS	-58 to 160°F (-50 to 71°C); models 36-39, 520-525, 540-548, 701-705: 0 to 160°F (-17 to 71°C); Types 820E, 822E: -40 to 160°F (-40 to 71°C) set point typically shifts less than 1% of range for a 50°F (28°C) ambient temperature change; less than 2% for types E121 & E122
SET POINT REPEATABILITY	Temperature models: ±1% of adjustable range Pressure models 126-164, S126B-S164B, 171-174, 270-274, 358-376, 520-535, 540-543, 560-564, 701-705: ±1% of adjustable range; models 450-559: ±1/2% of adjustable range; models 36-39, 183-194, 483-494, 544-548, 565-567, 612-680: ±1 1/2% of adjustable range
SHOCK	Set point repeats after 15 G, 10 millisecond duration
VIBRATION	Set point repeats after 2.5 G, 5-500 Hz
ENCLOSURE	Die cast aluminum (max. 0.4% copper), epoxy powder coated; gasketed; coverlock; internal set point lock standard on types J, C, F; gasketed aluminum tamper-resistant dial cover on types B, H, E; aluminum nameplate
ENCLOSURE CLASSIFICATION	Certified to enclosure type 4X. Types 820E, 822E; designed to meet NEMA 4 requirements with option M300; Class I, Division 1 product meet enclosure type 7; Class II, Division 1 products meet enclosure type 9. Certified to IP66 requirements
SWITCH OUTPUT	One or two SPDT; dual switch may be separated up to 100% of range; except type 822E where switch #2 can be set up to 25% of range span below switch #1 setpoint; switches may be wired "normally open" or "normally closed". Two SPDT hermetic sealed switches available on H122P models
ELECTRICAL RATING	15 A 125/250/480 VAC resistive (standard) except types H122P; 11A 125/250 VAC resistive; B121-13272, B122-13322, E121-13273, E122-13321; 22A 480VAC resistive
REFERENCE SCALES	Types B, E & H: external dial. Scale divisions vary with range.
WEIGHT	3-8 lbs. Varies with type and model
ELECTRICAL CONNECTION	Type H, B, E; one 3/4" NPT E/C; Type J, C, F, 820E, 822E; two 3/4" NPT E/C; terminal block standard
PRESSURE CONNECTION	Models S126B-S164B, 171-194, 483-494, 520-535: 1/2" NPT (female); models 560-564: 2" sanitary connection; models 565-567: 1 1/2" sanitary connection; models 540-548: 1/8" NPT (female); all others: 1/4" NPT (female)
TEMPERATURE ASSEMBLY	Bulb and capillary: 6 feet 304 stainless steel (standard) except for E121-13273 and E122-13321: 10 feet; Immersion stem: nickel-plated brass (standard) except for B121-13272 and B122-13322: stainless steel. Fill: Model 1BS: solvent filled; models 2BS-8BS: non-toxic oil filled
TEMPERATURE DEADBAND	Type F120, 820E, 822E: typically 1%; type B-, C-, and E- 121 and 122: typically 2% of range under laboratory conditions (70°F [21°C] ambient circulating bath at rate of 1/2°F per minute change)
PRESSURE DEADBAND	See Individual model charts
DIFFERENTIAL PRESSURE INDICATION (OPTION M210)	Differential pressure indication available types H121K and H122K with option M210; accuracy approximately 1% mid 50% of range, 3% at ends; window is plexiglass and gasketed; indicator may be field adjusted for approximately 1% accuracy at any set point within range
TEMPERATURE INDICATION	Temperature indication available types 820E and 822E. Indication accuracy is ±1% of adjustable range

AGENCY APPROVALS



Class I, Division 1 & 2, Groups B, C & D
Class II, Division 1 & 2, Groups E, F & G
Class III
Class I, Zone 1, Group IIB + H₂ T₆

UL Listed, **cUL** Certified
 Pressure: UL 50, 698; CSA C22.2 No. 25-1966, 30-M1986, CEC Part 1 – File #E40857
 Temperature: UL 50, 698; CSA C22.2 No. 25-1966, 30-M1986, CEC Part 1 – File #E43374



CENELEC/DEMKO A/S (N.B. #0539)
Demko A/S certified to **ATEX** Directive (94/9/EC)
 II 2 G EEx d IIC T₆, Tamb: -40 °C to +71 °C (-40 °F to +160 °F), IP 66
 II 2 D T+85°C, Tamb: -40 °C to +71 °C (-40 °F to +160 °F), IP 66

EN 50 014, EN 50 018, EN 50 281, EN 60529
 Certificate #DEMKO 03 ATEX 0305048



CENELEC/TÜV Süddeutschland Bau und Betrieb GmbH (N.B. #0036)
TÜV certified to PED (97/23/EC)
 Category IV, Module H1 (must select option M407)
 Certificate #USA 02/04/38/001 thru USA 02/07/38/033

UEC Compliant to LVD (73/23/EC & 93/68/EEC)
 Products rated lower than 50 VAC and 75 VDC are outside of the scope of the LVD
 The Low Voltage Directive does not apply to products for use in hazardous locations

PRESSURE MODEL CHART

Type J120, single switch with internal adjustment, dual conduits

Model	Adjustable Set Point Range		Deadband		Over Range Pressure*		Proof Pressure**	
	Low end of range on fall; "wc	High end of range on rise mbar	"wc	mbar	psi	bar	psi	bar
Buna N diaphragm and O-Ring with epoxy coated aluminum, 1/2" NPT (female) pressure connection (other wetted materials available see pg 15)								
520	300 Vac to 0	-746,7 to 0	0.2 to 8	0,5 to 19,9	200	13,8	400	27,6
521	10 Vac to 10	-24,9 to 24,9	0.1 to 0.6	0,2 to 1,5	200	13,8	400	27,6
522	50 Vac to 50	-124,5 to 124,5	0.1 to 3	0,2 to 7,5	200	13,8	400	27,6
523	0.5 to 5	1,2 to 12,4	0.1 to 0.3	0,2 to 0,7	200	13,8	400	27,6
524	2.5 to 50	6,2 to 124,5	0.1 to 0.8	0,2 to 2,0	200	13,8	400	27,6
525	10 to 250	24,9 to 622,3	0.1 to 6	0,2 to 14,9	200	13,8	400	27,6
Welded 316L stainless steel diaphragm and 1/2" NPT (female) pressure connection								
530	300 Vac to 0	-746,7 to 0	0.2 to 15	0,5 to 37,3	50	3,4	100	6,9
531	10 Vac to 10	-24,9 to 24,9	0.1 to 0.6	0,2 to 1,5	50	3,4	100	6,9
532	50 Vac to 50	-124,5 to 124,5	0.1 to 3	0,2 to 7,5	50	3,4	100	6,9
533	0.5 to 5	1,2 to 12,4	0.1 to 0.3	0,2 to 0,7	50	3,4	100	6,9
534	2.5 to 50	6,2 to 124,5	0.1 to 0.8	0,2 to 2,0	50	3,4	100	6,9
535	10 to 250	24,9 to 622,3	0.1 to 10	0,2 to 24,9	50	3,4	100	6,9
	psi	bar	psi	bar				
2" sanitary welded 316L stainless steel diaphragm and pressure connection. Mates with Tri-Clamp® fitting systems.								
560	0.5 to 15	0,03 to 1,0	0.1 to 1	0,01 to 0,1	200	13,8	300	20,7
561	1 to 25	0,07 to 1,7	0.1 to 1.5	0,01 to 0,1	200	13,8	300	20,7
562	2 to 50	0,14 to 3,4	0.1 to 2.5	0,01 to 0,2	200	13,8	300	20,7
563	4 to 100	0,3 to 6,9	0.1 to 4	0,01 to 0,3	200	13,8	300	20,7
564	8 to 200	0,6 to 13,8	0.1 to 5	0,01 to 0,3	200	13,8	300	20,7
1.5" sanitary welded 316L stainless steel diaphragm and pressure connection. Mates with Tri-Clamp® fitting systems.								
565	5 to 30	0,3 to 2,1	1 to 5	0,1 to 0,3	1000	68,9	1500	103,4
566	10 to 100	0,7 to 6,9	1 to 12	0,1 to 0,8	1000	68,9	1500	103,4
567	15 to 300	1,0 to 20,7	3 to 22	0,2 to 1,5	1000	68,9	1500	103,4
Welded 316L stainless steel diaphragm and 1/2" NPT (female) pressure connection, large 0.72" orifice for clean-out purposes								
171	1 to 20	0,07 to 1,4	0.1 to 1	0,01 to 0,1	500	34,5	1000	68,9
172	2 to 50	0,14 to 3,4	0.1 to 1.5	0,01 to 0,1	500	34,5	1000	68,9
173	4 to 100	0,3 to 6,9	0.1 to 2.5	0,01 to 0,2	500	34,5	1000	68,9
174	8 to 200	0,6 to 13,8	0.1 to 3.5	0,01 to 0,2	500	34,5	1000	68,9

Application Note: The use of metallic diaphragms where higher pressure shock or heavy cycling is expected should be avoided. Models 171-174 should not be used where system or start-up vacuum might exceed 26 " Hg Vac

***Over Range Pressure:** The maximum pressure that may be applied continuously without causing damage and maintaining set point repeatability.

****Proof Pressure:** The maximum pressure to which a pressure sensor may be occasionally subjected, which causes no permanent damage. The unit may require calibration (e.g. start-up, testing)

Deadband note: Models 190-194, 490-494 are expressed as the lower 75 % and top 25% of the range span because of the operating characteristics of the diaphragm sensor and switch.

Type J120, single switch with internal adjustment, dual conduits (cont)

Model	Adjustable Set Point Range		Deadband			Over Range Pressure*		Proof Pressure **	
	Low end of range on fall; High end of range on rise								
	psi (unless noted)	bar	psi (unless noted)	bar		psi (unless noted)	bar	psi	bar
316L stainless steel diaphragm (optional Hastelloy® C, Monel® or Tantalum); Viton® GLT O-Ring (optional Kalrez®, Silicone, Ethylene Propylene or Aflas®); 316 stainless steel 1/2" NPT (female) pressure connection (optional Hastelloy® B or C, or Monel®), 0.72" orifice for clean-out purposes. Models 188 and 189 have a 316L stainless steel 1/2" NPT (female) pressure connection									
183	1 to 20	0,07 to 1,4	0.3 to 2.5		0,021 to 0,2	500	34,5	1000	68,9
184	2 to 50	0,14 to 3,4	0.3 to 3		0,021 to 0,2	500	34,5	1000	68,9
185	4 to 100	0,3 to 6,9	0.5 to 6		0,03 to 0,4	500	34,5	1000	68,9
186	8 to 200	0,6 to 13,8	1 to 11		0,07 to 0,8	500	34,5	1000	68,9
188	50 to 1000	3,4 to 68,9	25 to 125		1,7 to 8,6	2000	137,9	7000	482,6
189	250 to 3500	17,2 to 241,3	50 to 300		3,4 to 20,7	4000	275,8	7000	482,6
316L stainless steel diaphragm (optional Hastelloy® C, Monel® or Tantalum); Viton®GLT O-Ring (optional Kalrez®, Silicone, Ethylene Propylene or Aflas®); 316 stainless steel 1/2" NPT (female) pressure connection (optional Hastelloy® B or C, or Monel®), 0.06" orifice to dampen pulsations. Models 488 and 489 have a 316L stainless steel 1/2" NPT (female) pressure connection									
483	1 to 20	0,07 to 1,4	0.3 to 2.5		0,021 to 0,2	500	34,5	1000	68,9
484	2 to 50	0,14 to 3,4	0.3 to 3		0,021 to 0,2	500	34,5	1000	68,9
485	4 to 100	0,3 to 6,9	0.5 to 6		0,03 to 0,4	500	34,5	1000	68,9
486	8 to 200	0,6 to 13,8	1 to 11		0,07 to 0,8	500	34,5	1000	68,9
488	50 to 1000	3,4 to 68,9	25 to 125		1,7 to 8,6	2000	137,9	7000	482,6
489	250 to 3500	17,2 to 241,3	50 to 300		3,4 to 20,7	4000	275,8	7000	482,6
Welded 316L stainless steel bellows and 1/2" NPT (female) pressure connection									
S126B	30 to 3 "Hg Vac	-1 to -0,1	0.2 to 0.6 "Hg		0,01 to 0,02	80 "wc	0,2	5	0,3
S134B	30 "Hg Vac to 20 psi	-1 to 1,4	0.2 to 0.6 "Hg		0,01 to 0,02	20	1,4	25	1,7
S137B	15 to 80 "wc	0,04 to 0,2	2 to 6 "wc		0,01 to 0,02	80 "wc	0,2	5	0,3
S144B	0.5 to 20	0,04 to 1,4	0.1 to 0.3		0,01 to 0,02	20	1,4	25	1,7
S152B	1 to 50	0,07 to 3,4	0.1 to 0.5		0,01 to 0,03	50	3,4	75	5,2
S156B	2 to 100	0,14 to 6,9	0.2 to 0.6		0,01 to 0,04	100	6,9	125	8,6
S164B	4 to 200	0,28 to 13,8	0.2 to 1		0,01 to 0,01	200	13,8	200	13,8
			Lower 75% range span	Top 25% range span	Lower 75% range span				
			psi	psi	bar				
Welded 316 stainless steel diaphragm and 1/2" NPT (female) pressure connection, 0.72" orifice for clean-out purposes									
190	5 to 30	0,3 to 2,1	1 to 3	6 max	0,07 to 0,2	1500	103,4	2500	172,4
191	10 to 100	0,7 to 6,9	1 to 8	15 max	0,07 to 0,6	1500	103,4	2500	172,4
192	15 to 300	1,0 to 20,7	3 to 18	25 max	0,2 to 1,2	1500	103,4	2500	172,4
193	20 to 500	1,4 to 34,5	4 to 30	45 max	0,3 to 2,1	1500	103,4	2500	172,4
194	80 to 1700	5,5 to 117,2	5 to 120	150 max	0,3 to 8,3	2000	138,9	2500	172,4
Welded 316 stainless steel diaphragm and 1/2" NPT (female) pressure connection, 0.06" orifice to dampen pulsations									
490	5 to 30	0,3 to 2,1	1 to 3	6 max	0,07 to 0,2	1500	103,4	2500	172,4
491	10 to 100	0,7 to 6,9	1 to 8	15 max	0,07 to 0,6	1500	103,4	2500	172,4
492	15 to 300	1,0 to 20,7	3 to 18	25 max	0,2 to 1,2	1500	103,4	2500	172,4
493	20 to 500	1,4 to 34,5	4 to 30	45 max	0,3 to 2,1	1500	103,4	2500	172,4
494	80 to 1700	5,5 to 117,2	5 to 120	150 max	0,3 to 8,3	2000	138,9	2500	172,4

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Hastelloy® is a registered trademark of Haynes International, Inc
Monel® is a registered trademark of the INCO family of companies

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Aflas® is a registered trademark of Asahi Glass
Tri-Clamp® is a registered trademark of Tri-Clover, Inc.

PRESSURE MODEL CHART

Type J120, single switch with internal adjustment, dual conduits (cont)

Model	Adjustable Set Point Range		Deadband		Over Range Pressure*		Proof Pressure**	
	Low end of range on fall; High end of range on rise psi (unless noted)		psi (unless noted)		psi (unless noted)		psi	
		bar		bar		bar		bar
Brass bellows with nickel-plated brass 1/4" NPT (female) pressure connection; models 126 & 134 have zinc-plated steel spring which is exposed to media								
126	30 to 3 "Hg Vac	-1 to 0,1	0.2 to 0.6 "Hg	0,01 to 0,02	80 "wc	0,2	5	0,3
134	30 "Hg Vac to 20 psi	-1 to 1,4	0.2 to 0.6 "Hg	0,01 to 0,02	20	1,4	25	1,7
137	15 to 80 "wc	0,04 to 0,19	2 to 6 "wc	0,01 to 0,02	80 "wc	0,2	5	0,3
144	0.5 to 20	0,04 to 1,4	0.1 to 0.3	0,01 to 0,02	20	1,4	25	1,7
152	1 to 50	0,07 to 3,4	0.1 to 0.5	0,01 to 0,03	50	3,4	75	5,2
156	2 to 100	0,14 to 6,9	0.2 to 0.6	0,01 to 0,04	100	6,9	125	8,6
164	4 to 200	0,3 to 13,8	0.2 to 1	0,01 to 0,01	200	13,8	200	13,8
Welded 316L stainless steel bellows and 1/4" NPT (female) pressure connection								
356	15 to 100	1,0 to 6,9	0.7 to 1.8	0,05 to 0,1	100	6,9	800	55,2
358	15 to 200	1,0 to 13,8	1 to 3	0,07 to 0,2	200	13,8	800	55,2
361	20 to 300	1,4 to 20,7	1 to 4	0,07 to 0,3	300	20,7	800	55,2
376	25 to 500	1,7 to 34,5	1.5 to 5	0,1 to 0,3	500	34,5	800	55,2
Phosphor bronze bellows with nickel-plated brass 1/4" NPT (female) pressure connection								
270	4 to 200	0,3 to 13,8	1 to 4	0,07 to 0,3	200	13,8	250	17,2
274	6 to 300	0,4 to 20,7	1 to 5	0,07 to 0,3	300	20,7	350	24,1

***Over Range Pressure:** The maximum pressure that may be applied continuously without causing damage and maintaining set point repeatability.

****Proof Pressure:** The maximum pressure to which a pressure sensor may be occasionally subjected, which causes no permanent damage. The unit may require calibration (e.g. start-up, testing)

Type J120, single switch with internal adjustment, dual conduits (cont)

Model	Adjustable Set Point Range		Deadband		Over Range Pressure*		Proof Pressure**	
	Low end of range on fall; High end of range on rise psi (unless noted)	bar	psi (unless noted)	bar	psi (unless noted)	bar	psi	bar
303 stainless steel piston with Buna N O-Ring and 303 stainless steel 1/4" NPT (female) pressure connection (not recommended for gas service since drying of the O-Ring seal can allow bleeding of medium into the atmosphere)								
612	125 to 3000	8,6 to 206,8	40 to 250	2,8 to 17,2	6000	413,7	10000	689,5
616	700 to 5000	48,3 to 344,7	40 to 375	2,8 to 25,9	6000	413,7	10000	689,5
316 stainless steel bellows and 1/4" NPT (female) pressure connection (not recommended for rapid or high cycling pressure changes)								
680	100 to 1700	6,9 to 117,2	9 to 40	0,6 to 2,8	1700	117,2	2500	172,4
Buna N diaphragm and O-Ring with nickel-plated brass 1/4" NPT (female) pressure connection; Optional Viton diaphragm and O-Ring available								
701	1.5 to 30	0,1 to 2,1	1 to 2	0,07 to 0,14	500	34,5	1000	68,9
702	3 to 100	0,2 to 6,9	1 to 4	0,07 to 0,3	500	34,5	1000	68,9
703	9 to 300	0,6 to 20,7	1 to 5	0,07 to 0,3	500	34,5	1000	68,9
704	15 to 500	1,0 to 34,5	2 to 8	0,14 to 0,6	1500	103,4	2500	172,4
705	30 to 1000	2,1 to 68,9	3 to 20	0,2 to 1,4	1500	103,4	2500	172,4
Buna N diaphragm and O-Ring with 1/4" NPT (female) aluminum connection and cap								
450	30 "Hg Vac to 3 "Hg Vac	-1,0 to -0,1	0.1 to 0.3 "Hg	0,003 to 0,1	80 "wc	0,2	225	15,5
451	2 to 80" wc	0,005 to 0,2	0.8 to 2 "wc	0,002 to 0,005	80 "wc	0,2	225	15,5
452	30 "Hg Vac to 20 psi	-1,0 to 1,4	0.1 to 0.4 "Hg	0,003 to 0,01	20	1,4	225	15,5
453	0.5 to 20	0,03 to 1,4	0.05 to 0.1	0,003 to 0,01	20	1,4	225	15,5
454	0.8 to 30	0,06 to 2,1	0.05 to 0.2	0,003 to 0,014	30	2,1	225	15,5
Teflon® diaphragm and O-Ring 316 stainless steel with 1/4" NPT (female) 316 stainless steel pressure connection and cap								
550	30 "Hg Vac to 3 "Hg Vac	-1,0 to -0,1	0.1 to 0.4 "Hg	0,003 to 0,01	80 "wc	0,2	225	15,5
551	2 to 80" wc	0,005 to 0,2	1 to 4 "wc	0,002 to 0,01	80 "wc	0,2	225	15,5
552	30 "Hg Vac to 20 psi	-1,0 to 1,4	0.2 to 0.5 "Hg	0,007 to 0,02	20	1,4	225	15,5
553	0.5 to 20	0,03 to 1,4	0.1 to 0.2	0,007 to 0,014	20	1,4	225	15,5
554	0.8 to 30	0,06 to 2,1	0.1 to 0.3	0,007 to 0,02	30	2,1	225	15,5
555	2 to 100	0,14 to 6,9	0.2 to 0.4	0,014 to 0,03	100	6,9	225	15,5

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***Over Range Pressure:** The maximum pressure that may be applied continuously without causing damage and maintaining set point repeatability.

****Proof Pressure:** The maximum pressure to which a pressure sensor may be occasionally subjected, which causes no permanent damage. The unit may require calibration (e.g. start-up, testing)

PRESSURE MODEL CHART

Type H121, single switch with external adjustment via reference dial, single conduit

Type H122, dual switch with external adjustment via reference dial, single conduit

Type H122P*, two hermetically sealed single switches with external adjustment via reference dial, single conduit

Model	Adjustable Set Point Range		Deadband		Proof Pressure**		Dial Divisions
	Low end of range on fall; High end of range on rise						
	psi (unless noted)	bar	psi (unless noted)	bar	psi	bar	psi (unless noted)
Welded 316 stainless steel bellows and 1/2" NPT (female) pressure connection							
S126B	30 "Hg Vac to 0 psi	-1 to 0	0.2 to 0.9 "Hg	0,007 to 0,03	5	0,3	0.5 "Hg
S134B	30 "Hg Vac to 20 psi	-1 to 1,4	0.2 to 1.2 "Hg	0,007 to 0,04	25	1,7	1 "Hg & 0.5 psi
S137B†	2 to 80 "wc	0,005 to 0,2	2 to 10 "wc	0,005 to 0,02	5	0,3	2 "wc
S144B	0 to 20	0 to 1,4	0.1 to 0.5	0,007 to 0,03	25	1,7	0.5
S146B	0 to 30	0 to 2,1	0.1 to 0.6	0,007 to 0,04	40	2,8	0.5
S156B	0 to 100	0 to 6,9	0.2 to 0.8	0,014 to 0,06	125	8,6	2
S164B	0 to 200	0 to 13,8	0.3 to 2	0,021 to 0,14	200	13,8	5
Brass bellows with nickel-plated brass 1/4" NPT (female) pressure connection; models 126 & 134 have a zinc-plated steel spring which is exposed to media							
126	30 "Hg Vac to 0 psi	-1 to 0	0.2 to 0.9 "Hg	0,007 to 0,03	5	0,3	0.5 "Hg
134	30 "Hg Vac to 20 psi	-1 to 1,4	0.2 to 1.2 "Hg	0,007 to 0,04	25	1,7	1 "Hg & 0.5 psi
137†	2 to 80 "wc	0,005 to 0,2	2 to 10 "wc	0,005 to 0,02	5	0,3	2 "wc
144	0 to 20	0 to 1,4	0.1 to 0.5	0,007 to 0,03	25	1,7	0.5
146	0 to 30	0 to 2,1	0.1 to 0.6	0,007 to 0,04	40	2,8	0.5
156	0 to 100	0 to 6,9	0.2 to 0.8	0,014 to 0,06	125	8,6	2
164	0 to 200	0 to 13,8	0.3 to 2	0,021 to 0,14	200	13,8	5
316L stainless steel bellows and 1/4" NPT (female) pressure connection							
358	0 to 200	0 to 13,8	1.5 to 8	0,1 to 0,6	250	17,2	5
361	0 to 300	0 to 20,7	2 to 9	0,1 to 0,6	350	24,1	10
376	0 to 500	0 to 34,5	3 to 12	0,2 to 0,8	575	39,6	10
303 stainless steel piston with Buna N O-Ring and 303 stainless steel 1/4" NPT (female) pressure connection (not recommended for gas service since drying of the O-Ring seal can allow bleeding of medium into the atmosphere)							
612	200 to 3000	13,8 to 206,8	40 to 250	2,8 to 17,2	10,000	689,5	50
614	500 to 6000	34,5 to 413,7	50 to 400	3,4 to 27,6	10,000	689,5	100

***Please note:** Must specify option code 1180 with all models.

****Proof Pressure:** The maximum pressure to which a pressure sensor may be occasionally subjected, which causes no permanent damage. The unit may require calibration (e.g. start-up, testing)

†Not available on types H122 and H122P

Type H121, single switch with external adjustment via reference dial, single conduit

Type H122, dual switch with external adjustment via reference dial, single conduit

Type H122P*, two hermetically sealed single switches with external adjustment via reference dial, single conduit

Model	Adjustable Set Point Range		Deadband		Proof Pressure**		Dial Divisions
	Low end of range on fall; High end of range on rise psi (unless noted)	bar	psi (unless noted)	bar	psi	bar	psi (unless noted)
Phosphor bronze bellows with nickel-plated brass 1/4" NPT (female) pressure connection							
270	0 to 200	0 to 13,8	1.5 to 8	0,1 to 0,6	250	17,2	5
274	0 to 300	0 to 20,7	2 to 10	0,1 to 0,7	350	24,1	10
Buna N diaphragm and O-Ring with aluminum 1/4" NPT (female) pressure connection and cap							
450	30 "Hg Vac to 0 psi	-1,0 to 0	0.1 to 0.4 "Hg	0,003 to 0,01	225	15,5	0.5 "Hg
452	30 "Hg Vac to 20 psi	-1,0 to 1,4	0.1 to 1 "Hg	0,003 to 0,03	225	15,5	1 "Hg & 0.5 psi
453	0 to 20	0 to 1,4	0.05 to 0.2	0 to 0,01	225	15,5	0.5
454	0 to 30	0 to 2,1	0.05 to 0.3	0 to 0,02	225	15,5	0.5
Teflon® diaphragm and O-Ring with stainless steel 1/4" NPT (female) 316 pressure connection and cap							
550	30 "Hg Vac to 0 psi	-1,0 to 0,	0.1 to .6 "Hg	0,003 to 0,02	225	15,5	0.5 "Hg
552	30 "Hg Vac to 20 psi	-1,0 to 1,4	0.2 to 1 "Hg	0,007 to 0,03	225	15,5	1 "Hg & 0.5 psi
553	0 to 20	0 to 1,4	0.05 to 0.3	0 to 0,02	225	15,5	0.5
554	0 to 30	0 to 2,1	0.1 to 0.4	0,01 to 0,03	225	15,5	0.5
555	0 to 100	0 to 6,9	0.25 to 0.75	0,02 to 0,05	225	15,5	2
Buna N diaphragm and O-Ring with nickel-plated brass 1/4" NPT (female) pressure connection; Optional Viton diaphragm and O-Ring available (models 701-703)							
701†	3 to 30	0,2 to 2,1	1 to 3	0,07 to 0,2	1000	68,9	0.5
702††	10 to 100	0,7 to 6,9	1 to 5	0,07 to 0,3	1000	68,9	2
703††	30 to 300	2,1 to 20,7	2 to 7	0,14 to 0,5	1000	68,9	10
704††	50 to 500	3,4 to 34,5	3 to 12	0,2 to 0,8	2500	172,4	10
705††	200 to 1000	13,8 to 68,9	5 to 25	0,3 to 1,7	2500	172,4	25

***Please note:** Must specify option code 1180 with all models.

****Proof Pressure:** The maximum pressure to which a pressure sensor may be occasionally subjected, which causes no permanent damage. The unit may require calibration (e.g. start-up, testing)

†Not available on types H122 and H122P

††Not available on type H122P

DIFFERENTIAL PRESSURE MODEL CHART

Type J120K, single switch with internal adjustment, dual conduits

Model	Adjustable Set Point Range		Deadband		Working Pressure***		Proof Pressure**	
	Low end of range on fall; High end of range on rise							
	psid (unless noted)	bar	psi (unless noted)	bar	psi (unless noted)	bar	psi	bar
316L stainless steel bellows and 1/2" NPT (female) pressure connections								
S147B	3 to 30	0,2 to 2,1	0.3 to 1.5	0,02 to 0,1	30 "Hg Vac to 100	-1 to 6,9	300	20,7
S157B	10 to 100	0,7 to 6,9	0.5 to 2	0,03 to 0,14	30 "Hg Vac to 180	-1 to 12,4	300	20,7
Brass bellows with nickel-plated brass 1/4" NPT (female) pressure connections								
147	3 to 30	0,2 to 2,1	0.3 to 1.5	0,02 to 0,1	30 "Hg Vac to 100	-1 to 6,9	180	12,4
157	10 to 100	0,7 to 6,9	0.5 to 2	0,03 to 0,14	30 "Hg Vac to 150	-1 to 10,3	180	12,4
316L stainless steel bellows and 1/4" NPT (female) pressure connections								
367	10 to 100	0,7 to 6,9	4 to 10	0,3 to 0,7	0 to 350	0 to 24,1	500	34,5
Buna N diaphragm and O-Ring with 303 stainless steel 1/4" NPT(female) pressure connections								
36	3 to 30	0,2 to 2,1	1 to 5	0,07 to 0,3	0 to 350	0 to 24,1	1000	68,9
37	10 to 100	0,7 to 6,9	2 to 8	0,1 to 0,6	0 to 500	0 to 34,5	1000	68,9
38	30 to 300	2,1 to 20,7	2 to 15	0,1 to 1,0	0 to 1000	0 to 68,9	2500	172,4
39	50 to 500	3,4 to 34,5	3 to 20	0,2 to 1,4	0 to 1000	0 to 68,9	2500	172,4
Buna N diaphragm and O-Ring with aluminum 1/4" NPT(female) pressure connections								
455	5 to 80 "wcd	12,4 to 200 mbar	1 to 4 "wc	2 to 10 mbar	30 "Hg Vac to 225	-1 to 15,5	225	15,5
456	2 to 20	0,1 to 1,4	0.1 to 0.3	7 to 21 mbar	30 "Hg Vac to 225	-1 to 15,5	225	15,5
457	3 to 30	0,2 to 2,1	0.1 to 0.4	7 to 28 mbar	30 "Hg Vac to 225	-1 to 15,5	225	15,5
Teflon® and Buna N diaphragms, Buna N O-Ring with aluminum 1/4" NPT (female) pressure connections								
559	10 to 100	0,7 to 6,90	0.2 to 1	14 to 69 m bar	30 "Hg Vac to 225	-1 to 15,5	225	15,5
Kapton® diaphragms, Buna N sealing diaphragms with aluminum 1/8" NPT (female) pressure connections								
540	0.2 to 7 "wcd	0,5 to 17,4 mbar	0.05 to 0,4 "wc	0,1 to 0,1 mbar	200	13,8	400	27,6
541	1 to 20 "wcd	2,5 to 49,7 mbar	0.1 to 0,7 "wc	0.2 to 1,7 mbar	200	13,8	400	27,6
542	5 to 50 "wcd	12,4 to 124,4 mbar	0.2 to 2,0 "wc	0,5 to 5,0 mbar	200	13,8	400	27,6
543	10 to 200 "wcd	24,9 to 497,0 mbar	0.5 to 6,0 "wc	1,2 to 14,9 mbar	200	13,8	400	27,6
544	2 to 20 psid	0,1 to 1,4 bar	0.1 to 0,8 psi	6,9 to 55,2 mbar	1200	82,7	2500	172,4
545	5 to 50 psid	0,3 to 3,4 bar	0.2 to 1,6 psi	0 to 0,1 bar	1200	82,7	2500	172,4
546	0 to 125 psid	0,7 to 8,6 bar	0.4 to 3,5 psi	0 to 0,2 bar	1200	82,7	2500	172,4
547	50 to 250 psid	3,4 to 17,2 bar	0.8 to 0,7 psi	0,1 to 0,5 bar	1200	82,7	2500	172,4
548	100 to 500 psid	6,9 to 34,5 bar	2.0 to 12,0 psi	0,1 to 0,8 bar	1200	82,7	2500	172,4

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****Proof Pressure:** The maximum pressure to which a pressure sensor may be occasionally subjected, which causes no permanent damage. The unit may require calibration (e.g. start-up, testing)

*****Working Pressure Range:** The pressure range within which two opposing sensors can be safely operated and still maintain set point adjustability provided the difference in pressure between them does not exceed the designated adjustable range

Type H121K, single switch with external adjustment dial via reference dial, single conduit

Type H122K, dual switch with external adjustment dial via reference dial, single conduit

Model	Adjustable Set Point Range		Deadband		Working Pressure***		Proof Pressure**		Dial Divisions
	Low end of range on fall; High end of range on rise								
	psid	bar	psi (unless noted)	bar	psi (unless noted)	bar	psi	bar	psi
316L stainless steel bellows and 1/2" NPT (female) pressure connections									
S147B	3 to 30	0,2 to 2,1	0.3 to 2	0,02 to 0,14	30 "Hg Vac to 100	-1 to 6,9	300	20,7	0.5
S157B	10 to 100	0,7 to 6,9	0.5 to 3	0,03 to 0,2	30 "Hg Vac to 180	-1 to 12,4	300	20,7	2
Brass bellows with nickel-plated brass 1/4" NPT (female) pressure connections									
147	3 to 30	0,2 to 2,1	0.3 to 2	0,02 to 0,14	30 "Hg Vac to 100	-1 to 6,9	180	12,4	0.5
157	10 to 100	0,7 to 6,9	0.5 to 3	0,03 to 0,2	30 "Hg Vac to 150	-1 to 10,3	180	12,4	2
Buna N diaphragm, O-Ring with aluminum 1/4" NPT (female) pressure connections									
456	2 to 20	0,1 to 1,4	0.1 to 0.3	0,01 to 0,02	30 "Hg Vac to 225	-1 to 15,5	225	15,5	0.5
457	3 to 30	0,2 to 2,1	0.1 to 0.4	0,01 to 0,03	30 "Hg Vac to 225	-1 to 15,5	225	15,5	0.5
Teflon® and Buna N diaphragms, Buna N O-Ring with aluminum 1/4" NPT (female) pressure connections									
559	10 to 100	0,7 to 6,9	0.2 to 1.0	0,01 to 0,07	30 "Hg Vac to 225	-1 to 15,5	225	15,5	2

****Proof Pressure:** The maximum pressure to which a pressure sensor may be occasionally subjected, which causes no permanent damage. The unit may require calibration (e.g. start-up, testing)

*****Working Pressure Range:** The pressure range within which two opposing sensors can be safely operated and still maintain set point adjustability provided the difference in pressure between them does not exceed the designated adjustable range



Differential Pressure Indicating Option M210

TEMPERATURE MODEL CHART

Type B121, B121-13272 (HTFP), single switch, immersion stem, external adjustment via reference dial, single conduit
 Type B122, B122-13322 (HTFP), dual switch, immersion stem, external adjustment via reference dial, single conduit
 Type C120, single switch, immersion stem, internal adjustment, dual conduits
 Type E121, E121-13273 (HTFP), single switch, bulb and capillary***, external adjustment via reference dial, single conduit
 Type E122, E122-13321 (HTFP), dual switch, bulb and capillary***, external adjustment via reference dial, single conduit
 Type F120, single switch, bulb and capillary***, internal adjustment, dual conduits

Model	Adjustable Set Point Range		Max. Temp.		Scale Div.		Stem or Bulb Size*/Finish**
	°F	°C	°F	°C	°F	°C	OD x Length
Type B121, B121-13272 (HTFP), single switch, immersion stem, external adjustment via reference dial.Type B122, B122-13322 (HTFP), dual switch, immersion stem, external adjustment via reference dial.Type C120, single switch, immersion stem, internal adjustment							
120*	0 to 225	-17.8 to 107.2	275	135	5	5	9/16" x 17/8" below thread, 1/2" NPT nickel-plated brass
121*	200 to 425	93 to 218.3	475	246.1	5	5	9/16" x 17/8" below thread, 1/2" NPT nickel-plated brass
HTFP (Freeze Protection)	15 to 140	-9.4 to 60	160	71.1	2	2	9/16" x 211/16" stainless steel
Type E121, E121-13273 (HTFP), single switch, bulb and capillary***, external adjustment via reference dial.Type E122, E122-13321 (HTFP), dual switch, bulb and capillary***, external adjustment via reference dial							
2BSA	-120 to 100	-84.4 to 37.8	150	65.5	5	5	3/8 x 2 5/8"
2BSB	30 to 250	-1.1 to 121.1	300	148.9	5	5	3/8 x 2 5/8"
3BS	100 to 400	37.8 to 204.4	450	232.2	5	5	3/8 x 2 1/8"
4BS	25 to 100	-3.9 to 37.8	150	65.5	2	1	3/8 x 6 3/4"
5BS	-20 to 80	-28.9 to 26.7	130	54.4	2	2	3/8 x 5"
8BS	350 to 640	176.7 to 337.8	690	365.6	5	5	3/8 x 3 1/4"
HTFP (Heat Tracing)	25 to 325	-3.9 to 162.8	360	182.2	5	5	1/4" x 10 1/4"
Type F120, single switch, bulb and capillary***, internal adjustment							
1BS	-180 to 120	-117.8 to 48.9	170	76.6	—	—	3/8 x 3 3/4"
2BS	-125 to 350	-87.2 to 176.7	400	204.4	—	—	3/8 x 2 5/8"
3BS	125 to 500	-87.2 to 260	550	287.8	—	—	3/8 x 2 1/8"
4BS	-40 to 120	-40 to 48.9	170	76.6	—	—	3/8 x 6 3/4"
5BS	-40 to 180	-40 to 82.2	230	110	—	—	3/8 x 5"
6BS	0 to 250	-17.8 to 121.1	300	148.8	—	—	3/8 x 4 1/2"
7BS	0 to 400	-17.8 to 204.4	450	232.2	—	—	3/8 x 3"
8BS	50 to 650	10 to 343.3	700	371.1	—	—	3/8 x 3 1/4"

*Optional immersion stem lengths and capillary lengths are available
 **Optional stainless steel immersion stem and capillary covering available.
 ***Standard capillary lengths are 6ft

EXPLOSION-PROOF

INDICATING TEMPERATURE CONTROLS

Type 820E, single switch, external adjustment and temperature indication, dual conduits

Type 822E, dual switch, external adjustment and temperature indication, dual conduits

Model	Adjustable Set Point Range		Max. Temp.		Scale Div.		Bulb Size
	°F	°C	°F	°C	°F	°C	OD x Length
1BS	-180 to 120	-117.8 to 48.9	170	76.7	5	5	3/8 x 3 3/4"
2BS	-125 to 350	-87.2 to 176.7	400	204.4	10	5	3/8 x 2 5/8"
3BS	-125 to 500	-87.2 to 260	550	287.8	10	5	3/8 x 2 1/8"
4BS	-40 to 120	-40 to 48.9	170	76.7	5	2	3/8 x 6 3/4"
5BS	-40 to 180	-40 to 82.2	230	110	5	2	3/8 x 5"
6BS	0 to 250	-17.8 to 121.1	300	148.8	5	2	3/8 x 4 1/2"
7BS	0 to 400	-17.8 to 204.4	450	232.2	10	5	3/8 x 3"
8BS	50 to 650	10 to 343.3	700	371.1	10	10	3/8 x 3 1/4"

Standard capillary length is 6ft. optional lengths available



HOW TO ORDER

BUILDING A PART NUMBER

Select a **Type**

Refer to the "Type" section below.

Determine type number based on switch output, enclosure, adjustment and reference.

Select a **Model**

Refer to the "Model Charts"

Determine model based on adjustable range, deadband and proof pressure.

Fill in the model portion of your part number with the corresponding number.

Select an **Option**

Refer to the "Options" section

Determine option number based on switch output, optional materials or other product enhancements.

Fill in the option portion of your part number with the corresponding number.

Leave "option" portion blank if no options are needed. FOR MULTIPLE OPTIONS: Call United Electric Controls.

TYPE

DESCRIPTION

Pressure	Type J120 - One SPDT; epoxy coated enclosure; internal adjustment with no reference scale, dual conduits Type H121 - One SPDT; epoxy coated enclosure; external adjustment with reference dial, single conduit Type H122 - Two SPDT; epoxy coated enclosure; external adjustment with reference dial, single conduit Type H122P - Two SPDT; hermetically sealed switches; epoxy coated enclosure; external adjustment with reference dial, single conduit
Differential Pressure	Type J120K - One SPDT; epoxy coated enclosure; internal adjustment with no reference scale, dual conduits Type H121K - One SPDT; epoxy coated enclosure; external adjustment with reference dial, single conduit Type H122K - Two SPDT; epoxy coated enclosure; external adjustment with reference dial, single conduit
Temperature	Type B121 - Immersion stem; one SPDT; epoxy coated enclosure; external adjustment with reference dial, single conduit Type B122 - Immersion stem; two SPDT; epoxy coated enclosure; external adjustment with reference dial, single conduit Type C120 - Immersion stem; one SPDT; epoxy coated enclosure; internal adjustment with no reference scale, dual conduits Type E121 - Bulb and capillary; one SPDT; epoxy coated enclosure; external adjustment with reference dial, single conduit Type E122 - Bulb and capillary; two SPDT; epoxy coated enclosure; external adjustment with reference dial, single conduit Type F120 - Bulb and capillary; one SPDT; epoxy coated enclosure; internal adjustment with no reference dial, dual conduits Type 820E - Bulb and capillary; one SPDT; external adjustment and temperature indication, dual conduits Type 822E - Bulb and capillary; two SPDT; external adjustment and temperature indication , dual conduits

SWITCH OPTIONS

0140	Gold contacts, 1 amp 125 VAC resistive, not available type H122P, 820E, & 822E
0500	Close deadband, 5 amp 125/250 VAC resistive. NOT AVAILABLE TYPE H122P MODELS 520-535
1010	DPDT switch, 10 amp 125/250 VAC resistive. NOT AVAILABLE TEMPERATURE VERSIONS; TYPES H122, H122P, H122K; OR J120K MODELS 36-39, 367, AND 540-548; OR J120 MODELS 171-194, 483-494, 520-535, 560-567, 680
1070	10 amp 125 VDC or VAC resistive; deadband and minimum set point will increase. NOT AVAILABLE TYPES 820E, 822E, H122P, H122K, B122, AND J120K MODELS 36-39; J120 MODELS 171-194, 483-494, 520-535
1180	Hermetically sealed, SPDT, 11 amp 125/250 VAC resistive, must be specified with type H122P. NOT AVAILABLE TYPES B122, E122, H122, H121K and H122K, 820 AND 822E; deadband and minimum set point will increase.
1190	Hermetically sealed, DPDT, 11 amp 125/250 VAC; products set on rising pressure or temperature due to inherent separation of circuits on falling pressure or temperature; specify option 1195 if setting on fall is required; deadband and minimum set point will increase. Not available types 820E, 822E, B121, B122, E121, E122, H121, H122, H121K, H122K, H122P or models 523, 533
1195	Hermetically sealed, DPDT, 11 amp 125/250 VAC; products set on falling pressure or temperature due to inherent separation of circuits on rising pressure or temperature; specify option 1190 if setting on rise is required; deadband and minimum set point will increase. Not available types 820E, 822E, B121, B122, E121, E122, H121, H122, H121K, H122K, H122P or models 523, 533
1519*	Adjustable deadband, 15 amp 125/250/480 VAC resistive; adjustable wheel changes rise setting only; if adjustment of fall setting is required use primary adjustment; deadband and minimum set point will increase. Not available types 820E, 822E, B121, B122, E121, E122, H121, H122, H121K, H122K, H122P or models 171-194, 483-494, 520-535, 612-616

*Please note: In order to accommodate free movement of adjustable wheel, left hand electrical conduit is permanently sealed.

SWITCH OPTIONS (CONT)

1530	External manual reset, 15 amp 125/250/480 VAC resistive; latches on rise only. Not available types 820E, 822E, B121, B122, E121, E122, H121, H122, H121K, H122K, H122P models 520-535 or with ATEX certification
1535	High ambient, 15 amp 125/250 VAC resistive; temperatures up to 250°F (120°C). Not available types 820E, 822E, H122P models 520-535
1537	Vapor sealed switch, 15 amp 125/250 VAC resistive. Not available types 820E, 822E, H122P or models 520-535
1539	Fungus resistant case, 15 amp 125/250 VAC resistive. Not available types 820E, 822E, H122P or models 520-535
2000	20 amp 125/250 VAC resistive. Not available models 520-535, 540-548
3000	30 amp 125/250/300 VAC resistive. Not available types 820E, 822E, B121, B122, H121, H122, H121K, H122K, H122P for models 36-39, 171-193, 483-493, 520-535, 540-548, 560-567

SENSOR OPTIONS

M504	316L stainless steel stem. Available temperature models 120 and 121 only
M540	Viton® construction; (deadbands and low end of range may increase slightly) wetted parts include Viton® diaphragm and O-Ring. Available models 36-39, 450-457, 540-548 (Kapton® diaphragm, Viton® O-ring and sealing diaphragms), 612-616 (O-ring only) with standard pressure connection. Available TYPE J120 MODELS 701-705 and TYPES H121 and H122 MODELS 701-703 with stainless steel pressure connection.

OPTIONAL SENSOR MATERIAL FOR "WC RANGES. AVAILABLE MODELS 520-525

XC001	Aluminum pressure connection, Viton® diaphragm, Viton® O-Ring
XC002	Aluminum pressure connection, Kapton® diaphragm, Buna N O-Ring
XC003	Aluminum pressure connection, Kapton® diaphragm, Viton® O-Ring
XC004	316L Stainless steel pressure connection, 316L Stainless steel diaphragm, Viton® O-Ring (Over range pressure is limited to 100 psi)
XC005	316L Stainless steel pressure connection, Viton® diaphragm, Viton® O-Ring
XC006	316L Stainless steel pressure connection, Kapton® diaphragm, Viton® O-Ring
XC007	316L Stainless steel pressure connection, Teflon® diaphragm, Viton® O-Ring

OPTIONAL SENSOR MATERIAL FOR CORROSIVE MEDIA. AVAILABLE MODELS 183-189, 483-489

XD002	Hastelloy® C diaphragm
XD003	Monel® diaphragm
XD004	Tantalum diaphragm
XP111	Hastelloy® B pressure connection
XP112	Hastelloy® C pressure connection
XP113	Monel® pressure connection
XR211	Kalrez® O-Ring
XR212	Silicone O-Ring. Not available models 188-189, 488-489
XR213	Ethylene propylene O-Ring
XR214	Aflas® O-Ring

OTHER OPTIONS

M201	Factory set one switch
M202	Factory set two switches. Not available single switch versions
M210	Differential pressure indication. Available on H121K, H122K, MODELS 147, 157, S147B, S157B only
M277	Range indicated on nameplate in kPa or MPa. Not available on temperature versions
M278	Range indicated on nameplate in Kg/cm ² . Not available on temperature versions
M300	NEMA 4 construction, available types 820E & 822E only
M320	Tamper resistant cover for indication portion of control , internal adjustment, available types 820E & 822E only
M407	CE Compliance to Pressure Equipment Directive (category IV). Not available on models 126, 137, 520-524, 530-534, 550, 551, S126B, S137B and all temperature models.
M440	Cover chain
M444	Paper ID tag
M446	Stainless steel ID tag & wire attachment
M450	Breather drain. Not available with options 1530, M210, M415 or with ATEX certification
M550	Oxygen service cleaning; internal construction may change
6361-704	Surface and pipe mounting hardware. (required for models 520-535, 540-548 when surface mounting)

ALSO AVAILABLE: Separable thermowells, optional immersion stem and capillary lengths; armor cable to protect capillaries; union connectors; 150# and 300# flanges (consult factory for part numbers)

NOTE: No options are available on Heat Trace and Freeze Protection products except M201, M444 and M446

OPTIONS FOR TEMPERATURE MODELS

UNION CONNECTORS

Option	Replacement Number	Description
<u>Brass</u>		
W027	SD6213-27	1/2" NPT w/ 3/4" bushing
W045	SD6213-45	3/4" NPT
W051	SD6213-51	1/2" NPT
<u>304 Stainless Steel</u>		
W028	SD6213-28	1/2" NPT w/ 3/4" bushing
W046	SD6213-46	3/4" NPT
W050	SD6213-50	1/2" NPT

THERMOWELLS

For all bulb & capillary switches, all 1/2" NPT Internal

<u>Brass</u>		
W075	SD6225-75	3/4" NPT bushing adapter, 4" BT
W191	SD6225-191	1/2" NPT, 4" BT
W118	SD6225-118	3/4" NPT bushing adapter, 7" BT
W192	SD6225-192	1/2" NPT, 7" BT
<u>316 Stainless Steel</u>		
W076	SD6225-76	3/4" NPT, 4.5" BT
W193	SD6225-193	1/2" NPT, 4.5" BT
W119	SD6225-119	3/4" NPT, 7.5" BT
W177	SD6225-177	1/2" NPT, 7.5" BT

For all immersion stem switches

W139	SD6225-139	3/4" NPT X 1 23/32" BT, BRASS
W140	SD6225-140	3/4" NPT X 1 23/32" BT, 316 ST/ST

W000 IMMERSION STEM AND THERMOWELLS

Note: Option W000 is a special Immersion Stem construction that has no external thread. This option fits inside a special thermowell and is secured with a set-screw; available 100, 105 (except Model 119), 117, 120 and 400 Series.

Option	Description
W000	Immersion stem only, BRASS
W097	Immersion stem and thermowell. Includes W000 stem and 1/2" NPT x 1 23/32" BT BRASS thermowell
W099	Immersion stem and thermowell. Includes W000 stem and 1/2" NPT x 1 23/32" BT 316 ST/ST thermowell

OPTIONAL LENGTHS

Optional immersion stem lengths to 15" available in brass, with or without 316 st/st thermowell. Consult UE for additional information.

Optional capillary length to *50' available in copper or 304 st/st. Armor or Teflon® capillary protection available to lengths less than or equal to capillary length. Consult UE for additional information.

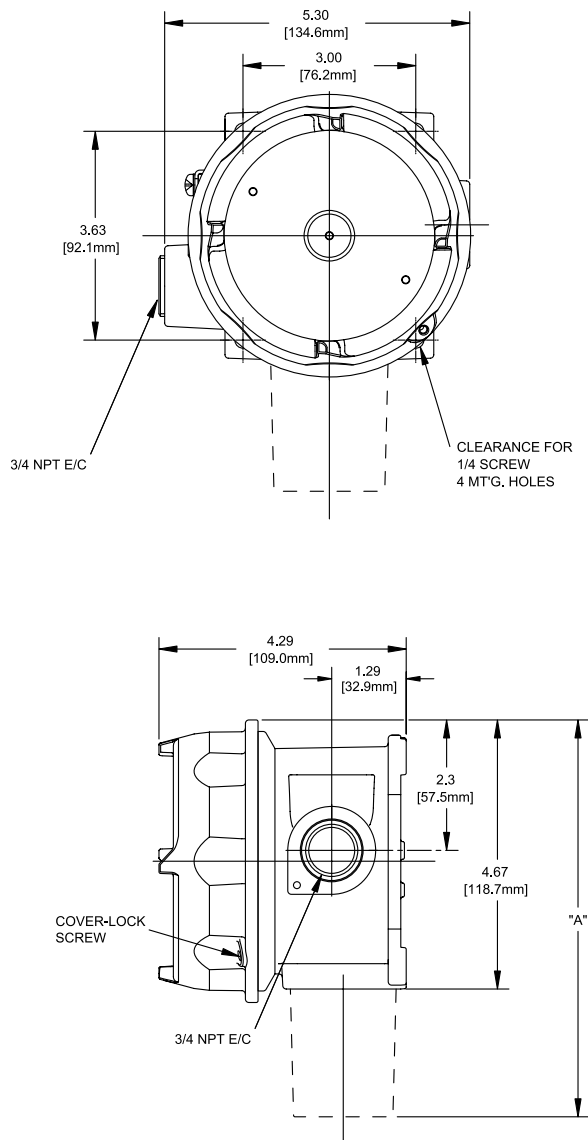
*Consult UE regarding repeatability and ambient effects on capillary lengths over 30'.

DIMENSIONAL DRAWINGS

120 Series
Explosion Proof

Internal Set Point Adjustment, dual conduits

Types J120, J120K, C120, F120



Dimension A			
Models	Inches	mm	NPT
Pressure			
126-164	7.30	185.4	1/4
5126B-S164B	7.70	195.6	1/2
171-174	8.53	216.7	1/2
183-186, 483-486	8.53	216.7	1/2
188-189, 488-489	7.53	191.3	1/2
190-194, 490-494	7.53	191.3	1/2
270-376, 680	8.20	208.3	1/4
450, 452	8.95	227.3	1/4
451, 453, 454	8.20	208.3	1/4
520-525	9.40	238.8	1/2
530-535	9.00	228.6	1/2
550, 552	8.95	227.3	1/4
551, 553-555	8.40	213.4	1/4
560-564	7.63	193.8	2" Sanitary
565-567	7.63	193.8	1 1/2" Sanitary
612, 616	7.90	200.7	1/4
701-705	7.53	191.3	1/4
Differential Pressure			
36-39, 367	7.63	193.8	1/4
147-157	7.63	193.8	1/4
S147B-S157B	7.63	193.8	1/2
455-559	8.55	217.2	1/4
540-543	9.60	243.8	1/8
544-548	9.70	246.47	1/8
Temperature			
120, 121	9.07	230.4	Immersion stem
1BS-8BS	9.03	229.4	Bulb & capillary

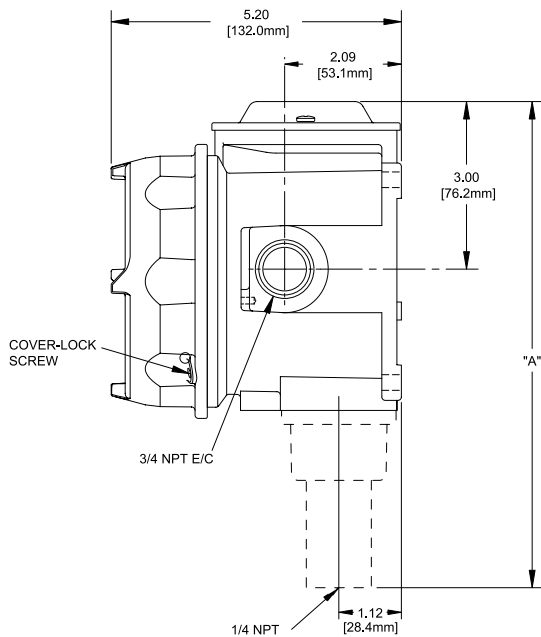
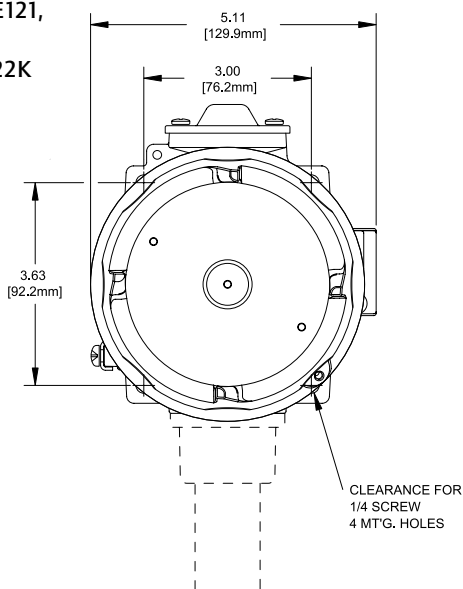
All dimensions stated in inches (millimeters)

DIMENSIONAL DRAWINGS

120 Series
Explosion Proof

External Set Point Adjustment, single conduit

Types B121, B122, E121,
E122, H121, H122,
H122P, H121K, H122K

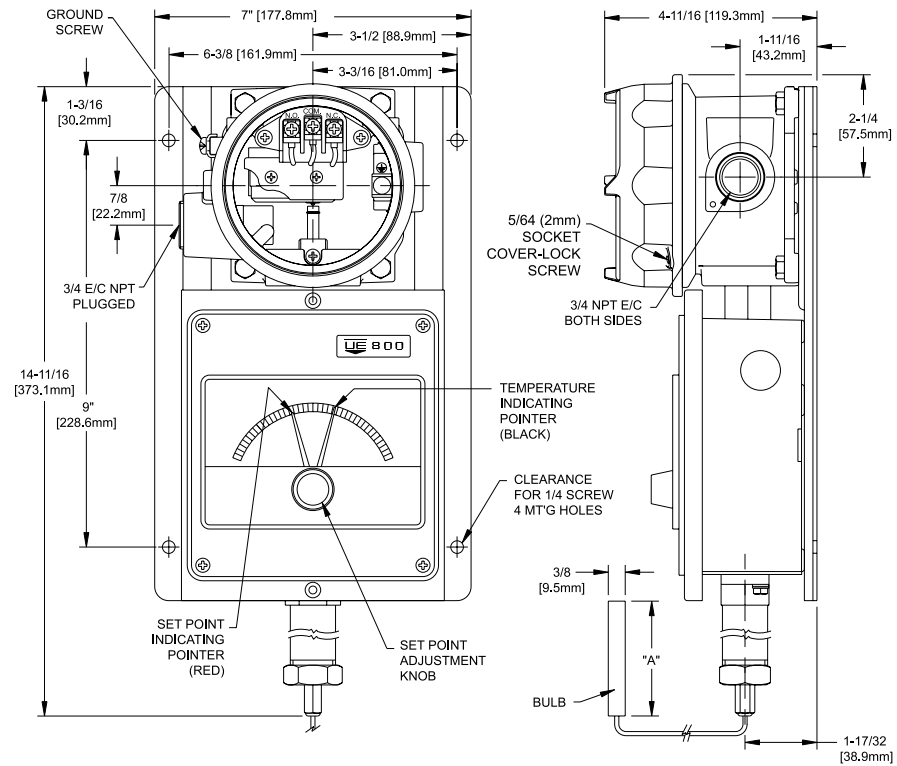


Dimension A			
Models	Inches	mm	NPT
Pressure			
126-164	8.13	206.5	1/4
S126B-S164B	8.58	217.9	1/2
270-376	7.85	199.4	1/4
450, 452	9.80	248.9	1/4
453, 454	9.10	231.1	1/4
550, 552	9.75	247.7	1/4
553-555	9.25	235.0	1/4
612, 616	8.65	219.7	1/4
701-705	8.31	211.1	1/4
Differential Pressure			
147-157	8.44	214.4	1/4
S147B-S157B	8.44	214.4	1/2
456-559	9.4	238.8	1/4
Temperature			
120, 121	10.00	254.0	Immersion stem
2B5-8B5	9.90	251.5	Bulb & capillary
13272, 13322	–	–	Immersion stem (Freeze protection)
13273, 13321	–	–	Bulb & capillary (Heat tracing)

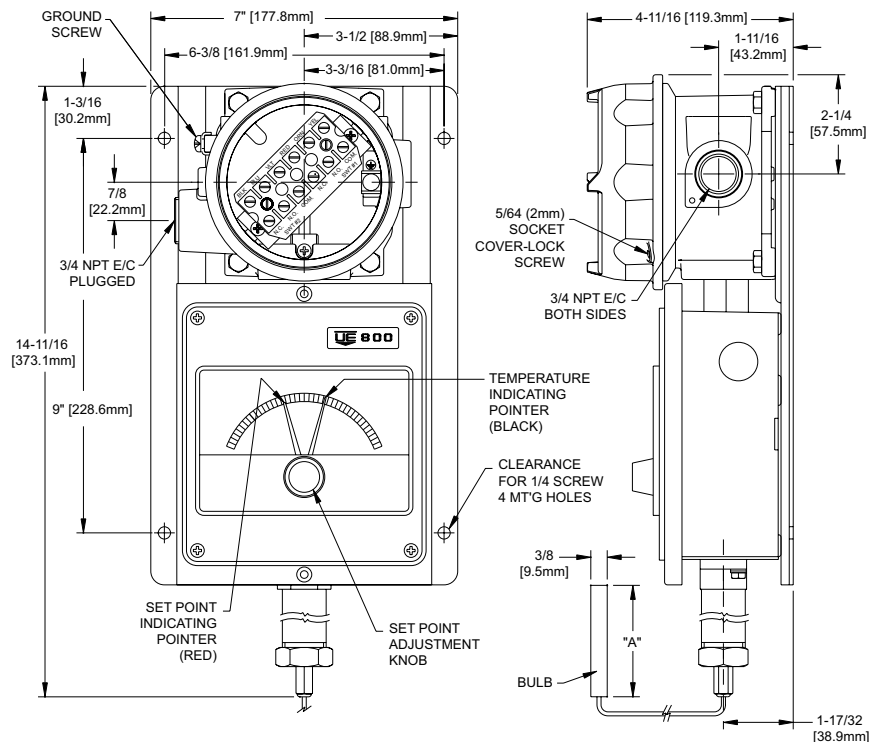
DIMENSIONAL DRAWINGS

External Set Point Adjustment & Temperature Indication

Type 820E
single switch



Type 822E
dual switch

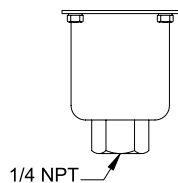


DIMENSIONAL DRAWINGS

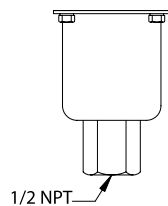
SENSORS

Pressure Sensors*

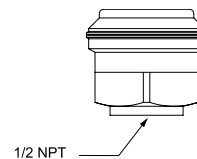
(see drawings and charts on page 17 & 18 for complete dimensions)



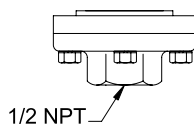
Models 126 - 164



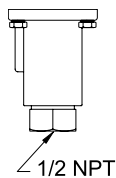
Models S126B - S164B



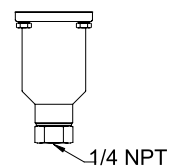
Models 171-174



Models 183 - 186, 483-486



Models 188-194, 488-494



J120 Models
270-376, 680

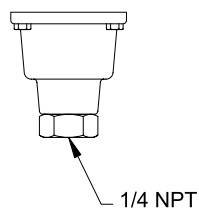
*For all pressure types unless noted

DIMENSIONAL DRAWINGS

SENSORS

Pressure Sensors*

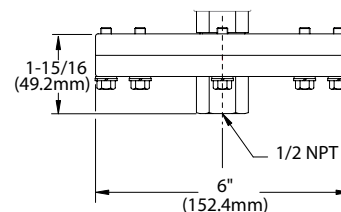
(see drawings and charts on page 17 & 18 for complete dimensions)



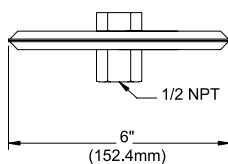
H121 Models 270-376



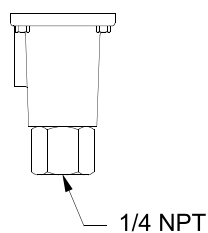
Models 450-454, 550-555



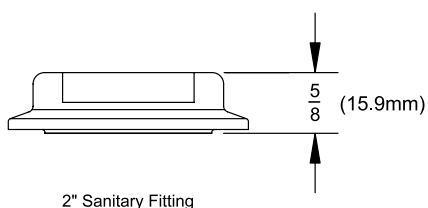
Models 520-525



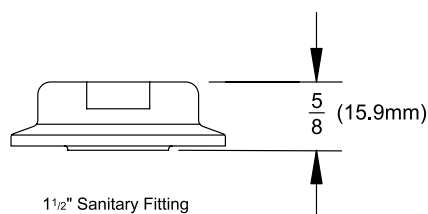
Models 530-535



Models 612-616, 701-706



Models 560-564



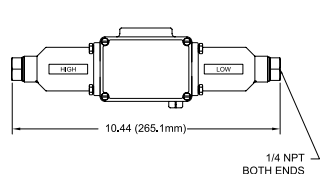
Models 565-567

DIMENSIONAL DRAWINGS

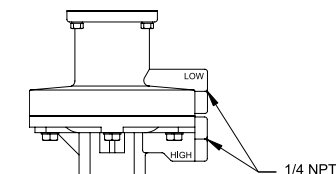
SENSORS

Differential Pressure Sensors

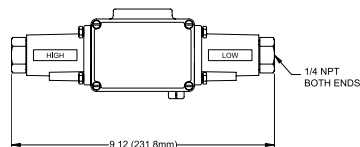
(see drawings and charts on page 17 & 18 for complete dimensions)



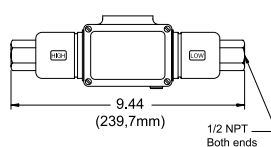
J120K Models 367



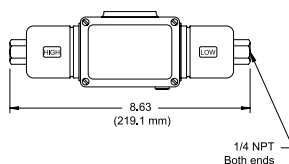
Models 455-457, 559



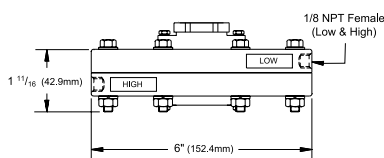
J120K Models 36-39



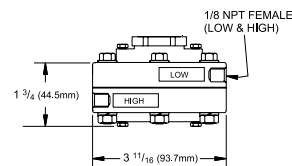
Models S147B - S157B



Models 147-157



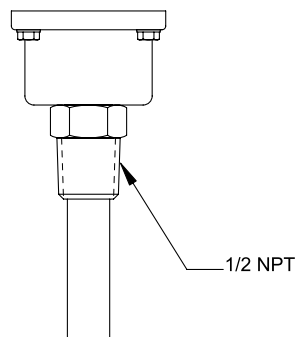
Models 540-543



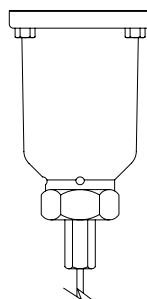
Models 544-548

Temperature Sensors

(see drawings and charts on page 16 and 17 for complete dimensions)



Models 120-121



Models 1B5-8B5

ALTERNATIVE PRODUCTS FROM UE

One Series Electronic Pressure and Temperature Switches

- Solid-state reliability with health-checking diagnostics
- Available with innovative low power "2-Wire" model for discrete input to PLC's or DCS; or models to switch 115/230 VAC loads
- Enclosure type 4X design, approved for Class I, Division 2 hazardous or intrinsically safe locations
- Digital display and tamper-proof keypad adjustment of setpoint and deadband
- Optional dual switch or 4-20 mA analog output



Spectra 12 Series Pressure & Temperature Switches for Hazardous Locations

- Compact, cylindrical stainless steel design
- Hermetically-sealed switch
- Explosion-proof, hazardous location agency approvals from UL, ATEX, cUL
- Snap-acting bellville spring mechanism to enhance vibration and setpoint stability
- Pressure Ranges 1 to 6000 psi; Differential Pressure Working Pressure Ranges 0 to 2500 psid; Temperature Ranges -130 to 650°F



360 Series Pressure Switches

- Compact, #316 Stainless Steel Housing
- Hermetically sealed switch
- CSA, NRTL/C, ATEX certified for hazardous locations
- Pressure ranges 3 to 9,000 psi



117 Series Single Switch for Corrosive and Hazardous Division 2 Locations

- Compact pressure, differential pressure and temperature models
- Hermetically-sealed SPDT and DPDT output
- Approved for Class I, Division 2 hazardous locations
- Epoxy-coated weather-tight design houses stainless steel internal construction
- Convenient terminal block wiring



460 Series Pressure Transmitters for Hazardous Locations

- Welded, #316 stainless steel construction
- CSA, NRTL/C, CENELEC EE xd certified for hazardous location
- Ranges 0 to 15,000 psi
- Choice of field or factory-sealed zero and span calibration
- 4-20 mA or 0-4 VDC output

AVAILABLE
FALL 2003



For more information, request Bulletins or visit www.ueonline.com

RECOMMENDED PRACTICES AND WARNINGS

United Electric Controls Company recommends careful consideration of the following factors when specifying and installing UE pressure and temperature units. Before installing a unit, the Installation and Maintenance instructions provided with unit must be read and understood.

- To avoid damaging unit, proof pressure and maximum temperature limits stated in literature and on nameplates must never be exceeded, even by surges in the system. Operation of the unit up to maximum pressure or temperature is acceptable on a limited basis (e.g., start-up, testing) but continuous operation must be restricted to the designated adjustable range. Excessive cycling at maximum pressure or temperature limits could reduce sensor life.
- A back-up unit is necessary for applications where damage to a primary unit could endanger life, limb or property. A high or low limit switch is necessary for applications where a dangerous runaway condition could result.
- The adjustable range must be selected so that incorrect, inadvertent or malicious setting at any range point cannot result in an unsafe system condition.
- Install unit where shock, vibration and ambient temperature fluctuations will not damage unit or affect operation. Orient unit so that moisture does not enter the enclosure via the electrical connection. When appropriate, this entry point should be sealed to prevent moisture entry.
- Unit must not be altered or modified after shipment. Consult UE if modification is necessary.
- Monitor operation to observe warning signs of possible damage to unit, such as drift in set point or faulty display. Check unit immediately.
- Preventative maintenance and periodic testing is necessary for critical applications where damage could endanger property or personnel.
- For all applications, a factory set unit should be tested before use.
- Electrical ratings stated in literature and on nameplate must not be exceeded. Overload on a switch can cause damage, even on the first cycle. Wire unit according to local and national electrical codes, using wire size recommended in installation sheet.
- Do not mount unit in ambient temp. exceeding published limits.

LIMITED WARRANTY

Seller warrants that the product hereby purchased is, upon delivery, free from defects in material and workmanship and that any such product which is found to be defective in such workmanship or material will be repaired or replaced by Seller (Ex-works, Factory, Watertown, Massachusetts. INCOTERMS); provided, however, that this warranty applies only to equipment found to be so defective within a period of 24 months from the date of manufacture by the Seller. Seller shall not be obligated under this warranty for alleged defects which examination discloses are due to tampering, misuse, neglect, improper storage, and in any case where products are disassembled by anyone other than authorized Seller's representatives. EXCEPT FOR THE LIMITED WARRANTY OF REPAIR AND REPLACEMENT STATED ABOVE, SELLER DISCLAIMS ALL WARRANTIES WHATSOEVER WITH RESPECT TO THE PRODUCT, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF SELLER'S LIABILITY

Seller's liability to Buyer for any loss or claim, including liability incurred in connection with (i) breach of any warranty whatsoever, expressed or implied, (ii) a breach of contract, (iii) a negligent act or acts (or negligent failure to act) committed by Seller, or (iv) an act for which strict liability will be inputted to seller, is limited to the "limited warranty" of repair and/or replacement as so stated in our warranty of product. In no event shall the Seller be liable for any special, indirect, consequential or other damages of a like general nature, including, without limitation, loss of profits or production, or loss or expenses of any nature incurred by the buyer or any third party.

UE specifications subject to change without notice.

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EMCO5000403

Check Valves (C Series)

*Catalog 4130-C
Revised, May 2001*



C Series Check Valves

Introduction

Parker C Series Check Valves are designed for uni-directional flow control of fluids and gases in industries such as chemical processing, oil and gas production and transmission, pharmaceutical, pulp and paper, power and utilities.

Features

- Resilient, custom molded, blow-out resistant seat design
- Back stopped poppet minimizes spring stress
- 100% factory tested for both crack and reseal
- Cracking pressures include: 1/3, 1, 5, 10, 25, 50, 75, and 100 psi.
- Port connections include male and female NPT, CPI™, A-LOK®, UltraSeal, VacuSeal, BSP, SAE and Seal-Lok®
- Heat code traceability

Materials of Construction

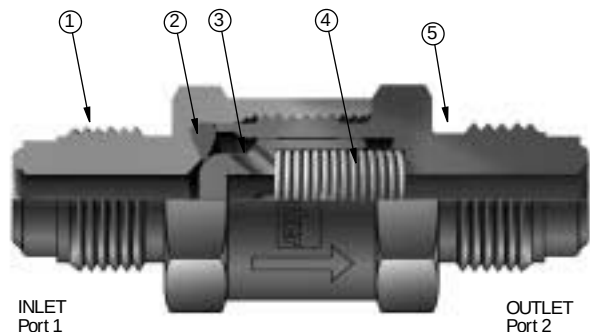
Item #	Part	Stainless Steel Valve	Brass Valve
1	Cap	ASTM A 276, TYPE 316	ASTM B 16 Alloy C36000
2	Seat*	Fluorocarbon Rubber*	
3	Poppet	ASTM A 479, TYPE 316	ASTM B 16 Alloy C36000
4	Spring	316 Stainless Steel	
5	Body	ASTM A 276, TYPE 316	ASTM B 16 Alloy C36000

* Optional seat materials are available. See How to Order section.
Lubrication: Silicone Paste

Note: PTFE seated valves employ an additional PTFE coated 316 SS gasket between the seat and the body and are distinguishable from elastomeric seated valves by the gap designed between the body and cap.

Specifications

- Pressure Rating:
316 SS - 1/8" to 3/4": 6000 psig (414 bar) CWP
1": 5000 psig (345 bar) CWP
All sizes with PTFE Seats: 4000 psig (276 bar) CWP
Brass - 1/8" to 1": 3000 psig (207 bar) CWP
- Temperature Rating:
Fluorocarbon Rubber
-15 °F to 400 °F (-26 °C to 204 °C)
Buna-N Rubber
-30 °F to 275 °F (-34 °C to 135 °C)
Ethylene Propylene Rubber
-70 °F to 275 °F (-57 °C to 135 °C)
Neoprene Rubber
-45 °F to 250 °F (-43 °C to 121 °C)
PTFE
-65 °F to 400 °F (-54 °C to 204 °C)
- Orifice: .078" to .656" (2.0 mm to 16.7 mm)
- C_v : .18 to 6.56



Model Shown: 4V-C4L-5-SS

Flow Calculations with 1000 psig (69 bar) Inlet Pressure

Valve Series	Maximum C_v	Pressure Drop ΔP		Water @ 60 °F (16 °C)		Air @ 60 °F (16 °C)	
		psig	bar	gpm	m³/hr	scfm	m³/hr
C2	0.31	10	0.7	1.0	0.2	30.8	52.1
		50	3.4	2.2	0.5	67.2	112.8
		100	6.9	3.1	0.7	92.0	155.3
C4	0.75	10	0.7	2.4	0.5	74.6	126.1
		50	3.4	5.3	1.2	162.7	273.0
		100	6.9	7.5	1.7	222.8	376.2
C6	2.26	10	0.7	7.1	1.6	225.3	380.9
		50	3.4	16.0	3.6	495.2	831.0
		100	6.9	22.6	5.1	685.1	1157.2
C8	3.53	10	0.7	11.2	2.5	352.0	595.0
		50	3.4	25.0	5.6	774.3	1299.4
		100	6.9	35.3	8.0	1072.4	1811.6
C12	6.01	10	0.7	19.0	4.3	596.6	1008.3
		50	3.4	42.5	9.6	1287.5	2160.4
		100	6.9	60.1	13.7	1738.5	2934.5
C16	6.56	10	0.7	20.7	4.7	648.9	1096.6
		50	3.4	46.4	10.5	1379.4	2314.7
		100	6.9	65.6	14.9	1824.4	3077.6

Crack and Re-seal Performance

Check Valve Rated Crack Pressure		Minimum Acceptable Crack Pressure		Maximum Acceptable Crack Pressure		Maximum Re-seal Back Pressure	
psig	bar	psig	bar	psig	bar	psig	bar
1/3	0.02	0	0.00	1	0.07	4	0.28
1	0.07	0	0.00	3	0.21	4	0.28
5	0.34	3	0.21	8	0.55	3 BCP	0.21 BCP
10	0.69	7	0.48	13	0.90	3 BCP	0.21 BCP
25	1.72	20	1.38	30	2.07	4 BCP	0.28 BCP
50	3.45	40	2.76	60	4.14	5 BCP	0.34 BCP
75	5.17	60	4.14	90	6.21	7 BCP	0.48 BCP
100	6.89	80	5.52	120	8.27	10 BCP	0.69 BCP

BCP means "Below Cracking Pressure"

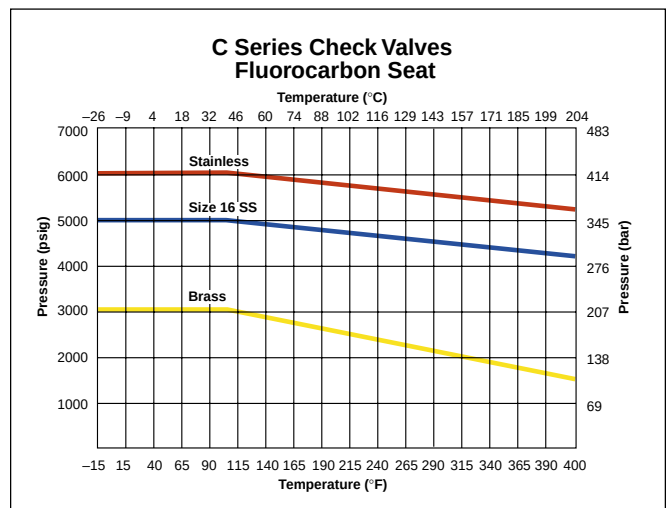
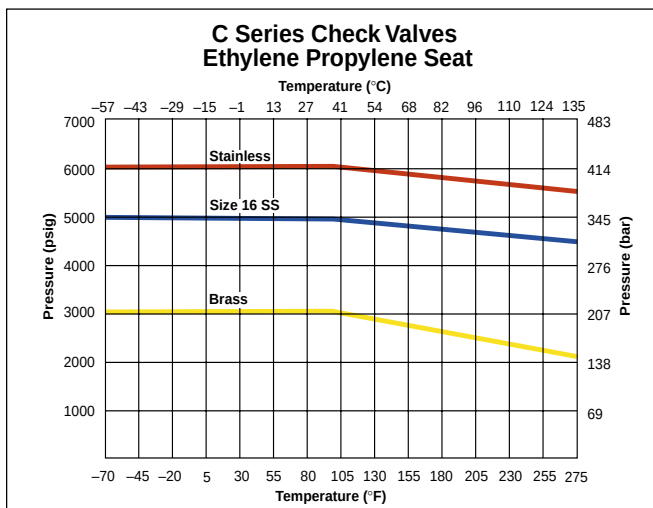
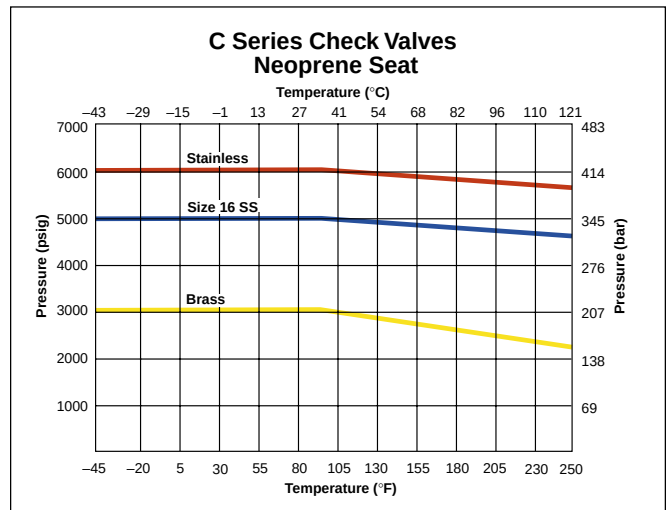
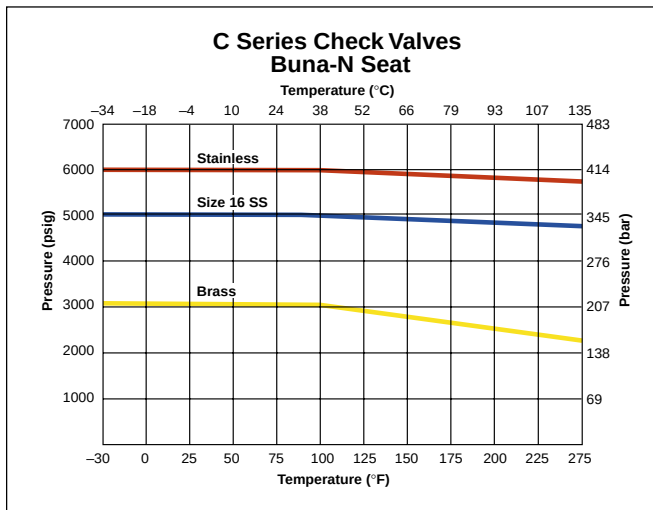
Cracking pressure is defined as the upstream pressure at which a detectable flow is measured.

Re-seal pressure is defined as the upstream pressure at which the check valve closes bubble-tight.

Example: For a valve with a spring having a rated cracking pressure of 25 psig (1.72 bar), the actual cracking pressure ranges between 20 and 30 psig (1.38 and 2.07 bar). The re-seal pressure range would be 16 to 20 psig (1.10 to 1.38 bar). Check valves having springs with rated crack pressures of 3 psig (0.21 bar) or less may require up to 4 psig (0.28 bar) back pressure to re-seal bubble-tight.

Note: Check valves which are not actuated for a period of time may initially crack at higher than the above crack pressure ranges. PTFE seated valves require a minimum back pressure of 100 psig (6.9 bar) to insure a leak-tight re-seal.

Pressure vs. Temperature



Note: To determine MPa, multiply bar by 0.1

C Series Check Valves

Flow Data/Dimensions

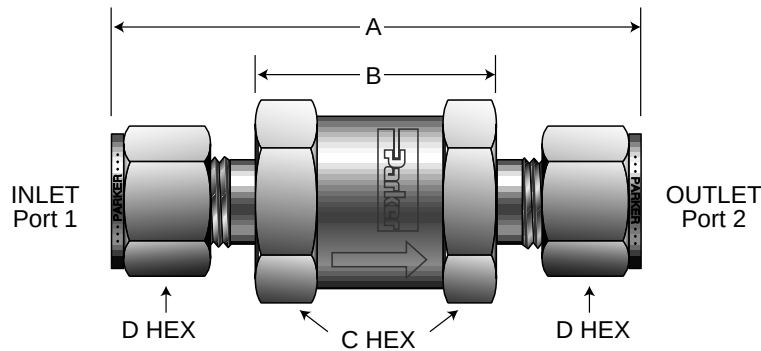
Basic Part Number	End Connections		Flow Data				Dimensions							
	(Inlet) Port 1	(Outlet) Port 2	Orifice		C_v	$x_T \pm$	A†		B		C		D	
			inch	mm			inch	mm	inch	mm	inch	mm	inch	mm
2A-C2L-*	1/8" A-LOK® Compression	1/8" A-LOK® Compression	.093	2.4	.22	0.46	2.29	58.2	1.09	27.7	.625	15.9	.438	11.1
2F-C2L-*	1/8" Female NPT	1/8" Female NPT	.125	3.2	.31	0.52	1.86	47.2	-	-	.625	15.9	-	-
2F5-C2L-*	1/8" Male SAE	1/8" Male SAE	.125	3.2	.31	0.52	1.69	42.9	1.09	27.7	.625	15.9	-	-
2G5-C2L-*	1/8" Female SAE	1/8" Female SAE	.125	3.2	.31	0.52	1.86	47.2	-	-	.625	15.9	-	-
2KF-C2L-*	1/8" Female BSP/ISO Tapered	1/8" Female BSP/ISO Tapered	.125	3.2	.31	0.52	1.86	47.2	-	-	.625	15.9	-	-
2KM-C2L-*	1/8" Male BSP/ISO Tapered	1/8" Male BSP/ISO Tapered	.125	3.2	.31	0.52	1.77	45.0	1.00	25.4	.625	15.9	-	-
2M-C2L-*	1/8" Male NPT	1/8" Male NPT	.125	3.2	.31	0.52	1.77	45.0	1.01	25.7	.625	15.9	-	-
2TA-C2L-*	1/8" Tube Adapter	1/8" Tube Adapter	.078	2.0	.18	0.43	2.07	52.6	.88	22.4	.625	15.9	-	-
2Z-C2L-*	1/8" CPI™ Compression	1/8" CPI™ Compression	.093	2.4	.22	0.46	2.29	58.2	1.09	27.7	.625	15.9	.438	11.1
M3A-C2L-*	3mm A-LOK® Compression	3mm A-LOK® Compression	.086	2.2	.20	0.45	2.30	58.4	1.05	26.7	.625	15.9	.472	12.0
M3Z-C2L-*	3mm CPI™ Compression	3mm CPI™ Compression	.086	2.2	.20	0.45	2.30	58.4	1.05	26.7	.625	15.9	.472	12.0
2M2A-C2L-*	1/8" Male NPT	1/8" A-LOK® Compression	.093	2.4	.22	0.46	2.03	51.6	1.05	26.7	.625	15.9	.438	11.1
2M2F-C2L-*	1/8" Male NPT	1/8" Female NPT	.125	3.2	.31	0.52	1.81	46.0	1.43	36.3	.625	15.9	-	-
2M2Z-C2L-*	1/8" Male NPT	1/8" CPI™ Compression	.093	2.4	.22	0.46	2.03	51.6	1.05	26.7	.625	15.9	.438	11.1
2F-C4L-*	1/8" Female NPT	1/8" Female NPT	.187	4.7	.75	0.53	2.01	51.1	-	-	.750	19.1	-	-
2M-C4L-*	1/8" Male NPT	1/8" Male NPT	.187	4.7	.75	0.53	1.82	46.2	1.06	26.9	.750	19.1	-	-
4A-C4L-*	1/4" A-LOK® Compression	1/4" A-LOK® Compression	.187	4.7	.75	0.53	2.42	61.5	1.03	26.2	.750	19.1	.563	14.3
4F-C4L-*	1/4" Female NPT	1/4" Female NPT	.187	4.7	.75	0.53	2.40	61.0	-	-	.750	19.1	-	-
4F5-C4L-*	1/4" Male SAE	1/4" Male SAE	.187	4.7	.75	0.53	2.02	51.3	1.15	29.2	.750	19.1	-	-
4G5-C4L-*	1/4" Female SAE	1/4" Female SAE	.187	4.7	.75	0.53	2.20	55.9	-	-	.750	19.1	-	-
4KF-C4L-*	1/4" Female BSP/ISO Tapered	1/4" Female BSP/ISO Tapered	.187	4.7	.75	0.53	2.40	61.0	-	-	.750	19.1	-	-
4KM-C4L-*	1/4" Male BSP/ISO Tapered	1/4" Male BSP/ISO Tapered	.187	4.7	.75	0.53	2.18	55.4	1.06	26.9	.750	19.1	-	-
4L-C4L-*	1/4" Seal-Lok®	1/4" Seal-Lok®	.172	4.4	.66	0.52	2.40	61.0	1.05	26.7	.750	19.1	-	-
4M-C4L-*	1/4" Male NPT	1/4" Male NPT	.187	4.7	.75	0.53	2.18	55.4	1.04	26.4	.750	19.1	-	-
4Q-C4L-*	1/4" UltraSeal	1/4" UltraSeal	.180	4.6	.72	0.53	1.97	50.0	1.04	26.4	.750	19.1	-	-
4V-C4L-*	1/4" VacuSeal	1/4" VacuSeal	.187	4.7	.75	0.53	2.22	56.4	.98	24.9	.750	19.1	-	-
4TA-C4L-*	1/4" Tube Adapter	1/4" Tube Adapter	.156	4.0	.58	0.52	2.35	59.7	1.07	27.2	.750	19.1	-	-
4Z-C4L-*	1/4" CPI™ Compression	1/4" CPI™ Compression	.187	4.7	.75	0.53	2.42	61.5	1.03	26.2	.750	19.1	.563	14.3
6A-C4L-*	3/8" A-LOK® Compression	3/8" A-LOK® Compression	.187	4.7	.75	0.53	2.55	64.8	1.03	26.2	.750	19.1	.688	17.5
6Z-C4L-*	3/8" CPI™ Compression	3/8" CPI™ Compression	.187	4.7	.75	0.53	2.55	64.8	1.03	26.2	.750	19.1	.688	17.5
M6A-C4L-*	6mm A-LOK® Compression	6mm A-LOK® Compression	.187	4.7	.75	0.53	2.43	61.7	1.03	26.2	.750	19.1	.551	14.0
M6Z-C4L-*	6mm CPI™ Compression	6mm CPI™ Compression	.187	4.7	.75	0.53	2.43	61.7	1.03	26.2	.750	19.1	.551	14.0
4M4A-C4L-*	1/4" Male NPT	1/4" A-LOK® Compression	.187	4.7	.75	0.53	2.29	58.2	1.02	25.9	.750	19.1	.563	14.3
4M4F-C4L-*	1/4" Male NPT	1/4" Female NPT	.187	4.7	.75	0.53	2.29	58.2	1.72	43.7	.750	19.1	-	-
4M4Z-C4L-*	1/4" Male NPT	1/4" CPI™ Compression	.187	4.7	.75	0.53	2.29	58.2	1.02	25.9	.750	19.1	.563	14.3
4M6A-C4L-*	1/4" Male NPT	3/8" A-LOK® Compression	.187	4.7	.75	0.53	2.35	59.7	1.02	25.9	.750	19.1	.688	17.5
4M6Z-C4L-*	1/4" Male NPT	3/8" CPI™ Compression	.187	4.7	.75	0.53	2.35	59.7	1.02	25.9	.750	19.1	.688	17.5
6A-C6L-*	3/8" A-LOK® Compression	3/8" A-LOK® Compression	.281	7.1	2.09	0.74	3.27	83.1	1.75	44.5	1.000	25.4	.688	17.5
6F-C6L-*	3/8" Female NPT	3/8" Female NPT	.359	9.1	2.26	0.77	3.03	77.0	-	-	1.000	25.4	-	-
6F5-C6L-*	3/8" Male SAE	3/8" Male SAE	.297	7.5	2.12	0.75	2.71	68.8	1.76	44.7	1.000	25.4	-	-
6G5-C6L-*	3/8" Female SAE	3/8" Female SAE	.359	9.1	2.26	0.77	2.96	75.2	-	-	1.000	25.4	-	-
6KF-C6L-*	3/8" Female BSP/ISO Tapered	3/8" Female BSP/ISO Tapered	.359	9.1	2.26	0.77	3.03	77.0	-	-	1.000	25.4	-	-
6KM-C6L-*	3/8" Male BSP/ISO Tapered	3/8" Male BSP/ISO Tapered	.359	9.1	2.26	0.77	2.96	75.2	1.84	46.7	1.000	25.4	-	-
6L-C6L-*	3/8" Seal-Lok®	3/8" Seal-Lok®	.264	6.7	2.05	0.74	2.65	67.3	1.77	45.0	1.000	25.4	-	-
6M-C6L-*	3/8" Male NPT	3/8" Male NPT	.359	9.1	2.26	0.77	2.96	75.2	1.82	46.2	1.000	25.4	-	-
6Q-C6L-*	3/8" UltraSeal	3/8" UltraSeal	.250	6.4	2.02	0.73	2.75	69.9	1.80	45.7	1.000	25.4	-	-
6V-C6L-*	3/8" VacuSeal	3/8" VacuSeal	.281	7.1	2.09	0.74	3.56	90.4	2.05	52.1	1.000	25.4	-	-
6TA-C6L-*	3/8" Tube Adapter	3/8" Tube Adapter	.281	7.1	2.09	0.74	3.24	82.3	1.80	45.7	1.000	25.4	-	-
6Z-C6L-*	3/8" CPI™ Compression	3/8" CPI™ Compression	.281	7.1	2.09	0.74	3.27	83.1	1.75	44.5	1.000	25.4	.688	17.5
8A-C6L-*	1/2" A-LOK® Compression	1/2" A-LOK® Compression	.359	9.1	2.26	0.77	3.55	90.2	1.81	46.0	1.000	25.4	.875	22.2
8Z-C6L-*	1/2" CPI™ Compression	1/2" CPI™ Compression	.359	9.1	2.26	0.77	3.55	90.2	1.81	46.0	1.000	25.4	.875	22.2
M8A-C6L-*	8mm A-LOK® Compression	8mm A-LOK® Compression	.250	6.4	2.02	0.73	3.33	84.6	1.87	47.5	1.000	25.4	.630	16.0
M8Z-C6L-*	8mm CPI™ Compression	8mm CPI™ Compression	.250	6.4	2.02	0.73	3.33	84.6	1.87	47.5	1.000	25.4	.630	16.0
M10A-C6L-*	10mm A-LOK® Compression	10mm A-LOK® Compression	.312	7.9	2.16	0.75	3.35	85.1	1.81	46.0	1.000	25.4	.748	19.0
M10Z-C6L-*	10mm CPI™ Compression	10mm CPI™ Compression	.312	7.9	2.16	0.75	3.35	85.1	1.81	46.0	1.000	25.4	.748	19.0
6M6A-C6L-*	3/8" Male NPT	3/8" A-LOK® Compression	.281	7.1	2.09	0.74	3.09	78.5	1.76	44.7	1.000	25.4	.688	17.5
6M6F-C6L-*	3/8" Male NPT	3/8" Female NPT	.359	9.1	2.26	0.77	2.95	74.9	2.38	60.5	1.000	25.4	-	-
6M6Z-C6L-*	3/8" Male NPT	3/8" CPI™ Compression	.281	7.1	2.09	0.74	3.09	78.5	1.76	44.7	1.000	25.4	.688	17.5
6M8A-C6L-*	3/8" Male NPT	1/2" A-LOK® Compression	.359	9.1	2.26	0.77	3.26	82.8	1.82	46.2	1.000	25.4	.875	22.2
6M8Z-C6L-*	3/8" Male NPT	1/2" CPI™ Compression	.359	9.1	2.26	0.77	3.26	82.8	1.82	46.2	1.000	25.4	.875	22.2

*Cracking pressure, seat material and body material

†For CPI™ and A-LOK®, dimensions are measured with nuts in the finger tight position.

‡Tested in accordance with ISA S75.02. Gas flow will be choked when $P_1 - P_2 / P_1 = x_T$.

C Series Check Valves



Model Shown: 4Z-C4L-1-SS

Flow Data/Dimensions (continued)

Basic Part Number	End Connections		Flow Data				Dimensions							
	(Inlet) Port 1	(Outlet) Port 2	Orifice		C_v	$\chi_T \ddagger$	$A \ddagger$		B		C		D	
			inch	mm			inch	mm	inch	mm	inch	mm	inch	mm
8A-C8L*	1/2" A-LOK® Compression	1/2" A-LOK® Compression	.423	10.7	3.30	0.77	4.08	103.6	2.34	59.4	1.250	31.8	.875	22.2
8F-C8L*	1/2" Female NPT	1/2" Female NPT	.453	11.5	3.53	0.81	3.56	90.4	-	-	1.250	31.8	-	-
8F5-C8L*	1/2" Male SAE	1/2" Male SAE	.453	11.5	3.53	0.81	3.45	87.6	2.34	59.4	1.250	31.8	-	-
8G5-C8L*	1/2" Female SAE	1/2" Female SAE	.453	11.5	3.53	0.81	3.56	90.4	-	-	1.250	31.8	-	-
8KF-C8L*	1/2" Female BSP/ISO Tapered	1/2" Female BSP/ISO Tapered	.453	11.5	3.53	0.81	3.56	90.4	-	-	1.250	31.8	-	-
8KM-C8L*	1/2" Male BSP/ISO Tapered	1/2" Male BSP/ISO Tapered	.453	11.5	3.53	0.81	3.56	90.4	2.06	52.3	1.250	31.8	-	-
8L-C8L*	1/2" Seal-Lok®	1/2" Seal-Lok®	.378	9.6	2.96	0.71	3.22	81.8	2.21	56.1	1.250	31.8	-	-
8M-C8L*	1/2" Male NPT	1/2" Male NPT	.453	11.5	3.53	0.81	3.56	90.4	2.05	52.1	1.250	31.8	-	-
8Q-C8L*	1/2" UltraSeal	1/2" UltraSeal	.375	9.5	2.93	0.71	3.28	83.3	2.33	59.2	1.250	31.8	-	-
8TA-C8L*	1/2" Tube Adapter	1/2" Tube Adapter	.375	9.5	2.93	0.71	4.04	102.6	1.78	45.2	1.250	31.8	-	-
8V-C8L*	1/2" VacuSeal	1/2" VacuSeal	.406	10.3	3.17	0.75	3.56	90.4	2.05	52.1	1.250	31.8	-	-
8Z-C8L*	1/2" CPI™ Compression	1/2" CPI™ Compression	.423	10.7	3.30	0.77	4.08	103.6	2.34	59.4	1.250	31.8	.875	22.2
M12A-C8L*	12mm A-LOK® Compression	12mm A-LOK® Compression	.375	9.5	2.93	0.71	4.06	103.1	2.34	59.4	1.250	31.8	.866	22.0
M12Z-C8L*	12mm CPI™ Compression	12mm CPI™ Compression	.375	9.5	2.93	0.71	4.06	103.1	2.34	59.4	1.250	31.8	.866	22.0
8M8A-C8L*	1/2" Male NPT	1/2" A-LOK® Compression	.423	10.7	3.30	0.77	3.82	97.0	2.19	55.6	1.250	31.8	.875	22.2
8M8F-C8L*	1/2" Female NPT	1/2" Female NPT	.453	11.5	3.53	0.81	3.56	90.4	2.80	71.1	1.250	31.8	-	-
8M8Z-C8L*	1/2" Male NPT	1/2" CPI™ Compression	.423	10.7	3.30	0.77	3.82	97.0	2.19	55.6	1.250	31.8	.875	22.2
12A-C12L*	3/4" A-LOK® Compression	3/4" A-LOK® Compression	.594	15.1	6.01	0.38	4.34	110.2	2.60	66.0	1.375	34.9	1.125	28.6
12F-C12L*	3/4" Female NPT	3/4" Female NPT	.594	15.1	6.01	0.38	4.09	103.9	-	-	1.375	34.9	-	-
12F5-C12L*	3/4" Male SAE	3/4" Male SAE	.594	15.1	6.01	0.38	4.05	102.9	2.59	65.8	1.375	34.9	-	-
12G5-C12L*	3/4" Female SAE	3/4" Female SAE	.594	15.1	6.01	0.38	4.13	104.9	-	-	1.375	34.9	-	-
12KF-C12L*	3/4" Female BSP/ISO Tapered	3/4" Female BSP/ISO Tapered	.594	15.1	6.01	0.38	4.09	103.9	-	-	1.375	34.9	-	-
12KM-C12L*	3/4" Male BSP/ISO Tapered	3/4" Male BSP/ISO Tapered	.594	15.1	6.01	0.38	4.09	103.9	2.59	65.8	1.375	34.9	-	-
12L-C12L*	3/4" Seal-Lok®	3/4" Seal-Lok®	.594	15.1	6.01	0.38	3.78	96.0	2.44	62.0	1.375	34.9	-	-
12M-C12L*	3/4" Male NPT	3/4" Male NPT	.594	15.1	6.01	0.38	4.09	103.9	2.58	65.5	1.375	34.9	-	-
12Q-C12L*	3/4" UltraSeal	3/4" UltraSeal	.500	12.7	5.63	0.37	3.78	96.0	2.64	67.1	1.375	34.9	-	-
12TA-C12L*	3/4" Tube Adapter	3/4" Tube Adapter	.594	15.1	6.01	0.38	4.24	107.7	2.18	55.4	1.375	34.9	-	-
12V-C12L*	3/4" VacuSeal	3/4" VacuSeal	.594	15.1	6.01	0.38	4.64	117.9	2.64	67.1	1.375	34.9	-	-
12Z-C12L*	3/4" CPI™ Compression	3/4" CPI™ Compression	.594	15.1	6.01	0.38	4.34	110.2	2.60	66.0	1.375	34.9	1.125	28.6
M20A-C12L*	20mm A-LOK® Compression	20mm A-LOK® Compression	.594	15.1	6.01	0.38	4.32	109.7	2.56	65.0	1.375	34.9	1.260	32.0
M20Z-C12L*	20mm CPI™ Compression	20mm CPI™ Compression	.594	15.1	6.01	0.38	4.32	109.7	2.56	65.0	1.375	34.9	1.260	32.0
M22A-C12L*	22mm A-LOK® Compression	22mm A-LOK® Compression	.594	15.1	6.01	0.38	4.30	109.2	2.56	65.0	1.375	34.9	1.260	32.0
M22Z-C12L*	22mm CPI™ Compression	22mm CPI™ Compression	.594	15.1	6.01	0.38	4.30	109.2	2.56	65.0	1.375	34.9	1.260	32.0
12M12A-C12L*	3/4" Male NPT	3/4" A-LOK® Compression	.594	15.1	6.01	0.38	4.22	107.2	2.59	65.8	1.375	34.9	1.125	28.6
12M12F-C12L*	3/4" Male NPT	3/4" Female NPT	.594	15.1	6.01	0.38	4.09	103.9	3.34	84.8	1.375	34.9	-	-
12M12Z-C12L*	3/4" Male NPT	3/4" CPI™ Compression	.594	15.1	6.01	0.38	4.22	107.2	2.59	65.8	1.375	34.9	1.125	28.6
16A-C16L*	1" A-LOK® Compression	1" A-LOK® Compression	.656	16.7	6.56	0.27	4.63	117.6	2.53	64.3	1.625	41.3	1.500	38.1
16F-C16L*	1" Female NPT	1" Female NPT	.656	16.7	6.56	0.27	4.84	122.9	-	-	1.625	41.3	-	-
16F5-C16L*	1" Male SAE	1" Male SAE	.656	16.7	6.56	0.27	4.10	104.1	2.64	67.1	1.625	41.3	-	-
16G5-C16L*	1" Female SAE	1" Female SAE	.656	16.7	6.56	0.27	4.84	122.9	-	-	1.625	41.3	-	-
16KF-C16L*	1" Female BSP/ISO Tapered	1" Female BSP/ISO Tapered	.656	16.7	6.56	0.27	4.84	122.9	-	-	1.625	41.3	-	-
16KM-C16L*	1" Male BSP/ISO Tapered	1" Male BSP/ISO Tapered	.656	16.7	6.56	0.27	4.52	114.8	2.64	67.1	1.625	41.3	-	-
16M-C16L*	1" Male NPT	1" Male NPT	.656	16.7	6.56	0.27	4.52	114.8	2.63	66.8	1.625	41.3	-	-
16L-C16L*	1" Seal-Lok®	1" Seal-Lok®	.656	16.7	6.56	0.27	3.83	97.3	2.45	62.2	1.625	41.3	-	-
16TA-C16L*	1" Tube Adapter	1" Tube Adapter	.656	16.7	6.56	0.27	5.11	129.8	2.52	64.0	1.625	41.3	-	-
16Z-C16L*	1" CPI™ Compression	1" CPI™ Compression	.656	16.7	6.56	0.27	4.63	117.6	2.53	64.3	1.625	41.3	1.500	38.1
M25A-C16L*	25mm A-LOK® Compression	25mm A-LOK® Compression	.656	16.7	6.56	0.27	4.74	120.4	2.64	67.1	1.625	41.3	1.496	38.0
M25Z-C16L*	25mm CPI™ Compression	25mm CPI™ Compression	.656	16.7	6.56	0.27	4.74	120.4	2.64	67.1	1.625	41.3	1.496	38.0
16M16A-C16L*	1" Male NPT	1" A-LOK® Compression	.656	16.7	6.56	0.27	4.58	116.3	2.59	65.8	1.625	41.3	1.500	38.1
16M16F-C16L*	1" Male NPT	1" Female NPT	.656	16.7	6.56	0.27	4.68	118.9	3.73	94.7	1.625	41.3	-	-
16M16Z-C16L*	1" Male NPT	1" CPI™ Compression	.656	16.7	6.56	0.27	4.58	116.3	2.59	65.8	1.625	41.3	1.500	38.1

*Cracking pressure, seat material and body material

†For CPI™ and A-LOK®, dimensions are measured with nuts in the finger tight position.

C Series Check Valves

How to Order

The correct part number is easily derived by following the circled number sequence. The six product characteristics required are coded as shown below. *Note: If both the inlet and outlet ports are the same, eliminate the outlet port designator.

Example: 12Z * - C12L - 5 - BN - B

 ① ② ③ ④ ⑤ ⑥

 Inlet Outlet Body Crack Seat Body

 Port Port Size Pressure Material Material

Describes a C Series Check Valve with 3/4" CPI™ compression inlet and outlet ports, a 5 psi cracking pressure, Buna-N seat and brass body construction.

Example: 16M 16A - C16L - 10 - NE - SS

 ① ② ③ ④ ⑤ ⑥

 Inlet Outlet Body Crack Seat Body

 Port Port Size Pressure Material Material

Describes a C Series Check Valve with a 1" male NPT inlet and a 1" A-LOK® compression outlet port, a 10 psi cracking pressure, neoprene seat and stainless steel body construction.

① Inlet Port	② Outlet Port	③ Body Size	④ Crack Pressure	⑤ Seat Material	⑥ Body Material
2A, 2F, 2F5, 2G5, 2KF, 2KM 2M, 2TA, 2Z, M3A, M3Z,	2A, 2F, 2F5, 2G5, 2KF, 2KM 2M, 2TA, 2Z, M3A, M3Z,	C2L	1/3 psi	Blank - Fluorocarbon Rubber	B - Brass
4A, 4F, 4F5, 4G5, 4KF, 4KM, 4L, 4M, 4Q, 4TA, 4V, 4Z, M6A, M6Z,	4A, 4F, 4F5, 4G5, 4KF, 4KM, 4L, 4M, 4Q, 4TA, 4V, 4Z, M6A, M6Z,	C4L	1 psi		
6A, 6F, 6F5, 6G5, 6KF, 6KM, 6L, 6M, 6Q, 6TA, 6V, 6Z, M8A, M8Z, M10A, M10Z,	6A, 6F, 6F5, 6G5, 6KF, 6KM, 6L, 6M, 6Q, 6TA, 6V, 6Z, M8A, M8Z, M10A, M10Z,	C6L	5 psi	BN - Buna-N Rubber	SS - 316 Stainless Steel
8A, 8F, 8F5, 8G5, 8KF, 8KM, 8L, 8M, 8Q, 8TA, 8V, 8Z, M12A, M12Z,	8A, 8F, 8F5, 8G5, 8KF, 8KM, 8L, 8M, 8Q, 8TA, 8V, 8Z, M12A, M12Z,	C8L	10 psi	EPR - Ethylene Propylene Rubber	
12A, 12F, 12F5, 12G5, 12KF, 12KM, 12L, 12M, 12Q, 12TA, 12V, 12Z, M20A, M20Z, M22A, M22Z,	12A, 12F, 12F5, 12G5, 12KF, 12KM, 12L, 12M, 12Q, 12TA, 12V, 12Z, M20A, M20Z, M22A, M22Z,	C12L	25 psi		
16A, 16F, 16F5, 16G5, 16KF, 16KM, 16L, 16M, 16TA, 16Z, M25A, M25Z,	16A, 16F, 16F5, 16G5, 16KF, 16KM, 16L, 16M, 16TA, 16Z, M25A, M25Z,	C16L	50 psi	NE - Neoprene Rubber	
			75 psi		
			100 psi	T - PTFE	

Options

Oxygen Cleaning - Add the suffix **-C3** to the end of the part number to receive valves cleaned and assembled for oxygen service in accordance with Parker specification ES8003. **Example:** 4A-C4L-1-BN-SS-C3

Special Cleaning - All face seal ended valves are cleaned in accordance with Parker Specification ES8001. This is an option for all valves by adding the suffix **-C1** to the end of the part number. **Example:** M12A-C8L-10-SS-C1

Laser Weld - Add the suffix **-LW** to the end of the part number to receive tamper-resistant stainless steel valves. **Example:** 2F-C2L-1-SS-LW

NGV Certification - To receive valves approved and certified by the Canadian Gas Association (CGA) and American Gas Association (AGA) for use on natural gas vehicles, please contact the Instrumentation Valve Division or your local authorized Parker distributor.

C Series Check Valves

Available End Connections

A - Two ferrule A-LOK® compression port



M -ANSI/ASME B1.20.1 External pipe threads



TA -Tube adapter connection



L -SAE J1453, Fitting – O-ring face seal – External thread with O-ring groove designed to seal with an elastomer against a sleeve



Z -Single ferrule CPI™ compression port



Q -UltraSeal face seal port



F5 -SAE J1926/2, Part 2: Heavy-duty (S Series) stud ends



KF -British Standard BS 21 (ISO 7-1), Internal pipe threads



F -ANSI/ASME B1.20.1 Internal pipe threads



V -VacuSeal face seal port



G5 -SAE J1926/1, Part 1: Threaded port with O-ring seal in truncated housing



KM -British Standard BS 21 (ISO 7-1), External pipe threads



Kit Information

To order repair kits for the C Series Check Valves simply fill in the designators from the chart below.

Size	Crack Pressure	Seat Material
C2	1/3	V - Fluorocarbon
C4	1	Rubber
C6	5	BN - Buna-N Rubber
C8	10	EPR - Ethylene
C12	25	Propylene
C16	50	Rubber
	75	NE - Neoprene
	100	Rubber
		T - PTFE

Examples: KIT-C8-10-V
KIT-C16-100-BN



Check Valve Kits Contain:
Seat
Spring
Instructions

WARNING

FAILURE, IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

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Offer of Sale

The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated in the "Offer of Sale" located in Catalog 4110-U Needle Valves (U Series).

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Catalog 4130-C, 30M, 05/01

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Integral-Bonnet Needle Valves



O, 1, 18, 20, and 26 Series

- Live-loaded packing system
- Compact design
- Working pressures up to 6000 psig (413 bar)
- Temperatures up to 600°F (315°C)

Features

Stem Designs

- Vee all series
- Soft-seat all series
- Regulating O, 1, and 18 series

Orifice Sizes

- From 0.080 to 0.375 in.
(2.0 to 9.5 mm)

Flow Coefficients (C_v)

- From 0.09 to 1.80

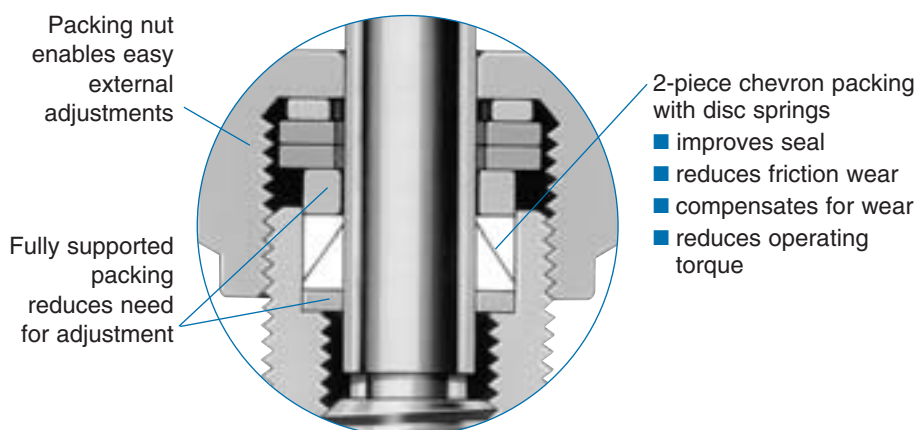
Flow Patterns

- Straight, angle, and cross patterns

Panel Mounting

- O, 1, and 18 series

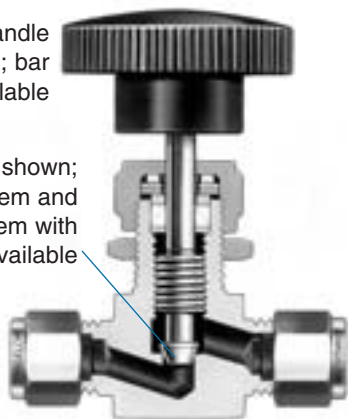
Live-Loaded Packing System



O, 1, and 18 Series

Round handle shown; bar handle available

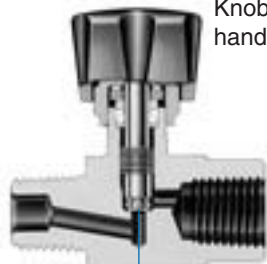
Vee stem shown; regulating stem and soft-seat stem with PCTFE tip available



20K Series

Knob handle

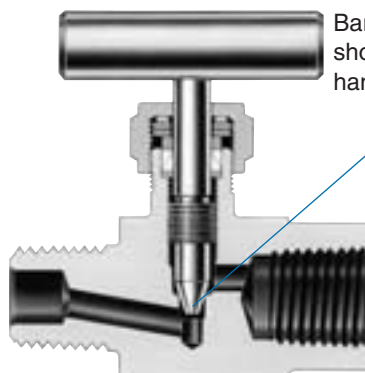
Soft-seat stem with PCTFE tip



20V and 26 Series

Bar handle shown; round handle available

Vee stem shown; soft-seat stem with PCTFE tip available



Pressure-Temperature Ratings

Valves are standard with PFA stem packing. Ratings are based on PEEK stem packing. Ratings are limited to:

- 200°F (93°C) max with PCTFE stem tip.
- 250°F (121°C) max with UHMWPE stem packing.
- 450°F (232°C) max with PFA stem packing.

To order other packing materials, see **Options and Accessories**, page 7.

O, 1, and 18 Series

ASME Class	2080	N/A		1500
Material Group	2.2	N/A		3.4
Material Name	316 SS	Brass	Steel	Alloy 400
Temperature, °F (°C)	Working pressure, psig (bar)			
65 (53) to 20 (28)	5000 (344)	3000 (206)		3000 (206)
20 (28) to 100 (37)	5000 (344)	3000 (206)	3000 (206)	3000 (206)
200 (93)	4295 (295)	2350 (161)	2730 (188)	2640 (181)
250 (121)	4085 (281)	2200 (151)	2695 (185)	2555 (176)
300 (148)	3875 (266)	2050 (141)	2660 (183)	2470 (170)
350 (176)	3715 (255)	1470 (101)	2615 (180)	2430 (167)
400 (204)	3560 (245)	390 (26)		2390 (164)
450 (232)	3435 (236)			2380 (163)
500 (260)	3310 (228)			2375 (163)
600 (315)	3130 (215)			

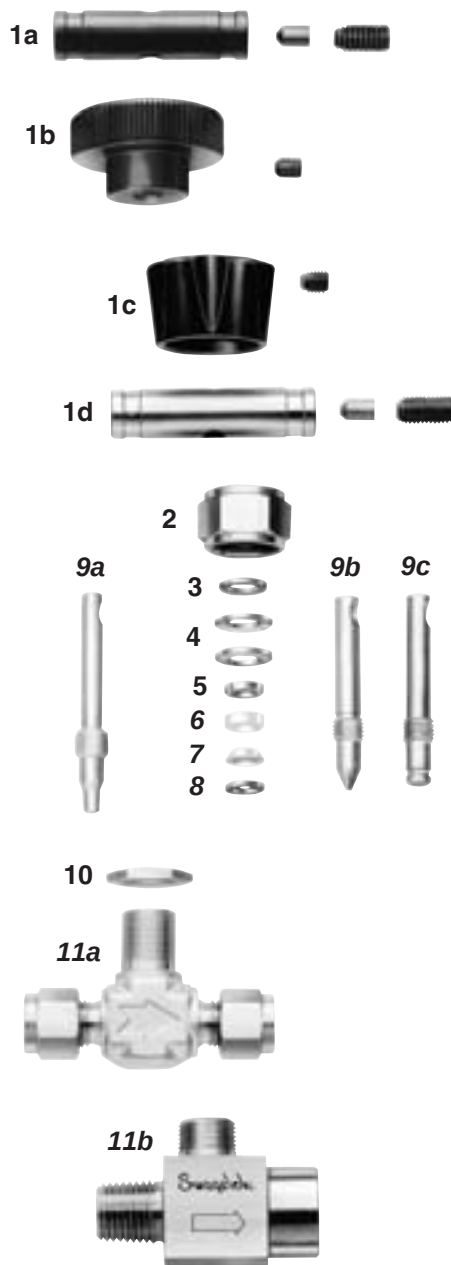
20 and 26 Series

ASME Class	2500
Material Group	2.2
Material Name	316 SS
Temperature, °F (°C)	Working pressure, psig (bar)
65 (53) to 100 (37)	6000 (413)
200 (93)	5160 (355)
250 (121)	4910 (338)
300 (148)	4660 (321)
350 (176)	4470 (307)
400 (204)	4280 (294)
450 (232)	4130 (284)
500 (260)	3980 (274)
600 (315)	3760 (259)

For more information about ASME classes, material groups, and ratings, see the Swagelok® Valve Pressure-Temperature Ratings technical bulletin.

For more information about pressure ratings of valves with tube fitting end connections, see Swagelok Tubing Data.

Materials of Construction



Component	Series	Valve Body Materials			
		Material Grade/ASTM Specification			
		316 SS	Brass	Steel	Alloy 400
1a Bar handle Handle Set screw	18	Anodized aluminum 7129/B221			
		S17400/A564			
1b Round handle Set screw	O and 1	Phenolic with brass insert			
		S17400/A564			
1c Knob handle Set screw	20K	Anodized aluminum 7129/B221			
		S17400/A564			
1d Bar handle Handle pin Set screw	20V and 26	316 SS/A276			
		S17400/A564			
2 Packing nut	All	316 SS/A276	Brass 360/ B16	12L14/ A108	Alloy R-405/ B164
3 Gland	O, 1, ① and 20	304 SS/A240, A167			
4 Packing springs	All②	S17700/A693			
5 Packing gland	All	316 SS/A276, A167, B783			
6 Upper packing	All	PFA/D3307			
7 Lower packing					
8 Lower gland	All	316 SS/A167			Alloy 400/ B127
9a Regulating stem	O, 1, and 18	Chrome-plated③ 316 SS/A276			Alloy R-405/ B164
9b Vee stem	All				
9c Soft-seat stem Stem tip	All	Chrome-plated④ 316 SS/A276			
		PCTFE/D1430			
10 Panel nut	O, 1, and 18	316 SS	Brass 360/B16		316 SS
11a Body	O, 1, and 18	316 SS/A182	Brass 377/ B283	Cadmium-plated 11L17/ A108	Alloy 400/ B564
11b Body	20 and 26	316 SS/A479	—		
Lubricant	All	Tungsten disulfide- and fluorocarbon-based			

Wetted components listed in *italics*.

See the NACE specification for information on stainless tube fitting requirements.

Valve series listed with standard handles. For handle options, see **Handles**, page 8.

① 1 series valves with orifice of 0.172 in. (4.4 mm).

② O and 20 series 2 springs; 1, 18, and 26 series 3 springs.

③ Stem tip and threads.

④ Stem threads.

Testing

Every integral-bonnet needle valve is factory tested with nitrogen at 1000 psig (69 bar). Seats have a maximum allowable leak rate of 0.1 std cm³/min. Shell testing is performed to a requirement of no detectable leakage with a liquid leak detector.

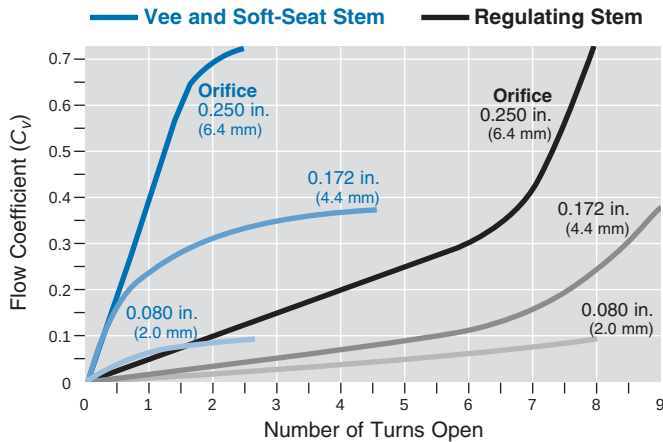
Cleaning and Packaging

All integral-bonnet needle valves are cleaned and packaged in accordance with *Swagelok Specification SC-10*. Cleaning and packaging in accordance with *Special Cleaning and Packaging (SC-11)* to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C are available as an option.

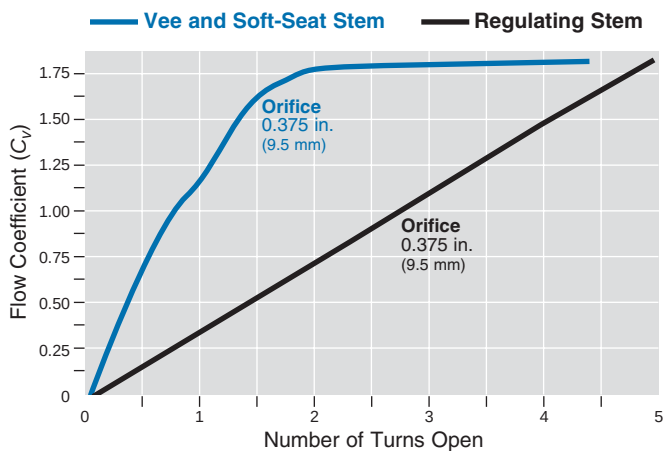
Flow Data at 100°F (37°C)

Flow Coefficient at Turns Open

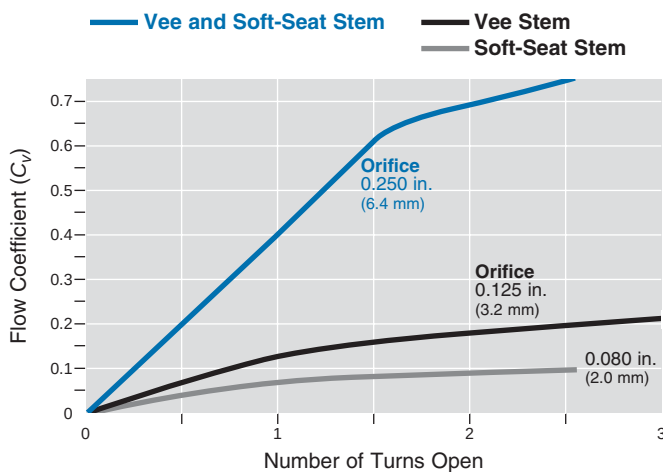
O and 1 Series



18 Series



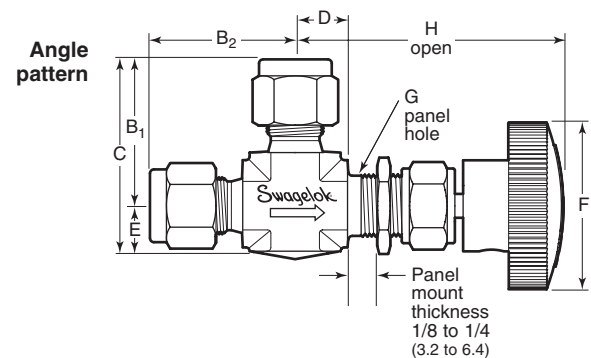
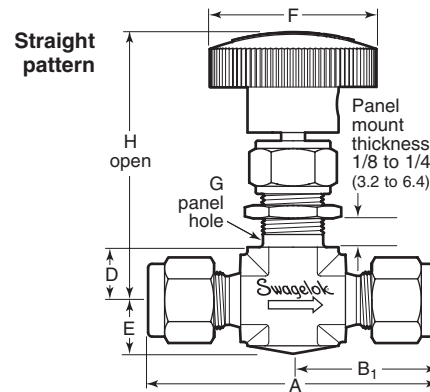
20 and 26 Series



Ordering Information and Dimensions

O, 1, and 18 Series

Dimensions, in inches (millimeters), are for reference only and are subject to change.



Stainless Steel Valves with Regulating Stems

Select an ordering number.

Alloy 400, Brass, and Steel Valves with Regulating Stems

Replace **SS** in the ordering number with a material designator.

Example: **M**-ORS2

Material	Designator
Alloy 400	M
Brass	B
Steel	S

Vee and Soft-Seal Stems

Replace **R** in the ordering number with **V** for a vee stem or **K** for a soft-seat stem with PCTFE stem tip.

Examples: **SS-OVS2**

SS-OKS2

Angle-Pattern Valves

Add **-A** to the ordering number.

Example: **SS-ORS2-A**

Cross-Pattern Valves

Certain 1 and 18 Series valves are available with cross-pattern bodies, which provide continuous flow between the side ports and on-off or regulating flow through the bottom port. Contact your independent Swagelok sales and service representative for more information.

End Connections		C _v	Orifice in. (mm)	Ordering Number	Dimensions, in. (mm)									
Inlet/Outlet	Size				A	B ₁	B ₂	C	D	E	F	G	H	
Fractional Swagelok tube fittings	1/8 in.	0.09	0.080 (2.0)	SS-ORS2	1.94 (49.3)	0.98 (24.9)		1.29 (32.8)	0.44 (11.2)	0.31 (7.9)	1.00 (25.4)	0.47 (11.9)	2.28 (57.9)	
	1/4 in.	0.37	0.172 (4.4)	SS-1RS4	2.27 (57.6)	1.13 (28.7)		1.51 (38.4)		0.38 (9.7)	1.38 (35.1)	0.53 (13.5)	2.50 (63.5)	
	3/8 in.	0.73	0.250 (6.4)	SS-1RS6	2.58 (65.5)	1.29 (32.8)		1.79 (45.5)	0.50 (12.7)	0.50 (12.7)	1.88 (47.8)	0.78 (19.8)	2.97 (75.4)	
	1/2 in.			SS-1RS8	2.80 (71.1)	1.40 (35.6)		1.90 (48.3)						
	1/2 in.	1.80	0.375 (9.5)	SS-18RS8	3.80 (96.5)	1.90 (48.3)		2.65 (67.3)	0.75 (19.1)		3.00 (76.2)	1.03 (26.2)	3.91 (99.3)	
	3/4 in.			SS-18RS12										
Metric Swagelok tube fittings	3 mm	0.09	0.080 (2.0)	SS-ORS3MM	1.94 (49.3)	0.98 (24.9)		1.29 (32.8)	0.44 (11.2)	0.31 (7.9)	1.00 (25.4)	0.48 (12.2)	2.28 (57.9)	
	6 mm	0.37	0.172 (4.4)	SS-1RS6MM	2.27 (57.6)	1.13 (28.7)		1.51 (38.4)		0.38 (9.7)	1.38 (35.1)	0.53 (13.5)	2.50 (63.5)	
	8 mm			SS-1RS8MM	2.34 (59.4)	1.17 (29.7)		1.54 (39.1)						
	10 mm	0.73	0.250 (6.4)	SS-1RS10MM	2.60 (66.0)	1.30 (33.0)		1.80 (45.7)	0.50 (12.7)		1.88 (47.8)	0.78 (19.8)	2.97 (75.4)	
	12 mm			SS-1RS12MM	2.80 (71.1)	1.40 (35.6)		1.90 (48.3)	0.55 (14.0)	0.50 (12.7)				
Female NPT	1/8 in.	0.09	0.080 (2.0)	SS-ORF2	1.88 (47.8)	0.94 (23.9)		1.25 (31.8)	0.44 (11.2)	0.31 (7.9)	1.00 (25.4)	0.47 (11.9)	2.28 (57.9)	
	1/8 in.	0.37	0.172 (4.4)	SS-1RF2	1.62 (41.1)	0.81 (20.6)		1.19 (30.2)		0.38 (9.7)	1.38 (35.1)	0.53 (13.5)	2.50 (63.5)	
	1/4 in.	0.73	0.250 (6.4)	SS-1RF4	2.12 (53.8)	1.06 (26.9)		1.56 (39.6)	0.50 (12.7)		1.88 (47.8)	0.78 (19.8)	2.97 (75.4)	
	3/8 in.	1.80	0.375 (9.5)	SS-18RF6	3.00 (76.2)	1.50 (38.1)		2.25 (57.2)	0.75 (19.1)		3.00 (76.2)	1.03 (26.2)	3.88 (98.6)	
	1/2 in.			SS-18RF8										
Male NPT	1/8 in.	0.09	0.080 (2.0)	SS-ORM2	1.50 (38.1)	0.75 (19.1)		1.06 (26.9)	0.44 (11.2)	0.31 (7.9)	1.00 (25.4)	0.47 (11.9)	2.28 (57.9)	
	1/8 in.	0.37	0.172 (4.4)	SS-1RM2	1.62 (41.1)	0.81 (20.6)		1.19 (30.2)		0.38 (9.7)	1.38 (35.1)	0.53 (13.5)	2.50 (63.5)	
	1/4 in.			SS-1RM4	1.97 (50.0)	0.98 (24.9)		1.36 (34.5)						
	3/8 in.	0.73	0.250 (6.4)	SS-1RM6	2.25 (62.5)	1.12 (28.4)		1.62 (41.1)	0.50 (12.7)		1.88 (47.8)	0.78 (19.8)	2.97 (75.4)	
	1/2 in.	1.80	0.375 (9.5)	SS-18RM8	3.00 (76.2)	1.50 (38.1)		2.25 (57.2)	0.75 (19.1)		3.00 (76.2)	1.03 (26.2)	3.88 (98.6)	
Male NPT/ Swagelok tube fitting	1/8 in.	0.09	0.080 (2.0)	SS-ORM2-S2	1.73 (43.9)	0.98 (24.9)	0.75 (19.1)	1.29 (32.8)	0.44 (11.2)	0.31 (7.9)	1.00 (25.4)	0.47 (11.9)	2.28 (57.9)	
	1/4 in.	0.37	0.172 (4.4)	SS-1RM4-S4	1.95 (49.5)	1.13 (28.7)	0.98 (24.9)	1.51 (38.4)		0.38 (9.7)	1.38 (35.1)	0.53 (13.5)	2.50 (63.5)	
	1/4/ 3/8 in.	0.73	0.250 (6.4)	SS-1RM4-S6	2.42 (61.5)	1.29 (32.8)	1.12 (28.4)	1.79 (45.5)	0.50 (12.7)		1.88 (47.8)	0.78 (19.8)	2.97 (75.4)	
	3/8 in.			SS-1RM6-S6										
	3/8/ 1/2 in.			SS-1RM6-S8	2.52 (64.0)	1.40 (35.6)		1.90 (48.3)						
Male/ female NPT	1/4 in.	0.73	0.250 (6.4)	SS-1RM4-F4	2.19 (55.6)	1.06 (26.9)	1.12 (28.4)	1.56 (39.6)	0.50 (12.7)		1.88 (47.8)	0.78 (19.8)	2.97 (75.4)	
	1/2 in.	1.80	0.375 (9.5)	SS-18RM8-F8	3.00 (76.2)	1.50 (38.1)		2.25 (57.2)	0.75 (19.1)		3.00 (76.2)	1.03 (26.2)	3.88 (98.6)	
Female ISO ^①	1/4 in.	0.73	0.250 (6.4)	SS-1RF4RT	2.12 (53.8)	1.06 (26.9)		1.56 (39.6)	0.50 (12.7)		1.88 (47.8)	0.78 (19.8)	2.97 (75.4)	
	3/8 in.	1.80	0.375 (9.5)	SS-18RF6RT	3.00 (76.2)	1.50 (38.1)		2.25 (57.2)	0.75 (19.1)		3.00 (76.2)	1.03 (26.2)	3.88 (98.6)	
	1/2 in.			SS-18RF8RT										

Dimensions determined using valves with regulating stems and standard handles. Dimensions are shown with Swagelok nuts finger-tight.

① See specifications ISO 7/1, BS 21, DIN-2999, JIS B0203.

Ordering Information and Dimensions

20 and 26 Series

Dimensions are for reference only and are subject to change.

Select an ordering number.

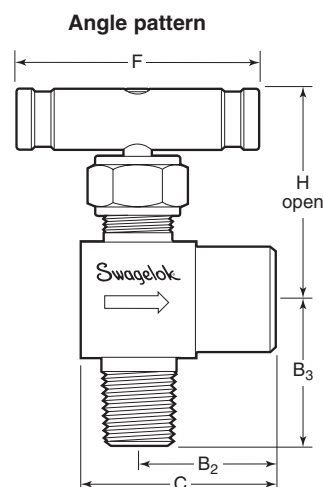
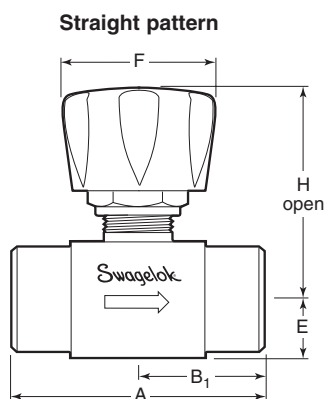
For soft-seat stems and PCTFE stem tips in valves that are standard with vee stems, replace **V** with **K**.

Example: SS-20KS4

Angle-Pattern Valves

Angle-pattern bodies are available for valves with C dimensions listed. To order, add **-A** to the ordering number.

Example: SS-20KM4-F4-A



End Connections		C _v	Orifice in. (mm)	Ordering Number	Dimensions, in. (mm)							
Inlet/Outlet	Size				A	B ₁	B ₂	B ₃	C	E	F	H
20 series with soft-seat stem and PCTFE stem tip												
Female NPT	1/4 in.	0.09	0.080 (2.0)	SS-20KF4	1.88 (47.8)	0.94 (23.9)				0.42 (10.7)	1.12 (28.4)	1.66 (42.2)
Male NPT	1/4 in.			SS-20KM4	1.94 (49.3)	0.97 (24.6)						
Male/ female NPT	1/4 in.			SS-20KM4-F4	1.91 (48.5)	0.94 (23.9)						
20 and 26 series with vee stem												
Swagelok tube fittings	1/4 in.	0.21	0.125 (3.2)	SS-20VS4	2.46 (62.5)	1.23 (31.2)	1.13 (28.7)	1.16 (29.5)	1.57 (39.9)	0.42 (10.7)	1.75 (44.4)	1.66 (42.2)
	3/8 in.	0.73	0.250 (6.4)	SS-26VS6	3.08 (78.2)	1.54 (39.1)				0.66 (16.8)	2.50 (63.5)	2.31 (58.7)
	1/2 in.			SS-26VS8	3.30 (83.8)	1.65 (41.9)						
Female NPT	1/4 in.	0.21	0.125 (3.2)	SS-20VF4	1.88 (47.8)	0.94 (23.9)	1.00 (25.4)		1.44 (36.6)	0.42 (10.7)	1.75 (44.4)	1.66 (42.2)
	3/8 in.	0.73	0.250 (6.4)	SS-26VF6	2.50 (63.5)	1.25 (31.8)				0.66 (16.8)	2.50 (63.5)	2.31 (58.7)
	1/2 in.			SS-26VF8			1.41 (35.8)		2.06 (52.3)			
Male NPT	1/4 in.	0.21	0.125 (3.2)	SS-20VM4	1.94 (49.3)	0.97 (24.6)				0.42 (10.7)	1.75 (44.4)	1.66 (42.2)
Male NPT/ Swagelok tube fitting	1/4 in.			SS-20VM4-S4			1.13 (28.7)	1.00 (25.4)	1.57 (39.9)			
Male/ female NPT	1/4 in.			0.73	0.250 (6.4)	SS-20VM4-F4	1.91 (48.5)	0.94 (23.9)	1.00 (25.4)	1.03 (26.2)	1.44 (36.6)	
	3/8 in.	SS-26VM6-F6	2.50 (63.5)			1.25 (31.8)	1.41 (35.8)	1.22 (31.0)	2.06 (52.3)	0.66 (16.8)	2.50 (63.5)	2.31 (58.7)
	1/2 in.	SS-26VM8-F8	2.55 (64.8)			1.25 (31.8)	1.41 (35.8)					
	3/4 to 1/2 in.	SS-26VM12-F8	2.50 (63.5)			1.25 (31.8)						
Female ISO ^①	1/4 in.	0.21	0.125 (3.2)	SS-20VF4RT	1.88 (47.8)	0.94 (23.9)				0.42 (10.7)	1.75 (44.4)	1.66 (42.2)
	1/2 in.	0.73	0.250 (6.4)	SS-26VF8RT	2.50 (63.5)	1.25 (31.8)				0.66 (16.8)	2.50 (63.5)	2.31 (58.7)

Dimensions are shown with Swagelok nuts finger-tight.

① See specifications ISO 7/1, BS 21, DIN-2999, JIS B0203.

Options and Accessories

Stem Packing Materials

Two-piece chevron-style PFA packing is standard. For an optional stem packing, add **-P** for UHMWPE or **-PK** for PEEK to the ordering number. See **Pressure-Temperature Ratings**, page 2, for ratings of valves with optional stem packings. See the table at right for lubricants used with optional stem packing materials.

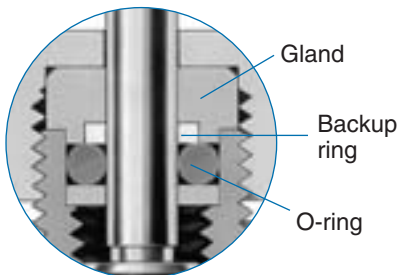
Examples: SS-ORS2-**P**
SS-20KF4-**PK**

Stem Packing Kits

PFA, UHMWPE, and PEEK packing kits are available. Kits contain stem packings, springs, lubricant, and instructions.

Valve Series	Orifice in. (mm)	Stem Packing Material, Kit Ordering Number		
		PFA	UHMWPE	PEEK
O	All	PFA-91K-O	PE-91K-O	PK-91K-O
1	0.172 (4.4)	PFA-91K-14	PE-91K-14	PK-91K-14
	0.250 (6.4)	PFA-91K-16	PE-91K-16	PK-91K-16
18	All	PFA-91K-18	PE-91K-18	PK-91K-28
20	All	PFA-91K-20	PE-91K-20	PK-91K-20
26	All	PFA-91K-16	PE-91K-16	PK-91K-16
Lubricant		Tungsten disulfide and fluorocarbon based	Molybdenum disulfide and hydrocarbon based	Molybdenum disulfide, tungsten disulfide, and fluorocarbon based

O-ring Stem Seals



O-ring stem seals include:

- 316 SS/ASTM A276 gland for 316 SS, steel, and alloy 400 valves, or brass 360 gland for brass valves
- PTFE/ASTM D1710 backup ring and silicone-based lubricant for all O-rings except ethylene propylene, which requires a polyethylene/ASTM D4020 backup ring, and molybdenum disulfide with hydrocarbon-based lubricant
- O-ring.

O-ring Material	Temperature Rating °F (°C)	O-ring Designator	Kit Designator	Kit Basic Ordering Number
Buna C	65 to 250 (53 to 121)	-BC	BC70	-9K-O (O and 20 series) -9K-14 (1 series, 0.172 in. orifice) -9K-16 (1 series, 0.250 in. orifice) -9K-18 (18 series)
Buna N	20 to 250 (28 to 121)	-B	BN70	
Ethylene propylene		-E	EP70	
Fluorocarbon FKM	20 to 450 (28 to 232)	-V	VA70	
Kalrez®		-KZ	KZ70	
Silicone	20 to 250 (28 to 121)	-SI	SI70	

Valves with O-ring Stem Seals

Add an O-ring designator to the ordering number.

Examples: SS-ORS2-**BC**
SS-20KF4-**B**

O-ring Maintenance Kits

Maintenance kits contain O-ring, backup ring, lubricant, and instructions.

To order, add a kit designator to a kit basic ordering number.

Example: **BC70-9K-O**

Handles

- A black phenolic round handle is standard for O and 1 series valves.
- An anodized black aluminum bar handle is standard for 18 series valves.
- An anodized black aluminum knob handle is standard for 20K series valves.
- A 316 SS bar handle is standard for 20V and 26 series valves.

Valves with Optional Handles

Add a handle designator to the ordering number.

Examples:
SS-ORS2-**BLP**
SS-20KF4-**SH**

Handle	Designator	Kit Color Designator
Black phenolic	-BKP	-BK
Blue phenolic	-BLP	-BL
Green phenolic	-GRP	-GR
Orange phenolic	-OGP	-OG
Red phenolic	-RDP	-RD
Yellow phenolic	-YWP	-YW
316 SS bar	-SH	

Sour Gas Service

Integral-bonnet needle valves with female NPT, female ISO, and male NPT end connections are available for sour gas service. Stem and lower gland are alloy 400 or alloy R-405. Materials for wetted components are selected in accordance with NACE Specification MR0175 for sulfide stress cracking-resistant materials.

To order, add **-SG** to the ordering number.

Example: SS-ORF2-**SG**

Special Cleaning and Packaging (SC-11)

To order integral-bonnet needle valves cleaned and packaged in accordance with *Special Cleaning and Packaging (SC-11)* to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C, add **-SC11** to the valve ordering number.

Example: SS-ORS2-**SC11**

⚠ Packing adjustment may be required during the valve's service life.

⚠ Valves that have not been cycled for a period of time may have a higher initial actuation torque.

Safe Product Selection

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Caution: Do not mix or interchange parts with those of other manufacturers.

Handle Kits

Handle kits contain handle and instructions. Select a handle kit ordering number.

For colored phenolic handles, replace **BK** in the ordering number with a kit color designator.

Valve Series	Orifice in. (mm)	Handle Kit Ordering Numbers		
		Black Phenolic	Black Aluminum Bar	316 SS Bar
O	All	PH-5K-OK-BK	A-5K-14B-BK	SS-5K-14B
1	0.172 (4.4)	PH-5K-14K-BK		
	0.250 (6.4)	PH-5K-4K-BK	A-5K-6NB-BK	SS-5K-6NB
18	All	PH-5K-7K-BK	A-5K-18B-BK	SS-5K-7B
20	All	PH-5K-14K-BK		SS-5K-14B
26	All	PH-5K-4K-BK		SS-FK-6NB

Example: PH-5K-OK-**BL**

To order an anodized black aluminum knob handle kit for the 20K series valve, use ordering number **A-5S-20K-BK**.

Oxygen Service

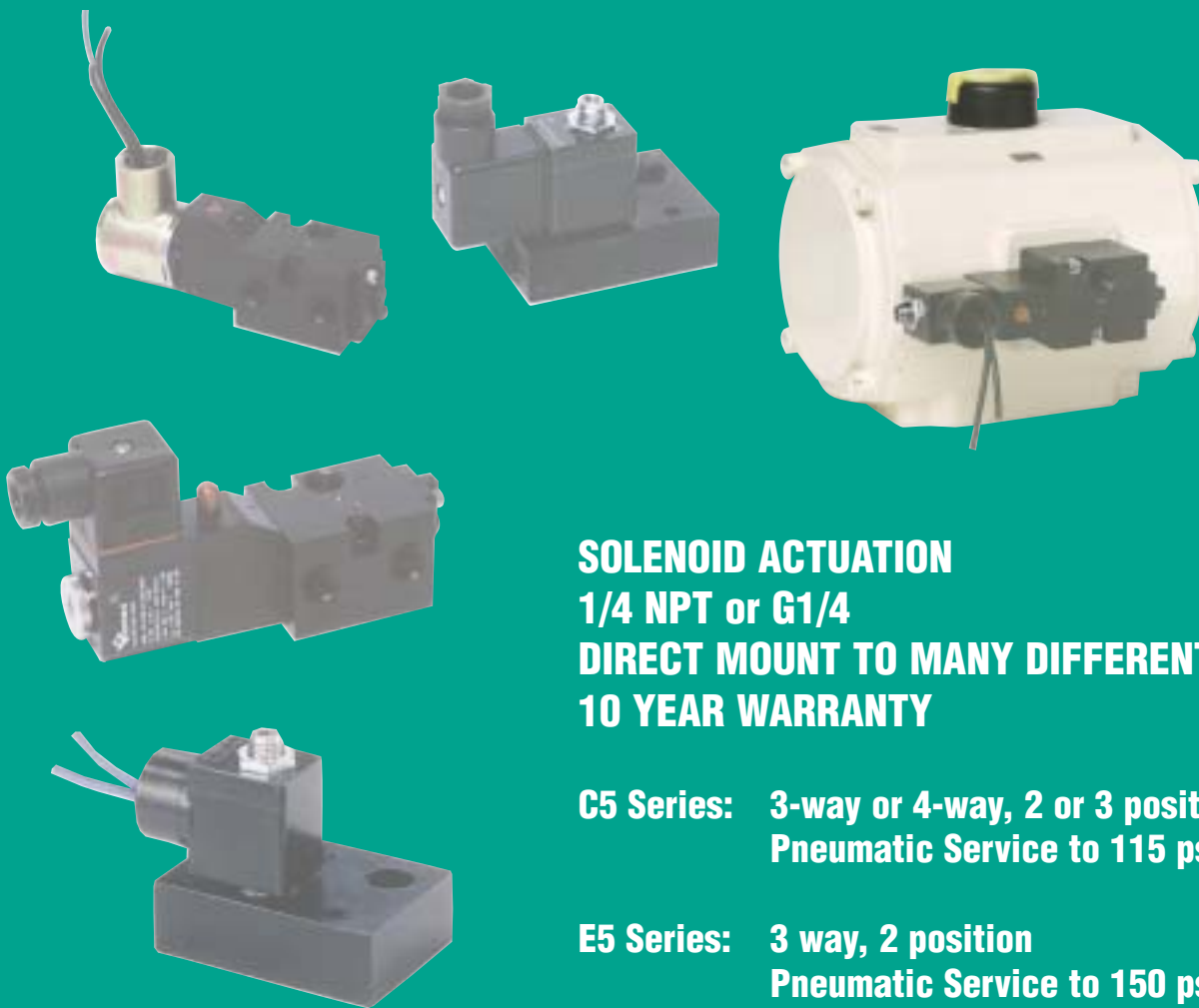
For more information about hazards and risks of oxygen-enriched systems, see the Swagelok *Oxygen System Safety* technical report.

NAMUR DIRECT MOUNT PNEUMATIC ACTUATOR VALVES

VERSA[®]

BULLETIN
NMce-2001

AIR VALVES FOR INDUSTRY SINCE 1949



SOLENOID ACTUATION

1/4 NPT or G1/4

DIRECT MOUNT TO MANY DIFFERENT ACTUATORS
10 YEAR WARRANTY

C5 Series: 3-way or 4-way, 2 or 3 position
Pneumatic Service to 115 psi (8 bar)

E5 Series: 3 way, 2 position
Pneumatic Service to 150 psi (10.3 bar)



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DIRECT MOUNT ACTUATOR VALVES

ALUMINUM CONSTRUCTION

SERIES C5 NAMUR

3-Way/4 Way Field Convertible Solenoid Valves

General Description

The Versa C5 NAMUR mount control valve is a high flow, 5-port, solenoid/pilot valve. It is designed to mount directly to any NAMUR actuator, thus reducing actuator response time and cost of tubing, fittings, brackets, and labor. Many adaptor kits are available for non-NAMUR actuators. Consult factory for kit availability.

The 5-port design allows the C5 NAMUR to be ordered as either 4-way (for double acting actuators) or 3-way (for spring return or fail-safe actuators). The function of this valve is field convertible utilizing no special tools, gaskets, or sealants. Relocation of a port plug converts a 3-way to a 4-way, or a 4-way to a 3-way. When the 4-way valve is converted to 3-way function, the unused exhaust port becomes an actuator vent into which a filter/muffler can be installed to prevent contaminants from entering either the valve or the actuator.

Single solenoid models (for 2-position control), or double solenoid models (for 2 or 3-position control) are available. Actuator positioning is possible with the use of 3-position valves since all Versa C5 NAMUR valves are leakfree/bubbletight. A complete selection of electrical connections, area classifications, and

Operating Pressures and Weights

Valve Type	Operating Pressure Range ^{††} Pneumatic	Approximate Weights	
		Ordinary Service	Hazardous Service
Single Solenoid/spring return (2-position)	15-115 psi (1-8 bar)	0.8 lbs. (363 g)	1.1 lbs. (500 g)
Double Solenoid/detented (2-position)	10-115 psi (0.7-8 bar)	1.2 lbs. (545 g)	1.8 lbs. (816 g)
Double Solenoid/spring centered (3-position)	15-115 psi (1-8 bar)	1.2 lbs. (545 g)	1.8 lbs. (816 g)

†† Pressure ranges may change based on solenoid option.

See page 4.

MPa = $\frac{\text{bar}}{10}$

For higher pressure applications, consult factory.

power requirements makes the most exacting and demanding specifications or applications easy to satisfy. Manual overrides (guarded-push to operate) are standard on all C5 NAMUR valves. Consult factory for other manual overrides available as an option.

Materials

Valve body and plunger: anodized aluminum (for stainless steel direct mount valve, consult factory)

Actuating Caps: solenoid—anodized aluminum
spring cap—synthetic resin

Valve seals: plunger and body—FKM (fluorocarbon)
pilot piston—NBR (nitrile)

valve/actuator mounting O rings—NBR (nitrile)

Pilot Piston: synthetic resin

Screws: stainless steel (except valve to actuator = carbon steel)

Port plug: brass

Solenoid parts: sleeve, plunger & spring—304 & 430F stainless steel

coils—epoxy encapsulated with 3 spade terminals (std) or 2 or 3 wire lead (opt)

coil cover—(when applicable) option:—C50 = carbon steel, painted;

—LB—XN, —LB—XX, —PC, —PC—XN,

—PC—XX, —XN, —XX= carbon steel,

zinc chromate plated

Porting Size

Inlet and exhaust — 1/4 NPT or G1/4

Cylinder ports — O ring seal per NAMUR standard (For non-NAMUR actuators, consult factory)

Installation, Filtration and Lubrication

Valves have no limitations on mounting orientation.

40 to 50 micron filtration and general purpose lubricating oil ISO, ASTM viscosity grade 32 recommended.

Ambient temperature range 5°F (15°C) to 125°F (50°C).

Flow Rates

Cv = 0.75 (Kv = 11) average for all ports (48 SCFM at 100 psi; 82 Nm³/h at 7 bar).

For actuator speed rates see page 4.

Options Suffix

Manual Override: none Standard on basic valves, guarded-push to operate.

All other options see page 4.

C5 NAMUR Valve Product Number Selector

Basic Valve Number*							
FUNCTION**	PORT SIZE	Cv (Kv)	SINGLE SOLENOID/SPRING RETURN, 2 POSITION	DOUBLE SOLENOID/ DETENT, 2 POSITION	DOUBLE SOLENOID/SPRING CENTERED, 3 POSITION		
					Blocked Center	Exhaust Ports Open	
4-way 5/2 & 5/3	1/4 NPT G1/4	.75 (11)	CGS-4232-NB1 -†- (coil code)	CGG-4232-NB1 -†- (coil code)	CXX-4233-NB1 -†- (coil code)	CXX-4234-NB1 -†- (coil code)	
		.75 (11)	CGS-4292-NB1 -†- (coil code)	CGG-4292-NB1 -†- (coil code)	CXX-4293-NB1 -†- (coil code)	CXX-4294-NB1 -†- (coil code)	
3-way** 3/2 & 3/3	1/4 NPT G1/4	.75 (11)	CGS-3232-NB1 -†- (coil code)	CGG-3232-NB1 -†- (coil code)	CXX-3233-NB1 -†- (coil code)	CXX-3234-NB1 -†- (coil code)	
		.75 (11)	CGS-3292-NB1 -†- (coil code)	CGG-3292-NB1 -†- (coil code)	CXX-3293-NB1 -†- (coil code)	CXX-3294-NB1 -†- (coil code)	

* All valves include O ring interface seals and #10-24 mounting screws.

For #10-32 screws change NB1 to NB2. For M5 screws change NB1 to NB3.

** 3-way is the same valve as 4-way, but is provided with a relocated cylinder port plug. See note on page 4

For coil code see page 4.

† Add suffix option here, if required.

SERIES E5 NAMUR

3-Way Solenoid Valves

General Description

The Versa E5 NAMUR mount control valve is an inexpensive, simple and effective 3-way direct-acting solenoid valve. It is designed to mount directly to any NAMUR actuator thus reducing cost of tubing, fittings, brackets and labor.

It is most effective on spring return or fail-safe actuators where high speed open or close is not important, but where cost is a factor. A threaded actuator vent port is standard.

Available as a 3-way, 2-position, direct solenoid, spring return only, and with most of the Versa solenoid options. See page 4.

Materials

Valve body: anodized aluminum
Valve seals: body/plunger — NBR (nitrile)
valve/actuator mounting O rings — NBR (nitrile)

Screws: (valve to actuator) = carbon steel

Solenoid parts: sleeve, plunger & spring— 304 & 430F stainless steel
coils—epoxy encapsulated with 3 spade terminals (std) or 2 or 3 wire lead (opt)
coil cover— (when applicable) option:—C50 = carbon steel, painted;
—LB—XN, —LB—XX,—PC,—PC—XN,
—PC—XX, —XN,—XX= carbon steel, zinc chromate plated

Operating Pressures and Weights

Valve Type	Operating Pressure Range Pneumatic	Approximate Weights	
		Ordinary Service	Hazardous Service
Single Solenoid/spring return (2-position)	0-150 psi (0-10.3 bar)	0.6 lbs. (272 g)	0.9 lbs. (408 g)

Porting Size

Inlet and Vent -1/4 NPT or G1/4
Exhaust -#10-32 (1/8 NPT or G1/8 available)
Cylinder ports -O ring seal for NAMUR standard
(For non-NAMUR actuators, consult factory)

Installation, Filtration and Lubrication

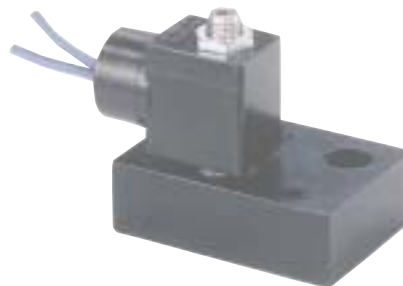
Valves have no limitations on mounting orientation.
40 to 50 micron filtration and general purpose lubricating oil ISO, ASTM viscosity grade 32 recommended.
Ambient temperature range 5°F (15°C) to 125°F (50°C).

Flow Rates

$C_v = 0.08$ ($K_v = 1.2$) average for all ports
(5 SCFM at 100 psi; 8.5 Nm³/h at 7 bar).
For actuator speed rates see page 4.

Options

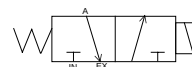
See page 4.



E5 NAMUR Valve

Product Number Selector

			Basic Valve Number*
FUNCTION	PORT SIZE	Cv (Kv)	SINGLE SOLENOID/SPRING RETURN 2-POSITION
3-way	1/4 NPT	.08 (1.2)	E5SM-3011-34-NB1 -† (coil code)
3/2	G1/4	.08 (1.2)	E5SM-3071-34-NB1 -† (coil code)



For coil code see page 4.
† Add suffix option here, if required.

* All valves include O ring interface seals and #10-24 mounting screws.
For #10-32 screws change NB1 to NB2.
For M5 screws change NB1 to NB3.

DIRECT MOUNT ACTUATOR VALVES

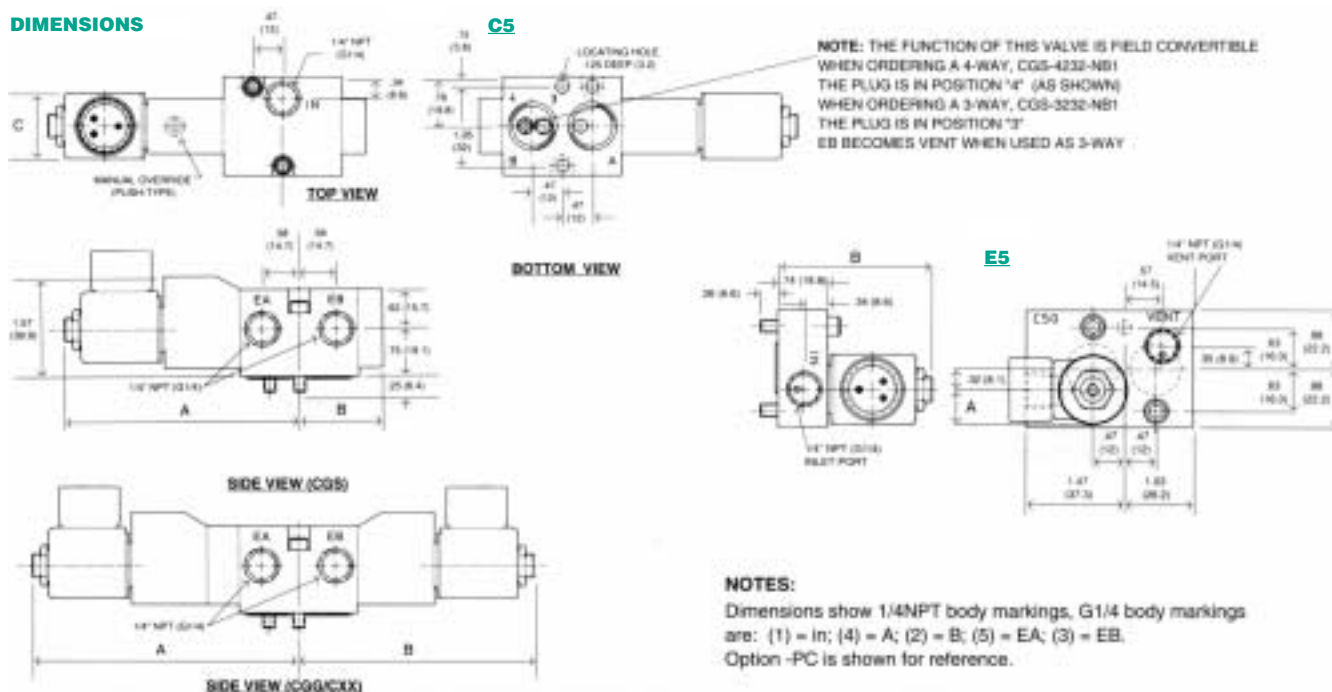
			VOLTAGES & COIL CODES**				
NAMUR OPTIONS			VALVE TYPE				NOMINAL COIL POWER
DESCRIPTION		SUFFIX DETAIL*	C5		E5		
NON-HAZARDOUS SERVICE	Spade Terminals (standard)	None					AC=8.5 W DC=10.5 W
	Strain Relief mini-DIN type connector, cord grip PG9	-HC					
	1/2 NPT conduit mini-DIN type connector	-HCC					
	1/2 NPT conduit, watertight, NEMA 4	-228L	110V50 (E110)	120V60 (A120)	24VDC (D012)	24VDC (D024)	
	1/2 NPT conduit, general purpose, NEMA 1,2,3	-C50	220V50 (E220)	240V60 (A240)	48VDC (D048)		AC=6 W DC=7 W
	1/2 NPT conduit, watertight, NEMA 4 & 4X	-PC	240V50 (E240)				
HAZARDOUS SERVICE	Flameproof, 1/2 NPT conduit, NEMA 7 & 9, UL listed, CSA approved	-XX	110V50 (E110)	120V60 (A120)	24VDC (D012)	24VDC (D024)	AC=5.6 W DC=7.2 W
	-watertight, dusttight, NEMA 4, 4X, 7 & 9, UL listed, CSA approved	-PC-XX	220V50 (E220)	240V60 (A240)	48VDC (D048)		
	Flameproof, M20x1.5 conduit, Zone 1 & 2		240V50 (E240)				
	INIEC approved per CENELEC, IP66	-XN					
	Flameproof, low power, 1/2 NPT conduit, NEMA 7 & 9, UL listed	-LB-XX	12V60 (A012)	6VDC (D006)	12VDC (D012)		AC or DC =1.8 W
	Flameproof, low power, M20x1.5 conduit, Zone 1 & 2 INIEC approved per CENELEC, IP66	-LB-XN	24V60 (A024)	24VDC (D024)	48VDC (D048)		
			120V60 (A120)	120VDC (D120)			
	Intrinsically safe, strain relief mini-DIN type connector, cord grip PG 9	-XISP	24VDC (D024)	not available			DC=1.6 W max
	-Factory Mutual/CSA approved		system voltage prior to barrier				
	-PTB approved per CENELEC						

* Add option number to basic valve number as suffix.

** Add coil code# to end of valve number.

For other options, voltages, or Versa's Direct Mount NAMUR Subplate for 1/4" brass V Series, please consult factory.

DIMENSIONS



NAMUR DIMENSIONS: INCHES (mm)												
Valve Type	Solenoid Option											
	Standard, -228L			-027, -043			-C50, -PC			-XX, -XN		
	A	B	C	A	B	C	A	B	C	A	B	C
CGS	3.71 (94.2)	1.31 (33.3)	.885 (22.5)	3.45 (87.6)	1.31 (33.3)	.875 (22.2)	3.71 (94.2)	1.31 (33.3)	1.04 (26.4)	3.79 (96.3)	1.31 (33.3)	1.45 (36.8)
CGG/CXX	4.21 (106.9)	3.71 (94.2)	.885 (22.5)	3.96 (100.6)	3.45 (87.6)	.875 (22.2)	4.21 (106.9)	3.71 (94.2)	1.04 (26.4)	4.29 (109.0)	3.79 (96.3)	1.45 (36.8)

NAMUR DIMENSIONS: INCHES (mm)						
Valve Type	Solenoid Option					
	STANDARD, -228L		-C50, -PC		-XX, -XN	
	A	B	A	B	A	B
E5	.44 (11.2)	2.31 (58.7)	.52 (13.2)	2.31 (58.7)	.73 (18.4)	2.39 (60.7)

ACTUATOR VOLUME in ³ (cm ³)										
Valve Type	5 (82)	10 (164)	25 (410)	50 (820)	100 (1640)	150 (2460)	200 (3280)	400 (6560)	600 (9840)	1000 (16400)
ACTUATOR CYCLE TIME IN SECONDS										
C5	.32	.36	.47	.63	.98	1.3	1.7	3.1	4.5	7.2
E5	.46	.64	1.1	2.0	3.9	5.7	7.5	--	--	--

The above chart represents approximate actuator operation times under average load conditions at 80 psi (5.5 bar). Due to differing designs of quarter-turn actuators, breakaway friction, loading, internal airflow, inlet piping, fittings and exhaust port options, the values shown are intended as an estimate. Faster or slower times may actually be achieved.

For double-acting actuators (open & close), use volumes from selected actuator specifications and the chart for estimated speed. The times indicated are per shift. For spring return actuators, use open volume to obtain time from chart. Actuator spring loading may affect shift time.

Slower speeds (adjustable) can always be accomplished by using Versa's Bleed Control Valves in the control valve exhaust port.

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Apollo® 76-100 Series

Stainless Steel Ball Valve

Threaded, 1/4" to 1" 2000 psig WOG, 1-1/4" to 2" 1500 psig WOG, 2-1/2" to 3" 1000 psig WOG
Cold Non-Shock. 150 psig Saturated Steam, Vacuum Service to 29 inches Hg.
Federal Specification: WW-V-35C, Type: II, Composition: SS, Style: 3.

FEATURES

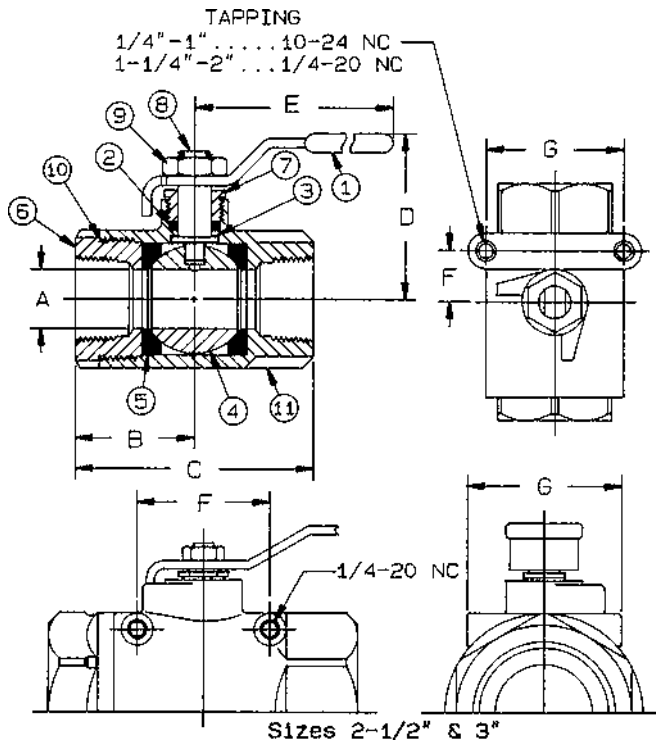
- Investment cast components
- RPTFE seats and stuffing box ring
- Mounting pad for easy actuator mounting
- Blow-out-proof stem design
- Adjustable packing gland
- Meets NACE MR-01-75
- SS lever and nut
- (-24) 1/4" to 2" Certified to API 607, 4th Edition, Class 600 burn

STANDARD MATERIAL LIST

1. Lever and grip	304 SS w/vinyl	7. Gland nut	A276-316
2. Stem packing	RPTFE	8. Stem	A276-316
3. Stem bearing	RPTFE	9. Lever nut	18-8 SS
4. Ball	A276-316	10. Body seal	PTFE
5. Seat (2)	RPTFE	(1-1/4" to 3")	
6. Retainer	A276-316 (1/4" to 1") A351-CF8M (1-1/4" to 3")	11. Body	A351-CF8M

OPTIONS AVAILABLE:

(SUFFIX)	OPTION	SIZES
-02-	Static Grounded	1/4" to 3"
-03-	1-1/4" Stem Extension	1/4" to 3"
-04-	2-1/4" Stem Extension	1/4" to 3"
-07-	Tee Handle	1/4" to 2"
-08-	90° Reversed Stem	1/4" to 3"
-14-	Vented Ball (see page J-2)	1/4" to 2"
-15-	Round Handle	1/4" to 2"
-16-	Vertical Chain Lever	3/4" to 2"
-19-	Lock Plate	1/4" to 2"
-21-	UHMWPE Seats (Non-PTFE)	1/4" to 3"
-24-	Graphite Stem Packing	1/4" to 3"
-27-	Latch Lock Lever	1/4" to 3"
-30-	CamLock Handle	1/4" to 2"
-32-	SS Tee Handle & Nut	1/4" to 2"
-35-	PTFE Trim	1/4" to 3"
-39-	SS Latch Lock Wheel Handle	1/4" to 2"
-40-	Cyl-Loc	1/4" to 2"
-44-	Seal Welded	1/4" to 2"
-45-	Less Lever & Nut	1/4" to 3"
-46-	Latch Lock Lever - Lock Close Only	1/4" to 3"
-47-	SS Latch Lock Oval Handle	1/4" to 1"
-48-	SS Oval Handle	1/4" to 2"
-49-	Assembled Dry	1/4" to 3"
-50-	2-1/4" Locking Stem Extension	1/4" to 3"
-57-	Cleaned For Gaseous Oxygen	1/4" to 3"
-58-	Horizontal Chain Lever	3/4" to 2"
-60-	Static Grounded Ball & Stem	1/4" to 3"
-64-	250 Lb. Steam Trim	1/4" to 3"
-P01-	BSPP (Parallel) Thread Connection	1/4" to 3"
-T01-	BSPT (Tapered) Thread Connection	1/4" to 3"



STAINLESS STEEL BALL VALVE

NUMBER	SIZE	A	B	C	D	E	F	G	Wt.
76-101-01	1/4"	.37	1.03	2.06	1.75	3.87	.50	1.12	.58
76-102-01	3/8"	.37	1.03	2.06	1.75	3.87	.50	1.12	.54
76-103-01	1/2"	.50	1.12	2.25	1.81	3.87	.50	1.12	.63
76-104-01	3/4"	.68	1.50	3.00	2.12	4.87	.87	1.37	1.27
76-105-01	1"	.87	1.68	3.37	2.25	4.87	.87	1.37	1.63
76-106-01	1-1/4"	1.00	2.00	4.00	2.62	5.50	.93	1.50	3.06
76-107-01	1-1/2"	1.25	2.18	4.37	3.05	8.00	.93	1.50	4.04
76-108-01	2"	1.50	2.75	5.50	3.24	8.00	.93	1.50	6.05
76-109-01	2-1/2"	2.50	3.37	6.75	4.12	8.00	2.75	3.37	15.57
76-100-01	3"	2.50	3.37	6.75	4.12	8.00	2.75	3.37	16.79

**For Pressure/Temperature Ratings,
Refer to Page N-15, Graph No. 14 (1/4"
to 1")
Refer to Page N-14, Graph No. 12
(1-1/4" to 2")
Refer to Page N-12, Graph No. 8
(2-1/2" to 3")**

Compactorque Pneumatic Actuators

(Corrosion Protection)

Specification

The Apollo® CompacTorque™ actuator is pneumatically operated and travels a minimum of 90 degrees in each direction and has internal and external travel stops to provide for + or - 4 degrees adjustment on a 90 degree stroke. The actuator is totally enclosed with no external moving parts. All pneumatic passageways are integral to the actuator housing so as to eliminate the need for external tubing. All solenoid mounting conforms to NAMUR specifications to permit direct mounting of a wide variety of solenoid valves. CompacTorque™ actuators are rack and pinion design; the output torque is linear throughout the travel and designed for pneumatic operation up to a maximum pressure of 142 psig (10 bar).

CompacTorque™ actuators are able to operate with other media such as hydraulic oil or water⁽¹⁾. All double acting and spring return units are suitable for both on/off and throttling applications.

Spring return units are dimensionally the same as double acting units, which saves space and weight.

The actuator is supplied with the following as standard:

- External end of travel adjustments integral with the end caps.
- One piece output pinion manufactured of high strength steel and electroless nickel coated for corrosion protection. NAMUR slotted connection
- Replaceable splined adapter to accommodate custom shaft connections. Size 030 thru 080 only
- Pistons and pinion that have a Nylon 4-6 bearing pad and rings, which extends the life of the actuator and reduces friction
- Corrosion resistant polyester powder coated end caps
- Hard anodized aluminum housing
- All fasteners are 304 stainless steel
- Permanently lubricated nitrile seals
- Self contained spring cartridges, heat treated and polyester powder coated for corrosion protection, that ensure safe disassembly
- Yellow chromate coated pistons and endcaps for internal corrosion resistance

The Apollo® CompacTorque™ Universal Shaft Adapter (U.S.A.)

Apollo® CompacTorque™ introduces the newest design concept in actuators, the Universal Shaft Adapter (U.S.A.). The universal shaft adapter concept, was designed and manufactured with ease of actuator mounting in mind. The actuator incorporates the use of a replaceable splined adapter instead of a drive shaft connection with a fixed machined dimension and configuration. ISO 5211 - DIN 3337 configuration can be obtained by indexing insert 45 degrees from parallel. Inserts with other shaft connections and configurations are available. Optional stainless steel inserts are available. Available on CT30 and larger actuators.

Hard Anodized Protection

Hard Anodic oxidation is an electrolytic conversion process which forms an oxide film approximately one half of the total depth of the entire hard anodizing process. Continuation of this process produces the "hard" anodic coating to approximately 2 mils (50 microns). The oxide coating is integral with the base substrate and is one of the hardest materials known with a hardness of corundum (45 to 65 Rockwell C).

EPC 316

Apollo® CompacTorque Numbering System

3 T X - X X - X X - X						
	0- Std. (Protection A)	Size	Option	Spring Set	Less One Spring Imbalance	Rev. Level
D - Double Acting	1- ENC(Protection C)	1	0-Nitrile (Std.)	0	0	A-Standard
	2- Seal Kit		-20°F to +250°F			B-Without Universal
S - Spring Return	3- Spring Kit	2	1-Viton	2	3	Shaft Adapter*
			32°F to +350°F			
K - Kit	4- Indicator Kit	3	2-Low Temp. Nitrile	3	4	M-Metric*
	5- Stop Kit	4	-50°F to +250°F	4	5	Z-Special**
	6- Polyester Powder Coated (Protection B)***	5	3-Neoprene	5	6	
		6		6		
	7- Stainless Steel Epoxy Coated (Protection D)	65				
		7				
	8- Stainless Steel Epoxy Coated 316 SS Pinion (Protection E)	8				
		9				
	G- Red End Caps (Protection A)	A				
	H- Blue End Caps (Protection A)					
	J- Black End Caps (Protection A)					

(1) Water should be properly filtered and inhibited to prevent corrosion and biological fouling.

* Select one USA (Universal Shaft Adapter) from selection chart

** Select one USA, specify bolt pattern on bottom of Actuator

*** Specify if Polyester Coating is Yellow, Red, Blue or Black

Fail open (Reverse Rotation) CW Open

Add letter 'F' to end of part number

Example: 3TS06060AF

Compactorque Pneumatic Actuators

(Corrosion Protection)

EPC 316 is a FDA Epoxy Powder pigmented with 316L stainless steel flakes applied by an electrostatic spray finishing process on a super clean surface. After application the pieces must be cured at 350°F (177°C). With a normal thickness of 3.0 - 4.0 mils (76-102 microns) of EPC 316 coating, resistance to salt spray in accordance with ASTM B-117 exceeds 2000 hours and has a pencil hardness of 2H as per ASTM D-3363.

Electroless Nickel Coating

Nickel deposits are produced by chemical reduction of nickel into catalytic metallic or catalyzed nonmetallic substrates without the use of electricity. Total "as plated" thickness is the same shape of the surface; therefore, close tolerances (within 20 to 30 microns) can be maintained. Normal hardness averages about 49 Rockwell C.

Polyester Powder Coating

Apollo® CompacTorque™ uses only the most modern thermosetting polyester powder coating resin. When subjected to elevated temperatures, these coatings melt, flow, and chemically cross link within themselves or with other reactive components to form a higher molecular weight reaction product. This resin system can produce thin paint like surface coatings in the 1 to 3 mil thickness range (25 to 76 microns) having a 2H pencil hardness as per ASTM D3363 and a salt spray resistance of 1000 hours in accordance with ASTM B117. Unlike epoxy coatings, polyester powder coatings offer excellent resistance to UV rays.

3T Series Valve Mounting Configuration

The 3T series actuator family utilizes an ISO 5211 mounting bolt pattern for the attachment of valve mounting brackets. Conbraco has been utilizing ISO 5211 mounting configurations since 1990. Therefore, there exists an extensive selection of engineered stainless steel brackets for the 3T series. The variety of valve and actuator combinations is so extensive that mounting kit identification is provided in a separate document (Mounting Kit Selection Guide). Many of the 3T series actuators have multiple mounting bolt patterns (see dimensions w-w1-w2 on the 3T series dimensional drawings). These alternate bolt patterns may be used as attachment points to brackets that have not been supplied by Conbraco or the automation of other manufacturer's valves. This flexibility of bracket attachment is provided so that the actuator can be used to automate any device that requires 90 degrees or less rotary motion and fits within the torque profile available from the actuator.

Universal Shaft Adapters			
NUMBER	CONBRACO DESCRIPTION	NUMBER	CONBRACO DESCRIPTION
CX01605	ADAPTER, 11MM SQ, 3T030/STD. REV. A	CX01637	ADAPTER, 19MM SQ, 3T060/STD. REV. A
CX01458	ADAPTER, 11MM SQ, 3T030, SS	CX01638	ADAPTER, 22MM SQ, 3T065/STD. REV. A
CX01606	ADAPTER, 14MM SQ, 3T030	CX01696	ADAPTER, 22MM SQ, 3T070/STD. REV. A
CX01614	ADAPTER, 14MM SQ, 3T040/STD. REV. A	CX03313	ADAPTER, 22MM SQ, 3T070/SS
CX01493	ADAPTER, 14MM SQ, 3T040/3T050, SS	CX01718	ADAPTER, 27MM SQ, 3T080/STD. REV. A
CX01615	ADAPTER, 17MM SQ, 3T040/3T050	CX03314	ADAPTER, 27MM SQ, 3T080, SS
CX01494	ADAPTER, 17MM SQ, 3T040/3T050, SS	CX01604	ADAPTER, BLANK, 3T030
CX01616	ADAPTER, 19MM SQ, 3T050/STD. REV. A	CX01486	ADAPTER, BLANK, 3T040/3T050
CX01495	ADAPTER, 19MM SQ, 3T040/3T050, SS	CX01636	ADAPTER, BLANK, 3T060/3T065
		CX01695	ADAPTER, BLANK, 3T070
		CX01717	ADAPTER, BLANK, 3T080

Butterfly/Actuator Mounting Kit Chart for ISO Drilling (B) - CarbonSteel/Zinc Plated Hardware									
141/143 Series Adapter Numbers [Double "D"]									
2		CX03447	CX03447	CX03450	CX03450	CX03454			
2.5		CX03447	CX03447	CX03450	CX03450	CX03454			
3		CX03447	CX03447	CX03450	CX03450	CX03454			
4		CX03448	CX03448	CX03451	CX03451	CX03455			
5			CX03449	CX03452	CX03452	CX03456			
6			CX03449	CX03452	CX03452	CX03456			
8				CX03453	CX03453	CX03457	CX03459		
10						CX03458	CX03460		
12							CX03461		
14							CX03461		

Apollo® Compactorque Pneumatic Actuators Mounting

Accessory Mounting

The 3T series actuator conforms to NAMUR VDI/VDE 3845 dimensional mounting standards. This insures the greatest compatibility with actuator mounted accessories. Mounting brackets for positioners and limit switches will therefore become standardized. This is a significant advantage to the end user in that it reduces the number of unique parts necessary to support an automation program. Eventually all actuator manufacturers will have to provide their products with NAMUR interface compatibility, the 3T series has it now. Proprietary product uniqueness is sacrificed to provide end users with a recognized international standard mounting arrangement.

Solenoid Mounting

The 3T series actuators also utilize NAMUR standard dimensions for this interface. Like the accessory interface this is an international standard set of dimensions. There are two methods of attaching solenoid control valves to the actuator. The most common is to use a NAMUR style solenoid of the correct designation. This solenoid is attached to the actuator with two 5 mm screws with O-Rings providing the required seals. A single pneumatic supply connection to a NPT threaded port is all that

is required to complete the air line assembly. The less common method is to remote mount the solenoid and connect it to the actuator with tubing and fittings. This configuration is necessary for 3TSOAO & 3TDOAO. The ports in the actuator are tapped with standard NPT pipe threads for this option. Electrical connections to the solenoids can be made in a variety of ways.

The 3TD-010 is so compact that the NAMUR mounting pattern had to be rotated 90°. An adapter has been designed that allows the installation of the Conbraco solenoid in the same orientation as the rest of the product family. To do this the adapter has to perform two tasks. First, it adapts the NAMUR mounting pattern to the Conbraco solenoid. Second, it rotates the solenoid so that the air connections are oriented the same as those on the rest of the product family.

Automated valve cycle time is dependent on many factors associated with each specific installation and is almost impossible to predict accurately. Cycle times of less than one second are generally not recommended. **Fast cycle times reduce seal life and expose the valve and actuator to shock loads that can reduce service life.**

DOUBLE ACTING CHART																				
AIR SUPPLY IN PSIG	ACTUATOR MODEL																			
	3T-010		3T-020		3T-030		3T-040		3T-050		3T-060		3T-065		3T-070		3T-080		3T-090	
40	30	72		130		274		416		650		1075		1409		2771		5198		
60	45	108		194		411		623		975		1613		2114		4155		7797		
80	60	144		259		548		831		1300		2151		2819		5548		10396		
100	74	180		324		685		1039		1625		2689		3524		6929		12995		
120	89	216		389		822		1247		1950		3226		4228		8310		15594		
UNITS	DA	DA	SR	DA	SR	DA	SR	DA	SR	DA	SR	DA	SR	DA	SR	DA	SR	DA	SR	SR
VOLUME CU. INCH**	3	13.4	7.9	27	10.5	37	14	56	21	98	40	159	61	220	92	483	196	855	366	
WEIGHT LB.	1	2.3	2.8	3.4	3.9	6.3	6.9	9.1	10.1	13.4	15.2	19.3	22.4	26.9	30.4	50.4	56.5	97	115	
ACTUATOR SPEED* OPEN/CLOSE SECONDS		.5/.5	.5/.5	.5/.6	.6/.8	.5/.6	.6/.1	.5/.8	.6/.1.2	.7/.8	1/1.2	.8/1	1.1/1.5	1/1	1.2/2	1.2/1.5	2/2.5	3.5/4.5	4.5/6	

*Actuator speed open/close based on 80 psi air at no load condition.

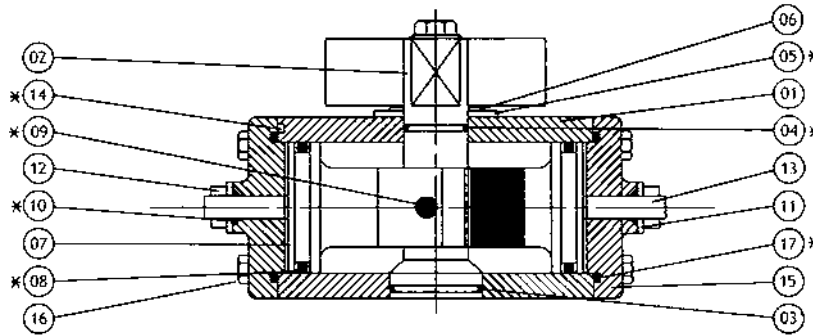
** Air consumption expressed in cubic inches per stroke.

Actuator Model	No. Springs per Piston	SIZING INFORMATION, END TORQUE (LB.-IN.)												Spring Stroke	End																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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		40	50	60	70	80	90	100	110	120	(psig)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
3TS-020-XX	2	45	61	77	97	116	134	151	169	186	21	27	32	38	43	48	53	59	64	69	75	80	86	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305	310	315	320	325	330	335	340	345	350	355	360	365	370	375	380	385	390	395	400	405	410	415	420	425	430	435	440	445	450	455	460	465	470	475	480	485	490	495	500	505	510	515	520	525	530	535	540	545	550	555	560	565	570	575	580	585	590	595	600	605	610	615	620	625	630	635	640	645	650	655	660	665	670	675	680	685	690	695	700	705	710	715	720	725	730	735	740	745	750	755	760	765	770	775	780	785	790	795	800	805	810	815	820	825	830	835	840	845	850	855	860	865	870	875	880	885	890	895	900	905	910	915	920	925	930	935	940	945	950	955	960	965	970	975	980	985	990	995	1000	1005	1010	1015	1020	1025	1030	1035	1040	1045	1050	1055	1060	1065	1070	1075	1080	1085	1090	1095	1100	1105	1110	1115	1120	1125	1130	1135	1140	1145	1150	1155	1160	1165	1170	1175	1180	1185	1190	1195	1200	1205	1210	1215	1220	1225	1230	1235	1240	1245	1250	1255	1260	1265	1270	1275	1280	1285	1290	1295	1300	1305	1310	1315	1320	1325	1330	1335	1340	1345	1350	1355	1360	1365	1370	1375	1380	1385	1390	1395	1400	1405	1410	1415	1420	1425	1430	1435	1440	1445	1450	1455	1460	1465	1470	1475	1480	1485	1490	1495	1500	1505	1510	1515	1520	1525	1530	1535	1540	1545	1550	1555	1560	1565	1570	1575	1580	1585	1590	1595	1600	1605	1610	1615	1620	1625	1630	1635	1640	1645	1650	1655	1660	1665	1670	1675	1680	1685	1690	1695	1700	1705	1710	1715	1720	1725	1730	1735	1740	1745	1750	1755	1760	1765	1770	1775	1780	1785	1790	1795	1800	1805	1810	1815	1820	1825	1830	1835	1840	1845	1850	1855	1860	1865	1870	1875	1880	1885	1890	1895	1900	1905	1910	1915	1920	1925	1930	1935	1940	1945	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075	2080	2085	2090	2095	2100	2105	2110	2115	2120	2125	2130	2135	2140	2145	2150	2155	2160	2165	2170	2175	2180	2185	2190	2195	2200	2205	2210	2215	2220	2225	2230	2235	2240	2245	2250	2255	2260	2265	2270	2275	2280	2285	2290	2295	2300	2305	2310	2315	2320	2325	2330	2335	2340	2345	2350	2355	2360	2365	2370	2375	2380	2385	2390	2395	2400	2405	2410	2415	2420	2425	2430	2435	2440	2445	2450	2455	2460	2465	2470	2475	2480	2485	2490	2495	2500	2505	2510	2515	2520	2525	2530	2535	2540	2545	2550	2555	2560	2565	2570	2575	2580	2585	2590	2595	2600	2605	2610	2615	2620	2625	2630	2635	2640	2645	2650	2655	2660	2665	2670	2675	2680	2685	2690	2695	2700	2705	2710	2715	2720	2725	2730	2735	2740	2745	2750	2755	2760	2765	2770	2775	2780	2785	2790	2795	2800	2805	2810	2815	2820	2825	2830	2835	2840	2845	2850	2855	2860	2865	2870	2875	2880	2885	2890	2895	2900	2905	2910	2915	2920	2925	2930	2935	2940	2945	2950	2955	2960	2965	2970	2975	2980	2985	2990	2995	3000	3005	3010	3015	3020	3025	3030	3035	3040	3045	3050	3055	3060	3065	3070	3075	3080	3085	3090	3095	3100	3105	3110	3115	3120	3125	3130	3135	3140	3145	3150	3155	3160	3165	3170	3175	3180	3185	3190	3195	3200	3205	3210	3215	3220	3225	3230	3235	3240	3245	3250	3255	3260	3265	3270	3275	3280	3285	3290	3295	3300	3305	3310	3315	3320	3325	3330	3335	3340	3345	3350	3355	3360	3365	3370	3375	3380	3385	3390	3395	3400	3405	3410	3415	3420	3425	3430	3435	3440	3445	3450	3455	3460	3465	3470	3475	3480	3485	3490	3495	3500	3505	3510	3515	3520	3525	3530	3535	3540	3545	3550	3555	3560	3565	3570	3575	3580	3585	3590	3595	3600	3605	3610	3615	3620	3625	3630	3635	3640	3645	3650	3655	3660	3665	3670	3675	3680	3685	3690	3695	3700	3705	3710	3715	3720	3725	3730	3735	3740	3745	3750	3755	3760	3765	3770	3775	3780	3785	3790	3795	3800	3805	3810	3815	3820	3825	3830	3835	3840	3845	3850	3855	3860	3865	3870	3875	3880	3885	3890	3895	3900	3905	3910	3915	3920	3925	3930	3935	3940	3945	3950	3955	3960	3965	3970	3975	3980	3985	3990	3995	4000	4005	4010	4015	4020	4025	4030	4035	4040	4045	4050	4055	4060	4065	4070	4075	4080	4085	4090	4095	4100	4105	4110	4115	4120	4125	4130	4135	4140	4145	4150	4155	4160	4165	4170	4175	4180	4185	4190	4195	4200	4205	4210	4215	4220	4225	4230	4235	4240	4245	4250	4255	4260	4265	4270	4275	4280	4285	4290	4295	4300	4305	4310	4315	4320	4325	4330	4335	4340	4345	4350	4355	4360	4365	4370	4375	4380	4385	4390	4395	4400	4405	4410	4415	4420	4425	4430	4435	4440	4445	4450	4455	4460	4465	4470	4475	4480	4485	4490	4495	4500	4505	4510	4515	4520	4525	4530	4535	4540	4545	4550	4555	4560	4565	4570	4575	4580	4585	4590	4595	4600	4605	4610	4615	4620	4625	4630	4635	4640	4645	4650	4655	4660	4665	4670	4675	4680	4685	4690	4695	4700	4705	4710	4715	4720	4725	4730	4735	4740	4745	4750	4755	4760	4765	4770	4775	4780	4785	4790	4795	4800	4805	4810	4815	4820	4825	4830	4835	4840	4845	4850	4855	4860	4865	4870	4875	4880	4885	4890	4895	4900	4905	4910	4915	4920	4925	4930	4935	4940	4945	4950	4955	4960	4965	4970	4975	4980	4985	4990	4995	5000	5005	5010	5015	5020	5025	5030	5035	5040	5045	5050	5055	5060	5065	5070	5075	5080	5085	5090	5095	5100	5105	5110	5115	5120	5125	5130	5135	5140	5145	5150	5155	5160	5165	5170	5175	5180	5185	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Apollo® CompacTorque™ Spring Return (Start Stroke) Torque Ratings

Actuator Model	No. Springs per Piston	SIZING INFORMATION, START TORQUE (LB.-IN.)												Spring Stroke	Spring Start								
		AIR SUPPLY AVAILABLE AT ACTUATOR						(psig)															
		40	50	60	70	80	90	100	110	120	(psig)												
3TS-020-XX	2	52	69	86	106	125	143	160	177	194	30	795	1048	1300	1586	1871	2130	2389	2646	2902	473		
	2/3	47	64	81	100	120	137	155	172	189	37	726	974	1222	1512	1802	2058	2315	2569	2824	593		
	3	42	59	75	95	115	132	149	166	183	44	657	901	1144	1439	1733	1987	2240	2493	2746	712		
	3/4										51			1062	1363	1664	1913	2162	2415	2668	830		
	4				64	85	105	122	139	156	172	58		979	1287	1595	1840	2084	2337	2590	947		
	4/5						100	117	134	150	167	66				1522	1766	2010	2261	2513	2766	1067	
3TS-030-XX	5					95	112	128	145	161	74					1478	1692	1935	2185	2435	2688	1186	
	5/6					90	106	123	139	156	82					1349	1620	1861	2109	2357	2606	1306	
	6					85	101	117	134	150	89					1310	1549	1787	2033	2279	2525	1425	
	2	96	127	157	191	225	256	287	319	350	54		1066	1398	1730	2106	2482	2819	3156	3501	3845	611	
	2/3	88	118	148	182	217	248	278	309	341	68		981	1307	1634	2015	2397	2731	3065	3407	3749	762	
	3	80	109	138	174	209	239	269	300	331	81		895	1217	1538	1925	2311	2642	2973	3313	3652	912	
3TS-040-XX	3/4										94					1442	1834	2226	2554	2882	3219	3556	1063
	4										107					1346	1743	2140	2465	2790	3125	3460	1213
	4/5										121												1368
	5										135												1522
	5/6										148												1673
	6										161												1823
3TS-050-XX	2	208	273	337	410	482	548	614	681	747	118		2091	2744	3396	4127	4858	5528	6198	6871	7543	1177	1777
	2/3	191	255	318	392	465	531	596	662	728	148		1920	2562	3204	3946	4687	5351	6015	6683	7351	1469	1969
	3	174	237	299	374	448	513	578	644	709	177		1749	2381	3012	3764	4516	5174	5832	6495	7158	1761	2261
	3/4										207												2058
	4										236												2354
	4/5										266												2646
3TS-060-XX	5										296												2938
	5/6										326												3235
	6										355												3531
	2	319	417	515	626	736	837	937	1039	1141	185		3889	5127	6365	7723	9080	10333	11586	12851	14115	2230	2788
	2/3	295	391	488	600	712	811	911	1012	1114	231		3563	4771	5979	7367	8755	9996	11237	12493	13749	15005	2346
	3	270	365	460	574	687	786	885	986	1086	277												3346
3TS-070-XX	3/4										323												3904
	4										369												4461
	4/5										415												5019
	5										461												5576
	5/6										507												6134
	6										553												6691
3TS-080-XX	2	491	644	796	967	1138	1296	1454	1614	1774	280												1186
	2/3	452	602	752	925	1098	1255	1412	1570	1729	350												1469
	3	412	560	707	883	1058	1214	1369	1527	1684	419												1969
	3/4										489												2469
	4										558												2969
	4/5										628												3469
3TS-090-XX	5										697												3969
	5/6										767												4469
	6										836												4969
	2	491	644	796	967	1138	1296	1454	1614	1774	280												1186
	2/3	452	602	752	925	1098	1255	1412	1570	1729	350												1469
	3	412	560	707	883	1058	1214	1369	1527	1684	419												1969
3TS-100-XX	3/4										489												2469
	4										558												2969
	4/5										628												3469
	5										697												3969
	5/6										767												4469
	6										836												4969

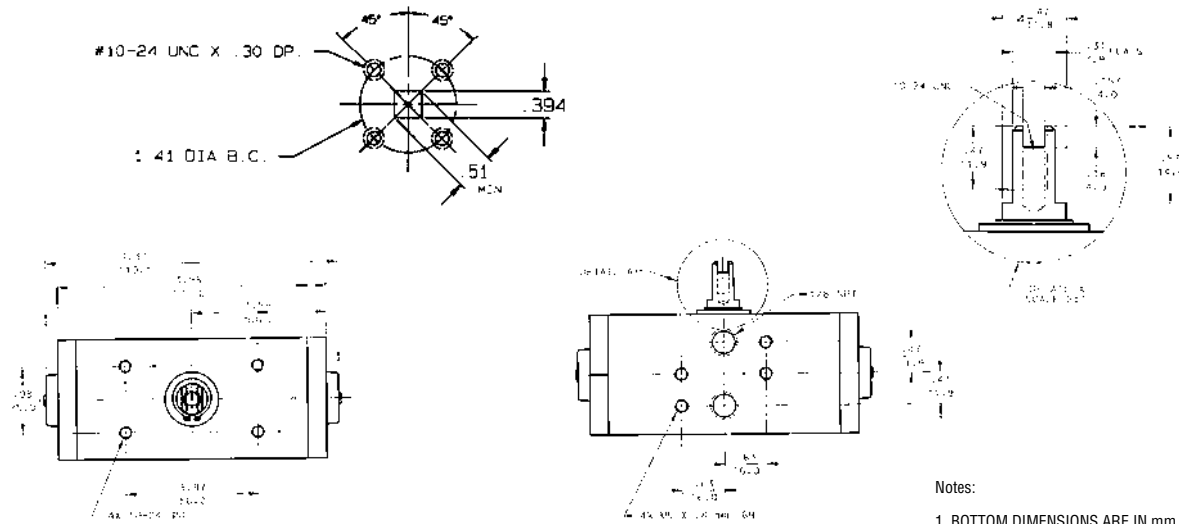
Apollo® CompacTorque™ 3TD-010-00A



** Suggested spare parts; Included in repair kit
Factory lubricated with Whitmore Matrix EP grease
Rebuild with calcium sulfonate grease or lithium
complex grease*

Actuator Temperature Limits

Nitrile (Buna) seals: -20°F to +200°F



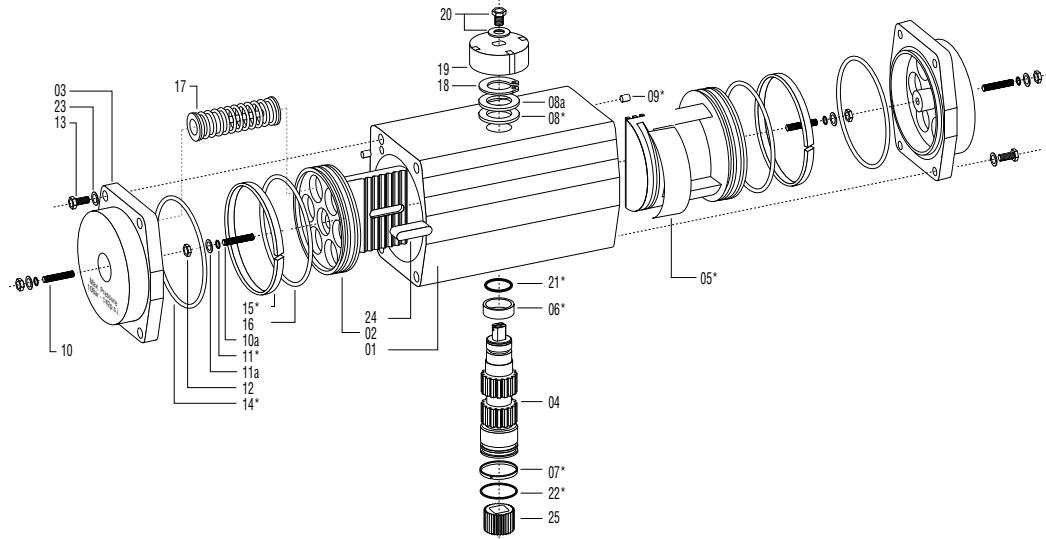
AIR SUPPLY PSIG	40	50	60	70	80	90	100	120
TORQUE Lb. In.	29.3	36.6	44	51.3	58.6	66	73.3	88

3TD-010-00A Parts List

ITEM	DESCRIPTION	MATERIAL	TREATMENT	UNIT QTY.
1	Body	Extruded Aluminum Alloy	Hard Anodized	1
2	Pinion	High Strength Alloy Steel	Nickel Plated	1
*3	O-Ring (Lower Pinion)	Nitrile (Buna-N)	N/A	1
*4	O-Ring (Upper Pinion)	Nitrile (Buna-N)	N/A	1
*5	Thrust Bearing (Pinion)	Nylon 4-6	N/A	1
6	Retaining Ring (Pinion)	Stainless Steel	N/A	1
7	Piston	Die Cast Aluminum	N/A	2
*8	O-Ring (Piston)	Nitrile (Buna-N)	N/A	2
*9	Bearing (Piston)	Nylon 4-6	N/A	2
*10	O-Ring (Adjustment Screw)	Nitrile (Buna-N)	N/A	2
11	Washer (Adjustment Screw)	Stainless Steel	N/A	2
12	Nut (Adjustment Screw)	Stainless Steel	N/A	2
13	Adjustment Screw	Stainless Steel	N/A	2
14	Left End Cap	Die Cast Aluminum	Powder Coat	1
15	Right End Cap	Die Cast Aluminum	Powder Coat	1
16	Screw (End Cap)	Stainless Steel	N/A	8
*17	O-Ring (End Cap)	Nitrile (Buna-N)	N/A	2

*Suggested spare parts; Included in repair kit (3TK-210-00).

Materials of Construction and Operation



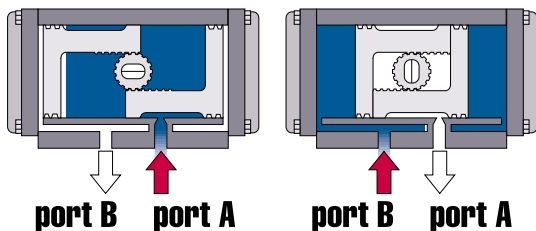
CompacTorque Part Number Designations

Part #	Unit Qty.	Part Description	Material	Specifications	Optional Materials	Protection
01	1	Body	Extruded aluminum alloy	ASTM 6063 T6		A, B, C, D, E, F
02	2	Piston	Aluminum	ASTM B179-DIN 1725/5		
03	2	End caps	Aluminum alloy	ASTM B179-DIN 1725/5		C, D, E, F
04	1	Drive shaft	Steel alloy	AISI 1144	SS	Nickel plated
05*	2	Bearing (piston back)	Nylon 46			
06*	1	Bearing (pinion top)	Nylon 46			
07*	1	Bearing (pinion bottom)	Nylon 46			
08*	1	Thrust bearing (pinion)	Polyphthalamide (PPA)			
08a	1	Thrust washer (pinion)	SS	AISI 304		
09*	2	Plug (transfer port)	Nitrile (NBR)		For extreme temperature	
10	2	Screw (ext. stroke adj.)	SS	18-8		
10a	1	Screw (int. stroke adj.)	SS	18-8		
11*	4	O-Ring (screw seal)	Nitrile (NBR)		For extreme temperature	
11a	4	Washer (seal)	SS	AISI 304		
12	4	Nut (stop adjustment)	SS	18-8		
13	8	Cap screw (end cap)	SS	18-8		
14*	2	O-Ring (end cap)	Nitrile (NBR)		For extreme temperature	
15*	2	Bearing (piston head)	Nylon 46			
16*	2	O-Ring (piston head)	Nitrile (NBR)		For extreme temperature	
17	12 (max)	Spring (cartridge)	High alloy spring steel			Polyester powder coating
18	1	Spring clip (pinion)	High alloy spring steel			Nickel plated
19**	1	Position indicator	Polyamide			
20**	1	Cap screw/washer	SS	18-8		
21*	1	O-Ring (pinion top)	Nitrile (NBR)		For extreme temperature	
22*	1	O-Ring (pinion bottom)	Nitrile (NBR)		For extreme temperature	
23	8	Washer (cap screw)	SS	18-8		
24***	2	Piston guide	Polyphthalamide (PPA)			
25	1	Universal shaft adapter	Sintered metal	FLN-4205-40	SS	

NOTES: (1) *Suggested spare parts; included in repair kit. Factory lubricated w/Whitmore Matrix EP grease. Rebuild with calcium sulfonate grease or lithium complex grease. Actuator temp. limits: Nitrile (BUNA) seals: -20°F to +200°F (2) ** Optional. (3) Model OAO Part No. 23 and 13 unit quantity is 12 pieces. (3) *** 3T 010 thru 3T 060 is cast onto piston

Diagram 3

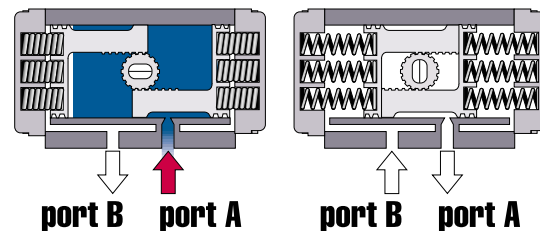
Double-Acting (TOP VIEW)



port B port A
Air supplied to port A forces pistons apart and toward end positions with exhaust air exiting at port B. (A CCW rotation is obtained.)

port B port A
Air supplied to port B forces pistons apart and toward end positions with exhaust air exiting at port A. (A CW rotation is obtained.)

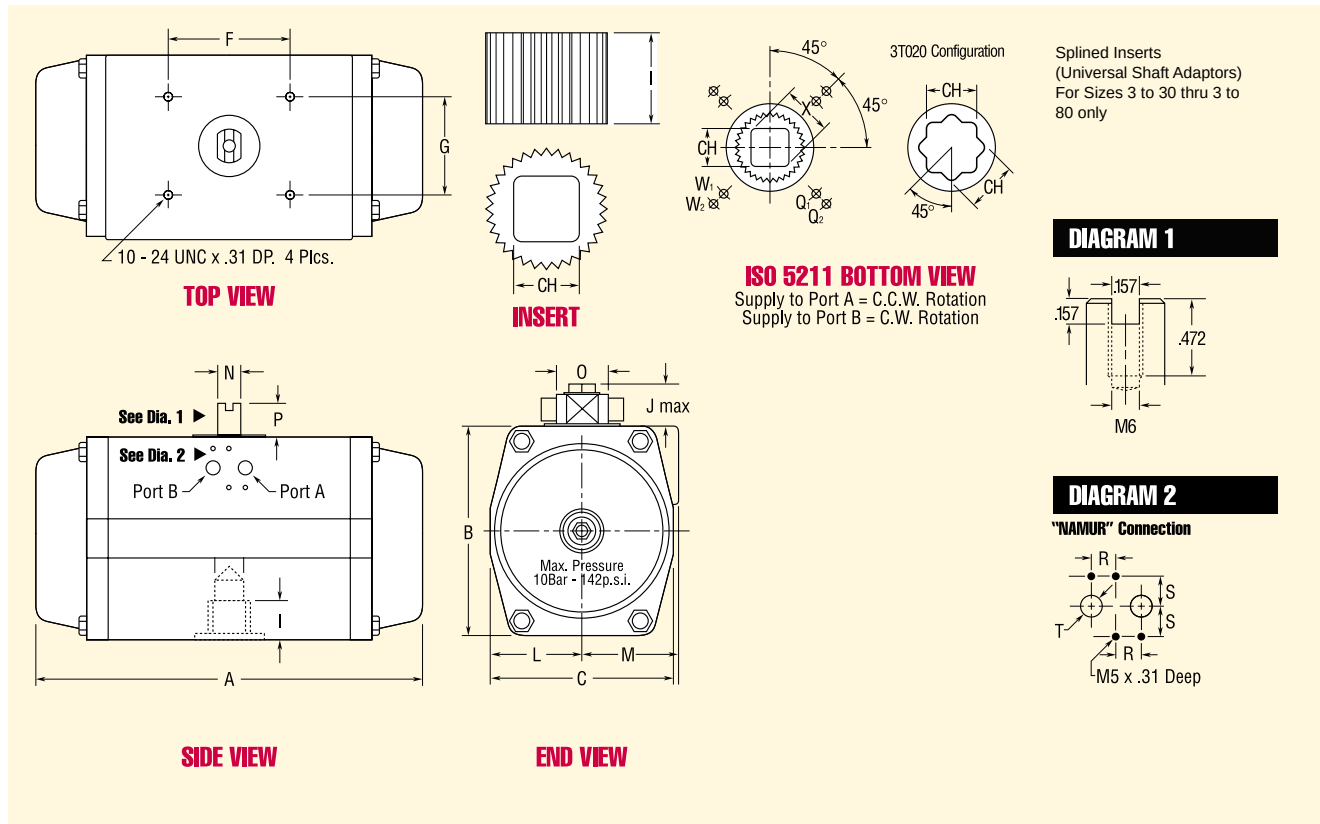
Spring Return (TOP VIEW)



port B port A
Air supplied to port A forces pistons apart and toward end position compressing springs. Exhaust air exits at port B. (A CCW rotation is obtained.)

port B port A
Air or electric failure allows springs to force pistons toward center position with exhaust air exiting at port A. (A CW rotation is obtained.)

Engineering



Dimensions									
	3T-20	3T-30	3T-40	3T-50	3T-60	3T-65	3T-70	3T-80	3T-90
A	5.30	5.98	7.95	9.05	10.66	12.13	14.17	18.18	22.60
B	2.63	3.26	3.93	4.33	4.92	5.59	6.10	7.70	9.44
C	2.28	2.87	3.34	3.85	4.33	5.04	5.51	6.92	8.66
F	1.97	3.15	3.15	3.15	3.15	5.12	5.12	5.12	5.12
G	.98	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
I	.51	.59	.748	.94	1.18	1.18	1.18	1.45	1.96
J	1.00	1.00	1.00	1.00	1.00	1.38	1.42	1.42	1.42
L	1.14	1.44	1.67	1.93	2.16	2.68	2.75	3.46	4.33
M	1.45	1.61	1.81	2.08	2.36	2.52	2.87	3.58	4.33
N	.31	.31	.55	.55	.55	1.06	1.06	1.06	1.26
O	.47	.47	.70	.70	.70	1.42	1.42	1.42	1.66
P	.78	.78	.78	.78	.78	1.18	1.18	1.18	1.18
R	.47	.47	.47	.47	.47	.47	.47	.47	.47
S	.63	.63	.63	.63	.63	.63	.63	.63	.63
T-NPT	1/8"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"
Q1-Q2 DIA B.C.	1.65	1.97	1.97-2.75	1.97-2.75	2.75-4.01	2.75-4.01	2.75-4.01	4.01-4.92	5.51**
CH	.43/11mm	.43/11mm	.55/14mm	.748/19mm	.748/19mm	.86/22mm	.86/22mm	1.06/27mm	1.41/36mm
X MIN.	.55	.55	.71	1.02	1.02	1.11	1.11	1.42	1.89
'W1' THD x 'Y' DEEP	1/4-20X.31	1/4-20X.33	1/4-20X.39	1/4-20X.35	5/16-18X.39	5/16-18X.39	5/16-18X.39	3/8-16X.47	5/8-11X.78
'W2' THD x 'Y' DEEP	—	—	5/16-18X.47	5/16-18X.47	3/8-16X.47	3/8-16X.47	3/8-16X.47	1/2-13X.59	—
ISO 5211	F04*	F05*	F05*-F07	F05-F07*	F07*-F10	F07-F10*	F07-F10*	F10-F12*	F14*

* F pattern Consistent with Conbraco's Mounting Bracket

** Rev. B = 4.92/6.50 Dia B.C. with 1/2-13 Threads (F12)

OSHA Lockout Device

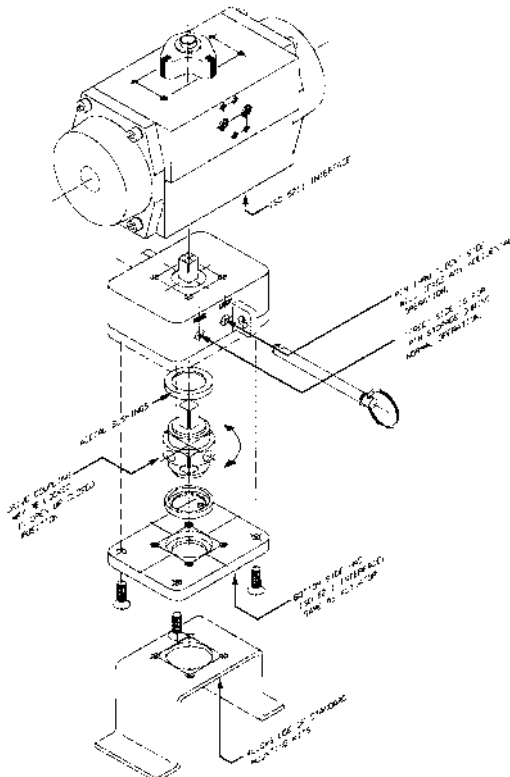
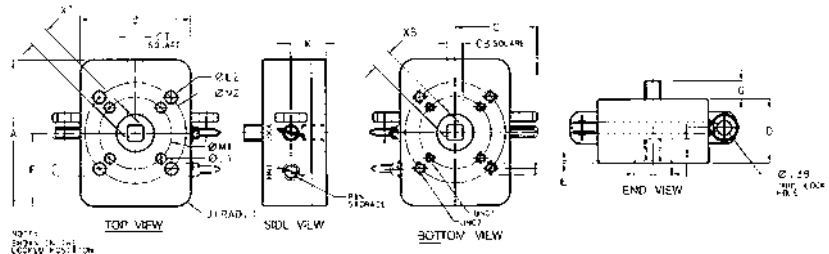
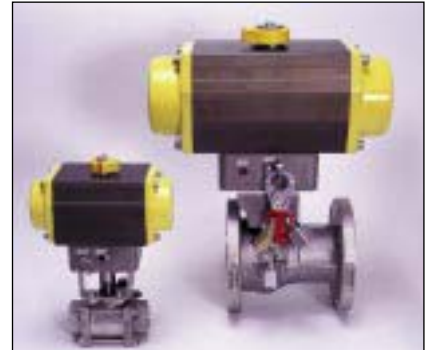
The Apollo® Lockout Tagout accessory for actuators complies with OSHA 1910.147 guidelines. It insures complete lockout capability in both the fully open or the fully closed position. Its design prevents accidental or malicious tampering of an automated valve's orientation.

The housing is constructed in investment cast 316SS, the fasteners, the lock pin, and the coupling are made of 300 Series stainless steel. This rugged construction, plus two acetal bushings located above and below the coupling, assures the strength and support necessary to withstand the torque and torsion generated by the actuator mounted above.

The top and bottom of the housing feature ISO 5211 mounting patterns. This design allows the accessory to be fitted between existing actuators and stainless steel bracketry that also comply with the ISO 5211 standard.

Available in six sizes, it is the perfect compliment to the CompacTorque Rack and Pinion Actuator and Apollo® Ball Valve. The design results in a safe automated package that will satisfy the concerns of the most discriminating safety engineer.

The lockout device may be used with electric actuators. However, caution should be exercised due to the possibility of motor burnout in an energized and locked position.



Material Specifications

HOUSING: INVESTMENT CAST 316 SS			BASE PLATE: 316 SS		DRIVE COUPLING: 303 SS	
BUSHINGS: ACETAL			LOCK PIN: 303 SS		FASTENERS: 18-8 SS	
DIMENSION	3TL3000	3TL4000	3TL5060	3TL6570	3TL8000	3TL9000
A	4.00	4.00	6.00	6.00	8.00	8.00
B	3.00	3.00	4.25	4.25	6.00	6.00
C	2.25	2.25	3.12	3.12	4.25	4.25
D	1.75	1.75	2.37	2.37	3.50	3.50
E	0.06	0.06	0.10	0.10	0.18	0.18
F	2.00	2.00	3.00	3.00	4.00	4.00
G	0.50	0.70	0.87	0.87	1.38	1.38
H	1.02	1.02	1.75	1.75	2.50	2.50
I	0.62	0.70	1.17	1.17	2.00	2.00
J(RAD.)	0.37	0.37	0.50	0.50	0.75	0.75
K	0.96	0.96	1.50	1.50	2.50	2.50
L1	0.265	0.265	0.328	0.328	0.515	0.640
L2	NA	NA	0.390	0.390	NA	NA
UNC1	1/4-20UNC	1/4-20UNC	5/16-18UNC	5/16-18UNC	1/2-20UNC	5/8-11UNC
UNC2	NA	NA	0.390	0.390	NA	NA
M1 B.C.	1.970 (F05)	1.970 (F05)	2.756 (F07)*	2.756 (F07)	4.920 (F12)	5.510 (F12)
M1 B.C.	NA	NA	4.016 (F10)	4.016 (F10)*	NA	NA
XT (MAX.)	0.540	0.690	0.955	1.080	1.325	1.780
XB (MIN.)	0.551	0.710	0.985	1.105	1.420	1.890
3T	.430/.432	.547/.550	.744/.747	.862/.865	1.056/1.059	1.413/1.416
CB	.433/.435	.551/.553	.748/.750	.866/.868	1.060/1.063	1.419/1.422
WEIGHT	3.65	3.75	9.90	10.40	28.90	29.50

*F Patterns Designated are Conbraco's Standard Mounting Arrangement

Ball Valves (B Series)

*Catalog 4121-B
Revised, November 2001*



Two-Way B Series Ball Valves

Introduction

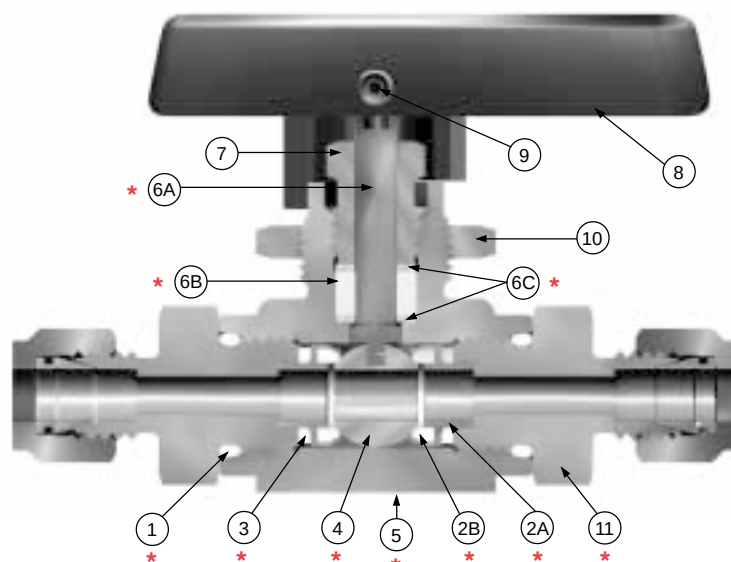
Parker manually, pneumatically, and electrically actuated two-way B Series Ball Valves provide quick 1/4 turn on-off control of fluids utilized in process and instrumentation applications. A broad selection of valve body, seat, and seal materials provide a wide range of pressures and temperatures at which the valve may be used.

Features

- Free floating ball design provides seat wear compensation
- Available in 316 stainless steel and brass construction. Alloy N24135 and Alloy N30002 construction available upon request
- Micro-finished ball provides a positive seal
- Straight through flow path for minimum pressure drop
- Bi-directional flow
- Wide variety of US Customary and SI ports
- 90 degree actuation
- Panel mountable
- Adjustable PTFE stem seal can be maintained in-line
- Handle indicates flow direction
- Low operating torques
- Positive handle stops
- Color coded handles
- Optional pneumatic and electric actuation
- Optional live-loaded PTFE stem seals
- Optional non-adjustable O-ring stem seals
- Optional upstream and downstream drain models
- Optional stainless steel and extended handles

Specifications

- Pressure Ratings:
 - 316 Stainless Steel**
 - 6000 psig (414 bar) CWP*
 - 1500 psig (103 bar) with PTFE seats
 - Brass**
 - 3000 psig (207 bar) CWP
 - 1500 psig (103 bar) with PTFE seats
 - Alloy N24135 (400)**
 - B2 and B6:
 - 3000 psig (207 bar) CWP
 - 1500 psig (103 bar) with PTFE seats
 - B8:
 - 2000 psig (138 bar) CWP
 - 1500 psig (103 bar) with PTFE seats
 - Alloy N30002 (C-276)**
 - B2 and B6:
 - 4000 psig (276 bar) CWP
 - 1500 psig (103 bar) with PTFE seats
 - B8:
 - 3000 psig (207 bar) CWP
 - 1500 psig (103 bar) with PTFE seats
- * B8 Series: 6000 psig rating or 4400 psig (303 bar) CWP



Model Shown: 6A-B6LJ-SSP

Pressure Rating and Tubing Selection

For working pressures of A-LOK® and CPI™ tube connections, please see the Instrument Tubing Selection Guide (Bulletin 4200-TS), found in the Technical Section of the Parker Instrumentation Products Master Binder, or the Parker Instrument Fitting Installation Manual (Bulletin 4200-B4).

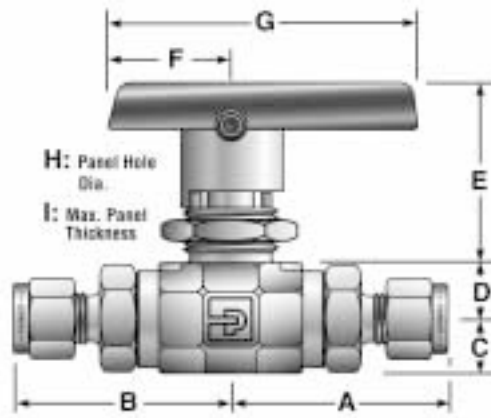
For working pressures of valves with external or internal pipe threads, please see Catalog 4260, Instrumentation Pipe Fittings.

Materials of Construction

Item #	Part Description	Stainless Steel	Brass
*1	Connector O-Ring	PTFE**	
*2A	Seat Retainer	ASTM A 276 Type 316	ASTM B 16 Alloy C36000
*2B	Seat	PTFE, PCTFE, PEEK	
*3	Retainer Seal	PTFE**	
*4	Ball	316 Stainless Steel	
*5	Body	ASTM A 351 Grade CF3M	ASTM B 283 Alloy C37700
*6A	Stem (PTFE Coated)	ASTM A 276 Type 316	
*6B	Stem Seal	PTFE**	
*6C	Stem Washer	316 Stainless Steel	
7	Packing Nut	ASTM A 479 Type 316	ASTM B 453 Alloy C34000
8	Handle	Nylon 6/6	
9	Handle Set Screw	Stainless Steel	
10	Panel Nut	316 Stainless Steel	
*11	End Connector	ASTM A 479 Type 316	ASTM B 16 Alloy C36000

- * Wetted Parts
** Optional stem seal and body seal materials are described in the How to Order section
Lubrication: Perfluorinated Polyether

Two-Way B Series Ball Valves



Model Shown: 4A-B6LJ-SSP

Two-Way Valve Dimensions / Flow Data

Port Size	Basic Part No.	Flow Data				End Connections		Dimensions Inches (mm)								
		Orifice		C_v	X_T^*	Port 1	Port 2	A*	B*	C	D	E	F	G	H	I
1A	B2L	0.052	1.3			1/16" A-LOK®		1.30	1.30	0.33 (8.4)	0.33 (8.4)	0.94 (23.9)	0.75 (19.1)	1.88 (47.8)	0.58 (14.7)	0.13 (3.3)
1Z						1/16" CPI™		(33.0)	(33.0)							
2A		0.093	2.4			1/8" A-LOK®		1.36	1.36							
2Z						1/8" CPI™		(34.5)	(34.5)							
2F		0.165	4.2			1/8" Female NPT		1.07	1.07							
								(27.2)	(27.2)							
2M		0.165	4.2			1/8" Male NPT		1.18	1.18							
								(30.0)	(30.0)							
4A		0.165	4.2			1/4" A-LOK®		1.48	1.48							
4Z						1/4" CPI™		(37.6)	(37.6)							
4M	B6L	0.165	4.2			1/4" Male NPT		1.35	1.35	0.42 (10.7)	0.47 (11.9)	1.53 (38.9)	1.00 (25.4)	2.50 (63.5)	0.77 (19.6)	0.25 (6.4)
								(34.3)	(34.3)							
4Q		0.165	4.2			1/4" UltraSeal		1.25	1.25							
								(31.8)	(31.8)							
4V		0.165	4.2			1/4" VacuSeal		1.38	1.38							
								(35.1)	(35.1)							
M3A		0.086	2.2			3mm A-LOK®		1.37	1.37							
M3Z						3mm CPI™		(34.8)	(34.8)							
2A		0.093	2.4			1/8" A-LOK®		1.65	1.65							
2Z						1/8" CPI™		(41.9)	(41.9)							
4A	B8L	0.187	4.7			1/4" A-LOK®		1.74	1.74	0.69 (17.5)	0.70 (17.8)	1.74 (44.2)	1.50 (38.1)	4.00 (101.6)	0.90 (22.9)	0.38 (9.7)
4Z						1/4" CPI™		(44.2)	(44.2)							
4F		0.250	6.4			1/4" Female NPT		1.51	1.51							
								(38.4)	(38.4)							
4M		0.250	6.4			1/4" Male NPT		1.62	1.62							
								(41.1)	(41.1)							
4Q		0.180	4.6			1/4" UltraSeal		1.51	1.51							
								(38.4)	(38.4)							
4V		0.188	4.8			1/4" VacuSeal		1.75	1.75							
								(44.5)	(44.5)							
6A	B8L	0.250	6.4			3/8" A-LOK®		1.80	1.80	0.69 (17.5)	0.70 (17.8)	1.74 (44.2)	1.50 (38.1)	4.00 (101.6)	0.90 (22.9)	0.38 (9.7)
6Z						3/8" CPI™		(45.7)	(45.7)							
6M		0.250	6.4			3/8" Male NPT		1.62	1.62							
								(41.1)	(41.1)							
6Q		0.250	6.4			3/8" UltraSeal		1.51	1.51							
								(38.4)	(38.4)							
M6A		0.187	4.7			6mm A-LOK®		1.75	1.75							
M6Z						6mm CPI™		(44.5)	(44.5)							
M8A		0.250	6.4			8mm A-LOK®		1.78	1.78							
M8Z						8mm CPI™		(45.2)	(45.2)							
M10A	B8L	0.250	6.4			10mm A-LOK®		1.81	1.81	0.69 (17.5)	0.70 (17.8)	1.74 (44.2)	1.50 (38.1)	4.00 (101.6)	0.90 (22.9)	0.38 (9.7)
M10Z						10mm CPI™		(46.0)	(46.0)							
6F		0.406	10.3			3/8" Female NPT		1.95	1.95							
								(49.5)	(49.5)							
8F		0.406	10.3			1/2" Female NPT		2.15	2.15							
								(54.6)	(54.6)							
8A		0.406	10.3			1/2" A-LOK®		2.34	2.34							
8Z						1/2" CPI™		(59.4)	(59.4)							
8M		0.406	10.3			1/2" Male NPT		2.22	2.22							
								(56.4)	(56.4)							
8Q	B8L	0.375	9.5			1/2" UltraSeal		1.92	1.92	0.69 (17.5)	0.70 (17.8)	1.74 (44.2)	1.50 (38.1)	4.00 (101.6)	0.90 (22.9)	0.38 (9.7)
								(48.8)	(48.8)							
8V		0.406	10.3			1/2" VacuSeal		2.21	2.21							
								(56.1)	(56.1)							
12A		0.406	10.3			3/4" A-LOK®		2.33	2.33							
12Z						3/4" CPI™		(59.2)	(59.2)							
M12A		0.375	9.5			12mm A-LOK®		2.33	2.33							
M12Z						12mm CPI™		(59.2)	(59.2)							
M16A		0.406	10.3			16mm A-LOK®		2.33	2.33							
M16Z						16mm CPI™		(59.2)	(59.2)							

* Tested in accordance with ISA S75.02. Gas flow will be choked when $P_1 - P_2 / P_1 = X_T$.

† For CPI™ and A-LOK®, dimensions are measured with nuts in the finger tight position

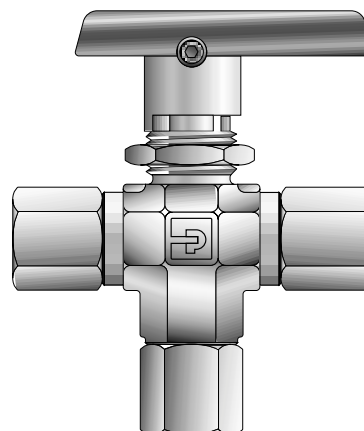
Three-Way B Series Ball Valves

Introduction

Parker manually, pneumatically, and electrically actuated three-way B Series Ball Valves may be used as diverting or selecting valves for fluids utilized in process and instrumentation applications. The standard three-way diverter valve is designed to accept media through the bottom port and direct it out of two outlet ports. When equipped with spring-loaded seats, the three-way valve may be used as a selector valve, alternately accepting media from either of two inlet sources (side ports) and directing it through a single outlet (bottom port).

Features

- Available in 316 stainless steel and brass construction.
Alloy N24135 and Alloy N30002 construction available for Diverter Valves upon request
- Micro-finished ball provides a positive seal
- Wide variety of US Customary and SI ports
- 180 degree actuation
- Panel mountable
- Adjustable PTFE stem seal can be maintained in-line
- Handle indicates flow direction
- Low operating torques
- Positive handle stops
- Color coded handles
- Optional pneumatic and electric actuation
- Optional live-loaded PTFE stem seals
- Optional non-adjustable O-ring stem seals
- Optional stainless steel and extended handles



Model Shown: 4F-B6XJ2-BP

Diverter Valve Specifications

- Pressure Ratings with bottom port as inlet:

316 Stainless Steel

6000 psig (414 bar) CWP*

1500 psig (103 bar) with PTFE seats

Brass

3000 psig (207 bar) CWP

1500 psig (103 bar) with PTFE seats

Alloy N24135 (400)

B2 and B6:

3000 psig (207 bar) CWP

1500 psig (103 bar) with PTFE seats

B8:

2000 psig (138 bar) CWP

1500 psig (103 bar) with PTFE seats

Alloy N30002 (C-276)

B2 and B6:

4000 psig (276 bar) CWP

1500 psig (103 bar) with PTFE seats

B8:

3000 psig (207 bar) CWP

1500 psig (103 bar) with PTFE seats

- Pressure Rating with side ports as inlet:
150 psig (10 bar)

* B8 Series: 6000 psig rating or 4400 psig (303 bar) CWP

Selector Valve Specifications

(Spring Loaded – B6 and B8 models only)

- Pressure Rating with bottom port as inlet:

316 Stainless Steel

6000 psig (414 bar) CWP*

Brass

3000 psig (207 bar) CWP

- Pressure Rating with side ports as inlet:

316 Stainless Steel and Brass

3000 psig (207 bar) CWP

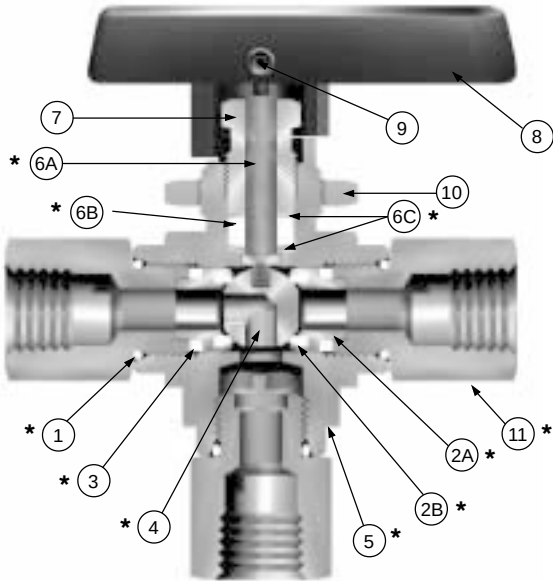
Pressure Rating and Tubing Selection

For working pressures of A-LOK® and CPI™ tube connections, please see the Instrument Tubing Selection Guide (Bulletin 4200-TS), found in the Technical Section of the Parker Instrumentation Products Master Binder, or the Parker Instrument Fitting Installation Manual (Bulletin 4200-B4).

For working pressures of valves with external or internal pipe threads, please see Catalog 4260, Instrumentation Pipe Fittings.

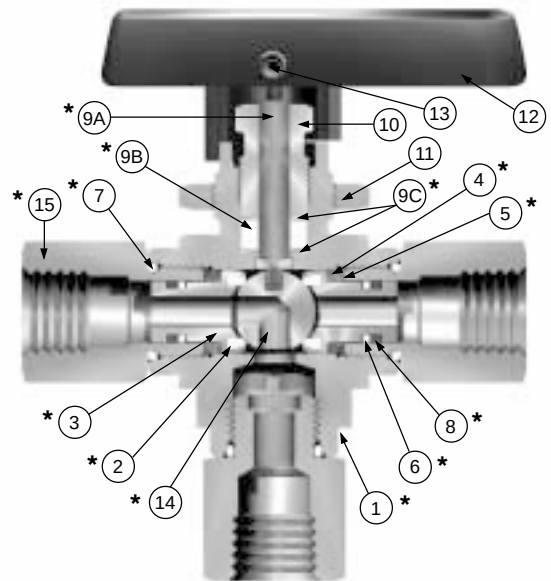
Three-Way B Series Ball Valves

Diverter Valve



Model Shown: 4F-B6XJ-SSP

Selector Valve



Model Shown: 4F-B6XS2-SSP

Materials of Construction

Item #	Part Description	Stainless Steel	Brass
*1	Connector O-Ring	PTFE**	
*2A	Seat Retainer	ASTM A 276 Type 316	ASTM B 16 Alloy C36000
*2B	Seat	PTFE, PCTFE, PEEK	
*3	Retainer Seal	PTFE**	
*4	Ball	316 Stainless Steel	
*5	Body	ASTM A 351 Grade CF3M	ASTM B 283 Alloy C37700
*6A	Stem (PTFE Coated)	ASTM A 276 Type 316	
*6B	Stem Seal	PTFE**	
*6C	Stem Washer	316 Stainless Steel	
7	Packing Nut	ASTM A 479 Type 316	ASTM B 453 Alloy C34000
8	Handle	Nylon 6/6	
9	Handle Set Screw	Stainless Steel	
10	Panel Nut	316 Stainless Steel	
*11	End Connector	ASTM A 479 Type 316	ASTM B 16 Alloy C36000

* Wetted Parts

** Optional stem seal and body seal materials are located in the How to Order section
Lubrication: Perfluorinated polyether

Materials of Construction

Item #	Part Description	Stainless Steel	Brass
*1	Body	ASTM A 351 Grade CF3M	ASTM B 283 Alloy C37700
*2	Seat	PCTFE, PEEK	
*3	Seat Retainer	ASTM A 276 Type 316	
*4	Spring	ASTM A 564 Type 360	
*5	Seat Retainer Washer	316 Stainless Steel	
*6	Back-up Ring	PTFE	
*7	Connector O-ring	PTFE**	
*8	Seat Retainer O-ring	Fluorocarbon Rubber**	
*9A	Stem (PTFE Coated)	ASTM A 276 Type 316	
9B	Stem Seal	PTFE	
*9C	Stem Washer	316 Stainless Steel***	
10	Packing Nut	ASTM A 479 Type 316	ASTM B 453 Alloy C34000
11	Panel Nut	316 Stainless Steel	
12	Handle	Nylon 6/6	
13	Handle Set Screw	Stainless Steel	
*14	Ball	316 Stainless Steel	
*15	End Connector	ASTM A 479 Type 316	ASTM B 16 Alloy C36000

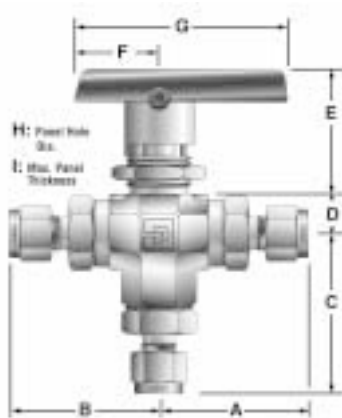
* Wetted Parts

** Optional stem seal, seat retainer, and body seal materials are located in the How to Order section

*** The lower stem washer material is PEEK for B8 Selector Valves

Lubrication: Perfluorinated polyether

Three-Way B Series Ball Valves



Model Shown: 4Z-B6XSPKR-V-SSP

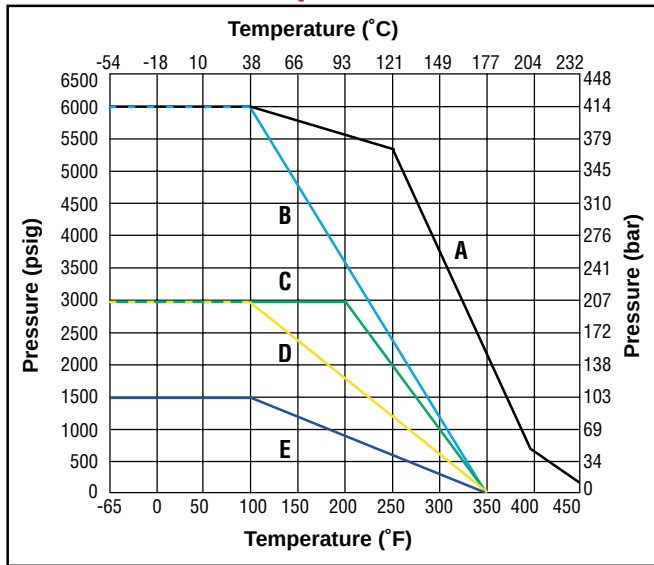
Three-Way Valve Dimensions / Flow Data

Port Size	Basic Part No.	Flow Data				End Connections			Dimensions Inches (mm)															
		Orifice		C _v	X _T *				A†	B†	C	D	E	F	G	H	I							
		Inch	mm			Port 1	Port 2	Port 3																
1A	B2X	0.052	1.3	0.06	0.56	1/16" A-LOK®			1.30	1.30	1.39	0.33 (8.4)	0.94 (23.9)	0.75 (19.1)	1.88 (47.8)	0.58 (14.7)	0.13 (3.3)							
1Z						1/16" CPI™			(33.0)	(33.0)	(35.3)													
2A		0.093	2.4	0.21	0.64	1/8" A-LOK®			1.36	1.36	1.45													
2Z						1/8" CPI™			(34.5)	(34.5)	(36.8)													
2F		0.165	4.2	0.63	0.59	1/8" Female NPT			1.07	1.07	1.15													
									(27.2)	(27.2)	(29.2)													
2M		0.165	4.2	0.63	0.59	1/8" Male NPT			1.18	1.18	1.26													
									(30.0)	(30.0)	(32.0)													
4A		0.165	4.2	0.63	0.59	1/4" A-LOK®			1.48	1.48	1.56													
4Z						1/4" CPI™			(37.6)	(37.6)	(39.6)													
4M		0.165	4.2	0.63	0.59	1/4" Male NPT			1.35	1.35	1.43													
									(34.3)	(34.3)	(36.3)													
4Q	B6X	0.165	4.2	0.63	0.59	1/4" UltraSeal			1.25	1.25	1.33	0.47 (11.9)	1.53 (38.9)	1.00 (25.4)	2.50 (63.5)	0.77 (19.6)	0.25 (6.4)							
4V		0.165	4.2	0.63	0.59	1/4" VacuSeal			1.38	1.38	1.46													
									(35.1)	(35.1)	(37.1)													
M3A		0.086	2.2	0.18	0.63	3mm A-LOK®			1.37	1.37	1.45													
M3Z						3mm CPI™			(34.8)	(34.8)	(36.8)													
2A		0.093	2.4	0.21	0.38	1/8" A-LOK®			1.65	1.65	1.79													
2Z						1/8" CPI™			(41.9)	(41.9)	(45.5)													
4A		0.187	4.7	0.70	0.69	1/4" A-LOK®			1.74	1.74	1.88													
4Z						1/4" CPI™			(44.2)	(44.2)	(47.8)													
4F		0.196	5.0	0.87	0.74	1/4" Female NPT			1.51	1.51	1.65													
									(38.4)	(38.4)	(41.9)													
4M		0.196	5.0	0.87	0.74	1/4" Male NPT			1.62	1.62	1.76													
									(41.1)	(41.1)	(44.7)													
4Q		0.180	4.6	0.68	0.67	1/4" UltraSeal			1.51	1.51	1.65													
									(31.8)	(31.8)	(33.8)													
4V		0.188	4.8	0.70	0.69	1/4" VacuSeal			1.75	1.75	1.89													
									(35.1)	(35.1)	(37.1)													
6A		0.196	5.0	0.87	0.74	3/8" A-LOK®			1.80	1.80	1.94													
6Z						3/8" CPI™			(45.7)	(45.7)	(49.3)													
6M		0.196	5.0	0.87	0.74	3/8" Male NPT			1.62	1.62	1.76													
									(41.1)	(41.1)	(44.7)													
6Q	B8X	0.196	5.0	0.87	0.74	3/8" UltraSeal			1.52	1.52	1.65	0.70 (17.8)	1.74 (44.2)	1.50 (38.1)	4.00 (101.6)	0.90 (22.9)	0.38 (9.7)							
									(38.6)	(38.6)	(41.9)													
M6A		0.187	4.7	0.70	0.69	6mm A-LOK®			1.75	1.75	1.88													
M6Z						6mm CPI™			(44.5)	(44.5)	(47.8)													
M8A		0.196	5.0	0.87	0.74	8mm A-LOK®			1.78	1.78	1.91													
M8Z						8mm CPI™			(45.2)	(45.2)	(48.5)													
M10A		0.196	5.0	0.87	0.74	10mm A-LOK®			1.81	1.81	1.95													
M10Z						10mm CPI™			(46.0)	(46.0)	(49.5)													
6F		B8X	0.406	10.3	3.62	0.64	3/8" Female NPT			1.95	1.95							2.29	0.70 (17.8)	1.74 (44.2)	1.50 (38.1)	4.00 (101.6)	0.90 (22.9)	0.38 (9.7)
										(49.5)	(49.5)							(58.2)						
8A	0.406		10.3	3.62	0.64	1/2" A-LOK®			2.34	2.34	2.68													
8Z						1/2" CPI™			(59.4)	(59.4)	(68.1)													
8F	0.406		10.3	3.62	0.64	1/2" Female NPT			2.15	2.15	2.49													
									(54.6)	(54.6)	(63.2)													
8M	0.406		10.3	3.62	0.64	1/2" Male NPT			2.22	2.22	2.59													
									(56.4)	(56.4)	(65.8)													
8Q	0.375		9.5	3.46	0.62	1/2" UltraSeal			1.93	1.93	2.27													
									(49.5)	(49.5)	(57.7)													
8V	0.406		10.3	3.62	0.64	1/2" VacuSeal			2.21	2.21	2.55													
									(56.1)	(56.1)	(65.0)													
12A	B8X	0.406	10.3	3.62	0.64	3/4" A-LOK®			2.33	2.33	2.68	0.70 (17.8)	1.74 (44.2)	1.50 (38.1)	4.00 (101.6)	0.90 (22.9)	0.38 (9.7)							
12Z						3/4" CPI™			(59.2)	(59.2)	(68.1)													
M12A		0.375	9.5	3.46	0.62	12mm A-LOK®			2.33	2.33	2.67													
M12Z						12mm CPI™			(59.2)	(59.2)	(67.8)													
M16A		0.406	10.3	3.62	0.64	16mm A-LOK®			2.33	2.33	2.67													
M16Z						16mm CPI™			(56.9)	(56.9)	(65.5)													

* Tested in accordance with ISA S75.02. Gas flow will be choked when $P_1 - P_2 / P_1 = x_T$

† For CPI™ and A-LOK®, dimensions are measured with nuts in the finger tight position

Pressure vs. Temperature



Legend: A – PEEK Seats; B – PCTFE Seats; C – Selector Valves; D – Brass Valves; E – PTFE Seats
Note: To determine MPa, multiply bar by 0.1

Note: This Pressure versus Temperature chart reflects the maximum temperature range of indicated materials.

When combining seat and seal materials, the most restrictive temperature rating of the seats or seals becomes the limiting factor on valve temperature range.

Elastomeric stem packing and seals are recommended if the application subjects the valve to thermal cycling.

Temperature Ratings:

PTFE:

-65 °F to 350 °F (-54 °C to 177 °C)

PCTFE:

-65 °F to 350 °F (-54 °C to 177 °C)

PEEK:

-65 °F to 450 °F (-54 °C to 232 °C)

Buna-N Rubber:

-40 °F to 250 °F (-40 °C to 121 °C)

Fluorocarbon Rubber:

-15 °F to 450 °F (-26 °C to 232 °C)

Ethylene Propylene Rubber:

-65 °F to 300 °F (-54 °C to 149 °C)

Flow Calculations with 1000 psig (69 bar) Inlet Pressure (Two-Way)

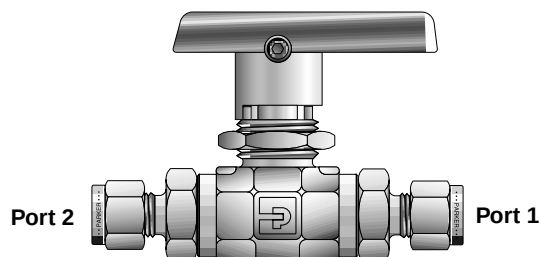
Valve Series	Maximum C_v	Pressure Drop Δp		Water @ 60 °F (16 °C)		Air @ 60 °F (16 °C)	
		psig	bar	gpm	m ³ /hr	scfm	m ³ /hr
B2L	0.93	10	0.7	2.9	0.7	92.4	156.2
		50	3.5	6.6	1.5	200.3	338.3
		100	6.9	9.3	2.1	272.0	458.9
B6L	2.34	10	0.7	7.4	1.7	231.7	391.5
		50	3.5	16.5	3.8	494.2	834.7
		100	6.9	23.4	5.3	657.0	1107.9
B8L	6.42	10	0.7	20.3	4.6	637.1	1076.8
		50	3.5	45.4	10.3	1373.6	2320.3
		100	6.9	64.2	14.6	1852.3	3124.8

Flow Calculations with 1000 psig (69 bar) Inlet Pressure (Three-Way)

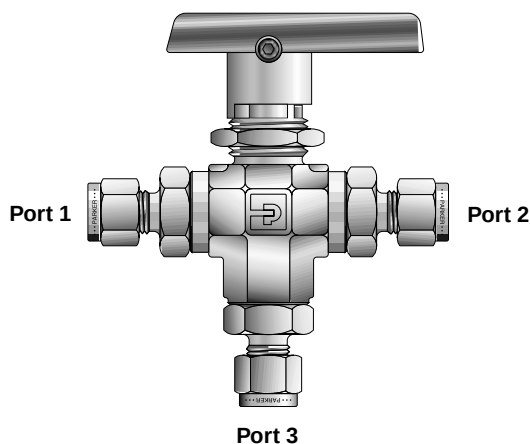
Valve Series	Maximum C_v	Pressure Drop Δp		Water @ 60 °F (16 °C)		Air @ 60 °F (16 °C)	
		psig	bar	gpm	m ³ /hr	scfm	m ³ /hr
B2X	0.63	10	0.7	2.0	0.5	62.7	106.0
		50	3.5	4.5	1.0	137.1	231.7
		100	6.9	6.3	1.4	188.4	317.9
B6X	0.87	10	0.7	2.8	0.6	86.7	146.6
		50	3.5	6.2	1.4	190.5	321.8
		100	6.9	8.7	2.0	263.2	444.4
B8X	3.62	10	0.7	11.5	2.6	360.6	609.5
		50	3.5	25.6	5.9	789.7	1343.5
		100	6.9	36.2	8.2	1087.4	1836.6

B Series Ball Valves

How to Order



Model Shown: 6A-B6LJ2-SSP



Model Shown: 6A-B6XJ2-SSP

1 Port 1	2 Port 2	3 Port 3	4 Valve Series	5 Seat Material	6 Seal Material	7 Body Material
1A - 1/16" A-LOK® 1Z - 1/16" CPI™ 2A - 1/8" A-LOK® 2Z - 1/8" CPI™ 2F - 1/8" Female NPT 2M - 1/8" Male NPT 4A - 1/4" A-LOK® 4Z - 1/4" CPI™ 4M - 1/4" Male NPT 4Q - 1/4" UltraSeal 4V - 1/4" VacuSeal M3A - 3mm A-LOK® M3Z - 3mm CPI™	2A - 1/8" A-LOK® 2Z - 1/8" CPI™ 4A - 1/4" A-LOK® 4Z - 1/4" CPI™ 4F - 1/4" Female NPT 4M - 1/4" Male NPT 4Q - 1/4" UltraSeal 4V - 1/4" VacuSeal 6A - 3/8" A-LOK® 6Z - 3/8" CPI™ 6M - 3/8" Male NPT 6Q - 3/8" UltraSeal M6A - 6mm A-LOK® M6Z - 6mm CPI™ M8A - 8mm A-LOK® M8Z - 8mm CPI™ M10A - 10mm A-LOK® M10Z - 10mm CPI™		B2L B2X	J - PTFE J2 - PCTFE	Blank - PTFE V - Fluorocarbon Rubber EPR - Ethylene Propylene Rubber BN - Buna-N Rubber LT - Live-Loaded PTFE Packing with PTFE Seals VLT - Live-Loaded PTFE Packing with Fluorocarbon Rubber Seals EPRLT - Live-Loaded PTFE Packing with Ethylene Propylene Rubber Seals BNLT - Live-Loaded PTFE Packing with Buna-N Rubber Seals	SSP - 316 Stainless Steel BP - Brass MP - Alloy N24135 HCP - Alloy N30002
6F - 3/8" Female NPT 8A - 1/2" A-LOK® 8Z - 1/2" CPI™ 8F - 1/2" Female NPT 8M - 1/2" Male NPT 8Q - 1/2" UltraSeal 8V - 1/2" VacuSeal 12A - 3/4" A-LOK® 12Z - 3/4" CPI™ M12A - 12mm A-LOK® M12Z - 12mm CPI™ M16A - 16mm A-LOK® M16Z - 16mm CPI™			B6L B6X	J - PTFE J2 - PCTFE S2 - Spring - Loaded PCTFE PKR - PTFE Reinforced PEEK SPKR - Spring - Loaded PTFE Reinforced PEEK		
6F - 3/8" Female NPT 8A - 1/2" A-LOK® 8Z - 1/2" CPI™ 8F - 1/2" Female NPT 8M - 1/2" Male NPT 8Q - 1/2" UltraSeal 8V - 1/2" VacuSeal 12A - 3/4" A-LOK® 12Z - 3/4" CPI™ M12A - 12mm A-LOK® M12Z - 12mm CPI™ M16A - 16mm A-LOK® M16Z - 16mm CPI™			B8L B8X	J - PTFE J2 - PCTFE S2 - Spring - Loaded PCTFE PKR - PTFE Reinforced PEEK		

Note: Panel Mounting Nut supplied with each valve. Various port combinations are available – See How to Order.

How to Order

Two-Way Valves

Example: $\frac{4Z}{1}$ $\frac{4F}{2}$ - $\frac{B6L}{4}$ $\frac{J}{5}$ - $\frac{BP}{6}$ $\frac{7}{7}$

Describes a B6L ball valve with a 1/4" CPI™ end connection for port 1 and a 1/4" female NPT end connection for port 2, PTFE seats, PTFE stem and body seals, brass construction, with a panel mounting nut.

Example: $\frac{8A}{1}$ * $\frac{2}{2}$ - $\frac{B8L}{4}$ $\frac{J}{5}$ - $\frac{BN}{6}$ - $\frac{SSP}{7}$

Describes a B8L ball valve with a 1/2" A-LOK® end connections for ports 1 and 2, PTFE seats, Buna-N rubber stem and body seals, stainless steel construction, with a panel mounting nut. *Note: If ports 1 and 2 are the same, eliminate the port 2 designator.

Example: $\frac{M3A}{1}$ * $\frac{2}{2}$ - $\frac{B2L}{4}$ $\frac{J2}{5}$ - $\frac{VLT}{6}$ - $\frac{SSP}{7}$

Describes a B2L ball valve with 3mm A-LOK® end connections for ports 1 and 2, PCTFE seats, fluorocarbon rubber body seals, live-loaded PTFE packing, stainless steel construction, with a panel mounting nut.

Three-Way Diverter Valves

Example: $\frac{4Z}{1}$ $\frac{4Z}{2}$ $\frac{4F}{3}$ - $\frac{B6X}{4}$ $\frac{J2}{5}$ - $\frac{V}{6}$ - $\frac{BP}{7}$

Describes a B6X ball valve with 1/4" CPI™ end connections for side ports 1 and 2, 1/4" female NPT end connection for bottom port 3, PCTFE seats, fluorocarbon rubber stem and body seals, brass construction, and a panel mounting nut.

Example: $\frac{2Z}{1}$ * $\frac{2}{2}$ $\frac{3}{3}$ - $\frac{B2X}{4}$ $\frac{J}{5}$ - $\frac{SSP}{6}$ $\frac{7}{7}$

Describes a B2X ball valve with 1/8" CPI™ end connections for ports 1, 2, and 3, PTFE seats, PTFE stem and body seals, stainless steel construction, and a panel mounting nut. *Note: If ports 1, 2, and 3 are the same, eliminate the port 2 and port 3 designators.

Three-Way Selector Valves

Example: $\frac{4M}{1}$ $\frac{4M}{2}$ $\frac{4F}{3}$ - $\frac{B6X}{4}$ $\frac{S2}{5}$ - $\frac{EPR}{6}$ - $\frac{SSP}{7}$

Describes a B6X ball valve with 1/4" male NPT end connections for side ports 1 and 2, 1/4" female NPT end connection for bottom port 3, spring-loaded PCTFE seats, ethylene propylene rubber stem and body seals, stainless steel construction, and a panel mounting nut.

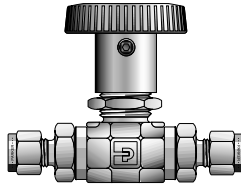
Example: $\frac{8A}{1}$ * $\frac{2}{2}$ $\frac{3}{3}$ - $\frac{B8X}{4}$ $\frac{S2}{5}$ - $\frac{BNLT}{6}$ - $\frac{SSP}{7}$

Describes a B8X ball valve with 1/2" A-LOK® end connections for ports 1, 2, and 3, spring-loaded PCTFE seats, Buna-N rubber body seals, live loaded PTFE packing, stainless steel construction, and a panel mounting nut.

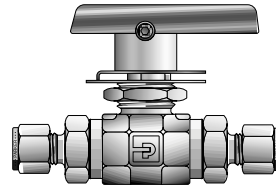
*Note: If ports 1, 2, and 3 are the same, eliminate the port 2 and port 3 designators.

B Series Ball Valves

Options

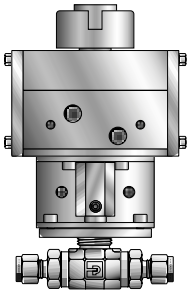


Round Handle

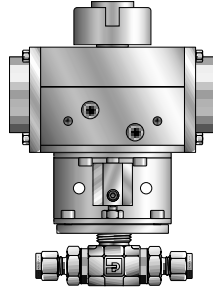


Lock-Out Device

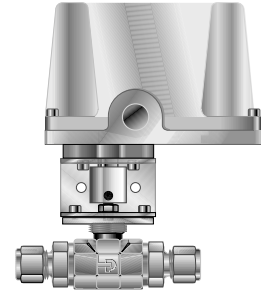
Actuation Options



**Double Acting (61AD)
Pneumatic Actuator**



**Spring Return (61AC & AO)
Pneumatic Actuator**



**70 and 80 Series
Electric Actuator**

Note: When ordering actuated B Series Ball Valves, O-ring stem seals or Live-loaded stem seals are recommended to minimize the need for stem seal maintenance.



O-Ring Stem Seals



Live-loaded Stem Seals

Two-Way Valve Upstream and Downstream Drain Options

For draining upstream or downstream media on two-way valves at pressures below 150 psig (10 bar), add the suffix **-VBU** (Vented Ball Upstream) or **-VBD** (Vented Ball Downstream). Example: 4Z-B6LJ-SSP-**VBU**. This option is also suitable to vent the ball cavity in vacuum applications. For pressures up to 3,000 psig (207 bar), select **S2** or **SPKR** spring-loaded seats and add the suffix **-VBU** (Vented Ball Upstream) or **-VBD** (Vented Ball Downstream). Example: 4Z-B6LS2-SSP-**VBU**

WARNING

FAILURE, IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

Offer of Sale

The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated in the "Offer of Sale" located in Catalog 4110-U Needle Valves (U Series).

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How to Order Options

Lock-Out Devices – Add the suffix **LD** to the end of the part number to order directly on the valve. Example: 4F-B6LJ2-BN-SSP-**LD**. For field installation, simply substitute the correct valve series number after **LD**. Example: **LD-B8L**.

Colored Lever Handles – Add the designator corresponding to the correct handle as a suffix to the part number (black is standard). **W** – white, **B** – blue, **G** – green, **R** – red, **Y** – yellow. Example: M6A-B6XPKR-SSP-**G**.

Colored Round Handles – Add the designator corresponding to the correct handle as a suffix to the part number. **S**-Black, **S-W** – white, **S-B** – blue, **S-G** – green, **S-R** – red, **S-Y** – yellow. Example: M6A-B6XPKR-SSP-**S-G**. **NOTE:** Round handles are not recommended for B8 valves with PEEK seats.

Metal Oval Handles – Add the designator corresponding to the correct handle as a suffix to the valve part number. **OVSS** - stainless steel, **OVAL** - aluminum. Example: 8F-B8LPKR-SSP-**OVSS**.

Stainless Steel Handles – Add the suffix **-ST** to the end of the part number. Example: 4F-B6LJ-SSP-**ST**

Pneumatic Actuators – For detailed actuator information, refer to Catalog 4123-PA. For factory assembly, add the actuator part number as the suffix to the valve part number. Example: 2F-B2XJ2-V-SSP-**61ACX-2**. For field installation, specify the actuator desired.

Example: **61ACX-2**. The appropriate mounting hardware may be obtained by adding the valve series and actuator size to the prefix **MK-**. Example: **MK-B2X-61**.

Electric Actuators – For detailed actuator information refer to Catalog 4123-EA. For factory assembly, add the actuator part number as the suffix to the valve part number. Example: 8A-B8LPKR-BN-SS-**71A**. For field installation, specify the actuator desired. Example: **71A**. The appropriate mounting hardware may be obtained by adding the valve series and actuator series to the prefix **MK-**. Example: **MK-B8L-70**.

Oxygen Cleaning – Add the suffix **-C3** to the end of the part number to receive valves cleaned and assembled for oxygen service in accordance with Parker Specification ES8003. Example: 4A-B6LJ-EPR-SSP-**C3**.

Electron Beam Welded End Connections – For tamper resistant valves, add the suffix **EBW** to the end of the part number of stainless steel valves to have end connections electron beam welded. Example: M6A-B6LSPKR-V-SSP-**EBW**.

Sour Gas – To obtain valves suitable for sour gas service in accordance with NACE Standard MR0175, add the suffix **NACE** to the end of the part number. Example: 8F-B8LJ-BN-SSP-**NACE**.

Grounding Spring – To obtain B8 series valves with a grounding spring, add the suffix **SPG** to the end of the part number. Example: 8A-B8LJ2-SSP-**SPG**.

How to Order Maintenance Kits

Colored Round Handle Kits - Series-Handle-Color. Example: **B6-RD-HANDLE-GREEN** (Consists of a green handle and handle screw)

Stainless Steel Handle Kits: Series-Handle-SS. Example: **B8-HANDLE-SS** (Consists of a stainless steel handle and handle screw)

Colored Lever Handle Kits: Series-Handle-Color. Example: **B6-HANDLE-RED** (Consists of a red handle and handle screw)

Two-way Valve Seal Kits:

PTFE Stem Seal Kits: Kit-Valve Series and Seat Material-Body Material. Example: **KIT-B2LJ-SS**. (Consists of one PTFE stem seal, two stem seal washers, two encapsulated PTFE ball seats, two end connector PTFE seals, one assembly mandrel, maintenance instructions.) **Elastomeric Stem Seal Kits:** Kit-Valve Series and Seat Material-Elastomer Material-Body Material. Example: **KIT-B2LJ2-BN-SS**. (Consists of two stem seal Buna-N rubber O-rings, two stem seal washers, two encapsulated PCTFE ball seats, two end connector Buna-N rubber O-ring seals, two seat retainer Buna-N rubber O-ring seals, maintenance instructions.)

Diverter Valve Seal Kits:

PTFE Stem Seal Kits: Kit-Valve Series and Seat Material-Body Material. Example: **KIT-B6XPKR-SS**. (Consists of one PTFE stem seal, two stem seal washers, two encapsulated PEEK ball seats, three end connector PTFE seals, one assembly mandrel, maintenance instructions.)

Elastomeric Stem Seal Kits: Kit-Valve Series and Seat Material-Elastomer-Body Material. Example: **KIT-B6XJ-V-SS**. (Consists of two stem seal fluorocarbon rubber O-rings, two stem seal washers, two encapsulated PTFE ball seats, three end connector fluorocarbon rubber O-ring seals, two seat retainer fluorocarbon rubber O-ring seals, maintenance instructions.)

Selector Valve Seal Kits:

PTFE Stem Seal Kits: Kit-Valve Series and Seat Material. Example: **KIT-B6XS2**. (Consists of one PTFE stem seal, two stem seal washers, two encapsulated spring-loaded PCTFE ball seats, two seat retainer fluorocarbon rubber O-rings, three end connector PTFE seals, one assembly mandrel, maintenance instructions.)

Elastomeric Stem Seal Kits: Kit-Valve Series and Seat Material-Elastomer. Example: **KIT-B6XSPKR-V**. (Consists of two stem seal fluorocarbon rubber O-rings, two stem seal washers, two encapsulated spring-loaded PEEK ball seat assemblies, three end connector fluorocarbon O-ring seals, two seat retainer fluorocarbon rubber O-rings, maintenance instructions.)

Live-loaded Seal Kits:

Kit-Valve Series and Seat Material-Seal Material-Body Material. Example: **KIT-B6LJ2-BNLT-SS**. (Consists of one live-loaded PTFE stem packing, two packing springs (B8 series valves have four springs), three packing washers, two PCTFE encapsulated ball seats, two Buna-N rubber end connector O-ring seals, two Buna-N rubber seat retainer O-ring seals, maintenance instructions.)



Catalog 4121-B, 20M, 11/01

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Instrumentation Valve Division
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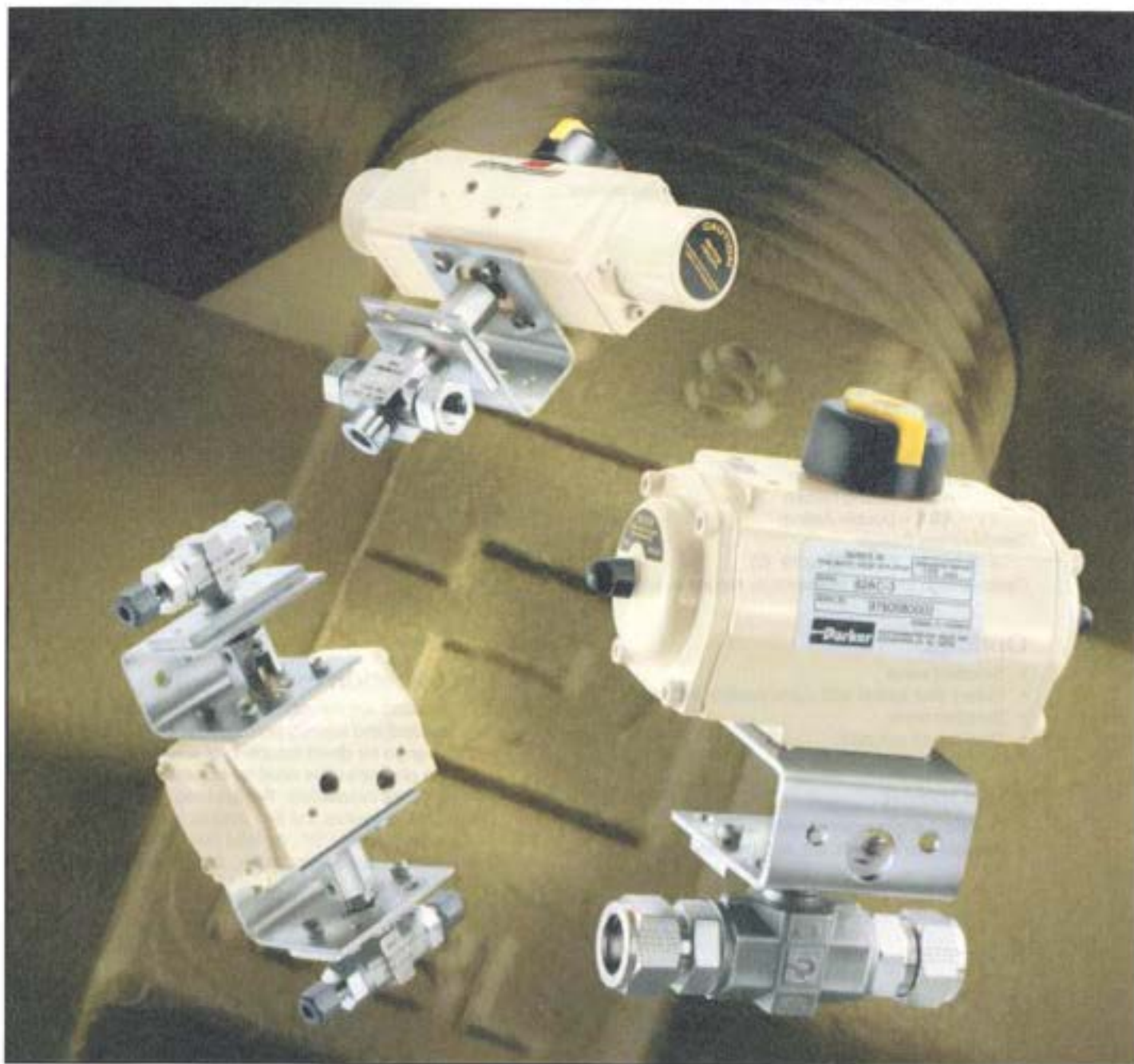


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Pneumatic Actuators

Catalog 4123-PA
Revised, April 2002





Catalog 4123-PA, 20M, 04/02

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Pneumatic Actuators

Introduction

Parker 60 Series spring return (AC/AO) or double acting (AD) rack and pinion actuators are compact, simply designed devices that are quality engineered to provide high torque outputs and a high cycle, trouble-free life.

A compact, dual opposed rack and pinion design and guide band suspension combine to produce a symmetrically balanced, center mount actuator. In addition, the actuator has a short powerful stroke, rapid response, and fully concentric operating load capability which ensures optimum performance.

Features

- Three point suspension system uses carbon filled PTFE guide bands for piston alignment and rack support
- Dual opposed piston design uses air pressure on two pistons to deliver a balanced force to the pinion gear
- Patented balanced piston design results in even distribution of bearing loads and eliminates piston tilting
- Multiple spring concept permits actuator use at 40 to 120 psig (2.8 to 8.3 bar) air supply requirements
- Suitable for use with dry or lubricated air, non-corrosive gas, or light hydraulic oil
- Aluminum alloy body construction with two component polyurethane coating
- Manual override

Specifications

Operating Pressure

90° Models:

40 to 120 psig (2.8 to 8.3 bar) maximum

AC – Normally Closed Spring Return

AD – Double Acting

AO – Normally Open Spring Return

180° Models:

80 psig (5.5 bar) maximum

ACX – Spring Return

ADX – Double Acting

Temperature Range

-4 °F to 175 °F (-20 °C to 79 °C)

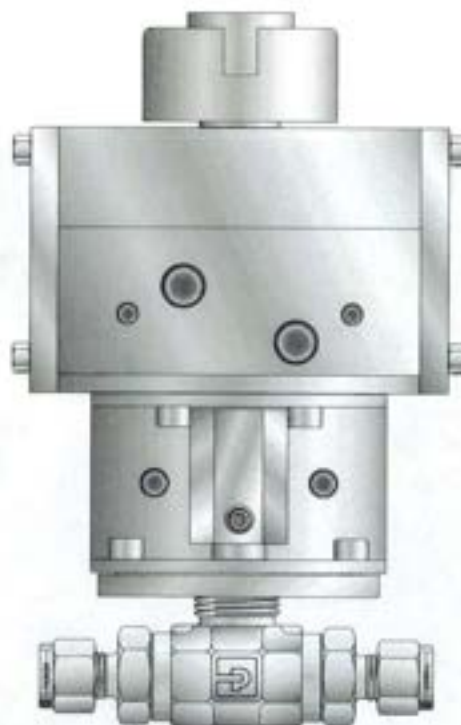
Optional high and low temperature ranges available

Options

- Solenoid valve
- Rotary limit switch with valve position indicator
- Breather block
- Dual mount actuator

61S Option

- Compact single piston design
- Available for MB, HB, B2, and B6 Series Valves

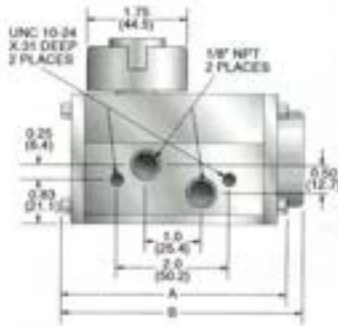


Model Shown: 4Z-B6LJ-V-SS-61AD

Operation

Actuators are manufactured with an integral air manifold and internal porting. The air manifold is designed for direct mounting of solenoid valves. This eliminates the need for external tubing and simplifies installation. For applications not requiring a solenoid valve, the air manifold inlet ports are marked "A" and "B". Air inlet port "A" will rotate the actuator counter-clockwise. Spring return actuators fail clockwise.

Dimensional Data for 61 and 61S Models



61S Actuator



61 Actuator

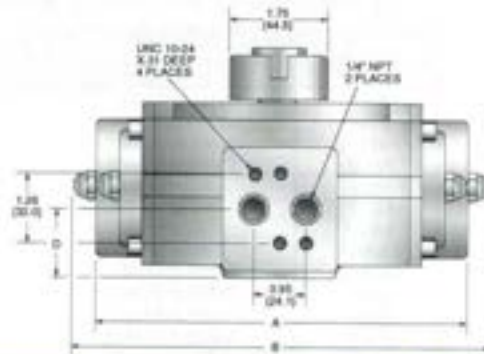
() Denotes dimensions in millimeters

Dim.	61SAD		61SAC/O		61SADX		61SACX	
	Inch	mm	Inch	mm	Inch	mm	Inch	mm
A	3.37	85.6	-	-	4.63	117.6	-	-
B	-	-	3.66	93.0	-	-	5.83	148.1
C	3.38	85.9	3.38	85.9	3.38	85.9	3.38	85.9

Dim.	61AD		61AC/O		61ADX		61ACX	
	Inch	mm	Inch	mm	Inch	mm	Inch	mm
A	4.06	103.1	-	-	6.30	154.9	-	-
B	-	-	4.65	118.1	-	-	8.50	215.9
C1	3.38	85.9	3.38	85.9	3.38	85.9	3.38	85.9
C2	2.36	59.9	2.36	59.9	2.36	59.9	2.36	59.9

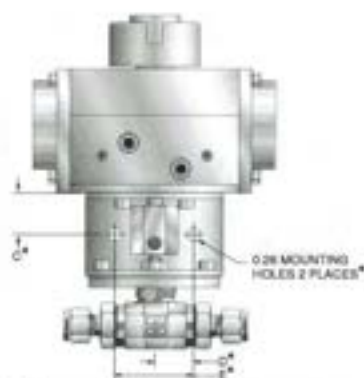
C1 - Single Mount C2 - Dual Mount

Dimensional Data for 62, 63, 64, 65, 66, 68 and 69 Models



Model	A		B		C				D		E		F	
	Inch	mm	Inch	mm	Single Mount		Dual Mount		Inch	mm	Inch	mm	Inch	mm
					Inch	mm	Inch	mm						
62AD	6.26	159.0	-	-	4.17	105.9	3.15	80.0	1.26	32.0	2.91	73.9	3.15	80.0
62AC/O	-	-	6.77	172.0	4.17	105.9	3.15	80.0	1.26	32.0	2.91	73.9	3.15	80.0
63AD	7.09	180.1	-	-	4.68	118.9	3.86	98.0	1.32	33.5	3.39	86.1	3.66	93.0
63AC/O	-	-	8.03	204.0	4.68	118.9	3.86	98.0	1.32	33.5	3.39	86.1	3.66	93.0
64ADX	6.34	161.0	-	-	5.00	127.0	3.98	101.1	1.69	42.9	4.27	108.5	3.98	101.1
64ACX	-	-	7.17	182.1	5.00	127.0	3.98	101.1	1.69	42.9	4.27	108.5	3.98	101.1
65AD	7.83	198.9	-	-	5.15	130.8	4.13	104.9	1.54	39.1	3.86	98.0	4.13	104.9
65AC/O	-	-	9.8	248.9	5.15	130.8	4.13	104.9	1.54	39.1	3.86	98.0	4.13	104.9
66AD	8.7	221.0	-	-	5.67	144.0	4.65	118.1	1.59	40.4	4.25	108.0	4.65	118.1
66AC/O	-	-	10.51	267.0	5.67	144.0	4.65	118.1	1.59	40.4	4.25	108.0	4.65	118.1
68ADX	7.28	184.9	-	-	6.33	160.8	5.31	134.9	2.09	53.1	5.61	142.5	5.31	134.9
68ACX	-	-	8.5	215.9	6.33	160.8	5.31	134.9	2.09	53.1	5.61	142.5	5.31	134.9
69AD	11.14	283.0	-	-	6.65	168.9	5.63	143.0	1.99	50.5	5.04	128.0	5.63	143.0
69AC/O	-	-	14.17	359.9	6.65	168.9	5.63	143.0	1.99	50.5	5.04	128.0	5.63	143.0

Pneumatic Actuators



Valve Dimensional Data

Model Shown: 4Z-B6LJ-V-SS-61AC-2

Valve Series	A		B*		C*		D*		E*	
	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm
B2	2.23	56.6	1.61	40.9	0.80	20.3	0.75	19.1	1.50	38.1
B6	2.49	63.2								
B8	2.91	73.9								
MB2	2.33	59.2								
MB4	2.33	59.2								
MB6	2.48	63.0								
HB4	2.70	68.6								
SB8	2.94	74.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SB12	3.03	77.0								
SB16	3.27	83.1								
SB20	3.46	87.9								
SB24	3.73	94.7								
SB32	3.92	99.6								

* Not applicable for SB Series Ball Valves

Recommended Actuators for B, MB, and HB Series Ball Valves*

Valve Series	Double Acting AD	Spring Return AD	Spring Return AC
B2LJ	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or 61SAC
B2LJ2	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or R 61SAC
B2XJ	61ADIX or 61SAOIX	61ACX-2 or 61SACX	61ACX-2 or 61SACX
B2XJ2	61ADIX or 61SAOIX	61ACX-2 or 61SACX	61ACX-2 or 61SACX
B6LJ	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or 61SAC
B6LJ2	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or 61SAC
B6LS2	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or 61SAC
B6LPKR	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or 61SAC
B6LSPKR	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or 61SAC
B6XJ	61ADIX or 61SAOIX	61ACX-2 or 61SACX	61ACX-2 or 61SACX
B6XJ2	61ADIX or 61SAOIX	61ACX-2 or 61SACX	61ACX-2 or 61SACX
B6XS2	61ADIX or 61SAOIX	61ACX-2 or 61SACX	61ACX-2 or 61SACX
B6XPKR	61ADIX or 61SAOIX	61ACX-2 or 61SACX	61ACX-2 or 61SACX
B6XSPKR	61ADIX or 61SAOIX	61ACX-2 or 61SACX	61ACX-2 or 61SACX
B8LJ	61AD	61AD-2	61AC-2
B8LJ2	61AD	62AD-3	62AC-3
B8LS2	61AD	62AD-3	62AC-3
B8LPKR	61AD	62AD-3	62AC-3
B8XJ	61ADIX	61ACX-2	61ACX-2
B8XJ2	61ADIX	64ACX-12	64ACX-12
B8XS2	61ADIX	64ACX-12	64ACX-12
B8XPKR	61ADIX	64ACX-12	64ACX-12
HB4LPKR	61AD	62AD-3	62AC-3
HB4LK	61AD	61AD-2	61AC-2
HB4XPKR	61ADIX	64ACX-8	64ACX-8
HB4XK	61ADIX	61ACX-2	61ACX-2
MB2A	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or 61SAC
MB2L	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or 61SAC
MB2X	61ADIX or 61SAOIX	61ACX-2 or 61SACX	61ACX-2 or 61SACX
MB4A	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or 61SAC
MB4L	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or 61SAC
MB4X	61ADIX or 61SAOIX	61ACX-2 or 61SACX	61ACX-2 or 61SACX
MB6A	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or 61SAC
MB6L	61AD or 61SAO	61AD-2 or 61SAO	61AC-2 or 61SAC
MB6X	61ADIX or 61SAOIX	61ACX-2 or 61SACX	61ACX-2 or 61SACX

* With 60 psig (4.1 bar) actuation pressure

Suggested Actuators for SB Series Ball Valves

Actuators were sized in this table using the maximum allowable pressure differential across the seats with a 1.20 multiplier for application factor. Please determine, by reading page 6, if the media or service conditions would render the information in this table questionable. Actuators for SB Series Ball Valves may also be downsized to fit the application using the technique found on page 6.

Two-way Valves SBL					Three-way Diverter Valves SBXD					Three-way Selector Valves SBX				
Valve Size	Double Acting AD		Spring Return AC/AD		Valve Size	Double Acting AD		Spring Return AC		Valve Size	Double Acting AD		Spring Return AC	
	60 psig (4.1 bar)	80 psig (5.5 bar)	60 psig (4.1 bar)	80 psig (5.5 bar)		60 psig (4.1 bar)	80 psig (5.5 bar)	60 psig (4.1 bar)	80 psig (5.5 bar)		60 psig (4.1 bar)	80 psig (5.5 bar)	60 psig (4.1 bar)	80 psig (5.5 bar)
T Seats					T Seats					T Seats				
SB8	61AD	61AD	62AC-3	61AC-2	SB8	61ADX	61ADX	64ACX-8	61ACX-2	SB8	61ADX	61ADX	64ACX-8	64ACX-8
SB12	61AD	61AD	62AC-3	61AC-2	SB12	61ADX	61ADX	64ACX-8	61ACX-2	SB12	61ADX	61ADX	68ACX-8	64ACX-12
SB16	62AD	61AD	63AC-3	63AC-3	SB16	64ADX	61ADX	64ACX-8	68ACX-2	SB16	64ADX	61ADX	68ACX-8	68ACX-8
SB20	62AD	62AD	65AC-3	63AC-4										
SB24	63AD	62AD	66AC-3	65AC-4	SB24	64ADX	64ADX	-	68ACX-12	SB24	68ADX	64ADX	*	*
SB32	63AD	63AD	69AC-3	66AC-4	SB32	68ADX	68ADX	*	*	SB32	68ADX	68ADX	*	*
RT Seats					RT Seats									
SB8	61AD	61AD	62AC-3	61AC-2	SB8	61ADX	61ADX	64ACX-8	61ACX-2					
SB12	61AD	61AD	62AC-3	62AC-3	SB12	61ADX	61ADX	64ACX-8	64ACX-8					
SB16	62AD	61AD	63AC-3	63AC-3	SB16	61ADX	61ADX	68ACX-8	68ACX-8					
SB20	63AD	63AD	69AC-3	66AC-4										
SB24	63AD	63AD	69AC-3	66AC-4	SB24	68ADX	68ADX	*	*					
SB32	66AD	65AD	69AC-3	69AC-3	SB32	-	68ADX	*	*					
PF Seats					PF Seats					PF Seats				
SB8	61AD	61AD	62AC-3	61AC-2	SB8	61ADX	61ADX	64ACX-8	61ACX-2	SB8	61ADX	61ADX	68ACX-8	64ACX-12
SB12	61AD	61AD	62AC-3	62AC-3	SB12	61ADX	61ADX	64ACX-8	64ACX-8	SB12	64ADX	61ADX	68ACX-8	68ACX-8
SB16	62AD	61AD	63AC-3	63AC-3	SB16	64ADX	64ADX	68ACX-8	68ACX-12	SB16	64ADX	64ADX	-	68ACX-12
SB20	63AD	62AD	66AC-3	64AC-4										
SB24	63AD	63AD	66AC-3	66AC-3	SB24	68ADX	64ADX	*	*	SB24	68ADX	68ADX	*	*
SB32	66AD	65AD	69AC-3	69AC-3	SB32	68ADX	68ADX	*	*	SB32	-	68ADX	*	*
PKP Seats					PKP Seats									
SB8	61AD	61AD	63AC-3	63AC-4	SB8	61ADX	61ADX	68ACX-8	64ACX-12					
SB12	63AD	62AD	66AC-3	65AC-4	SB12	64ADX	64ADX	68ACX-10	68ACX-10					
SB16	63AD	63AD	69AC-3	66AC-4	SB16	68ADX	68ADX	*	*					
SB20	65AD	63AD	69AC-3	69AC-4										
SB24	66AD	65AD	69AC-3	69AC-4	SB24	68ADX	68ADX	*	*					
SB32	69AD	66AD	-	69AC-4	SB32	*	*	*	*					
UPE Seats					UPE Seats					UPE Seats				
SB8	61AD	61AD	62AC-3	62AC-3	SB8	61ADX	61ADX	64ACX-8	64ACX-8	SB8	61ADX	61ADX	68ACX-8	64ACX-10
SB12	61AD	61AD	63AC-3	62AC-4	SB12	61ADX	61ADX	64ACX-8	64ACX-8	SB12	64ADX	61ADX	68ACX-8	68ACX-8
SB16	62AD	62AD	65AC-3	63AC-4	SB16	64ADX	61ADX	68ACX-8	68ACX-8	SB16	64ADX	64ADX	68ACX-10	68ACX-10
SB20	62AD	62AD	65AC-3	64AC-4										
SB24	63AD	62AD	66AC-3	65AC-4	SB24	64ADX	64ADX	-	68ACX-12	SB24	68ADX	68ADX	*	*
SB32	63AD	63AD	69AC-4	66AC-4	SB32	68ADX	64ADX	-	68ACX-12	SB32	68ADX	68ADX	*	*
DE Seats					DE Seats									
SB8	61AD	61AD	63AC-3	63AC-3	SB8	61ADX	61ADX	68ACX-8	64ACX-12					
SB12	62AD	61AD	63AC-3	63AC-3	SB12	64ADX	61ADX	68ACX-8	64ACX-12					
SB16	62AD	61AD	65AC-3	63AC-4	SB16	64ADX	61ADX	68ACX-8	68ACX-8					
SB20	65AD	63AD	69AC-3	66AC-4										
SB24	66AD	65AD	69AC-3	69AC-4	SB24	68ADX	68ADX	*	*					
SB32	69AD	66AD	-	69AC-4	SB32	*	*	*	*					

* Consult the factory for methods to actuate these valves.

Pneumatic Actuators

Determination of Valve Torque

By properly sizing an actuator to a valve for a specific application, performance is guaranteed and economies are gained. Before an actuator can be sized for an application, the amount of torque required must be determined. The operating torque of a ball valve is influenced by the design, seat material, and application (service) conditions.

Stem torque is primarily dependent upon the tightness of the stem nut. The design of the SB Series Ball Valve is such that the stem torque is constant. Ball/seat torque is created by the friction between the ball and seat and is also very sensitive to service conditions. The "floating ball" design concept allows the system pressure to force the ball into the downstream seat. The higher the system pressure, the harder the ball is forced into the downstream seat, and, therefore, the higher the torque. Also, since different seat materials have different coefficients of friction, the ball/seat torque also becomes a function of the seat material being used.

Valve torque is also a function of the media flowing through the valve. Abrasive medias have a tendency to increase the amount of friction between the ball and seats, whereas some light oils, which provide additional lubricity, may reduce the amount of torque required.

The pressure torque curves on page 7 are the result of laboratory testing using water at ambient temperature as the medium. Torque values derived from these curves, when the appropriate service condition correction factors are applied, will be adequate for the vast majority of applications.

Based upon the valve size, seat material, and differential pressure across the valve (in the closed position), the amount of torque required may be determined using the following procedure:

1. Find the valve torque from the appropriate curve by using the differential pressure. Locate the differential pressure on the horizontal axis of the chart and move up until you arrive at the appropriate valve size. Transfer the intersecting point across to the vertical axis of the graph and read the required torque.
2. Multiply this torque by the service and media application factor multipliers. The maximum combined multiplier should never be greater than 2.

Application Factor

Multiplier

A. Service

On-Off	1.00
Emergency shutdown (cycled less than once per month)	2.00
Applications with less than two cycles per day	1.20
Applications below -20 °F (-29 °C)	1.25

B. Media

Saturated steam	1.20
Clean saturated steam	1.00
Liquid, clean (particle free)	1.00
Liquid, dirty (slurry), raw water	1.80
Gas, clean and wet	1.20
Gas, clean and dry (superheated strn.)	1.00
Gas, dirty (natural gas)	1.50
Chlorine	1.50

Actuator Selection

When the torque requirements have been determined, the actuator may be properly sized.

1. Double Acting Operation (AD)

Select the actuator whose torque output, at the minimum air supply pressure, **exceeds** the calculated torque. Actuator torque output charts are shown on pages 8 and 9.

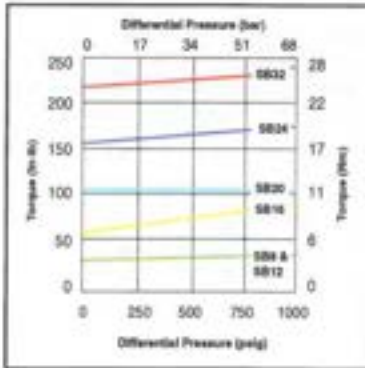
2. Spring Return Operation, Fail Closed (AC)

Select the actuator whose spring torque output **exceeds** the calculated torque. Actuator torque output charts are shown on pages 8 and 9. In addition, check the selected actuator to insure the air torque output at the minimum air supply pressure **also exceeds** the calculated torque.

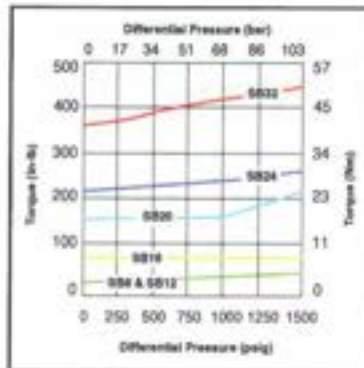
3. Spring Return Operation, Fail Open (AO)

Select the actuator whose spring torque output **exceeds** the calculated torque. Actuator torque output charts are shown on pages 8 and 9. In addition, check the selected actuator to insure the air torque output at the minimum air supply pressure **also exceeds** the calculated torque.

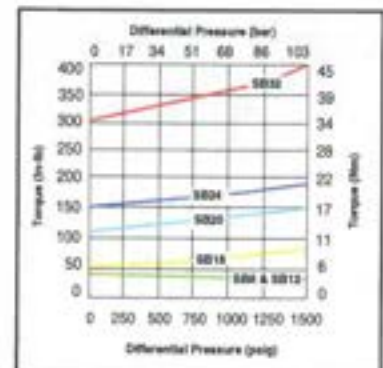
SB Series Pressure Torque Curves: Two-way (L) and Three-way (XD) Diverter Valves



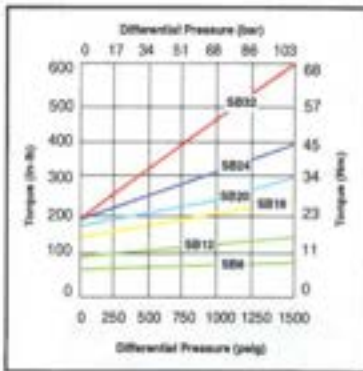
T Seats



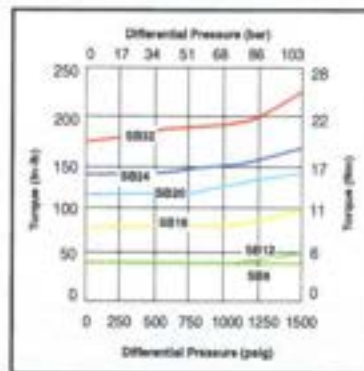
RT Seats



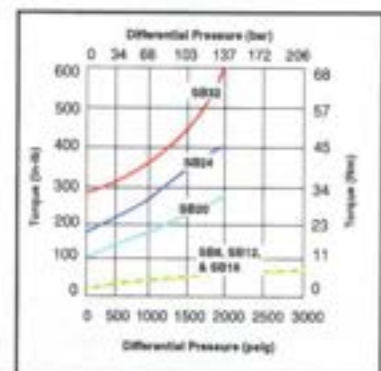
PF Seats



PKP Seats

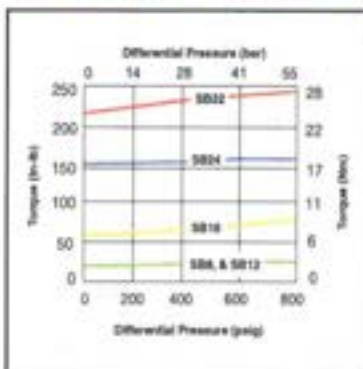


UPE Seats

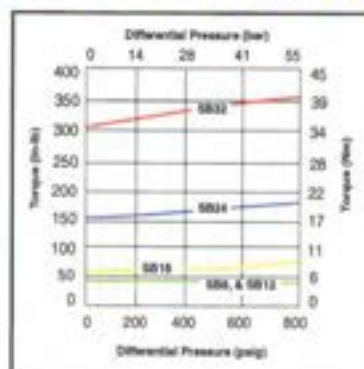


DE Seats

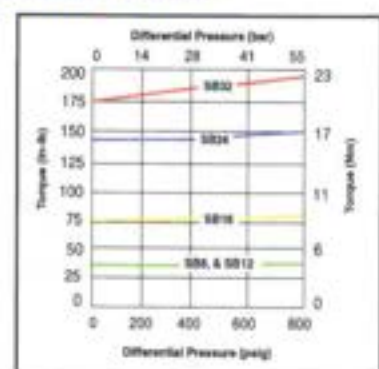
SB Series Pressure Torque Curves: Three-way (X) Selector Valves



T Seats



PF Seats



UPE Seats

Pneumatic Actuators

90° Models (AC, AO, and AD)

Performance Characteristics

Series	Bore		Stroke		Weight				Operating Time	Air Consumption		Air Consumption	
					AD		AC/AO			in		cc	
	Inch	mm	Inch	mm	lb	kg	lb	kg	sec	Port "A"	Port "B" +	Port "A"	Port "B" +
61	1.8	45.7	0.5	12.7	1.3	0.6	1.5	0.7	0.4	3.1	3.7	50.8	60.7
61S	1.8	45.7	0.5	12.7	1.2	0.5	1.2	0.6	0.4	2.4	1.2	39.3	19.7
62	2.2	55.9	0.6	15.2	2.9	1.3	3.7	1.7	0.5	6.1	6.7	100.0	109.8
63	2.8	71.1	0.7	17.8	4.0	1.8	5.3	2.4	0.7	9.8	13.4	160.7	219.7
65	3.1	78.7	0.9	22.1	5.3	2.4	7.9	3.6	1.1	20.1	22.0	329.5	360.7
66	3.6	91.4	1.0	25.4	6.8	3.1	10.1	4.6	1.2	21.4	29.9	350.8	490.2
69	4.3	109.2	1.5	38.1	12.8	5.8	20.1	9.1	2.3	49.0	61.0	803.3	1000.0

+Double acting only

AD Torques

Series	40 psig (2.8 bar)		60 psig (4.1 bar)		80 psig (5.5 bar)		100 psig (6.9 bar)	
	in-lb	Nm	in-lb	Nm	in-lb	Nm	in-lb	Nm
61	59	6.7	89	10.1	119	13.4	149	16.8
61S	-	-	45	5.1	59	6.7	75	8.5
62	109	12.3	165	18.6	220	24.9	276	31.2
63	205	23.2	309	34.9	413	46.7	518	58.5
65	312	35.2	471	53.2	630	71.2	789	89.1
66	461	52.1	696	78.6	930	105.1	1165	131.6
69	1011	114.2	1527	172.5	2042	230.7	2557	288.9

AC and AO Torques

Series	Spring Set	Air Torque								Spring Torque	
		40 psig (2.8 bar)		60 psig (4.1 bar)		80 psig (5.5 bar)		100 psig (6.9 bar)			
		in-lb	Nm	in-lb	Nm	in-lb	Nm	in-lb	Nm	in-lb	Nm
61	2	-	-	23	2.6	55	6.2	87	9.8	41	4.6
61S	-	-	-	16	1.8	21	2.4	26	2.9	21	2.4
62	2	44	5.0	103	11.6	162	18.3	220	24.9	39	4.4
	3	8	0.9	66	7.5	126	14.2	185	20.9	58	6.6
	4	-	-	31	3.5	90	10.2	149	16.8	78	8.8
	5	-	-	-	-	54	6.1	113	12.8	98	11.1
	6	-	-	-	-	18	2.0	77	8.7	117	13.2
63	2	82	9.3	193	21.8	304	34.3	413	46.7	74	8.4
	3	15	1.7	126	14.2	236	26.7	346	39.1	110	12.4
	4	-	-	58	6.6	169	19.1	279	31.5	146	16.5
	5	-	-	-	-	101	11.4	212	24.0	183	20.7
	6	-	-	-	-	34	3.8	144	16.3	220	24.9
65	2	117	13.2	285	32.2	453	51.2	622	70.3	117	13.2
	3	10	1.1	178	20.1	347	39.2	515	58.2	175	19.8
	4	-	-	72	8.1	240	27.1	408	46.1	234	26.4
	5	-	-	-	-	133	15.0	301	34.0	292	33.0
	6	-	-	-	-	26	2.9	195	22.0	351	39.7
66	2	192	21.7	441	49.8	690	78.0	939	106.1	161	18.2
	3	43	4.9	293	33.1	542	61.2	790	89.3	242	27.3
	4	-	-	143	16.2	392	44.3	641	72.4	323	36.5
	5	-	-	-	-	244	27.6	492	55.6	403	45.5
	6	-	-	-	-	95	10.7	344	38.9	484	54.7
69	2	406	45.9	952	107.6	1498	169.2	2043	230.8	361	40.8
	3	73	8.2	620	70.0	1165	131.6	1711	193.3	543	61.3
	4	-	-	287	32.4	833	94.1	1378	155.7	723	81.7
	5	-	-	-	-	500	56.5	1045	118.1	904	102.1
	6	-	-	-	-	167	18.9	713	80.6	1085	122.6

180° Models (ACX AND ADX)

Performance Characteristics

Series	Bore		Stroke		Weight				Operating Time	Air Consumption		Air Consumption	
					AD		AC			in ³		cc	
	Inch	mm	Inch	mm	lb	kg	lb	kg		Port "A"	Port "B" +	Port "A"	Port "B" +
61	1.8	45.7	1.0	25.4	1.9	0.9	2.4	1.1	0.8	4.5	5.7	73.8	93.4
61S	1.8	45.7	1.0	25.4	1.4	0.7	1.7	0.8	0.8	6.1	3.1	100.0	50.0
64	3.2	81.3	0.7	17.8	5.5	2.5	6.4	2.9	1.5	16.0	23.0	262.3	377.0
68	4.3	109.2	1.0	25.4	11.6	5.3	13.6	6.2	2.8	37.0	49.0	606.6	803.3

+Double acting only

ADX Torques

Series	40 psig (2.8 bar)		60 psig (4.1 bar)		80 psig (5.5 bar)	
	in-lb	Nm	in-lb	Nm	in-lb	Nm
61	59	6.7	89	10.1	119	13.4
61S	-	-	45	5.1	59	6.7
64	139	15.7	210	23.7	281	31.7
68	351	39.7	530	59.9	709	80.1

ACX Torques

Series	Spring Set	Air Torque						Spring Torque	
		40 psig (2.8 bar)		60 psig (4.1 bar)		80 psig (5.5 bar)			
		in-lb	Nm	in-lb	Nm	in-lb	Nm	in-lb	Nm
61	2	-	-	25	2.8	57	6.4	39	4.4
61S	-	-	-	16	1.8	21	2.4	21	2.4
64	8	19	2.1	90	10.2	161	18.2	62	7.0
	10	-	-	60	6.8	131	14.8	78	8.8
	12	-	-	30	3.4	101	11.4	93	10.5
	14	-	-	-	-	71	8.0	109	12.3
68	8	76	8.6	255	28.8	433	48.9	150	16.9
	10	-	-	186	21.0	365	41.2	187	21.1
	12	-	-	117	13.2	296	33.4	225	25.4
	14	-	-	48	5.4	227	25.6	262	29.6

Pneumatic Actuators

SB Series Actuator Sizing Examples

EXAMPLE 1

Valve Desired: 24Z-SB24L-PF-T-SS
Actuator Desired: Spring Return, Normally Closed
Differential Pressure: 250 psig
Minimum Air Supply Pressure: 80 psig
Service: On-off
Media: Raw Water

Calculation

From the PF Seal Pressure-Torque graph on page 7:

Torque at 250 psig = 170 in-lb

Service Factor from page 6:

Multiplier = 1.00

Media Factor from page 6:

Multiplier = 1.80

Application Operating Torque =

Operating Torque x Application Factor =
170 in-lb x 1.00 x 1.80 = 306 in-lb

From the AC Spring Torques on page 8, proceed down the table looking for a torque exceeding 306 in-lb. The 65AC-6 meets the requirement, but the Air Torque at 80 psig does not. Repeat this step to find a larger actuator. The next actuator in the table to meet both requirements is the 66AC-4.

Valve Model: 24Z-SB24L-PF-T-SS-66AC-4

EXAMPLE 2

Valve Desired: 12A-SB12L-T-SS
Actuator Desired: Spring Return, Normally Open
Differential Pressure: 400 psig
Minimum Air Supply Pressure: 60 psig
Service: -20 °F
Media: Dirty Gas

Calculation

From the T Seal Pressure-Torque graph on page 7:

Torque at 400 psig = 30 in-lb

Service Factor from page 6:

Multiplier = 1.25

Media Factor from page 6:

Multiplier = 1.50

Application Operating Torque =

Operating Torque x Application Factor =
30 in-lb x 1.25 x 1.50 = 57 in-lb

From the AC Spring Torques on page 8, proceed down the table looking for a torque exceeding 57 in-lb. The 62AO-3 meets the requirement for both Spring Torque and Air Torque.

Valve Model: 12A-SB12L-T-SS-62AO-3

How to Order Actuators

Factory Assembled

Add the actuator model designation as a suffix to the ball valve part number.

Example: **4Z-B6LJ2-SS-61AC-2**. Describes a B6 ball valve with a normally closed actuator.

For Field Assembly

Simply specify the actuator. Example: **65AC-3**. Mounting bracket kits are required when mounting actuators to valves.

With Mounting Brackets

Specify the ball valve series and seat material followed by the actuator. Examples: **B6LJ-61AO-2**, **MB6XPFA-61ACX**, **SB12LRT-62AC-3**.

Options

High Temperature Seals – Extends the high temperature from 175 °F (79 °C) to 250 °F (121 °C) and to 400 °F (204 °C) on special Series 62 and 63 90° models.

Low Temperature Seals – Extends the low temperature from -4 °F (-20 °C) to -40 °F (-40 °C).

Solenoid Valve (Single coil) – Mounts directly to the actuator inlet manifold. NEMA 4 or 7 housings with voltages of 24 VDC, 120 VAC, and 240 VAC. A manual override is standard.

Limit Switch – Rugged, fully enclosed unit contains two SPDT snap-acting switches operated by two independently adjustable cams on a rotating shaft coupled directly to the actuator auxiliary drive. Features a visual valve position indicator. Meets NEMA 4, 7, and 9 classifications for weather-resistant and hazardous locations.

Breather Block – A direct mount diverter module redirects instrument quality air to the spring chamber during the spring stroke (fail stroke) of AC and AO actuators. Ideal for corrosive, wet, or dusty environments. Also improves spring stroke speed and allows the solenoid valve to be mounted to it.

Dual Mount Actuator – Two valves may be actuated with a single actuator. Available with both valves open, both closed, or one open and one closed.

NOTE: Parker pneumatically actuated B Series Ball Valves should be ordered with elastometric stem packing and seals or the optional live-loaded PTFE packing. This reduces the need for any further packing adjustment after receipt from the factory.

How to Order Options

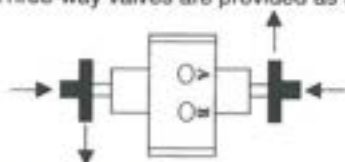
High Temperature Seals – Add the suffix **–HT** to the end of the part number for service up to 250 °F (121 °C). Add the suffix **–HT4** to the end of the part number for service up to 400 °F (204 °C). **NOTE:** The **–HT4** option is only available on series 62 and 63 90° models. Example: 2F-HB4LK-BN-SS-61AD-**HT**.

Low Temperature Seals – Add the suffix **–LT** to the end of the part number. Example: 4A-MB4LPFA-SS-61SAC-**LT**.

Accessories – Add one of the following suffixes to the end of the part number. Example: 16F-SB16L-PF-T-SS-63AC-3-**2D**.

Suffix	Accessory
Single Option	
-1A	Breather Block
-1B	Solenoid Valve, (NEMA 4, 120 VAC)
-1C	Solenoid Valve, (NEMA 7, 120 VAC)
-1D	Solenoid Valve, (NEMA 4, 24 VDC)
-1E	Solenoid Valve, (NEMA 7, 24 VDC)
-1F	Solenoid Valve, (NEMA 4, 240 VAC)
-1G	Solenoid Valve, (NEMA 7, 240 VAC)
-1H	Limit Switch – Two SPDT switches with mounting kit
Double Option	
-2A	Breather Block, Solenoid Valve, (NEMA 4, 120 VAC)
-2B	Breather Block, Solenoid Valve, (NEMA 7, 120 VAC)
-2C	Breather Block, Solenoid Valve, (NEMA 4, 24 VDC)
-2D	Breather Block, Solenoid Valve, (NEMA 7, 24 VDC)
-2E	Breather Block, Solenoid Valve, (NEMA 4, 240 VAC)
-2F	Breather Block, Solenoid Valve, (NEMA 7, 240 VAC)
-2G	Limit Switch, Solenoid Valve, (NEMA 4, 120 VAC)
-2H	Limit Switch, Solenoid Valve, (NEMA 7, 120 VAC)
-2J	Limit Switch, Solenoid Valve, (NEMA 4, 24 VDC)
-2K	Limit Switch, Solenoid Valve, (NEMA 7, 24 VDC)
-2L	Limit Switch, Solenoid Valve, (NEMA 4, 240 VAC)
-2M	Limit Switch, Solenoid Valve, (NEMA 7, 240 VAC)
Triple Option	
-3A	Breather Block, Limit Switch, Solenoid Valve, (NEMA 4, 120 VAC)
-3B	Breather Block, Limit Switch, Solenoid Valve, (NEMA 7, 120 VAC)
-3C	Breather Block, Limit Switch, Solenoid Valve, (NEMA 4, 24 VDC)
-3D	Breather Block, Limit Switch, Solenoid Valve, (NEMA 7, 24 VDC)
-3E	Breather Block, Limit Switch, Solenoid Valve, (NEMA 4, 240 VAC)
-3F	Breather Block, Limit Switch, Solenoid Valve, (NEMA 7, 240 VAC)

Dual Mount Actuator – Add **–DVM** as a suffix to the end of the part number. Example: 6F-B6LPKC-SS-61AC-2-**DVM**. With **DVM** dual mount valve options, the following are standard arrangements: Two-way valves are provided in their failed position (in their closed position with AD actuators). Three-way valves are provided as shown below. Contact the factory for details on other available options.



How to Order Mounting Bracket Kits

Add the valve series and actuator model designation as a suffix to **MK-**. Example: **MK-MB4L-61S**. Describes a mounting kit for a MB Series ball valve with a 61S Series actuator.



WARNING

FAILURE, IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

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Rosemount 3051 Pressure Transmitter

HART® AND FIELDBUS PROTOCOLS

- *Industry's best total performance of $\pm 0.15\%$*
- *Five year stability of $\pm 0.125\%$*
- *Unmatched dynamic performance*
- *Coplanar™ platform enables Complete Point Solutions™*
- *Advanced PlantWeb™ Functionality*



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Setting the Standard for Pressure Measurement

Industry's best total performance, a flexible Coplanar platform, and guaranteed 5- year stability, has made the Rosemount 3051 the standard in pressure measurement.

Industry's best total performance of $\pm 0.15\%$

Total performance is the true measure of "real-world" transmitter performance. Using superior sensor technology and engineered for optimal performance, the 3051 delivers unprecedented $\pm 0.075\%$ reference accuracy, resulting in total operating performance of $\pm 0.15\%$. Superior total performance equates to reduced variability and improved plant safety.

Five year stability of $\pm 0.125\%$

Transmitter stability is a critical measure of transmitter performance over time. Through aggressive simulation testing, the 3051 has proven its ability to maintain performance over a five year period under the most demanding process conditions. Superior transmitter stability reduces calibration frequency to save operation and maintenance costs.

Unmatched dynamic performance

In dynamic applications, speed of measurement is as important as repeatability. The 3051 responds up to eight times faster than the typical Smart pressure transmitter to detect and control variations quickly and efficiently. Superior dynamic response yields more accurate measurements to reduce variability and increase profitability.

Coplanar platform enables complete point solutions

The versatile Coplanar platform design enables the right process connection for all your pressure, flow and level applications. Right out of the box, the solution arrives factory calibrated, pressure-tested, and ready to install. Only the 3051 has a scalable, flexible design to reduce engineering and inventory costs.

Advanced PlantWeb Functionality

Optional functionality includes performance diagnostics and Control Anywhere™. Performance diagnostics - such as plugged impulse line detection and statistical process monitoring - go beyond the transmitter to evaluate the performance of the entire measurement system. Control Anywhere provides user-configurable transmitter-resident function blocks, such as PID, Math, and signal characterization.

Rosemount Pressure Solutions

Rosemount 3051S Series of Instrumentation

Scalable pressure, flow and level measurement solutions improve installation and maintenance practices.

Rosemount 3095MV Mass Flow Transmitter

Accurately measures differential pressure, static pressure and process temperature to dynamically calculate fully compensated mass flow.

Rosemount 305 and 306 Integral Manifolds

Factory-assembled, calibrated and seal-tested manifolds reduce on-site installation costs.

Rosemount 1199 Diaphragm Seals

Provides reliable, remote measurements of process pressure and protects the transmitter from hot, corrosive, or viscous fluids.

Orifice Plate Primary Element Systems: Rosemount 1495 and 1595 Orifice Plates, 1496 Flange Unions and 1497 Meter Sections

A comprehensive offering of orifice plates, flange unions and meter sections that is easy to specify and order. The 1595 Conditioning Orifice provides superior performance in tight fit applications.

Annubar Flowmeter Series: Rosemount 3051SFA, 3095MFA, and 485

The state-of-the-art, fifth generation Rosemount 485 Annubar combined with the 3051S or 3095MV MultiVariable transmitter creates an accurate, repeatable and dependable insertion-type flowmeter.

Compact Orifice Flowmeter Series: Rosemount 3051SFC, 3095MFC, and 405

Compact Orifice Flowmeters can be installed between existing flanges, up to a Class 600 (PN100) rating. In tight fit applications, a conditioning orifice plate version is available, requiring only two diameters of straight run upstream.

ProPlate Flowmeter Series: Rosemount ProPlate, Mass ProPlate, and 1195

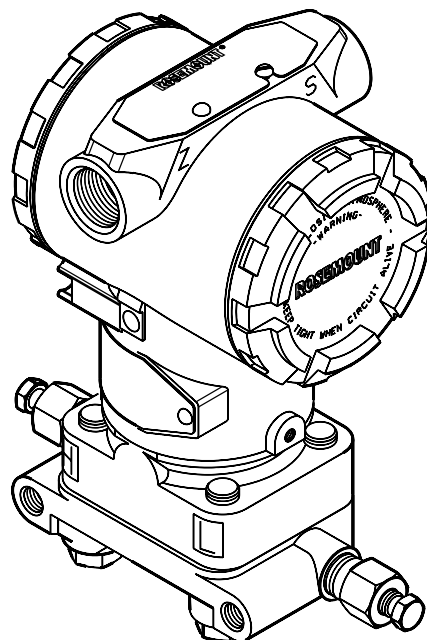
These integral orifice flowmeters eliminate the inaccuracies that become more pronounced in small orifice line installations. The completely assembled, ready to install flowmeters reduce cost and simplify installation.

Product Offering

Rosemount 3051C Differential, Gage, and Absolute

See ordering information on page 24.

- Performance up to 0.075% accuracy with 100:1 turndown
- Five year stability of 0.125%
- Coplanar platform enables integrated manifold, primary element and diaphragm seal solutions
- Calibrated spans/ranges from 0.1 inH₂O to 4000 psi (0,25 mbar to 276 bar)
- 316L SST, Hastelloy C®, Monel®, Tantalum, Gold-plated Monel, or Gold-plated 316L SST process isolators

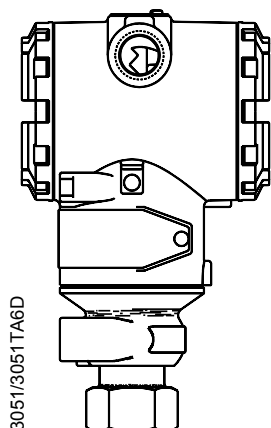


3051/3031A07E

Rosemount 3051T Gage and Absolute

See ordering information on page 28.

- Performance up to 0.075% accuracy
- Five year stability of 0.125%
- Calibrated spans from 0.3 to 10000 psi (10,3 mbar to 689 bar)
- Multiple process connections available
- 316L SST and Hastelloy C process isolators

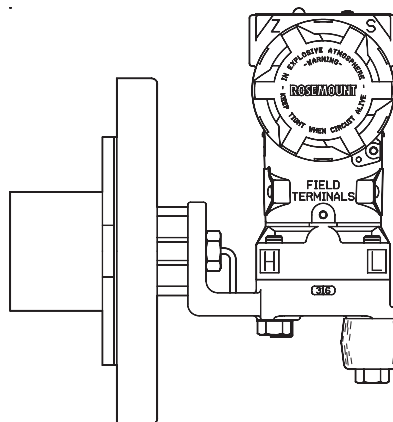


3051/3051TA6D

Rosemount 3051L Liquid Level

See ordering information on page 30.

- Performance up to 0.075% accuracy with 100:1 turndown
- Flush, 2-, 4-, and 6-in. extended diaphragms
- Multiple fill fluids available
- 316L SST, Hastelloy, or Tantalum wetted materials



3051/3031C27C

Specifications

This product data sheet covers both HART and fieldbus protocols unless specified.

PERFORMANCE SPECIFICATIONS⁽¹⁾

Total Performance is based on combined errors of reference accuracy, ambient temperature effect, and static pressure effect.

Rosemount 3051C (Ranges 2–5), Rosemount 3051T

Reference Accuracy

±0.075% of span

Total Performance

±0.15% of span for ±50 °F (28 °C) temperature changes, up to 1000 psi (6,9 MPa) line pressure (CD only), from 1:1 to 5:1 rangedown.

Stability

±0.125% of URL for 5 years for ±50 °F (28 °C) temperature changes, and up to 1000 psi (6,9 MPa) line pressure.

Dynamic Performance Total Response Time ($T_d + T_c$)

HART output: 100 ms

Fieldbus and Profibus output: 152 ms

Rosemount 3051CD, Low/Draft Range (Ranges 0–1)

Reference Accuracy

±0.10% of span

Stability

±0.2% of URL for 1 year

Rosemount 3051P—Reference Class

Reference Accuracy

±0.05% of span

Total Performance

±0.10% of span for ±50 °F (28 °C) temperature changes, up to 1000 psi (6,9 MPa) line pressure, from 1:1 to 5:1 rangedown

Stability

±0.125% of URL for 5 years for ±50 °F (28 °C) temperature changes, and up to 1000 psi (6,9 MPa) line pressure

Dynamic Performance

Total Response Time ($T_d + T_c$)

100 ms

Rosemount 3051L—Liquid Level

Reference Accuracy

±0.075% of span

Rosemount 3051H—High Process Temperature

Reference Accuracy

±0.075% of span

Stability

±0.1% of URL for 12 months for Ranges 2 and 3.

±0.2% of URL for 12 months for Ranges 4 and 5.

DETAILED PERFORMANCE SPECIFICATIONS

For zero-based spans, reference conditions, silicone oil fill, SST materials, Coplanar flange (3051C) or 1/2 in.-18 NPT (3051T) process connections, digital trim values set to equal range points.

Reference Accuracy⁽¹⁾

Stated reference accuracy includes hysteresis, terminal-based linearity and repeatability.

Rosemount 3051CD

Ranges 2–5 and 3051CG

±0.075% of span

For spans less than 10:1, accuracy =

$$\pm \left[0.025 + 0.005 \left(\frac{URL}{Span} \right) \right] \% \text{ of Span}$$

Rosemount 3051CD Range 1

±0.10% of span

For spans less than 15:1, accuracy =

$$\pm \left[0.025 + 0.005 \left(\frac{URL}{Span} \right) \right] \% \text{ of Span}$$

Rosemount 3051CD Range 0

±0.10% of span

For spans less than 2:1, accuracy =

±0.05% of URL

Rosemount 3051T/CA Ranges 1–5

±0.075% of span

For spans less than 10:1, accuracy =

$$\pm \left[0.0075 \left(\frac{URL}{Span} \right) \right] \% \text{ of Span}$$

Rosemount 3051CA Range 0

±0.075% of span

For spans less than 5:1, accuracy =

$$\pm \left[0.025 + 0.01 \left(\frac{URL}{Span} \right) \right] \% \text{ of Span}$$

(1) For FOUNDATION™ fieldbus transmitters, use calibrated range in place of span.

Rosemount 3051H/3051L

±0.075% of span.

For spans less than 10:1, accuracy =

$$\pm \left[0.025 + 0.005 \left(\frac{URL}{Span} \right) \right] \% \text{ of Span}$$

Rosemount 3051P

±0.05% of span

Ambient Temperature Effect per 50 °F (28 °C)

Rosemount 3051CD/CG

±(0.0125% URL + 0.0625% span) from 1:1 to 5:1

±(0.025% URL + 0.125% span) from 5:1 to 100:1

Range 0: ±(0.25% URL + 0.05% span)

Range 1: ±(0.1% URL + 0.25% span)

Rosemount 3051CA

±(0.025% URL + 0.125% span) from 1:1 to 30:1

±(0.035% URL + 0.125% span) from 30:1 to 100:1

Range 0: ±(0.1% URL + 0.25% span)

Rosemount 3051P

±(0.006% URL + 0.03% span)

Rosemount 3051H

±(0.025% URL + 0.125% span + 0.35 inH₂O)

For spans below 30:1 rangedown:

±(0.035% URL + 0.125% span + 0.35 inH₂O)

Rosemount 3051L

See Rosemount Inc. Instrument Toolkit™ software.

Rosemount 3051T

±(0.025% URL + 0.125% span) from 1:1 to 30:1

±(0.035% URL + 0.125% span) from 30:1 to 100:1

Range 5: ±(0.1% URL + 0.15% span)

Range 1: ±(0.025% URL + 0.125% span) from 1:1 to 10:1

±(0.05% URL + 0.125% span) from 10:1 to 100:1

Line Pressure Effect per 1000 psi (6,9 MPa)

Rosemount 3051CD

Zero Error (can be calibrated out at line pressure)

±0.05% of URL for line pressures from 0 to 2000 psi (0 to 13,7 MPa)

For line pressures above 2000 psi (13,7 MPa), see user manual (Rosemount publication number 00809-0100-4001)

Range 0: ±0.125% of URL/100 psi (6,89 bar)

Range 1: ±0.25% of URL

Span Error

±0.1% of reading

Range 0: ±0.15% of reading/100 psi (6,89 bar)

Range 1: ±0.4% of reading

Rosemount 3051P

Zero Error (can be calibrated out at line pressure)

±0.04% of URL

Span Error

±0.10% of reading

Rosemount 3051HD

Zero Error (can be calibrated out at line pressure)

±0.1% of URL for line pressures from 0 to 2000 psi (0 to 13,7 MPa)

For line pressures above 2000 psi (13,7 MPa), see user manual (Rosemount publication number 00809-0100-4001)

Span Error

±0.1% of reading

Dynamic Performance

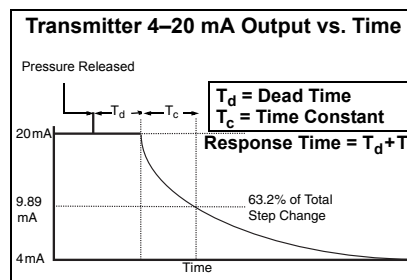
	4 - 20 mA (HART® protocol) ⁽¹⁾	Fieldbus protocol ⁽³⁾
Total Response Time (T_d + T_c)⁽²⁾:		
3051C/P, Ranges 2-5:	100 ms	152 ms
Range 1:	255 ms	307 ms
Range 0:	700 ms	752 ms
3051T:	100 ms	152 ms
3051H/L:	Consult factory	Consult factory
Dead Time (T_d)	45 ms (nominal)	97 ms
Update Rate	22 times per second	22 times per second

(1) Dead time and update rate apply to all models and ranges; analog output only

(2) Nominal total response time at 75 °F (24 °C) reference conditions.

(3) Transmitter fieldbus output only, segment macro-cycle not included.

FIGURE 1. Typical Smart Transmitter Response Time



3051-3051_17A

Mounting Position Effects

Rosemount 3051C/P

Zero shifts up to ± 1.25 inH₂O (3,11 mbar), which can be calibrated out. No span effect.

Rosemount 3051H

Zero shifts up to ± 5 inH₂O (127 mmH₂O), which can be calibrated out. No span effect.

Rosemount 3051L

With liquid level diaphragm in vertical plane, zero shift of up to 1 inH₂O (25,4 mmH₂O).

With diaphragm in horizontal plane, zero shift of up to 5 inH₂O (127 mmH₂O) plus extension length on extended units. All zero shifts can be calibrated out. No span effect.

Rosemount 3051T/CA

Zero shifts up to 2.5 inH₂O (63,5 mmH₂O), which can be calibrated out. No span effect.

Vibration Effect

All Models

Measurement effect due to vibrations is negligible except at resonance frequencies. When at resonance frequencies, vibration effect is less than $\pm 0.1\%$ of URL per g when tested between 15 and 2000 Hz in any axis relative to pipe-mounted process conditions.

Power Supply Effect

All Models

Less than $\pm 0.005\%$ of calibrated span per volt.

RFI Effects

All Models

$\pm 0.1\%$ of span from 20 to 1000 MHz and for field strength up to 30 V/m.

Transient Protection (Option Code T1)

All Models

Meets IEEE Standard 587, Category B

1 kV crest (10 $\times$ 1 000 microseconds)

3 kV crest (8 $\times$ 20 microseconds)

6 kV crest (1,2 $\times$ 50 microseconds)

Meets IEEE Standard 472, Surge Withstand Capability

SWC 2,5 kV crest, 1 MHz wave form

General Specifications:

Response Time: < 1 nanosecond

Peak Surge Current: 5000 amps to housing.

Peak Transient Voltage: 100 V dc.

Loop Impedance: < 25 ohms

Applicable Standards: IEC 801-4, IEC 801-5

NOTE:

Calibrations at 68 °F (20 °C) per ASME Z210.1 (ANSI)

FUNCTIONAL SPECIFICATIONS

Range and Sensor Limits

TABLE 1. 3051CD, 3051CG, 3051P, 3051L, and 3051H Range and Sensor Limits

Range	Minimum Span		Range and Sensor Limits							
	3051CD ⁽¹⁾ , CG, L, H	3051P	Upper (URL)	3051C Differential	3051C/P ⁽²⁾ Gage	Lower (LRL)				
						3051P Differential	3051L Differential	3051L Gage	3051H Differential	3051H Gage
0	0.1 inH ₂ O (0,25 mbar)	NA	3.0 inH ₂ O (7,47 mbar)	-3.0 inH ₂ O (-7,47 mbar)	NA	NA	NA	NA	NA	NA
1	0.5 inH ₂ O (1,2 mbar)	NA	25 inH ₂ O (62,3 mbar)	-25 inH ₂ O (-62,3 mbar)	-25 inH ₂ O (-62,3 mbar)	NA	NA	NA	NA	NA
2	2.5 inH ₂ O (6,2 mbar)	25 inH ₂ O (62,3 mbar)	250 inH ₂ O (0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)
3	10 inH ₂ O (24,9 mbar)	100 inH ₂ O (0,25 bar)	1000 inH ₂ O (2,49 bar)	-1000 inH ₂ O (-2,49 bar)	0.5 psia (34,5 mbar abs)	-1000 inH ₂ O (-2,49 bar)	-1000 inH ₂ O (-2,49 bar)	0.5 psia (34,5 mbar abs)	-1000 inH ₂ O (-2,49 bar)	0.5 psia (34,5 mbar abs)
4	3 psi (0,20 bar)	30 psi (2,07 bar)	300 psi (20,6 bar)	-300 psi (-20,6 bar)	0.5 psia (34,5 mbar abs)	NA	-300 psi (-20,6 bar)	0.5 psia (34,5 mbar abs)	-300 psi (-20,6 bar)	0.5 psia (34,5 mbar abs)
5	20 psi (1,38 bar)	200 psi (13,8 bar)	2000 psi (137,9 bar)	-2000 psi (-137,9 bar)	0.5 psia (34,5 mbar abs)	NA	NA	NA	-2000 psi (-137,9 bar)	0.5 psia (34,5 mbar abs)

(1) Range 0 only available with 3051CD. Range 1 only available with 3051CD or 3051CG.

(2) Range 1 not available with 3051P.

Product Data Sheet

00813-0100-4001, Rev DB

September 2003

Rosemount 3051

TABLE 2. Range and Sensor Limits

3051CA			
Range	Range and Sensor Limits		
	Minimum Span	Upper (URL)	Lower (LRL)
0	0.167 psia (11,51 mbar)	5 psia (0,34 bar)	0 psia (0 bar)
1	0.3 psia (20,6 mbar)	30 psia (2,07 bar)	0 psia (0 bar)
2	1.5 psia (0,103 bar)	150 psia (10,3 bar)	0 psia (0 bar)
3	8 psia (0,55 bar)	800 psia (55,2 bar)	0 psia (0 bar)
4	40 psia (2,76 bar)	4000 psia (275,8 bar)	0 psia (0 bar)

3051T				
Range	Range and Sensor Limits			
	Minimum Span	Upper (URL)	Lower (LRL)	Lower ⁽¹⁾ (LRL) (Gage)
1	0.3 psi (20,6 mbar)	30 psi (2,07 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
2	1.5 psi (0,103 bar)	150 psi (10,3 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
3	8 psi (0,55 bar)	800 psi (55,2 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
4	40 psi (2,76 bar)	4000 psi (275,8 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
5	2000 psi (137,9 bar)	10000 psi (689,4 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)

(1) Assumes atmospheric pressure of 14.7 psig.

Zero and Span Adjustment Requirements (HART and Low Power)

Zero and span values can be set anywhere within the range limits stated in Table 1 and Table 2.

Span must be greater than or equal to the minimum span stated in Table 1 and Table 2.

Service

Liquid, gas, and vapor applications

4–20 mA (Output Code A)

Output

Two-wire 4–20 mA, user-selectable for linear or square root output. Digital process variable superimposed on 4–20 mA signal, available to any host that conforms to the HART protocol.

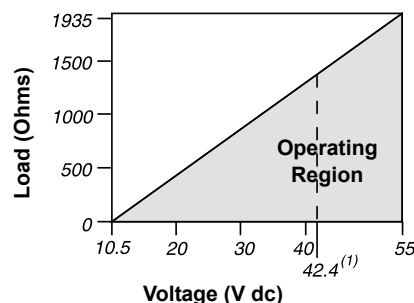
Power Supply

External power supply required. Standard transmitter (4–20 mA) operates on 10.5 to 55 V dc with no load.

Load Limitations

Maximum loop resistance is determined by the voltage level of the external power supply, as described by:

$$\text{Max. Loop Resistance} = 43.5 (\text{Power Supply Voltage} - 10.5)$$



Communication requires a minimum loop resistance of 250 ohms.

(1) For CSA approval, power supply must not exceed 42.4 V.

FOUNDATION fieldbus (output code F) and Profibus (output code W)

Power Supply

External power supply required; transmitters operate on 9.0 to 32.0 V dc transmitter terminal voltage.

Current Draw

17.5 mA for all configurations (including LCD meter option)

Low Power (Output Code M)

Output

Three wire 1–5 V dc or 0.8–3.2 V dc (Option Code C2) user-selectable output. Also user selectable for linear or square root output configuration. Digital process variable superimposed on voltage signal, available to any host conforming to the HART protocol. Low-power transmitter operates on 6–12 V dc with no load.

Power Consumption

3,0 mA, 18–36 mW

Minimum Load Impedance

100 k Ω (V_{out} wiring)

Indication

Optional 5-digit LCD meter

Overpressure Limits

Transmitters withstand the following limits without damage:

Rosemount 3051CD/CG

Range 0: 750 psi (51,7 bar)

Range 1: 2000 psig (137,9 bar)

Ranges 2–5: 3626 psig (250 bar)

Rosemount 3051CA

Range 0: 60 psia (4,14 bar)

Range 1: 750 psia (51,7 bar)

Range 2: 300 psia (20,7 bar)

Range 3: 1600 psia (110,3 bar)

Range 4: 6000 psia (413,7 bar)

Rosemount 3051H

All Ranges: 3626 psig (25 MPa)

Rosemount 3051TG/TA

Range 1: 750 psi (51,7 bar)

Range 2: 1500 psi (103,4 bar)

Range 3: 1600 psi (110,3 bar)

Range 4: 6000 psi (413,7 bar)

Range 5: 15000 psi (1034,2 bar)

Rosemount 3051PG

Ranges 2-5: 3626 psig (250 bar)

Rosemount 3051PD

Ranges 2 and 3: 2000 psig (13,8 MPa)

For 3051L or Level Flange Option Codes FA, FB, FC, FD, FP, and FQ, limit is 0 psia to the flange rating or sensor rating, whichever is lower.

TABLE 3. 3051L and Level Flange Rating Limits

Standard	Type	CS Rating	SST Rating
ANSI/ASME	Class 150	285 psig	275 psig
ANSI/ASME	Class 300	740 psig	720 psig
ANSI/ASME	Class 600	1480 psig	1440 psig
At 100 °F (38 °C), the rating decreases with increasing temperature.			
DIN	PN 10–40	40 bar	40 bar
DIN	PN 10/16	16 bar	16 bar
DIN	PN 25/40	40 bar	40 bar
At 248 °F (120 °C), the rating decreases with increasing temperature.			

Static Pressure Limit

Rosemount 3051CD Only

Operates within specifications between static line pressures of 0.5 psia and 3626 psig (4500 psig for Option Code P9).

Range 0: 0.5 psia and 750 psig

Range 1: 0.5 psia and 2000 psig

Rosemount 3051PD Only

Operates within specifications between static line pressures of 0.5 psia and 2000 psig.

Burst Pressure Limits

Burst pressure on Coplanar, traditional, or 3051H process flange is 10000 psig (69 MPa).

Burst pressure for the 3051T is

Ranges 1–4: 11000 psi (75,8 MPa)

Range 5: 26000 psig (179 MPa)

Failure Mode Alarm

Output Code A

If self-diagnostics detect a gross transmitter failure, the analog signal will be driven either below 3,75 mA or to 22 mA to alert the user. High or low alarm signal is user-selectable by internal jumper.

Output Code M

If self-diagnostics detect a gross transmitter failure, the analog signal will be driven either below 0.94 V or above 5.4 V to alert the user (below 0.75 V or above 4.4 V for Option C2). High or low alarm signal is user-selectable by internal jumper.

Output Code F and W

If self-diagnostics detect a gross transmitter failure, that information gets passed as a status along with the process variable.

Temperature Limits

Ambient

–40 to 185 °F (–40 to 85 °C)

With integral meter: –4 to 175 °F (–20 to 80 °C)

Storage

–50 to 230 °F (–46 to 110 °C)

With integral meter: –40 to 185 °F (–40 to 85 °C)

Process

At atmospheric pressures and above. See Table 4

TABLE 4. 3051 Process Temperature Limits

3051CD, 3051CG, 3051CA, 3051P	
Silicone Fill Sensor ⁽¹⁾	
with Coplanar Flange	–40 to 250 °F (–40 to 121 °C) ⁽²⁾
with Traditional Flange	–40 to 300 °F (–40 to 149 °C) ⁽²⁾⁽³⁾
with Level Flange	–40 to 300 °F (–40 to 149 °C) ⁽²⁾
with 305 Integral Manifold	–40 to 300 °F (–40 to 149 °C) ⁽²⁾
Inert Fill Sensor ⁽¹⁾	0 to 185 °F (–18 to 85 °C) ⁽⁴⁾⁽⁵⁾
3051H (Process Fill Fluid)	
D.C.® Silicone 200 ⁽¹⁾	–40 to 375 °F (–40 to 191 °C)
Inert ⁽¹⁾	–50 to 350 °F (–45 to 177 °C)
Neobee M-20 ⁽¹⁾	0 to 375 °F (–18 to 191 °C)
3051T (Process Fill Fluid)	
Silicone Fill Sensor ⁽¹⁾	–40 to 250 °F (–40 to 121 °C) ⁽²⁾
Inert Fill Sensor ⁽¹⁾	–22 to 250 °F (–30 to 121 °C) ⁽²⁾
3051L Low-Side Temperature Limits	
Silicone Fill Sensor ⁽¹⁾	–40 to 250 °F (–40 to 121 °C) ⁽²⁾
Inert Fill Sensor ⁽¹⁾	0 to 185 °F (–18 to 85 °C) ⁽²⁾
3051L High-Side Temperature Limits (Process Fill Fluid)	
Syltherm® XLT	–100 to 300 °F (–73 to 149 °C)
D.C. Silicone 704®	60 to 400 °F (15 to 205 °C)
D.C. Silicone 200	–40 to 400 °F (–40 to 205 °C)
Inert	–50 to 350 °F (–45 to 177 °C)
Glycerin and Water	0 to 200 °F (–18 to 93 °C)
Neobee M-20	0 to 400 °F (–18 to 205 °C)
Propylene Glycol and Water	0 to 200 °F (–18 to 93 °C)

(1) Process temperatures above 185 °F (85 °C) require derating the ambient limits by a 1.5:1 ratio (0.6:1 ratio for the 3051H).

(2) 220 °F (104 °C) limit in vacuum service; 130 °F (54 °C) for pressures below 0.5 psia.

(3) 3051CD0 process temperature limits are –40 to 212 °F (–45 to 100 °C)

(4) 160 °F (71 °C) limit in vacuum service.

(5) Not available for 3051CA.

Humidity Limits

0–100% relative humidity

Turn-On Time

Performance within specifications less than 2.0 seconds (10.0 s for Profibus protocol) after power is applied to the transmitter

Volumetric Displacement

Less than 0.005 in³ (0.08 cm³)

Damping

Analog output response to a step input change is user-selectable from 0 to 36 seconds for one time constant. This software damping is in addition to sensor module response time.

PHYSICAL SPECIFICATIONS

Electrical Connections

1/2–14 NPT, PG 13.5, G 1/2, and M20 × 1.5 (CM20) conduit. HART interface connections fixed to terminal block.

Process Connections

All Models except 3051L and 3051T

1/4–18 NPT on 2 1/8-in. centers

1/2–14 NPT on 2-, 2 1/8-, or 2 1/4-in. centers

Rosemount 3051L

High pressure side: 2-, 3-, or 4-in., ASME B 16.5 (ANSI) Class 150, 300 or 600 flange; 50, 80 or 100 mm, PN 40 or 10/16 flange

Low pressure side: 1/4–18 NPT on flange 1/2–14 NPT on adapter

Rosemount 3051T

1/4–18 NPT, 1/2–14 NPT female, Non-Threaded instrument flange (available in SST for Range 1–4 transmitters only), G 1/2 A DIN 16288 Male (available in SST for Range 1–4 transmitters only), or Autoclave type F-250-C (Pressure relieved 9/16–18 gland thread; 1/4 OD high pressure tube 60° cone; available in SST for Range 5 transmitters only).

Process-Wetted Parts

Drain/Vent Valves

316 SST, Hastelloy C, or Monel material (Monel not available with 3051L or 3051H)

Process Flanges and Adapters

Plated carbon steel, CF-8M (Cast version of 316 SST, material per ASTM-A743), Hastelloy C, or Monel

Wetted O-rings

Glass-filled TFE (Graphite-filled TFE with isolating diaphragm Option Code 6)

Process Isolating Diaphragms

Isolating Diaphragm Material	3051CD/CG	3051T	3051CA	3051P	3051H
316L SST	•	•	•	•	•
Hastelloy C-276®	•	•	•	•	•
Monel	•		•		
Tantalum	•				•
Gold-plated Monel	•		•		
Gold-plated SST	•		•		

Rosemount 3051L Process Wetted Parts

Flanged Process Connection (Transmitter High Side)

Process Diaphragms, Including Process Gasket Surface:

316L SST, Hastelloy C-276, or Tantalum

Extension

CF-3M (Cast version of 316L SST, material per ASTM-A743), or Hastelloy C. Fits schedule 40 and 80 pipe.

Mounting Flange

Zinc-cobalt plated CS or SST

Reference Process Connection (Transmitter Low Side)

Isolating Diaphragms

316L SST or Hastelloy C-276

Reference Flange and Adapter

CF-3M (Cast version of 316L SST, material per ASTM-A743)

Non-Wetted Parts

Electronics Housing

Low-copper aluminum or CF-3M (Cast version of 316L SST, material per ASTM-A743). NEMA 4X, IP 65, IP 66

Coplanar Sensor Module Housing

CF-3M (Cast version of 316L SST, material per ASTM-A743)

Bolts

Plated carbon steel per ASTM A449, Type 1: Austenitic 316 SST, ASME B 16.5 (ANSI)/ASTM-A-193-B7M, or Monel

Sensor Module Fill Fluid

Silicone or inert halocarbon (inert not available with 3051CA or 3051H). 3051T uses Fluorinert® FC-43

Process Fill Fluid (3051L and 3051H only)

3051L: Syltherm XLT, D.C. Silicone 704, D.C. Silicone 200, inert, glycerin and water, Neobee M-20 or propylene glycol and water

3051H: inert, Neobee M-20, or D.C. Silicone 200

Paint

Polyurethane

Cover O-rings

Buna-N

Shipping Weights

Refer to "Shipping Weights" on page 40

Product Certifications

Approved Manufacturing Locations

Rosemount Inc. — Chanhassen, Minnesota USA
Fisher-Rosemount GmbH & Co. — Wessling, Germany
Emerson Process Management Asia Pacific
Private Limited — Singapore
Beijing Rosemount Far East Instrument Co., LTD — Beijing, China

European Directive Information

The EC declaration of conformity for all applicable European directives for this product can be found on the Rosemount website at www.rosemount.com. A hard copy may be obtained by contacting our local sales office.

ATEX Directive (94/9/EC)

Emerson Process Management complies with the ATEX Directive.

European Pressure Equipment Directive (PED) (97/23/EC)

3051CA4; 3051CG2, 3, 4, 5; 3051CD2, 3, 4, 5
(also with P9 option); 3051HD2, 3, 4, 5; 3051HG2, 3, 4, 5;
3051PD2, 3; and 3051PG2, 3, 4, 5 Pressure Transmitters
— QS Certificate of Assessment - EC No. PED-H-20
Module H Conformity Assessment

All other 3051/3001 Pressure Transmitters

— Sound Engineering Practice

Transmitter Attachments: Diaphragm Seal - Process Flange - Manifold

— Sound Engineering Practice

Electro Magnetic Compatibility (EMC) (89/336/EEC)

All 3051 and 3001 Pressure Transmitters
— EN 50081-1: 1992; EN 50082-2:1995;
EN 61326:1997 / A1:1998 – Industrial

Ordinary Location Certification for Factory Mutual

As standard, the transmitter has been examined and tested to determine that the design meets basic electrical, mechanical, and fire protection requirements by FM, a nationally recognized testing laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

HART PROTOCOL

Hazardous Locations Certifications

North American Certifications

FM Approvals

- E5** Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II, Division 1, Groups E, F, and G. Dust-Ignition-Proof for Class III, Division 1. T5 ($T_a = 85^\circ\text{C}$), Factory Sealed, Enclosure Type 4X
- I5** Intrinsically Safe for use in Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1 when connected per Rosemount drawing 03031-1019 and 00268-0031 (When used with a HART communicator); Non-incendive for Class I, Division 2, Groups A, B, C, and D. Temperature Code: T4 ($T_a = 40^\circ\text{C}$), T3 ($T_a = 85^\circ\text{C}$), Enclosure Type 4X. For input parameters see control drawing 03031-1019.

Canadian Standards Association (CSA)

- E6** Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D for indoor and outdoor hazardous locations. Enclosure type 4X, factory sealed
- C6** Explosion-Proof and intrinsically safe approval. Intrinsically safe for Class I, Division 1, Groups A, B, C, and D when connected in accordance with Rosemount drawings 03031-1024. Temperature Code T3C. Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D hazardous locations. Enclosure type 4X, factory sealed. For input parameters see control drawing 03031-1024.

European Certifications

- I1** ATEX Intrinsic Safety and Dust
Certification No.: BAS 97ATEX1089X  II 1 GD
EEx ia IIC T5 ($-60 \leq T_a \leq +40^\circ\text{C}$)
EEx ia IIC T4 ($-60 \leq T_a \leq +70^\circ\text{C}$)
Dust Rating: T80 $^\circ\text{C}$ ($-20 \leq T_a \leq 40^\circ\text{C}$) IP66
CE 1180

TABLE 5. Input Parameters

$U_i = 30\text{V}$

$I_i = 200\text{mA}$

$P_i = 0.9\text{W}$

$C_i = 0.012\text{ }\mu\text{F}$

Special Conditions for Safe Use (X):

When the optional transient protection terminal block is installed, the apparatus is not capable of withstanding the 500V insulation test required by Clause 6.4.12 of EN50020:1994. This must be taken into account when installing the apparatus.

- N1** ATEX Type n and Dust
Certification No.: BAS 00ATEX3105X  II 3 GD
EEx nL IIC T5 ($-40 \leq T_a \leq +70^\circ\text{C}$)
 $U_i = 55\text{Vdc max}$
Dust rating: T80 $^\circ\text{C}$ ($-20 \leq T_a \leq 40^\circ\text{C}$) IP66
CE

Special Conditions for Safe Use (X):

When the optional transient protection terminal block is installed, the apparatus is not capable of withstanding a 500V r.m.s. test to case. This must be taken into account on any installation in which it is used, for example by assuring that the supply to the apparatus is galvanically isolated.

- E8** ATEX Flame-Proof and Dust
Certification No.: KEMA 00ATEX2013X  II 1/2 GD
EEx d IIC T6 ($-50 \leq T_a \leq 65^\circ\text{C}$)
EEx d IIC T5 ($-50 \leq T_a \leq 80^\circ\text{C}$)
Dust rating T90 $^\circ\text{C}$, IP66
CE 1180
 $V_{max} = 55\text{V dc}$

Special Conditions for Safe Use (X):

This device contains a thin wall diaphragm. Installation, maintenance, and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.

Japanese Certifications

- E4** JIS Flame-Proof
Ex d IIC T6

Certificate	Description
C15850	3051C/D/1 4–20 mA HART — no meter
C15851	3051C/D/1 4–20 mA HART — with meter
C15854	3051T/G/1 4–20 mA HART, SST, Silicon — no meter
C15855	3051T/G/1 4–20 mA HART, Hast, Silicon — no meter
C15856	3051T/G/1 4–20 mA HART, SST, Silicon — with meter
C15857	3051T/G/1 4–20 mA HART, Hast, Silicon — with meter

- I4** JIS Intrinsic Safety
Ex ia IIC T4

Certificate	Description
C16406	3051CD/CG

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Australian Certifications

I7 SAA Intrinsic Safety

Certification No.: AUS EX 1249X

Ex ia IIC T4 ($T_{amb} = 70^{\circ}\text{C}$)

Ex ia IIC T5 ($T_{amb} = 40^{\circ}\text{C}$)

IP66

When connected per Rosemount drawing 03031-1026

The apparatus may only be used with a passive current limited power source Intrinsic Safety application. The power source must be such that $P_o \leq (U_o * I_o) / 4$. Modules using transient protection in the terminal assembly (T1 transient protection models) the apparatus enclosure is to be electrically bonded to the protective earth. The conductor used for the connection shall be equivalent to a copper conductor of 4 mm² minimum cross-sectional area.

TABLE 6. Input Parameters

$U_i = 30\text{V}$

$I_i = 200\text{ mA}$

$I_i = 160\text{ mA}$ (output code A with T1)

$P_i = 0.9\text{W}$

$C_i = 0.01\text{ }\mu\text{F}$

$C_i = 0.042\text{ }\mu\text{F}$ (output code M)

$L_i = 10\text{ }\mu\text{H}$

$L_i = 1.05\text{ mH}$ (output code A with T1)

$L_i = 0.75\text{ mH}$ (output code M with T1)

E7 SAA Explosion-Proof (Flame-Proof)

Certification No.: AUS EX 03.1347X

Ex d IIC T6 ($T_{amb} = 40^{\circ}\text{C}$)

Ex d IIC T5 ($T_{amb} = 80^{\circ}\text{C}$)

DIP T6 ($T_{amb} = 40^{\circ}\text{C}$)

DIP T5 ($T_{amb} = 80^{\circ}\text{C}$)

IP66

Special Conditions for Safe Use (X):

It is a condition of safe use for transmitter enclosures having cable entry thread other than metric conduit thread that the equipment be utilized with an appropriate certified thread adaptor.

N7 SAA Type n (Non-sparking)

Certification No.: AUS EX 1249X

Ex n IIC T4 ($T_{amb} = 70^{\circ}\text{C}$)

Ex n IIC T5 ($T_{amb} = 40^{\circ}\text{C}$)

IP66

Special Conditions for Safe Use (X):

Where the equipment is installed such that there is an unused conduit entry, it must be sealed with a suitable blanking plug to maintain the IP40 degree of protection. Any blanking plug used with the equipment shall be of a type which requires the use of a tool to effect its removal. Voltage source shall not exceed 60V ac or 75V dc.

Combinations of Certifications

Stainless steel certification tag is provided when optional approval is specified. Once a device labeled with multiple approval types is installed, it should not be reinstalled using any other approval types. Permanently mark the approval label to distinguish it from unused approval types.

K5 **E5** and **I5** combination

KB **K5** and **C6** combination

K6 **C6**, **I1**, and **E8** combination

K8 **E8** and **I1** combination

K7 **E7**, **I7**, and **N7** combination

FIELDBUS PROTOCOL

Hazardous Locations Certifications

North American Certifications

Factory Mutual (FM) Approvals

- E5** Explosion-Proof for Class I, Division 1, Groups B, C, and D.
Dust-Ignition-Proof for Class II, Division 1, Groups E, F, and G.
Dust-Ignition-Proof for Class III, Division 1.

T5 (Ta = 85 °C), Factory Sealed, Enclosure Type 4X

- I5** Intrinsically Safe for use in Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1 when connected per Rosemount drawing 03031-1019 and 00268-0031 (When used with a HART communicator); Non-incendive for Class I, Division 2, Groups A, B, C, and D.

Temperature Code: T4 (Ta = 40 °C), T3 (Ta = 85 °C),

Enclosure Type 4X

For input parameters see control drawing 03031-1019.

Canadian Standards Association (CSA)

- E6** Explosion-Proof for Class I, Division 1, Groups B, C, and D.
Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D for indoor and outdoor hazardous locations.
Enclosure type 4X, factory sealed

- C6** Explosion-Proof and intrinsically safe approval. Intrinsically safe for Class I, Division 1, Groups A, B, C, and D when connected in accordance with Rosemount drawings 03031-1024. Temperature Code T3C.
Explosion-Proof for Class I, Division 1, Groups B, C, and D.
Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D hazardous locations. Enclosure type 4X, factory sealed
For input parameters see control drawing 03031-1024.

European Certifications

- I1** ATEX Intrinsic Safety and Dust
Certification No.: BAS 98ATEX1355X  II 1 GD
EEx ia IIC T4 (Tamb = -60 to +60 °C)
Dust Rating: T70 °C (Tamb -20 to 40 °C) IP66
CE 1180

TABLE 7. Input Parameters

Ui = 30V

Ii = 300 mA

Pi = 1.3 W

Ci = 0 µF

Special Conditions for Safe Use (X):

The device is not capable of withstanding the 500V insulation test required by Clause 6.4.12 of EN50020:1994. This must be taken into account when installing the apparatus.

- N1** ATEX Type n and Dust
Certification No.: BAS 98ATEX3356X  II 3 GD
EEx nL IIC T5 (Tamb = -40 to +70 °C)
Ui = 40 Vdc max
Dust rating: T80 °C (Tamb = -20 to 40 °C) IP66

Special Conditions for Safe Use (X):

The device is not capable of withstanding the 500V insulation test required by Clause 6.4.12 of EN50020:1994. This must be taken into account when installing the apparatus.

- E8** ATEX Flame-Proof and Dust
Certification No.: KEMA 00ATEX2013X  II 1/2 GD
EEx d IIC T6 (Tamb = -50 to 65 °C)
EEx d IIC T5 (Tamb = -50 to 80 °C)
Dust rating T90 °C, IP66
CE 1180
Vmax = 55 V dc

Special Conditions for Safe Use (X):

This device contains a thin wall diaphragm. Installation, maintenance, and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.

Japanese Certifications

- E4** JIS Flame-Proof
Ex d IIC T6

Certificate	Description
C15852	3051C/D/1 FOUNDATION Fieldbus — no meter
C15853	3051C/D/1 FOUNDATION Fieldbus — with meter
C15858	3051T/G/1 FOUNDATION Fieldbus, SST, Silicon — no meter
C15859	3051T/G/1 FOUNDATION Fieldbus, Hast, Silicon — no meter
C15860	3051T/G/1 FOUNDATION Fieldbus, SST, Silicon — with meter
C15861	3051T/G/1 FOUNDATION Fieldbus, Hast, Silicon — with meter

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Australian Certifications

- I7** SAA Intrinsic Safety
Certification No.: AUS EX 1249X
Ex ia IIC T4 ($T_{amb} = 60\text{ }^{\circ}\text{C}$)
IP66

When connected per Rosemount drawing 03031-1026

The apparatus may only be used with a passive current limited power source Intrinsic Safety application. The power source must be such that $P_o \leq (U_o * I_o) / 4$. Modules using transient protection in the terminal assembly (T1 transient protection models) the apparatus enclosure is to be electrically bonded to the protective earth. The conductor used for the connection shall be equivalent to a copper conductor of 4 mm² minimum cross-sectional area.

TABLE 8. Input Parameters

$U_i = 30\text{ V}$

$I_i = 300\text{ mA}$

$P_i = 1.3\text{ W}$

$C_i = 0\text{ }\mu\text{F}$

$L_i = 0\text{ }\mu\text{H}$

- E7** SAA Explosion-Proof (Flame-Proof)
Certification No.: AUS EX 1347X
Ex d IIC T6 ($T_{amb} = 40\text{ }^{\circ}\text{C}$)
Ex d IIC T5 ($T_{amb} = 80\text{ }^{\circ}\text{C}$)
DIP T6 ($T_{amb} = 40\text{ }^{\circ}\text{C}$)
DIP T5 ($T_{amb} = 80\text{ }^{\circ}\text{C}$)
IP65

Special Conditions for Safe Use (X):

It is a condition of safe use for transmitter enclosures having cable entry thread other than metric conduit thread that the equipment be utilized with an appropriate certified thread adaptor.

- N7** SAA Type n (Non-sparking)
Certification No.: AUS EX 1249X
Ex n IIC T4 ($T_{amb} = 70\text{ }^{\circ}\text{C}$)
Ex n IIC T5 ($T_{amb} = 40\text{ }^{\circ}\text{C}$)
IP66

Special Conditions for Safe Use (X):

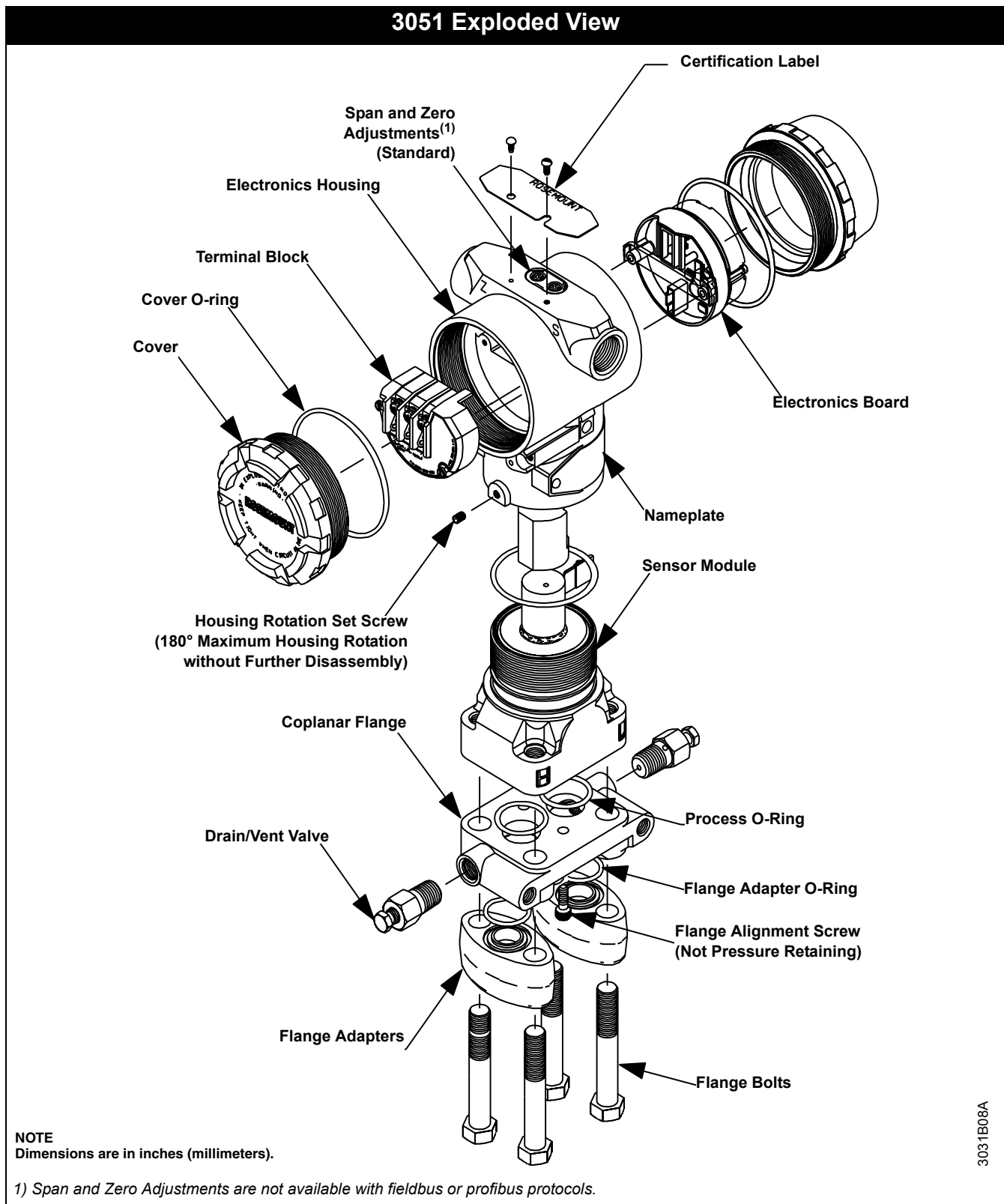
Where the equipment is installed such that there is an unused conduit entry, it must be sealed with a suitable blanking plug to maintain the IP40 degree of protection. Any blanking plug used with the equipment shall be of a type which requires the use of a tool to effect its removal. Voltage source shall not exceed 60V ac or 75V dc.

Combinations of Certifications

Stainless steel certification tag is provided when optional approval is specified. Once a device labeled with multiple approval types is installed, it should not be reinstalled using any other approval types. Permanently mark the approval label to distinguish it from unused approval types.

- K5** E5 and I5 combination
KB K5 and C6 combination
K6 C6, I1, and E8 combination
K8 E8 and I1 combination
K7 E7, I7, and N7 combination

Dimensional Drawings



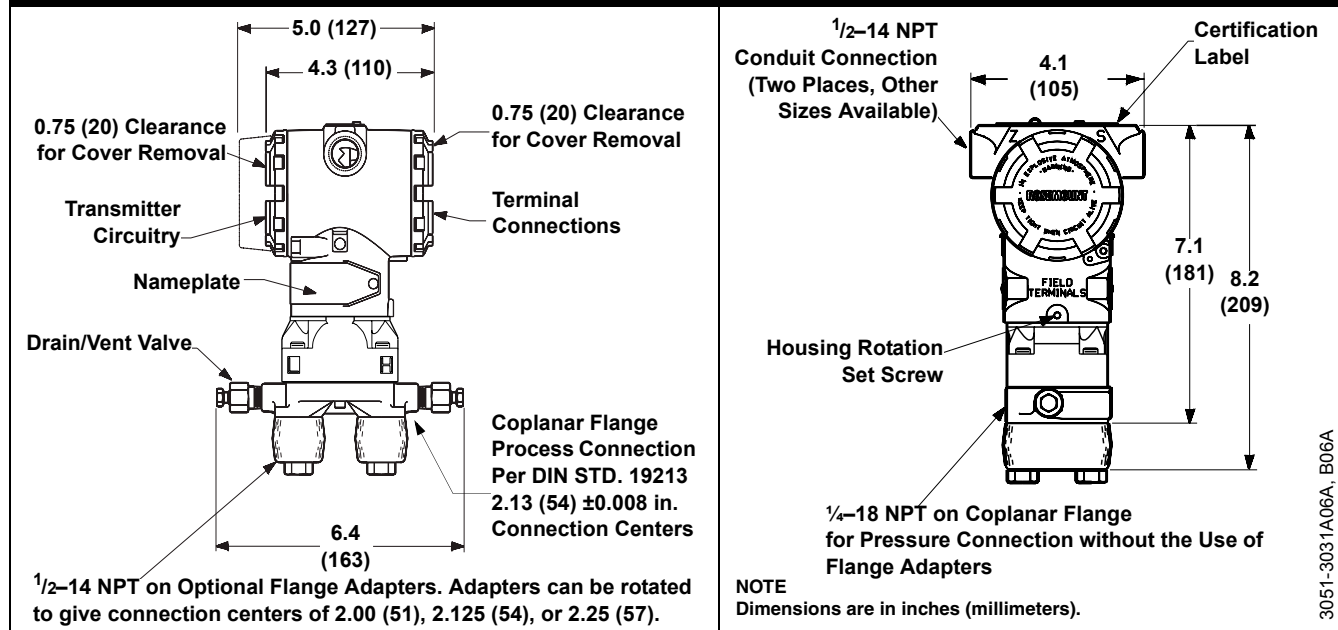
Product Data Sheet

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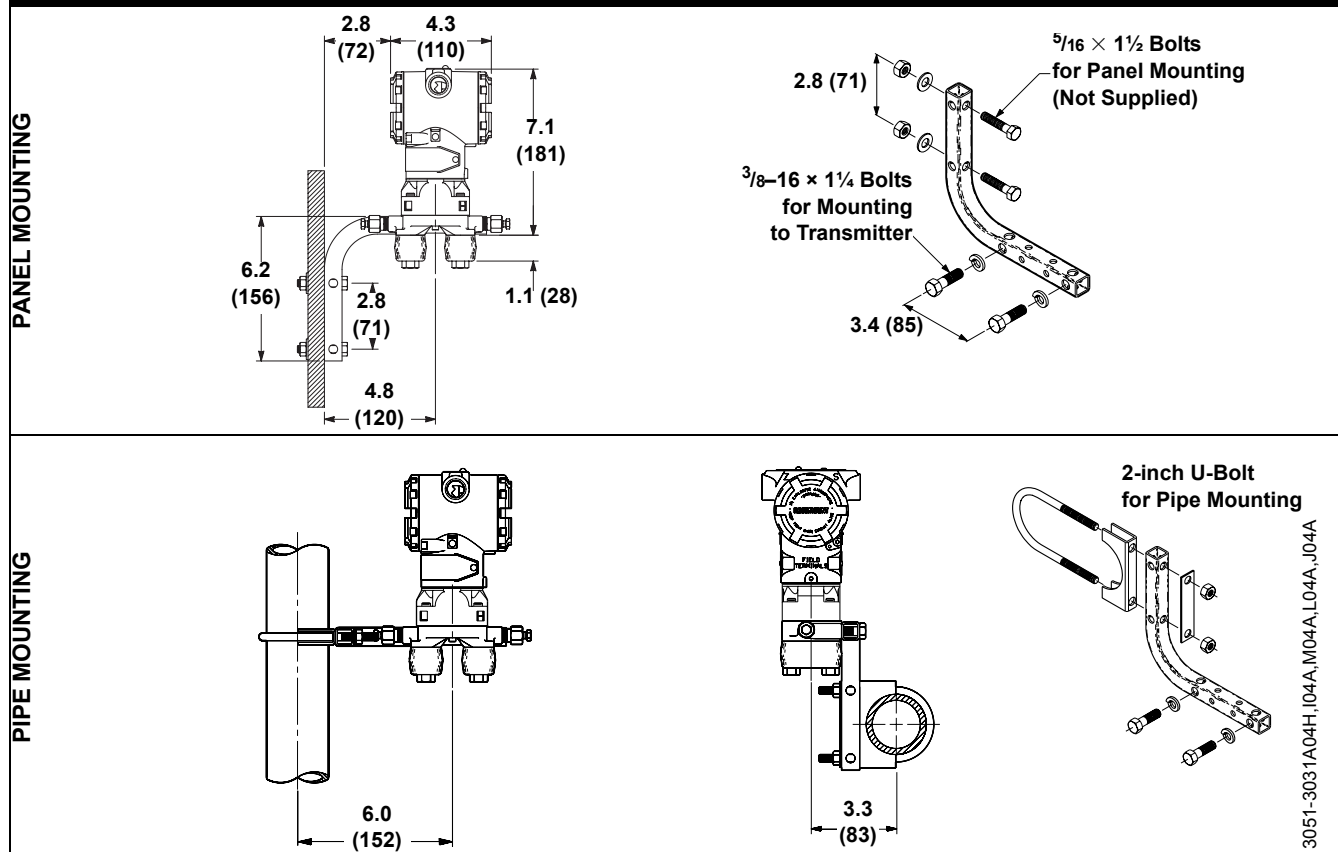
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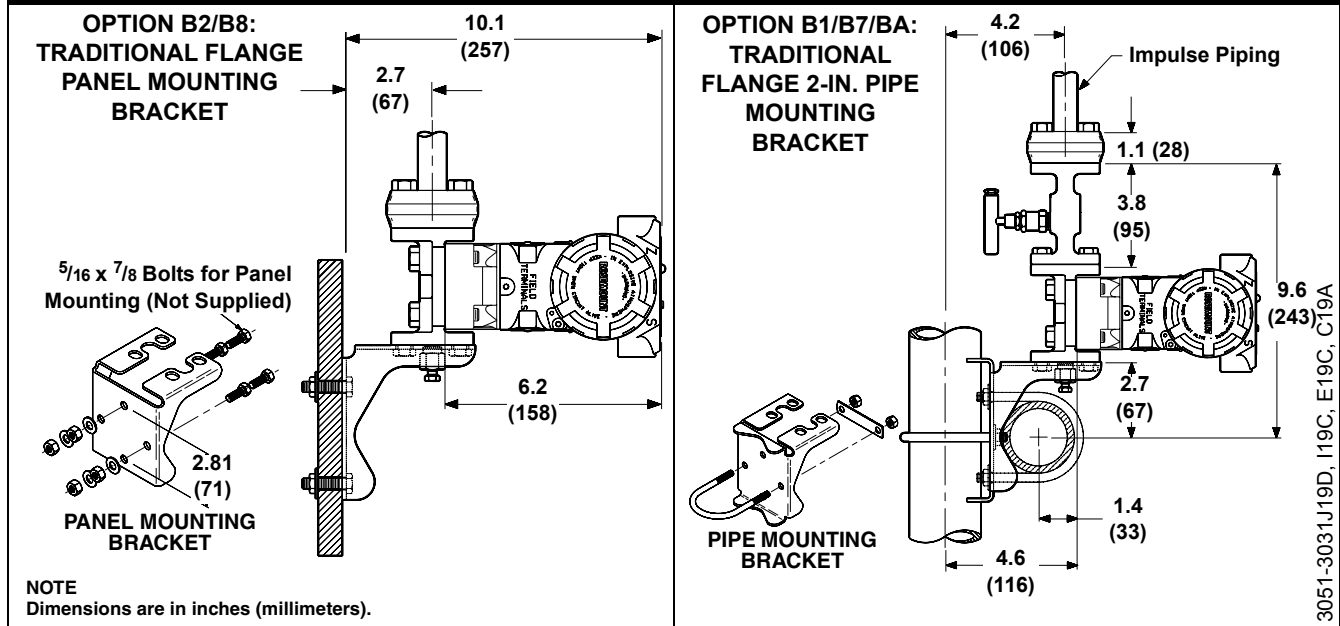
3051C Coplanar Flange Dimensional Drawing (Differential Pressure Transmitter Shown)



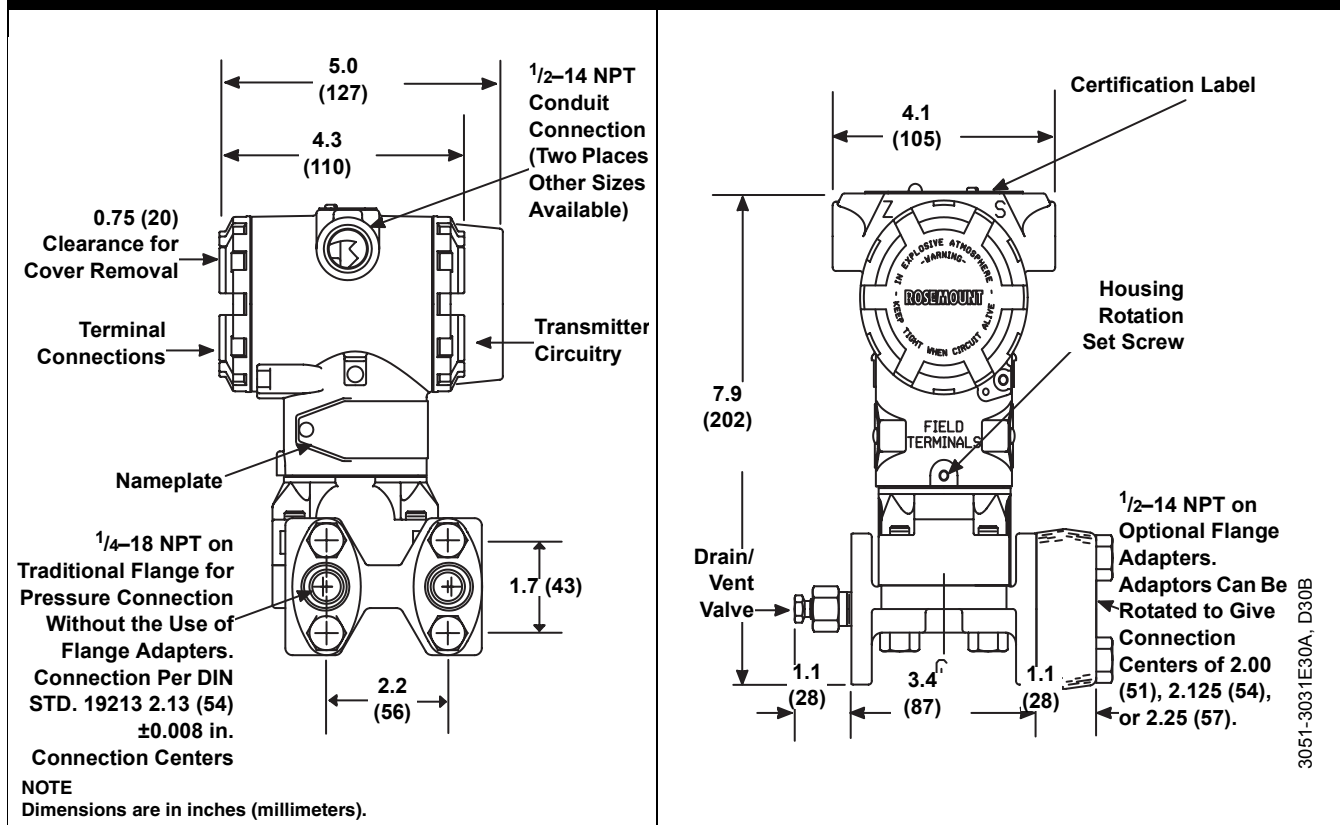
Coplanar Flange Mounting Configurations with Optional Bracket (B4) for 2-in. Pipe or Panel Mounting



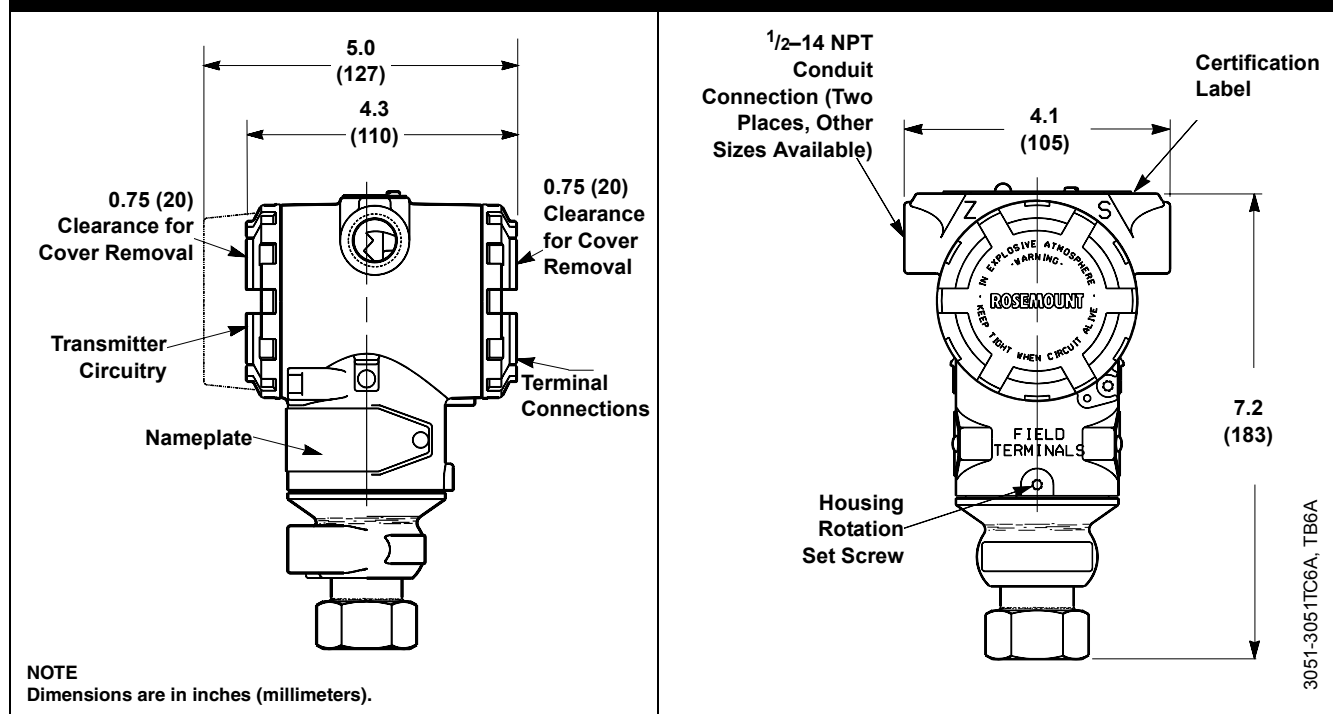
Traditional Flange Mounting Configurations with Optional Brackets for 2-in. Pipe or Panel Mounting



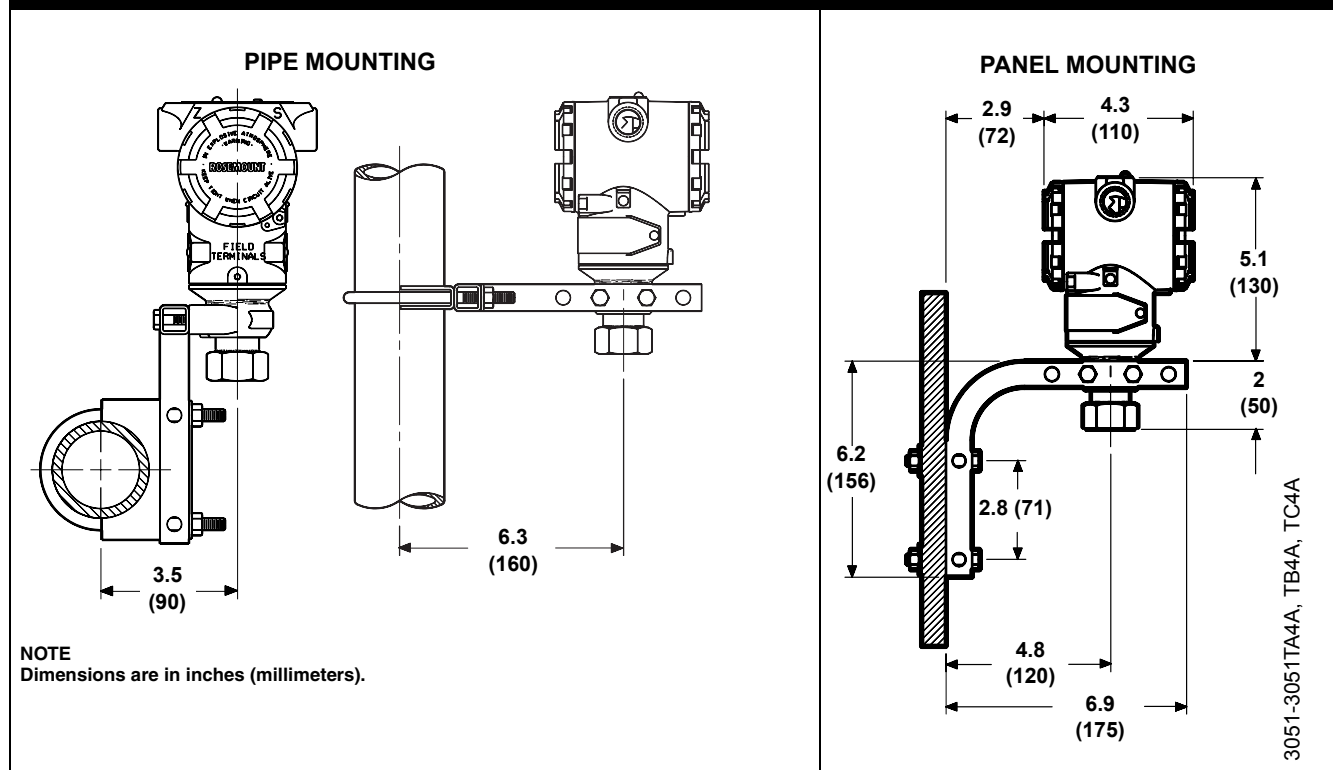
Traditional Flange (Options H2–H7) Dimensional Drawing



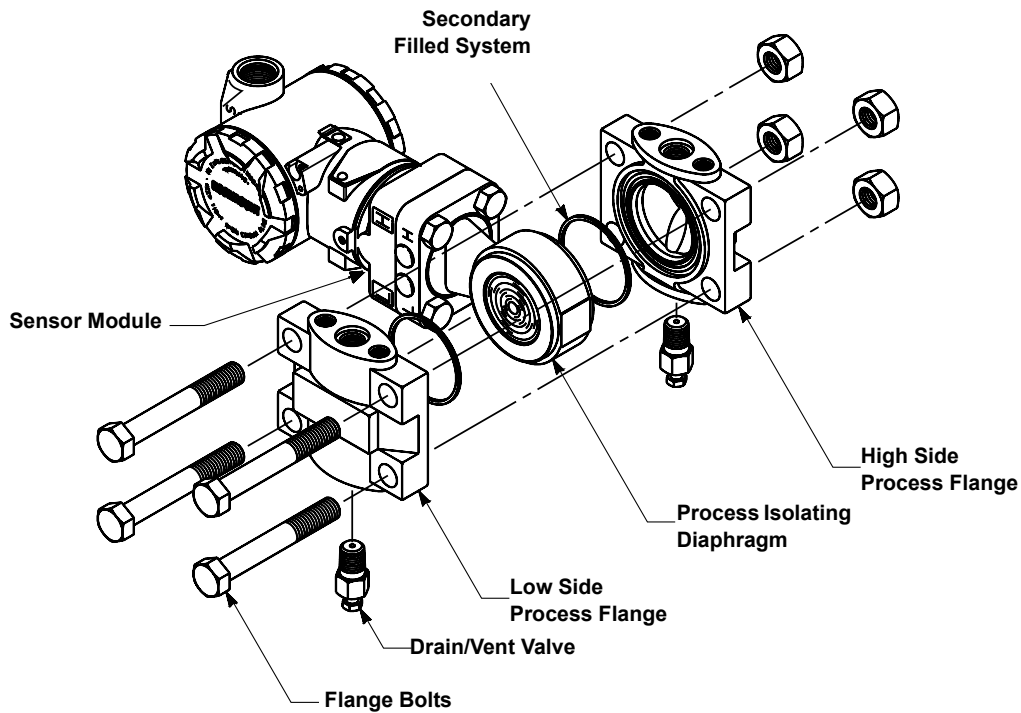
3051T Dimensional Drawings



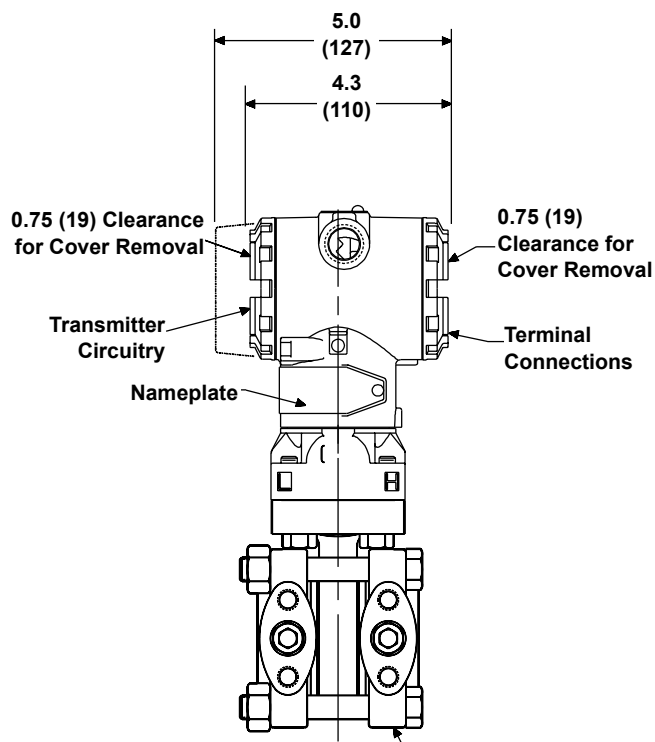
3051T Typical Mounting Configurations with Optional Mounting Bracket



3051H Pressure Transmitter Exploded View and Dimensional Drawings

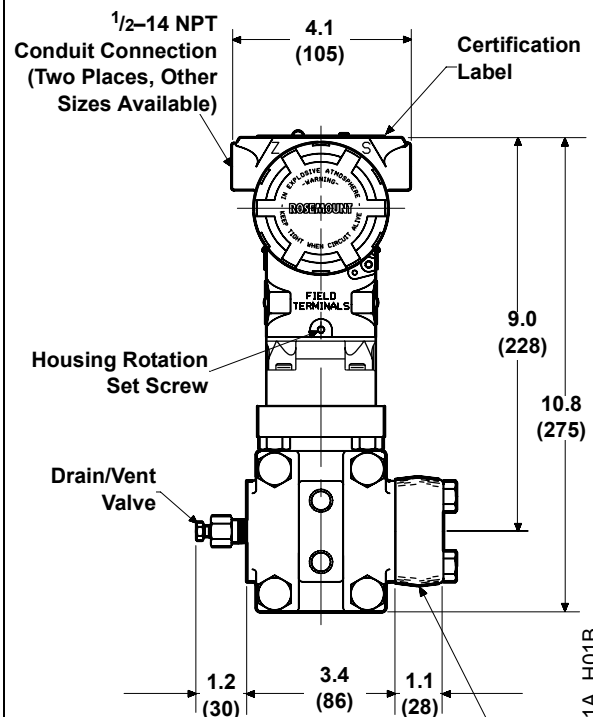


3051-3051HB2G



NOTE
Dimensions are in inches (millimeters).

$\frac{1}{2}$ -18 NPT on Process Flange for Pressure Connection Without the Use of Mounting Adapters



$\frac{1}{2}$ -14 NPT on Optional Mounting Adapters. Adapters Can Be Rotated to Give Adapter Connection Centers of 2.00 (51), 2.1256 (54), or 2.25 (57).

3051-3051i01A, H01B

Product Data Sheet

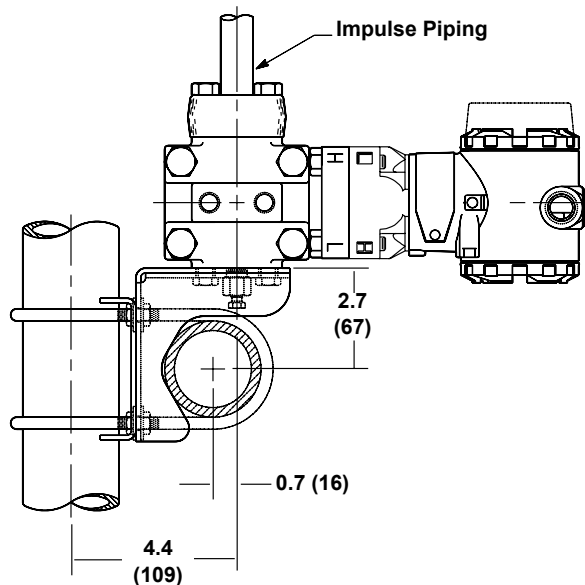
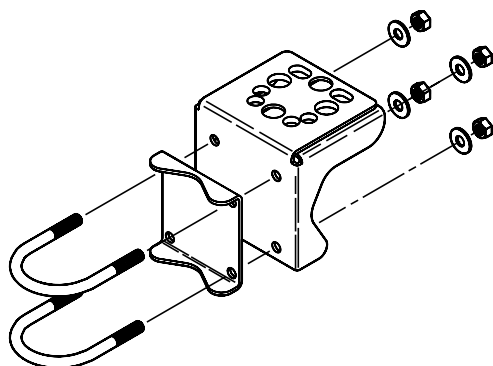
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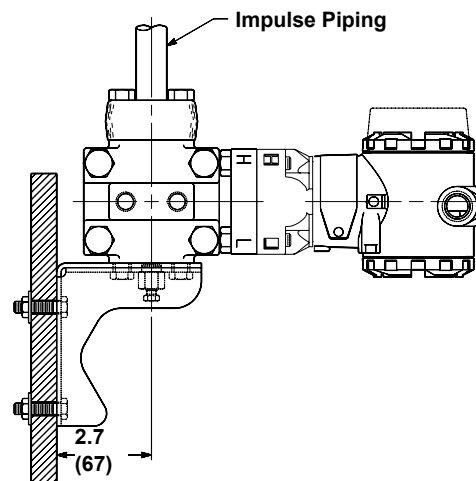
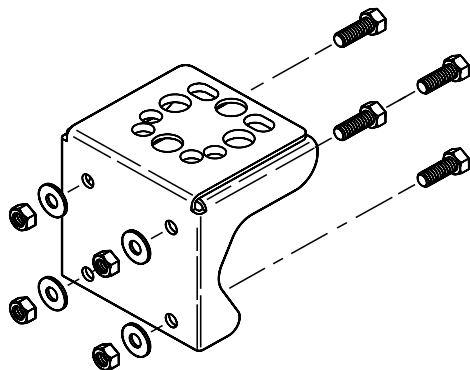
3051H Mounting Brackets for 2-in. Pipe and Panel Mount (Option Code B5/B6)

PIPE MOUNTING CONFIGURATION



PANEL MOUNTING CONFIGURATION

$\frac{7}{16}$ -20 $\times$ $\frac{3}{4}$ Bolts Supplied for
Attaching Bracket to Transmitter

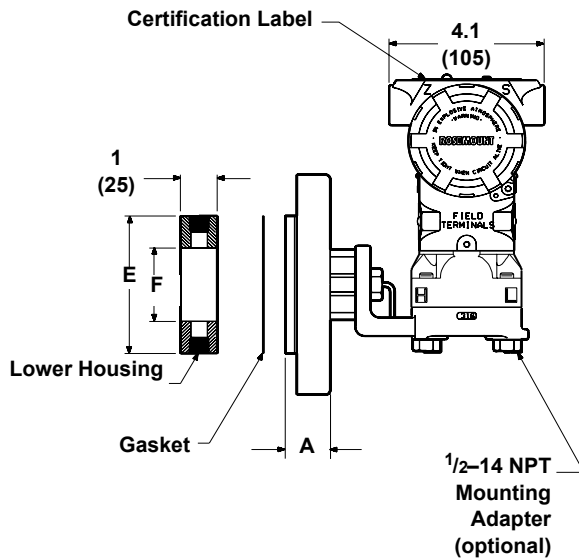


NOTE
Dimensions are in inches (millimeters).

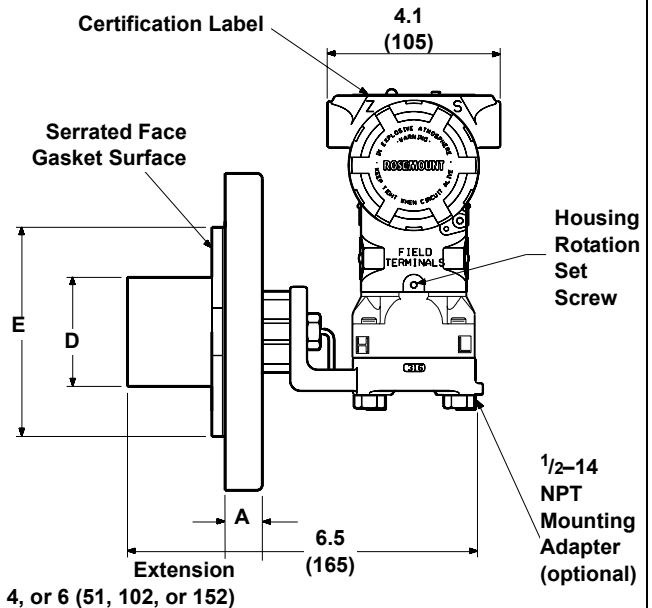
3051-3031G19A, F19B, 3051HB3A, HA3B

3051L Dimensional Drawings

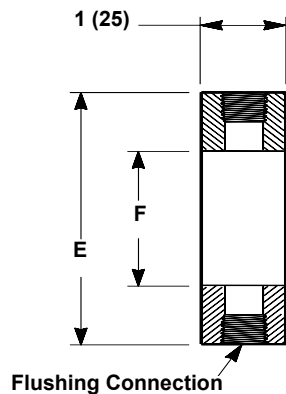
2-IN. FLANGE CONFIGURATION (FLUSH MOUNT ONLY)



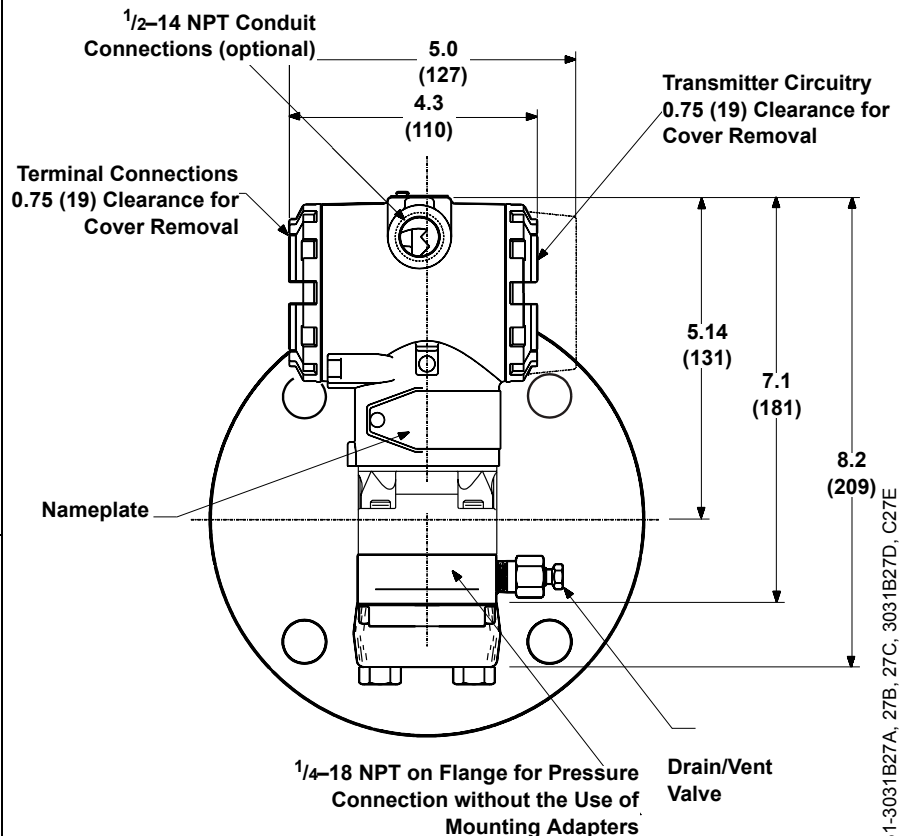
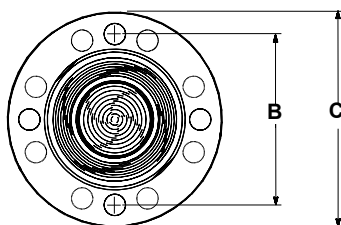
3- AND 4-IN. FLANGE CONFIGURATION



OPTIONAL FLUSHING CONNECTION RING (LOWER HOUSING)



DIAPHRAGM ASSEMBLY AND MOUNTING FLANGE



NOTE
Dimensions are in inches (millimeters).

3051-3031B27A, 27B, 27C, 3031B27D, C27E

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TABLE 9. 3051L Dimensional Specifications

Except where indicated, dimensions are in inches (millimeters).

Class	Pipe Size	Flange Thickness	Bolt Circle Diameter	Outside Diameter	No. of Bolts	Bolt Hole Diameter	Exten. Diam. ⁽¹⁾ D	O.D. Gask. Surf. E	Proc. Side F
ASME B 16.5 (ANSI) 150	2 (51)	1.12 (28)	4.75 (121)	6.0 (152)	4	0.75 (19)	NA	3.6 (92)	2.12 (54)
	3 (76)	1.31 (33)	6.0 (152)	7.5 (191)	4	0.75 (19)	2.58 (66)	5.0 (127)	3.5 (89)
	4 (102)	1.31 (33)	7.5 (191)	9.0 (229)	8	0.75 (19)	3.5 (89)	6.2 (158)	4.5 (114)
ASME B 16.5 (ANSI) 300	2 (51)	1.25 (32)	5.0 (127)	6.5 (165)	8	0.75 (19)	NA	3.6 (92)	2.12 (54)
	3 (76)	1.50 (38)	6.62 (168)	8.25 (210)	8	0.88 (22)	2.58 (66)	5.0 (127)	3.5 (89)
	4 (102)	1.62 (41)	7.88 (200)	10.0 (254)	8	0.88 (22)	3.5 (89)	6.2 (158)	4.5 (114)
ASME B 16.5 (ANSI) 600	2 (51)	1.12 (28)	5.0 (127)	6.5 (165)	8	0.75 (19)	NA	3.6 (92)	2.12 (54)
	3 (76)	1.37 (35)	6.62 (168)	6.62 (168)	8	0.88 (22)	2.58 (66)	5.0 (127)	3.5 (89)
DIN PN 10–40	DN 50	26 mm	125 mm	165 mm	4	18 mm	NA	4.0 (102)	2.5 (63)
DIN PN 25/40	DN 80	30 mm	160 mm	200 mm	8	18 mm	65 mm	5.4 (138)	3.7 (94)
	DN 100	30 mm	190 mm	235 mm	8	22 mm	89 mm	6.2 (158)	4.5 (114)
DIN PN 10/16	DN 100	26 mm	180 mm	220 mm	8	18 mm	89 mm	6.2 (158)	4.5 (114)

(1) Tolerances are 0.040 (1,02), –0.020 (0,51)

Ordering Information

TABLE 10. 3051C Differential, Gage, and Absolute Pressure Transmitters — = Not Applicable • = Applicable

Model	Transmitter Type (Select One)			CD	CG	CA
3051CD	Differential Pressure Transmitter			•	—	—
3051CG	Gage Pressure Transmitter			—	•	—
3051CA	Absolute Pressure Transmitter			—	—	•
	Rosemount 3051CD	Rosemount 3051CG	Rosemount 3051CA			
0 ⁽¹⁾	–3 to 3 inH ₂ O/0.1 inH ₂ O (–7,5 to 7,5 mbar/0,25 mbar)	Not Applicable	0 to 5 psia/0.167 psia (0 to 0,34 bar/11,5 mbar)	•	—	•
1	–25 to 25 inH ₂ O/0.5 inH ₂ O (–62,2 to 62,2 mbar/1,2 mbar)	–25 to 25 inH ₂ O/0.5 inH ₂ O (–62,2 to 62,2 mbar/1,2 mbar)	0 to 30 psia/0.3 psia (0 to 2,1 bar/20,7 mbar)	•	•	•
2	–250 to 250 inH ₂ O/2.5 inH ₂ O (–623 to 623 mbar/6,2 mbar)	–250 to 250 inH ₂ O/2.5 inH ₂ O (–623 to 623 mbar/6,2 mbar)	0 to 150 psia/1.5 psia (0 to 10,3 bar/0,1 bar)	•	•	•
3	–1000 to 1000 inH ₂ O/10 inH ₂ O (–2,5 to 2,5 bar/25 mbar)	–407 to 1000inH ₂ O/10in H ₂ O (–1,01 to 2,5 bar/25 mbar)	0 to 800 psia/8 psia (0 to 55,2 bar/0,55 bar)	•	•	•
4	–300 to 300 psi/3 psi (–20,7 to 20,7 bar/0,2 bar)	–14.7 to 300 psi/3 psi (–1,01 to 20,7 bar/0,2 bar)	0 to 4000 psia/40 psia (0 to 275,8 bar/2,8 bar)	•	•	•
5	–2000 to 2000 psi/20 psi (–137,9 to 137,9 bar/1,4 bar)	–14.7 to 2000 psig/20 psi (–1,01 to 137,9 bar/1,4 bar)	Not Applicable	•	•	—
NOTE: 3051CG lower range limit varies with atmospheric pressure.						
Code	Output			CD	CG	CA
A	4–20 mA with Digital Signal Based on HART Protocol			•	•	•
M	Low-Power, 1–5 V dc with Digital Signal Based on HART Protocol (See Option C2 for 0.8–3.2 V dc) NOTE: Not available with hazardous locations certification Options Codes I1, N1, E4, K6 and K8.					
F	FOUNDATION fieldbus					
W	Profibus — PA					
Materials of Construction						
Code	Process Flange Type	Flange Material	Drain/Vent	CD	CG	CA
2	Coplanar	SST	SST	•	•	•
3 ⁽²⁾	Coplanar	Hastelloy C	Hastelloy C	•	•	•
4	Coplanar	Monel	Monel	•	•	•
5	Coplanar	Plated CS	SST	•	•	•
7 ⁽²⁾	Coplanar	SST	Hastelloy C	•	•	•
8 ⁽²⁾	Coplanar	Plated CS	Hastelloy C	•	•	•
0	Alternate Flange—See Options on page 25			•	•	•
Code	Isolating Diaphragm			CD	CG	CA
2 ⁽²⁾	316L SST			•	•	•
3 ⁽²⁾	Hastelloy C-276			•	•	•
4	Monel			•	•	•
5	Tantalum (Available on 3051CD and CG, Ranges 2–5 only. Not available on 3051CA)			•	•	—
6	Gold-plated Monel (Use in combination with O-ring Option Code B.)			•	•	•
7	Gold-plated SST			•	•	•
Code	O-ring					
A	Glass-filled TFE			•	•	•
B	Graphite-filled TFE			•	•	•
Code	Fill Fluid			CD	CG	CA
1	Silicone			•	•	•
2	Inert fill (Halocarbon)			•	•	—

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TABLE 10. 3051C Differential, Gage, and Absolute Pressure Transmitters — = Not Applicable • = Applicable

Code	Housing Material	Conduit Entry Size	CD	CG	CA
A	Polyurethane-covered Aluminum	½–14 NPT	•	•	•
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)	•	•	•
C	Polyurethane-covered Aluminum	PG 13.5	•	•	•
D	Polyurethane-covered Aluminum	G½	•	•	•
J	SST	½–14 NPT	•	•	•
K	SST	M20 × 1.5 (CM20)	•	•	•
L	SST	PG 13.5	•	•	•
M	SST	G½	•	•	•
Code	PlantWeb Functionality				
A01	Regulatory control suite: PID, arith, signal char, integ, etc.; requires FOUNDATION fieldbus				
D01	Diagnostics suite, Plugged Impulse Line and SPM diagnostics; requires FOUNDATION fieldbus				
Code	Alternate Flange Options (Requires Materials of Construction Code 0)		CD	CG	CA
H2	Traditional Flange, 316 SST, SST Drain/Vent		•	•	•
H3 ⁽²⁾	Traditional Flange, <i>Hastelloy C</i> , <i>Hastelloy C</i> Drain/Vent		•	•	•
H4	Traditional Flange, <i>Monel</i> , <i>Monel</i> Drain/Vent		•	•	•
H7 ⁽²⁾	Traditional Flange, 316 SST, <i>Hastelloy C</i> Drain/Vent		•	•	•
HJ	DIN Compliant Traditional Flange, SST, 7/16 in. Adapter/Manifold Bolting		•	•	•
HK	DIN Compliant Traditional Flange, SST, 10 mm Adapter/Manifold Bolting		•	•	•
HL	DIN Compliant Traditional Flange, SST, 12mm Adapter/Manifold Bolting (not available on 3051CD0)		•	•	•
FA	Level Flange, SST, 2 in., ANSI Class 150, Vertical Mount		•	•	•
FB	Level Flange, SST, 2 in., ANSI Class 300, Vertical Mount		•	•	•
FC	Level Flange, SST, 3 in., ANSI Class 150, Vertical Mount		•	•	•
FD	Level Flange, SST, 3 in., ANSI Class 300, Vertical Mount		•	•	•
FP	DIN Level Flange, SST, DN 50, PN 40, Vertical Mount		•	•	•
FQ	DIN Level Flange, SST, DN 80, PN 40, Vertical Mount		•	•	•
Code	Integral Mount Manifold Options				
S5	Assemble to Rosemount 305 Integral Manifold				
Code	Integral Mount Primary Elements (Optional)		CD	CG	CA
S4	Factory Assembly to Rosemount Primary Element (<i>Annubar</i> or Rosemount 1195 Integral Orifice) <i>NOTE: With the primary element installed, the maximum operating pressure will equal the lesser of either the transmitter or the primary element. Option is available for factory assembly to range 1–4 transmitters only.</i>				
Code	Diaphragm Seal Assemblies (Optional) <i>NOTE: Standard flange and adapter bolts are austenitic 316 SST.</i>		CD	CG	CA
S1	One Diaphragm Seal (Direct Mount or Capillary Connection Type)		•	•	•
S2	Two Diaphragm Seals (Direct Mount or Capillary Connection Type)		•	—	—
Code	Optional All Welded Diaphragm Seal Systems (for high vacuum applications) <i>NOTE: Standard flange and adapter bolts are austenitic 316 SST.</i>		CD	CG	CA
S7	One Diaphragm Seal, All-Welded System (Capillary Connection Type)		•	•	•
S8	Two Diaphragm Seals, All-Welded System (Capillary Connection Type)		•	—	—
S0	One Diaphragm Seal, All-Welded System (Direct Mount Connection Type)		•	•	•
S9	Two Diaphragm Seals, All-Welded System (One Direct Mount and One Capillary Connection Type)		•	—	—
Code	Mounting Bracket Options		CD	CG	CA
B4	<i>Coplanar</i> Flange Bracket for 2-in. Pipe or Panel Mounting, all SST		•	•	•
B1	Traditional Flange Bracket for 2-in. Pipe Mounting, CS Bolts		•	•	•
B2	Traditional Flange Bracket for Panel Mounting, CS Bolts		•	•	•
B3	Traditional Flange Flat Bracket for 2-in. Pipe Mounting, CS Bolts		•	•	•
B7	B1 Bracket with Series 300 SST Bolts		•	•	•
B8	B2 Bracket with Series 300 SST Bolts		•	•	•
B9	B3 Bracket with Series 300 SST Bolts		•	•	•
BA	SST B1 Bracket with Series 300 SST Bolts		•	•	•
BC	SST B3 Bracket with Series 300 SST Bolts		•	•	•

TABLE 10. 3051C Differential, Gage, and Absolute Pressure Transmitters — = Not Applicable • = Applicable

Code	Hazardous Locations Certification Options	CD	CG	CA
E5	FM Explosionproof Approval	•	•	•
I5	FM Non-incendive and Intrinsic Safety Approval	•	•	•
K5	FM Explosionproof and Intrinsic Safety Approval	•	•	•
I1	BASEEFA/CENELEC Intrinsic Safety and Dust Certification <i>NOTE: Not available with low-power Option Code M.</i>			
N1	BASEEFA/CENELEC Type N and Dust Certification <i>NOTE: Not available with low-power Option Code M.</i>			
E8	KEMA/CENELEC Flameproof and Dust Certification			
E4	JIS Flameproof Certification <i>NOTE: Not available with low-power Option Code M.</i>			
C5 ⁽³⁾	Measurement Canada Accuracy Approval <i>NOTE: Limited availability depending on transmitter type and range. Contact your Rosemount representative.</i>			
C6	Canadian Standards Association (CSA) Explosionproof and Intrinsic Safety Approval			
K6	Combination of CSA and CENELEC Explosionproof and Intrinsic Safety Approval <i>NOTE: Not available with low-power Option Code M.</i>			
KB	Combination of FM and CSA Explosion proof and Intrinsic Safety Approvals			
K7	Combination of SAA Flameproof and Intrinsic Safety Approvals			
K8	Combination of CENELEC Flameproof and Intrinsic Safety Approvals <i>NOTE: Not available with low-power Option Code M.</i>			
I7	SAA Intrinsic Safety Certification			
E7	SAA Flameproof Certification			
N7	SAA Type N Certification			
IA	BASEEFA/CENELEC Intrinsic Safety for FISCO; for FOUNDATION fieldbus protocol only			
Code	Bolting Options	CD	CG	CA
L4	Austenitic 316 SST Bolts	•	•	•
L5	ASME B 16.5 (ANSI)/ASTM-A-193-B7M Bolts	•	•	•
L6	Monel Bolts	•	•	•
Code	Meters (Optional)	CD	CG	CA
M5	LCD Meter for Aluminum Housing (Housing Codes A, B, C, and D only)	•	•	•
M6	LCD Meter for SST Housing (Housing Codes J, K, L, and M only)	•	•	•

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TABLE 10. 3051C Differential, Gage, and Absolute Pressure Transmitters — = Not Applicable • = Applicable

Code	Other Options			
Q4	Calibration Data Sheet	•	•	•
Q8	Material Traceability Certification per EN 10204 3.1.B <i>NOTE: This option is available for the sensor module housing and Coplanar or traditional flanges and adapters (3051C), and for the sensor module housing and low-volume Coplanar flange and adapter (3051C with Option Code S1).</i>			
QP	Calibration certification and tamper evident seal			
QS	Quality Certification for safety			
J1 ⁽³⁾	Local Zero Adjustment Only <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>			
J3 ⁽³⁾	No Local Zero or Span Adjustment <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>			
T1	Transient Protection Terminal Block <i>NOTE: Not available with hazardous locations certification Option Code I1, K6 or K8.</i>			
C1 ⁽³⁾	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)	•	•	•
C2 ⁽³⁾	0.8–3.2 V dc Output with Digital Signal Based on HART Protocol (Output Code M only)			
C3	Gage Calibration (3051CA4 only)	—	—	•
C4 ⁽³⁾	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>			
CN ⁽³⁾	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Alarm Configuration—Low <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>			
P1	Hydrostatic Testing	•	•	•
P2	Cleaning for Special Service	•	•	•
P3	Cleaning for <1 PPM Chlorine/Fluorine	•	•	•
P4	Calibrate at line pressure <i>Note: Specify Q48 on order for corresponding certificate</i>	•	•	•
DF	1/2 -14 NPT flange adapter(s)— Material determined by flange material	•	•	•
D7	Coplanar Flange Without Drain/Vent Ports	•	•	•
D8	Ceramic Ball Drain/Vents	•	•	•
D9	JIS Process Connection—RC 1/4 Flange with RC 1/2 Flange Adapter	•	•	•
P9	4500 psig Static Pressure Limit (3051CD Ranges 2–5 only)	•	—	—
V5 ⁽⁴⁾	External Ground Screw Assembly	•	•	•
Typical Model Number: 3051CD 2 A 2 2 A 1 A B4				

(1) *NOTE: 3051CD0 is available only with Output Code A, Process Flange Code 0 (Alternate Flange H2, H7, HJ, or HK), Isolating Diaphragm Code 2, O-ring Code A, and Bolting Option L4.*

(2) *Materials of Construction meet NACE material recommendation per MR 01-75. Environmental limits apply to certain materials. Consult latest standard for details.*

(3) *Not available with Fieldbus (output code F) or Profibus (output code W).*

(4) *The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.*

TABLE 11. 3051T Gage and Absolute Pressure Transmitter

Model	Transmitter Type	
3051T	Pressure Transmitter	
Code	Pressure Type	
G	Gage	
A	Absolute	
Code	Pressure Ranges (Range/Min. Span)	
	3051TG	3051TA
1	−14.7 to 30 psi/0.3 psi (−1,01 to 2,1 bar/20,7 mbar)	0 to 30 psia/0.3 psia (0 to 2,1 bar/20,7 mbar)
2	−14.7 to 150 psi/1.5 psi (−1,01 to 10,3 bar/103,4 mbar)	0 to 150 psia/1.5 psia (0 to 10,3 bar/103,4 mbar)
3	−14.7 to 800 psi/8 psi (−1,01 to 55,2 bar/0,55 bar)	0 to 800 psia/8 psia (0 to 55,2 bar/0,55 bar)
4	−14.7 to 4000 psi/40 psi (−1,01 to 275,8 bar/2,8 bar)	0 to 4000 psia/40 psia (0 to 275,8 bar/2,8 bar)
5	−14.7 to 10000 psi/2000 psi (−1,01 to 689,5 bar/138 bar)	0 to 10000 psia/2000 psia (0 to 689,5 bar/138 bar)
NOTE: 3051TG lower range limit varies with atmospheric pressure.		
Code	Output	
A	4–20 mA with Digital Signal Based on <i>HART</i> Protocol	
M	Low-Power 1–5 V dc with Digital Signal Based on <i>HART</i> Protocol (See Option Code C2 for 0.8–3.2 V dc Output) NOTE: Not available with hazardous certification Option Codes I1, N1, E4, K6 or K8.	
F	FOUNDATION fieldbus	
W	Profibus — PA	
Code	Process Connection Style	
2A	¼–18 NPT Female	
2B	½–14 NPT Female	
2C	G½ A DIN 16288 Male (Available in SST for Range 1–4 only)	
2F	Coned and Threaded, Compatible with Autoclave Type F-250-C (Available in SST for Range 5 only)	
61	Non-threaded Instrument flange	
Code	Isolating Diaphragm	Process Connection Wetted Parts Material
2 ⁽¹⁾	316L SST	316L SST
3 ⁽¹⁾	Hastelloy	Hastelloy
Code	Fill Fluid	
1	Silicone	
2	Inert	
Code	Housing Material	Conduit Entry Size
A	Polyurethane-covered Aluminum	½–14 NPT
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)
C	Polyurethane-covered Aluminum	PG 13.5
D	Polyurethane-covered Aluminum	G½
J	SST	½–14 NPT
K	SST	M20 × 1.5 (CM20)
L	SST	PG 13.5
M	SST	G½
Code	PlantWeb Functionality	
A01	Regulatory control suite: PID, arith, signal char, integ, etc.; requires FOUNDATION fieldbus	
D01	Diagnostics suite, Plugged Impulse Line and SPM diagnostics; requires FOUNDATION fieldbus	
Code	Integral Mount Manifold (Optional)	
S5	Assemble to Rosemount 306 Integral Manifold (Requires ½ in. process connection code 2B)	
Code	Remote Diaphragm Seals Assemblies (Optional)	
S1	One remote diaphragm seal (Direct Mount or Capillary Connection Type)	

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TABLE 11. 3051T Gage and Absolute Pressure Transmitter

Code	Mounting Brackets (Optional)
B4	Bracket for 2-in. Pipe or Panel Mounting, All SST
Code	Hazardous Locations Certifications (Optional)
E5	FM Explosion proof Approval
I5	FM Non-incendive and Intrinsic Safety Approval
K5	FM Explosion proof and Intrinsic Safety Approval
C5	Measurement Canada accuracy approval <i>Note: Limited availability depending on transmitter type and range. Contact your Rosemount representative.</i>
C6	CSA Explosion proof and Intrinsic Safety Approval
K6	Combination of CSA and CENELEC Explosion proof and Intrinsic Safety Approval <i>NOTE: Not available with low-power Option Code M.</i>
K8	Combination of CENELEC Flameproof and Intrinsic Safety Approvals <i>NOTE: Not available with low-power Option Code M.</i>
K7	Combination of SAA Flameproof and Intrinsic Safety Approvals
KB	Combination of FM and CSA Explosion proof and Intrinsic Safety Approvals
I7	SAA Intrinsic Safety Certification
E4	JIS Flameproof Certification <i>NOTE: Not available with low-power Option Code M.</i>
E7	SAA Flameproof Certification
N7	SAA Type N Certification
I1	BASEEFA/CENELEC Intrinsic Safety and Dust Certification <i>NOTE: Not available with low-power Option Code M.</i>
N1	BASEEFA/CENELEC Type N and Dust Certification <i>NOTE: Not available with low-power Option Code M.</i>
E8	KEMA/CENELEC Flameproof and Dust Certification
DW	NSF drinking water approval
IA	BASEEFA/CENELEC Intrinsic Safety for FISCO; for FOUNDATION fieldbus protocol only
Code	Other Options
Q4	Calibration Data Sheet
Q8	Material Traceability Certification per EN 10204 3.1.B <i>NOTE: This option applies to the process connection only.</i>
QP	Calibration certification and tamper evident seal
QS	Quality certification for safety
J1 ⁽²⁾	Local Zero Adjustment Only <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>
J3 ⁽²⁾	No Local Zero or Span Adjustment <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>
M5	LCD Meter for Aluminum Housing (Housing Codes A, B, C, and D only)
M6	LCD Meter for SST Housing (Housing Codes J, K, L and M only)
T1	Transient Protection Terminal Block <i>NOTE: Not available with hazardous locations certification Option Code I1, K6 or K8.</i>
C1 ⁽²⁾	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)
C2 ⁽²⁾	0.8–3.2 V dc Output with Digital Signal Based on HART Protocol (Output Code M only)
C4 ⁽²⁾	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>
CN ⁽²⁾	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Low Alarm Configuration <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>
P1	Hydrostatic Testing
P2	Cleaning for Special Service
P3	Cleaning for <1 PPM Chlorine/Fluorine
V5 ⁽³⁾	External Ground Screw Assembly
Typical Model Number: 3051T G 5 F 2A 2 1 A B4	

(1) Materials of Construction meet NACE material recommendation per MR 01-75. Environmental limits apply to certain materials. Consult latest standard for details.

(2) Not available with fieldbus (output code F) or Profibus protocols (output code W).

(3) The V5 option is not needed with T1 option; external ground screw assembly is included with the T1 option.

TABLE 12. 3051L Flange-Mounted Liquid Level Transmitter

Model	Transmitter Type		
3051L	Flange-Mounted Liquid Level Transmitter		
Code	PRESSURE RANGES (RANGE/MIN. SPAN)		
2	–250 to 250 inH ₂ O/2.5 inH ₂ O (–0,6 to 0,6 bar/6,2 mbar)		
3	–1000 to 1000 inH ₂ O/10 inH ₂ O (–2,5 to 2,5 bar/25 mbar)		
4	–300 to 300 psi/3 psi (–20,7 to 20,7 bar/0,2 bar)		
Code	Output		
A	4–20 mA with Digital Signal Based on <i>HART</i> Protocol		
M	Low-Power 1–5 V dc with Digital Signal Based on <i>HART</i> Protocol (See Option Code C2 for 0.8–3.2 V dc Output) <i>NOTE: Not available with hazardous certification Option Codes I1, N1, E4, K6, and K8.</i>		
F	FOUNDATION fieldbus		
W	Profibus – PA		
HIGH PRESSURE SIDE			
Code	Diaphragm Size	Material	Extension Length
G0	2 in./DN 50	316L SST	Flush Mount Only
H0	2 in./DN 50	<i>Hastelloy</i>	Flush Mount Only
J0	2 in./DN 50	Tantalum	Flush Mount Only
A0	3 in./DN 80	316L SST	Flush Mount
A2	3 in./DN 80	316L SST	2 in./50 mm
A4	3 in./DN 80	316L SST	4 in./100 mm
A6	3 in./DN 80	316L SST	6 in./150 mm
B0	4 in./DN 100	316L SST	Flush Mount
B2	4 in./DN 100	316L SST	2 in./50 mm
B4	4 in./DN 100	316L SST	4 in./100 mm
B6	4 in./DN 100	316L SST	6 in./150 mm
C0	3 in./DN 80	<i>Hastelloy</i>	Flush Mount
C2	3 in./DN 80	<i>Hastelloy</i>	2 in./50 mm
C4	3 in./DN 80	<i>Hastelloy</i>	4 in./100 mm
C6	3 in./DN 80	<i>Hastelloy</i>	6 in./150 mm
D0	4 in./DN 100	<i>Hastelloy</i>	Flush Mount
D2	4 in./DN 100	<i>Hastelloy</i>	2 in./50 mm
D4	4 in./DN 100	<i>Hastelloy</i>	4 in./100 mm
D6	4 in./DN 100	<i>Hastelloy</i>	6 in./150 mm
E0	3 in./DN 80	Tantalum	Flush Mount Only
F0	4 in./DN 100	Tantalum	Flush Mount Only

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TABLE 12. 3051L Flange-Mounted Liquid Level Transmitter

MOUNTING FLANGE				
Code	Size	ASME B 16.5 (ANSI) or DIN Flange Rating	Material	
M	2 in.	Class 150	CS	
A	3 in.	Class 150	CS	
B	4 in.	Class 150	CS	
N	2 in.	Class 300	CS	
C	3 in.	Class 300	CS	
D	4 in.	Class 300	CS	
P	2 in.	Class 600	CS	
E	3 in.	Class 600	CS	
X	2 in.	Class 150	SST	
F	3 in.	Class 150	SST	
G	4 in.	Class 150	SST	
Y	2 in.	Class 300	SST	
H	3 in.	Class 300	SST	
J	4 in.	Class 300	SST	
Z	2 in.	Class 600	SST	
L	3 in.	Class 600	SST	
Q	DN 50	PN 10-40	CS	
R	DN 80	PN 40	CS	
S	DN 100	PN 40	CS	
V	DN 100	PN 10/16	CS	
K	DN 50	PN 10-40	SST	
T	DN 80	PN 40	SST	
U	DN 100	PN 40	SST	
W	DN 100	PN 10/16	SST	
Code	Process Fill-High Pressure Side		Temperature Limits	
A	Syltherm XLT		–100 to 300 °F (–73 to 135 °C)	
C	D. C. Silicone 704		60 to 400 °F (15 to 205 °C)	
D	D. C. Silicone 200		–40 to 400 °F (–40 to 205 °C)	
H	Inert (Halocarbon)		–50 to 350 °F (–45 to 177 °C)	
G	Glycerine and Water		0 to 200 °F (–17 to 93 °C)	
N	Neobee M-20		0 to 400 °F (–17 to 205 °C)	
P	Propylene Glycol and Water		0 to 200 °F (–17 to 93 °C)	
LOW PRESSURE SIDE				
Code	Configuration	Flange Adapter	Diaphragm Material	Sensor Fill Fluid
11	Gage	SST	316L SST	Silicone
21	Differential	SST	316L SST	Silicone
22	Differential	SST	Hastelloy C-276	Silicone
2A	Differential	SST	316L SST	Inert (Halocarbon)
2B	Differential	SST	Hastelloy C-276	Inert (Halocarbon)
31	Remote Seal	SST	316L SST	Silicone (Requires Option Code S1)
Code	O-ring Material			
A	Glass-filled TFE			

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TABLE 12. 3051L Flange-Mounted Liquid Level Transmitter

Code	Housing Material	Conduit Entry Size
A	Polyurethane-covered Aluminum	½–14 NPT
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)
C	Polyurethane-covered Aluminum	PG 13.5
D	Polyurethane-covered Aluminum	G½
J	SST	½–14 NPT
K	SST	M20 × 1.5 (CM20)
L	SST	PG 13.5
M	SST	G½
Code	PlantWeb Functionality	
A01	Regulatory control suite: PID, arith, signal char, integ, etc.; requires FOUNDATION fieldbus	
D01	Diagnostics suite, Plugged Impulse Line and SPM diagnostics; requires FOUNDATION fieldbus	
Code	Diaphragm Seal Assemblies (Optional)	
S1	One Diaphragm Seal (requires low pressure side Option Code 31 capillary connection type)	
Code	Hazardous Locations Certification Options	
E5	FM Explosion proof Approval	
I5	FM Non-incendive and Intrinsic Safety Approval	
K5	FM Explosion proof and Intrinsic Safety Approval	
I1	BASEEFA/CENELEC Intrinsic Safety and Dust Certification (<i>NOTE: Not available with low-power Option Code M.</i>)	
N1	BASEEFA/CENELEC Type N and Dust Certification (<i>NOTE: Not available with low-power Option Code M.</i>)	
E8	KEMA/CENELEC Flameproof and Dust Certification	
E4	JIS Flameproof Certification (<i>NOTE: Not available with low-power Option Code M.</i>)	
C6	CSA Explosion proof and Intrinsic Safety Approval	
K6	Combination of CSA and CENELEC Explosion proof and Intrinsic Safety Approval <i>NOTE: Not available with low-power Option Code M.</i>	
K7	Combination of SAA Flameproof and Intrinsic Safety Approvals	
K8	Combination of CENELEC Flameproof and Intrinsic Safety Approvals <i>NOTE: Not available with low-power Option Code M.</i>	
KB	Combination of FM and CSA Explosion proof and Intrinsic Safety Approvals	
I7	SAA Intrinsic Safety Certification	
E7	SAA Flameproof Certification	
N7	SAA Type N Certification	
IA	BASEEFA/CENELEC Intrinsic Safety for FISCO; for FOUNDATION fieldbus protocol only	
Code	Bolt for Flange and Adapters (Optional)	
L5	ASME B 16.5 (ANSI)/ASTM-A-193-B7M Bolts (Austenitic 316 SST bolts standard)	
Code	Meter Options	
M5	LCD Meter for Aluminum Housing (Housing Codes A, B, C, and D only)	
M6	LCD Meter for SST Housing (Housing Codes J, K, L, and M only)	

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TABLE 12. 3051L Flange-Mounted Liquid Level Transmitter

Code	Other Options
Q4	Calibration Data Sheet
Q8	Material Traceability Certification per EN 10204 3.1.B <i>NOTE: This options is available with the diaphragm, upper housing, Coplanar flange, adapter, sensor module housing, lower housing/flushing connection, and extension.</i>
QP	Calibration certification and tamper evident seal
J1 ⁽¹⁾	Local Zero Adjustment Only <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>
J3 ⁽¹⁾	No Local Zero or Span Adjustment <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>
T1	Transient Protection Terminal Block <i>NOTE: Not available with hazardous locations certification Option Code I1, K6, or K8.</i>
C1 ⁽¹⁾	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)
C2 ⁽¹⁾	0.8–3.2 V dc Output with Digital Signal Based on HART Protocol (Output Code M only)
C4 ⁽¹⁾	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>
CN ⁽¹⁾	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Alarm Configuration–Low <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>
D8	Ceramic Ball Drain/Vents
V5 ⁽²⁾	External Ground Screw Assembly

Lower Housing Flushing Connections

Code	Ring Material	Number	Size	Diaphragm Size		
				2 in.	3 in.	4 in.
F1	SST	1	¼	•	•	•
F2	SST	2	¼	•	•	•
F3	Hastelloy	1	¼	•	•	•
F4	Hastelloy	2	¼	•	•	•
F7	SST	1	½	•	•	•
F8	SST	2	½	•	•	•
F9	Hastelloy	1	½	•	•	•
F0	Hastelloy	2	½	•	•	•

NOTE: Flushing Codes F3 and F4 are not available with Option Codes A0, B0, and G0.

Typical Model Number:

(1) Not available with fieldbus (output code F) or profibus protocols (output code W).

(2) The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

TABLE 13. 3051H Pressure Transmitter for High-Temperature Processes — = Not Applicable • = Applicable

Model	Transmitter Type (Select One)	Available	
		HD	HG
3051HD	Differential Pressure Transmitter for High-Temperature Processes	•	—
3051HG	Gage Pressure Transmitter for High-Temperature Processes	—	•
Code	3051HD	3051HG	
2	–250 to 250 inH ₂ O/2.5 inH ₂ O (–0,62 to 0,62 bar/6,2 mbar)	–250 to 250 inH ₂ O/2.5 inH ₂ O (–0,62 to 0,62 bar/6,2 mbar)	
3	–1000 to 1000 inH ₂ O/10 inH ₂ O (–2,5 to 2,5 bar/25 mbar)	–407 to 1000 inH ₂ O/10 in H ₂ O (–1,01 to 2,5 bar/25 mbar)	
4	–300 to 300 inH ₂ O/3 psi (–747 to 747 mbar/0,2 bar)	–14.7 to 300 psi/3 psi (–1,01 to 20,7 bar/0,2 bar)	
5	–2000 to 2000 psi/20 psi (–138 to 138 bar/1,4 bar)	–14.7 to 2000 psig/20 psi (–1,01 to 138 bar/1,4 bar)	
NOTE: 3051HG lower range limit varies with atmospheric pressure.			
Code	Output	HD	HG
A	4–20 mA with Digital Signal Based on HART Protocol	•	•
M	Low-Power 1–5 V dc with Digital Signal Based on HART Protocol (See Option Code C2 for 0.8–3.2 V dc Output)	•	•
NOTE: Not available with hazardous certification Option Codes I1, N1, E4, K6, and K8.			
F	FOUNDATION fieldbus	•	•
W	Profibus – PA	•	•
Code	PROCESS CONNECTION		
	Process Flange Material	Drain/Vent	
2	SST	SST	•
7 ⁽¹⁾	SST	Hastelloy	•
Code	Process Isolating Diaphragm	HD	HG
2	316L SST	•	•
3 ⁽¹⁾	Hastelloy C-276 (Meets NACE material recommendations per MR 01-75)	•	•
5	Tantalum	•	•
Code	O-ring Material	HD	HG
A	Glass-Filled TFE	•	•
Code	Process Fill Fluid	HD	HG
D	D.C. 200 Silicone	•	•
H	Inert	•	•
N	Neobee M-20	•	•
Code	Sensor Module Isolator Material	HD	HG
2	SST	•	•
Code	Sensor Module Fill Fluid	HD	HG
1	Silicone	•	•
2	Inert (Halocarbon)	•	•
Code	Housing Material	Conduit Entry Size	HD
A	Polyurethane-covered Aluminum	½–14 NPT	•
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)	•
C	Polyurethane-covered Aluminum	PG 13.5	•
D	Polyurethane-covered Aluminum	G½	•
J	SST	½–14 NPT	•
K	SST	M20 × 1.5 (CM20)	•
L	SST	PG 13.5	•
M	SST	G½	•
Code	PlantWeb Functionality		
A01	Regulatory control suite: PID, arith, signal char, integ, etc.; requires FOUNDATION fieldbus		
D01	Diagnostics suite, Plugged Impulse Line and SPM diagnostics; requires FOUNDATION fieldbus		
Code	Integral Mount Primary Elements (Optional)	HD	HG
S4	Factory Assembly to Rosemount Primary Element (Diamond II+Annubar/Rosemount 1195 Integral Orifice)	•	—
NOTE: With the primary element installed, the maximum operating pressure will equal the lesser of either the transmitter or the primary element. Option is available for factory assembly to range 1–4 transmitters only.			

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Rosemount 3051

TABLE 13. 3051H Pressure Transmitter for High-Temperature Processes — = Not Applicable • = Applicable

Code	Mounting Bracket Options	HD	HG
B5	Universal Mounting Bracket for 2-in. Pipe or Panel Mount, CS Bolts	•	•
B6	Universal Mounting Bracket for 2-in. Pipe or Panel Mount, SST Bolts	•	•
Code	Hazardous Locations Certification Options	HD	HG
E5	FM Explosion proof Approval	•	•
I5	FM Non-incendive and Intrinsic Safety Approval	•	•
K5	FM Explosion proof and Intrinsic Safety Approval	•	•
I1	BASEEFA/CENELEC Intrinsic Safety and Dust Certification (<i>NOTE: Not available with low-power Option Code M.</i>)	•	•
N1	BASEEFA/CENELEC Type N and Dust Certification (<i>NOTE: Not available with low-power Option Code M.</i>)	•	•
E8	KEMA/CENELEC Flameproof and Dust Certification	•	•
E4	JIS Flameproof Certification (<i>NOTE: Not available with low-power Option Code M.</i>)	•	•
C6	CSA Explosion proof and Intrinsic Safety Approval	•	•
K6	Combination of CSA and CENELEC Explosion proof and Intrinsic Safety Approval (<i>NOTE: Not available with low-power Option Code M.</i>)	•	•
K7	Combination of SAA Flameproof and Intrinsic Safety Approvals	•	•
K8	Combination of CENELEC Flameproof and Intrinsic Safety Approvals (<i>NOTE: Not available with low-power Option Code M.</i>)	•	•
KB	Combination of FM and CSA Explosion proof and Intrinsic Safety Approvals	•	•
I7	SAA Intrinsic Safety Certification	•	•
E7	SAA Flameproof Certification	•	•
N7	SAA Type N Certification	•	•
IA	BASEEFA/CENELEC Intrinsic Safety for FISCO; for FOUNDATION fieldbus protocol only	•	•
IE	FM FISCO Intrinsic Safety; for FOUNDATION fieldbus protocol only	•	•
Code	Bolt for Flange and Adapter Options	HD	HG
L4	Austenitic 316 SST Bolts	•	•
Code	Meter Options	HD	HG
M5	LCD Meter for Aluminum Housing (Housing Codes A, B, C, and D only)	•	•
M6	LCD Meter for SST Housing (Housing Codes J, K, L, and M only)	•	•
Code	Other Options	HD	HG
Q4	Calibration Data Sheet	•	•
Q8	Material traceability certification per EN 10204 3.1.B	•	•
QP	Calibration certification and tamper evident seal	•	•
J1 ⁽²⁾	Local Zero Adjustment Only <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>	•	•
J3 ⁽²⁾	No Local Zero or Span Adjustment <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>	•	•
T1	Transient Protection Terminal Block <i>NOTE: Not available with hazardous locations certification Option Code I1, K6, or K8.</i>	•	•
C1 ⁽²⁾	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)	•	•
C2 ⁽²⁾	0.8–3.2 V dc Output with Digital Signal Based on HART Protocol (Output Code M only)	•	•
C4 ⁽²⁾	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>	•	•
CN ⁽²⁾	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Alarm Configuration—Low <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>	•	•
P1	Hydrostatic Testing	•	•
P2	Cleaning for Special Service	•	•
P3	Cleaning for <1 PPM Chlorine/Fluorine	•	•
DF	¹ / ₂ –14 NPT flange adapters—SST	•	•
D8	Ceramic Ball Drain/Vents	•	•
V5 ⁽³⁾	External Ground Screw Assembly	•	•
Typical Model Number:		3051HG	2 A 2 2 A H 2 1 A B5

(1) Materials of Construction meet NACE material recommendation per MR 01-75. Environmental limits apply to certain materials. Consult latest standard for details.

(2) Not available with fieldbus (output code F) or profibus protocols (output code W).

(3) The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

TABLE 14. 3051P Reference Class Transmitter — = Not Applicable • = Applicable

				Available	
Model	Transmitter Type (Select One)			PD	PG
3051PD	Rosemount 3051P <i>Reference Class</i> Differential Pressure Transmitter			•	—
3051PG	Rosemount 3051 P <i>Reference Class</i> Gage Pressure Transmitter				
Pressure Ranges (Range/Min. Span)					
Code	Rosemount 3051 PD		Rosemount 3051 PG		
2	–250 to 250 inH ₂ O/25 inH ₂ O (–0,62 to 0,62 bar/62,3 mbar)		–250 to 250 inH ₂ O/25 inH ₂ O (–0,62 to 0,62 bar/6,2 mbar)		
3	–1000 to 1000 inH ₂ O/100 inH ₂ O (–2,5 to 2,5 bar/25 mbar)		–407 to 100 inH ₂ O/100 in H ₂ O (–1,01 to 2,5 bar/250 mbar)		
4	Not Applicable		–14.7 to 30 psi/30 psi (–1,01 to 20,7 bar/207 mbar)		
5	Not Applicable		–14.7 to 200 psig/200 psi (–1,01 to 138 bar/1,4 bar)		
NOTE: 3051PG lower range limit varies with atmospheric pressure.					
Code	Output			PD	PG
A	4–20 mA with Digital Signal Based on <i>HART</i> Protocol			•	•
MATERIALS OF CONSTRUCTION					
Code	Process Flange Type	Flange Material	Drain/Vent	PD	PG
2	<i>Coplanar</i>	SST	SST	•	•
0 ⁽¹⁾	Alternate Flange—See Alternate Flange Options page 36.				
Code	Isolating Diaphragm			PD	PG
2	316L SST			•	•
Code	O-ring Material			PD	PG
A	Glass-Filled TFE			•	•
Code	Fill Fluid			PD	PG
1	Silicone			•	•
2	Inert (Halocarbon)			•	•
Code	Housing Material	Conduit Entry Size		PD	PG
A	Polyurethane-covered Aluminum	½–14 NPT		•	•
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)		•	•
C	Polyurethane-covered Aluminum	PG 13.5		•	•
D	Polyurethane-covered Aluminum	G½		•	•
J	SST	½–14 NPT		•	•
K	SST	M20 × 1.5 (CM20)		•	•
L	SST	PG 13.5		•	•
M	SST	G½		•	•
Code	Alternate Flange Options (Requires Materials of Construction Code 0)			PD	PG
H2	Traditional Flange, 316 SST Drain/Vent, SST Flange Adapter			•	•
FA	Level Flange, SST, 2 in., ANSI Class 150, Vertical Mount			•	•
FB	Level Flange, SST, 2 in., ANSI Class 300, Vertical Mount			•	•
FC	Level Flange, SST, 3 in., ANSI Class 150, Vertical Mount			•	•
FD	Level Flange, SST, 3 in., ANSI Class 300, Vertical Mount			•	•
FP	DIN Level Flange, SST, DN 50, PN 40, Vertical Mount				
FQ	DIN Level Flange, SST, DN 80, PN 40, Vertical Mount				
Code	Integral Mount Manifold Options			PD	PG
S5	Assemble to Rosemount 305 Integral Manifold				
Code	Integral Mount Primary Elements (Optional)			PD	PG
S4	Factory Assembly to Rosemount Primary Element (Diamond II+Annubar/Rosemount 1195 Integral Orifice)			•	—
NOTE: With the primary element installed, the maximum operating pressure will equal the lesser of either the transmitter or the primary element. Option is available for factory assembly to range 2–3 transmitters only.					

Product Data Sheet

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Rosemount 3051

TABLE 14. 3051P *Reference Class* Transmitter — = Not Applicable • = Applicable

Code	Mounting Bracket Options	PD	PG
B4	Coplanar Flange Bracket for 2-in. Pipe or Panel Mounting, All SST	•	•
B1	Traditional Flange Bracket for 2-in. Pipe Mounting, CS Bolts	•	•
B2	Traditional Flange Bracket for Panel Mounting, CS Bolts	•	•
B7	B1 Bracket with Series 300 SST Bolts	•	•
B8	B2 Bracket with Series 300 SST Bolts	•	•
BA	SST B1 Bracket with Series 300 SST Bolts	•	•
BC	SST B3 Bracket with Series 300 SST Bolts	•	•
Code	Hazardous Locations Certification Options		
E5	FM Explosion proof Approval	•	•
I5	FM Non-incendive and Intrinsic Safety Approval	•	•
K5	FM Explosion proof and Intrinsic Safety Approval	•	•
I1	BASEEFA/CENELEC Intrinsic Safety and Dust Certification	•	•
N1	BASEEFA/CENELEC Type N and Dust Certification	•	•
E8	KEMA/CENELEC Flameproof and Dust Certification	•	•
E4	JIS Flameproof Certification	•	•
C6	Canadian Standards Association (CSA) Explosion proof and Intrinsic Safety Approval	•	•
K6	Combination of CSA and CENELEC Explosion proof and Intrinsic Safety Approval	•	•
K7	Combination of SAA Flameproof and Intrinsic Safety Approvals	•	•
K8	Combination of CENELEC Flameproof and Intrinsic Safety Approvals	•	•
KB	Combination of FM and CSA Explosion proof and Intrinsic Safety Approvals	•	•
I7	SAA Intrinsic Safety Certification	•	•
E7	SAA Flameproof Certification	•	•
N7	SAA Type N Certification	•	•
Code	Other Options		
Q4	Calibration Data Sheet	•	
Q8	Material Traceability Certification per EN 10204 3.1.B <i>NOTE: This option is available for the sensor module housing and Coplanar or traditional flanges and adapters.</i>	•	•
QP	Calibration Certification and Tamper Evident Seal	•	•
L4	Austenitic 316 SST Bolts	•	•
L5	ANSI/ASTM-A-193-B7M Bolts	•	•
L6	<i>Monel</i> Bolts	•	•
M5	LCD Meter for Aluminum Housing (Housing Codes A, B, C, and D only)	•	•
M6	LCD Meter for SST Housing (Housing Codes J, K, L, and M only)	•	•
J1	Local Zero Adjustment Only <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>	•	•
J3	No Local Zero or Span Adjustment <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>	•	•
T1	Transient Protection Terminal Block <i>NOTE: Not available with hazardous locations certification Option Code I1.</i>	•	•
C1	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)	•	•
C4	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>	•	•
CN	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Alarm Configuration—Low <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>	•	•
P1	Hydrostatic Testing	•	•
P2	Cleaning for Special Service	•	•
P3	Cleaning for <1 PPM Chlorine/Fluorine	•	•
P4	Calibrate at line pressure <i>NOTE: Specify Q48 on order for corresponding certificate.</i>	•	•
DF	¹ / ₂ –14 NPT flange adapters—SST	•	•
D7	<i>Coplanar</i> Flange Without Drain/Vent Ports	•	•
V5 ⁽²⁾	External Ground Screw Assembly	•	•
Typical Model Number: 3051PD 3 A 2 2 A 1 A B4			

(1) *NOTE: May impact temperature performance under certain conditions.*

(2) *The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.*

OPTIONS

Standard Configuration

Unless otherwise specified, transmitter is shipped as follows:

ENGINEERING UNITS

Differential/Gage: inH₂O (Range 0, 1, 2, and 3) psi
(Range 4 and 5)

Absolute/3051T: psi (all ranges)

4 mA (1 V dc)⁽¹⁾: 0 (engineering units above)

20 mA (5 V dc): Upper range limit

Output: Linear

Flange type: Specified model code option

Flange material: Specified model code option

O-ring material: Specified model code option

Drain/vent: Specified model code option

Integral meter: Installed or none

Alarm⁽¹⁾: Upscale

Software tag: (Blank)

(1) Not applicable to fieldbus.

Custom Configuration HART protocol only (Option Code C1)⁽¹⁾

If Option Code C1 is ordered, the customer may specify the following data in addition to the standard configuration parameters.

- Output Information
- Transmitter Information
- LCD Meter Configuration
- Hardware Selectable Information
- Signal Selection

Refer to the "HART Protocol C1 Option Configuration Data Sheet" on page 41.

Tagging

Three customer tagging options are available:

1. Standard SST hardware tag is wired to the transmitter. Tag character height is 0.125 in. (3,18 mm), 56 characters maximum.
2. Tag may be permanently stamped on transmitter nameplate upon request, 56 characters maximum.
3. Tag may be stored in transmitter memory (30 characters maximum). Software tag is left blank unless specified.

Commissioning tag (fieldbus only)

A temporary commissioning tag is attached to all transmitters. The tag indicates the device ID and allows an area for writing the location.

Optional Rosemount 305 or 306 Integral Manifolds

Factory assembled to 3051C and 3051T transmitters. Refer to the following Rosemount document for more information: Product Data Sheet 00813-0100-4733

Optional Three-Valve Manifolds

(Packaged Separately)

Part No.1151-0150-0001

3-Valve Manifold, Carbon Steel

Part No. 1151-0150-0002

3-Valve Manifold, 316 SST

Optional Diaphragm and Sanitary Seals

Refer to Product Data Sheet 00813-0100-4016 or 00813-0201-4016.

Output Information⁽¹⁾

Output range points must be the same unit of measure. Available units of measure include:

inH ₂ O	inH ₂ O@4 °C ⁽¹⁾	psi	Pa
inHg	ftH ₂ O	bar	kPa
mmH ₂ O	mmH ₂ O@4 °C ⁽¹⁾	mbar	torr
mmHg	g/cm ²	kg/cm ²	atm

(1) Not available on low power or previous versions.

LCD Meter

M5 Digital Meter, 5-Digit, 2-Line LCD

- Direct reading of digital data for higher accuracy
- Displays user-defined flow, level, volume, or pressure units
- Displays diagnostic messages for local troubleshooting
- 90-degree rotation capability for easy viewing

M6 Digital Meter with 316 Stainless Steel Cover

- For use with stainless steel housing option (housing codes J, K, and L)

(1) Not applicable to fieldbus.

Local Span and Zero Adjustment⁽¹⁾

Transmitters ship with local span and zero adjustments standard unless otherwise specified.

- Non-interactive external zero and span adjustments ease calibration
- Magnetic switches replace standard potentiometer adjustments to optimize performance

J1 Local Zero Adjustment Only⁽¹⁾**J3 No Local Zero or Span Adjustment⁽¹⁾****Transient Protection**

- Integral transient protection terminal block
- Meets IEEE Standard 587, Category B
1 kV crest ($10 \times 1\,000$ microseconds)
3 kV crest (8×20 microseconds)
6 kV crest (1.2×50 microseconds)
- Meets IEEE Standard 472,
Surge Withstand Capability
SWC 2,5 kV crest, 1 MHz wave form
- Applicable standards: IEC 801-4, 801-5

T1 Integral Transient Protection Terminal Block**Bolts for Flanges and Adapters**

- Options permit bolts for flanges and adapters to be obtained in various materials
- Standard material is plated carbon steel per ASTM A449, Type 1

L4 Austenitic 316 Stainless Steel Bolts**L5 ASTM-A-193-B7M Bolts****L6 Monel Bolts****Rosemount 3051C/P Coplanar Flange and 3051T Bracket Option****B4 Bracket for 2-in. Pipe or Panel Mounting**

- For use with the standard Coplanar flange configuration
- Bracket for mounting of transmitter on 2-in. pipe or panel
- Stainless steel construction with stainless steel bolts

Rosemount 3051H Bracket Options**B5 Bracket for 2-in. Pipe or Panel Mounting**

- For use with the 3051H Pressure Transmitter for high process temperatures
- Carbon steel construction with carbon steel bolts

B6 B5 Bracket with SST Bolts

- Same bracket as the B5 option with Series 300 stainless steel bolts.

Traditional Flange Bracket Options**B1 Bracket for 2-in. Pipe Mounting**

- For use with the traditional flange option
- Bracket for mounting on 2-in. pipe
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B2 Bracket for Panel Mounting

- For use with the traditional flange option
- Bracket for mounting transmitter on wall or panel
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B3 Flat Bracket for 2-in. Pipe Mounting

- For use with the traditional flange option
- Bracket for vertical mounting of transmitter on 2-in. pipe
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B7 B1 Bracket with SST Bolts

- Same bracket as the B1 option with Series 300 stainless steel bolts

B8 B2 Bracket with SST Bolts

- Same bracket as the B2 option with Series 300 stainless steel bolts

B9 B3 Bracket with SST Bolts

- Same bracket as the B3 option with Series 300 stainless steel bolts

(1) Not applicable to fieldbus.

BA Stainless Steel B1 Bracket with SST Bolts

- B1 bracket in stainless steel with Series 300 stainless steel bolts

BC Stainless Steel B3 Bracket with SST Bolts

- B3 bracket in stainless steel with Series 300 stainless steel bolts

Shipping Weights

TABLE 15. Transmitter Weights without Options

Transmitter	Add Weight In lb (kg)
3051C/P	6.0 (2,7)
3051L	Table 16 on page 40
3051H	13.6 (6,2)
3051T	3.0 (1,4)

TABLE 16. 3051L Weights without Options

Flange	Flush lb. (kg)	2-in. Ext. lb (kg)	4-in. Ext. lb (kg)	6-in. Ext. lb (kg)
2-in., 150	12.5 (5,7)	—	—	—
3-in., 150	17.5 (7,9)	19.5 (8,8)	20.5 (9,3)	21.5 (9,7)
4-in., 150	23.5 (10,7)	26.5 (12,0)	28.5 (12,9)	30.5 (13,8)
2-in., 300	17.5 (7,9)	—	—	—
3-in., 300	22.5 (10,2)	24.5 (11,1)	25.5 (11,6)	26.5 (12,0)
4-in., 300	32.5 (14,7)	35.5 (16,1)	37.5 (17,0)	39.5 (17,9)
2-in., 600	15.3 (6,9)	—	—	—
3-in., 600	25.2 (11,4)	27.2 (12,3)	28.2 (12,8)	29.2 (13,2)
DN 50/ PN 40	13.8 (6,2)	—	—	—
DN 80/ PN 40	19.5 (8,8)	21.5 (9,7)	22.5 (10,2)	23.5 (10,6)
DN 100/ PN 10/16	17.8 (8,1)	19.8 (9,0)	20.8 (9,5)	21.8 (9,9)
DN 100/ PN 40	23.2 (10,5)	25.2 (11,5)	26.2 (11,9)	27.2 (12,3)

TABLE 17. Transmitter Options Weights

Code	Option	Add lb (kg)
J, K, L, M	Stainless Steel Housing(T)	3.9 (1,8)
J, K, L, M	Stainless Steel Housing (C, L, H, P)	3.1 (1,4)
M5	LCD Meter for Aluminum Housing	0.5 (0,2)
M6	LCD Meter for SST Housing	1.25 (0,6)
B4	SST Mounting Bracket for <i>Coplanar</i> Flange	1.0 (0,5)
B1 B2 B3	Mounting Bracket for Traditional Flange	2.3 (1,0)
B7 B8 B9	Mounting Bracket for Traditional Flange	2.3 (1,0)
BA, BC	SST Bracket for Traditional Flange	2.3 (1,0)
B5 B6	Mounting Bracket for 3051H	2.9 (1,3)
H2	Traditional Flange	2.4 (1,1)
H3	Traditional Flange	2.7 (1,2)
H4	Traditional Flange	2.6 (1,2)
H7	Traditional Flange	2.5 (1,1)
FC	Level Flange—3 in., 150	10.8 (4,9)
FD	Level Flange—3 in., 300	14.3 (6,5)
FA	Level Flange—2 in., 150	10.7 (4,8)
FB	Level Flange—2 in., 300	14.0 (6,3)
FP	DIN Level Flange, SST, DN 50, PN 40	8.3 (3,8)
FQ	DIN Level Flange, SST, DN 80, PN 40	13.7 (6,2)

HART Protocol C1 Option Configuration Data Sheet

★ = Default Value⁽¹⁾

CONFIGURATION DATA SHEET

Customer: _____ P.O. No.: _____

Model No.: _____ Line Item: _____

SST Tag No.:

Software Tag: | | | | | | | | | |

OUTPUT INFORMATION: (Software Selectable)

4 mA (1, 0.8 Volts) = 0 ★

20 mA (5, 3.2 Volts) = Upper Range Limit ★

Pressure Units = ☐ inH₂O⁽²⁾★ ☐ psi ⁽³⁾ ★ ☐ Pa ☐ ftH₂O
☐ inHg ☐ bar ☐ kPa ☐ g/cm²
☐ mbar ☐ Torr ☐ mmH₂O ☐ inH₂O at 4 °C⁽⁵⁾
☐ Atm ☐ kg/cm² ☐ mmHg ☐ mmH₂O at 4 °C ⁽⁵⁾

Output = ☐ Linear ★ ☐ Square Root (For DP transmitters only)

Damping⁽⁴⁾= ☐ 0.00 sec. ☐ 0.05 sec. ☐ 0.10 sec. ☐ 0.20 sec. ☐ 0.40 sec.★
☐ 0.80 sec. ☐ 1.60 sec. ☐ 3.20 sec. ☐ 12.8 sec. ☐ 25.6 sec.

TRANSMITTER INFORMATION: (Software Selectable)

Descriptor⁽⁴⁾: | | | | | | | | | | | | | | | | (16 characters)

[illegible]

Date⁽⁴⁾: / /

Day Month Year

Local Span and Zero: ☒ Enabled ★ ☐ Disabled

(1) Default values may be different outside the U.S. A. Consult your Rosemount Sales Representative for details.

(2) *inH20* for CD/CG ranges 1-3

(3) *psi* for CD/CG range 4 and 5, all CA ranges

(4) C1 option required for configuration of this parameter.

(5) Not available with low power output.

LCD METER CONFIGURATION (Software Adjustable – M5 or M6 option must be specified in model number)

Meter Display Type⁽⁴⁾:

☐ Eng. Units only	☐ Alternate Eng. Units &% of Range ★
☐ % of Range only	☐ Alternate Eng. Units & Custom Display ⁽⁵⁾
☐ Custom Display only	☐ Alternate % of Range & Custom Display ⁽⁵⁾

Custom Display Configuration: (must be filled out if Custom Display is selected as meter type)

Decimal Point Position

(fixed)—

indicate decimal point location:

X_□ X_□ X_□★ X_□ X_□

Enter Lower Range Value (Decimal point must be in the same position as specified above.)

(circle sign) + – +000.00 ★

Enter Upper Range Value (Decimal point must be in the same position as specified above.)

(circle sign) + – +100.00 ★

Custom Units—spaces consume A-Z, 0-9, /, *, %, blank

%RNGE ★

Custom Display Transfer Function (Independent of Analog Output)

☐ Linear ★ ☐ Square Root

HARDWARE SELECTABLE INFORMATION

Alarm Option: ☐ High ☐ Low

Transmitter Security: ☐ Off ☐ On

Note: Specify C4 Option in model structure when ordering NAMUR-compliant alarm and saturation limits.⁽⁵⁾

SIGNAL SELECTION: (Software Selectable)

☐ 4–20 mA with simultaneous digital signal based on HART protocol★

☐ Burst mode of HART digital process variable ⁽⁴⁾

Burst mode output options:

- ☐ Primary variable in engineering units
- ☐ Primary variable in percent of range
- ☐ All dynamic variables in engineering units and the primary variable mA value

☐ Multidrop Communication⁽⁴⁾⁽⁶⁾

Choose transmitter address⁽⁷⁾ (1-15): _____

⁽⁴⁾ C1 option required for configuration of this parameter.

⁽⁵⁾ Not available with low power output.

⁽⁶⁾ This option fixes the transmitter analog output at 4mA.

⁽⁷⁾ Default address is 1 if multidrop communication is selected.

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Rosemount 3051

3051C Differential/Gage Pressure Transmitter Range Limits										
Units	Range 1 Span		Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
	min	max	min	max	min	max	min	max	min	max
inH ₂ O	0.5	25	2.5	250	10	1000	83.040	8304	553.60	55360
inHg	0.03678	1.8389	0.18389	18.389	0.73559	73.559	6.1081	610.81	40.720	4072.04
ftH ₂ O	0.04167	2.08333	0.20833	20.8333	0.83333	83.3333	6.9198	691.997	46.13	4613.31
mmH ₂ O	12.7	635.5	63.553	6355	254	25421	2110.95	211095	14073	1407301
mmHg	0.93416	46.7082	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
psi	0.01806	0.903	0.0902	9.03183	0.36127	36.127	3	300	20	2000
bar	0.00125	0.06227	0.00623	0.62272	0.02491	2.491	0.20684	20.6843	1.37895	137.895
mbar	1.2454	62.2723	6.22723	622.723	24.9089	2490.89	206.843	20684.3	1378.95	137895
g/cm ²	1.26775	63.3875	6.33875	633.875	25.355	2535.45	210.547	21054.7	1406.14	140614
kg/cm ²	0.00127	0.0635	0.00635	0.635	0.0254	2.54	0.21092	21.0921	1.40614	140.614
Pa	124.545	6227.23	622.723	62160.6	2490.89	249089	20684.3	2068430	137895	13789500
kPa	0.12545	6.2272	0.62272	62.2723	2.49089	249.089	20.6843	2068.43	137.895	13789.5
torr	0.93416	46.7082	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
atm	0.00123	0.06146	0.00615	0.61460	0.02458	2.458	0.20414	20.4138	1.36092	136.092

NOTE

When used with the HART Communicator or the Rosemount 268 Communicator, $\pm 5\%$ adjustability is allowed on the sensor limit to allow for unit conversions.

3051P Differential/Gage Pressure Transmitter Range Limits								
Units	Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
	min	max	min	max	min	max	min	max
inH ₂ O	25	250	100	1000	830.40	8304	5536.0	55360
inHg	1.8389	18.389	7.3559	73.559	61.081	610.81	407.20	4072.04
ftH ₂ O	2.08333	20.8333	8.3333	83.3333	69.200	691.997	461.3	4613.31
mmH ₂ O	635.5	6355	2542	25421	21109.5	211095	140730	1407301
mmHg	46.7082	467.082	186.833	1868.33	1551.45	15514.5	10343	103430
psi	0.903	9.03183	3.6127	36.127	30	300	200	2000
bar	0.06227	0.62272	0.2491	2.491	2.0684	20.6843	13.7895	137.895
mbar	62.2723	622.723	249.089	2490.89	2068.43	20684.3	13789.5	137895
g/cm ²	63.3875	633.875	253.55	2535.45	2105.47	21054.7	14061.4	140614
kg/cm ²	0.0635	0.635	0.254	2.54	2.1092	21.0921	14.0614	140.614
Pa	6216.06	62160.6	24908.9	249089	206843	2068430	1378950	13789500
kPa	6.2272	62.2723	24.9089	249.089	206.843	2068.43	1378.95	13789.5
torr	46.7082	467.082	186.833	1868.33	1551.45	15514.5	10343	103430
atm	0.06146	0.61460	0.2458	2.458	2.0414	20.4138	13.6092	136.092

NOTE

When used with the HART Communicator or the Rosemount 268 Communicator, $\pm 5\%$ adjustability is allowed on the sensor limit to allow for unit conversions.

3051L/3051H Pressure Transmitter Range Limits								
Units	Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
	min	max	min	max	min	max	min	max
inH ₂ O	2.5	250	10	1000	83.040	8304	553.60	55360
inHg	0.18389	18.389	0.73559	73.559	6.1081	610.81	40.720	4072.04
ftH ₂ O	0.20833	20.8333	0.83333	83.3333	6.9198	691.997	46.13	4613.31
mmH ₂ O	63.553	6355	254	25421	2110.95	211095	14073	1407301
mmHg	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
psi	0.0902	9.03183	0.36127	36.127	3	300	20	2000
bar	0.00623	0.62272	0.02491	2.491	0.20684	20.6843	1.37895	137.895
mbar	6.22723	622.723	24.9089	2490.89	206.843	20684.3	1378.95	137895
g/cm ²	6.33875	633.875	25.355	2535.45	210.547	21054.7	1406.14	140614
kg/cm ²	0.00635	0.635	0.0254	2.54	0.21092	21.0921	1.40614	140.614
Pa	622.723	62160.6	2490.89	249089	20684.3	2068430	137895	13789500
kPa	0.62272	62.2723	2.49089	249.089	20.6843	2068.43	137.895	13789.5
torr	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
atm	0.00615	0.61460	0.02458	2.458	0.20414	20.4138	1.36092	136.092

NOTE

When used with the HART Communicator or the Rosemount 268 Communicator, $\pm 5\%$ adjustability is allowed on the sensor limit to allow for unit conversions.

3051T Gage and Absolute Pressure Transmitter Range Limits										
Units	Range 1 Span		Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
	min	max	min	max	min	max	min	max	min	max
inH ₂ O	8.30397	831.889	41.5198	4159.45	221.439	22143.9	1107.2	110720	55360	276799
inHg	0.61081	61.0807	3.05403	305.403	16.2882	1628.82	81.441	8144.098	4072.04	20360.2
ftH ₂ O	0.69199	69.3241	3.45998	345.998	18.4533	1845.33	92.2663	9226.63	4613.31	23066.6
mmH ₂ O	211.10	21130	1054.60	105460.3	5634.66	563466	28146.1	2814613	1407301	7036507
mmHg	15.5145	1551.45	77.5723	7757.23	413.72	41372	2068.6	206860.0	103430	517151
psi	0.3	30	1.5	150	8	800	40	4000	2000	10000
bar	0.02068	3.06843	0.10342	10.3421	0.55158	55.1581	2.75791	275.7905	137.895	689.476
mbar	20.6843	2068.43	103.421	10342.11	551.581	55158.1	2757.91	275790.5	137895	689476
g/cm ²	21.0921	2109.21	105.461	10546.1	561.459	56145.9	2807.31	280730.6	140614	703067
kg/cm ²	0.02109	2.10921	0.10546	10.5461	0.56246	56.2456	2.81228	281.228	140.614	701.82
Pa	2068.43	206843	10342.1	1034212	55158.1	5515811	275791	27579054	13789500	68947600
kPa	2.06843	206.843	10.3421	1034.21	55.1581	5515.81	275.791	27579.05	13789.5	68947.6
torr	15.5145	1551.45	77.5726	7757.26	413.721	413721	2068.6	206859.7	103430	517151
atm	0.02041	2.04138	0.10207	10.2069	0.54437	54.4368	2.72184	272.1841	136.092	680.46

NOTE

When used with the HART Communicator or the Rosemount Communicator, $\pm 5\%$ adjustability is allowed on the sensor limit to allow for unit conversions.

3051T Gage and Absolute Pressure Transmitter Range Limits										
Units	Range 1 Span		Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
	min	max	min	max	min	max	min	max	min	max
inH ₂ O	4.62254	138.399	8.30397	831.889	41.5198	4151.98	221.439	22143.9	1107.2	110720
inHg	0.34002	10.1801	0.61081	61.0807	3.05403	305.403	16.2882	1628.82	81.441	8144.098
ftH ₂ O	0.38521	11.5333	0.69199	69.3241	3.45998	345.998	18.4533	1845.33	92.2663	9226.63
mmH ₂ O	117.510	3518.2	211.10	21130	6.35308	635.308	5634.66	563466	28146.1	2814613
mmHg	8.63642	258.575	15.5145	1551.45	1055.47	105547	413.72	41372	2068.6	206860.0
psi	0.16667	5	0.3	30	1.5	150	8	800	40	4000
bar	0.01151	0.344738	0.02068	2.06843	0.10342	10.342	0.55158	55.1581	2.75791	275.7905
mbar	11.5142	344.738	20.6843	2068.43	103.421	10342.1	551.581	55158.1	2757.91	275790.5
g/cm ²	11.74	350.91	21.0921	2109.21	105.27	105.27	561.459	56145.9	2807.31	280730.6
kg/cm ²	0.01174	0.351535	0.02109	2.10921	0.10546	10.546	0.56246	56.2456	2.81228	281.228
Pa	1151.42	34473.8	2068.43	206843	10342.1	1034210	55158.1	5515811	275791	27579054
kPa	1.15142	34.4738	2.06843	206.843	10.3421	1034.21	55.1581	5515.81	275.791	27579.05
torr	8.63642	258.575	15.5145	1551.45	77.5726	7757.26	413.721	413721	2068.6	206859.7
atm	0.01136	0.34023	0.02041	2.04138	0.10207	10.207	0.54437	54.4368	2.72184	272.1841

NOTE

When used with the HART Communicator or the Rosemount 268 Communicator, $\pm 5\%$ adjustability is allowed on the sensor limit to allow for unit conversions.

Product Data Sheet

00813-0100-4001, Rev DB

September 2003

Rosemount 3051

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*Rosemount Model 3051 Smart Pressure Transmitters may be protected by one or more of the following U.S. Patent Nos. 4,370,890; 4,466,290; 4,612,812; 4,791,352; 4,798,089; 4,818,994; 4,833,922; 4,866,435; 4,926,340; 4,988,990; and 5,028,746. Mexico Patentado No. 154,961. May depend on model.
Other foreign patents issued and pending.*

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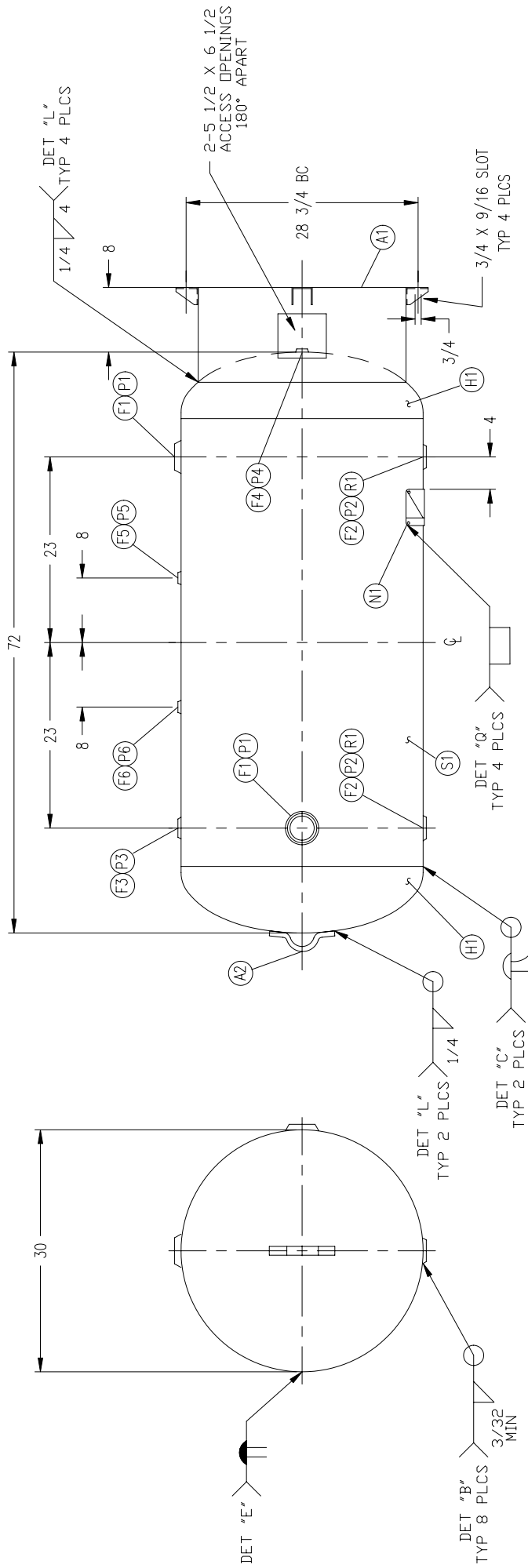
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CODE/ADDENDA _____ APPROVED _____
RELEASED FOR PRODUCTION _____
Q.C. _____ DATE _____



SYN DATE		BY	REVISION	APP	NOTES	SPECIFICATIONS		MANCHESTER TANK					
7	8/97	GG	ADDED FIND#S	AS		O.D.: 30 LGTH: 72 SH: 199 MAT'L: SA455 MAWP: 200 PSI @ 400 °F HD: 163 MAT'L: SA414-G RT noMDMT- 20 F@ 200 PSI GAL: 200 SA: 51 ft ² EXMT:UG 20(f)TEST 260 PSI WGT: 556 # CU.FT: 26.8 X-RAY: NONE CORR ALW: SH -- HD -- CRN# L4878.5C CODE: ASME / NB PER DATE OF DWG/LAST REV		VERTICAL AIR RECEIVER FOR REMOTE COMPRESSOR INSTALLATION	DRAWN BY	DATE	SCALE: NONE		
8	1/00	GG	TEMP WAS 650. TEST WAS 300	AS					JMG	02/07/86			
9	01/01	LB	HD WAS .186. CRN WAS F06281C TEMP WAS 400°F	AS							DRAWING NO.		
10	7/02	LB	SH WAS .227. TEMP WAS 650°F	AS									
									APP: BY	DATE			
						RC	02/07/86					3240	
					WELD DETAILS M-1932			STD. TOLERANCES (UNLESS OTHERWISE NOTED) M-2461					

T585-70-PL

Two-Piece, Full Port, 600 psi CWP Bronze Ball Valve for general purpose or utility service applications. Cast bronze body and end piece, blowout proof silicon bronze stem. NPT threaded ends are standard.



T585-70-PL

Design Features:

- Full port for high flow coefficient
- Dezincification resistant silicon bronze stem
- Pad lock lever handle
- $\frac{1}{4}$ " – 2"

Specifications:

- MSS SP-110
- ANSI B1.20.1 (threaded end)

Applications:

- HVAC
- Hot and cold water
- Compressed air
- Vacuum service
- Where valves must be locked out for safety reasons, valve can be locked in the open or closed position

Full Port, Two Piece Bronze 600 psi CWP with Rough Chrome Plate

T585-70-CP

This two-piece full port bronze ball valve is for use in general utility services. The rough chrome plating is for mating to other chrome plated equipment and for additional corrosion resistance.



T585-70-CP

Design Features:

- Chrome plated cast bronze body & end-piece
- Blowout proof stem (silicon bronze)
- Full port for high flow coefficient
- $\frac{1}{4}$ " – 2"

Specifications:

- MSS SP-110
- ANSI B1.20.1

Options:

- Memory stop
- Nib-Seal® insulated handle
- Horizontal or vertical chain lever
- Locking lever

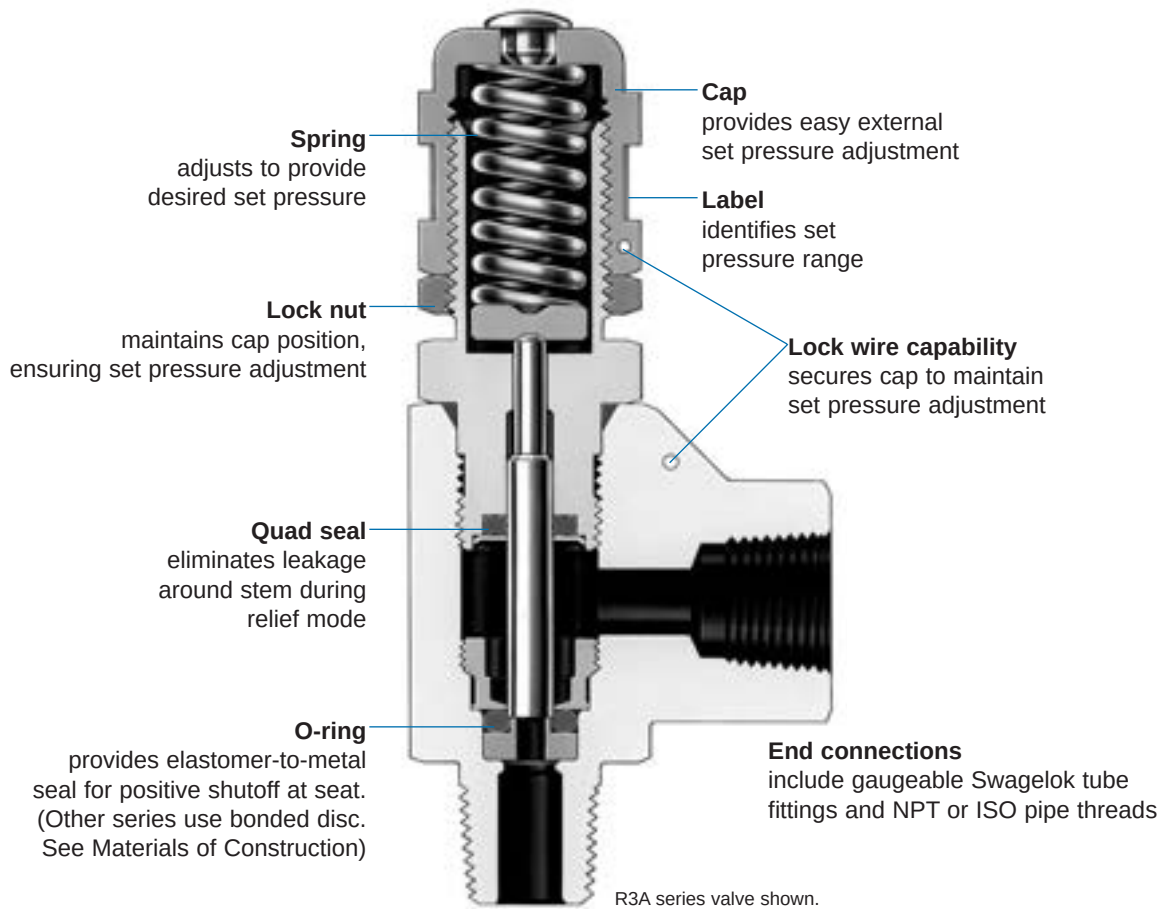


Proportional Relief Valves



R Series

- Liquid or gas service
- Set pressures from 10 to 6000 psig (0.68 to 413 bar)
- 1/4 and 1/2 in. and 6 to 12 mm end connections



Features

High-Pressure Valves

- Service up to 6000 psig (413 bar)
- Multiple springs for a selection of set pressure ranges
- 1/4 in. and 6 and 8 mm end connections—R3A series
- 1/2 in. and 12 mm end connections—R4 series

Low-Pressure Valves

- Service up to 300 psig (20.6 bar)
- One spring for the full set pressure range
- 1/4 in. and 6 and 8 mm end connections—RL3 series
- 1/2 in. and 12 mm end connections—RL4 series

Applications

R series relief valves are proportional relief valves that open gradually as the pressure increases. Consequently, they do not have a capacity rating at a given pressure rise (accumulation), and they are not certified to ASME or any other codes.

⚠ The system designer and user must determine applicable code requirements and whether R series relief valves are acceptable for use.

Operation

R series relief valves OPEN when system pressure reaches the set pressure and CLOSE when system pressure falls below the set pressure.

- High-pressure R3A and R4 series—select and install the spring that covers the required set pressure; apply the matching label to the cap.

- Low-pressure RL3 and RL4 series—the spring is already installed.

⚠ For valves not actuated for a period of time, initial relief pressure may be higher than the set pressure.

Technical Data

Pressure-Temperature Ratings

Series	R3A				R4				RL3 and RL4			
Working Pressure at 70°F (20°C)	6000 psig (413 bar); up to 8000 psig (551 bar) during relief				6000 psig (413 bar)				300 psig (20.6 bar)			
Set Pressure^①	50 to 6000 psig (3.4 to 413 bar)				50 to 1500 psig (3.4 to 103 bar)				10 to 225 psig (0.68 to 15.5 bar)			
Outlet Pressure^②	1500 psig (103 bar)				2500 psig (172 bar)				225 psig (15.5 bar)			
Seal Material	Fluoro-carbon FKM	Buna N	Neo-prene	Ethylene pro-pylene	Fluoro-carbon FKM	Buna N	Neo-prene	Ethylene pro-pylene	Fluoro-carbon FKM	Buna N	Neo-prene	Ethylene pro-pylene
Temperature, °F (°C)	Maximum Set Pressure, psig (bar)											
-40 (-40)	—	—	—	—	—	—	—	—	—	—	—	—
-30 (-34)												
-10 (-23)												
0 (-17)												
10 (-12)												
25 (-4)												
30 (-1)												
50 (10)												
150 (65)	6000 (413)	6000 (413)	6000 (413)	6000 (413)	1500 (103)	1500 (103)	1500 (103)	1500 (103)	225 (15.5)	225 (15.5)	225 (15.5)	225 (15.5)
200 (93)	5580 (384)	5580 (384)	5580 (384)	5580 (384)								
250 (121)	5160 (355)	5160 (355)	5160 (355)	5160 (355)								
275 (135)	4910 (338)	4910 (338)	4910 (338)	4910 (338)								
300 (148)	4660 (321)	4660 (321)	4660 (321)	4660 (321)								
—	—	—	—	—								
—	—	—	—	—								
—	—	—	—	—								

① The pressure-temperature ratings are based upon laboratory testing to ensure that the cracking pressure does not deviate by more than 20 % from the initial room temperature set pressure.

② Outlet pressure should not exceed inlet pressure.

Set Pressure and Resealing Pressure

- Set pressure is the upstream pressure at which the first indication of flow occurs. Set pressure of each valve **after initial relief** is repeatable within $\pm 5\%$ at room temperature.
- Resealing pressure is the upstream pressure at which there is no indication of flow. Resealing pressure is always lower than set pressure.

Testing

Every R series proportional relief valve is tested for set and resealing performance.

Series	Test Set Pressure psig (bar)	Minimum Resealing Pressure as a Percentage of Set Pressure, %
RL3, RL4	10 to 20 (0.68 to 1.3)	50
	175 to 225 (12.0 to 15.5)	91
R3A, R4	100 to 200 (6.8 to 13.7)	50
	850 to 1000 (58.5 to 68.9)	84

Cleaning and Packaging

All Swagelok R series relief valves are cleaned and packaged in accordance with *Swagelok Specification SC-10*.

Back Pressure

High-Pressure Valves (R3A and R4 Series)

The effect of system back pressure is minimized by the design of these high-pressure valves.

Low-Pressure Valves (RL3 and RL4 Series)

System back pressure increases the set pressure of the valve. To compensate, multiply the back pressure by 0.8 and subtract the result from the desired set pressure. Use the result to pre-set the valve while back pressure is equal to atmospheric pressure.

Example:

Desired set pressure is 120 psig. System back pressure is 40 psig.

Step 1. Multiply back pressure by 0.8.
 $40 \text{ psig} \times 0.8 = 32 \text{ psig}$

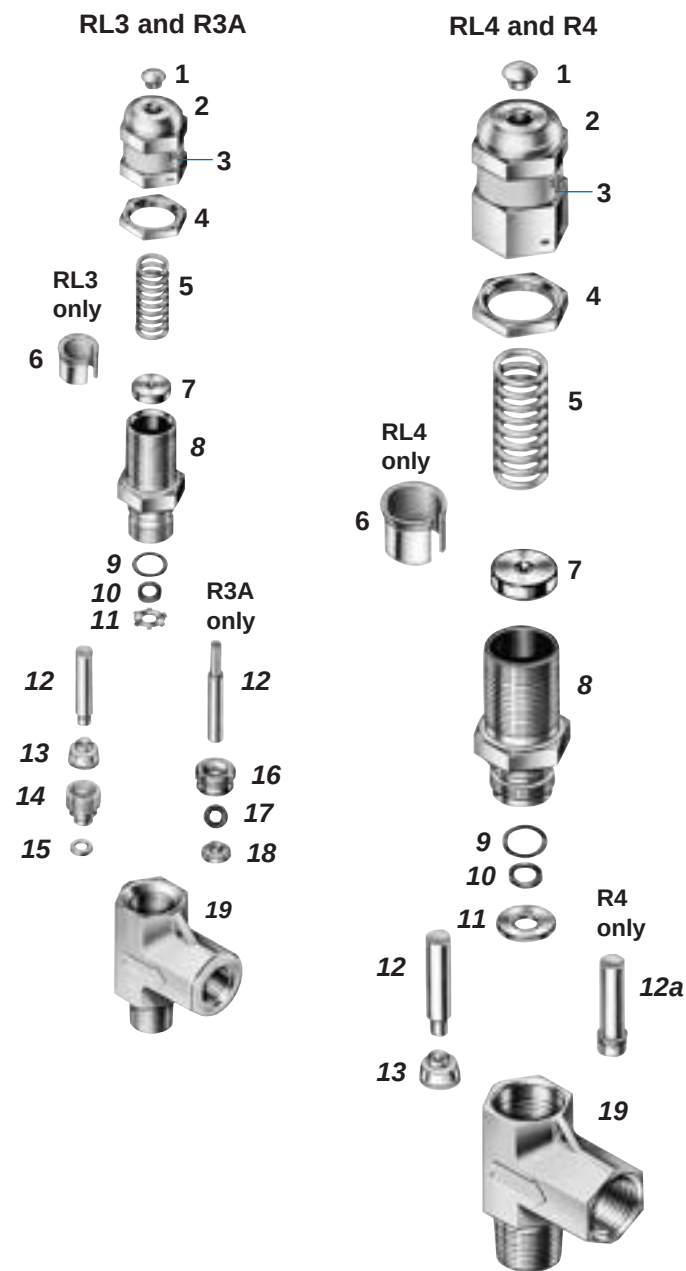
Step 2. Subtract result from desired set pressure.
 $120 \text{ psig} - 32 \text{ psig} = 88 \text{ psig}$

Step 3. Pre-set proportional relief valve to 88 psig.

Oxygen Service

For more information about hazards and risks of oxygen-enriched systems, see the *Swagelok Oxygen System Safety* technical report.

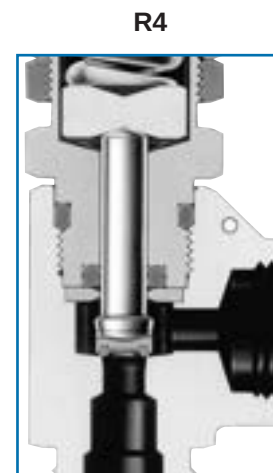
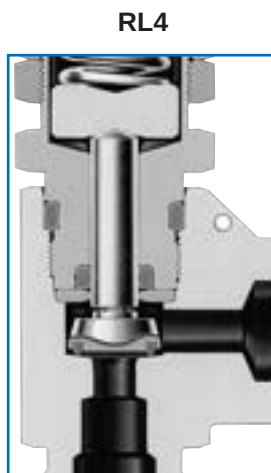
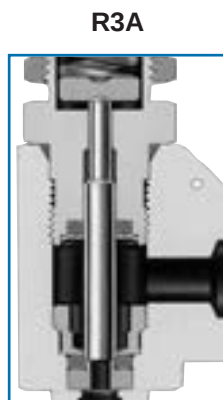
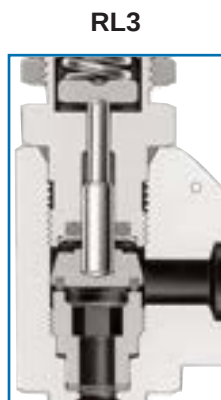
Materials of Construction



Component	Material Grade/ASTM Specification
1 Plug	RL3, R3A—nickel-plated brass; RL4, R4—brass
2 Cap	316 SS/A479
3 Label	Polyester
4 Lock nut	RL3, R3A—316 SS powdered metal; RL4, R4—316 SS/A276
5 Spring	S17700 SS/AMS 5678
6 Sleeve	304 SS/A240
7 Spring support	RL3, R3A—316 SS powdered metal; RL4, R4—316 SS/A276
8 Bonnet	316 SS/A479
9 O-ring	Fluorocarbon FKM
10 Quad seal	PTFE-coated fluorocarbon FKM
11 Retainer	RL3, R3A—316 SS/A666; RL4, R4—316 SS/A479
12 Stem	316 SS/A479
12a Bonded stem	Fluorocarbon FKM-bonded ^①
13 Bonded disc	316 SS/A479
14 Seat	316 SS/A479
15 Gasket	PTFE-coated 316 SS/A240
16 Seat retainer	316 SS/A479
17 O-ring	Fluorocarbon FKM
18 Insert	316 SS/A479
19 Body	316 SS/A182
Lubricants	Molybdenum disulfide-based dry film and paste; silicone-based

Wetted components listed in *italics*.

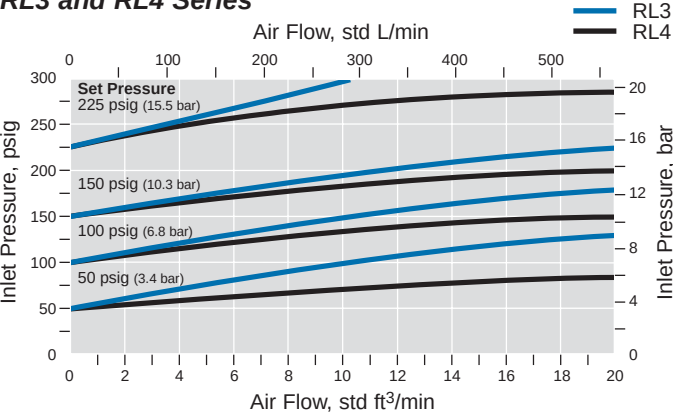
① Material Safety Data Sheet for bonding agents available on request.



Flow Data at 70°F (20°C)

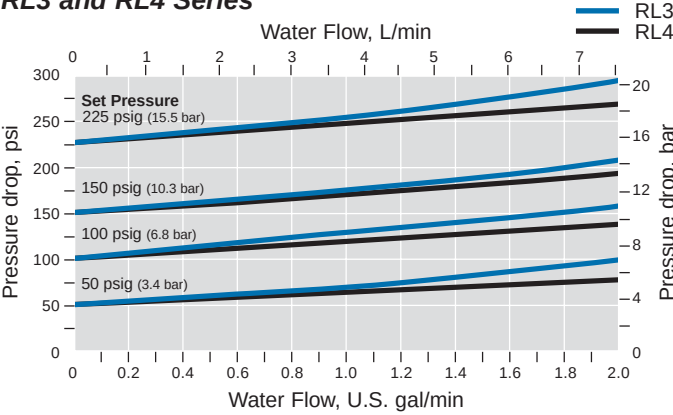
Air

RL3 and RL4 Series

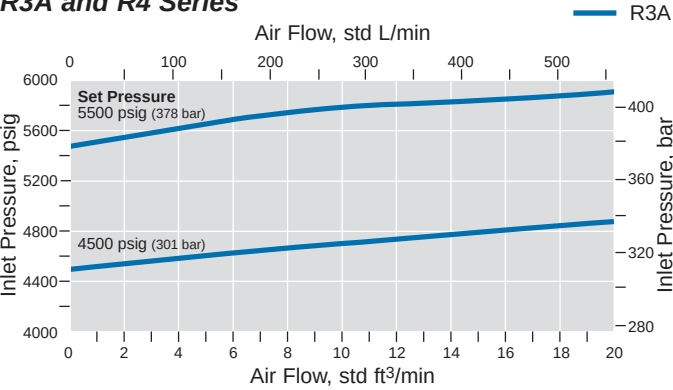


Water

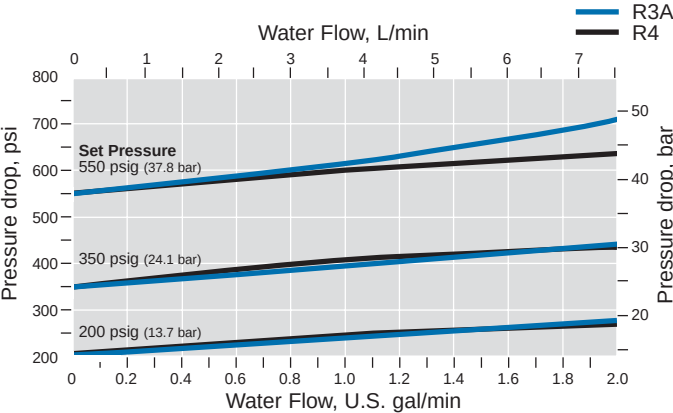
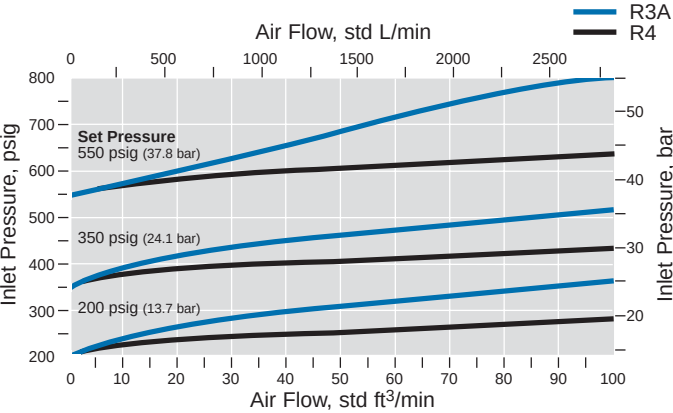
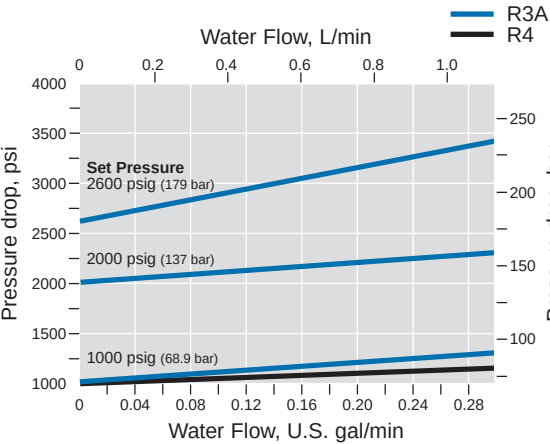
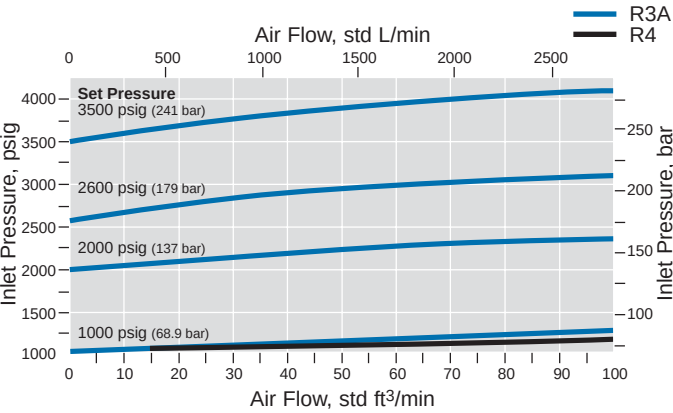
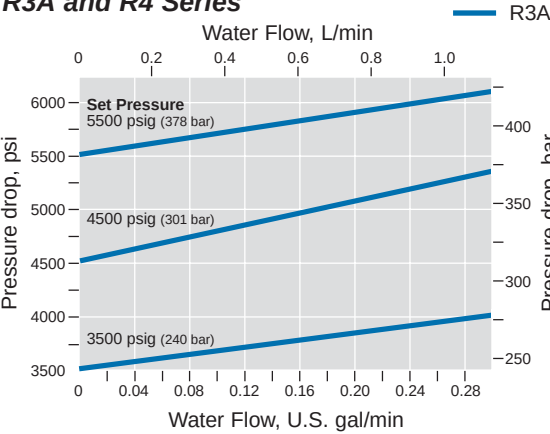
RL3 and RL4 Series



R3A and R4 Series

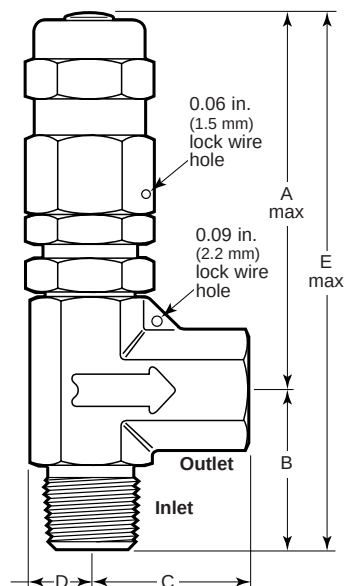


R3A and R4 Series



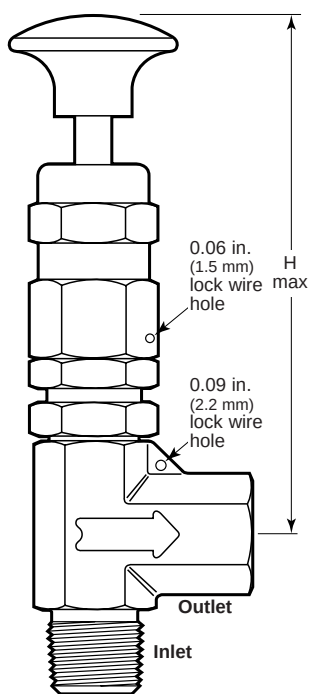
Dimensions

Dimensions, in inches (millimeters), are for reference only and are subject to change.



Low-Pressure Valves (RL3 and RL4 Series)

End Connections		Ordering Number	Dimensions, in. (mm)					
Inlet/Outlet	Size		A	B	C	D	E	H
RL3 series: 0.19 in. (4.8 mm) fully open orifice								
Swagelok tube fittings	1/4 in.	SS-RL3S4	2.70 (68.6)	1.44 (36.6)	1.60 (40.6)	0.43 (10.9)	4.14 (105)	4.09 (104)
	6 mm	SS-RL3S6MM						
	8 mm	SS-RL3S8MM						
Male NPT/ Swagelok tube fitting	1/4 in.	SS-RL3M4-S4		1.19 (30.2)	1.17 (29.7)	3.89 (98.8)		
Male NPT/ female NPT	1/4 in.	SS-RL3M4-F4						
Male ISO/ female ISO ^①	1/4 in.	SS-RL3M4F4-RT						
RL4 series: 0.25 in. (6.4 mm) fully open orifice								
Swagelok tube fittings	1/2 in.	SS-RL4S8	4.09 (104)	1.72 (43.7)		0.50 (12.7)	5.81 (148)	5.37 (136)
	12 mm	SS-RL4S12MM		1.83 (46.5)			5.92 (150)	
Male NPT/ Swagelok tube fitting	1/2 in.	SS-RL4M8S8		1.43 (36.3)	1.72 (43.7)		5.52 (140)	
Male NPT/ female NPT	1/2 in.	SS-RL4M8F8			1.43 (36.3)			



**Valve with Manual
Override Handle**

High-Pressure Valves (R3A and R4 Series)

End Connections		Ordering Number	Dimensions, in. (mm)					
Inlet/Outlet	Size		A	B	C	D	E	H
R3A series: 0.14 in. (3.6 mm) fully open orifice								
Swagelok tube fittings	1/4 in.	SS-4R3A	2.70 (68.6)	1.44 (36.6)	1.60 (40.6)	0.43 (10.9)	4.14 (105)	4.09 (104)
	6 mm	SS-6R3A-MM						
	8 mm	SS-8R3A-MM						
Male NPT/ Swagelok tube fitting	1/4 in.	SS-4R3A1		1.19 (30.2)			1.17 (29.7)	
Male NPT/ female NPT	1/4 in.	SS-4R3A5						
Male ISO/ female ISO ^①	1/4 in.	SS-4R3A5-RT						
R4 series: 0.25 in. (6.4 mm) fully open orifice								
Swagelok tube fittings	1/2 in.	SS-R4S8	4.09 (104)	1.72 (43.7)		0.50 (12.7)	5.81 (148)	5.37 (136)
	12 mm	SS-R4S12MM		1.83 (46.5)			5.92 (150)	
Male NPT/ Swagelok tube fitting	1/2 in.	SS-R4M8S8		1.43 (36.3)	1.72 (43.7)		5.52 (140)	
Male NPT/ female NPT	1/2 in.	SS-R4M8F8						

Dimensions shown with Swagelok tube fitting nuts finger-tight.

^① See specifications ISO 7/1, BS21, DIN-2999, and JIS B0203.

Ordering Information

Low-Pressure Valves (RL3 and RL4 Series)

Valve contains spring; set pressure must be adjusted. Select a valve ordering number.

Spring Kits

Spring kits include spring and installation instructions. Select a spring kit ordering number.

Series	Spring Kit Ordering Number	Set Pressure Range psig (bar)
RL3	177-13K-RL3	10 to 225 (0.68 to 15.5)
RL4	177-13K-RL4	

High-Pressure Valves (R3A and R4 Series)

Valve does not contain spring. Select a valve ordering number and a spring kit ordering number.

Spring Kits

Spring kits include spring, label, 302 SS lock wire with seal, spring support, and installation instructions.

Select a spring kit basic ordering number and add the spring designator for the desired set pressure range.

Examples: **177-R3A-K1-F**
177-13K-R4-C

Set Pressure Range psig (bar)	Spring Designator	Spring Color
R3A series spring kit: basic ordering number 177-R3A-K1-		
50 to 350 (3.5 to 25)	A	Blue
350 to 750 (25 to 50)	B	Yellow
750 to 1500 (50 to 100)	C	Purple
1500 to 2250 (100 to 155)	D	Orange
2250 to 3000 (155 to 205)	E	Brown
3000 to 4000 (205 to 275)	F	White
4000 to 5000 (275 to 340)	G	Red
5000 to 6000 (340 to 410)	H	Green
R4 series spring kit: basic ordering number 177-13K-R4-		
50 to 350 (3.5 to 25)	A	Blue
350 to 750 (25 to 50)	B	Yellow
750 to 1500 (50 to 100)	C	Purple

Special Cleaning and Packaging (SC-11)

To order R series relief valves processed in accordance with *Swagelok Special Cleaning and Packaging (SC-11)* to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C, add **-SC11** to the valve ordering number.

Example: **SS-RL3S4-SC11**

Options and Accessories

Seal Materials

Fluorocarbon FKM is the standard seal material. Optional seal materials are available. To order, add a seal material designator to the valve ordering number.

Example: **SS-RL3S4-BU**

Seal Material	Designator
Buna N	-BU
Ethylene propylene	-EP
Neoprene	-NE
Fluorocarbon FKM	-VI for seal kits; no designator for valves

Seal Kits

Fluorocarbon FKM, Buna N, ethylene propylene, and neoprene seal kits are available. To order, insert a seal material designator as a prefix (R3A series) or suffix (all others) to the seal kit basic ordering number.

Examples: **BU-R3A-K2**
SS-3K-RL3-BU

RL3 Series	R3A Series	RL4 Series	R4 Series
Seal kit basic ordering number			
SS-3K-RL3-	-R3A-K2	SS-3K-RL4-	SS-3K-R4-
Seal kit contents			
O-ring, quad seal, bonded disc, retainer, instructions	O-rings (2), quad seal, retainer, instructions	O-ring, quad seal, bonded disc, retainer, instructions	O-ring, quad seal, bonded stem, instructions

Manual Override Handles

A manual override handle opens the valve without changing the set pressure.

For use with:

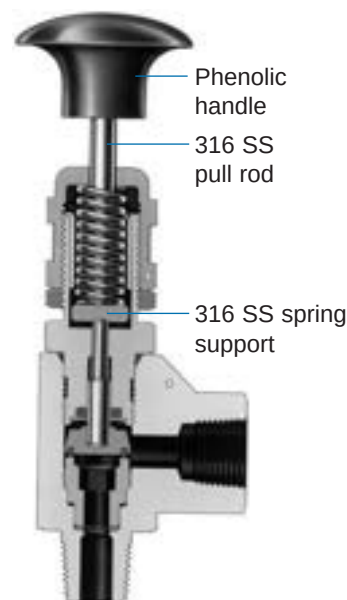
- RL3 and RL4 series—standard spring
- R3A series—A, B, and C springs only
- R4 series—A spring only. Handle diameter is 1.50 in. (38.1 mm). Maximum overall height of valve with handle in closed position:
 - 5.16 in. (131 mm) for R3A and RL3 series
 - 6.78 in. (172 mm) for R4 and RL4 series.

To order, add **-MO** to the valve ordering number.

Example: **SS-RL3S4-MO**

Manual Override Handle Kits

Kits contain handle, pull rod, spring support, and instructions. To order, select the desired kit ordering number.



Series	Manual Override Kit Ordering Number
RL3, R3A	SS-R3A-K5
RL4, R4	SS-R4-K5

 **Some system applications require relief valves to meet specific safety codes. The system designer and user must determine when such codes apply and whether these relief valves conform to them.**

Safe Product Selection

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Caution: Do not mix or interchange parts with those of other manufacturers.



DATA SHEET

Three-phase Induction Motor - Squirrel Cage

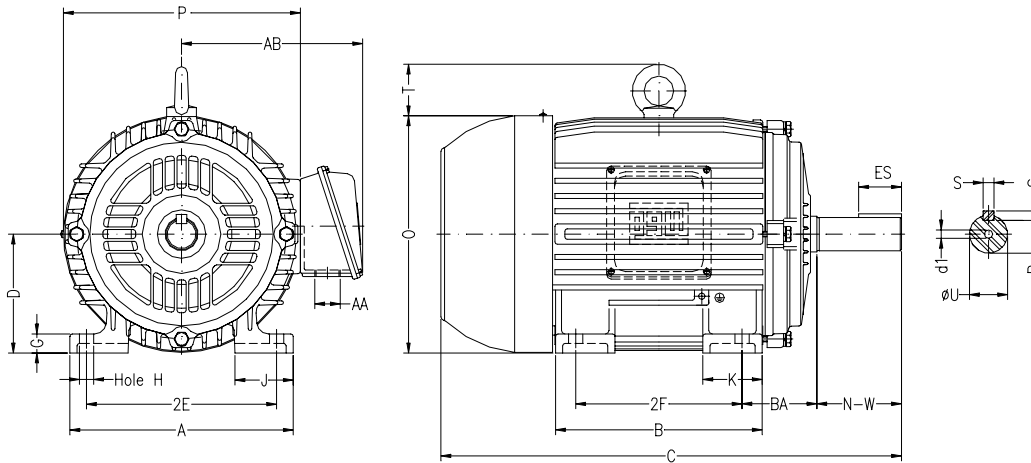
Customer	: US Filter	Service factor	: 1.15
Motor line	: W21 Severe Duty Premium Efficiency	Duty cycle	: S1
Frame	: 447T	Ambient temperature	: 40 °C
Rated Output	: 200 HP (cv)	Altitude	: 1000 m.a.s.l
Frequency	: 60 Hz	Degree of protection	: IP55
Poles	: 4 poles	Aprox. weight	: 1996 lb
Full load speed	: 1780 rpm	Moment of inertia	: 70.5008 sq.ft.lb
Slip	: 1.11 %	Noise level	: 82 dB(A)
Voltage	: 208-230/460 V		
Full load current	: 509-460/230 A		
Locked rotor amps	: 3255-2944/1472 A		
Locked rotor current (I _L /I _n)	: 6.40 - Code G		
No load current	: 133-120/60.0 A		
Full load torque	: 582 ft.lb		
Locked rotor torque	: 230 %		
Breakdown torque	: 240 %		
Design	: B (meets C)		
Insulation class	: F		
Temperature rise	: 80 K		
Locked rotor time	: 23 s		

	D.E.	N.D.E.
Bearings	NU-319-C3	6316-C3
Regreasing int.	4706 h	8568 h
Grease amount	45 g	34 g

Performance under load		
Load	cos ϕ	Efficiency(%)
100%	0.86	95.0
75%	0.84	95.0
50%	0.80	94.1

Note:

DRAWING AND DIMENSIONS



2E	2F	H	BA	A	B	C	D
18.000	20.000	0.807	7.500	21.496	23.622	47.299	11.000
G	J	K	O	P	T	S	R
1.654	3.937	5.591	22.713	23.622	3.543	0.875	2.880
ES	N-W	U	AB	AA	d1		
7.087	8.500	3.375	19.370	2xNPT 3"	UNC 3/4"		

Performed:
James Rohrer

Checked:



Type Test Report
Three-Phase Induction Motors

Nº: PT08783

Date: 10/05/2004

Customer : WEG ELECTRIC MOTORS CORP.

Order : -

Assembly : B3R

Approximate weight : - kg

IDENTIFICATION

Model : 447T
Frequency : 60 Hz
Full Speed : 1780 rpm
Power : 200 HP
Voltage : 460 V
Current : 230 A
II/In : -

Item : -
Design : B
Time rating : S1

Ins. Class : F
Service Factor : 1.15
Enclosure : IP 55
Power Factor 100%: 0.86
Eff. - 75% : 95.0
Eff. - 100% : 95.0
D.T. (K) : 80

TESTS

Resistance Measurement

Resistance : 0.01920 Ohms

Ambient Temp. : 24.70 °C

Connection : Duplo-Delta

No Load Test

Voltage : 460 V

Frequency : 60 Hz

Current : 59.55 A

Losses : 2739.40 W

Locked Rotor Test

Voltage : 460 V

Frequency : 60 Hz

Current : 1527.57 A

Power : 493.70 KW

TI/Tn : 2.60

Full load Torque(Tn): 80.45 mkgf

(1 mkgf or mkp = 9.813 Nm)

Load Test

Voltage : 460 V

Frequency : 60 Hz

% of Full Load	Current (A)	Speed (rpm)	Efficiency (%)	Power Factor
50	121.77	1792	95.0	0.80
75	168.74	1787	95.3	0.86
100	220.69	1782	95.1	0.88

Temperature rise by resistance at 100 % of Full Load = 73.92 K

Break-Down Torque Test

Voltage : 460 V

Frequency : 60 Hz

Tb/Tn : 2.51

High Voltage Test

1.92 kV

for : 60 Seconds

Insulation Resistance

5000.0 MOhms

Ambient Temp. : 25.50 °C

Notes

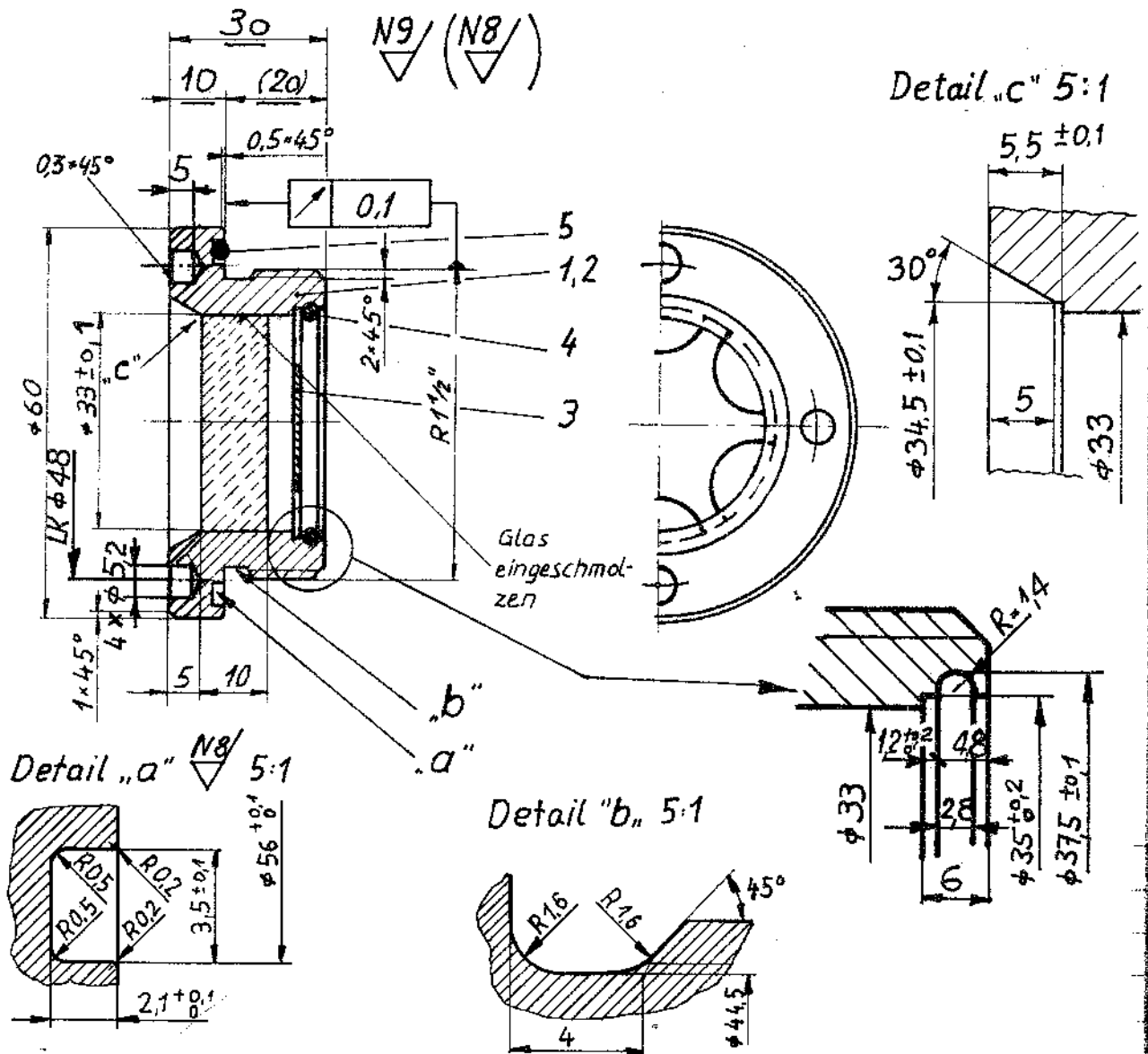
The values included in this report refer to an unit electrically identical.
High Efficiency

Adolar Friedemann

Approved/Laboratory: WEG

Approved/Witness: CUSTOMER

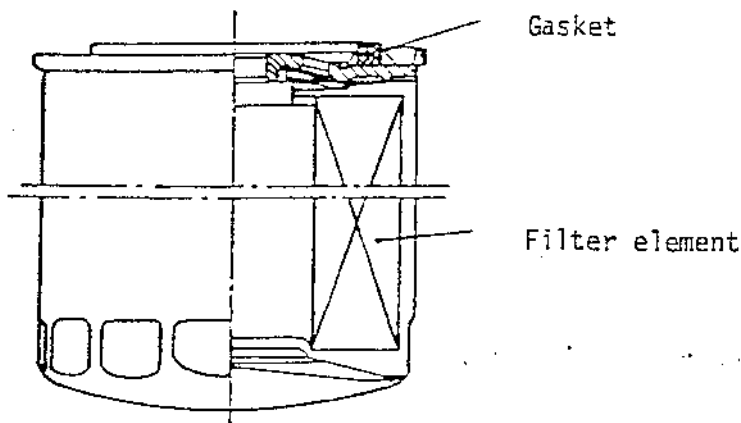
Berechnungsüberdruck 20 bar
max. zul. Betriebstemp. 120 °C



O-Ring - Einstich Detail „a“
nicht n. Norm

Änderungen dürfen nicht von der Werkstatt gemacht werden!
Aucune modification ne doit être faite par l'atelier!

		1	5	O-Ring	φ 50×φ 3	Viton	10389						
		1	4	Sprengring DIN7993B für Bohr'g	φ35×2,5	Fed.St.	912158						
		1	3	Reflektorscheibe			10697						
*		1	2	Ölstandauge Glas einschmelzen				AB					
		1	1	Ölstandauge vorbearbeitet	φ60×30	St52-3	11087	2					
Menge Nb		Pos Rep		Benennung Designation		Grosstmasse Dimens extrêmes		Werkstoff Matériau		Mat - Mag Mod - Nr		Vermerke Obs.	
III	II	I	a			26.7.93	<i>hinder</i>	Ersetzt durch Remplace par Ersatz für Remplace 475 883 Ähnlich wie Sembliable a 475 881 Transparent von Transparent de					
			d	siehe Änderungsmitteilung (Detail "c" neu)		7.6.93	<i>A. Geesing</i>						
			c	siehe Änderungsmitteilung		26.5.86	<i>R. Gerzad</i>						
			g	wegen CNC: in Detail "b" Winkel neu 45° statt 60°		9.6.94	<i>B. Binder</i>						
			f	Pos. 1 von Teilort 8 auf Teilort 2 geändert		4.3.94	<i>B. Binder</i>						
				Änderungen		Modifications		Datum Date		Name Nom		Visa	
				Schauglas		R1 1/2"		Maßstab Echelle		Gezeichnet Dessiné			
								Geprüft Contrôlé		<i>5.12.84</i>		5.12.84	
								Norm gepr. Norme contr.					
								Gesehen Vu					
Erste Kom. 1ère Com.				 GreenField						477 173		9	
101252													



Technical datas

Max. operating pressure : 25 bar eff.
 Temperature range : - 40 °C to + 120 °C
 Fineness : 10 µm

Materials

Housing: steel
 Gaskets: Perbunan
 Filter element: Organic paper

Mounting of filter

- Apply oil resp. grease onto gaskets
- Screw in filter until gasket touches sealing face of crank casing
- Finally tighten filter by applying one more revolution
- Start compressor
- Check sealing of faces, if necessary retighten filter
- Check oil level

Attention: When exchanging filters, do only use original filters with installed non-return valve.

- o follow strictly the intervals for oil change and oil-filter change
- o change oilfilter also at each oil change
- o never reuse "cleaned oilfilters"
- o run compressor with new oil filling and new oilfilter after each change of cylinders and piston rings. Oil change and oilfilter change is necessary after further 100 running hours.
- o keep enough oilfilters on stock
- o use original oilfilters only.

When replacing oil filter with relief valve instead filter without relief valve, the set pressure of the oil pressure switch has to be changed from 1,5 bar eff. to 2,5 bar eff.

SKETCH No.: 93DS1839

REV.: 7

DATE: FEB.28/96

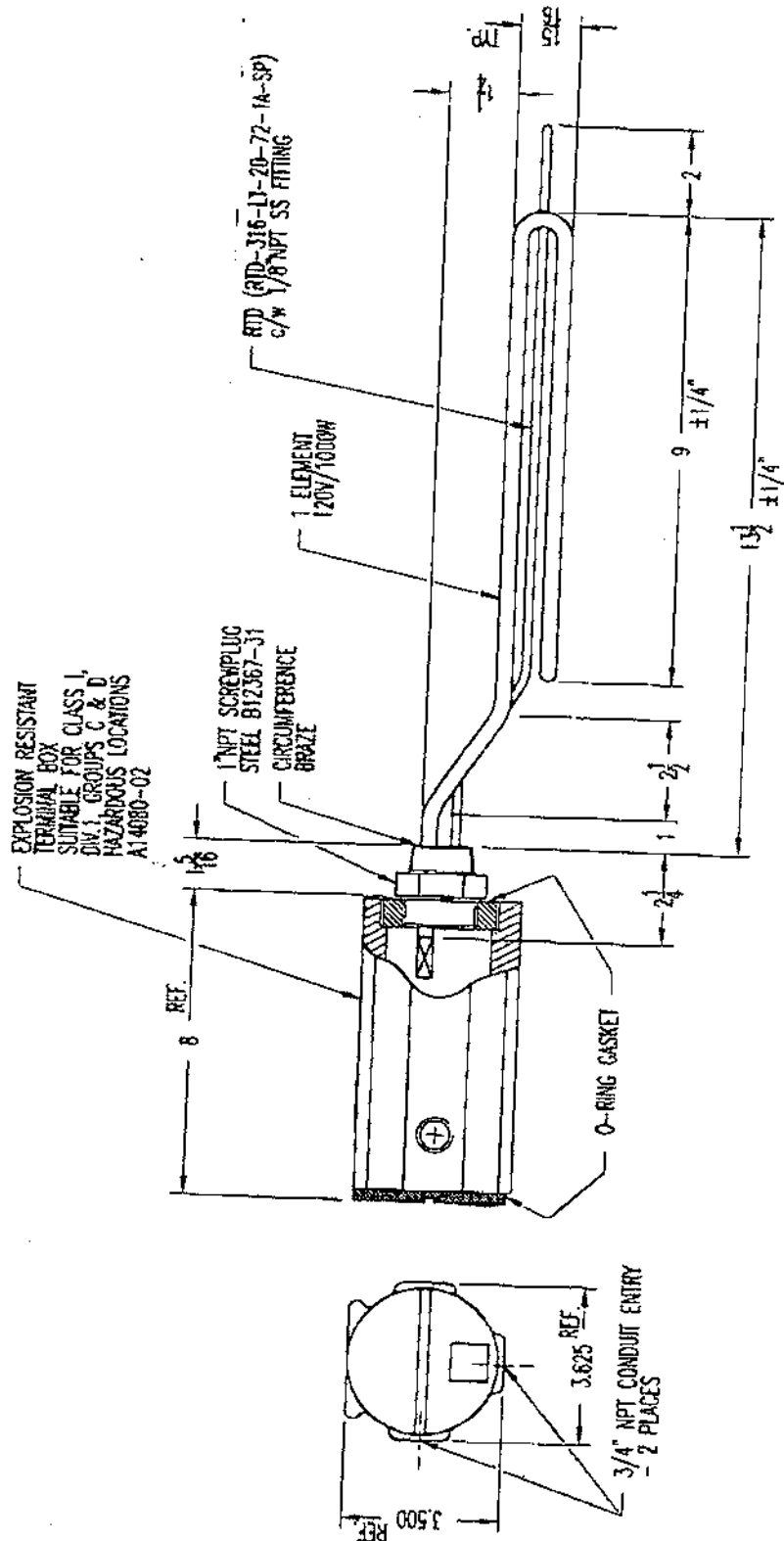
CUSTOMER:



DRAWN BY: B.A.

O.T.

REV.: 3	REDRAWN.	FEB. 28/96	A/D.T.
REV.: 4	TERMINAL BOX REVISED.	MAR. 27/98	T.C./T.K.
REV.: 5	DRILLING PATTERN REVISED.	NOV. 25/99	J.A./D.T.
REV.: 6	RTD PART NO. REVISED.	APR. 5/00	H.N./T.K.
REV.: 7	SCREWPLUG PART NO. REVISED.	AUG.21/02	J.A. D.T.



NOTE:

- [1] ALL DIMENSIONS IN INCHES.
- [2] TERMINAL BOX TO BE BLACK ANODIZED.
- [3] REPRESS ELEMENT HARPIN BENDS.

ITEM No.	CATALOG No.	VOLTS	PH	WATTS	1000	INDUCLOY	.315"	1	AA	5"	29	WATTS/IN ²
01	CXF93DS1839-01	120	1	1000	1	1000	.315"	1	AA	5"	29	

RTD Specifications

Fig. 1: Comparison of Tolerance
ASTM Grade A vs. Grade B

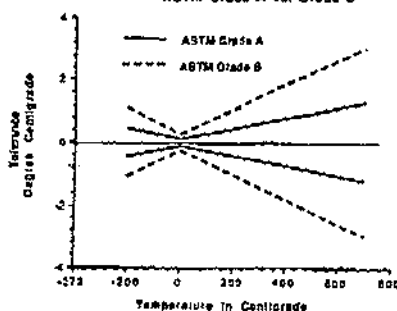
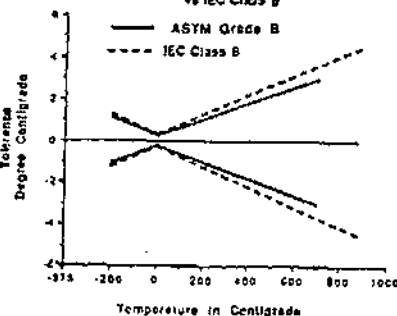


Fig. 2: Comparison ASTM Grade B
vs IEC Class B



An RTD is specified when greater accuracy, stability, and repeatability is needed versus broader temperature ranges. RTD's are selected based on the degree of accuracy and stability of calibration needed for a specific application.

RTD's are specified by grades, A or B as established by ASTM E1137, in the U.S.A. and IEC 751 in Europe. Grades A or B are the recognized tolerances, although they differ slightly between ASTM and IEC. The graph shown in fig. 1, derived from ASTM E1137, illustrates the difference in tolerance between Grade A and Grade B. As shown Grade A holds a tighter tolerance than Grade B, therefore, it is a more accurate RTD. The graph in fig. 2 shows the tighter tolerances held by an ASTM Grade B versus the comparable Class B in IEC. Remember, all Thermo Electric RTD's are verified to the ASTM standard and represent a greater accuracy value to the customer than specifying the IEC equivalent. Higher accuracy RTD's are available on special order.

Standard Specifications

Element: Platinum

Temperature Coefficient of Resistance: 0.00385 ohms/ohm/°C (DIN 43760)

Resistance at Ice Point (0°C): 100 ohms

Tolerance: ±0.1 ohm per ASTM E 1137 Grade B

Typical Performance

Time Constant in water moving at 3 fps: 1/8" diameter 1.5 sec.
3/16" diameter 3.0 sec.
1/4" diameter 5.0 sec.

Self Heating: 0.01 °C/mW in still liquid.

STANDARD RTD

LT-

Recommended for uses up to 260°C (500°F).

The Standard RTD employs either film or wire wound element and is suitable for uses from -50°C to 260°C. The element is calibrated to ASTM E1137 Grade B. The probe is available in lengths up to 28". Internal lead wires are nickel clad copper, insulated with Teflon. Available in either three wire or four wire design. Film elements are sometimes better suited for high vibration applications. Consult your local applications engineer for assistance.

INDUSTRIAL RTD

CE- Rugged RTD

Recommended for rugged industrial applications and for applications requiring higher accuracies up to 500°C. (932°F)

The ceramo design RTD is available in lengths up to 20 feet. It is made utilizing Ceramo (MgO insulated, metal sheathed cable). It is bendable from 3" below tip. Internal lead wires are made from a patented low alpha constantan. This provides the minimum lead wire resistance change with temperature. It has an alpha of less than 10°C ohms/ohm/°C.

Ceramo RTD's employ a Ceramic wire wound element that can be calibrated to ASTM E1137 Grade A or B. Calibration to the IEC standard is also available. Higher accuracy specifications can be met on application.

Three wire and four wire designs are available. The temperature range for Ceramo RTD's is -180 to 500°C. (-266°F to 932°F)

HT-HIGH TEMPERATURE Special Application Designs

These are custom design RTD's that are suitable for uses up to 650°C. Selection of diameter, sheath material and construction should be based on the application. Please consult Thermo Electric for design assistance.

Calculating a Tolerance at Temperature

The most frequently asked question is how to determine the tolerance one can expect for an RTD assembly at a specific temperature. Our standard assemblies are manufactured to conform to the tolerances of ASTM E1137, Grade B and IEC 751, Class B. At any temperature, this is defined by the equation:

Tolerance

where t =
For exam
would be

Tolerance
Tolerance

The equ
Therefo

For spe
Grade /

Tolerance

To dete
equatic

Tolerance
Tolerance

To ord

LEAD

2-WI
One
lead

3-W
Tw
mc
res

Code	Temperature Ranges
LT	-58°F to 500°F
HT	-292°F to 1202°F
CE	-292°F to 932°F (CERAMO®)

RTD Specifications

$$\text{Tolerance } (\pm) = 0.25 + (0.0042 [t])$$

where t = the absolute value of temperature in °C.

For example, to calculate the Grade B tolerance of an RTD at 300°C, the equation would be:

$$\text{Tolerance } (\pm) = 0.25 + (0.0042 [300])$$

$$\text{Tolerance (at 300°C)} = \pm 1.51 \text{ °C}$$

The equivalent tolerances in °F is obtained by multiplying the tolerance in °C by 1.8. Therefore, at 300°C (572°F) the tolerance would be $\pm 2.72^\circ\text{F}$.

For special applications, assemblies are available which conform to ASTM E1137, Grade A. At any temperature, this is defined by the equation:

$$\text{Tolerance } (\pm) = 0.13 + (0.0017 [t])$$

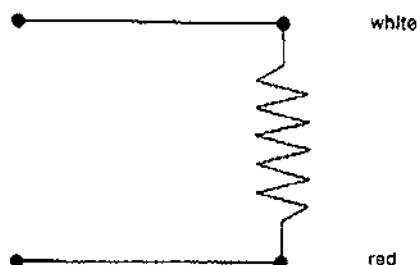
To determine the Grade A tolerance for the temperature in the previous example, the equation would be:

$$\text{Tolerance } (\pm) = 0.13 + (0.0017 [t])$$

$$\text{Tolerance (at 300°C)} = \pm 0.64^\circ\text{C}$$

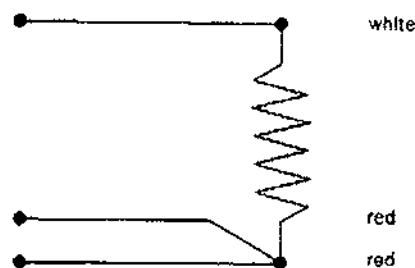
To order assemblies which meet Grade A tolerances please consult the factory.

LEADWIRE CONFIGURATION



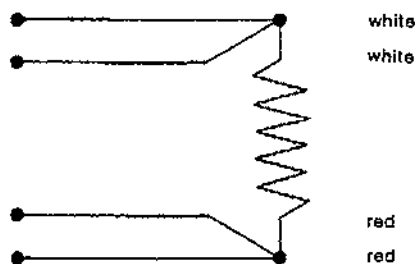
2-Wire Connection (fig. 1)

One wire is connected to one end of the RTD. Generally used when the changes in leadwire resistance due to ambient temperature changes can be ignored.



3-Wire Connection (fig. 2)

Two wires are connected to one end of the RTD and one wire to the other. This is the most commonly used configuration. The third wire compensates for changes in leadwire resistance.



4-Wire Connection (fig. 3)

Two wires are connected to each end of the RTD. This type of connection is used for high precision measurements.

RTD Specifications

Dual RTD's

All 3/16" and 1/4" RTD's are available in duplex construction as indicated in the ordering code with standard 3 wire (6 wire total) configuration. To order, add the prefix "D" to the desired ordering code. RTD's normally terminated with a type "T" 3 pin connector, will be supplied with two 3 pin connectors secured with a "U" bracket.

Example: DRTD-14-HT-0-24-1A

Lead Wire

For instrumentation systems requiring 2 or 4 wire, or 4 wire compensating loop configuration, add the suffix 2W (for 2 wire) -4W (for 4 wire) or -4WL (for 4 wire compensating loop) to the ordering code. Note: 4 wire is not always available in 1/8" diameter. For RTD's normally terminated with a type "T" 3 pin connector a 2 pin type "L" or a 4 pin type "C" will be used.

Example: RTD14-LT-12-OC-4W

Other Available RTD Elements

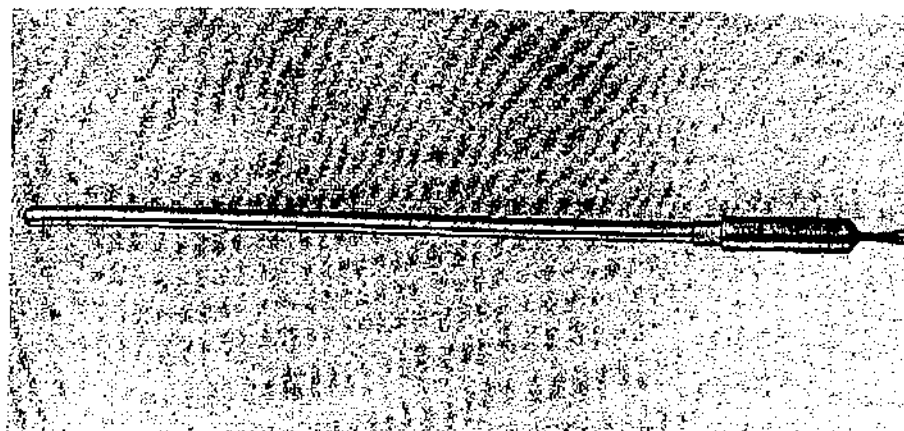
The most commonly used element material is the standard platinum with a resistance of 100 ohms at 0°C and a temperature coefficient of resistance of 0.00385 ohms/ohms°C. Other types of RTD's are available from Thermo Electric. Below is a listing for some of the more common bulb types that we regularly supply.

Contact your nearest sales representative for ordering information.

Element Material	Base Resistance	Temperature Coefficient ($\Omega/\Omega/^{\circ}\text{C}$)	Sensitivity (Avg. $\Omega/^{\circ}\text{C}$)*	Standards	Temperature Range
Platinum	50 Ω at 0°C	0.003916	0.01958	JIS	-260 to 538°C
Platinum	100 Ω at 0°C	0.00385	0.385	DIN	-436 to 1100°F
Platinum	100 Ω at 0°C	0.003916	0.391	JIS	
Platinum	100 Ω at 0°C	0.00392	0.392	Sama	
Platinum	130 Ω at 0°C	0.00390	0.507	British	
Platinum	200 Ω at 0°C	0.00385	0.770	N/A	
Platinum	500 Ω at 0°C	0.00391	1.955	N/A	
Nickel	100 Ω at 0°C	0.00617	0.617	DIN	-100 to 260°C
Nickel	120 Ω at 0°C	0.00672	0.806	Edison 7	-148 to 500°F
Nickel/Iron	604 Ω at 0°C	0.00518	3.133	N/A	-100 to 204°C
					-148 to 400°F
Copper	10 Ω at 25°C	0.00427	0.039	Sama	-100 to 204°C
					-148 to 400°F

* Sensitivity figures are shown as a guideline, specific values should be verified for each actual temperature.

RTD's with Leads



RTD with Leads

Type - Platinum, 100 ohms @ °C, 0.00385 ohms/ohm/°C temp. coefficient, 3 wire

Sheath Material - 316 St. Stl.

Lead Wire - Teflon insulation for low temperature

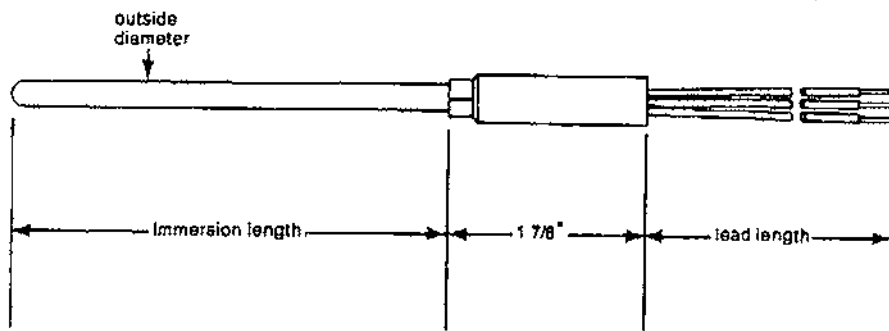
Fiberglass insulation for high temperature

Termination - Quick disconnect 3 pin connector or bare ends for terminal connection

Immersion Length - LT & HT 28" maximum

CERAMO® 20 feet (longer lengths consult factory)

Application - For immersion in a liquid or gas, can be mounted with tube fittings



Code	Duplex
18	Use only when duplex construction is required

Code	Outside Diameter
18	1/8"
316	3/16"
4	1/4"

*1/8" diameter duplex construction is only available in ceramo temperature range.

Code	Temperature Ranges
LT	-58°F to 500°F
HT	-292°F to 1202°F
CERAMO	-292°F to 932°F (CERAMO®)

Code	Immersion Length
	In inches

Code	Lead Length
	In inches

Code	Lead Length Insulation
	TEFLON® (-300°F to +400°F)
	Fiberglass (950°F)

Code	Termination
	Bare ends
	2 pin plug (425°F 220°C)
	2 pin jack (425°F 220°C)
	2 pin plug (560°F 350°C)
	2 pin jack (560°F 350°C)
	Three pin plug
	Three pin jack
	4 pin plug
	4 pin jack
	6 pin plug
	6 pin jack

Code	Wire Configuration
	2-wire (4 total if duplex)
	3-wire (6 total if duplex)*
	4-wire (8 total if duplex)
	4-wire compensating loop
	*3-wire std. code not required



Example: RTD-18-LT-5-96-4A

Direct Immersion/Replacement RTD Assemblies

TABLE A (CONT.)

Figure 14

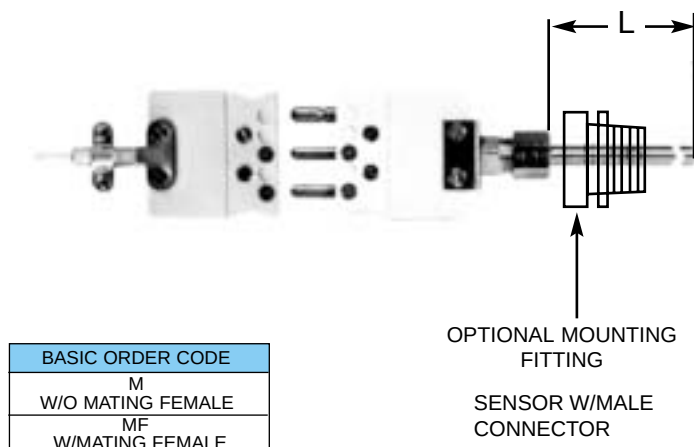


Figure 15

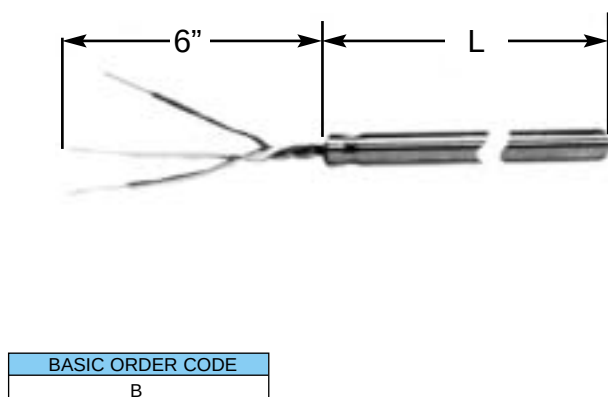


Figure 16

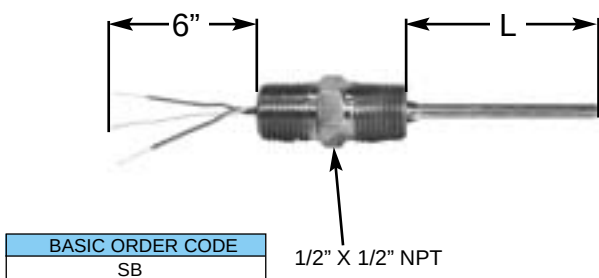


Figure 17

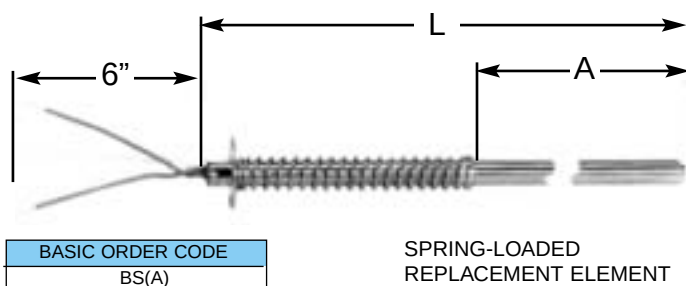
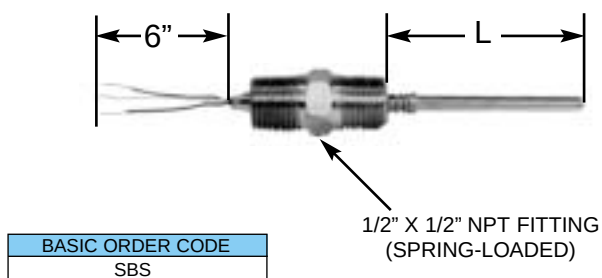


Figure 18



Example on how to order

pgs. 6-8	Page 9							Page 10
BASIC ORDER CODE	SENSOR DIAMETER	ELEMENT	TOLERANCE	TEMP RANGE	SHEATH MAT'L	LEAD CONN.	"L" LENGTH	OPTIONS
SB	4	A	1	A	1	B	6	L
TABLE A	TABLE B	TABLE C	TABLE D	TABLE E	TABLE F	TABLE G	TABLE H	TABLE I

TABLE B (sensor diameter)		
Sensor Diameter		Order Code
1/8"	(.125")	2
3/16"	(.188")	3
1/4"	(.250")STD	4
5/16"	(.312")	5
3/8"	(.375")	6

TABLE C (element)				
RESISTANCE Ω/°C	MATERIAL	TEMPERAURE COEFFICIENT ALPHA (α)	ORDER CODE	
			SINGLE ELEMENT	DUAL ELEMENT
100Ω	Platinum	.00385Ω/Ω°C	A	2A
100Ω	Platinum	.003916Ω/Ω°C	B	2B
100Ω	Platinum	.003902Ω/Ω°C	C	2C
98.129Ω (100Ωnom-)	Platinum Sama Standard RC21-4-1966	.00392Ω/Ω°C	D	2D
120Ω	Nickel	.00672Ω/Ω°C	E	2E
9.035Ω	Copper	.00427Ω/Ω°C	F	2F

TABLE D (tolerance)		
Accuracy at 0 Deg. C		Order Code
± .12%	Class B	1
± .06%	Class A	2
± .03%	Lab Grade	3
± .02%	Lab Grade	4
± .01%	Lab Grade	5

TABLE E (temperature range)	
Temperature Range	Order Code
-50 to +260 Deg. C -58 to +482 Deg. F	A
-50 to +400 Deg. C -58 to +752 Deg. F	B
-50 to +660 Deg. C -58 to +1220 Deg. F	C

TABLE F (sheath material)	
Sheath Material	Order Code
316 SS	1
Alloy 600	2
Alloy C-276	3

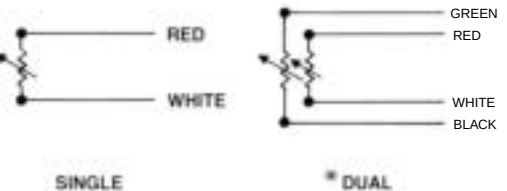
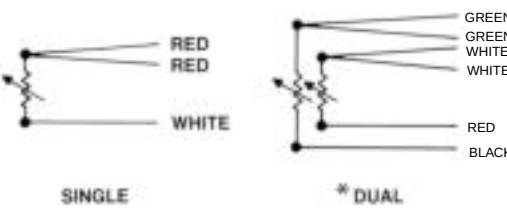
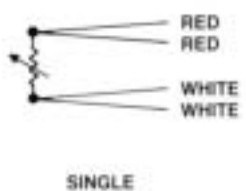
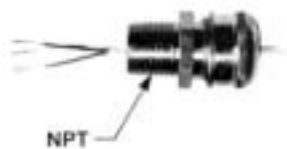
TABLE G (lead Connection)	
2-WIRE	ORDER CODE A
	
3-WIRE	ORDER CODE B
	
4-WIRE	ORDER CODE C
	

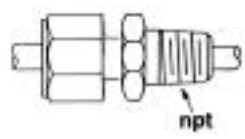
TABLE H (length)
Specify "L" in Inches Length NOT required when Thermowell is used.

OPTIONAL CONNECTIONS (FOR EXTENDED LEAD TYPES)

Table I (options)

	DESCRIPTION	ORDER CODE
	SPADE LUGS FOR #8 SCREW	L
	MALE PLUG	M
	FEMALE JACK	F
	WATERTIGHT CONNECTOR	1/2" NPT
		3/4" NPT
	WATERTIGHT CONNECTOR WITH LUGS FOR #8 SCREWS	1/2" NPT
		3/4" NPT

OPTIONAL MOUNTING FITTINGS

DESCRIPTION	NPT	ORDER CODE
	1/8"	1AS
	1/4"	2AS
	3/8"	3AS
	1/2"	4AS
	3/4"	6AS
FOR TEFLON READJUSTABLE INSERT, REPLACE "A" WITH "R" EXAMPLE: 4RS		

OPTIONAL SPRING-LOADING DEVICES

DESCRIPTION	ORDER CODE
 ADJUSTABLE SPRING	FP 275
 1/2" NPT DOUBLE THREADED ADJUSTABLE HEX BUSHING	FP 240
 1/2" NPT SINGLE THREADED ADJUSTABLE HEX BUSHING	SSL



Class I, Div. 1 & 2, Groups C,D
Class I, Zones 1 & 2, Groups IIB, IIA
Class II, Div. 1 & 2, Groups E,F,G
Class III, Div. 1 & 2
Suitable for wet locations
Marine
NEMA 3, 4, 4X
Factory Sealed

Listed - Files E10514 and E91793 (Marine)

Certified - File LR11713

FEATURES-SPECIFICATIONS

HOSTILELITE®

Applications

HOSTILELITE® EM, EB, & EQ Series fixtures are designed for installations where moisture, dirt, dust, corrosion and vibration may be present, or NEMA 3 and 4x areas where wind, water, snow or high ambients can be expected. They can be used in locations made hazardous due to the presence of flammable or explosive gases, vapors and combustible dusts as defined by the NEC.

Applications include classified areas such as paint manufacturing plants, ammunition facilities, oil and gas producing and refining plants, off-shore and dockside installations, tank farms, pipeline pumping stations and marine loading and fuel transfer terminals.

Features:

- Five light sources—Incandescent, compact fluorescent, high pressure sodium, metal halide and mercury vapor
- Mounting choice—Pendant, ceiling, 25° stanchion or 90° wall mount, all with “wireless” design that allows fast, easy fixture installation
- Factory sealed—No external seal needed. Simply wire mounting cap and thread on fixture to install
- Compact size—Medium base incandescent and HID lamps, plus PL fluorescent lamps allow smaller fixture design
- Corrosion resistant—Copper-free aluminum die-cast construction. Baked powder epoxy finish, electrostatically applied. Exposed hardware is 316 grade stainless steel

Accessories

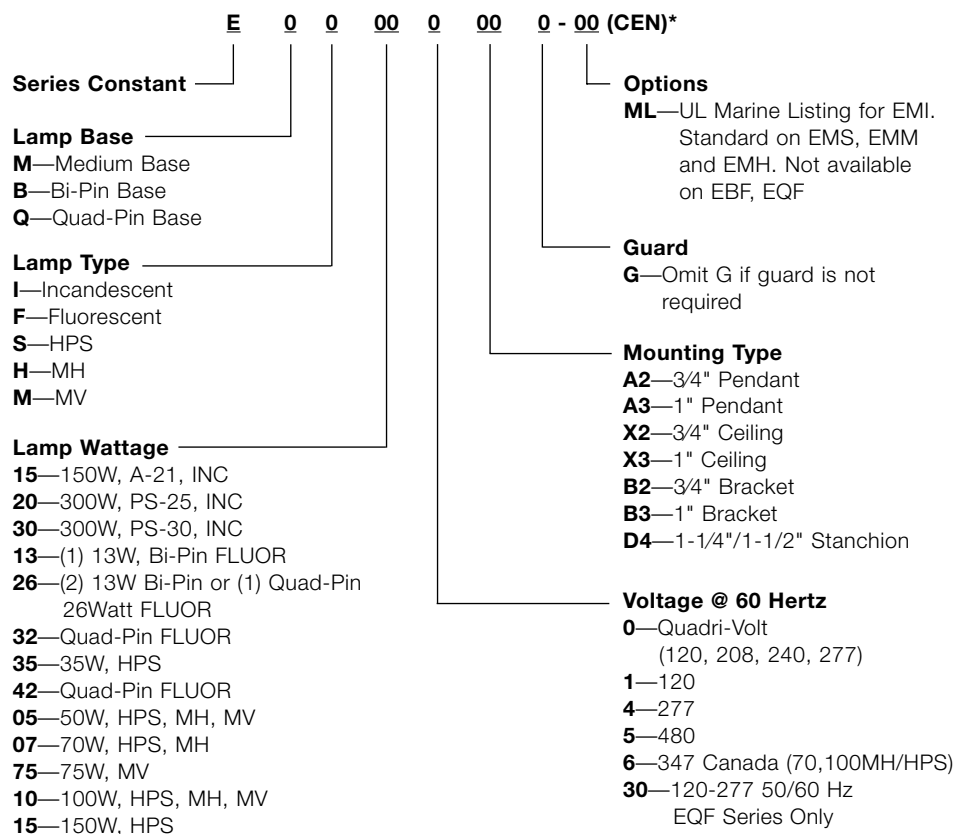
- Available with or without guard, standard dome or 25° angle reflector, exit sign and inner colored globes

Compliances

- UL-844 Electric Lighting Fixtures for use in Hazardous Locations
- UL Marine Type Electric Lighting Fixtures

- UL-1570 Standard for Fluorescent Lighting Fixtures
- UL-1571 Standard for Incandescent Lighting Fixtures
- UL-1572 Standard for HID Lighting Fixtures
- CSA C22.2 no. 137-M1981 Electric Luminaires for use in Hazardous Locations
- NEMA 3, 4, 4X, 7CD, 9EFG

Catalog Number Logic



KILLARK®

*CEN (CENELEC) approval option available. See pages L150-151 for more information.

Class I, Div. 1 & 2, Groups C,D
 Class I, Zones 1 & 2, Groups IIB, IIA
 Class II, Div. 1 & 2, Groups E,F,G
 Class III, Div. 1 & 2
 Suitable for wet locations
 Marine
 NEMA 3, 4, 4X
 Factory Sealed

UL Listed - Files E10514 and E91793 (Marine)

SP Certified - File LR11713

ORDERING INFORMATION



Pendant



Ceiling



Wall



Stanchion

EM 60-300W MEDIUM BASE INCANDESCENT^①

LAMP TYPE	LAMP/WATTS	LAMP SIZE	CATALOG NUMBER ^④			
			PENDANT 3/4" ^②	CEILING 3/4" ^②	WALL 3/4" ^②	STANCHION 1-1/4" ^③
INC	60, 75, 100, 150	A-19, A-21	EMI15A2G	EMI15X2G	EMI15B2G	EMI15D4G
	100, 150, 200, 300	A-23, PS-25	EMI20A2G	EMI20X2G	EMI20B2G	EMI20D4G
	200, 300	PS-25, PS-30	EMI30A2G	EMI30X2G	EMI30B2G	EMI30D4G

EBF 13-26W Bi-Pin COMPACT FLUORESCENT^①

LAMP TYPE	Bi-Pin FLUORESCENT ^⑤		CATALOG NUMBER ^④			
	LAMP INCLUDED	LINE VOLTAGE @60Hz	PENDANT 3/4" ^②	CEILING 3/4" ^②	WALL 3/4" ^②	STANCHION 1-1/4" ^③
COMPACT FLUOR.	13 (1 X 13)	120	EBF131A2G	EBF131X2G	EBF131B2G	EBF131D4G
		277	EBF134A2G	EBF134X2G	EBF134B2G	EBF134D4G
	26 (2 X 13)	120	EBF261A2G	EBF261X2G	EBF261B2G	EBF261D4G
		277	EBF264A2G	EBF264X2G	EBF264B2G	EBF264D4G

EQF 26-42W WORLD VOLTAGE QUAD-PIN COMPACT FLUORESCENT^①

LAMP TYPE	Quad-Pin FLUORESCENT ^⑤		CATALOG NUMBER ^{④ ⑥}			
	LAMP INCLUDED	LINE VOLTAGE	PENDANT 3/4" ^②	CEILING 3/4" ^②	WALL 3/4" ^②	STANCHION 1-1/4" ^③
COMPACT FLUOR.	26 Watt	120-277VAC 50-60Hz	EQF2630A2G	EQF2630X2G	EQF2630B2G	EQF2630D4G
	32 Watt	120-277VAC 50-60Hz	EQF3230A2G	EQF3230X2G	EQF3230B2G	EQF3230D4G
	42 Watt	120-277VAC 50-60Hz	EQF4230A2G	EQF4230X2G	EQF4230B2G	EQF4230D4G

① See Hazardous Location Application Data on pages L77-78 for specific suitabilities.

② For 1" pendant, ceiling and wall hubs, substitute "3" for "2" in catalog number; example: **EBF131A3G**.

③ Stanchion conduit hub size supplied is 1-1/2" with 1-1/2" to 1-1/4" reducer for 1-1/4" mounting. (refer to catalog logic).

④ Luminaire catalog numbers include guards. To order luminaire without guard, omit last letter "G" from catalog number.

⑤ Minimum starting temperature is 0°F. Lamps supplied with fixture.

⑥ EQF fixtures use a tank extension ring and are 2.5" taller than EBF fixtures.

NOTE: Reflectors must be ordered separately (see page L73). All luminaires are designed for mounting with lamp in base up position.



KILLARK®

Class I, Div. 1 & 2, Groups C,D
Class I, Zones 1 & 2, Groups IIB, IIA
Class II, Div. 1 & 2, Groups E,F,G
Class III, Div. 1 & 2
Suitable for wet locations
Marine
NEMA 3, 4, 4X
Factory Sealed

UL Listed - Files E10514 and E91793 (Marine)

SP Certified - File LR11713

ORDERING INFORMATION



Pendant



Ceiling



Wall



Stanchion

EM 35-150W MEDIUM BASE HIGH PRESSURE SODIUM^{① ④}

LAMP TYPE	LAMP WATTS	ANSI LAMP TYPE	VOLTAGE @60 HERTZ	CATALOG NUMBER ^④			
				PENDANT 3/4" ^②	CEILING 3/4" ^②	WALL 3/4" ^②	STANCHION 1-1/4" ^③
HPS	35	S-76	120	EMS351A2G	EMS351X2G	EMS351B2G	EMS351D4G
	50	S-68	120, 208, 240, 277	EMS050A2G	EMS050X2G	EMS050B2G	EMS050D4G
	70	S-62	120, 208, 240, 277	EMS070A2G	EMS070X2G	EMS070B2G	EMS070D4G
	70	S-62	480	EMS075A2G	EMS075X2G	EMS075B2G	EMS075D4G
	100	S-54	120, 208, 240, 277	EMS100A2G	EMS100X2G	EMS100B2G	EMS100D4G
	100	S-54	480	EMS105A2G	EMS105X2G	EMS105B2G	EMS105D4G
	150	S-55	120	EMS151A2G	EMS151X2G	EMS151B2G	EMS151D4G

EM 50-100W MEDIUM BASE METAL HALIDE^{① ④}

LAMP TYPE	LAMP WATTS	ANSI LAMP TYPE	VOLTAGE @60 HERTZ	CATALOG NUMBER ^④			
				PENDANT 3/4" ^②	CEILING 3/4" ^②	WALL 3/4" ^②	STANCHION 1-1/4" ^③
MH	50	M-110	120, 208, 240, 277	EMH050A2G	EMH050X2G	EMH050B2G	EMH050D4G
	70	M-98	120, 208, 240, 277	EMH070A2G	EMH070X2G	EMH070B2G	EMH070D4G
	100	M-90	120, 208, 240, 277	EMH100A2G	EMH100X2G	EMH100B2G	EMH100D4G

EM 50-100W MEDIUM BASE MERCURY VAPOR^{① ④}

LAMP TYPE	LAMP WATTS	ANSI LAMP TYPE	VOLTAGE @60 HERTZ	CATALOG NUMBER ^④			
				PENDANT 3/4" ^②	CEILING 3/4" ^②	WALL 3/4" ^②	STANCHION 1-1/4" ^③
MV	50	H-46	120/277	EMM0510A2G	EMM0510X2G	EMM0510B2G	EMM0510D4G
	75	H-43	120	EMM751A2G	EMM751X2G	EMM751B2G	EMM751D4G
	75	H-43	277	EMM754A2G	EMM754X2G	EMM754B2G	EMM754D4G
	100	H-38	120, 208, 240, 277	EMM100A2G	EMM100X2G	EMM100B2G	EMM100D4G
	100	H-38	480	EMM105A2G	EMM105X2G	EMM105B2G	EMM105D4G

① See Hazardous Location Application Data on page L77-78 for specific suitabilities.

② For 1" pendant, ceiling and wall hubs, substitute "3" for "2" in catalog number; example: EMS351A3G.

③ Stanchion conduit hub size supplied is 1-1/2" with 1-1/2" to 1-1/4" reducer for 1-1/4" mounting. (refer to catalog logic).

④ Luminaire catalog numbers include guards. To order luminaire without guard, omit last letter "G" from catalog number.

NOTE: Reflectors must be ordered separately (see page L73). All luminaires are designed for mounting with lamp in base up position.



KILLARK®



EMI15/20/EBF



EMI30 & HID

**Housing, Globe and
Globe Support Assemblies^①**

INCANDESCENT			
CATALOG NUMBER	LAMP TYPE	WATTS	VOLTS
EMI15	A-19	60, 75	250 MAX. VAC
	A-19, A-21	100	
	A-21	150	
EMI20	A-23, PS-25	150	250 MAX. VAC
	A-23, PS-25	200	
	PS-25	300	
EMI30	PS-25	200	250 MAX. VAC
	PS-30	300	

FLUORESCENT			
CATALOG NUMBER	ANSI LAMP TYPE	WATTS	VOLTS
EBF131	Bi-Pin Fluorescent	13	120VAC 277VAC
EBF134	Bi-Pin Fluorescent	13	120VAC 277VAC
EBF261	Bi-Pin Fluorescent	26 (2x13)	120VAC 277VAC
EBF264	Bi-Pin Fluorescent	26 (2x13)	120VAC 277VAC
EQF2630	Quad Pin	26	120-277 VAC
EQF3230	Pin	32	120-277 VAC
EQF4230	Fluorescent	42	50-60Hz

HPS			
CATALOG NUMBER	ANSI LAMP TYPE	WATTS	VOLTS @60HZ.
EMS351	S-76	35	120
EMS050	S-68	50	Quadri-Volt
EMS070	S-62	70	Quadri-Volt 480
EMS075	S-62	70	Quadri-Volt 480
EMS100	S-54	100	Quadri-Volt 480
EMS105	S-54	100	Quadri-Volt 480
EMS151	S-55	150	120

METAL HALIDE			
CATALOG NUMBER	ANSI LAMP TYPE	WATTS	VOLTS @60HZ.
EMH050	M-110	50	Quadri-Volt
EMH070	M-98	70	Quadri-Volt
EMH100	M-90	100	Quadri-Volt

MERCURY VAPOR			
CATALOG NUMBER	ANSI LAMP TYPE	WATTS	VOLTS @60HZ.
EMM0510	H-46	50	120, 277
EMM751	H-43	70	120 277
EMM754	H-43	70	120 277
EMM100	H-38	100	Quadri-Volt 480
EMM105	H-38	100	Quadri-Volt 480

^① Assemblies may be ordered with the CEN (CENELEC) suffix. See pages L150-151 for more information.



Listed - Files E10514 and E91793 (Marine)



Certified - File LR11713



Pendant



Ceiling



Wall Bracket



25° Stanchion

MOUNTING BOXES				
CATALOG NUMBER				HUB SIZE
PENDANT	CEILING	BRACKET	STANCHION	
EZA2	EZX2	EZB2	—	3/4"
EZA3	EZX3	EZB3	—	1"
—	—	—	EZD4*	1-1/4"/1-1/2"*

*1-1/2" furnished with 1-1/2"-1-1/4" reducer



EMG1



EMG2



EAC^②



Standard Dome



Angle Dome

GUARDS		
CATALOG NUMBER	SERIES	LAMP TYPE
EMG1	EMI15	INC
	EMI20	INC
	EBF	Bi-Pin
	EQF	Quad-Pin
EMG2	EMI30	INC
	EMS	HPS
	EMH	MH
	EMM	MV
	ESX	Strobe

Guards are cast of copper-free aluminum with electrostatically applied epoxy/polyester finish.

^② Adapters for discontinued Killark "H" Series and Crouse Hinds® available. See page L148 for more information.

REFLECTORS		
CATALOG NUMBER		SERIES
STANDARD DOME	ANGLE	
ERSD15	ERA15	EMI15/EMI20
		EBF
		EQF
ERSD30	ERA30	EMI30
		EMS
		EMH
		EMM

Reflectors are aluminum with white finish.



KILLARK®



Exit Sign Accessory



Replacement Globe & Support Assemblies

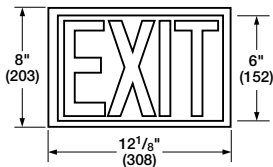
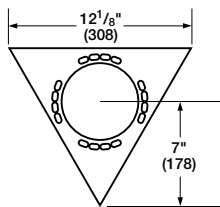
Hazardous Locations Exit Sign Applications

For use in hazardous areas to mark exits over doorways and in hallways.

Features

- Three sided illuminated sign visible from all three sides
- EXIT printed in 6" high red letters with 3/4" strokes as required by OSHA. Sign has open bottom providing light on exit area while illuminating the panel

EXIT SIGN	
CATALOG NUMBER	DESCRIPTION
HEXA-100	Fits EMI15, EM120, EBF/EQF/EEQ Series without guard (Fixture not included)



REPLACEMENT GLOBE AND GLOBE SUPPORTS			
CATALOG NUMBER ^①	SERIES	LAMP TYPE	MAX. WATTAGE
EMGS1	EMI15	INC	150
	EM120	INC	300
	EBF13/26	PL Bi-Pin Fluorescent	26
	EQF	PL Quad-Pin Fluorescent	42
EMGS2 EMGS3	EMI30	INC	300
	EMS	HPS	150
	EMH	MH	100
	EMM	MV	100

^① EMGS1, EMGS3 are internally fluted glass. EMGS2 is smooth clear glass used for ESX strobe.



EM Series



EB Series



Male



Female

REPLACEMENT SOCKETS	
CATALOG NUMBER	DESCRIPTION
EMRS	EM Series E-26 Medium Base
EBRS	EB Series

REPLACEMENT CONNECTION BLOCKS	
CATALOG NUMBER	DESCRIPTION
EZTB	Male
EZCB	Female

COLORED GLOBE KITS FOR HAZARDOUS LOCATIONS ^②		
KIT NO.	CATALOG NUMBER	DESCRIPTION
	REPLACEMENT COLORED GLOBE	
KT-100SU41R	VRGA-100	Red
KT-100SU41G	VGGA-100	Green

Used to modify EMI20 Series only fixtures to accept a colored inner globe. The kit includes the globe plus an adapter assembly and mounting instructions.

^② Maximum lamp size A-21 150 Watt.

REPLACEMENT FLUORESCENT LAMPS	
CATALOG NUMBER	SIZE & TYPE
MPL13	13W Bi-Pin
MQL26	26W Quad-Pin
MQL32	32W Quad-Pin
MQL42	42W Quad-Pin





PMC/BETA

□ 1711 Townhurst Dr., Houston, TX 77043-2899
Tel: 713-461-2131 or 713-299-4029 (after hours)
e-mail: service@metrix1.com Fax: 713-461-8223



2-WIRE SEISMIC VIBRATION TRANSMITTER MODEL 162VTC-XXX-XXX-XX INSTALLATION INSTRUCTIONS

- Provides 4-20 mA signal proportional to velocity vibration
- Direct connection to PLC, DCS or other recording monitor
- Two wire, loop powered, simplifies field wiring, IPT® reversable power
- Different top wiring configurations and mounting stud types, see table

The Model 162VTC Seismic Vibration Transmitter is a new version of an established series of transmitters from Metrix. It incorporates state-of-the-art electronic components and circuits. It also offers several new options in terms of features and configurations. Be sure to study the configuration of the transmitter before putting it in service.

The transmitter combines a vibration sensor and signal conditioner in a single package. They provide the ideal solution for sensing machinery vibration level and transmitting a proportional 4-20 mA signal directly to a PLC, DCS, monitor, or computer. Typical applications include low and medium speed machines, such as fans, blowers, pumps, motors, and centrifuges. The transmitter can be supplied with optional screw cover elbow fittings for connecting flexible conduit.

The transmitter is all solid state, has no moving parts, and is encapsulated in a stainless steel housing. Each transmitter is factory calibrated to the sensitivity marked on the label.

An optional dynamic signal output can be specified. This signal is an acceleration signal with 100 mV/g sensitivity. This signal can be used for vibration analysis with portable instruments. It cannot drive long lines without a buffer amplifier. This is due to the low operating power typical in loop powered devices. Be aware that low impedance portable instruments will load this output.



**Model 162VTC
2-wire, Loop-
powered
Vibration
Transmitter**

Flying lead version
shown

Verify Transmitter Configuration

Be sure to determine the transmitter configuration before installing it. See inside for configuration details.

162VTC-XXX-XXX-XX

1st XXX denotes measurement range
2nd XXX denotes mounting type, area
use rating, and top connection
(including signal output option)
3rd XX denotes optional filtering

IPT® (Independent Polarity) is a registered trademark of Metrix Instrument Co./PMC BETA

162VTC CONFIGURATION

162VTC - **A** **B C D** **E F**

A - Full Scale

1	2	1	= 1.0 ips (25.4 mm/s), pk
1	2	3	= 2.0 ips (50.8 mm/s), pk
1	2	6	= 0.8 ips (20.3 mm/s), pk
1	3	4	= 1.97 ips (50.0 mm/s), pk
2	0	0	= 1.60 ips (40.6 mm/s), pk
2	0	1	= .32 ips (8.0 mm/s), pk
2	0	2	= .64 ips (16 mm/s), pk
2	0	3	= 1.26 ips (32.0 mm/s), pk
2	0	4	= 2.52 ips (64.0 mm/s), pk
2	0	5	= 3.2 ips (81.3 mm/s), pk
2	0	6	= 0.4 ips (10.2 mm/s), pk

B - Mounting

0	= Integral 1/4" NPT
1	= Integral 1/2" NPT
2	= 3/8-24 UNF X 1/2"
3	= 1/2-20 UNF X 1/2"
4	= M8 X 1-12
5	= M10 X 1.25-12

C - Hazardous Area Rating

1	= Non-hazardous & CSA/NRTL/C (for all connections) Class I, Div 2, Grps A,B,C & D
2	= Class I, Div 1, Grps B,C & D & Class II, Div 1, Grps E,F & G (only available with flying leads configuration)

D - Connection

0	= 4-20 mA; Flying leads (C = 1 or 2)
1	= 4-20 mA & Dynamic Signal; Flying leads (C = 1 or 2)
2	= 4-20 mA; 2-pin terminal block (C = 1 or 3)
3	= 4-20 mA & Dynamic Signal; 4-pin terminal block (C = 1 or 3)
4	= 4-20 mA; 2-pin MS connector (C = 1 or 3)

E - HP Filter

0	= Integral 1/4" NPT
1	= Integral 1/2" NPT
2	= 3/8-24 UNF X 1/2"
3	= 1/2-20 UNF X 1/2"
4	= M8 X 1-6
5	= M10 X 1.25-6

F - LP Filter

0	= No Filter (2 Hz)
1	= 5 Hz
2	= 10 Hz
3	= 20 Hz
4	= 50 Hz
5	= 100 Hz
6	= 200 Hz

Standard Configuration:

162VTC-121-020-00

A - 1.0 ips Full scale range
 B - 1/4 in. NPT (pipe thread) mounting
 C - Class I, Div 1 Area rating
 D - 4-20 mA Flying leads connection
 E - No High pass filter
 F - No Low pass filter

The complete Model Number, showing the configuration and serial number, is etched onto the body of the Transmitter.

INSTALLATION

1. MOUNTING It is important the the transmitter body be solidly mounted to the machine surface. See the section on transducer placement. Different machine preparations are required for the two basic transmitter mounting styles; NPT (National Pipe Thread) and machine thread (UNF and Metric). Transmitters with the NPT type mounting stud are secured by the thread engagement and the base of the transmitter does not come in contact with the machine surface. On the other hand, transmitters with the machine thread studs must make contact with the machine surface. The base of the transmitter must make square and direct contact. This requires preparing the surface of the machine with a 1 1/2 inch counterbore (surfacing tool). This tool can be used with a portable drill equipped with a magnetic base but care must be taken so that the tapped and threaded hole is perpendicular to the machined surface. The transmitter must make contact all the way around its base surface. Contact Metrix for more detailed instructions for using a counterbore.

If installing a transmitter with a standard 1/4 inch NPT stud, drill a hole using a 7/16 inch bit, 5/8 inch deep. Then tap using a 1/4 - 18 NPT (tapered pipe tap). Hand tighten the transmitter and then turn an additional 1 to 2 turns using a wrench on the wrench flats. Do not use a pipe wrench. A pipe wrench can apply extreme forces to the body and potentially damage electronic components. A minimum of five (5) threads of engagement should be made. A 1/4 inch to 1/2 inch NPT bushing is available for mounting the transmitter in existing 1/2 inch NPT holes. Also, a Model 7084 Flange Adapter can be used between the transmitter and the machine surface when there is not enough surface thickness to drill and tap a hole. The flange adaptor mounts with three small screws. See accessories.

INSTALLATION (Continued)

If installing a transmitter with one of the straight machined thread sizes, follow standard drill and tap procedures. Be sure to not drill a hole larger than the counterbore pilot diameter before using the counterbore to prepare the machine surface. Drill out the hole with the correct tap drill size after preparing the surface.

The sensitive axis of the transmitter is in line with the mounting stud. The transmitter can be oriented in any (0 to 360 degree) position.

2. WIRING The 162VTC is connected like any other loop powered transmitter. The following is a summary based on area designations.

2.A SAFE AREA INSTALLATION Connect the field wiring in accordance with the appropriate diagram on page 4. The 162VTC transmitter requires a minimum of 11 VDC for proper operation. The minimum loop power supply voltage required is 11 VDC plus 1 volt for each 50 ohms of loop resistance.

162VTC Example:	Signal wire resistance	= 10 ohms
	Resistance of receiver	= <u>250 ohms</u>
	Total loop resistance	= 260 ohms

Minimum supply voltage = $260 (1V/50 \text{ ohms}) + 11V = 16.2 \text{ VDC}$

The maximum loop power supply voltage that may be applied is 30 VDC. The maximum loop resistance (RL) is calculated by the equation:

$RL = 50 (VS - 11) \text{ ohms}$

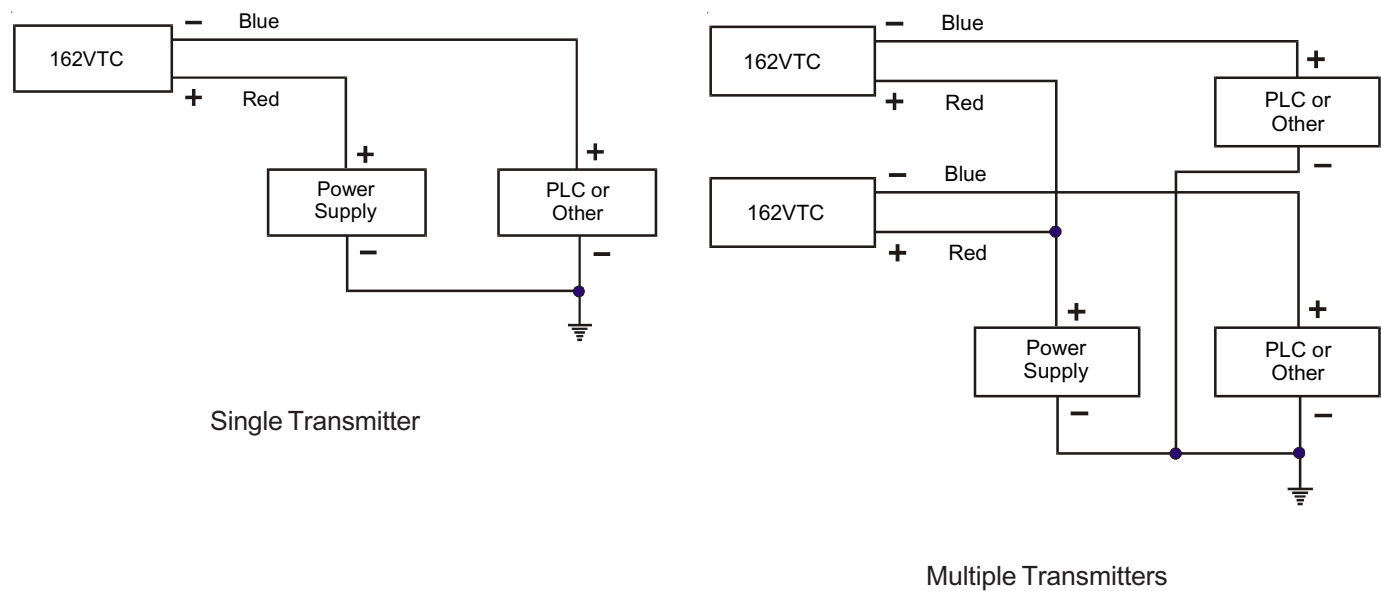
Example: $RL = 50 (24 - 11) = 650 \text{ ohms}$ for 24 VDC loop supply.

2.B EXPLOSION-PROOF INSTALLATION IN HAZARDOUS LOCATIONS  162VTC transmitters are CSA certified explosion-proof, Class I (B, C & D); Class II (E, F & G₁). Connect the field wiring in accordance with the appropriate diagram on page 4. Refer to paragraph 2.A for loop voltage and resistance requirements. All conduit and junction boxes used must be certified explosion-proof for the class, division and group required by the application. Installation of the transmitter must meet all of the explosion-proof installation requirements of the local governing agency and facility safety procedures.

3. ELECTROMAGNETIC COMPATIBILITY In order to meet the requirements of  electromagnetic compatibility in areas of high electromagnetic interference, the field wiring must be:

- 1. shielded twisted pair cable enclosed in grounded metallic conduit, or
- 2. double shielded twisted pair cable with a metallic body cable gland fitting and with the outer shield grounded to earth.

WIRING DIAGRAMS



Use standard two-conductor, twisted pair, shielded wiring for the long run to the instrumentation enclosure. The transmitter is connected like any other loop powered end device.

CONNECTION TO PLC OR OTHER INDICATING INSTRUMENT

The first step in configuring the PLC, DCS, or other recording instrument is to determine the source of power. The 162VTC requires loop power be supplied to it. Some Analog Input channels, on a PLC or DCS, for example, provide this power from within. If they do not provide power, an external power supply must be provided. Connect the transmitter field wiring using standard instrumentation practices.

Scaling of the display is on the basis of the range of the transmitter. The measurement parameter name is “vibration” and the units are “ips” (inches per second) or “mm/s” (millimeters per second). The example below is based on a standard 1.0 ips transmitter.

Vibration Level	Transmitter Output	PLC (or other) Scale
None	4 mA +/- 0.1 mA	0.00 ips
1.0 ips	20 mA +/- 0.4 mA	1.00 ips

In order to prevent nuisance alarms, due to transient operating conditions, program a time delay into the alarm. Momentary “jolts” that can occur at start-up or during some operating condition changes, do not reflect a machines steady state operating condition. The indicated vibration level must cross the threshold level and stay above it for a preset time before any alarm action is taken. A 2 to 3 second delay is normally applied to most machinery. Consult Metrix if you have a question about your machines operating characteristics.

Some rough starting machinery may also need a start-up time lockout for alarms. A start-up lockout is different than a time delay! Both may be needed.

TYPICAL TRANSMITTER PLACEMENT

The 162VTC measures seismic vibration at the attachment point on the machine. Its sensitive direction is through its cylindrical body. It will not measure side to side motion. It measures velocity vibration in ips (inches per second). Velocity vibration is a common measurement for a large variety of machinery.

Typical transmitter mounting for casing vibration measurements is in the horizontal direction at the bearing housings. Usually the horizontal direction is more sensitive because of the way machinery is typically mounted. Figure 2 shows the flying leads being spliced in the conduit elbow. Please be aware the splice can not be made at this point if in a hazardous area. In this case, make the splice in a second conduit hub (meeting splicing requirements) at the end of the flexible

conduit. The standard lead length is 24 inches. We recommend using the “Y” conduit elbow because it prevents the conduit from extending too far away from the transmitter, limiting the likelihood of getting snagged while working near the machinery. If a 1 inch to 3/4 inch reducer is used at the elbow, a smaller diameter flexible conduit can be used. It is always a good idea to limit the mass that “hangs” on the transmitter. The flexible conduit should make a bend in order to be sure any rigid conduit motion can not feed into the transmitter body.

Typical Application and Mounting Arrangement

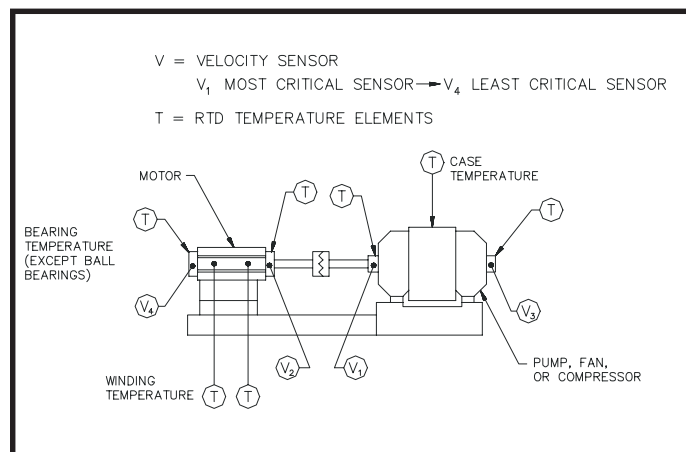


Figure 1

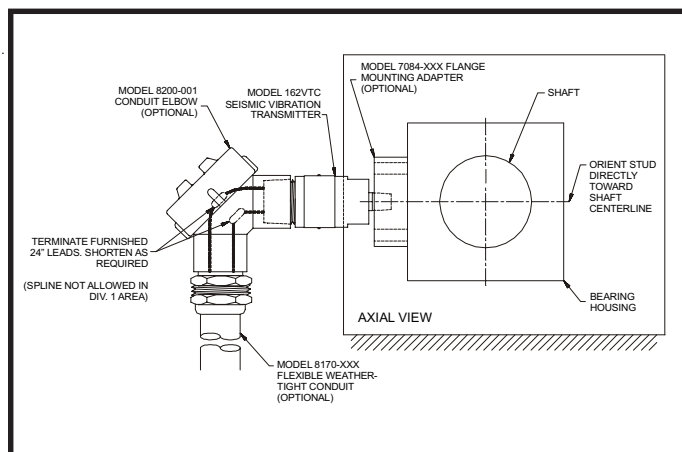


Figure 2

CALIBRATION

The 162VTC transmitter has been factory calibrated for the full scale vibration level marked on the label. If the calibration is in doubt the unit can be verified in the field by following the procedures outlined below. Note that there are no Zero and Span adjustments on the transmitter.

1. Zero Verification In the absence of vibration the output current should be $4 \text{ mA} \pm 0.1 \text{ mA}$. If the ambient vibration is more than 2% of full scale, the transmitter should be removed from the machine and placed on a vibration free surface for this measurement. Often a piece of foam can be used to isolate the transmitter from external motion.

2. Span Verification Subject the transmitter to a known vibration within the full scale range marked on the label. If using a portable vibration shaker where it can be tested at full scale, the output should be $20 \text{ mA} \pm 0.4 \text{ mA}$. If using another reference, like a similar machine, calculate the current value on a proportional basis.

The output level can also be compared to a vibration level read on a portable vibration meter. This reading should be taken as close to the transmitter location as possible.

If you shake the transmitter by hand you can produce a high output as long as there are no high pass filters. Check the configuration for filters. There is no way of knowing the expected output when shaking it by hand.

OPTIONAL DYNAMIC OUTPUT

The transmitter can be configured with an optional dynamic output. This output is an acceleration signal with a sensitivity of 100 mV/g . An electrically isolated or battery powered portable vibration analyzer can only be used to analyze this signal. Since this is a loop powered device an external ground will affect the loop output and could cause a false alarm. When using a portable vibration analyzer, or data collector, be sure to turn the instrument sensor power off. Be aware, most portable vibration analyzers have a low input impedance and they will load this signal resulting in attenuation of as much as 20 to 30%.

NOTE: In all cases for all locations, the use of this signal is for temporary use only. Permanent connection could violate hazard location installations. Care should be exercised to avoid introducing electrical noise or mechanical vibrations when using this output. When output is not in use, be sure leads cannot touch conduit or each other. This will affect the 4-20 mA current output. This output can not be accessed using leads longer than 10 or 12 feet.

OPTIONAL MOUNTING & CONNECTION

The 162VTC is available with different mounting options as well as different field wiring options. Some of these are illustrated here. The performance of the transmitter does not change (except for the dynamic output option, discussed earlier).



162VTC-XXX-X20-XX
With 2-24" flying leads.



162VTC-XXX-X32-XX
With two slot terminal block.



162VTC-XXX-X14-XX
With 2-pin MS style connector.

162VTC-XXX-X21-XX
With 4-24" flying leads. The dynamic signal leads (black & white) provide a buffered 100 mV/g connection for analysis.

162VTC-XXX-X33-XX
Four slot terminal block top connection. The dynamic signal terminals (two outside ones) provide a buffered 100 mV/g connection for analysis.

OPTIONAL MOUNTING ACCESSORIES



8200-001, Conduit Elbow & Reducer
Provides access and physical protection for field wiring. Suitable for Class I, Div. 1 (Grps C & D) and Class II, Div. 1 (Grps E, F & G), hazardous areas. 1" to 3/4" NPT reducer for customer connection included. NEMA 4 IP 65. Material: copper free aluminum.

8200-002, Conduit Elbow & Reducer
Conduit Elbow with terminal block



8200-005, Stainless Steel Conduit Elbow & Reducer
Provides access and physical protection for field wiring. 1/2" NPT suitable for Class I, Div. 1 (Grps B, C & D)*, Class II, Div. 1 (Grps E, F & G)*. Material: stainless steel

8200-006, Conduit Elbow & Reducer
Stainless Steel Conduit Elbow with terminal block

* Certification Pending



8201-001, Conduit Union
Fits between transmitter and 8200-001 conduit elbow to facilitate installation and wiring where there is not enough room to rotate the elbow. Suitable for Class I, Div. 1 (Grps A, B, C & D) and Class II, Div. 1 (Grps E, F & G), hazardous areas. Material: zinc plated steel.



7084-001, Stainless Steel Flange Mount Adaptor
Provides a means to surface mount transmitters rather than NPT stud (1/2" NPT center hole). Three equally spaced 6.6 mm (0.26") diameter mounting holes on 38 mm (1.50") diameter circle.

7084-002, Flange Mount Adaptor
Same as 7084-001, except center hole is 1/4" NPT. Material: stainless steel



8253-002, Bushing
Bushing for 1/2" NPT mount when screwed onto standard 1/4" NPT base. Material: stainless steel.

OPTIONAL CONNECTION ACCESSORIES



8978-111-XXXX, Splashproof Cable Assembly
Two (2) pin socket connector with integral, molded splash proof boot with 6.4 mm (0.25") diameter polyurethane jacketed cable with twisted shielded pair wires. xxx.x = Cable length in meters.



9334-111-YYYY-XXXX, Splashproof Cable Assembly w/Stainless Steel Armor
Two (2) pin socket connector with integral, molded splash proof boot with 7.1 mm (0.28") diameter, SST armored jacket with cable, twisted shielded pair wires. xxx.x = Cable length in meters. yyy.y = Armor length in meters.



8978-211-XXXX, Cable Assembly
Two (2) pin socket connector with cable strain relief with 6.4 mm (0.25") diameter polyurethane jacketed cable with twisted shielded pair wires. xxx.x = Cable length in meters.

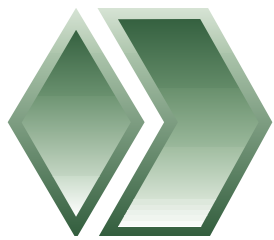
Note: All 8978 connector/cable assemblies rated to 121°C (250°F) max.



9334-211-YYYY-XXXX, Cable Assembly, w/Stainless Steel Armor
Two (2) pin socket connector with 7.1 mm (0.28") diameter, SST armored jacket with cable, twisted shielded pair wires. xxx.x = Cable length in meters. yyy.y = Armor length in meters.



8169-75-002-XXX, Two-wire, Cable Assembly
2 conductor (20 AWG) twisted, shielded PVC jacketed cable, with plated steel grip for cable strain relief, male 3/4" NPT end. Specify -XXX for length in feet. Example: 8169-75-002-010 = 10 ft (3.1M). Material: zinc plated steel.



RUFFNECK® Heaters



We ship the heat in a week!

FX4



EXPLOSION - PROOF ELECTRIC AIR HEATERS



www.ruffneck.com



RUFFNECK® FX4 SERIES

*We ship the heat
in a week!*

Leads the way with new features...

3 YEAR WARRANTY

MORE MODELS 2.5 kW to 35 kW

OPTIONAL BUILT-IN THERMOSTAT & DISCONNECT SWITCH

IMPORTANT: RUFFNECK FX4 heaters are for dry indoor use only.
Do not immerse in water. Do not store or use in areas exposed to rain or snow.

Suitable for the following hazardous location classification:

Class I, Divisions 1 & 2, Group C & D

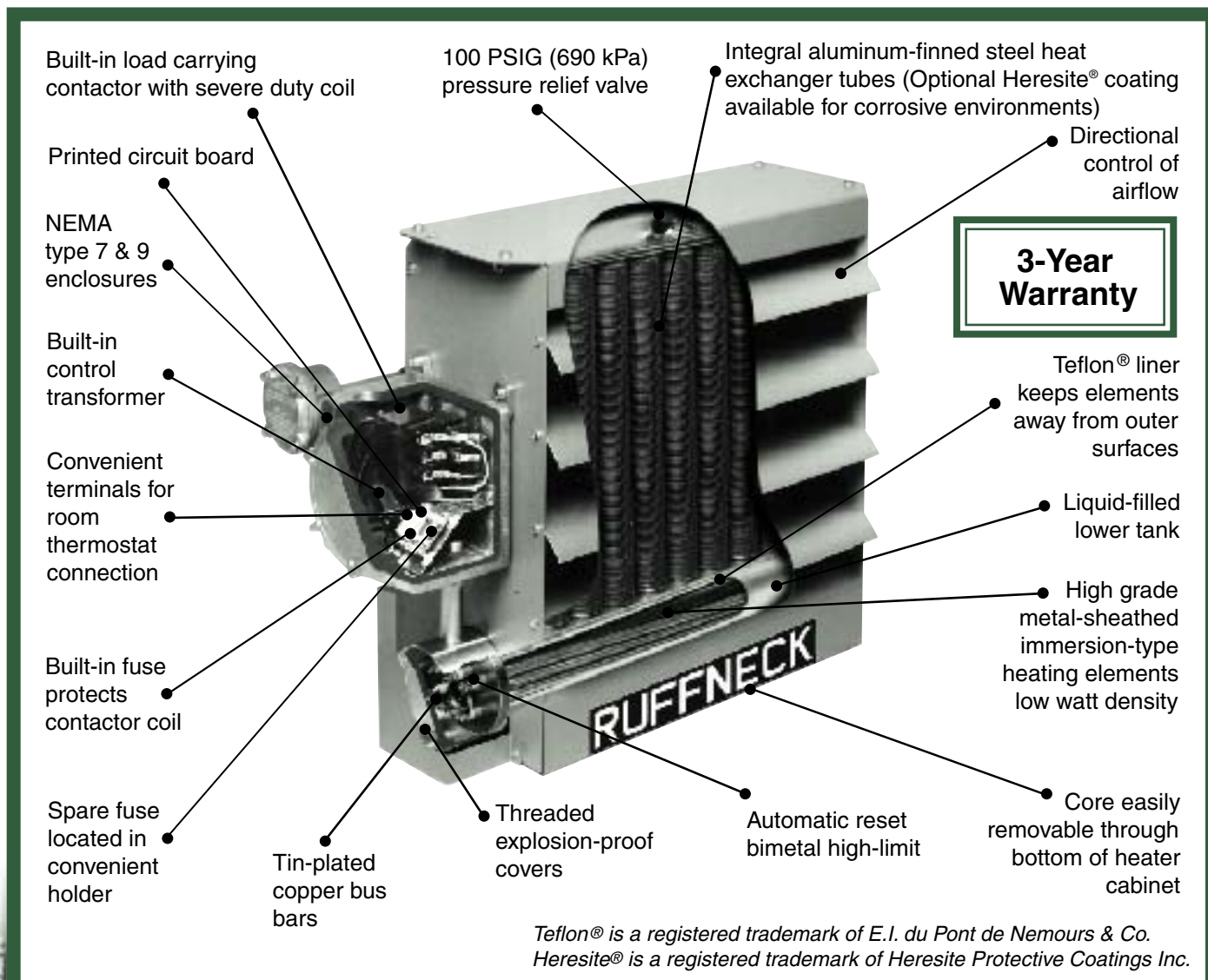
Class II, Division 1, Groups E, F & G

Class II, Division 2, Groups F & G

Class I, Zones 1 & 2, Groups IIA & IIB

Temperature Code T3B 165°C (329°F)

Pat. 5,654,525 USA; Pat. Pending 2,130,062 CAN; Des. Pat. 356,367 USA; Rd. 1994, 74297 CAN



RUFFNECK® FX4 SERIES

A new generation of liquid-filled Explosion-Proof Electric Air Heaters.

FX4 heaters are UL listed and/or CSA certified for use in hazardous locations. They are designed for dry indoor industrial applications such as oil refineries, petrochemical plants, pulp and paper mills, coal mines, grain elevators, hazardous waste storage facilities, wastewater treatment plants, etc., where specific explosive gases or dusts are present.

All FX4 heaters utilize the VacuCore® liquid-to-air heat exchanger. The induced vacuum within the sealed core provides greater efficiency, even distribution of heat across the face of the exchanger, and a faster warm-up. When necessary, the entire core can be safely and easily replaced with a new or factory reconditioned exchange unit.

The heater core assembly is contained in a sturdy, epoxy-coated 14-gauge steel cabinet which also carries the motor and fan assembly. Adjustable louvers allow directional control of the airflow. A narrow gap, two-piece fan guard is provided to shield all moving parts. All fasteners are zinc plated for corrosion protection.

RUFFNECK heaters are built to last. All aspects and details of RUFFNECK products are subjected to exhaustive technical analysis and testing during design and development, and are manufactured under a registered quality assurance program. As a result, they have consistently proven their safety and reliability.

**A Company Dedicated
to Quality and Safety...
A Reputation Built on Service!**



Easy access to controls in explosion-proof enclosure



VacuCore® exchanger is easy to remove



Optional side-mounted built-in room thermostat and disconnect switch for added convenience.



The FX4 SERIES

More features...more benefits.

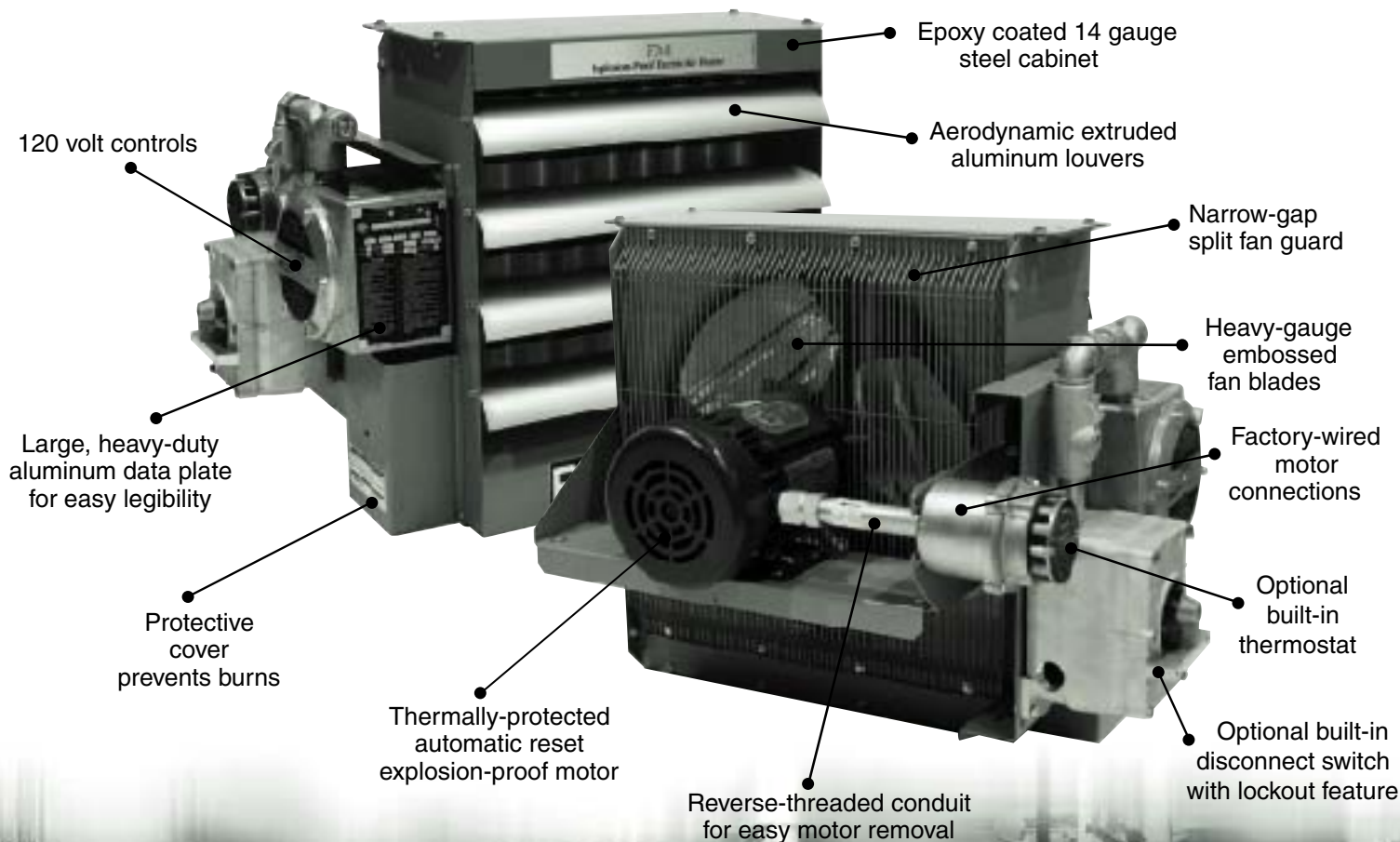
For hazardous-location heating, rely on the RUFFNECK FX4 heater for the most dependable, trouble-free service available. Since 1982, RUFFNECK has produced thousands of explosion-proof electric air heaters. The FX4 VacuCore® Series represents the fourth generation of its kind and offers these outstanding features and benefits:

FEATURE

evacuated core
greater kW range up to 35 kW
three year warranty
split fan guard
compact design & lighter weight
optional built-in accessories
bimetal high-limit
large explosion-proof control box
with screw-on cover

BENEFIT

heats up faster, with even heat distribution
more economical to heat large areas
trouble free, peace of mind
easy access to fan
easier to handle and saves space
reduced field installation costs
high altitude applications, better reliability
easy access for installation and maintenance



Performance Data for 60 Hertz

UL listed and/or CSA certified

Temperature Code T3B 165 C (329 F)



NOMINAL WATTAGE (kW)	MODEL	VOLTAGE	PHASE	TOTAL CURRENT (A)	OPTIONAL BUILT-IN DISCONNECT SWITCH	AIR TEMPERATURE RISE		BTU/HR
						°F	°C	
3	FX412-208160-3	208	1	14.4	DS4-48	19.0	10.5	10,250
	FX412-240160-3	240	1	12.5	DS4-48			
	FX412-208360-3	208	3	8.3	DS4-48			
	FX412-240360-3	240	3	7.2	DS4-48			
	FX412-480160-3*	480	1	6.3	DS4-48			
	FX412-480360-3	480	3	3.6	DS4-48			
	FX412-600360-3*	600	3	2.9	DS4-48			
5	FX412-208160-5	208	1	24.0	DS4-48	31.6	17.6	17,050
	FX412-240160-5	240	1	20.8	DS4-48			
	FX412-208360-5	208	3	13.9	DS4-48			
	FX412-240360-5	240	3	12.0	DS4-48			
	FX412-480160-5*	480	1	10.4	DS4-48			
	FX412-480360-5	480	3	6.0	DS4-48			
	FX412-600360-5*	600	3	4.8	DS4-48			
7.5	FX412-208160-7.5	208	1	36.1	DS4-48	27.9	15.5	25,600
	FX412-240160-7.5	240	1	31.3	DS4-48			
	FX412-208360-7.5	208	3	20.8	DS4-48			
	FX412-240360-7.5	240	3	18.0	DS4-48			
	FX412-480160-7.5*	480	1	15.6	DS4-48			
	FX412-480360-7.5	480	3	9.0	DS4-48			
	FX412-600360-7.5*	600	3	7.2	DS4-48			
10	FX412-208160-10*	208	1	48.1	Not Available	37.2	20.6	34,100
	FX412-240160-10	240	1	41.7	DS4-48			
	FX412-208360-10	208	3	27.8	DS4-48			
	FX412-240360-10	240	3	24.1	DS4-48			
	FX412-480160-10*	480	1	20.8	DS4-48			
	FX412-480360-10	480	3	12.0	DS4-48			
	FX412-600360-10*	600	3	9.6	DS4-48			
15	FX416-240160-15*	240	1	62.5	Not Available	27.1	15.0	51,200
	FX416-208360-15	208	3	41.6	DS4-48			
	FX416-240360-15	240	3	36.1	DS4-48			
	FX416-480160-15*	480	1	31.3	DS4-48			
	FX416-480360-15	480	3	18.0	DS4-48			
	FX416-600360-15*	600	3	14.4	DS4-48			
20	FX416-208360-20*	208	3	55.5	Not Available	36.1	20.1	68,250
	FX416-240360-20*	240	3	48.1	Not Available			
	FX416-480160-20*	480	1	41.7	DS4-48			
	FX416-480360-20	480	3	24.1	DS4-48			
	FX416-600360-20*	600	3	19.2	DS4-48			
25	FX420-240360-25*	240	3	60.1	Not Available	21.9	12.2	85,300
	FX420-480360-25	480	3	30.1	DS4-48			
	FX420-600360-25*	600	3	24.1	DS4-48			
30	FX420-480360-30	480	3	36.1	DS4-48	26.3	14.6	102,350
	FX420-600360-30*	600	3	28.9	DS4-48			
35	FX420-480360-35	480	3	42.1	DS4-48	28.0	15.6	119,450
	FX420-600360-35*	600	3	33.7	DS4-48			

Heaters are also suitable for voltages of 220, 230, 460 & 575, but subject to derated output.

Note: * CSA certified ONLY.

Exceeds the 48 amp. circuit limit of NEC 424-22.

To order a heater with a built-in room thermostat, add a **T** suffix to model number.

To order a heater with a built-in disconnect switch, add a **DS4-48** suffix to model number.

Please specify **CSA** or **UL** heater when ordering.

Defender explosion-proof thermostats are suitable for all FX4 models.

See Page 6 for Model
Coding and Installation
Conditions.



Performance Data for 50 Hertz

CSA certified only

Class I, Divisions 1 & 2, Groups C & D;

Class II, Division 1, Groups E, F & G;

Class II, Division 2, Groups F & G;

Class I, Zones 1 & 2, Groups IIA & IIB.

Temperature Code T3B 165 C (329 F)



NOMINAL WATTAGE (kW)	MODEL	VOLTAGE	PHASE	TOTAL CURRENT (A)	OPTIONAL BUILT-IN DISCONNECT SWITCH	AIR TEMP. RISE °F °C		BTU/HR
2.5	FX412-220150-2.5	220	1	11.4	DS4-48	19.7	11.0	8,550
4.2	FX412-220150-4.2	220	1	19.1	DS4-48	33.2	18.4	14,350
6.3	FX412-220150-6.3	220	1	28.6	DS4-48	28.4	15.8	21,500
8.4	FX412-220150-8.4	220	1	38.2	DS4-48	37.9	21.1	28,650
12.6	FX416-220150-12.6	220	1	57.3	Not Available	27.5	15.3	43,000
2.5	FX412-380350-2.5	380	3	3.8	DS4-48	19.7	11.0	8,550
4.2	FX412-380350-4.2	380	3	6.4	DS4-48	33.2	18.4	14,350
6.3	FX412-380350-6.3	380	3	9.6	DS4-48	28.4	15.8	21,500
8.4	FX412-380350-8.4	380	3	12.8	DS4-48	37.9	21.1	28,650
12.5	FX416-380350-12.5	380	3	19.0	DS4-48	27.2	15.1	42,650
16.7	FX416-380350-16.7	380	3	25.4	DS4-48	36.4	20.2	57,000
20.9	FX420-380350-20.9	380	3	31.8	DS4-48	22.0	12.2	71,300
3.7	FX412-415350-3.7	415	3	5.1	DS4-48	29.2	16.2	12,600
7.5	FX412-415350-7.5	415	3	10.4	DS4-48	33.9	18.8	25,600
14.9	FX416-415350-14.9	415	3	20.7	DS4-48	32.5	18.0	50,850
22.4	FX420-415350-22.4	415	3	31.2	DS4-48	23.6	13.1	76,450

To order a heater with a built-in room thermostat, add a "T" suffix to model number.

To order a heater with a built-in disconnect switch, add a "DS4-48" suffix to model number.

Model Coding

FX 4 20-480 3 60-35-T and/or DS4-48

MODEL SERIES
 4th GENERATION
 FAN SIZE (INCHES)
 VOLTAGE
 PHASE
 HERTZ
 KILOWATT RATING
 OPTIONS

Installation Conditions

1. The FX4 Series Electric Air Heaters are for dry indoor use only. Do not immerse in water. Do not store or use in areas exposed to rain or snow.
2. The FX4 Heaters are to be used only in atmospheres having an ignition temperature higher than Temperature Code T3B 165 °C (329°F) for Class I & II.
3. Altitude restrictions apply see Specifications on page 7.
4. Heaters should be connected to a fixed power supply and must be permanently mounted in a level, upright position during operation.
5. Read and be aware of the terms of our Warranty (see back cover).
6. Refer to Owner s Manual.

Specifications

60 HERTZ		FX412				FX416		FX420		
	Nominal kW	3	5	7.5	10	15	20	25	30	35
Max. Altitude	(ft.) (m)	12,000 3,658	8,000 2,438	10,000 3,048	7,000 2,134	10,000 3,048	7,000 2,134	10,000 3,048	7,000 2,134	6,000 1,829
Air Delivery @ 70°F @ 21°C	(CFM) (m³/hr.)	500 850	850 1444	850 1444	850 1444	1750 2973	1750 2973	3600 6116	3600 6116	3950 6711
Horizontal Throw	(ft.) (m)	15 4.6	30 9.1	30 9.1	30 9.1	40 12.2	40 12.2	70 21.3	70 21.3	70 21.3
Max. Mounting Height (to underside)	(ft.) (m)	7 2.1	10 3.0	10 3.0	10 3.0	10 3.0	10 3.0	20 6.1	20 6.1	20 6.1
Motor Power	(HP) (kW)	1/4 0.187				1/4 0.187		1/2 0.373		
Motor Speed	(RPM)	1725				1725		1725		
Fan Diameter	(in.) (mm)	12 305				16 406		20 508		
Net Weight		without disconnect	with disconnect	without disconnect	with disconnect	without disconnect	with disconnect	without disconnect	with disconnect	without disconnect
	(lbs.)	111	125	133	147	154	168	154	168	168
	(kg)	50	57	61	67	70	76	70	76	76
Shipping Weight	(lbs.)	151	165	173	187	204	218	204	218	218
	(kg)	69	75	79	85	93	99	93	99	99

See Page 8 for general specifications common to all models.

50 HERTZ		FX412				FX416		FX420	
	Nominal kW	2.5	3.7 & 4.2	6.3 & 7.5	8.4	12.5 & 12.6	14.9 & 16.7	20.9	22.4
Max. Altitude	(ft.) (m)	12,000 3,658	8,000 2,438	10,000 3,048	7,000 2,134	10,000 3,048	7,000 2,134	10,000 3,048	7,000 2,134
Air Delivery @ 70°F @ 21°C	(CFM) (m³/hr.)	400 679	700 1189	700 1189	700 1189	1450 2463	1450 2463	3000 5096	3000 5096
Horizontal Throw	(ft.) (m)	13 4.0	25 7.6	25 7.6	25 7.6	35 10.7	35 10.7	60 18.2	60 18.2
Max. Mounting Height (to underside)	(ft.) (m)	7 2.1	10 3.0	10 3.0	10 3.0	10 3.0	10 3.0	20 6.1	20 6.1
Motor Speed	(RPM)	1437				1437		1437	
Fan Diameter	(in.) (mm)	12 305				16 406		20 508	
Net Weight		without disconnect	with disconnect	without disconnect	with disconnect	without disconnect	with disconnect	without disconnect	with disconnect
	(lbs.)	111	125	133	147	154	168	154	168
	(kg)	50	57	61	67	70	76	70	76
Shipping Weight	(lbs.)	151	165	173	187	204	218	204	218
	(kg)	69	75	79	85	93	99	93	99

See Page 8 for general specifications common to all models.



Specifications

GENERAL: For All Models

Approvals	UL listed and/or CSA certified
Hazardous Location Classifications	Class I, Divisions 1 & 2, Groups C & D; Class II, Division 1, Groups E, F & G; Class II, Division 2, Groups F & G; Class I, Zones 1 & 2, Group IIA & IIB. Temperature Code T3B 165 C (329 F)
Enclosures	NEMA Type 7 & 9. For dry indoor use only. Do not immerse in water. Do not store or use in areas exposed to rain or snow.
Motor Type	Explosion-proof. Thermally protected. Permanently lubricated ball bearings.
Fan	Aluminum blade. Steel spider and hub with 5/8 in. (15.875 mm) bore.
Fan Guard	Split design with close wire spacing. 1/4 in. (6.3 mm) diameter probe will not enter.
Mounting Holes	Two 9/16 in. (14.3 mm) diameter holes at top of heater.
Heating Elements	Three long-life, low watt-density, high grade metal-sheathed elements.
Temperature High-Limit	Automatic reset type, snap-action bimetal, open on temperature rise. Rated 100,000 cycles at 10 amp, handles 0.128 amps.
Control Circuit	120 Volts, 0.128 amps, 15VA. (Grounded)
Optional Built-in Thermostat	Explosion-proof. 36°F to 82°F (2°C to 28°C).
Optional Built-in Disconnect Switch	For heaters with a total current no greater than 48-Amps. Lockout bar accepts 1/4" to 7/16" diameter padlock shackle. Provision for field installed remote room thermostat.
Control Transformer	Multitap primary, 120 V secondary, 25 VA.
Contactor	40 or 75 amp. Rated for 500,000 mechanical operations. 120 Volts, 15 VA coil (separately fuse-protected).
Heat Transfer Fluid	Long-life formulated ethylene glycol and water, freeze protected to -49°F (-45°C).
Cabinet Material	14 ga. (0.075 in.) (1.90 mm) steel. Epoxy coated with five-stage pretreatment, including iron phosphate. Optional Heresite® coating available for corrosive atmospheres.
Core	Steel with integral aluminum fins, vacuum charged and sealed. Optional Heresite® coating available for corrosive atmospheres.
Conduit Material	Heavy wall, 0.122 in. (3.1 mm), steel.
Overpressure Protection	Preset 100 psig (690 kPa) pressure relief valve, aluminum body, no serviceable parts.
Operational Temperature Limitations	-49°F to 104°F (-45°C to 40°C).
Storage Limitations	-49°F to 176°F (-45°C to 80°C), short term to 248°F (120°C). Do not immerse in water. Do not store or use in areas exposed to rain or snow.

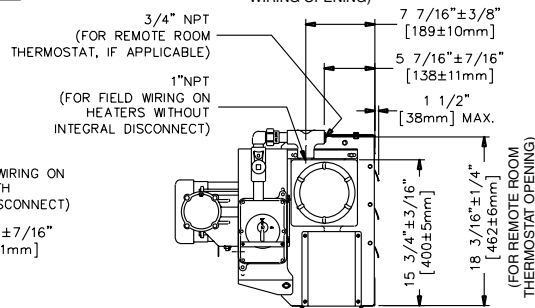
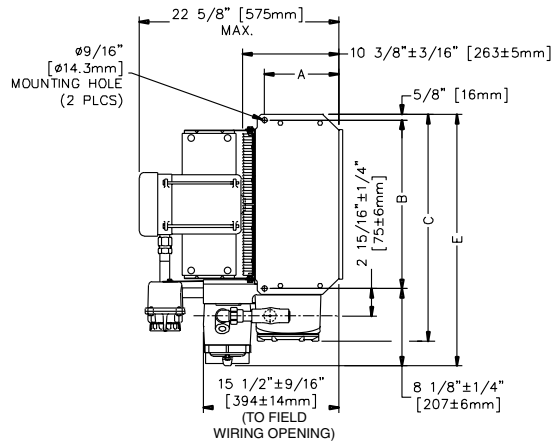
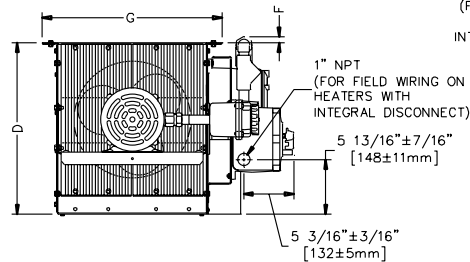
See Page 7 for additional specifications for 60 Hertz & 50 Hertz models.



Physical Dimensions

DIM.	kW	2.5-10	12.5-20	20.9-35	DIM. TOL. ±
		in.	in.	in.	
A	in.	8-1/16	6-11/16	7-1/16	1/8
	mm	204	170	179	3
B	in.	18-3/16	22-3/16	26-3/16	1/8
	mm	462	564	665	3
C	in.	24-5/8	28-5/8	32-5/8	5/16
	mm	625	727	828	8
D	in.	18-1/2	22-1/2	26-1/2	1/8
	mm	470	572	674	3
E	in.	26-15/16	31	34-15/16	3/8
	mm	685	787	888	10
F	in.	9/16	N/A	N/A	3/8
	mm	15	N/A	N/A	10
G	in.	19-7/16	23-7/16	27-7/16	1/8
	mm	494	596	697	3

DIMENSIONAL TOLERANCES ±1/8" [±3mm]
UNLESS OTHERWISE SPECIFIED.

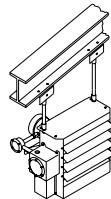


Accessories



Defender® Hazardous Location Thermostats

Temperature range
(2 - 28°C/36 - 82°F)
XT-211 (Feed-Thru, Heating Only)
XT-212 (Feed-Thru, Heating or Cooling)



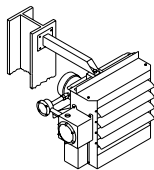
HMK Hanging Mounting Kit

Simple and economical
if adequate overhead
structure exists.
Requires 1/2" pipe, cut and
threaded
(not supplied).



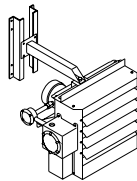
SHMK Swivel Hanging Mounting Kit

Swivels 360°. Requires
1/2" pipe, cut and
threaded
(not supplied).



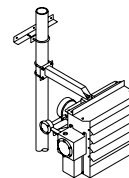
BMK Basic Mounting Kit

The BMK is suitable for
applications where the support
arm can be bolted or welded
directly to structural steel or
concrete.



WMK Wall Mounting Kit

Ideal for use in
buildings that have
substantial walls. The
Z sections provide
additional support
where necessary.



PMK Pipe Mounting Kit

Particularly useful in
buildings with insufficient
strength to use other types
of mounts. Requires 3" pipe
(3 1/2" O.D.) not supplied.

NOTE: Mounting kits are made of steel with a wet applied enamel paint.

If the heater is installed on a structure that is to be transported, provide additional support for the heater during transit. The suspended weight should not exceed 300 lbs (136 kg).

How to Order Mounting Kits:

When ordering mounting kits, specify the type of kit required and the basic model of the heater to be mounted, e.g. WMK - FX416.

Ask our Sales Department for details. Literature available.

Engineering Specifications

1.0 General

- 1.1 The explosion-proof unit heater(s) shall be supplied and installed in accordance with the plans and specifications, with ratings as listed in the schedule of electrical heating equipment, and shall be RUFFNECK FX4 Series Explosion-Proof Electric Air Heaters.

1.2 The unit heater(s) shall be - (select one)

- ☐ 60 Hertz models and be Underwriters Laboratories Inc. listed for use in Class I, Divisions 1 & 2 , Groups C & D; Class II, Division 1, Groups E, F & G; Class II, Division 2, Groups F & G; and Class I, Zones 1 & 2, Groups IIA & IIB Hazardous Locations, and shall be rated for National Electrical Code Temperature Code T3B, 165 C (329 F).
- ☐ 60 Hertz models and be CSA certified for use in Class I, Divisions 1 & 2 , Groups C & D; Class II, Division 1, Groups E, F & G; Class II, Division 2, Groups F & G; Class I, Zones 1 & 2, Groups IIA & IIB Hazardous Locations, and shall be rated for Canadian Electrical Code Temperature Code T3B, 165 C (329 F).
- ☐ 50 Hertz models and be CSA certified for use in Class I, Divisions 1 & 2, Groups C & D; Class II, Division 1, Groups E, F & G; Class II, Division 2, Groups F & G; Class I, Zones 1 & 2, Groups IIA & IIB Hazardous Locations, and shall be rated for Canadian Electrical Code Temperature Code T3B, 165 C (329 F).

- 1.3 The unit heater(s) shall be manufactured under a registered ISO 9002 quality system.

2.0 Heat Exchanger

- 2.1 The heat exchanger shall be fluid-to-air type consisting of steel tubes with roll-formed aluminum fins and be vacuum charged.
- 2.2 The heat exchanger shall be protected by a preset 100 psig(690 kPa) pressure-relief valve, aluminum body, no serviceable parts.
- 2.3 The heat exchanger shall be filled to design level with a custom-blended, long-life solution of ethylene-glycol, water, and corrosion inhibitors.
- 2.4 The heat exchanger shall have three heavy-duty immersion heating elements brazed into a heavy steel bulkhead. The elements shall consist of high-quality resistance wire embedded in a compacted magnesium oxide refractory and sheathed in a metal tubing. The heater is to be protected by a snap-action bimetal temperature high-limit cutout rated 100,000 cycles at 10 amps. The high-limit shall not be effected by altitude or changes in atmospheric pressure. The high-limit shall be an automatic reset type, and will shut off the heater if the exchanger temperature rises due to a lack of heat dissipation.

3.0 Fan and Motor assembly

- 3.1 The fan assembly shall include a ball bearing, permanently lubricated, thermally protected explosion-proof motor rated for continuous duty.
- 3.2 The fan blades shall be aluminum to prevent sparking. The fan shall be directly connected to the motor, balanced, and designed specifically for heater application.
- 3.3 The fan shall be shielded with a heavy-duty epoxy coated guard. To provide easy maintenance and cleaning of the fan and motor, the fan guard shall be of a two-piece construction. The guard shall not allow a 1/4" or larger probe to enter.

4.0 Control Center

- 4.1 The control center shall be completely factory prewired and tested, and enclosed in an explosion-proof control enclosure with a large threaded cover for easy access.
- 4.2 The control center shall include a magnetic contactor sized to handle the heater and motor current. The contactor shall be rated for 500,000 mechanical operations. The coil shall be 120V encapsulated severe duty and separately fuse-protected.
- 4.3 The control center shall include a control circuit transformer, the primary voltage being the same as the heater voltage and the secondary being a 120V grounded circuit.
- 4.4 The control center shall include printed circuit board with a terminal block for room thermostat connection.
- 4.5 The control circuit shall include in-line fuse protection on secondary side of transformer. The fuse holder shall be mounted on the printed circuit board and contain both an operating fuse and a spare fuse.

5.0 Cabinet assembly

- 5.1 The cabinet assembly shall be fabricated from 14 gauge steel with a baked epoxy powder coating over a 5-stage pretreatment including iron phosphate, for protection from corrosive atmospheres.
- 5.2 The cabinet shall include two (2) 9/16 inch (14.3 mm) mounting holes located on the top.
- 5.3 Louvers shall be individually adjustable and made of anodized extruded aluminum.

6.0 Mounting Kits

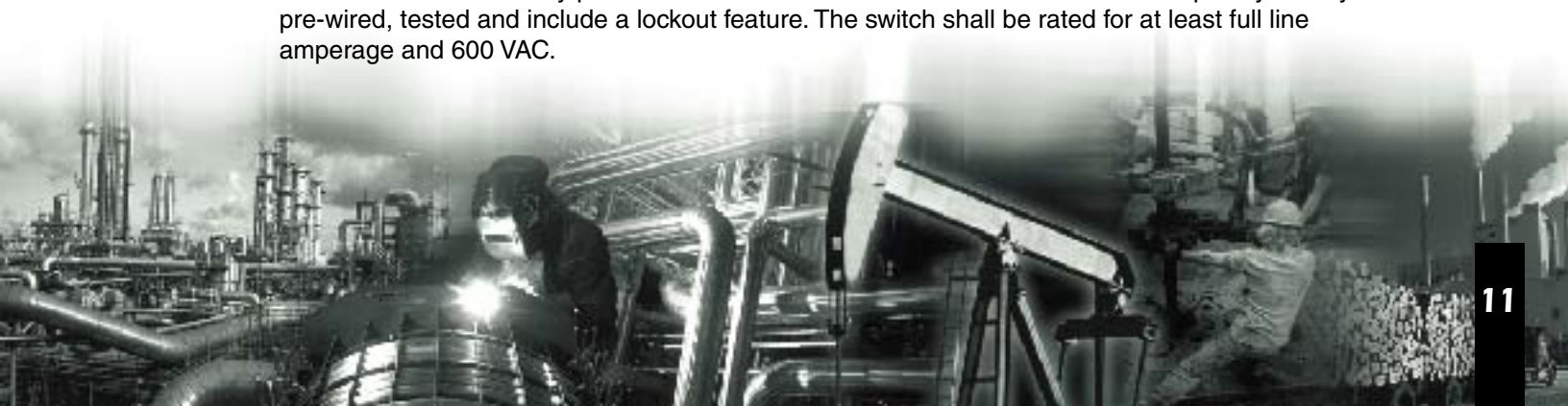
- 6.1 The heater shall be provided with a steel mounting kit, with wet applied enamel paint, specifically designed to bear the weight of the heater assembly.
- 6.2 The mounting kit shall be - (select one):
 - ☐ Type BMK - basic mounting kit
 - ☐ Type WMK - wall mounting kit
 - ☐ Type PMK - pipe mounting kit
 - ☐ Type HMK - hanging mounting kit
 - ☐ Type SHMK - swivel hanging mounting kit

7.0 Thermostat Options

- 7.1 The heater shall be supplied with - (select one):
 - ☐ Built-in, **Defender**®, explosion-proof room thermostat mounted on the control enclosure side of the heater.
 - ☐ Field installed, **Defender**®, explosion-proof room thermostat.

8.0 Disconnect Switch Option

- 8.1 The heater shall be supplied with a factory built-in disconnect switch mounted on the control enclosure side of the heater. The conduit between the heater control enclosure and the switch enclosure shall be factory pre-sealed. The built-in disconnect switch shall be completely factory pre-wired, tested and include a lockout feature. The switch shall be rated for at least full line amperage and 600 VAC.



ALSO AVAILABLE FROM RUFFNECK®

Advanced Horizontal Series

Heat-Exchanger Unit Heaters

37 models to meet your requirements
Bolt-together cabinet for easy maintenance
Split fan guard designed for ease of fan blade removal
Max. operating press. of 450 psi and max. operating temp. of 650 F
Standard or explosion-proof industrial grade motors



CX1 ProVector® Series

Explosion-proof Convection Heaters

High velocity airflow
14-gauge steel cabinet
Optional built-in thermostat
No exposed copper or brass
Incoloy 840 heating elements
Radial-embossed aluminum plate fins



Heat-Exchanger Unit Heaters

For Steam/Water/Glycol

26 models from 5,000 to over 1,500,000 BTU/HR
Frost Resistant series
High Pressure series
Explosion-proof and 50 Hertz models available
Extra heavy-duty steel construction



WARRANTY

RUFFNECK Heaters warrants all RUFFNECK FX4 Series Explosion-Proof Electric Fan Forced Air Heaters against defects in materials and workmanship for a period of three (3) years from date of purchase on the following terms:

1. We will provide replacement parts free of charge as necessary to restore any unit to normal operating condition, provided that the inoperative parts be returned to us freight prepaid and that the replacement parts be accepted freight collect.
2. The complete heater may be returned to our plant for repair or replacement (at our discretion), provided that all related freight costs be borne by the customer.
3. Corrosion and contamination by dirt, dust, etc. will not be considered as defects and, therefore, are not warrantable.
4. The heater must not be modified in any way.
5. The heater must be installed, used and stored only in accordance with the owner's manual and placarded information.

This warranty shall be limited to the actual equipment involved and, under no circumstances, shall include or extend to installation or removal costs, or to consequential losses or damages.



RUFFNECK®
Heaters

2827 Sunridge Blvd. N.E.
Calgary, Alberta, T1Y 6G1
Canada
Phone: (403) 291-5488
Fax: (403) 291-7042
Customer Toll Free:
1-800-661-8561
U.S. & Canada
www.ruffneck.com

Available from:

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Cat No. FX4-0102-13

 GreenField		ANSCHLUSSLISTE LIST OF CONNECTIONS LISTE DES CONNEXIONS		Typ(e): C5T223.-LC Com: 10246 S/No: 700550/51
KUNDE CLIENT		GreenField Compression Inc. USA		
SCHEMA Nr. P + I DIAGRAM No.		0-GFZ.101.435		
ANSCHLUSS CONNECTION CONNEXION	BENENNUNG DESIGNATION DESIGNATION	ABMESSUNG DIMENSION DIMENSION	NORM NORME NORME	
1	FLANSCH TYP FLANGE TYPE BRIDE TYPE LINSENDICHTUNG LENS SEAL JOINT LENTILLE	3" SCHED. 40 D.88.9 x 5.5	c)	
2	FLANSCH TYP FLANGE TYPE BRIDE TYPE LINSENDICHTUNG LENS SEAL JOINT LENTILLE	3" SCHED. 40 D.88.9 x 5.5	c)	
3	FLANSCH TYP FLANGE TYPE BRIDE TYPE LINSENDICHTUNG LENS SEAL JOINT LENTILLE	2 1/2" SCHED. 80 D.78.2 x 5.16	b)	
4	FLANSCH TYP FLANGE TYPE BRIDE TYPE LINSENDICHTUNG LENS SEAL JOINT LENTILLE	2 1/2" SCHED. 80 D.78.2 x 5.16	b)	
5	FLANSCH TYP FLANGE TYPE BRIDE TYPE WELDING NECK SAE, CLASS 3000	1 1/2" SCHED. 80 D.48.3 x 5.08	a)	
6	FLANSCH TYP FLANGE TYPE BRIDE TYPE WELDING NECK SAE, CLASS 3000	1 1/2" SCHED. 80 D.48.3 x 5.08	a)	
7	FLANSCH TYP FLANGE TYPE BRIDE TYPE WELDING NECK SAE, CLASS 3000	1 1/2" SCHED. 80 D.48.3 x 5.08	a)	
8	FLANSCH TYP FLANGE TYPE BRIDE TYPE WELDING NECK SAE, CLASS 3000	1 1/2" SCHED. 160 D.48.3 x 7.14	a)	
9	FLANSCH TYP FLANGE TYPE BRIDE TYPE WELDING NECK SAE, CLASS 3000	1 1/2" SCHED. 160 D.48.3 x 7.14	a)	
10	FLANSCH TYP FLANGE TYPE BRIDE TYPE WELDING NECK SAE, CLASS 6000	1 1/2" SCHED. XXS D.48.3 x 10.16	a)	
11	FLANSCH TYP FLANGE TYPE BRIDE TYPE WELDING NECK SAE, CLASS 3000	1 1/2" SCHED. 80 D.48.3 x 5.08	a)	

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überprüft / reviewed	12.05.04C.Zinck				Seite
genehmigt / approved					page 1-2

 GreenField		ANSCHLUSSLISTE LIST OF CONNECTIONS LISTE DES CONNEXIONS	Typ(e): C5T223.-LC Com: 10246 S/No: 700550/51
ANSCHLUSS CONNECTION CONNEXION	BENENNUNG DESIGNATION DESIGNATION	ABMESSUNG DIMENSION DIMENSION	NORM NORME NORME
12			
13			
14	INNENGEWINDE TYP FEMALE THREAD TYPE FILETAGE INTERIEUR TYPE WHITWORTH	R G 1"	DIN 159 BS 2779 ISO R 228
15	INNENGEWINDE TYP FEMALE THREAD TYPE FILETAGE INTERIEUR TYPE WHITWORTH	R G 1/2"	DIN 159 BS 2779 ISO R 228
16			
17			
18	ROHR (AUSSEN-D. x WANDSTÄRKE) PIPE (OUTER DIAMETER x WALL THICKNESS) TUBE (DIAM.EXT. x EPAISSEUR)	D. 8 x 1.5	C-STAHLL C-STEEL ACIER-C
19	INNENGEWINDE TYP FEMALE THREAD TYPE FILETAGE INTERIEUR TYPE WHITWORTH	R G 1"	DIN 159 BS 2779 ISO R 228
20	INNENGEWINDE TYP FEMALE THREAD TYPE FILETAGE INTERIEUR TYPE WHITWORTH	R G 1/4"	DIN 159 BS 2779 ISO R 228
21	INNENGEWINDE TYP FEMALE THREAD TYPE FILETAGE INTERIEUR TYPE WHITWORTH	R G 1/2"	DIN 159 BS 2779 ISO R 228

- a) acc. to drawing No. 4-122.F63.179
- b) acc. to drawing No. 4-122.240.446
- c) acc. to drawing No. 4-122.240.339

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überprüft / reviewed	12.05.04C.Zinck			Seite
genehmigt / approved				page 2-2

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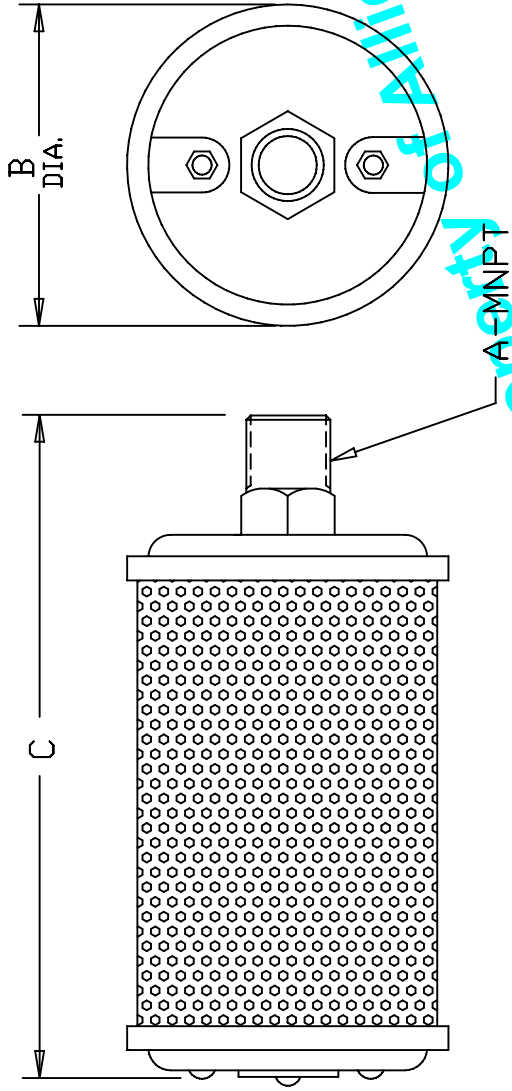
Atomuffler

High Pressure
Muffler
Single Chamber
Male



Model	EDP Number (Order Code)	Pipe Size	Thread	PDF Drawing
P01	0316001	1/8"	NPT	0316XXX.PDF
P02	0316002	1/4"	NPT	0316XXX.PDF
P00	0316000	3/8"	NPT	0316XXX.PDF
P05	0316005	1/2"	NPT	0316XXX.PDF
P07	0316007	3/4"	NPT	0316XXX.PDF
P10	0316010	1"	NPT	0316XXX.PDF
P12	0316012	1-1/4"	NPT	0316XXX.PDF
P15	0316015	1-1/2"	NPT	0316XXX.PDF
P20	0316020	2"	NPT	0316XXX.PDF
P01	0326001	1/8"	BSPT	0326XXX.PDF
P02	0326002	1/4"	BSPT	0326XXX.PDF
P00	0326000	3/8"	BSPT	0326XXX.PDF
P05	0326005	1/2"	BSPT	0326XXX.PDF
P07	0326007	3/4"	BSPT	0326XXX.PDF
P10	0326010	1"	BSPT	0326XXX.PDF
P12	0326012	1-1/4"	BSPT	0326XXX.PDF
P15	0326015	1-1/2"	BSPT	0326XXX.PDF
P20	0326020	2"	BSPT	0326XXX.PDF

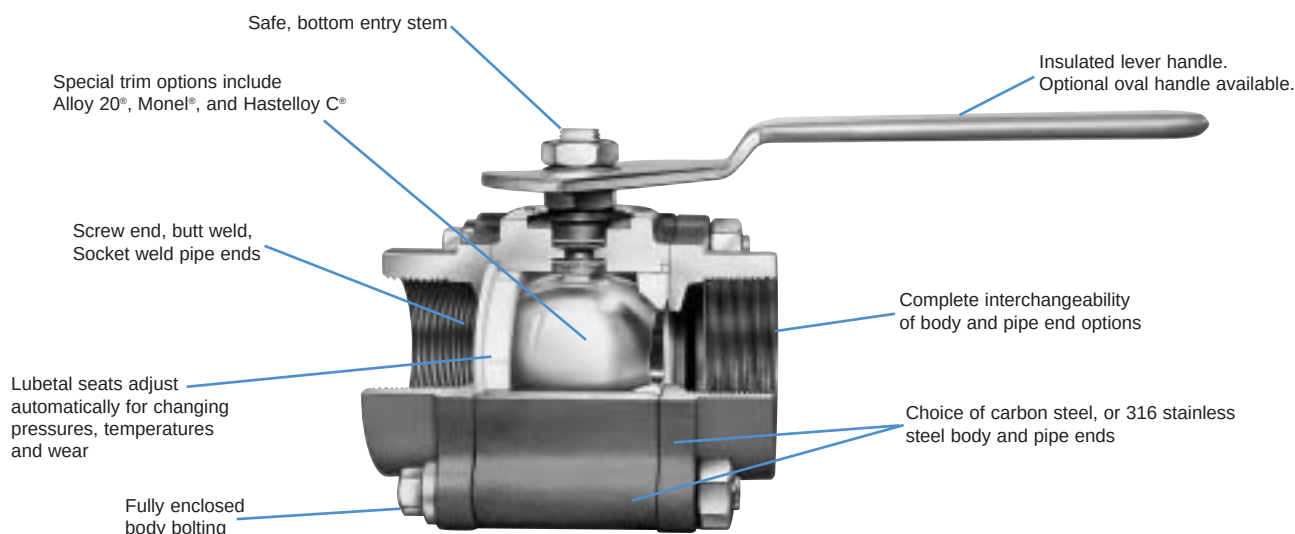
DIMENSIONS			
MODEL	PART NO.	A	B C
P01	0316001	.12	1.84 3.12
P02	0316002	.25	1.84 4.37
P00	0316000	.37	2.59 5.12
P05	0316005	.50	3.15 6.00
P07	0316007	.75	3.40 7.18
P10	0316010	1.00	3.90 8.75
P12	0316012	1.25	3.90 8.75
P15	0316015	1.50	5.25 13.56
P20	0316020	2.00	5.25 18.87



ALLIED WITAN CO. CLEVELAND, OH			
SCALE: -		L I B R A R Y	DRAWN BY: DAN M.
DATE: 3-3-94		C:\ACAD\0316XXX\T REVISED: 8/20/96	
ATOMUFFLER LATERAL-RADIAL FLOW HIGH PRESSURE-MUFFLER-TYPE PH			
ST'D P-- HIGH PRESSURE MUFFLER			DRAWING NUMBER EDP-0316(P)

Series 4 High Pressure Ball Valve

Lubetal™ seated high performance ball valves capable of pressures to 3000 psi, temperatures to 180°F



Worcesterc's Series 4 is a rugged, 3-piece valve designed to handle high pressure applications beyond the capabilities of the Series 44 ball valve line, i.e., above ANSI Class 600. The unique seat design assures bi-directional tight shutoff and adjusts automatically for changing pressure and temperature variations and wear.

Available through a nation wide network of distributors, Series 4 quarter turn ball valves and replacement parts are stocked and ready to be adapted to each application. Features that make this tough, reliable ball valve so unique include tight shutoff, smooth, two-way flow, Lubetal seats, a variety of interchangeable end connections, swing away 3-piece construction, and a design based on automation.

Specifications

Valve Sizes: 1/4", 3/8", 1/2", 3/4", 1", 1-1/4", 1-1/2", 2"

Valve Pressure Ratings:

From 20 micron absolute to:

1/4" - 3/4" —3000 psi

1" —2500 psi

1 1/4" - 2" —2000 psi

Body and Pipe End Materials:

Carbon Steel

Stainless Steel

Ball/Stem Choice of:

Stainless Steel, Monel, Alloy 20, Hastelloy C

Seats: Lubetal (Delrin®) - Max. temp. 180° F. Lubetal will handle the full range of pressure within the valves rating.

Thrust Bearing: Delrin

Stem Seals: Polyfill® and PEEK

Body Seals: Buna, Viton®, EPDM, Neoprene

Valve Temperature Range:

-20°F to + 180°F

Seat/Seal Leakage:

All valves 100% tested to bubbletight standards.

Design Specifications:

ANSI B16.25 - Buttweld ends

ANSI B16.11 - Screw and socket weld end, socket diameter, depth and length only.

ANSI B1.20.1 - NPT pipe threads

MSS SP25 - Valve marking

NACE - MRO 1-75 1984 Rev.

Category 3

For dimensions, refer to brochure no. PB 401

Automation

Where automation is required, Series 4 valves can be electrically or pneumatically automated for on/off applications.

Worcesterc Controls' unique stem seal package for the Series 4 is ideal for high cycle, on/off applications. The control stem assembly greatly increases stem seal cycle life. **For torque curves refer to the Actuator Sizing Manual (ASM).**

*Variation Listings

(V-Numbered Options)

Blank - No Variations

V 3 - Upstream Relief Hole

V 5 - Hydrostatic Testing

V 6 - Source Inspection

V32 - Oval Handle

V36 - Certificate of Compliance

V37 - Certificate of Compliance & Hydro Testing

V38 - Assemble without Lubricant

V46 - Silicon Free Lubricant

V48 - Extended Lever Handle

V59 - Extended Oval Handle

V60 - Osha Lockout

V66 - Certificate of Compliance,

European Valve Orders

Flow Coefficient

C_v Values and Equivalent Length of Pipe

Valve Size	C_v	Equivalent length of Sched. 40 pipe Ft.
1/4", 3/8"	8	0.9
1/2"	8	3.1
3/4"	12	6.3
1"	32	3.1
1-1/4"	46	6.3
1-1/2"	82	4.3
2"	120	7.5

How to Order

Valve Size	Product Series	Body Pipe Ends	Ball Stem	Seat	Body Seals	Ends
1-1/2" 4 6 6 Y V SE *						
1/4" 3/8" 1/2" 3/4" 1" 1-1/4" 1-1/2" 2"	4	4 - Carbon Steel 6 - 316 S.S.	6 - 316 S.S. 7 - Monel C - Hastelloy C A - Alloy 20	L - Lubetal	B - Buna E - EPDM V - Viton N - Neoprene	SE - Screwed Pipe Ends (NPT) Any Sch. Pipe † Carbon Steel Stainless Steel Butt Weld Ends BW4 - Carbon Steel, Sch. 40 BW4 - Stainless Steel, Sch. 40 BW5 - Stainless Steel, Sch. 50 (1/2" - 2" only) BW8 - Stainless Steel, Sch. 80 SW - Socket Weld Ends, Any Sch. Pipe † Carbon Steel Stainless Steel SWO - Socket Weld Ends, O.D. Tube (not available in 1/4" & 3/8" sizes). Stainless Steel

† All IPS schedules of stainless, carbon and alloy steel pipe

Externals, including handles, are normally constructed of zinc plated carbon steel. Handles are vinyl coated. When required, the body bolts, nuts, adjusting nut and handle nut, lock washer, stop pin and handle are also available in stainless steel by special order (S-7 suffix in order code), and come standard when ordering a 466 valve.

To order a Series 4 for use with:

Series 34 or 36 actuators, use prefix ordering code "A". Example: I" A 446 YBSE

Series 39 or 75 actuators, use prefix ordering code "B".

Example: 1 1/2" Series 4 valve with 316 S.S. body, 316 S.S. ball & stem, Lubetal seats, Viton body seals and screwed pipe ends.

Viton® is a registered trademark of E.I. DuPont

Polyfill® is a registered trademark of Worcester Controls Corporation.

Lubetal™ is a trademark of Garlock

Hastelloy® C is a registered trademark of Union Carbide Corporation

Alloy® 20 is a registered trademark of Carpenter Technology

Monel® is a registered trademark of Inco Alloys International.

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Invensys™ is a registered trademark of BTR SIEBE PLC.

CAUTION: Ball Valves can retain pressurized media in the body cavity when closed. Use care when disassembling. Always open valve to relieve pressure prior to disassembly.

Due to continuous development of our product range, we reserve the right to alter the information contained in this brochure as required.



Worcester Controls / McCANNA

33 LOCKE DRIVE
P.O. BOX 538
MARLBOROUGH, MA 01752 -
(508) 481-4800
(508) 481-4454 FAX
<http://www.worcestercc.com>
<http://www.mccannainc.com>

20 MID-DOMINION ACRES
SCARBOROUGH, ONTARIO
M1S 4A5 CANADA
(416) 298-1671
(416) 298-8330 FAX

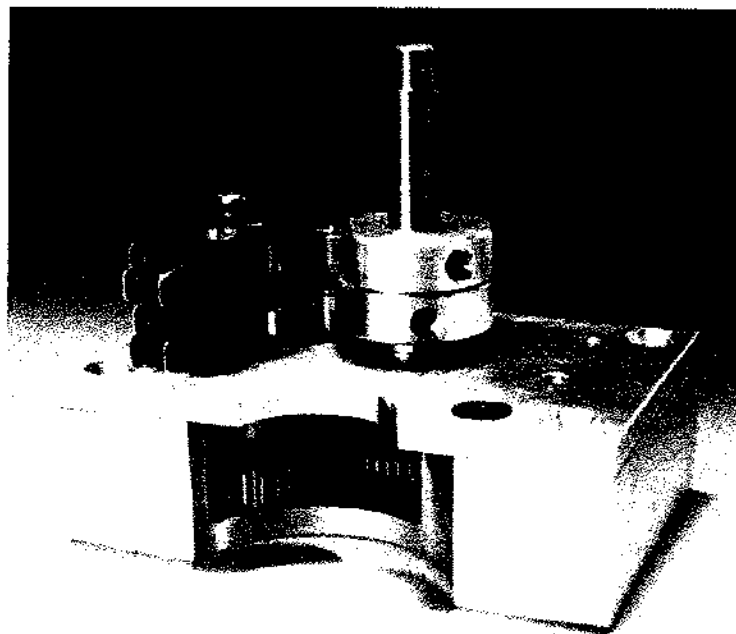
RUA TOCANTINS, 128 - VILA GERTY
SÃO CAETANO DO SUL
SÃO PAULO - CEP: 09580-130
BRAZIL
(55-11) 4239.3500
(55-11) 4238.4757 FAX

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Multi-Turn Operation

Option allows for multiple revolution on non-rising stem devices.

Electrical Mechanical Motor Brake

Available for all actuator models. Brakes are employed to eliminate motor run-on and to insure that the actuator and driven device maintain their position. Recommended applications include; all resilient seated valves, valves with high flow rates, all modulating services and any time in which increased position control is needed.

Three Position Control

Typically used for multiported valves, operation can be set for 0°-45°-90° or 0°-90°-180° with a stop at mid position from one extreme or both.

Potentiometers

Mechanically linked to the actuators output to provide a resistance signal proportional to the actuator's and driven device's position. Used to give continuous feedback to control panels, modulating position control and other closed loop devices.

Torque/Current Trip Module (for DC Motors)

- Protects the valve and actuator from excessive torque conditions by comparing the motor current with a *factory adjustable* trip value.
- Provides *dynamic braking*, in order to improve positioning accuracy at both mid and end of travel stop points. (**Caution:** A mechanical brake should also be used in conjunction with the dynamic brake feature, for applications that require the valve to be held in place after stopping.)

Control Latching Relay

- Allows the actuator to run full travel upon receiving a **non-maintained** control signal, ranging from 0-240VAC or 0-110VDC.

Control Relay

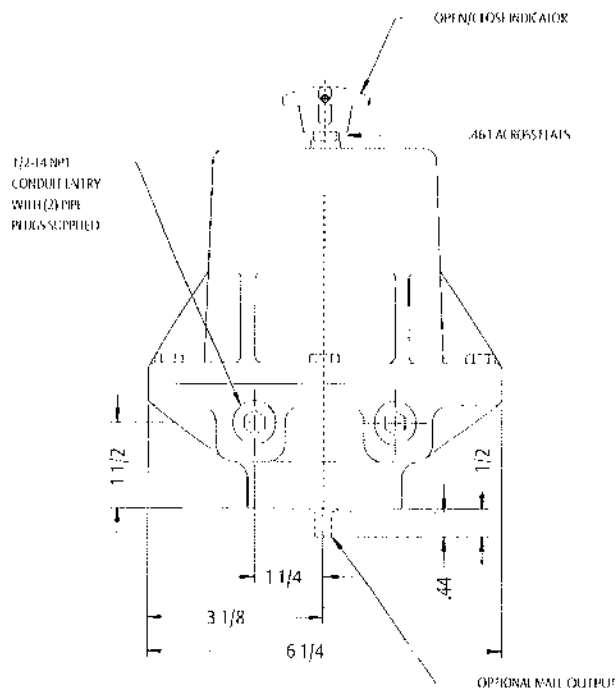
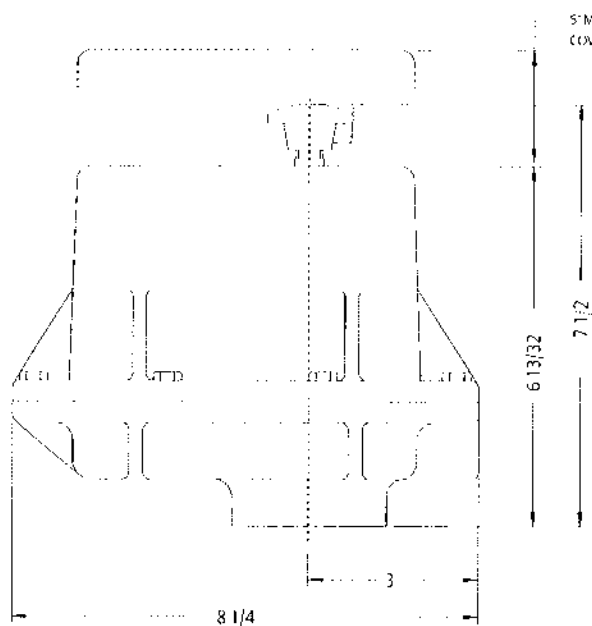
- Provides a means of opening and closing a valve with a variety of standard AC or DC **maintained** control signals, such as 120 VAC, 24 VAC, 12 or 24 VDC.
- Can be used for a *fail close* (or open) application upon *loss of the control signal*. An internal coil (designed to be continuously energized) maintains the open signal to the actuator. When the signal is removed, the coil de-energizes, causing the actuator to close.

Additional Control Options

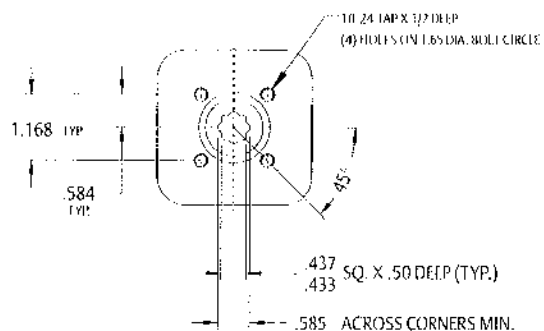
- Up to 6 SPDT aux. limit switches
- Electronic Transmitters (4-20mA output from a DC transmitter or 4-20mA, 0-10V output from an AC transmitter)
- Dual 1k ohm potentiometers
- Two speed operation (pulse timer package)
- Unidirectional controls (up to 30 rotations)
- Control stations including buttons, lights, selector switches
- 3-phase motor controls
- Three position operation (such as 0-45-90 or 0-90-180 degrees)
- Torque seating for multi-turn and quarter turn
- Torque switch trip indication



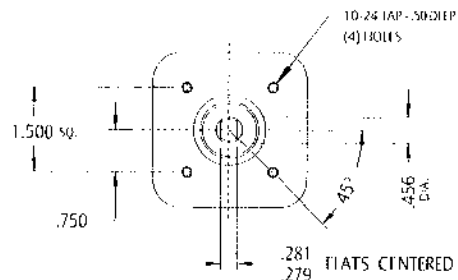
**MODEL EM-300
EM-310
EM-320**



DIN/ISO F04 FLANGE
F04 DIN/ISO FEMALE DRIVE



FLANGE DIMENSIONS
WITH MALE OUTPUT



Bettis Electric

2500 Park Avenue West, Mansfield, OH 44906 U.S.A. T 419-529-4296 F 419-529-4484

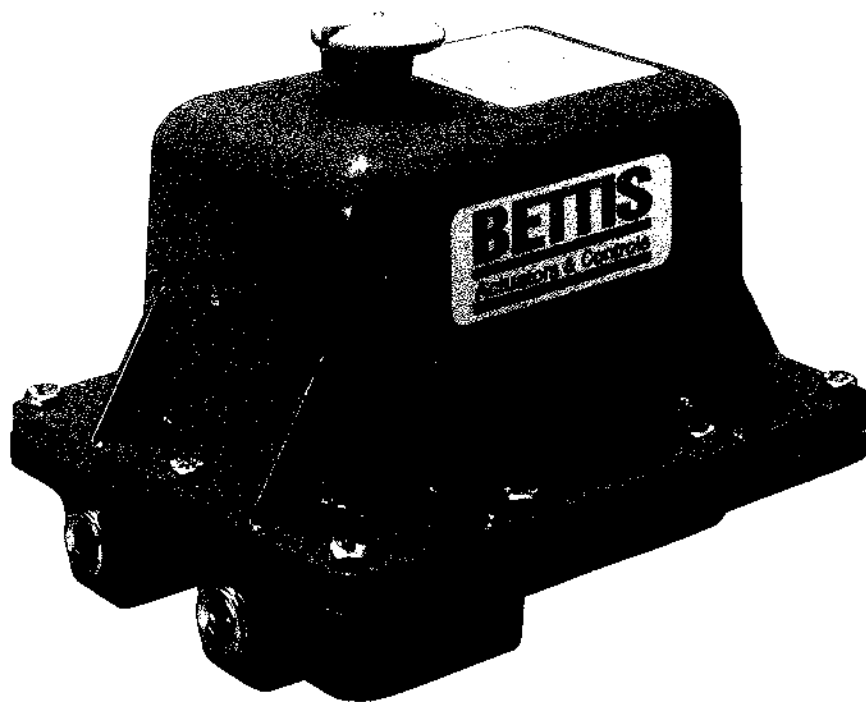
Website: www.EmersonProcess.com/Bettis E-Mail: Info.Bettis.Electric@EmersonProcess.com

Torque 150 IN/LB – 600 IN/LB

The Engineered Solution

Bettis TorqPlus quality line of electric actuators are designed for quarter turn applications – ball, butterfly and plug valves; dampers; vents and similar uses. TorqPlus actuators are manufactured in a wide range of **guaranteed** output torques and operating speeds to fit your specific requirements.

The Model EM-300 actuators combine compactness with manual override capability and an extensive array of available options for a broad spectrum of applications.



STANDARD FEATURES

- Two year warranty
- Heater and thermostat installed in all actuators
- Case hardened steel spur gear train is permanently lubricated
- Hardened steel drive shaft
- Female DIN/ISO F04 output drive and bolt pattern or male output drive

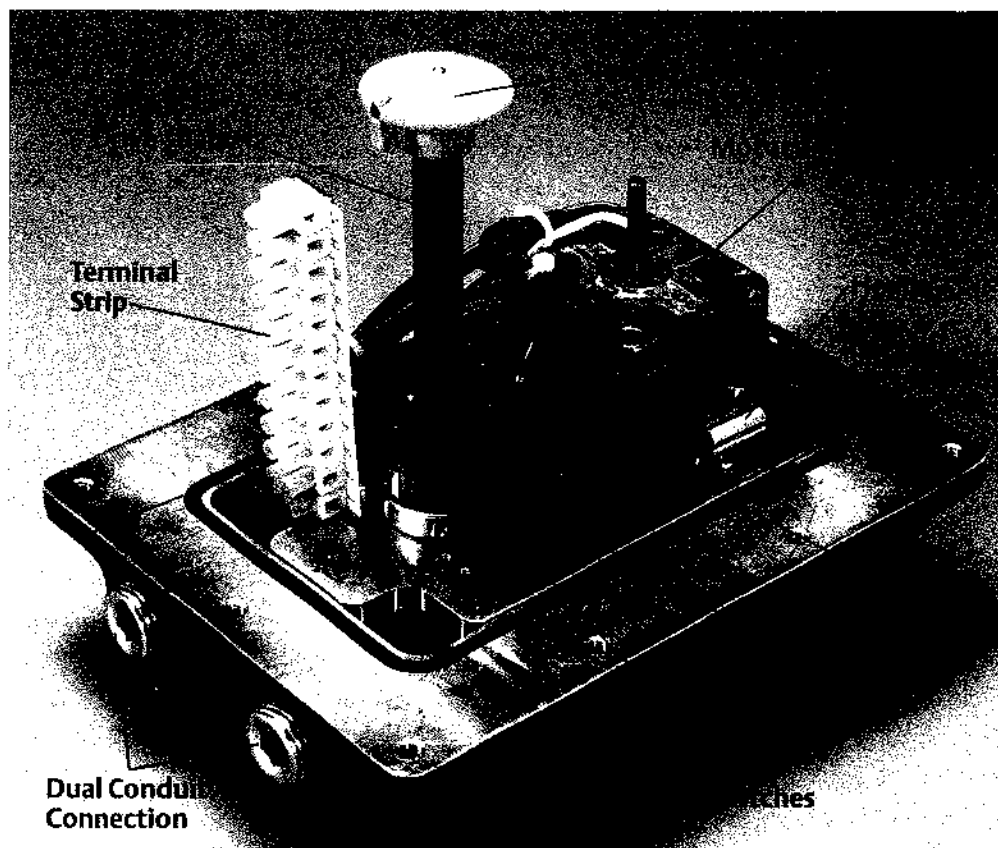
- Operating temperatures:
 - 40° F with standard heater activated to +140° F
- Single phase capacitor run motor with thermal overload protection
- Internal motor brake on 4 and 10 second units
- Enclosure certified to weatherproof C.S.A. specifications that conform to NEMA type 1, 2, 3, 3R, 4, 4X & 12
- Two single pole double throw travel-stop limit switches with adjustable cams
- Dec clutchable manual override with position indicator
- Dual 1/2-inch NPT conduit entrance
- Operational in any mounting orientation.
- Weight: 11 to 12 lbs

OPTIONAL FEATURES

- 75% or 100% extended duty cycle motors
- Electromechanical brake for 15 second and 30 second units
- Standard 1K Ω potentiometer. Other ranges provided upon request.
- Relay control
- Electronic proportional positioner for 4-20 mA, 1-5 VDC, or 0-10 VDC control input and 4-20mA output signal
- Optional voltages
 - 230 VAC 50/60 Hz single phase
 - 12/24 VDC
 - 24 VAC
- Maximum of four additional auxiliary single pole double throw auxiliary limit switches with adjustable cams.
- Handwheel
- Canadian Standards Association general purpose for electrical certification available under file #LR90062
- Dual purpose weatherproof and explosion-proof enclosures are certified by Canadian Standards Association for services: Class I Groups C, D, Division I; Class II Groups E, F, G Division I that conform to NEMA type 7 and 9



Torque 150 IN/LB – 600 IN/LB



MODEL EM-300 SERIES								
TORQUE		SPEED 90°	MODEL	LOCKED ROTOR AMP				MOTOR DUTY CYCLE @ 75°F AC DC
IN/LB	NM			115VAC	230VAC	12VDC	24VDC	
150	17	4 SEC	300-04	0.57 *	0.29	1.2A	2.5A	* *30% 100%
300	34	10 SEC	300-10	0.57 *	0.29	1.2A	2.5A	* *30% 100%
400	45	15 SEC	300-15	0.56 *	0.25	1.2A	2.5A	* *30% 100%
600	68	30 SEC	300-30	0.56 *	0.25	1.2A	2.5A	* *30% 100%

* Locked rotor current for all 75% and 100% duty cycle motors is 0.50 amp

* * 75% and 100% duty cycle motors are available for 115 VAC service

Bettis Electric

2500 Park Avenue West
Mansfield, OH 44906 U.S.A.

T 419-529-4296

F 419-529-4484

Website: www.EmersonProcess.com/Bettis

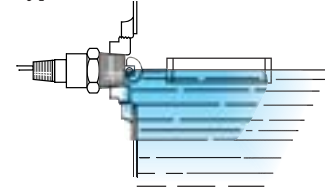
E-Mail: Info.Bettis.Electric@EmersonProcess.com

Large Size – Alloys

Side Mounting Switches Solve the Problem of Inaccessible Tank Tops & Bottoms

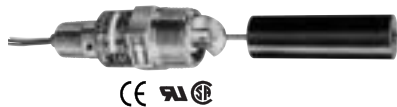
These units solve the problem of point level sensing in tanks with inaccessible tops or bottoms, or at intermediate locations in larger tanks. Operation is positive and dependable. The float pivots with changing liquid level, displacing a shuttle which magnetically actuates a hermetically sealed switch within the unit. Installation is through the tank side at the detection point.

Typical Installation



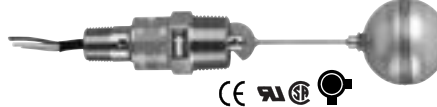
**UL Approved
Explosion-Proof**

LS-2050 Series – Brass and Buna N



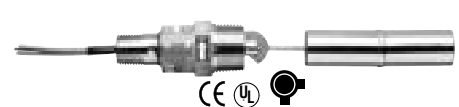
General purpose materials designed to provide reliable service in oils and water.

LS-2050 Series – All-Stainless Steel



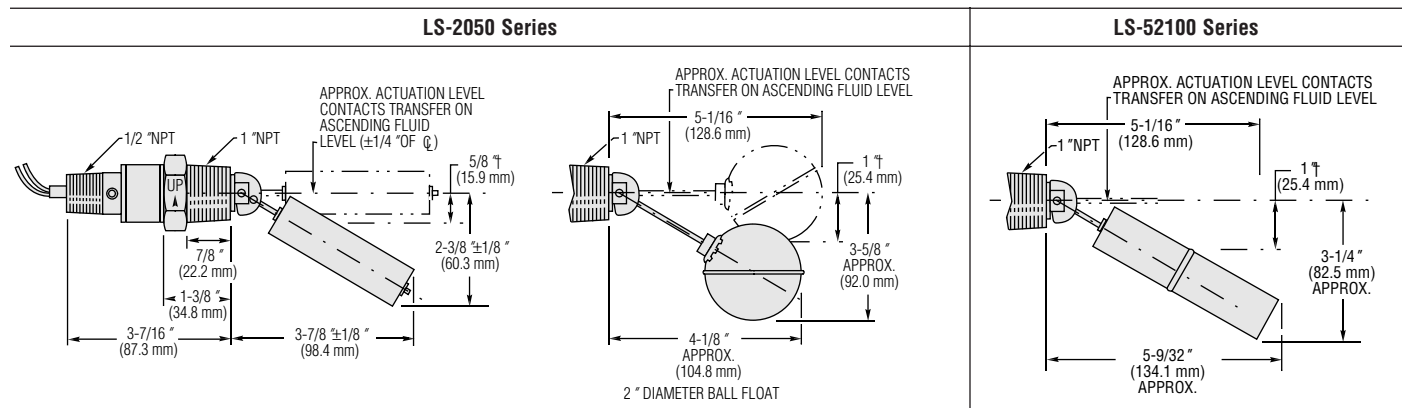
Ultimate strength: for pressures to 900 PSIG and temperatures to 300°F. Explosion-proof models available.

LS-52100 Series – All Stainless Steel



Rugged, all-stainless steel unit offers broad chemical compatibility at temperatures to 300°F. Explosion-proof models available.

Dimensions



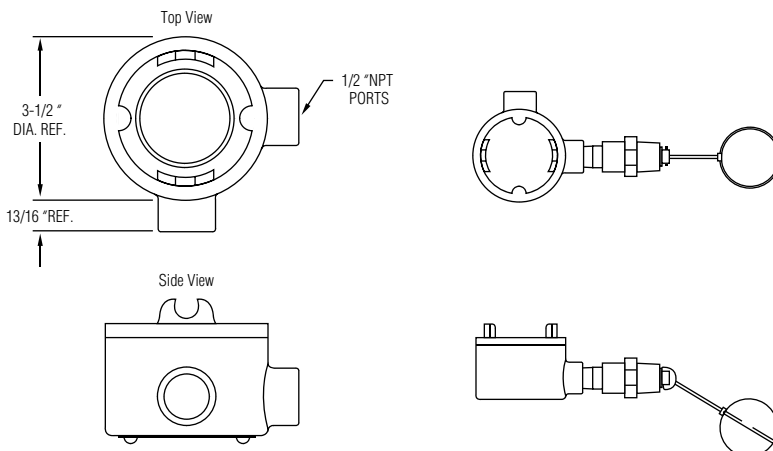
†Approximate de-actuation level, nominal (based on a liquid specific gravity of 1.0).

* Switch Mounting dimensions are the same as shown on the LS-2050 Series drawing (far left).

Explosion-Proof Versions

CSA or FM Approved versions are available in all-stainless steel configurations only.

Typical Example (P/N 55690 Shown):



For Remote Alarms – See Page D-33

- Adjustable Volume
- Indoor Outdoor
- Solid-State



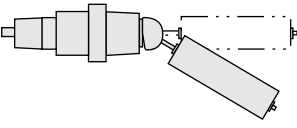
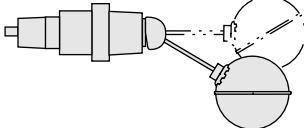
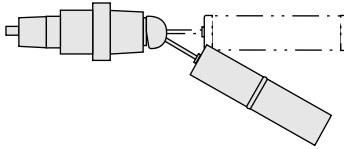
Common Specifications

Electrical Termination: No.18 AWG, 24" L., Polymeric Lead Wires.

Approvals: LS-2050 Series Switches are U.L. Recognized – File No. E45168 and are CSA Listed. Explosion-proof units are approved for Class I, Division 1, Group D hazardous areas.

Mounting Attitude: Horizontal, $\pm 15^\circ$.

Performance

	LS-2050 Series		LS-52100 Series
	Brass Mounting/Buna-N Float	All-Stainless Steel	
			
Operating Temperature	Water: to $+180^\circ\text{F}$ (82.2°C) Oil: -40°F to $+250^\circ\text{F}$ (-40°C to $+121^\circ\text{C}$)		-40°F to $+300^\circ\text{F}$ (-40°C to $+148.9^\circ\text{C}$)
Pressure, PSIG Max. @ 70°F	150	900	500
Min. Liquid Sp. Gr.	.8	.9	.85
Switch Differential in Liquid	1/2" Minimum	Approximately 3/4"	

How To Order – Select Part Number based on specifications required.

Series Number	Materials			Switch ¹	Part Numbers		
	Stem and Mounting	Float	Other Wetted		Standard Versions	With Bellows (Details Below)	Explosion-Proof FM SR
LS-2050	Brass	Buna N	316 Stainless Steel, Beryllium Copper, Teflon®, Ceramic	SPDT, 20 VA	30288 ⚡	—	—
	316 Stainless Steel	316 Stainless Steel	Stainless Steel, Teflon®, Ceramic	SPDT, 20 VA	30290 ⚡	175650	55690
				SPST, 100 VA, N.O. ^{2,4}	48068	—	—
				SPST, 100 VA, N.C. ^{2,4}	48069	—	—
LS-52100	316 Stainless Steel	304 Stainless Steel	430 Stainless Steel, Teflon®, Ceramic	SPDT, 20 VA	52100 ⚡	—	121753
				SPST, 100 VA, N.O. ³	116971 ⚡	—	—
				SPST, 100 VA, N.C. ³	116972	—	—

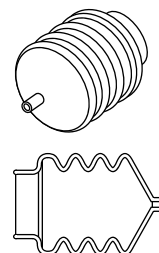
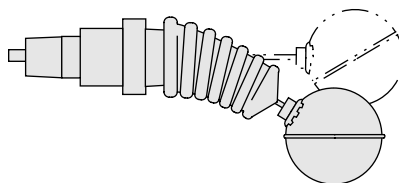
Notes

- See "Electrical Data" on Page X-5 for more information.
- Not CSA Approved.
- Not U.L. Recognized or CSA Approved.
- UL Resistive Rated

⚡ – Stock Items.

Switch with Bellows - P/N 175650

Seals moving parts from debris and particulates that might impede shuttle movement. **Note:** Bellows are installed only on Part Number 175650 – LS-2050 Series, 316 Stainless Steel with SPDT, 20VA switch. Bellows are not sold separately or with any other switch version.



Rated for:
• 250°F , Max.
• Atmospheric pressure.



P/N: 175650 (switch with bellows)
Bellows to be used only with spherical floats.

200 Series 0 to 3,000 psig Check Valves

H200 Series 0 to 6,000 psig Check Valves



Features & Benefits

Quick opening/positive closing

- Provides a wide range of adaptability

Large flow capacity

- The patented sealing principle effects complete leakproof closing under all pressure conditions

Zero leakage

- Compact, easy installation. Efficient inline piston reduces size and weight

Floating o-ring

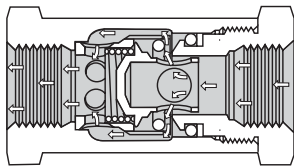
- The streamlined poppet and full ports offer minimum restriction to flow

Technical Data

Body Construction Materials	Aluminum, brass, steel, 303 or 316 stainless steel
O-ring Materials	Buna N, ethylene propylene, fluorosilicone, Kalrez®, neoprene, Teflon®, and Viton®
Operating Pressure	200 Series: to 3,000 psig (207 BAR) H200 Series: to 6,000 psig (414 BAR)
Proof Pressure	1½ times operating pressure
Rated Burst Pressure	200 Series: 2.5 : 1 H200 Series: 4 : 1
Cracking Pressure	0.1 to 25 psig (0.007 to 1.72 BAR)
Temperature Range	–320° F to +550° F (–196° C to +288° F) Based on o-ring & body material, see “How to Order”
Connection Sizes	⅛” to 2”

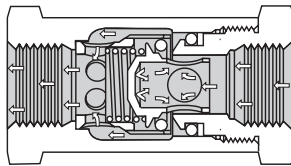
Note: Proper filtration is recommended to prevent damage to sealing surfaces.

How it Works



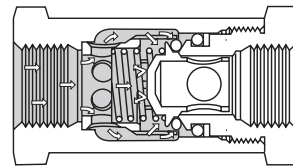
Open

Full flow passages offer minimum restriction to flow. Spring is completely removed from flow path



Closing

Floating o-ring automatically establishes line contact with conical metal surfaces of poppet and seat to cushion closing and insure perfect sealing.



Closed

O-ring only seals. Full pressure load is carried by metal-to-metal seat. Increasing pressure increases sealing efficiency; metal seat prevents any possibility of deformation or extrusion of o-ring.

Circle Seal Controls

2301 Wardlow Circle • Corona, CA 92880
Phone (909) 270-6200 • Fax (909) 270-6201
www.circle-seal.com

check valves

200 Series / H200 Series

Cracking Pressure

Minimum cracking pressure available: 0.1 psi

Standard cracking pressure: see page 7

Maximum cracking pressure available: 25 psi

Note: Cracking pressure is defined at which flow is 5cc/min except for 220 Series for which flow is approximately 0.02 cfm. When ordering a cracking pressure within the standard range or below the standard range of the cracking pressure, the dash number is a "maximum". Example: 259A-4TT-.3 (cracking pressure tolerance will be +0%, -50%). When ordering a cracking pressure equal to or greater than the upper limit of the standard cracking pressure shown above, cracking pressure tolerance will be ±10%. Example: 259A-4TT-5. Cracking pressure over 8 psi should not be specified without consulting the factory. Where 200 Series valves are supplied with higher cracking pressures, a shroud ring may be used to confine the o-ring.

Note: Reseat pressure is the back pressure required to seal a check valve. It varies with different springs and seals. Reseat pressure is not specified unless called out on the sales order.

Leakage

External: Zero

Internal:

Elastomeric seals: Zero

Teflon® seals: 0-50 psi = 5cc/min max.
50+ psi = 0.5cc/min max.

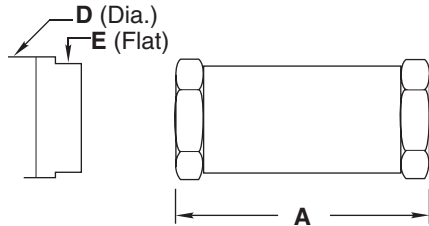
Operating Pressure: 200 Series

Aluminum (A)	Tube	3/16"-1 1/2"	0-3,000 psig to 200° F
	Pipe	1/8"-1 1/2"	0-3,000 psig to 200° F
Brass	Tube	3/16"-1 1/2"	0-3,000 psig to 300° F
	Pipe	1/8"-1 1/2"	0-3,000 psig to 300° F
	Pipe	2"	0-1,500 psig to 300° F
Steel	Tube	3/16"-1 1/2"	0-3,000 psig to 300° F
	Pipe	1/8"-2"	0-3,000 psig to 300° F
Stainless steel	Tube	3/16"-1 1/2"	0-3,000 psig to 450° F
	Pipe	1/8"-2"	0-3,000 psig to 450° F

Operating Pressure: H200 Series

Aluminum (A)	Tube	3/16"-1 1/4"	0-6,000 psig to 200° F
	Pipe	1/8"-1 1/2"	0-6,000 psig to 200° F
Brass	Tube	3/16"-1 1/4"	0-5,000 psig to 300° F
	Pipe	1/8"-1 1/2"	0-5,000 psig to 300° F
Steel	Tube	3/16"-1 1/4"	0-5,000 psig to 300° F
	Pipe	1/8"-2"	0-5,000 psig to 300° F
Stainless steel	Tube	3/16"-2"	0-6,000 psig to 450° F
	Pipe	1/8"-2"	0-6,000 psig to 450° F

End Connections, Dimensions (Inches) & Weights



Optional
(Based on availability)

-RR, -BB: Female Tube

Dash No.	Tube Size	A ±0.050	C Hex & Rd.	Opt. Dimensions		Weights (Lbs)	
				D	E	Alum.	All Steel
-4BB	1/4"	1.98	0.75	—	—	0.06	0.16
-5BB	5/16"	2.07*	0.81	—	—	0.08	0.22
-6BB	3/8"	2.44	0.81	—	—	0.08	0.22
-8BB	1/2"	3.06	1.00	—	—	0.13	0.37
-10BB	5/8"	3.42	1.12	—	—	0.18	0.50
-12BB	3/4"	3.83	1.50	1.75	1.50	0.34	0.88
-16BB	1"	4.37	1.75	2.00	1.75	0.52	1.50
-20BB	1 1/4"	4.99	2.00	2.25	2.00	0.68	2.18
-24BB	1 1/2"	5.75	2.75	2.75	2.25	2.05	5.95

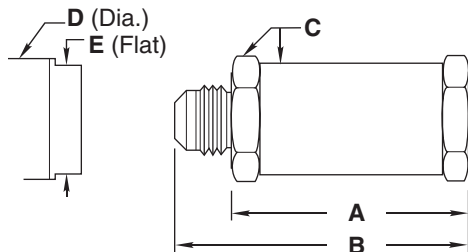
* Exception: 200T-5BB, 'A' dimension is 2.44

-BT: Female Tube to Male Tube

-TB: Male Tube to Female Tube

Dash No.	Tube Size	A ±0.050	B Ref.	C Hex & Rd.	Opt. Dimensions		Weights (Lbs)	
					D	E	Alum.	All Steel
-4BT	1/4"	1.53	2.08	0.75	—	—	0.06	0.15
-6BT	3/8"	1.98	2.54	0.81	—	—	0.08	0.21
-8BT	1/2"	2.37	3.03	1.00	—	—	0.12	0.34
-12BT	3/4"	3.00	3.86	1.50	1.75	1.50	0.32	0.96
-16BT	1"	3.50	4.41	1.75	2.00	1.75	0.50	1.46
-20BT	1 1/4"	3.97	4.93	2.00	2.25	2.00	0.68	1.90
-24BT	1 1/2"	4.73	5.81	2.75	2.75	2.25	1.82	5.31

Dash No.	Tube Size	A ±0.050	B Ref.	C Hex & Rd.	Opt. Dimensions		Weights (Lbs)	
					D	E	Alum.	All Steel
-4TB	1/4"	1.98	2.53	0.75	—	—	0.07	0.20
-5TB	5/16"	1.98	2.53	0.81	—	—	0.07	0.20
-6TB	3/8"	1.98	2.54	0.81	—	—	0.08	0.21
-8TB	1/2"	2.49	3.15	1.00	—	—	0.14	0.37
-10TB	5/8"	2.80	3.56	1.12	—	—	0.18	0.50
-12TB	3/4"	3.33	4.19	1.50	1.75	1.50	0.37	1.07
-16TB	1"	3.74	4.65	1.75	2.00	1.75	0.55	1.60
-20TB	1 1/4"	4.39	5.35	2.00	2.25	2.00	0.80	2.30
-24TB	1 1/2"	5.06	6.14	2.75	2.75	2.25	2.03	5.90

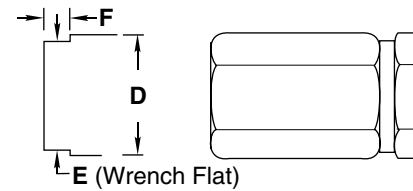


Optional
(Based on availability)

200 Series / H200 Series

H200 Series

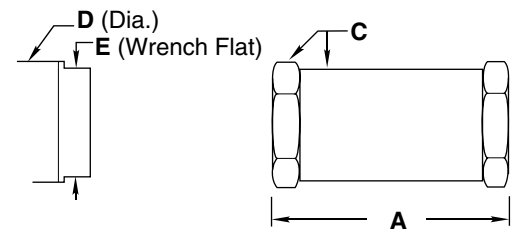
End Connection	Alum.	Brass	St. Steel	Steel		
	(Stock Size Hex)			D Dia.	E	F ± 0.015
-3T / -3C	0.625	0.625	0.625	0.650	0.560	0.220
-4T / -4B	0.875	0.875	0.812	0.875	0.750	0.280
-1P/-5T, -6T, -6B	0.937	0.937	0.875	0.960	0.813	0.280
-2P/-8T, -8B	1.125	1.250	1.125	1.250	1.000	0.300
-3P/-10T, -10B	1.375	1.375	1.250	1.375	1.125	0.350
-4P/-12T, -12B	1.750	1.875	1.750	1.875	1.625	0.450
-6P/-16T, -16B	2.000	2.250	2.000	2.125	1.875	0.500
-8P/-20T, -20B	2.250	2.500	2.250	2.50	2.125	0.620



Optional
(Based on availability)

-PP: Female Pipe

Dash No.	Tube Size	A ±0.050	B Ref.	C Hex & Rd.	Opt. Dimensions		Weights (Lbs)	
					D	E	Alum.	All Steel
-1PP	1/8"	1.70	0.81	—	—	0.05	0.15	0.14
-2PP	1/4"	2.25	1.00	—	—	0.12	0.36	0.34
-3PP	3/8"	2.43	1.12	—	—	0.15	0.46	0.43
-4PP	1/2"	2.93	1.50	1.50	1.25	0.32	0.98	0.92
-6PP	3/4"	3.37	1.75	1.75	1.50	0.49	1.50	1.41
-8PP	1"	3.99	2.00	2.00	1.75	0.73	2.25	2.11
-10PP	1 1/4"	4.50	2.75	2.75	2.25	1.60	5.00	4.80
-12PP	1 1/2"	5.35	2.75	2.75	2.25	1.73	5.34	4.97
-16PP	2"	6.10	—	3.50	2.75	2.60	8.00	7.50

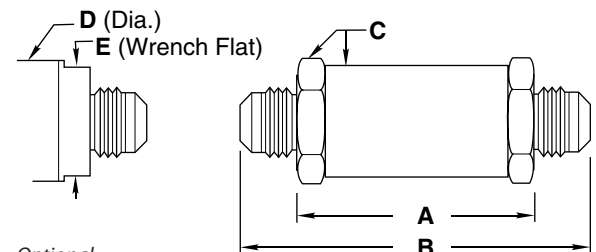


Optional
(Based on availability)

-TT: Female Tube

Dash No.	Tube Size	A ±0.050	B Ref.	C Hex & Rd.	Opt. Dimensions		Weights (Lbs)	
					D	E	Alum.	All Steel
-3TT	3/16"	0.97*	1.93*	0.56*	—	—	0.03	0.08
-4TT	1/4"	1.53	2.63	0.75	—	—	0.07	0.18
-5TT	5/16"	1.53	2.63	0.81	—	—	0.07	0.20
-6TT	3/8"	1.53	2.63	0.81	—	—	0.07	0.20
-8TT	1/2"	1.81	3.12	1.00	—	—	0.13	0.35
-10TT	5/8"	2.06	3.58	1.12	—	—	0.18	0.49
-12TT	3/4"	2.50	4.23	1.50	1.75	1.50	0.35	1.00
-16TT	1"	2.87	4.69	1.75	2.00	1.75	0.53	1.50
-20TT	1 1/4"	3.37	5.29	2.00	2.25	2.00	0.79	2.30
-24TT	1 1/2"	4.04	6.21	2.75	2.75	2.25	1.80	5.22

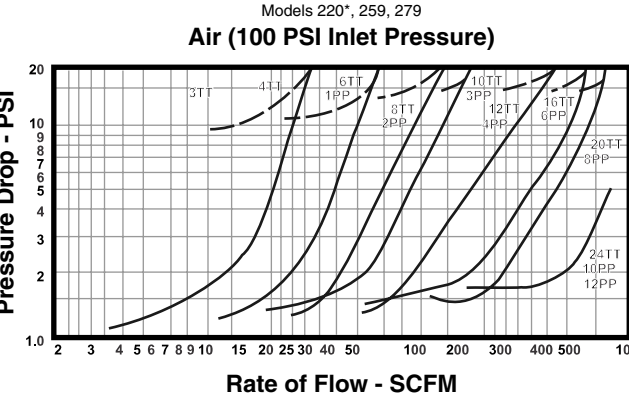
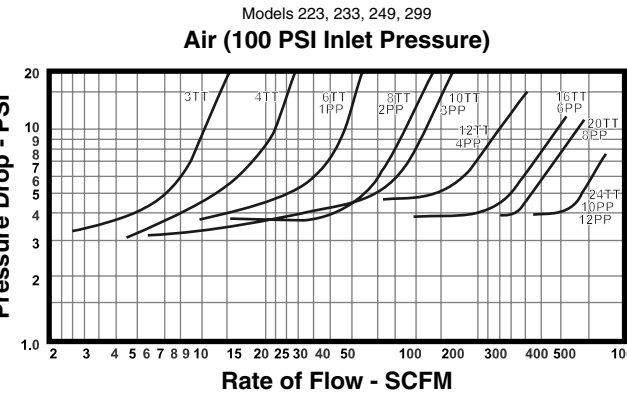
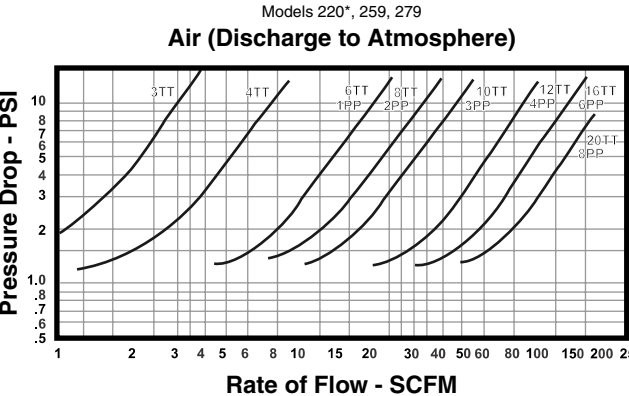
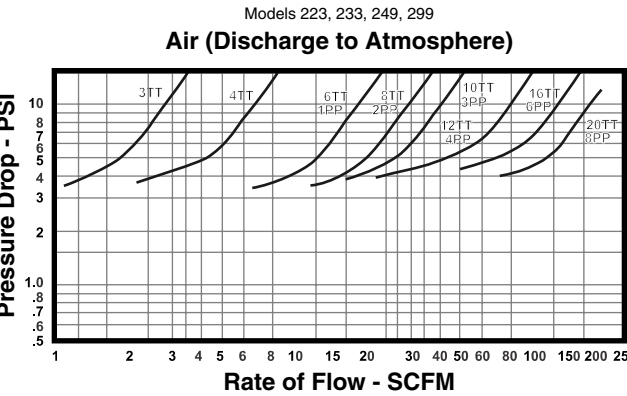
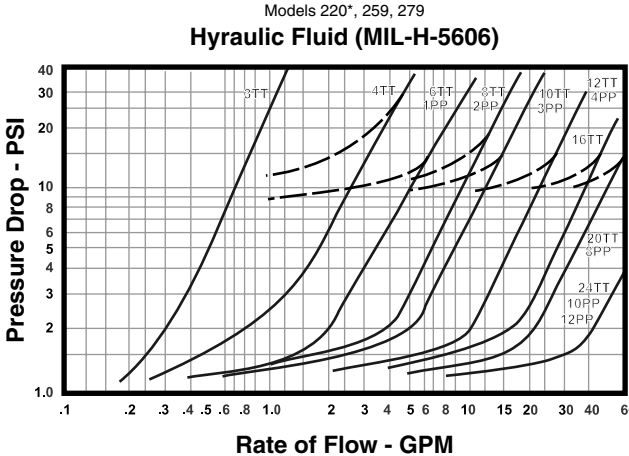
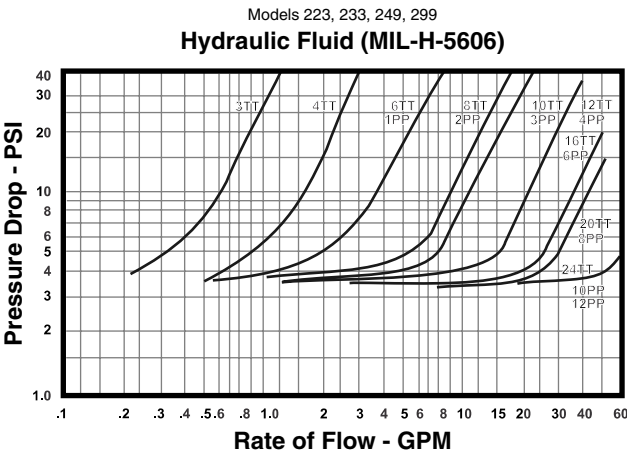
Exception: 200T-3TT: 'A' dimension is 1.00, 'B' dimension is 1.96, 'C' dimension is 0.625



Optional
(Based on availability)

200 Series / H200 Series

Flow Curves

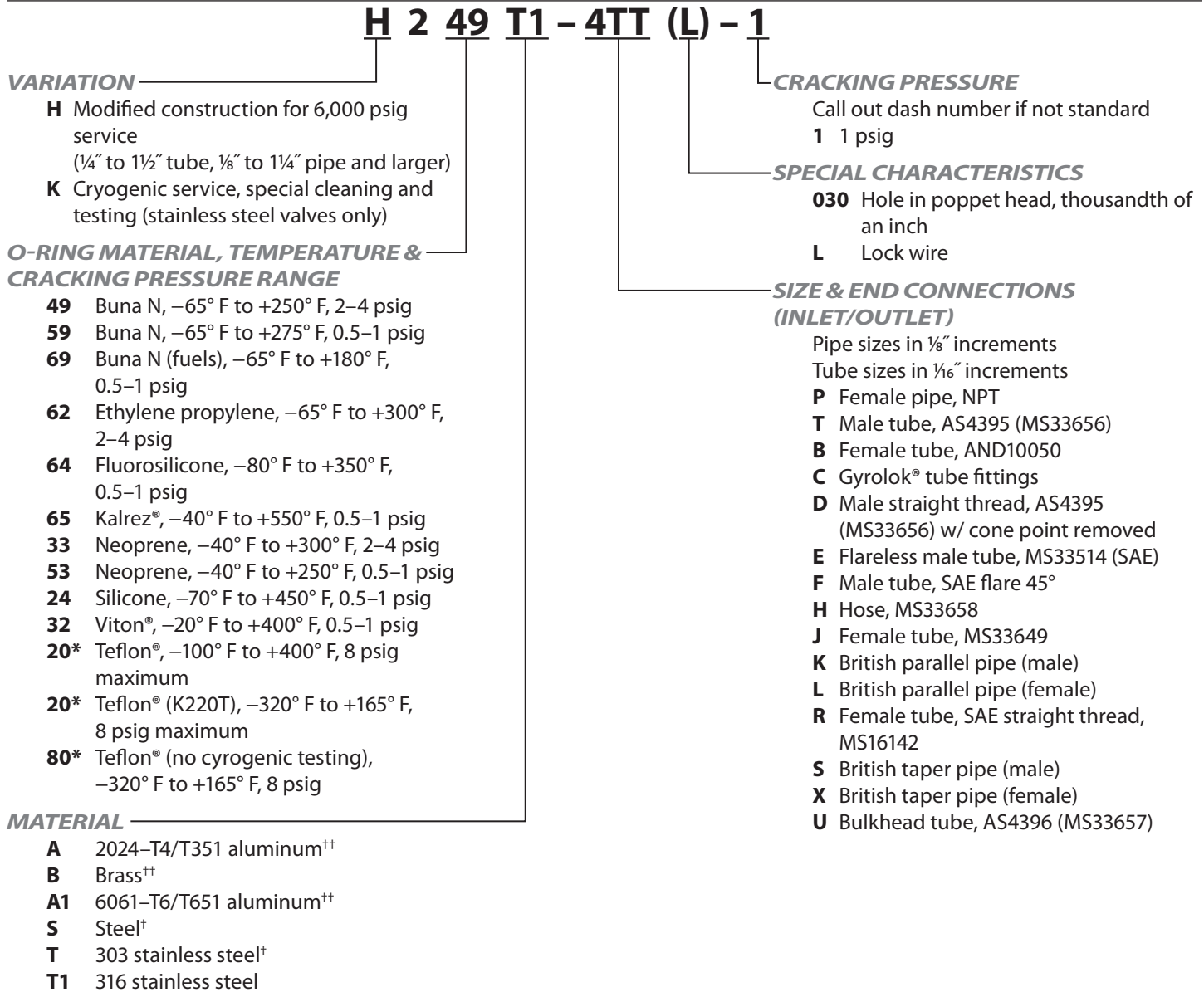


Flow Rates

Valve size	Tube	3	4	6	8	10	12	16	20	24	32
	Pipe	—	—	1	2	3	4	6	8	10-12	16
Cv (nominal)		0.30	0.7	1.6	2.7	3.5	6.6	10.3	12.5	23.2	51

200 Series / H200 Series

How to Order



* For Teflon®, specify stainless steel body material. The stainless steel valve design provides a Teflon® static seal for use in systems with low or high temperatures or with liquids or gases which would cause excessive swell or shrinkage of elastomeric compounds.

† Not available for PED applications.

†† For PED applications, brass bodies are limited to a maximum temperature of +100° F (+38° C), aluminum bodies are limited to a maximum temperature of +200° F (+93° C)

Repair Kits

In normal service, the only part(s) which may require replacement is(are) the seal(s). A repair kit may be ordered by placing a 'K/' in front of the complete part number (i.e. K/H249T1–4TT(L)–1).

For Your Safety

It is solely the responsibility of the system designer and user to select products suitable for their specific application requirements and to ensure proper installation, operation, and maintenance of these products. Material compatibility, product ratings and application details should be considered in the selection. Improper selection or use of products described herein can cause personal injury or property damage.

Gyrolok® is a registered trademark of HOKE Incorporated.
Kalrez® and Viton® are registered trademarks of DuPont Dow Elastomers.
Teflon® is a registered trademark of the DuPont Company.



12. Spare Parts

12.1. COMPRESSOR SPARE PARTS

Having a supply of the most important spare and wear parts on hand is an important prerequisite for continuous functionality and standby condition of the compressor.

Please make use of the spare part list when ordering spare parts. We only guarantee spare parts supplied by GreenField.

We expressly point out that spare parts and accessories not supplied by GreenField have not been inspected and approved for use. Under certain circumstances the installation and/or use of such products can therefore negatively alter the structurally specified characteristics of the compressor, and thus impair the active or passive safety. GreenField is exempt from the assumption of any liability and guarantee for damage, which arises from the use of non-original spare parts and accessories.

Please note that particular manufacturing and delivery specifications often exist for internal and external parts and that we always provide you with state of the art spare parts in accordance with the latest availability.

When ordering spare parts, give the following information, which can be found in SECTION 9:

Station S/N:

Compressor Type:

Compressor S/N:

Designation:

12.2. Description of the Wearing Parts

In order to specifically order and stock spare wearing parts, we have divided the spare part list into 4 sets. Sets 1 & 3 are parts for the compressor block only. Sets 2 & 4 are for auxiliary items supplied on the compressor skid.



Note: GreenField recommends keeping a minimum of one complete set of items in Set 1 and items from Set 2. Depending on the geographic location, operating conditions, etc., some items in Sets 3 and 4 may be required.

12.2.1. (Set 1) *Recommended customer stocked spare parts.

This set contains all wear parts, which could be required at any time. This set consists mainly of valves, valve gaskets, O-rings, piston rings, etc. Many of these parts will be required for every 3,000-hour overhaul. See section 12.5.1 for items not listed.

Description	Ref Tag No	Part Number	Qty Req'd
• Valve, combined suct./disch.; 1 st Stage	CBB 88	700851	2
• Valve, combined suct./disch.; 2 nd Stage	CBB 88	703077	1
• Valve, combined suct./disch.; 3 rd Stage	CBB 88	704368	1



Description	Ref Tag No	Part Number	Qty Req'd
• Valve, combined suct./disch.; 4 th Stage	CBB 88	702174	1
• Valve, combined suct./disch.; 5 th Stage	CBB 88	704369	1
• Valve, gasket, cylinder side; 1 st Stage	CBB 88	700856	2
• Valve, gasket, valve head side, 1 st Stage	CBB 88	700861	2
• Valve, gasket, valve head side; inner 1 st Stage	CBB 88	700866	2
• Valve, gasket, cylinder side; 2 nd Stage	CBB 88	704276	1
• Valve, gasket, valve head side; 2 nd Stage	CBB 88	704277	1
• Valve, gasket, valve head side, inner, 2 nd Stage	CBB 88	704278	1
• Valve, gasket, cylinder side; 3 rd Stage	CBB 88	700858	1
• Valve, gasket, valve head side 3 rd Stage	CBB 88	700863	1
• Valve, gasket, inner side; 3 rd Stage	CBB 88	700868	1
• Valve, gasket, cylinder side; 4 th Stage	CBB 88	700859	1
• Valve, gasket, valve head side; 4 th Stage	CBB 88	700864	1
• Valve, gasket, inner side, 4 th Stage	CBB 88	700869	1
• Valve, gasket, cylinder side, 5 th Stage	CBB 88	700860	1
• Valve, gasket, valve head side; 5 th Stage	CBB 88	700865	1
• Valve, gasket, valve head side; inner 5 th Stage	CBB 88	700870	1
• Preferred oil; 40wt, 5 gal. other oils see section 1	CBB 88	110-3605-5	4
• Oil filter compressor	F-81	103982	1
• O-Ring to Crankcase Cover CT (Heater Side)	CBB 88	700885	1

• **(Set 2) *Recommended customer stocked spare parts.**

This set contains the auxiliary components, which could be required at any time, and some parts required for every 2,000-hour overhaul.

Description	Ref Tag No	Part Number	Qty Req'd
12.2.1.1. Filters			
• Filter Element for Filter P/N 110-1386; Suction	F-89/90	110-1387	2
• Filter Element for Filter P/N 701766, 1 st Stage	SPF 3/4	703877	2
• O-Ring for Filter P/N 701766; 1 st Stage	SPF 3/4	700349	2
• Filter Element for Filter P/N 701201, 1 st Stage	SPF 12	703877	1
• O-Ring for Filter P/N 701201; 1 st Stage	SPF 12	700349	1
• Filter Element for Filter P/N 701201; 2 nd Stage	SPF 18	703877	1
• O-Ring for Filter P/N 701201; 2 nd Stage	SPF 18	700349	1
• Filter Element for Filter P/N 701201, 3 rd Stage	SPF 23	703877	1
• O-Ring for Filter P/N 701201; 3 rd Stage	SPF 23	700349	1
• Filter Element for Filter P/N 703875; 4 th Stage	SPF 28	703878	1
• O-Ring for Filter P/N 703875; 4 th Stage	SPF 28	701155	1
• Filter Element for Filter P/N 700304; Discharge	SPF 36	705304	2
• O-Ring for Filter P/N 700304; Discharge	SPF 36	701154	2
12.2.1.2. Belts			
• V-Belts Main Motor Drive @ 570 rpm		702825	1



Description	Ref Tag No	Part Number	Qty Req'd
V-Belts Main Motor Drive @ 1045 rpm		107656	1
12.2.1.3. O-Rings			
Parker O-Ring Set, Port, SAE Fittings 1/4" – 1 1/2"		700826	1
Parker O-Ring Set, Face ORFS Fittings 1/4" – 1 1/2"		700827	1
Parker Super O-Ring Lube		700096	1
12.2.1.4. Miscellaneous			
Rebuild Kit, Check Valve, 1"	VC 300	702943	1
Light Bulb, 100W, heavy duty	LI 85/96	700511	2
Leak Detection Fluid (1gal.)		700165	1
Rebuild Kit, Check Valve, 1/2"	VC 43-49	700823	7
Rebuild Kit, Blow Down Valve	VB-63	700751	1
Rebuild Kit, Blow Down Valve	VB-58-62	703389	6
Rebuild Kit, Actuator Blow Down	VB-63	700888	1
Rebuild Kit, Actuator Blow Down	VB-58-62	703388	6
Rebuild Kit, Solenoids	SV 50-56	705548	7

12.2.2. (Set 3)

This set contains the main components that could be required as a result of any abnormal occurrence, and some parts required for each major overhaul (i.e., 12,000 & 24,000 hour overhauls). This set consists mainly of shell bearings, piston pins, mechanical seals, etc. This section includes special tools. See section 12.5.2 for items not listed.

Description	Ref Tag No	Part Number	Qty Req'd
12.2.2.1. Special Tools			
Pull-off device for flywheel	CBB-88	704270	1
Cam action pliers for inspection glasses (oil level and condensate collector)	CBB-88	701295	1
2 pull-out eyebolts to dismantle and assemble the ring behind the double axial mechanical seal	CBB-88	701296	1
Special hexagon wrench to undo and tighten the carrier screw of the oil distribution rings	CBB-88	701297	1
Special wrench to counterhold the crankshaft while the threaded bush is fitted or taken off	CBB-88	701298	1
Key to hold up crankshaft when loosening or tightening the screwed seal jacket.	CBB-88	704271	1
2 threaded bolts to dismantle the oil pump and the intermediate ring	CBB-88	701299	1
Special wrench to tighten the axial mechanical seal insert or the insert of pressure-free versions	CBB-88	704272 704273	1 1
Tap wrench for special wrench	CBB-88	701302	1
Hexagon wrench for assembly and dismantling the middle connecting rod	CBB-88	701303	1

**12.2.3. (Set 4)**

This set contains the auxiliary components that could be required as a result of any abnormal occurrence, and some parts required for each major overhaul (i.e., 12,000 & 24,000 hour overhauls). These are typically major replacement items like safety relief valves, gauges, main drive motor, etc.

Description	Ref Tag No	Part Number	Qty Req'd
12.2.3.1. Filters			
• Filter, Suction	F-89/90	110-1386	2
• Filter, 1 st Stage, Hot	SPF 3 / 4	701766	2
• Filter, 1 st Stage, Cold	SPF 12	701201	1
• Filter, 2 nd Stage,	SPF 18	701201	1
• Filter, 3 rd Stage	SPF 23	701201	1
• Filter, 4 th Stage	SPF 28	703875	1
• Filter, 5 th Stage	BVD 30	703875	1
• Filter, Discharge	SPF 36	700304	1
12.2.3.2. Instruments			
• RTD, Process Air	RTD	702816	12
• RTD, Ambient and Enclosure	RTD 14/84	105295	2
• Transmitter, Blow Down	PT-64	705431	1
• Transmitter, Oil Level	DPT-73	705432	1
• Transmitter, Oil Pressure	PT-77	705429	1
• Transmitter, Discharge	PT-31	705430	1
• Switch, Discharge	PSH-32	105286	1
• Restriction Gauge Suction	VG-1 / 2	110-1390	1
• Pressure Gauge 1 st Stage	PI-5 / 6	104996	1
• Pressure Gauge 2 nd Stage	PI 15	106809	1
• Pressure Gauge 3 rd Stage	PI 20	106341	1
• Pressure Gauge 4 th Stage	PI 25	100042	1
• Pressure Gauge Discharge	PI 33	700701	1
• Pressure Gauge Oil	PI 78	100039	1
12.2.3.3. Valves			
• Valve, Safety Relief	PSV 70	700181	1
• Spring		701124	1
• Valve, Safety Relief, 1 st Stage	PSV 13	705423	1
• Valve, Safety Relief, 2 nd Stage	PSV 19	705424	1
• Valve, Safety Relief, 3 rd Stage	PSV 24	705425	1
• Valve, Safety Relief, 4 th Stage	PSV 29	705426	1
• Valve, Safety Relief, 5 th Stage	PSV 37	705427	1
• Valve, Check ½"	VC 43-49	701647	7
• Valve Check 1"	VC 300	702562	1
• Valve, Ball, ¾"	VB 39/41	705641	2
• Valve, Needle, ½"	VN 42	110-1652	1
• Valve, Ball, ¾", Oil Drain	VB-76	105638	1
• Valve Blow Down	VB-63	700535	1



Description	Ref Tag No	Part Number	Qty Req'd
• Valve, Blow Down	VB 57-63	110-3226	6
• Valve Solenoid	SV-56	705540	1
• Valve Solenoid	SV 50-55	705541	6

12.3. Average Life Span of Wear Parts

The assessment of the average life of wearing parts depends to a great extent on the following factors:

- Operating conditions
- Operating methods
- Ambient conditions
- Based on the perfect installation of every compressor, as described in
 - ❑ The terms of delivery, and
 - ❑ In Section 3.

Particular attention must also be paid to the purity of the gas to be compressed. GreenField Customer Service is to be informed of possible impurities without delay.

12.4. Spare Parts and Customer Service Addresses

Our address for sales, spare part distribution and technical customer service:

GreenField Compression, Inc
909 N. Bowser Rd
Richardson, TX 75081
ATTN: IG Customer Service

Telephone: (972) 889-2400 – Ask for IG Customer Service
Fax: (972) 234-4829 – ATTN: IG Customer Service

12.5. GreenField AG Compressor Parts List

Parts listed here may already be in previous lists. These are parts referenced in the following diagrams by the ET-code. The ET-code is only a reference to the diagram and is not enough information to make an order. The part number must be used.

12.5.1. Compressor Bare Block Wearing Parts

Contains all wearing parts, which may be needed at any time. This set consists of valves, piston rings, shaft seals, and o-rings.

QTY	Description	Loc.	Article No.	ET-Code
10	piston ring	1 st	122.000.010.054	316400
5	piston ring	2 nd	122.000.010.055	326400
10	piston ring	3 rd	122.000.004.050	336400
12	piston ring	4 th	122.000.010.183	346400



QTY	Description	Loc.	Article No.	ET-Code
14	piston ring	5 th	122.000.010.056	356400
2	shaft seal		122.000.009.934	012500
1	locking washer to flywheel		122.000.007.529	013510
1	locking washer to fan		122.000.002.605	013270
2	oil filter		122.000.010.953	018490
1	o-ring to lubrication pump		122.000.007.367	018100
2	o-ring to end cover		122.000.007.367	011790
1	o-ring to crankcase cover		122.000.007.380	011730
1	o-ring to non-return valve for oil		122.000.006.721	018900
6	o-ring to guiding cyl./motion work		122.000.010.951	303590
3	o-ring to cylinder/guiding-cylinder		122.000.010.952	303640
2	o-ring to bearing cover		122.000.007.389	011710
1	o-ring to oil orifice		122.000.007.315	018910
2	combined suct/discharge valve	1 st	122.342.977.201	318800
1	combined suct/discharge valve	2 nd	122.342.978.201	328800
1	combined suct/discharge valve	3 rd	122.342.979.201	338800
1	combined suct/discharge valve	4 th	122.344.449.201	348800
1	combined suct/discharge valve	5 th	122.342.981.201	358800
4	valve gasket cylinder side	1 st	122.000.010.068	317750
2	valve gasket head side inner	1 st	122.000.010.069	317760
2	valve gasket head side outer	1 st	122.000.911.030	317760
1	valve gasket cylinder side	2 nd	122.000.010.072	327750
1	valve gasket head side inner	2 nd	122.000.010.073	327760
1	valve gasket head side outer	2 nd	122.000.911.031	327780
1	valve gasket cylinder side	3 rd	122.000.010.074	337750
1	Valve gasket head side inner	3 rd	122.000.010.075	337760
1	Valve gasket head side outer	3 rd	122.000.911.032	337780
1	Valve gasket cylinder side	4 th	122.000.010.076	347750
1	Valve gasket head side inner	4 th	122.000.010.077	347760
1	Valve gasket head side outer	4 th	122.000.911.033	347780
1	Valve gasket cylinder side	5 th	122.000.010.078	357750
1	Valve gasket head side inner	5 th	122.000.010.079	357760
1	Valve gasket head side outer	5 th	122.000.912.019	357780

12.5.2. Compressor Bare Block Major Components

Contains major components that would need replacement only under abnormal conditions. This set contains cylinders, pistons, connecting rods, etc.

QTY	Description	Loc.	Article No.	ET-Code
2	Crankshaft bearing		122.000.010.064	014030
2	Connecting rod	1 st	122.000.010.857	312320
1	Connecting rod	2 nd	122.000.010.857	322320
1	Connecting rod	3 rd	122.000.010.857	332320
1	Connecting rod	4 th	122.000.010.857	342320
1	Connecting rod	5 th	122.000.010.857	352320
6	Crank pin bearing		122.000.010.061	014200
2	Piston without rings	1 st	122.000.010.105	316100



QTY	Description	Loc.	Article No.	ET-Code
1	Piston without rings	2 nd	122.000.010.106	326100
1	Piston without rings	3 rd	122.000.010.107	336100
1	Piston without rings	4 th	122.000.010.112	346100
1	Piston without rings	5 th	122.000.010.113	356100
2	Piston pin	1 st	122.000.010.063	316300
1	Piston pin	2 nd	122.000.010.063	326300
1	Piston pin	3 rd	122.000.010.063	336300
1	Piston pin	4 th	122.000.010.063	346300
1	Piston pin	5 th	122.000.010.063	356300
2	Piston pin bearing	1 st	122.000.911.665	316320
1	Piston pin bearing	2 nd	122.000.911.665	326320
1	Piston pin bearing	3 rd	122.000.911.665	336320
1	Piston pin bearing	4 th	122.000.911.665	346320
1	Piston pin bearing	5 th	122.000.911.665	356320
2	Cylinder	1 st	122.142.101.001	313060
1	Cylinder	2 nd	122.142.103.001	323060
1	Cylinder	3 rd	122.142.112.001	333060
1	Cylinder	4 th	122.143.697.001	343060
1	Cylinder	5 th	122.143.694.001	353060
3	Guiding cylinder		122.000.010.099	303500
3	Oil level glass		122.000.010.388	018640
4	Circlips to piston pin	1 st	122.000.010.067	316330
2	Circlips to piston pin	2 nd	122.000.010.067	326330
2	Circlips to piston pin	3 rd	122.000.010.067	336330
2	Circlips to piston pin	4 th	122.000.010.067	346330
2	Circlips to piston pin	5 th	122.000.010.067	356330
1	Lubrication pump		122.479.182.200	018060
1	Pair of oil distrubution rings		122.239.019.201	018070
1	Bush flywheel side		122.000.010.478	012811
1	o-ring to bush flywheel side		122.000.008.077	012821
1	Bush oil pump side		122.247.139.001	012812
1	o-ring to bush oil pump side		122.000.006.676	012822
1	Suction oil filter		122.000.010.065	18480



12.6 Bill of Materials; SN IG0344

Tag No.	Description	Part Number
VG-1	Restriction Gauge, Inlet	110-1390
VG-2	Restriction Gauge, Inlet	110-1390
SPF-3	Separator, Hot Side, 1 st Stage	701766
-	Filter Element	703877
SPF-4	Separator, Hot Side, 1 st Stage	701766
-	Filter Element	703877
PI-5	Pressure Gauge, 1 st Stage	104996
PI-6	Pressure Gauge, 1 st Stage	104996
C-7	Heat Exchanger	108-171
RTD-8	RTD, Hot Side, TSHH, 1 st Stage	702816
RTD-9	RTD, Hot Side, TSHH, 1 st Stage	702816
RTD-10	RTD, Cold Side, 1 st Stage	702816
RTD-11	RTD, Cold Side, 1 st Stage	702816
SPF-12	Separator, Cold Side, 1 st Stage	701201
-	Filter Element	703877
PSV-13	Safety Relief Valve, 1 st Stage	705423
RTD-14	Ambient Temperature Sensor	105295
PI-15	Pressure Gauge, 2 nd Stage	106809
RTD-16	RTD, Hot Side, TSHH, 2 nd Stage	702816
RTD-17	RTD, Cold Side, 2 nd Stage	702816
SPF-18	Separator, 2 nd Stage	701201
-	Filter Element	703877
PSV-19	Safety Relief Valve, 2 nd Stage	705424
PI-20	Pressure Gauge, 3 rd Stage	106341
RTD-21	RTD, Hot Side, TSHH, 3 rd Stage	702816
RTD-22	RTD, Cold Side, 3 rd Stage	702816
SPF-23	Separator, 3 rd Stage	701201
-	Filter Element	703877
PSV-24	Safety Relief Valve, 3 rd Stage	705425
PI-25	Pressure Gauge, 4 th Stage	100042
RTD-26	RTD, Hot Side, TSHH, 4 th Stage	702816
RTD-27	RTD, Cold Side, 4 th Stage	702816
SPF-28	Separator, 4 th Stage	703875
-	Filter Element	703878
PSV-29	Safety Relief Valve, 4 th Stage	705426
BVD-30	Buffer Volume, Discharge	703875
PT-31	Pressure Transmitter, Discharge Pressure	705430



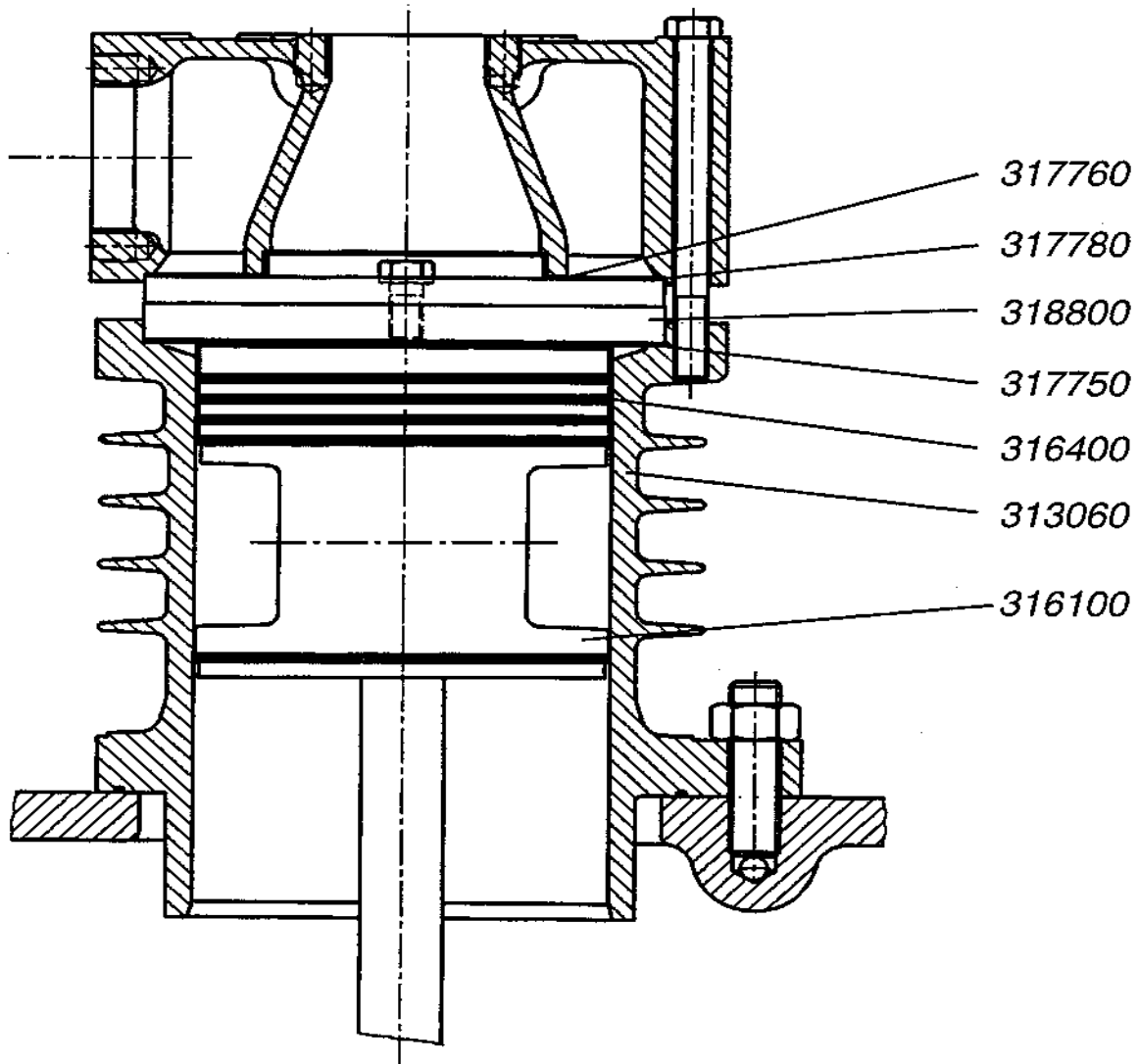
GreenField Compression Incorporated

12.6 (continued)

Tag No.	Description	Part Number
PSH-32	Switch, High Gas Pressure	105286
PI-33	Pressure Gauge, Discharge	700701
RTD-34	RTD, Hot Side, TSHH, Discharge	702816
RTD-35	RTD, Cold Side, Discharge	702816
SPF-36	Separator, Discharge	700304
-	Filter Element	705304
PSV-37	Safety Relief Valve, Discharge	705427
VC-38	Check Valve, Discharge	702562
BV-39	Ball Valve, Discharge	705641
SI-40	Silencer, Manual Vent	705764
VB-41	Ball Valve, Discharge Vent	705641
VN-42	Needle Valve, Discharge Vent	110-1652
VC-43	Check Valve, 1 st Stage Blow-down	701647
VC-44	Check Valve, 1 st Stage Blow-down	701647
VC-45	Check Valve, 1 st Stage Blow-down	701647
VC-46	Check Valve, 2 nd Stage Blow-down	701647
VC-47	Check Valve, 3 rd Stage Blow-down	701647
VC-48	Check Valve, 4 th Stage Blow-down	701647
VC-49	Check Valve, 5 th Stage Blow-down	701647
SV-50	Solenoid Valve, 1 st Stage Blow-Down	705541
SV-51	Solenoid Valve, 1 st Stage Blow-Down	705541
SV-52	Solenoid Valve, 1 st Stage Blow-Down	705541
SV-53	Solenoid Valve, 2 nd Stage Blow-Down	705541
SV-54	Solenoid Valve, 3 rd Stage Blow-Down	705541
SV-55	Solenoid Valve, 4 th Stage Blow-Down	705541
SV-56	Solenoid Valve, 5 th Stage Blow-Down	705540
VB-57	Pneumatic Ball Valve, 1 st Stage Blow-Down	110-3226
VB-58	Pneumatic Ball Valve, 1 st Stage Blow-Down	110-3226
VB-59	Pneumatic Ball Valve, 1 st Stage Blow-Down	110-3226
VB-60	Pneumatic Ball Valve, 2 nd Stage Blow-Down	110-3226
VB-61	Pneumatic Ball Valve, 3 rd Stage Blow-Down	110-3226
VB-62	Pneumatic Ball Valve, 4 th Stage Blow-Down	110-3226
VB-63	Pneumatic Ball Valve, 5 th Stage Blow-Down	700535
PT-64	Pressure Transmitter, Blow-Down	705431
VB-65	Pneumatic Ball Valve, Blow Down Tank Drain	110-3226
SV-67	Solenoid Valve, Blow Down Tank Drain	705541
LS-68	Level Switch, Blow Down Tank	705838
VC-69	Check Valve, Blow Down Tank	110-4200



Tag No.	Description	Part Number
SPT-66	Blow-Down Tank	105255
PSV-70	Safety Relief Valve, Instrument Air	700181
-	Spring Safety Relief Valve	701124
SPF-71	Separator, Crank Case Blow By	106337
MM-72	Electric Motor, Primary Mover	705360
DPT-73	Differential Pressure Transmitter, Oil Level	705432
LG-74	Sight Glass, Oil Level	702042
LG-75	Sight Glass, Oil Level	702042
VB-76	Ball Valve, Crankcase Oil Drain	105638
PT-77	Pressure Transmitter, Low Oil Pressure	705429
PI-78	Pressure Gauge, Oil Pressure	100039
PSV-79	Safety Relief Valve, Blow Down Tank	705428
F-81	Filter, Crank Case Oil	103982
RTD-82	RTD, Crank Case Oil	105335
HEA-83	Heater, Crank Case Oil	
RTD-84	RTD, Ambient Enclosure Temperature	105295
LI-85	Light, Enclosure	101407
VT-86	Vibration Transmitter	704330
SPH-87	Space Heater, Enclosure	705433
CBB-88	Compressor Bare Block, C5T223.13 LC	705305
F-89	Intake Silencer / Filter	110-1386
-	Replacement Element	110-1387
F-90	Intake Silencer / Filter	110-1386
-	Replacement Element	110-1387
M-90	Motor, Intake Actuated Damper	705760
ACT-91	Actuator, Intake Actuated Damper	705760
M-92	Motor, Exhaust Actuated Damper	705760
ACT-93	Actuator, Exhaust Actuated Damper	705760
M-94	Motor, Recirculation Actuated Damper	705760
ACT-95	Actuator, Recirculation Damper	705760
LI-96	Light, Enclosure	101407



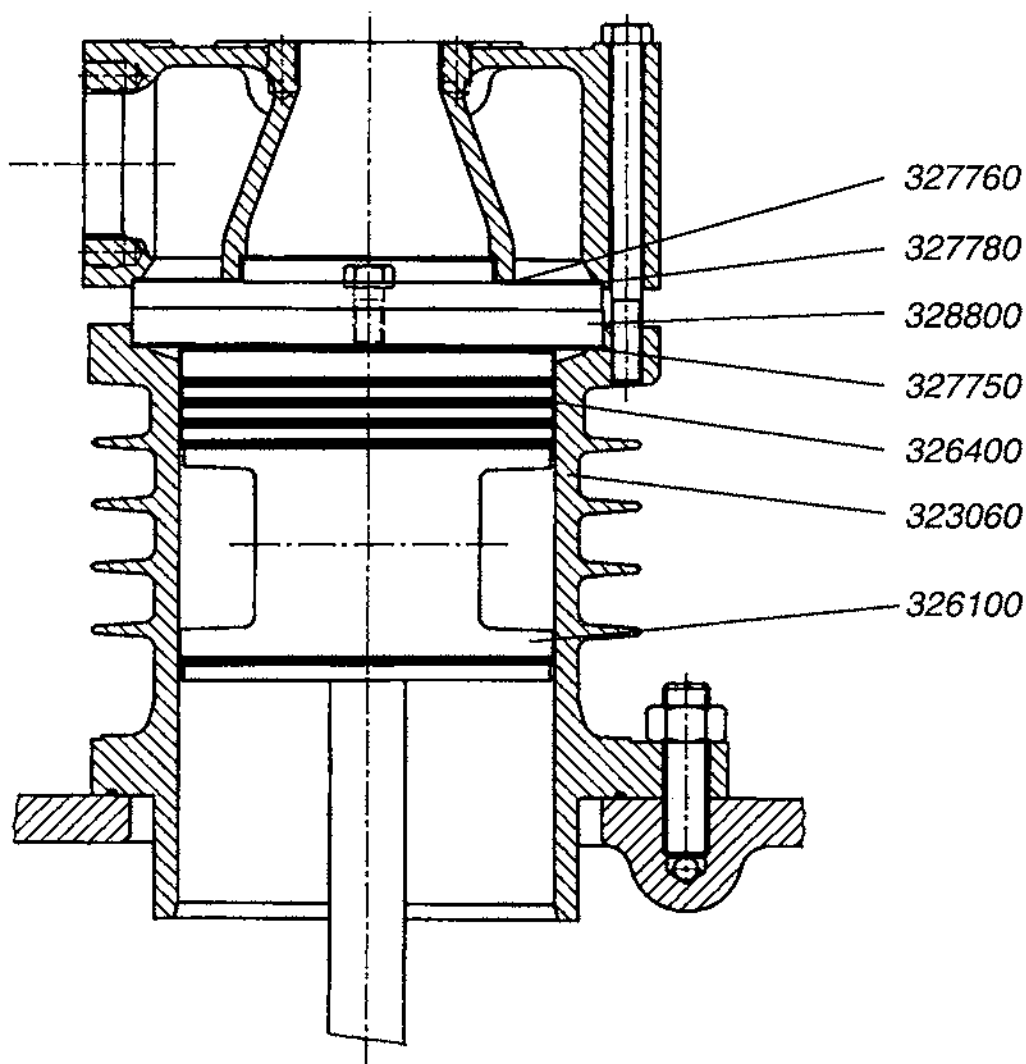
STUECKZAHL UND ABMESSUNGEN, SIEHE ERSATZTEILLISTEN

QUANTITY AND DIMENSIONS, SEE SPARE PARTS LISTS

NOMBRE ET DIMENSIONS DES PIECES VOIR LES LISTES DES PIECES DE RECHANGE

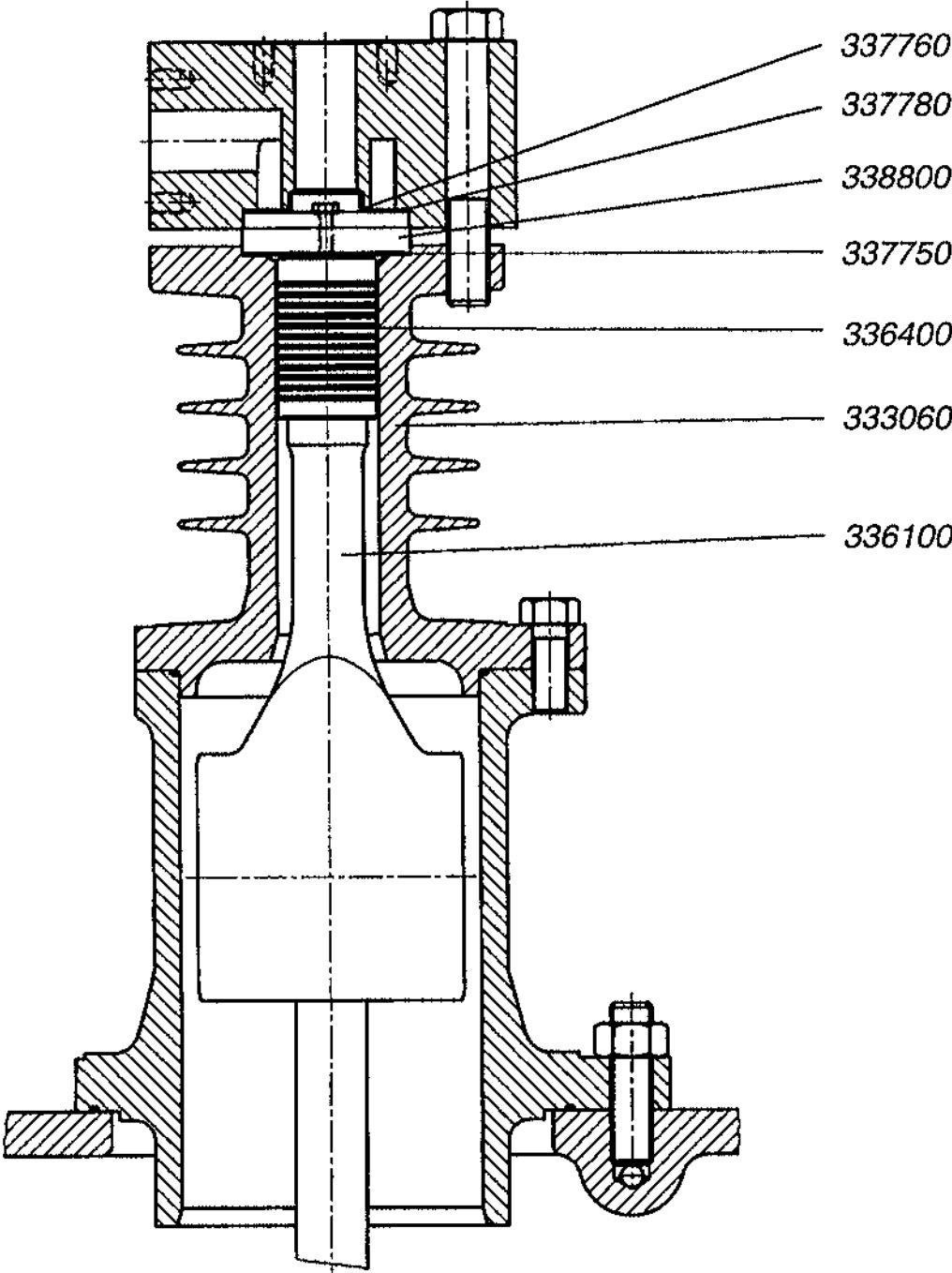
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Reg. Nr.				
 GreenField	ZYLINDER	2	STUFE	CT/C
	CYLINDER		STAGE	
	CYLINDRE		ETAGE	

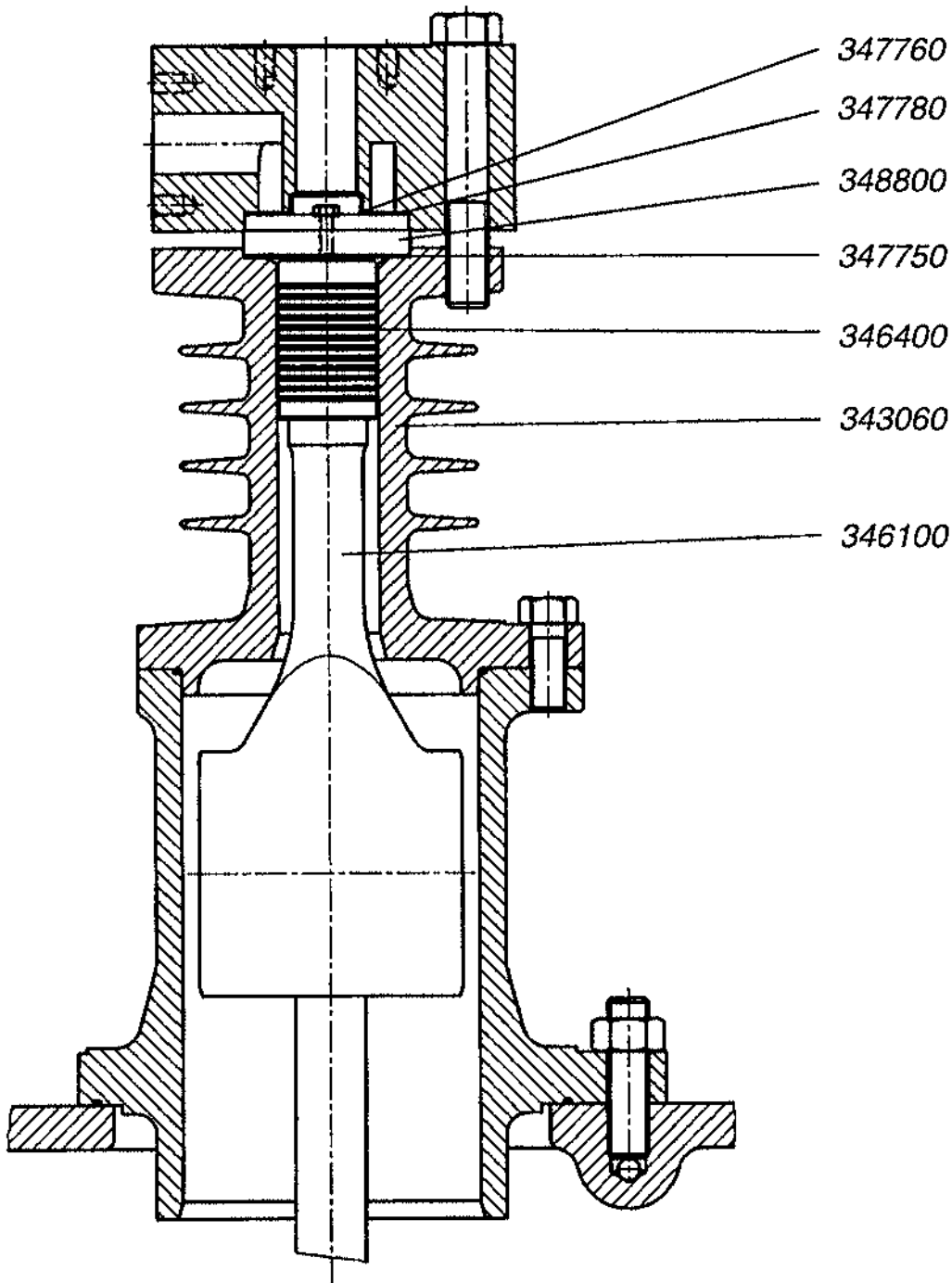


STUECKZAHL UND ABMESSUNGEN, SIEHE ERSATZTEILLISTEN
 QUANTITY AND DIMENSIONS, SEE SPARE PARTS LISTS
 NOMBRE ET DIMENSIONS DES PIECES VOIR LES LISTES DES PIECES DE RECHANGE

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		Reg. Nr.					
 GreenField	ZYLINDER CYLINDER CYLINDRE		3	STUFE STAGE ETAGE		CT/C	
							
STUECKZAHL UND ABMESSUNGEN, SIEHE ERSATZTEILLISTEN QUANTITY AND DIMENSIONS, SEE SPARE PARTS LISTS NOMBRE ET DIMENSIONS DES PIECES VOIR LES LISTES DES PIECES DE RECHANGE							
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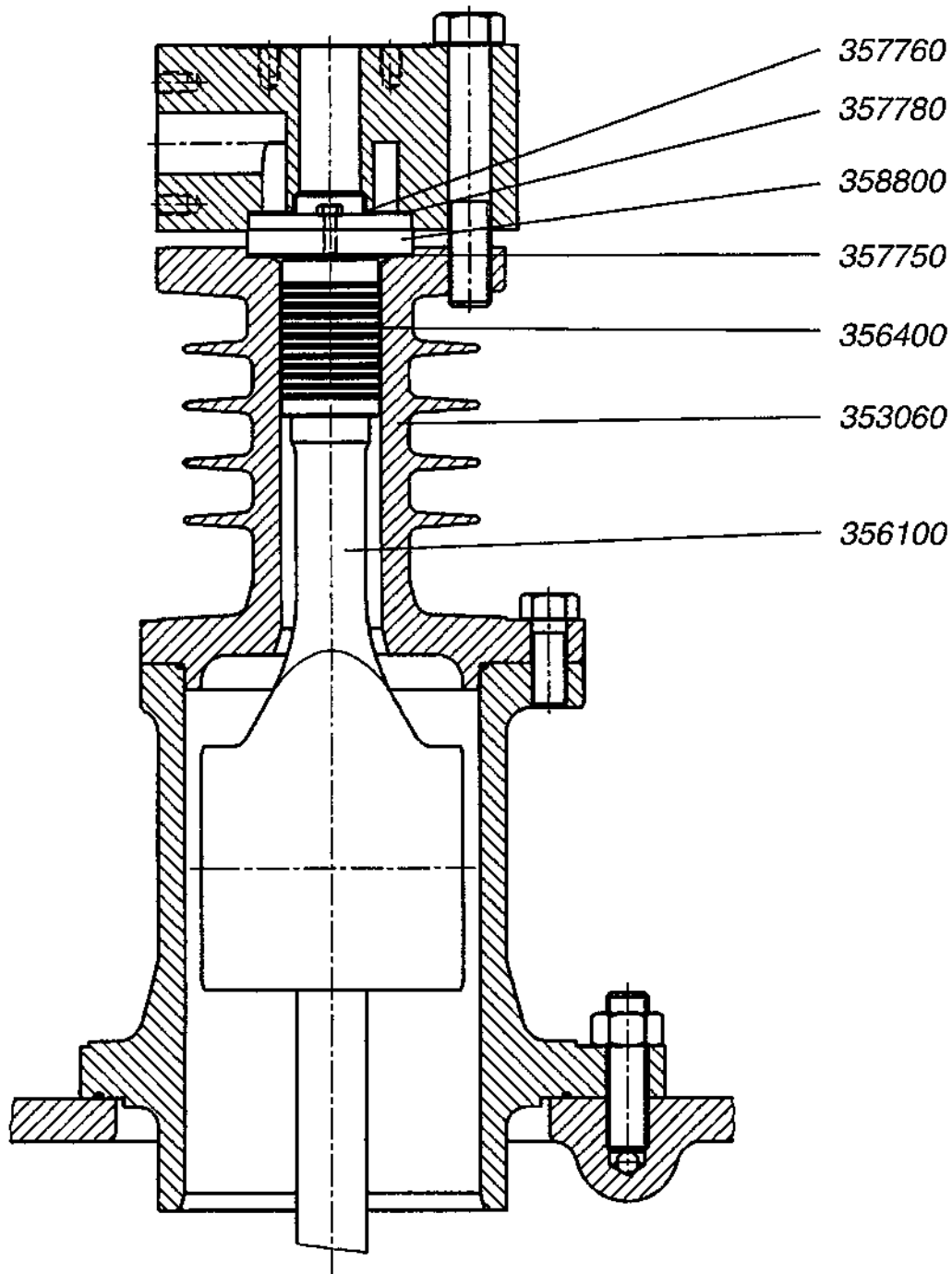
Reg. Nr.				
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STUECKZAHL UND ABMESSUNGEN, SIEHE ERSATZTEILLISTEN
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 NOMBRE ET DIMENSIONS DES PIECES VOIR LES LISTES DES PIECES DE RECHANGE

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Reg. Nr.				
 GreenField	ZYLINDER CYLINDER CYLINDRE	5	STUFE STAGE ETAGE	CT/C



STUECKZAHL UND ABMESSUNGEN, SIEHE ERSATZTEILLISTEN
 QUANTITY AND DIMENSIONS, SEE SPARE PARTS LISTS
 NOMBRE ET DIMENSIONS DES PIECES VOIR LES LISTES DES PIECES DE RECHANGE

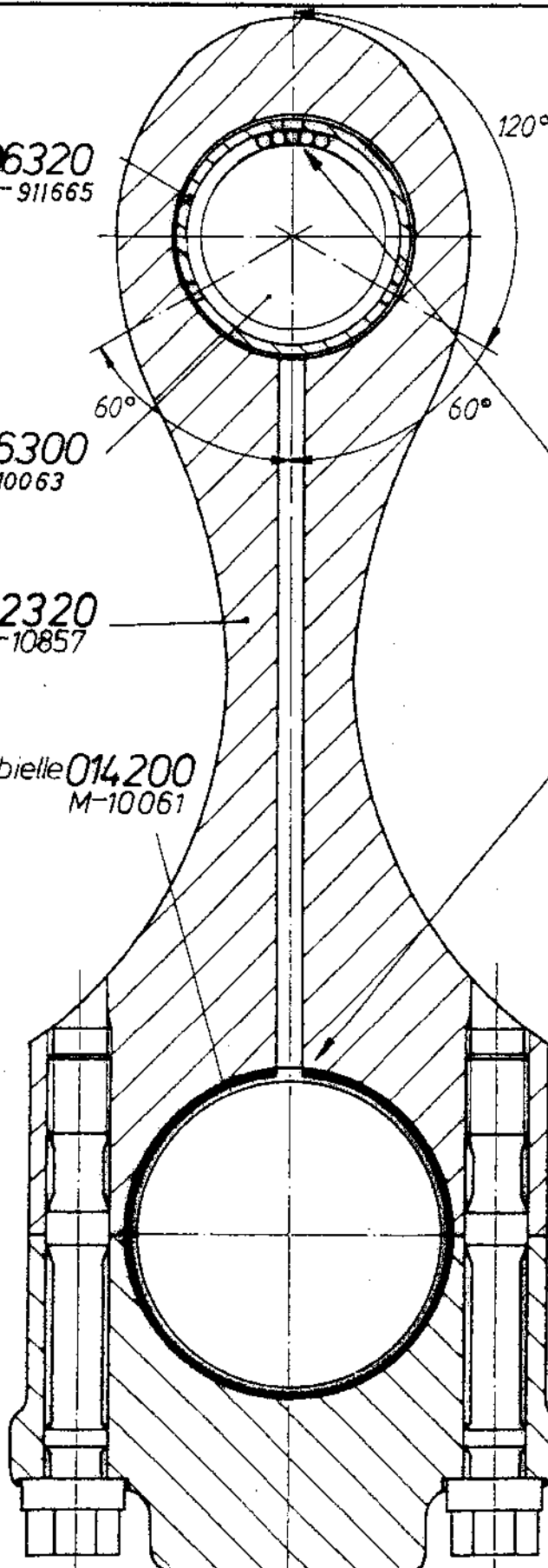
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Nadellager
 roul. à aiguilles **306320**
 needle bearing M-911665

Kolbenzapfen
 axe de piston **306300**
 piston pin M-10063

Schubstange
 bielle **012320**
 connecting rod M-10857

Kurbelzapfenlager
 palier de tête de bielle **014200**
 crank pin bearing M-10061



Richtige Lage der
 Schmierbohrung beachten
 Check the right position
 of the lubrication hole
 Vérifier la bonne position
 du trou de graissage

Achtung:

Attention:

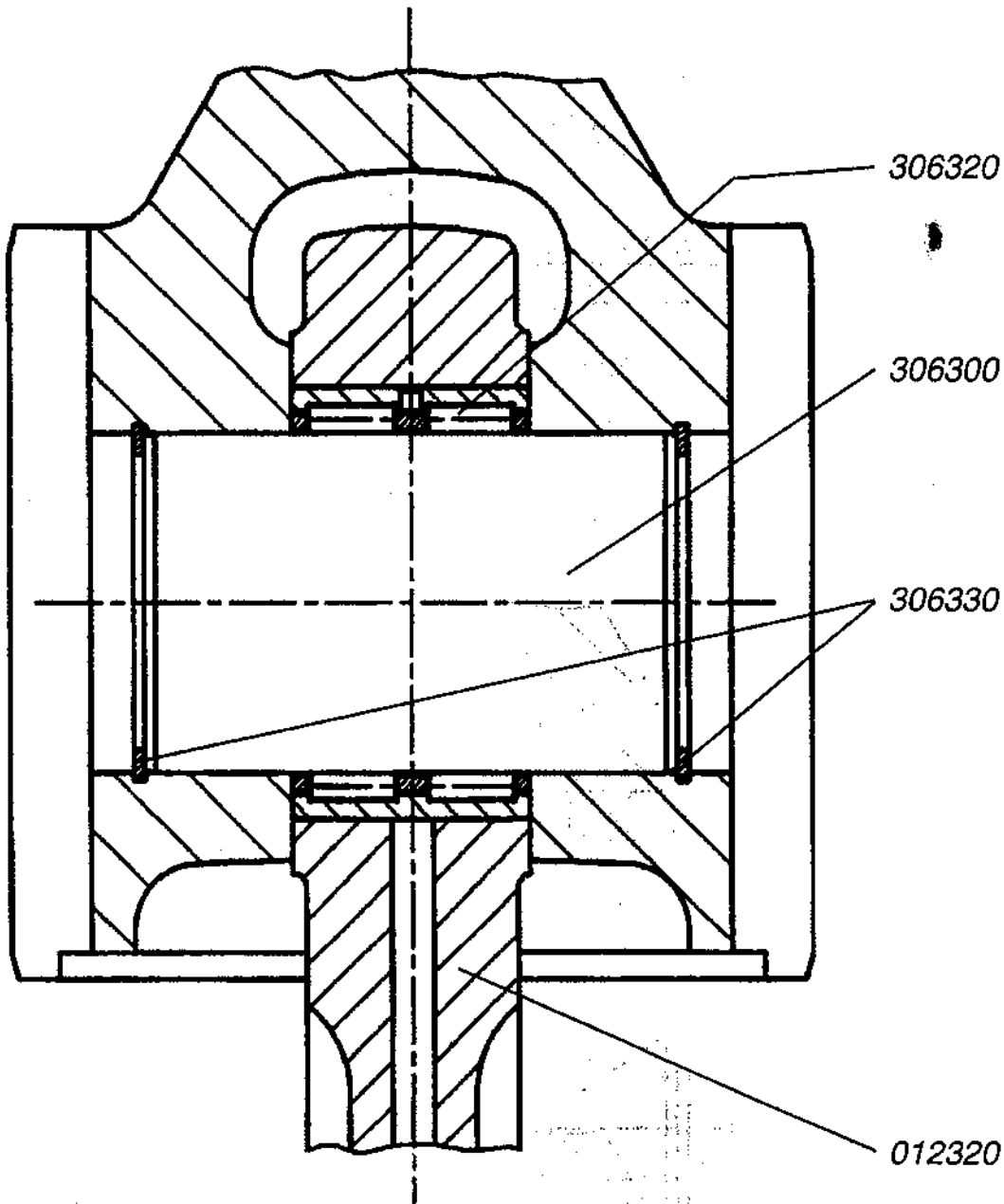
Attention:

STÜCKZAHL UND ABMESSUNGEN, SIEHE ERSATZTEILLISTEN
 QUANTITY OF PARTS AND DIMENSIONS, SEE SPARE PARTS LISTS
 NOMBRE ET DIMENSIONS DES PIÉCES, VOIR LES LISTES DES PIÉCES DE RÉCHANGE



GreenField

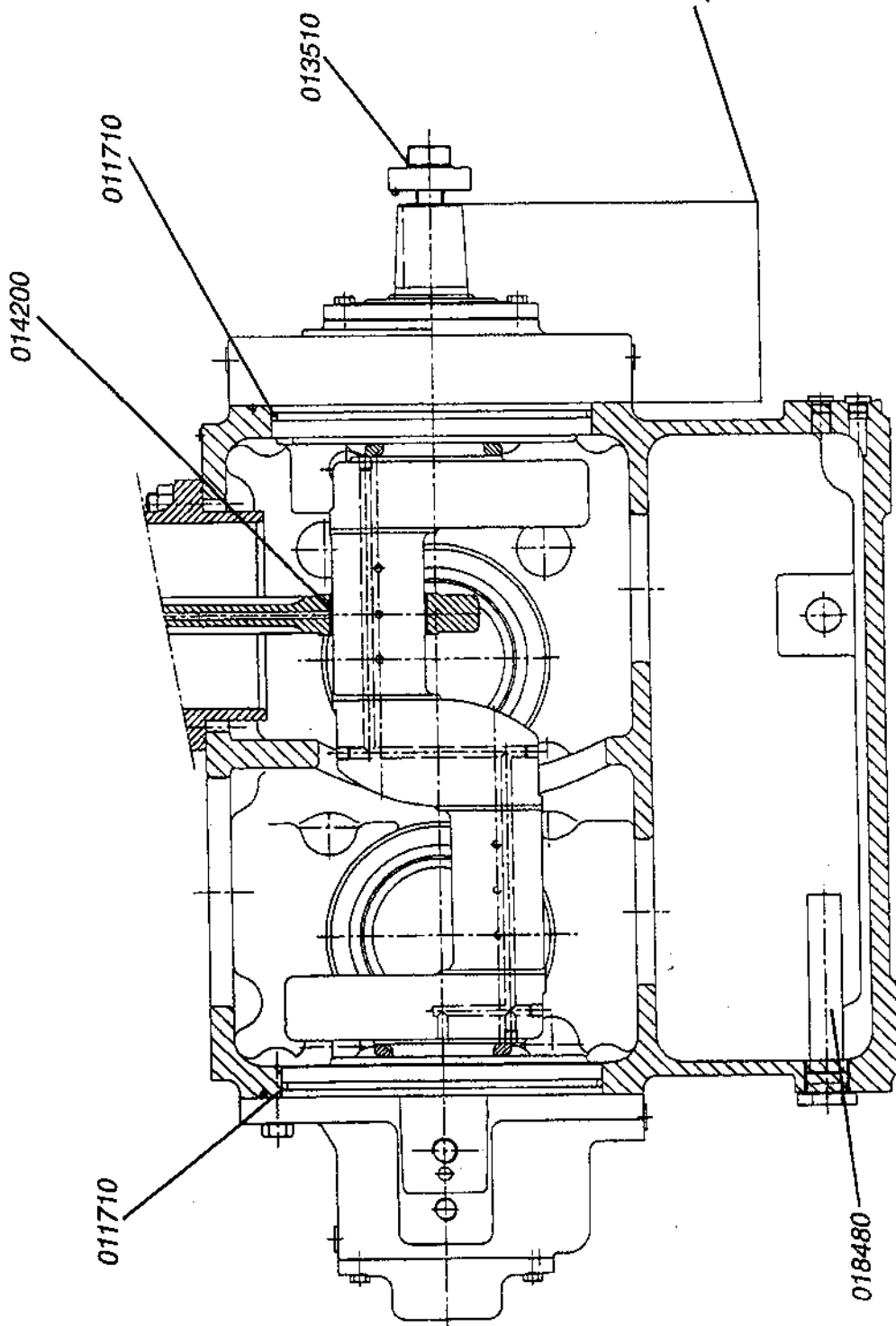
KOLBENZAPFENLAGER
PALIER DE TETE DE BIELLE
PISTON PIN BEARING

CT

STUECKZAHL UND ABMESSUNGEN, SIEHE ERSATZTEILLISTEN
QUANTITY AND DIMENSIONS, SEE SPARE PARTS LISTS
NOMBRE ET DIMENSIONS DES PIECES VOIR LES LISTES DES PIECES DE RECHANGE

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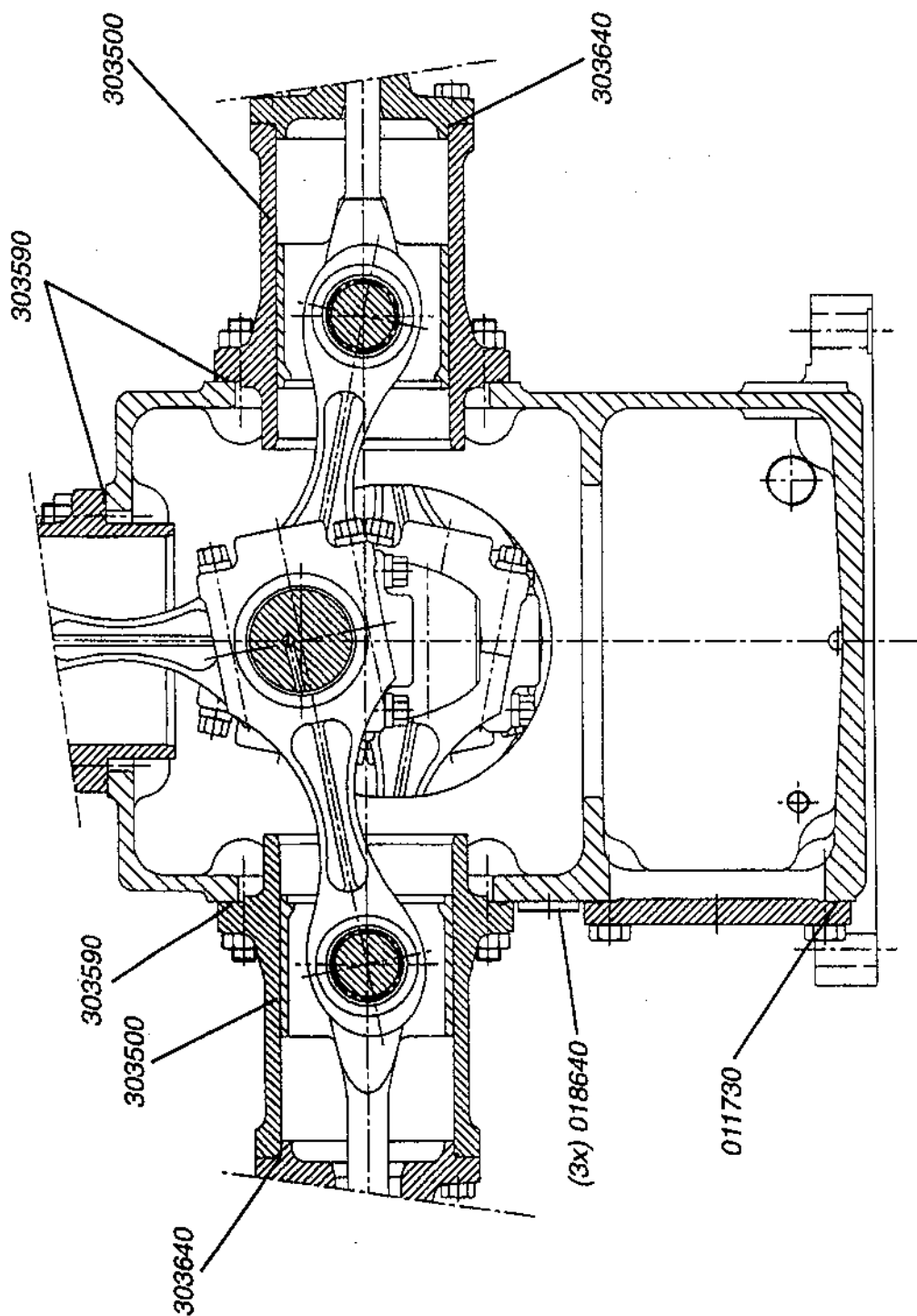
Achsiales Spiel der Kurbelwelle
Axial clearance of crankshaft 0.37-1.44 mm
Jeu axial du vilebrequin



Stückzahl und Abmessungen, siehe Ersatzteillisten
Quantity of parts and dimensions, see spare part list
Quantité et dimensions des pièces, voir liste des pièces de rechange

ORIGINAL

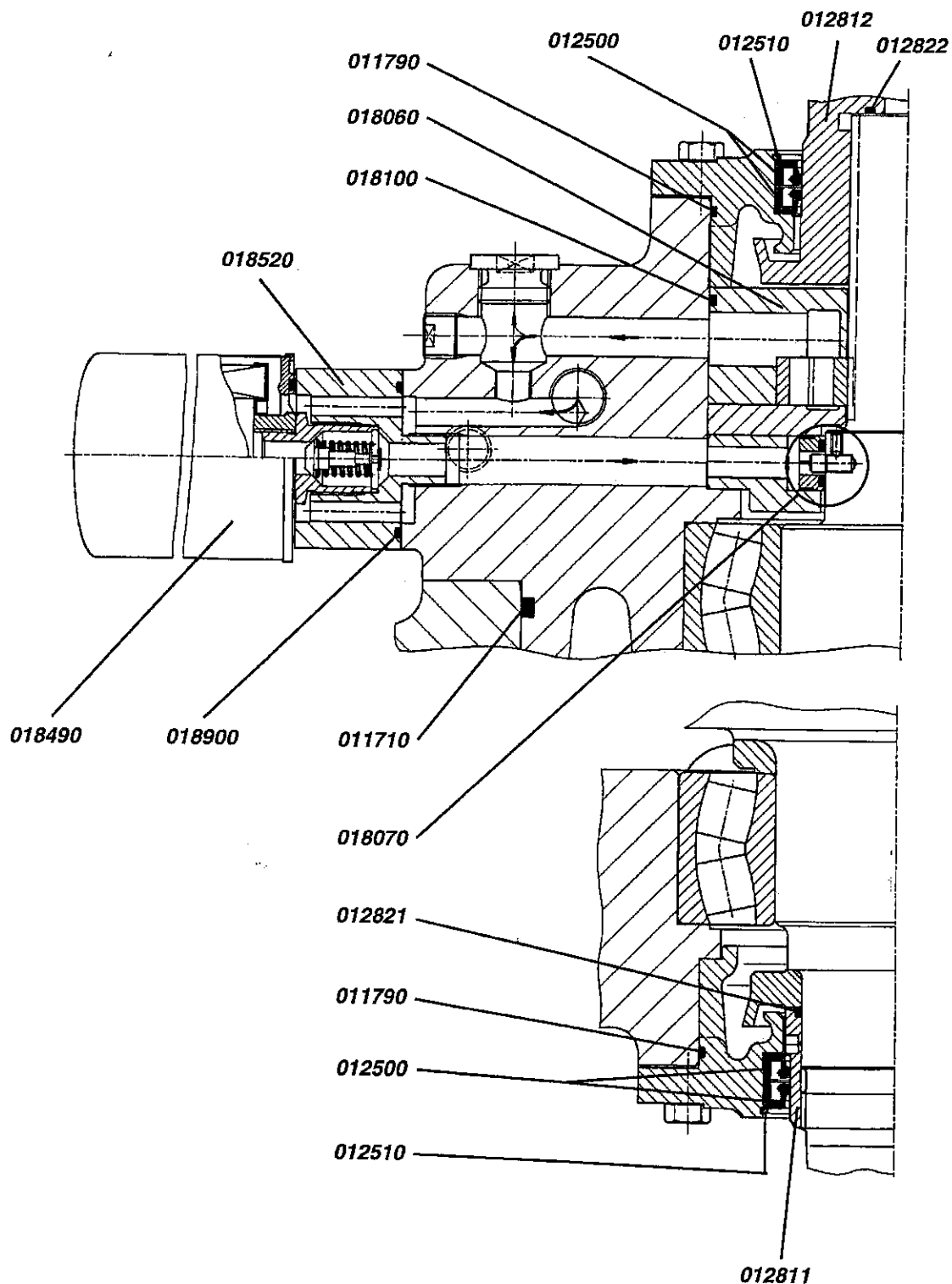
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Stückzahl und Abmessungen, siehe Ersatzteillisten
Quantity of parts and dimensions, see spare part list
Quantité et dimensions des pièces, voir liste des pièces de rechange

ORIGINAL

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Stückzahl und Abmessungen, siehe Ersatzteilliste
Quantity and dimensions, see spare part list
Nombre et dimensions, voir liste des pièces de rechange

ORIGINAL

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GreenField

Kurbelwellenlagerung
Crankshaft main bearings
Paliers de vilebrequin

014030

Schrumpftemperatur
Shrinking temperature
Température de rétraction

100-120°C

Zwischenring
Spacer
Bague de distance

Kurbelwelle
Crankshaft
Vilebrequin

Stückzahl und Abmessungen, siehe Ersatzteilliste
Quantity and dimensions, see spare part list
Nombre et dimensions, voir liste des pièces de rechange

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4-122.900.668

1

ORIGINAL



Montageanleitung Pendelrollenlager CT
Assembly instruction self aligning roller bearing CT
Instruction de montage palier à rouleaux articulés CT

Côté entraînement: M30
Longueur de tige: 70 mm
Côté ventilateur: M20
Longueur de tige: 60 mm

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2. MONTAGE DES PENDEL-ROLLENLAGER

ACHTUNG!

Die Kurbelwellenlager werden bei einer Temperatur von 100 bis 120°C aufgezo- gen. Die Erwärmung, zum aufziehen der Lager erfolgt vorzugsweise in einem Ölbad oder mit einem Induktionsheizgerät.

Vor Montage der neuen Lager sollte die Kurbelwelle auf Umgebungstemperatur abgekühlt sein!

2. ASSEMBLY OF THE SELF-ALIGNING ROLLER BEARING

CAUTION!

The crankshaft bearings are mounted at a temperature between 100 and 120°C. Heating prior to mounting the bearings should preferably take place in an oil bath or in an induction heater.

Prior to assembling the new bearings, the crankshaft should be cooled down to ambient temperature!

2. MONTAGE DU ROULEMENT À ROULEAUX ARTICULÉS

ATTENTION!

Monter les paliers de vilebrequin à une température de 100 à 120°C. Effectuer de préférence le réchauffement pour le montage des paliers dans un bain d'huile ou avec un appareil de chauffage à induction.

Avant le montage des nouveaux paliers, laisser refroidir le vilebrequin à la température ambiante!

Induktionsheizgerät
 Induction heater
 Chauffage à induction



- Stellen Sie die Kurbelwelle senkrecht, vorzugsweise in einem Holzsockel auf.
- Legen Sie den Zwischenring auf die Kurbelwellenschulter.
- Erwärmen Sie ein Lager auf die vorgegebene Temperatur.

- Put the crankshaft in an upright position, their mounting on a wood base has proven advisable.
- Put the spacer on the crankshaft shoulder
- Heat a bearing up to the specified temperature.

- Placer le vilebrequin à la verticale, de préférence dans un socle en bois.
- Posez la bague de distance sur l'épaule du vilebrequin.
- Réchauffer un palier à température préindiquée.

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Montageanleitung Pendelrollenlager CT
Assembly instruction self aligning roller bearing CT
Instruction de montage palier à rouleaux articulés CT

 **Das Lager hat eine Temperatur von ca. 120°C. Nicht mit ungeschützten Händen berühren → Verbrennungsgefahr. Benutzen Sie ein paar dicke Handschuhe oder eine entsprechend grosse Zange → Vorsicht, Lager nicht beschädigen.**

- Nehmen Sie das Lager und setzen Sie es auf die Kurbelwelle auf. Das Lager muss vom Eigengewicht bis zum Anschlag an der Kurbelwellenschulter rutschen.

ACHTUNG!
Es ist strikte verboten ein verkantetes Lager mit Hammer-schlägen in seine endgültige Position zu bringen!!

 **The bearing has a temperature of approx. 120° C. Never touch the bearing without wearing gloves → Danger of burns. Use a pair of thick gloves or a pair of sufficiently large pliers → Caution! Do not damage the bearing.**

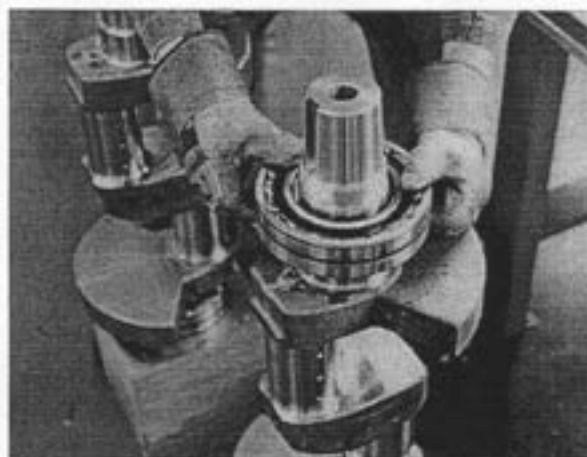
- Place the bearing onto the crankshaft. The bearing must slide by its own weight up to the stop on the crankshaft shoulders.

CAUTION!
NEVER force a jammed bearing into its final position using a hammer!!

 **Le palier a une température d'environ 120°C. Ne pas le toucher sans protection des mains → Risque de brûlure. Utiliser une paire de gants épais ou une pince de taille adéquate → Attention → ne pas endommager le palier.**

- Prendre le palier et le poser sur le vilebrequin. Le palier doit glisser par son propre poids de la butée à l'épaulement du vilebrequin.

ATTENTION!
Il est strictement interdit d'amener un palier qui est de travers à sa position finale à coups de marteau!!



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13.0 Test Data

This section provides test data that pertains to this project



GreenField

IG Station Manual

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1045 RPM GREENFIELD IG COMPRESSOR TEST DATA - PAGE 1 START TIME: 3:40 PM

JOB ORDER NO: _____ TECHNICIAN: _____ GAS: AIR DATE: 12/14/09

MODEL NO: C 57 Serial No: 3004 SN: 700550

ACCEPTANCE SIGNATURE: _____ SERIAL NO: _____ TEST NO: _____

CUSTOMER: USF/1142 / 312000

READING NO:	1	2	3	4	5	6	7	8
TIME	4:10	4:40	5:10	5:40	6:10	6:40	7:10	7:40
AMBIENT TEMPERATURE	56.6	53	52.5	51	5			
BAROMETRIC PRESSURE: mmHg	—	—	—	—	—	—	—	—

COOLING WATER

TEMPERATURE F: INLET _____ OUTLET _____

PRESSURE PSIG: INLET _____ OUTLET _____

FLOW: GPM _____

TEST GAUGE _____

SUCTION PRESSURE _____

STAGES

1ST	2ND	3RD	4TH	5TH	6TH	7TH	8TH
DISCHARGE	40	40	40	40			
TEMPERATURE	120	120	120	120			
PRESSURE	320	320	320	320			
PSIG	4th 1050	1050	1050	1050			
6th	2550	2550	2550	2550			
Relief Valve Settings Panel	2552	2558	2564	2561			
SUCTION	59	68	69	68			
TEMPERATURE	78/80	95/96	97/97	96/97			
(CYL)	3RD 60	93	93	93			
	4th 79	90	90	90			
	5th 75	85	85	85			
Oil Panel Drive 1B	—	—	—	—			

Fan 1ST	2ND	3RD	4TH	5TH	6TH	7TH	8TH
DISCHARGE	302	277	277	276			
TEMPERATURE	281	307	303	303			
(CYL)	309	319	320	319			
	4th 298	306	307	306			
	5th 282	261	262	262			
Oil Panel Drive 1B	301	284	284	283			

FINAL DISCHARGE TEMP.: F. 74 85 84 85

OIL PRESSURE: Panel PSIG 65 64 60 59

OIL TEMPERATURE OF 152 164 170 172

COMPRESSOR: 1045 RPM — — — — —

VIBRATION IPS 0.2 0.2 0.2 0.2

OIL LEVEL In/In 13 12 13 13

AMBIENT Temp F 56.6 53 52.5 51

Humidity % 45 57 57 59

Air Flow cfm 370 375 374 375

Motor Current 193/200/202

* Calibrated for natural gas

Compressor noise — stove shut down 6:10 PM
Restart @ 7:00 PM

1045 RPM GREENFIELD IG COMPRESSOR TEST DATA - PAGE 1 START 9:00 PM

JOB ORDER NO: _____ TECHNICIAN: _____ GAS: AIR DATE: 12/16/04

MODEL NO: C5T CROCK SN 72A500 700550

ACCEPTANCE SIGNATURE: _____ SERIAL NO: _____ TEST NO: _____

CUSTOMER: US Filter / Zimpro

READING NO:	1	2	3	4	5	6	7	8
TIME	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00
AMBIENT TEMPERATURE	44.9	43.2	42.2	40.7	40.4	40.7	41.7	41.9
BAROMETRIC PRESSURE: MMHG	—	—	—	—	—	—	—	—

COOLING WATER

TEMPERATURE F:	INLET	OUTLET
PRESSURE PSIG:	INLET	OUTLET
FLOW:	GPM	

TEST GAUGE

SUCTION PRESSURE

STAGES

1ST	2ND	3RD	4TH	5TH	6TH	7TH	8TH	9TH
DISCHARGE PRESSURE	40	40	40	40	40	40	40	40
PSIG	120	120	120	118	117	115	115	115
Panel / Gauge	315	315	315	310	310	305	310	310
Relief Valve Settings	1050	1050	1050	1050	1050	1050	1050	1050
Suction Temperature @ Panel	255/255	258/258	258/258	258/258	258/258	258/258	258/258	258/258
Fan 1ST	65	66	65	64	63	63	63	62
2ND	72/73	74/74	73/73	72/72	72/72	70/70	88/89	87/87
3RD	87	90	89	88	86	87	85	84
4TH	87	88	87	86	83	84	82	81
5TH	82	83	81	81	78	78	77	76
Drive 1/3	—	—	—	—	—	—	—	—

Fan 1ST	2ND	3RD	4TH	5TH	6TH	7TH	8TH	9TH
DISCHARGE TEMPERATURE @ Panel	272	273	273	272	270	270	268	267
2ND	357	358	357	357	353	353	351	349
3RD	313	313	314	312	306	307	305	302
4TH	302	301	302	301	294	298	296	295
5TH	257	258	257	256	257	254	252	250
Drive 1/3	280	281	280	280	277	277	275	274

FINAL DISCHARGE TEMP: F	83	83	82	81	79	79	76	77
OIL PRESSURE: PSIG	64/64	63/63	63/63	62/63	63/63	63/63	63/63	64/63
OIL TEMP: °F	165	169	171	171	171	171	170	169
COMPRESSOR: 1045 RPM	—	—	—	—	—	—	—	—
VIBRATION, IPS	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
OIL LEVEL, In	13	13	12	11	11	11	11	11
Humidity, %	71	76	77	80	83	87	90	90
* Air Flow, cfm	380	372	380	350	375	380	375	380
Motor Current	192/198/200							198/197/201

* Calibrated for natural gas

570 RPM		GREENFIELD IG COMPRESSOR TEST DATA - PAGE 1 START TIME: 9:20 AM							
JOB ORDER NO:		TECHNICIAN		GAS <u>AIR</u>		DATE <u>12/17/04</u>			
MODEL NO:				Block No. <u>700550</u>		700550			
ACCEPTANCE SIGNATURE		SERIAL NO:		TEST NO:					
CUSTOMER <u>USF/ITC/2 imp.</u>									
READING NO:	1	2	3	4	5	6	7	8	
TIME	9:50	10:20	10:50	11:20	11:50	12:20	12:50	1:20	
AMBIENT TEMPERATURE	49°	50	52	52	53	55°	56°	58	
BAROMETRIC PRESSURE: MMHG									
COOLING WATER									
TEMPERATURE F:	INLET								
	OUTLET								
PRESSURE PSIG:	INLET								
	OUTLET								
FLOW:	GPM								
TEST GAUGE									
SUCTION PRESSURE									
STAGES									
DISCHARGE PRESSURE PSIG	1ST	36/37	36/36	36/36	36/36	36/36	36/35	36/35	36/35
	2ND	117	117	117	117	117	117	117	117
	3RD	315	315	315	315	315	315	315	315
	4th	980	980	980	980	980	990	990	990
Panel/Edge	5th	2540/2660	2574/2640	2575/2640	2575/2640	2581/2640	2582/2640	2584/2640	2579/2640
Relief Valve Settings									
SUCTION TEMPERATURE @ Panel	1st	60/	62/	65/	67/	68/	68	69	71
	2ND	86/86	88/89	90/91	92/93	93/93	94/95	95/96	96/96
	3RD	83	85	85	89	89	91	92	95
	4th	79	81	82	84	85	88	88	89
	5th	76	78	80	82	83	85	86	87
Drive/B		/	/	/					
DISCHARGE TEMPERATURE @ Panel	1st	237	242	244	247	248	248	251	251
	2ND	234	238	241	243	245	247	248	248
	3RD	278	281	284	287	289	290	292	292
	4th	270	273	276	277	282	284	285	286
	5th	249	253	255	258	258	260	261	261
Drive/B		247	252	255	257	258	258	261	260
FINAL DISCHARGE TEMP. F		76	79	80	82	84	86	86	87
OIL PRESSURE: Panel/PSIG		79/72	88/61	83/63	61/61	59/59	59/59	58/59	59/56
OIL TEMP. F/Panel		125	138	147	152	157	158	160	161
COMPRESSOR: 570 RPM									
VIBRATION, IPS		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
OIL LEVEL IN HZ		13	12	12	12	10	11	11	8
Humidity, %		58%	55%	52%	52%	51%	45%	44%	39%
* Air Flow		300-314	300-315	300-315	300-315	300-315	300-315	295-300	295-300
Motor Current		152/161/162	150	150	147	147	149	149	149
		161	160	160	160	156	159	159	
		162	160	161	160	158	159	158	

* Calibrated for natural gas
 ① During Blowdown Cycle

GREENFIELD IG COMPRESSOR TEST DATA - PAGE 1

JOB ORDER NO: ~~1072~~ 3000 TECHNICIAN *River* GAS *Helium* DATE *12/28/04*
 MODEL NO: *5722313* START: *8:15 AM*
 ACCEPTANCE SIGNATURE SERIAL NO: *243* TEST NO: *1*
 CUSTOMER *LIS Filter* 441372003

READING NO.	1	2	3	4	5	6	7	8
TIME hours	<i>0.5</i>	<i>1</i>	<i>1.5</i>	<i>2</i>	<i>2.5</i>	<i>3</i>	<i>3.5</i>	<i>4</i>
AMBIENT TEMPERATURE	<i>58</i>	<i>58</i>	<i>59</i>	<i>59</i>	<i>60</i>	<i>60</i>	<i>60</i>	<i>60</i>
BAROMETRIC PRESSURE MMHG	<i>94</i>	<i>91</i>	<i>89</i>	<i>84</i>	<i>84</i>	<i>83</i>	<i>83</i>	

COOLING WATER

TEMPERATURE F:	INLET							
	OUTLET							
PRESSURE PSIG:	INLET							
	OUTLET							
FLOW:	GPM							

TEST GAUGE								
SUCTION PRESSURE	<i>0</i>							
STAGES								

A/B 1ST	<i>39/38</i>	<i>39/39</i>	<i>39/39</i>	<i>39/39</i>	<i>39/39</i>	<i>39/38</i>	<i>39/38</i>	<i>39/38</i>
DISCHARGE 2ND	<i>117</i>	<i>117</i>	<i>117</i>	<i>117</i>	<i>117</i>	<i>116</i>	<i>116</i>	<i>116</i>
PRESSURE 3RD	<i>315</i>	<i>320</i>	<i>320</i>	<i>325</i>	<i>330</i>	<i>330</i>	<i>330</i>	<i>330</i>
PSIG 4th	<i>1050</i>	<i>1050</i>	<i>1050</i>	<i>1000</i>	<i>1000</i>	<i>1000</i>	<i>1000</i>	<i>1000</i>
<i>Gas Pressure</i> 5th	<i>2500</i>	<i>2500</i>	<i>2500</i>	<i>2500</i>	<i>2500</i>	<i>2500</i>	<i>2500</i>	<i>2500</i>
Relief Valve Settings								

A/B 1ST	<i>62</i>	<i>63</i>	<i>64</i>	<i>65</i>	<i>65</i>	<i>66</i>	<i>66</i>	<i>66</i>
SUCTION 2ND	<i>76/74</i>	<i>76/72</i>	<i>77/77</i>	<i>78/73</i>	<i>78/74</i>	<i>79/74</i>	<i>78/74</i>	<i>78/76</i>
TEMPERATURE 3RD	<i>80</i>	<i>78</i>	<i>80</i>	<i>80</i>	<i>81</i>	<i>81</i>	<i>81</i>	<i>84</i>
4th	<i>81</i>	<i>78</i>	<i>78</i>	<i>79</i>	<i>79</i>	<i>79</i>	<i>79</i>	<i>83</i>
5th	<i>75</i>	<i>72</i>	<i>72</i>	<i>73</i>	<i>74</i>	<i>74</i>	<i>73</i>	<i>78</i>

A/B 1ST	<i>265/273</i>	<i>278/277</i>	<i>279/278</i>	<i>280/278</i>	<i>281/280</i>	<i>281/281</i>	<i>281/280</i>	<i>277/277</i>
DISCHARGE 2ND	<i>334</i>	<i>334</i>	<i>332</i>	<i>330</i>	<i>331</i>	<i>331</i>	<i>330</i>	<i>329</i>
TEMPERATURE 3RD	<i>305</i>	<i>303</i>	<i>297</i>	<i>292</i>	<i>294</i>	<i>293</i>	<i>292</i>	<i>291</i>
4th	<i>296</i>	<i>295</i>	<i>289</i>	<i>282</i>	<i>273</i>	<i>266</i>	<i>265</i>	<i>264</i>
5th	<i>249</i>	<i>251</i>	<i>250</i>	<i>249</i>	<i>249</i>	<i>233</i>	<i>234</i>	<i>234</i>

Oil Temp				<i>168</i>	<i>169</i>	<i>168</i>	<i>167</i>	<i>167</i>
FINAL DISCHARGE TEMP. F.	<i>74</i>	<i>70</i>	<i>71</i>	<i>72</i>	<i>72</i>	<i>72</i>	<i>72</i>	<i>77</i>
OIL PRESSURE: PSIG	<i>93</i>	<i>76</i>	<i>70</i>	<i>68</i>	<i>68</i>	<i>68</i>	<i>70</i>	<i>71</i>
Discharge Pressure Band	<i>2539</i>	<i>2544</i>	<i>2544</i>	<i>2536</i>	<i>2540</i>	<i>2544</i>	<i>2540</i>	<i>2545</i>
COMPRESSOR: RPM	<i>1045</i>	<i>1045</i>	<i>1045</i>	<i>1045</i>	<i>1045</i>	<i>1045</i>	<i>1045</i>	<i>1045</i>

Vibration IPS	<i>0.3</i>	<i>0.3</i>	<i>0.3</i>	<i>0.3</i>	<i>0.3</i>	<i>0.3</i>	<i>0.3</i>	<i>0.3</i>
Oil Level In H ₂ O	<i>14</i>	<i>13</i>	<i>10</i>	<i>11</i>	<i>11</i>	<i>11</i>	<i>12</i>	
Air Flow	<i>375-385</i>	<i>365-380</i>	<i>365-380</i>	<i>370</i>	<i>370</i>	<i>370</i>	<i>370</i>	<i>370</i>
Motor Current L ₁	<i>212</i>	<i>211</i>	<i>210</i>	<i>208</i>	<i>208</i>	<i>206</i>	<i>206</i>	<i>205</i>
L ₂	<i>205</i>	<i>206</i>	<i>202</i>	<i>200</i>	<i>199</i>	<i>199</i>	<i>197</i>	<i>198</i>
L ₃	<i>212</i>	<i>211</i>	<i>210</i>	<i>208</i>	<i>207</i>	<i>206</i>	<i>205</i>	<i>205</i>

Calibrated for Natural Gas

GREENFIELD IG COMPRESSOR TEST DATA - PAGE 1 *Air*

JOB ORDER NO: *4372200* TECHNICIAN *Rohrer* GAS *HELIUM* DATE *12/29/04*
 MODEL NO: *C5T-223.13* ACCEPTANCE SIGNATURE SERIAL NO: *345* TEST NO: *2*
 CUSTOMER *US Filter* 11/13/2003

READING NO:	1	2	3	4	5	6	7	8
TIME <i>Hours</i>	<i>0.5</i>	<i>0.5</i>						
AMBIENT TEMPERATURE		<i>62</i>						
BAROMETRIC PRESSURE MMHG	<i>73</i>	<i>73</i>						

COOLING WATER

TEMPERATURE F:	INLET							
	OUTLET							
PRESSURE PSIG:	INLET							
	OUTLET							
FLOW:	GPM							

TEST GAUGE								
SUCTION PRESSURE								

STAGES								
<i>Intake</i> ~~1ST~~ 1ST	<i>64</i>	<i>36/35</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	
DISCHARGE ~~2ND~~ 2ND	<i>241/247</i>	<i>119</i>						
PRESSURE 3RD	<i>315</i>	<i>320</i>						
PSIG 4	<i>256</i>	<i>950</i>						
5	<i>252</i>	<i>2500</i>						

Relief Valve Settings								
<i>A/B</i> 1ST	<i>78/76</i>	<i>64</i>						
SUCTION 2ND	<i>82</i>	<i>78/76</i>						
TEMPERATURE 3RD	<i>80</i>	<i>82</i>						
4	<i>77</i>	<i>80</i>						
5		<i>78</i>						

DISCHARGE 1ST		<i>241/247</i>						
TEMPERATURE 2ND		<i>314</i>						
3RD		<i>256</i>						
4		<i>251</i>						
5		<i>221</i>						

<i>Oil Temp</i>		<i>133</i>						
FINAL DISCHARGE TEMP.: F.		<i>77</i>						
OIL PRESSURE: PSIG		<i>78</i>						
<i>Discharge Pressure</i> ~~PSIG~~		<i>2465</i>						
COMPRESSOR: RPM								

Vibration IPS	<i>0.4</i>							
Oil Level In H ₂ O	<i>16</i>							
*Air Flow	<i>300-315</i>							
Motor Current L1	<i>162</i>							
L2	<i>152</i>							
L3	<i>160</i>							

* Flow calibrated to Natural Gas

GREENFIELD IG COMPRESSOR TEST DATA - PAGE 1

JOB ORDER NO: 1972-2000 TECHNICIAN Rehner GAS HELIUM DATE 1/15/05

MODEL NO: CST-228-13

700551

ACCEPTANCE SIGNATURE

SERIAL NO: 345

TEST NO: 2

CUSTOMER US Filter 44/13/2003

READING NO:	1	2	3	4	5	6	7	8
Start Time hours	0.5	1	1.5	2	2.5	3	3.5	4
AMBIENT TEMPERATURE	59	59	61	66	66	68	68	68
BAROMETRIC PRESSURE: MMHG	67	67	68	56	56	52	52	52
Panel Ambient	62	64	66	71	73	75	76	78

COOLING WATER								
TEMPERATURE F: INLET								
OUTLET								
PRESSURE PSIG: INLET								
OUTLET								
FLOW: GPM								

TEST GAUGE								
SUCTION PRESSURE								

STAGES								
A/B 1ST	35/34	35/34	35/34	35/34	35/34	34/34	35/34	35/34
DISCHARGE 2ND	116	116	116	116	116	116	116	117
PRESSURE 3RD	320	320	320	315	320	320	315	320
PSIG 4th	1000	980	1000	1000	1000	1000	970	970
5th	2520	2470	2520	2550	2550	2570	2520	2580
Panel High Dis Press	75	64	60	59	58	56	55	56
A/B 1ST	64	66	69	74	76	77	79	83
SUCTION 2ND	78/76	81/79	85/82	90/88	92/90	93/91	95/93	98/97
TEMPERATURE 3RD	83	85	89	95	96	98	100	103
4th	80	83	87	93	95	96	98	101
5th	78	81	84	90	92	94	96	98

A/B 1ST	241/248	246/252	250/257	255/263	257/264	259/266	264/269	257/266
DISCHARGE 2ND	327	327	332	342	343	345	347	347
TEMPERATURE 3RD	276	280	284	290	293	295	295	297
4th	273	276	282	289	291	291	292	287
5th	240	241	248	253	255	256	258	257

Oil Temp	125	142	149	155	159	162	165	166
FINAL DISCHARGE TEMP.: F.	77	80	82	89	90	92	94	97
OIL PRESSURE: PSIG	73	62	58	57	56	55	54	55
Dis Press Panel	2615	2530	2512	2620	2620	2630	2576	2650
COMPRESSOR: RPM	570	570	570	570	570	570	570	570

Vibration IPS	4	4	4	4	4	4	4	4
Oil Level In H2O	13	12	11	11	10	9	7	15
* Air Flow	290-310	300-310	290	290	290	295	295	290
motor Current L1	163	161	160	161	160	160	159	159
L2	162	160	159	160	160	160	159	158
L3	152	150	148	149	149	149	148	148

Calibrated For Natural Gas



Quality documentation

GreenField order no : I 0246/700,551
Machine type : C5T 223.-LC
Client : GreenField Compr. North America
Client's reference : US Filter, 6979
Plant : USA

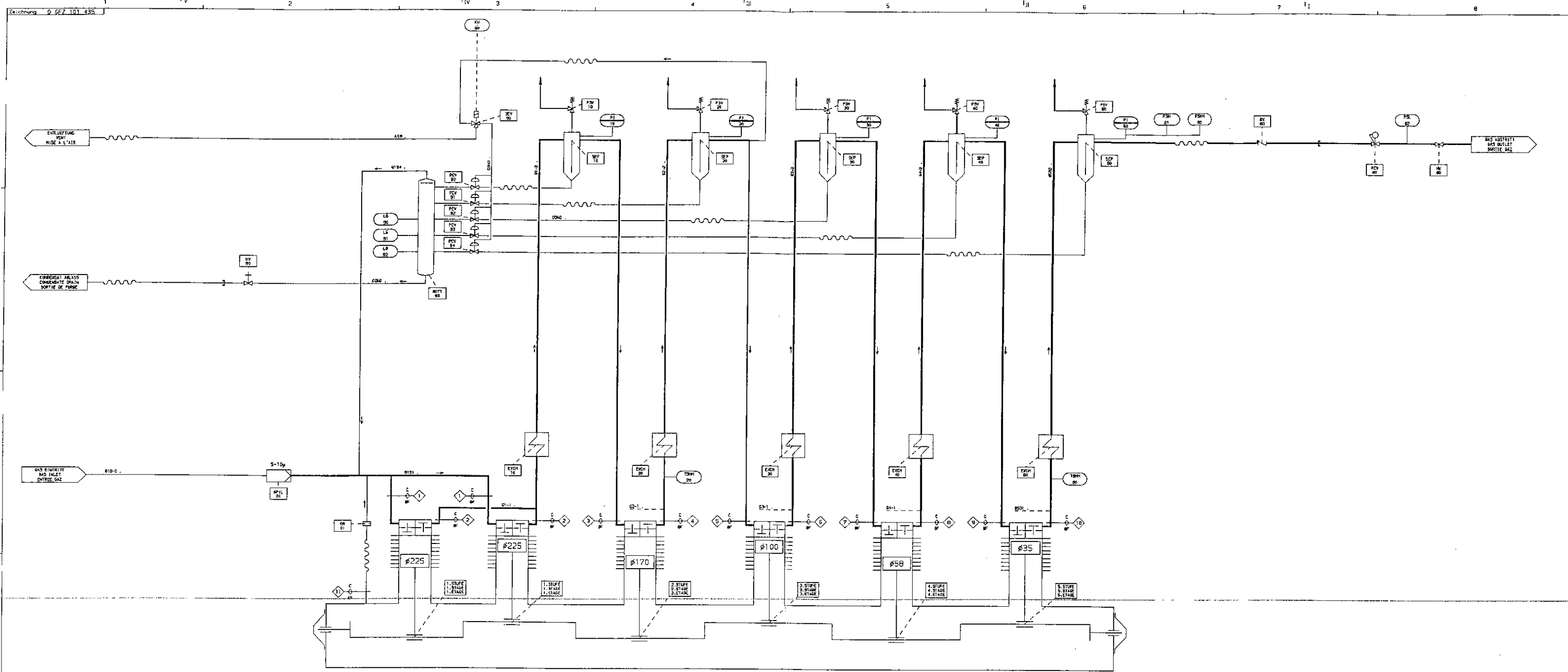
Please state in all further correspondence and telephone messages the GreenField order no:

Address: GreenField Ltd.
Güterstrasse 107
CH – 4133 Pratteln

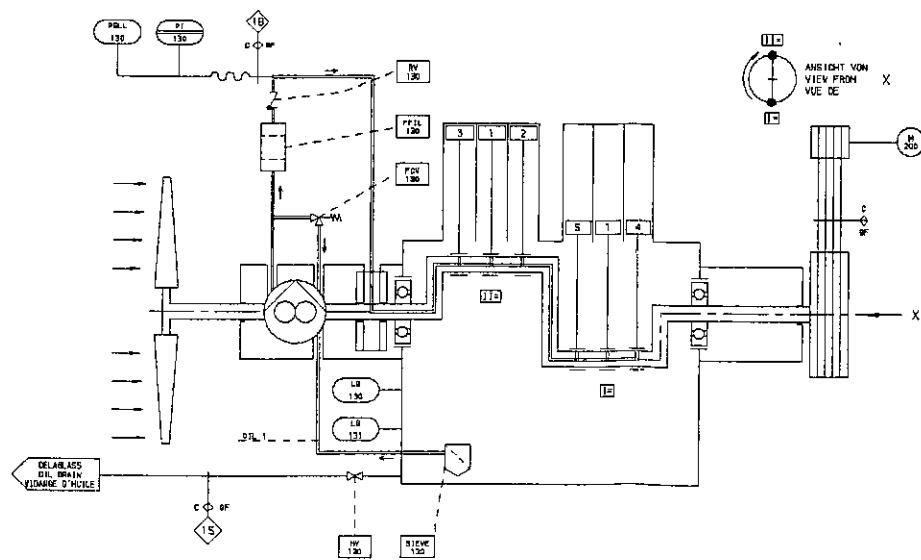
Telephone: 061 / 827 35 35
Telefax : 061 / 827 34 97
E-Mail : quality@greenfield.ch

CONTENT

File No:	Designation	chapter No:	sheet No:
No.	Designation	Chapter	Sheet No.
	Compressor P&I Diagram of compressor Test run certificate	1	
	Crank case Pressure Test, material certificate	2	
	Cylinder Head Pressure Test, material certificate	3	
	Cylinder Jacket Pressure Test, material certificate	4	
	Cylinder Pressure Test, material certificate	5	



TRIEBWERKSCHMIERUNG - MOTION WORK LUBRICATION - LUBRIFICATION DE L'EMBIELLAGE



Die Unterzeichnenden erklären, dass die vorliegende Zeichnung ein Original ist und dass sie die Verantwortung für die Richtigkeit der Darstellung übernehmen. Die Unterzeichnenden erklären, dass die vorliegende Zeichnung ein Original ist und dass sie die Verantwortung für die Richtigkeit der Darstellung übernehmen.

LEITUNGS-UND INSTRUMENTENSCHEMA PIPING & INSTRUMENT DIAGRAM SCHEMA TUYAUTERIES ET INSTRUMENTS CLIENT REF. NR.		LIEFERGRENZE LIMIT OF SUPPLY LIMITÉ DE FOURNITURE ANSCHLUSSEN CONNECTION NO. NO. DE CONNEXION	
GreenField		KUNDE-CLIENT	
GF COMPRESSION CST223-LS BARE BL		P & I DIAGRAM	
STANDARD AIR		CT - AIR-COOLED BARE BLOCK	
CAD-Zeichnung		Folien-Druck	
D		0-GFZ.101.435	

Reg. Nr.							
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test				Aufgegeben von R. K. Dat: 17.2.04	
Objekt Nr. No d'objet: Reg. No.		122.078.645/646		Kom. Nr. No de com. Com. No.		F-Auftr. 007817	
Maschinen Typ: Type de la mach. machine type:				Masch. Nr.: No mach. Machine No.			
KundenRef.: ClientRef.: ClientRef.: KURBELGEHÄUSE 122.078.645/646				Aufstellungsland: Pays d'exploitation: Country of instalt			
Prüfung durch: Epreuve exécutée par: Test by: new ambrosetti				Vorschriften: Spécifications: Specifications: GFV.500.027			
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. adms Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Durt	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks
			bar	bar	min		Qualitätsprüfung Inspection-qualité Quality check AMI 2 HT 17.2.04
10	KURBELGEHÄUSE BE 7817.21 ÷ 30 (23)	122.078.645/646	16	30	30	Wasser	AMI 2 HT
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success						Markierung: Marquage: Marking: AMI 2 HT	
Qualitätsrech. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de Inspector from			Datum 17.2.04	

Nr./No./no.: 1825

Datum/date/date: 19.01.04 / d

Pos. Item pos	Charge			Anzahl Quantity quantité	Gewicht kg/St. Weight kg/piece poids kg/pièce	A %	R _{0,2} N/mm ²	R _m N/mm ²	A _v %	Brinellhärte Brinell hardness dureté Brinell HB
Sollwert / nominal value / valeur effective						>15	>250	>400		
	Datum Date date	Nr. No. no.	Laufnr. consec. No. conséc. no.				Ist is est			Ist is est
3	16.12.03	6236	3 ✓	1	462	17.5	380	480		163
4	16.12.03	6238	2 ✓	1	462	16.2	380	464		156
5	18.12.03	6253	2 ✓	1	462	17.7	380	473		159
6	18.12.03	6254	3 ✓	1	462	18.2	380	468		156
7	08.01.04	6286	2 ✓	1	462	17.5	380	467		163
8	08.01.04	6287	4 ✓	1	462	16.0	410	510		170
9	08.01.04	6289	3 ✓	1	462	16.0	390	492		167
10	12.01.04	6307	- ✓	1	462	15.0	410	526		179

Pos. Item pos.	Chemische Zusammensetzung / Chemical composition / composition chimique									
	% C	% Si	% Mn	% P	% S	% Cu	% Ni	% Mo	% Cr	% Mg
3	3.85	2.37	0.109	0.037	0.017					0.048
4	3.95	2.42	0.099	0.035	0.017					0.042
5	3.93	2.22	0.094	0.034	0.018					0.037
6	3.98	2.26	0.095	0.030	0.018					0.039
7	3.85	2.23	0.103	0.041	0.013					0.046
8	3.86	2.36	0.106	0.043	0.013					0.048
9	3.83	2.34	0.093	0.039	0.011					0.054
10	3.76	2.27	0.144	0.041	0.016					0.041

Pos. Item pos.	Gefüge / structure / structure

BOCCA 04/28

Zyko. A. 8012

Reg. Nr.									
GREENFIELD		Bescheinigung über Druck- und Dichtheitsprüfung <i>Certificat d'épreuve de pression et d'étanchéité</i> Certificate of pressure and leaking test					Aufgegeben von: Dat: 05.06.2002 Visum: A. Leiby		
Objekt Nr.: No d'objet:		122 138 739 001			Kom. Nr.: No de com.:		A043952		
Maschinen Typ: Type de la mach.:							Masch. Nr.: No mach.:		
Kunden/Ref.: Client/Réf.:							Aufstellungsland: Pays d'exploitation:		
Prüfung durch: Epreuve exécutée par:		GreenField			Vorschriften: Spécifications:		KV4009		
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admis Max. allow work pressure	Prüddruck P. d'épreuve Test pressure	Dauer Durée Durat	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks	Qualitätsprüfung Inspection-qualité Quality check Dat.	
			bar	bar	min				
18	Zylinderkopf	1-122138739	29	44	30	Wasser			
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden <i>Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès</i> The above mentioned parts have passed the test with success						Markierung: Marquage: Marking:			
GREENFIELD AG Qualitätstechn. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de: Inspector from:						
Datum:			Datum:			Datum: 05. JUNI 2002			
Visum:			Visum:			Visum:			

Reg. Nr.		1							
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test				Aufgegeben von Dat: 6-6-03 Visum: R. L. H.			
Objekt Nr.: no d'objet: Reg. No.		122.138.739		Kom. Nr.: no de com.: Cov. No.		F-Auftr. 6287			
Maschinen Typ: Type de la mach.: machine type:				Masch. Nr.: No mach.: Machine No.:					
Kunden/Ref.: Client/Ref.: Client/Ref.:				Aufstellungsland: Pays d'implantation: Country of install:					
Prüfung durch: Epreuve effectuée par: Test by:				Vorschriften: Spécifications: Specifications: GFV.500.027					
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admiss. Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Durst	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks	Qualitätsprüfung Inspection/qualité Quality check	
			bar	bar	min			Dat.	
9	Zylinder Ø 225 122-138.739		29	44	30	Wasser		HT R. L. H. 6-6-03	

Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden
Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès
The above mentioned parts have passed the test with success

Markierung:
Marquage:
Marking:

Qualitätsfach / Techn. de qualité / Quality Engineering

Inspektor von:
Inspecteur de:
Inspector from:

Datum:

Datum

10.06.03

Datum:

Zyko. 2.

Reg. Nr.									
GreenField		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test					Aufgegeben von: Dat: 12.04.01 Visum: R. Riegert		
Objekt Nr.: No d'objet:		122 138 740 001		Kom. Nr.: No de com.:		FAUF001533			
Reg. No.:				Com. No.:					
Maschinen Typ: Type de la mach.:		CT		Masch. Nr.: No mach.:					
machine type:				Machine No.:					
Kunden/Ref.: Client/Réf.:				Aufstellungsland: Pays d'exploitation:					
Client/Ref.:				Country of install:					
Prüfung durch: Epreuve exécutée par:		GRF		Vorschriften: Spécifications:		KV4009			
Test by:				Specifications:					
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admis Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Durat	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks	Qualitätsprüfung Inspection-qualité Quality check	
			bar	bar	min			Dat.	
18 2 10	Zylinderkopf d255X115	1-122.138.740	25	37,5	30	Wasser	 	03. MAI 2001 	
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success						Markierung: Marquage: Marking:			
GreenField AG Qualitätstechn. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de: Inspector from:						
Datum:			Datum:			Datum:			
Visum:			Visum:			Visum:			

Reg. Nr.		3						
Allweier Präzisionsteile GmbH		Bescheinigung über Druck- und Dichtheitsprüfung <i>Certificat d'épreuve de pression et d'étanchéité</i> Certificate of pressure and leaking test				Aufgegeben von: Dat: 01.09.2003 Visum: <i>Wag</i>		
		Objekt Nr.: No d'objet: 122247729001 No.:		Korn. Nr.: No de corn.: BE007616 Corn. No.:				
Maschin Typ: Type de la mach.: machine type:				Masch. Nr.: No mach.: Machine No.:				
Kunden/Ref.: Client/Réf.: Client/Ref.:			Aufstellungsland: Pays d'exploitation: Country of install:					
Prüfung durch: Epreuve exécutée par: Test by: Allweier Präzisionsteile GmbH			Vorschriften: Spécifications: Specifications: GFV.500.027					
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admis Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Durat	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks	Qualitätsprüfung Inspection-qualité Quality check Dat.
			bar	bar	min			
23	Zylinderkopf D215/35x106	2-122.247.729	X	165	30	Wasser		A 56
24	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
25	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
26	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
27	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
28	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
29	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
30	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
31	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
32	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
33	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
34	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
35	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
36	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
37	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
38	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
39	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
40	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
41	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		
42	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden <i>Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès</i> The above mentioned parts have passed the test with success						Markierung: Marquage: Marking:		
Qualitätstechn. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de: Inspector from:			03.12.03		
Datum:			Datum:			Datum:		
Visum:			Visum:			Visum: <i>B. Kell</i>		

Reg. Nr.		4					
		Bescheinigung über Druck- und Dichtheitsprüfung <i>Certificat d'épreuve de pression et d'étanchéité</i> Certificate of pressure and leaking test				Aufgegeben von: Dat: 03.09.2003 Visum: <i>Wery</i>	
Objekt Nr.: No d'objet:		122247727001		Kom. Nr.: No de com.:		BE007738	
Reg. No.:						Masch. Nr.: No mach.: Machine No.:	
Maschinen Typ: Type de la mach.: machine type:							
Kunden/Ref.: Client/Réf.: Client/Ref.:		Aufstellungsland: Pays d'exploitation: Country of install:					
Prüfung durch: Epreuve exécutée par: Test by:		Allweier Präzisionsteile GmbH				Vorschriften: Spécifications: Specifications:	
						GFV.500.027	
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admis Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Durat	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks
			bar	bar	min		Qualitätsprüfung Inspection-qualité Quality check Dat.
31	Zylinderkopf D215/35x106	2-122.247.727	X	295	30	Wasser	A 56
32	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	A 56
33	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	A 56
34	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	A 56
35	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	A 56
36	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	A 56
37	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	A 56
38	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	A 56
39	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	A 56
40	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	A 56
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden <i>Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès</i> The above mentioned parts have passed the test with success						Markierung: Marquage: Marking:	
Qualitätstechn. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de: Inspector from:			10.12.03	
Datum:			Datum:			Datum:	
Visum:			Visum:			Visum: <i>B. All</i>	

From: GREENFIELD

061 827 34 80

5

22/03/2004 11:09 #026 P.001/001

DERO Feinmechanik		Bescheinigung über Druck- und Dichtheitsprüfung <i>Certificat d'épreuve de pression et d'étanchéité</i> <i>Certificate of pressure and leakage test</i>				Aufgegeben von: Dat: 02.03.2004 Visum: kd		
Objekt Nr.: No d'objet Reg. No.: 2-122247726d		KöM. Nr.: No de com.: Com. No.: BE 007751						
Maschinen Typ: Type de la mach.: machine type: CT		Masch. Nr.: No mach: Machine No.:						
Kunden/Ref.: Client/Réf.: Client/Ref.:		Aufstellungsort: Lieu d'exploitation: Country of install:						
Prüfung durch: Epreuve effectuée par: Test by: DERO		Vorschriften: Spécifications: Specifications: GFV.500.027						
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admise Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Dural	Prüfmedium Milieu d'essai Testmedium	Bemerkung Remarque Remarks	Qualitätsprüfung Inspection-qualité Quality check Dat.
10	Zylinderkopf	2-122247726d	385	580	30	Wasser		02. März 2004
								(V6)
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success						Markierung: marquage: Marking: (VG)		
QualitätsTech. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de: Inspector from:					
Datum: 02. März 2004 Visum: (KL)			Datum: Visum:			Datum: Visum:		

Bescheinigung über Werkstoffprüfung nach EN 10204

Procès-verbal des matériaux selon EN 10204
Record of material testing in acc. with EN 10204

Nr./No: 47 / 8419

Seite 1 von 1 Seiten
Page de/of pages

Kunde / Client / Customer GreenField AG, Basel	Anlage / Projet / Project
Bestell-Nr. / No. du Cde. / Order No. BE 002338 Pos. 4	Bestelldatum / Date de Cde. / Date of Order 26.04.01
Gegenstand / Objet / Item Zylinderkopf Cylinder head	Mod.-Nr. / No du Mod. / Pattern No. 122 M38 504.401
	Zchnng.-Nr. / No du Plan / Drg. No.
Werkstoff / Matériaux / Material EN-GJL-250 EN 1561	Vorschrift / Spécification / Specification MBV 416 F / MBV 1004 I, Pt. 2 + 4

Chemische Zusammensetzung Composition chimique Chemical composition					Art der Bescheinigung nach Genre d'attestation selon Kind of record to					
Giessdatum/Probe-Nr. Date coulée/No d'épr. Cast date/Specim. No.	Anzahl Nombre Quantity	C %	P %	S %	Si %	Mn %	Cu %	Mg %		
15.6.01	9	3.31	0.056	0.039	1.56	0.65	0.41			

Mechanische Eigenschaften Propriétés mécaniques Mechanical properties					Art der Bescheinigung nach Genre d'attestation selon Kind of record to					
Art des Probematerials Type de matériel d'essai Kind of test material					EN 10204 3.1 B					
☒ separat gegossen coulée à part separately cast					☐ angegossen attendant cast on					
					Typ / Abmessung Type / Dimension Ø 30					

	Zugprobe Epreuve Test specim. do / L mm	Dehngrenze L. d'élasticité Proof stress Rp 0.2 % N/mm²	Zugfestigkeit Rés à la tract. Tensile str. Rm N/mm²	Dehnung Allongement Elongation A ₅ %	Härte Dureté Hardness HB	Kerbschlagarbeit an Energie de choc selon Impact energie on			
Sollwerte min	Ø 20		250			Einzelwert Xi			
Val. spec. max									

Giessdatum/Probe-Nr. Date coulée/No d'épr. Cast date/Specim. No.	Gemessene Werte / Valeurs mesurées / Measured values								
15.6.01 / 71	Ø 20		288		201				

Prüfer Contrôleur Tester	Datum Date Date	Visum Sign. Sign.	Materialprüfung Essai de matériaux Material testing	Datum Date Date	18.6.01	Visum Sign. Sign.

Härte (Stück) Dureté (Pièce) Hardness (Item)	Soll Spéc. Spec.	HB	Gemessen Mesurée Measured	HB

Wärmebehandlung / Traitement thermique / Heat treatment

Bemerkungen; weitere Prüfungen / Remarques; autres essais / Remarks; further tests

Aussteller	Abnahme durch / Réception par / Inspection by	BÜLGUSS Giesserei AG
Datum 24.8.01	Gesellsch./Kunde Société/Client Agency/Customer	Qualitätsstelle / Qualité / Quality Der Werksachverständige
Frö	Datum / Date	Datum / Date 24.08.2001
Anzahl 1	Unterschrift Signature	Unterschrift Signature

Fonderie des Rondez SA

Abnahmeprüfzeugnis /
Inspection certificate
DIN 50 049-3.18

Nr./No.

Datum/Date

96-1249

19.03.96

Lieferschein/Delivery note
Nr./No vom/of

22 MAR 1996

SULZER BURCKHARDT AG
Zhd Herrn Tombers
Dornacherstrasse 210
4002 BASEL

Zeichen des Herstellerwerkes/
Marke of the manufacturer :

VR

Zeichen des Sachverständigen/
Stamp of the expert :

326/Sch

Besteller/Purchaser zer-Burckhardt Basel		Bestellung Nr./Order No. 9511592/063		Datum/Date 05.12.95						
Unsere Komm-Nr./Our order-No. 93 100		Unsere Abtlg./Our section Qualitätsservice		Telefon 066/21.12.11						
Prüfgegenstand/Product 33 Zylinderkopf 122 M 38505 400		Lieferbedingungen/Terms of delivery MBV 416 Rev. B								
Werkstoff/Kind of material GG 25		Lieferbedingungen und/oder amtliche Vorschriften Terms of delivery and/or official regulations DIN 1691								
Giessdatum/Date Charge Nr./No.	Anzahl/ Quantity	C	Si	Mn	P	S	Mg	Cr	Ni	Cu
A08036	33	3.27	1.85	0.62	0.14	0.08				0.29
Giessdatum/Date Charge Nr./No.	Zugfestigkeit/ Tensile strength Rm in N/mm2 Min 250	0,2-Dehngrenze/ 0,2-proof stress Rp 0,2 in N/mm2	Bruchdehnung/ Elongation A5 in %	Kerbschlagarbeit/Impact value (...-Probe/Test piece) in Joule				Probe/1) Sample		
A08036	316			1	2	3	X	oC	9	

Wärmebehandlung/Heat treatment

1) getrennt gegossen/separately cast
= angegossen/cast on
= aus dem Stück/out of casting

(Der Werksachverständige/The plant expert)

new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test			Aufgegeben von Der: AMI 2 Vom: 23.02.04	
Objekt Nr. No. d'objet Reg. Nr. 122.136.603 "I"		Korn. Nr. No. de corn. Corn. Nr. BE-Aut. 007647				
Maschinen Typ: Type de la mach. Machine type				Masch. Nr.: No. mach. Machine No.		
Kunden Ref.: Client Ref. Zylinder ϕ 170 (Führung)				Aufstellungsland: Pays d'installation Country of install		
Prüfung durch: Epreuve réalisée par Test by new ambrosetti TECHNOLOGIES SA				Vorschriften: Spécifications GFV.500.027		
CH-6928 MANNO		Max. zulässiger Betriebsdruck Pression de serv. max. admise Max. allow. work pressure		Prüfdruck P. d'épreuve Test pressure		Dauer Durée Cycle
Anz. Vers. Qty. Balzschmung Casing Casing		Zeichnung Dessin Drawing		Prüfmedium Milieu d'essai Test medium		Bemerkung Remarques Remarks
				bar		min
50 Führungszylinder ϕ 170 1647. 1 ÷ 50 13 34 32				20 30 30 Wasser		Qualifizierung Inspection-qualité Quality check AMI 2 HT 23.02.04
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success				Markierung: Marquage AMI 2 HT 23.02.04		
Qualitätszsch. / Team en qualité / Quality Engineering		Inspektor von: Inspecteur de Inspector from new ambrosetti TECHNOLOGIES SA		Datum: 22.02.04		
Datum:		Datum: CH-6928 MANNO		Datum:		

Beschainigung nach EN 10204

certificate acc. to / certificat selon

über / Werkstoffprüfung

of material testing

d'essai des matériaux

3. 1 B

EN-JL 1040 (GG-25) EN-GJL-250

DIN EN 1561



ALLWEILER

GIßEREI/TECHNIK

Kennzeichnung: Chargen-Nr.

Marking: cast-no

Marquage: coulée-no

/ Herstellerzeichen

/ Brand of manufacturer

/ Marque de fabricant

Lieferzustand:

State of delivery:

Etat de livraison:

Bestellnummer:

number of order.

nr. de commande:

Bezeichnung des Gußteils

designation of casted part

désignation du produit coulé

ZYLINDER

263 1100 011

Modell-Nr.

pattern-no.

no de modèle

122M38500.400

Ident - Nr.
i.d.-number

507147

Anzahl quantity nombre	Charge-Nr. cast-no. no. de coulée	C %	Si %	Mn %	P %	S %	Sc-Value	d0 [mm]	F max [N]	HBS 10/3000 Probesslab min: 250	Rm [N/mm ²]
22	03 10 15 06	3,21	2,08	0,862	0,046	0,048	0,904	18,90	84100	243	270
34	03 10 15 07	3,22	2,06	0,768	0,046	0,047	0,905	20	84167	232	269
35	03 10 15 08	3,25	2,01	0,81	0,058	0,050	0,910	19,96	83799	237	268
12	03 10 16 08	3,26	2,12	0,735	0,06	0,056	0,923	19,99	84850	226	271
36	03 10 16 09	3,24	2,07	0,746	0,084	0,051	0,915	19,96	86498	226	263
35	03 10 16 010	3,26	2,02	0,741	0,069	0,050	0,917	19,99	84613	223	270
36	03 10 17 07	3,25	2,05	0,720	0,061	0,051	0,916	20,03	91870	230	282
36	03 10 17 08	3,22	2,07	0,724	0,082	0,054	0,910	19,96	86630	242	309
37	03 10 17 09	3,26	2,04	0,695	0,081	0,053	0,918	19,99	87043	219	277

Zugprobekorb der getrennt eingesetzten Probe nach DIN EN 10 002

éprouvette de traction de l'éprouvette de coulée séparée selon DIN EN 10 002

la même test specimen of separate casted sample according to DIN EN 10 002

Datum: 30.03.2004

Werkstoffverständiger

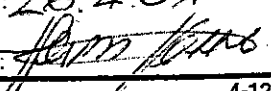
Quality Inspector / Expert d'entreprise

F. 2y. 3, 4, 5

5, 6, 7

Zg. 1

new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test			Reg. Nr. AMI 2		Ausgegeben von Dat: 19.11.03 Von: <i>mm</i>	
Objekt Nr. Ne d'objet Reg. Nr.		122.142.101		Kom. Nr. No de com. Com. No.		F-Auftr. 007308		
Maschinen Typ: Type de la mach. machine type:						Masch. Nr.: No mach. Machine No.		
KundenRef.: ClientRef. <i>Zylinder φ 225</i> ClientRef.				Aufstellungsland: Pays d'installation: Country of instalt.				
Prüfung durch: Epreuve exécutée par: Test by:				Vorschriften: Spécifications: Specifications:				
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO				GFV.500.027				
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zzeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. adms Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Durst	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks	
			bar	bar	min			
6	<i>Zylinder φ 225</i> <i>7308.1 ÷ 6</i>	<i>122.142.101</i>	<i>19</i>	<i>44</i>	<i>30</i>	<i>Wasser</i>	<i>i.o</i>	
4 6								
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success				Markierung: Marquage: Marking:				
Inspektor von: Inspecteur de: Inspector from:				new ambrosetti TECHNOLOGIES SA CH-6928 MANNO				
Datum:				Datum: 19.11.03 <i>mm</i>				

Reg. Nr.		82							
SULZER TURCKHARDT		Bescheinigung über Druck- und Dichtheitsprüfung <i>Certificat d'épreuve de pression et d'étanchéité</i> <i>Certificate of pressure and leaking test</i>						Aufgegeben von: Dat: 26.04.2001 Visum: R. Riegert	
Objekt Nr.: 122 142103 001 No d'objet:				Kom. Nr.: F-Auftr. 07231 No de com.:					
Reg. No.:				Masch. Nr.: No mach.:					
Maschinen Typ: CT Type de la mach.:				Aufstellungsland: Pays d'exploitation:					
Kunden/Ref.: Client/Ref.:				Vorschriften: KV4009 Spécifications:					
Prüfung durch: GRF Epreuve exécutée par:				Vorschriften: KV4009 Spécifications:					
Test by:									
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admis Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Durat	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks	Qualitätsprüfung Inspection-qualité Quality check	
			bar	bar	min			Dat.	
5	Zylinder d 170X315	1-122.142.103	38	57	30	Wasser			
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden <i>Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès</i> The above mentioned parts have passed the test with success								Markierung:  Marquage: Marking:	
GREENFIELD AG Qualitätstechn. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de: Inspector from:						
Datum:			Datum:			Datum: 26.4.01			
Visum:			Visum:			Visum: 			

Zyfl. 3. Stufe

Reg. Nr.		Aufgegeben von						
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test						
Objekt Nr. No. d'objet Prop. Nr.		Korn. Nr. No. de corn. Corn. Nr.						
122.142.112" B.		BE-Auftr. 007759/2						
Maschinen Typ. Type de machine Machine type		Masch. Nr. No. mach. Machine No.						
KundenRef. Clientel Clientel		Aufstellungsland: Pays d'installation Country of install.						
Prüfung durch: Epreuve exécutée par Test by		Vorschriften: Specifications Specifications						
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		GFV.500.027						
Anz. Nbre. Qty.	Bezeichnung Designation Designation	Zachnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admise Max. allow. work pressure	Prüfdruck P. d'épreuve Test pressure	Druck Course Unit	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks	Qualitätsprüfung in section-qualité Quality check
			bar	bar	min			AMI 2 HT
30	Zylinder φ 100 7759/2 1 ÷ 30	122.142.112	75	113	30	Wasser	1.2	AMI 2 HT
								
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success							Markierung: Marquage Marking	
Qualitätszsch. / Techn. de qualité / Quality Engineering							Inspektor von: Inspecteur de Inspector from	
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO							Datum: 05.02.04	

Reg. Nr.		4					
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test				Aufgegeben von Dat: 11.12.03 <i>MM</i>	
Objekt Nr. No d'objet Reg. No.		122.143.697		Kom. Nr. No de com. Com. No.		BE-Auftr. 007758 	
Maschinen Typ: Type de la mach. Machine type				Masch. Nr.: No mach. Machine No.:			
KundenRef.: ClientRef. ClientRef.				Aufstellungsland: Pays d'installation Country of install			
Prüfung durch: Epreuve exécutée par: Test by:				Vorschriften: Spécifications: Specifications:			
new ambrosetti		TECHNOLOGIES SA		GFV.500.027			
CH-6928 MANNO							
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zzeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. adms Max. allow work pressure	Prüfdruck P d'épreuve Test pressure	Dauer Durée Durst	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks  
			bar	bar	min		
30	Zylinder ϕ 58 7758.1 ÷ 30 	122.143.697	181	272	30	Wasser	1.0  
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success				Markierung:  			
QualitätsTech / Techn. de qualité / Quality Engineering		Inspektor Inspecteur de Inspector from		new ambrosetti TECHNOLOGIES SA			
Datum:		Datum		CH-6928 MANNO		Datum: 11.12.03	

• Zgl. 5. Seite

Nr. 4742 P. 2

NEW AMBROSETTI TECHNOLOGIES SA

12. Feb. 2004 17:34

new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test				Aufgegeben von <i>mf</i> Datum 03.02.04 Visum <i>mf</i>	
Objekt Nr. No. d'objet Reg. Nr. 122.143.694		Korn. Nr. No. de corn. Corn. Nr. BE-Auffr. 007727					
Maschinen Typ: Type de la mach. Machine type				Masch. Nr.: No mach. Machine No.			
Kundenref: Client ref. Client ref. Zylinder Ø 35				Aufstellungsland: Pays d'installation Country of install			
Prüfung durch: Epreuve réalisée par Test by new ambrosetti TECHNOLOGIES SA CH-6928 MANNO				Vorschriften: Spécifications Specifications GFV.500.027			
ANZ. Nbre. Qty.	Bezeichnung Designation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admiss. Max. allow. work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Dural	Prüfmedium Médium d'essai Test medium	Bemerkung Remarque Remarks
			bar	bar	min		Qualitätsprüfung in execution-qualité Quality check
20	Zylinder Ø 35 7727.1 ÷ 20	122.143.694	355	553	30	Wasser	<i>mf</i> AMI 2 BCA 41 03.02.04
13							
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success						Markierung: Marquage Marking AMI 2	
Qualitätsnachw. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de Inspector from new ambrosetti TECHNOLOGIES SA CH-6928 MANNO			Datum: 03.02.04 Visum:	



Integriertes Managementsystem
Bescheinigung Materialprüfung
 certificate of material testing
 nach DIN EN 10204 according to DIN EN 10204

Ausgabe 24.08.00/LK

FO 03.50

IMS 03.05

Seite 1 von 1
page 1 / 1

- ☐ Werksbescheinigung 2.1
certificate of compliance
- ☐ Werkszeugnis 2.2
test report
- ☐ Werksprüfzeugnis 2.3
manufacturer's test certificate

Abnahmeprüfzeugnis ☐ 3.1 A ☒ 3.1 B ☐ 3.1 C
inspection certificate

Abnahmeprotokoll ☐ 3.2 A ☐ 3.2 C
inspection report

Giessereikennzeichen: HO
foundry's identification: HO

Kennzeichnung am Stück: Mod.-Nr. / Mat. / Dat.
piece's identification: pattern no. HO / Ch.Nr./GG25

Kunde customer:	GreenField Basel	Ort adress:	4053 Basel
Auftr.-Nr. order no.:	30718	Losgrösse quantity:	5
Bezeichnung designation:	Zylinder	Zeich.Nr. drawing no.:	1-122 142101 Ind. C
Modell-Nr. pattern no.:	122 M 38.786.400	Werkstoff material:	EN-GJL-250
Bestell-Nr. order no.:	BE002461	Norm norm:	DIN EN 1561
Datum date:	10.05.01		

Analysenergebnisse chemical composition

Sollwerte setpoint												
Datum date	Charge cast-no.	C [%]	Si [%]	Mn [%]	P [%]	S [%]	Cu [%]	Mg [%]	Ni [%]	Ti [%]	Sn [%]	Cr [%]
19.06.01	643	3.13	2.22	0.69	0.052	0.062	0.191	0.000	0.033	0.015	0.010	0.115

Mechanische Werte mechanical properties

Art des Probematerials: ☐ angegossen cast on ☒ separat gegossen separately cast ☐ aus dem Gussstück out of the casting

Sollwerte setpoint		250										
Datum date	Charge cast-no.	Ø [mm]	R _m [N/mm ²]	R _{p0.2} [N/mm ²]	A [%]	HB	Kerbschlagzähigkeit [Joule] notched bar impact value					
19.06.01	643	20.0	251			178	Ø/3 [J]	1/3 [J]	2/3 [J]	3/3 [J]		

Bemerkungen remarks

Wir bestätigen, dass die Lieferung geprüft wurde und den Vereinbarungen bei der Bestellannahme entspricht.
 We certify, that the described material has been tested and correspond to the terms of the order.

Oberburg, 08.08.2001

Visum + Stempel:
signature + stamp



P. Herlin
 Werkssachverständiger works expert

	Giesserei Hegi AG Eisen - und Alugiesserei Mech. Werkstätte 3414 Oberburg	Formular form Bescheinigung Materialprüfung <i>certificate of material testing</i> nach DIN EN 10204 according to DIN EN 10204 <i>Zug Z. St. 1</i>	Nr. 29.01.99/SW Form. 10.01 <i>form 10.01</i>
			Seite 1 von 1 page 1 / 1

- ☐ Werksbescheinigung 2.1
certificate of compliance
☐ Werkszeugnis 2.2
test report
☐ Werksprüfzeugnis 2.3
manufacturer's test certificate

Abnahmeprüfzeugnis ☐ 3.1 A ☒ 3.1B ☐ 3.1C
inspection certificate

Abnahmeprotokoll ☐ 3.2 A ☐ 3.2 C
inspection report

Giessereikennzeichen: HO
founry's identification: HO

Kennzeichnung am Stück: Mod.-Nr. /Mat./Dat.
piece's identification: pattern no.

Kunde <i>customer:</i>	GreenField AG	Ort <i>address:</i>	4053 Basel
Auftr.-Nr. <i>order no.:</i>	27885	Losgrösse <i>quantity:</i>	11
Bezeichnung <i>designation:</i>	Zylinder	Zeich.Nr. <i>drawing no.:</i>	1-122 142.103 C
Modell-Nr. <i>pattern no.:</i>	122 M 38.785.400 *komb*	Werkstoff <i>material:</i>	EN-GJL-250
Bestell-Nr. <i>order no.:</i>	108338	Norm <i>norm:</i>	DIN EN 1561
Datum <i>date:</i>	23.10.00		

Analysenergebnisse *chemical composition*

Sollwerte <i>setpoint</i>												
Datum <i>date</i>	Charge <i>cast-no.</i>	C [%]	Si [%]	Mn [%]	P [%]	S [%]	Cu [%]	Mg [%]	Ni [%]	Ti [%]	Sn [%]	Cr [%]
14.11.00	Nr.451	3.08	2.10	0.62	0.065	0.071	0.123	0.001	0.028	0.016	0.009	0.051
14.11.00	Nr.452	3.05	2.12	0.62	0.067	0.069	0.122	0.001	0.028	0.016	0.009	0.050

Mechanische Werte *mechanical properties*

Art des Probenmaterials: ☐ angegossen ☒ separat gegossen ☐ aus dem Gussstück
kind of test material cast on separately cast out of the casting

Sollwerte <i>setpoint</i>			250								
Datum <i>date</i>	Charge <i>cast-no.</i>	Ø [mm]	R _m [N/mm ²]	R _{p0.2} [N/mm ²]	A [%]	HB	Kerbschlagzähigkeit [Joule] <i>notched-bar impact value</i>				
							Ø/3 [J]	1/3 [J]	2/3 [J]	3/3 [J]	
14.11.00	Nr.451	20.0	296			194					
14.11.00	Nr.452	20.0	291			192					

Bemerkungen *remarks*

Wir bestätigen, dass die Lieferung geprüft wurde und den Vereinbarungen bei der Bestellannahme entspricht.
We certify, that the described material has been tested and correspond to the terms of the order.

Oberburg, 19.12.2000

Visum + Stempel:
signature + stamp




 Werkssachverständiger *works expert*

Bescheinigung nach EN 10204

Certificate acc. to / certificat selon

3. 1 B

Werkstoffprüfung

of material testing

Essai des matériaux

gefaxt

16. Okt. 2003

281



Zeichen

EN-JL1040 (GG-25)

EN-GJL-250

nach: / acc.to: / selon:

DIN EN 1561

Werkstoff:

material:

matériaux:

Kennzeichnung:

Chargen-Nr. / Herstellerzeichen

Marking:

cast-no / Brand of manufacturer

Marquage:

coulée-no / Marque de fabricant

Lieferzustand:

State of delivery:

Etat de livraison:

Gußzustand

State of cast

état de fond

Anforderungs-Nr.:

requirement-no.: 01797586 / 01

numero de demande:

Bestellnummer:

number of order: 2.003.00000 608

nr. de commande:

Anzahl quantity nombre	Bezeichnung des Gußteils designation of casted part désignation du produit coulé	Ident - Nr. i.d.-number	Modell-Nr. pattern-no. no de modèle	Charge-Nr. cast-no. no. de coulée	Anforderung requirement demande selon
29	ZYLINDER 263 1100 010	507145	122M38745.400	03 10 06 04	DIN EN 1561

CHEMISCHE ZUSAMMENSETZUNG / CHEMICAL COMPOSITION / COMPOSITION CHIMIQUE [%]

Chargen-Nr. cast-no. no. de coulée	C %	Si %	Mn %	P %	S %	Sc-Wert
03 10 06 04	3,23	1,93	0,682	0,034	0,052	0,896

FESTIGKEITSEIGENSCHAFTEN / MECHANICAL PROPERTIES / CARACTÉRISTIQUES MÉCANIQUES

Chargen-Nr. cast-no. no. de coulée	d ₀ [mm]	F _{max} [N]	HBS 10/3000	R _m [N/mm ²]		
Anforderung:	Zugprobestab der getrennt gegossenen Probe nach DIN EN 10 002			Zugfestigkeit	min.250	
					max.350	
requirement:	tensile test specimen of separate casted sample according to DIN EN 10 002			tensile strength		
demande:	épreuve de traction de l'éprouvette de coulée séparée selon DIN EN 10 002			résistance à la traction		
03 10 06 04	20,02	91490	218	291		

Datum: 16.10.2003
date:

BEA 03/632

Werkstoffachverständiger
Quality Inspector / Expert démontre

122 R 3 8739401

4

Einigung nach EN 10204

acc. to / certificat selon

Werkstoffprüfung

material testing

des matériaux

3 1 B



Verkstoff:

aterial:

matériaux:

Chargen-Nr / Herstellerzeichen
Marking: cast-no / Brand of manufacturer
Marquage: coulée-no / Marque de fabricant

EN-JL1040 (GG-25)
EN-GJL-250

nach:

acc.to:

selon:

DIN EN 1561

Lieferzustand: Gußzustand
State of delivery: State of cast
Etat de livraison: état de fond

Anforderungs-Nr.:

requirement-no.: 01770409 / 01

numero de demande:

Bestellnummer:

number of order:

nr. de commande:

Anzahl quantity nombre	Bezeichnung des Gußteiles designation of casted part désignation du produit coulé	Ident - Nr. i.d.-number	Modell-Nr. pattern-no. no de modèle	Charge-Nr. cast-no. no. de coulée	Anforderung requirement demande selon
27	ZYLINDER 263 1100 008	507034	122M38739.401	03 06 02 05	DIN EN 1561

CHEMISCHE ZUSAMMENSETZUNG / CHEMICAL COMPOSITION / COMPOSITION CHIMIQUE [%]

Chargen-Nr. cast-no. no. de coulée	C %	Si %	Mn %	P %	S %	Sc-Wert
03 06 02 05	3,25	1,95	0,71	0,052	0,051	0,905

FESTIGKEITSEIGENSCHAFTEN / MECHANICAL PROPERTIES / CARACTÉRISTIQUES MÉCANIQUES

Chargen-Nr. cast-no. no. de coulée	d ₀ [mm]	F max [N]	HBS 10/3000	R _m [N/mm ²]	
Anforderung:	Zugprobekörper der getrennt gegossenen Probe nach DIN EN 10 002			Zugfestigkeit min.250 max.350	
requirement:	tensile test specimen of separate casted sample according to DIN EN 10 002			tensile strength	
demande:	éprouvette de traction de l'éprouvette de coulée séparée selon DIN EN 10 002			resist à la traction	
03 06 02 05	19,99	93170	237	297	

Datum: 11.06.2003
date:

Werksachverständiger
Quality Inspector / Expert d'entreprise

Angabe nach EN 10204

certificate acc. to / certificat selon
r Werkstoffprüfung
material testing
essai des matériaux

3 1 B



241.5.8

Markierung:

Material:

Legierung:

EN-JL1040 (GG-25)
EN-GJL-250

nach:

acc.to:

selon:

DIN EN 1561

Bezeichnung:

King:

Quage:

Chargen-Nr. / Herstellerzeichen
cast-no / Brand of manufacturer
coulée-no / Marque de fabricant

Lieferzustand:

State of delivery:

Etat de livraison:

Gußzustand

State of cast

etat de fond

Bestellungs-Nr.:

Orderment-no.:

Numero de demande:

01796781 / 01

Bestellnummer:

number of order: 2.003/00000607

nr. de commande:

Anzahl quantity nombre	Bezeichnung des Gußteiles designation of casted part désignation du produit coulé	Ident - Nr. i.d.-number	Modell-Nr. pattern-no. no de modèle	Charge-Nr. cast-no. no. de coulée	Anforderung requirement demande selon
40	Zylinder / 263 1100 009	507146	122M 38738. 401	03 10 28 05	DIN EN 1561

CHEMISCHE ZUSAMMENSETZUNG / CHEMICAL COMPOSITION / COMPOSITION CHIMIQUE [%]

Chargen-Nr. cast-no. no. de coulée	C %	Si %	Mn %	P %	S %	Sc-Wert	
03 10 28 05	3,28	1,94	0,8	0,066	0,052	0,913	

ESTIGKEITSEIGENSCHAFTEN / MECHANICAL PROPERTIES / CARACTÉRISTIQUES MÉCANIQUES

Chargen-Nr. cast-no. no. de coulée	do [mm]	F max [N]	HBS 10/3000	Rm [N/mm ²]			
Anforderung:	Zugprobekörper der getrennt gegossenen Probe nach DIN EN 10 002			Zugfestigkeit	min.250		
requirement:	tensile test specimen of separate casted sample according to DIN EN 10 002			tensile strength	max.350		
demande:	épreuve de traction de l'éprouvette de coulée séparée selon DIN EN 10 002			résistance à la traction			
03 10 28 05	19,97	89928	223	287			

Datum:
date:

04.11.2003

Werkstoffsachverständiger
Quality Inspector / Expert d'entreprise

2.003/665



Quality documentation

GreenField order no : 1 0246/700,550
Machine type : C5T 223.-LC
Client : GreenField Compr. North America
Client's reference : US Filter, 6979
Plant : USA

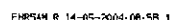
Please state in all further correspondence and telephone messages the GreenField order no:

Address: GreenField Ltd.
Güterstrasse 107
CH – 4133 Pratteln

Telephone: 061 / 827 35 35
Telefax : 061 / 827 34 97
E-Mail : quality@greenfield.ch

CONTENT

File No:	Designation	chapter No:	sheet No:
No.	Designation	Chapter	Sheet No.
	Compressor P&I Diagram of compressor Test run certificate	1	
	Crank case Pressure Test, material certificate	2	
	Cylinder Head Pressure Test, material certificate	3	
	Cylinder Jacket Pressure Test, material certificate	4	
	Cylinder Pressure Test, material certificate	5	



Reg. Nr.							
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test				Aufgegeben von Dat: 17-2-04 <i>RKH</i>	

Objekt Nr. No d'objet: Reg. No.		122.078.645/646		Korn. Nr. No de corn. Corn. No.		F-Auftr. 007817	
Maschinen Typ: Type de la mach. Machine type:				Masch. Nr.: No mach. Machine No.:			
Kunden/Ref.: Client/Ref.: Client/Ref. <i>KURBELGEHÄUSE 122.078.645/646</i>				Aufstellungsland: Pays d'implantation: Country of install:			
Prüfung durch: Epreuve exécutée par: Test by:				Vorschriften: Spécifications: Specifications:			

Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. adms Max. allow work pressure	Prüfdruck P d'épreuve Test pressure	Dauer Durée Durst	Prüfmedium Milieu d'essai Testmedium	Bemerkung Remarques Remarks	Qualitätsprüfung Inspection-qualité Quality check
	new ambrosetti TECHNOLOGIES SA CH-6928 MANNO							
			bar	bar	min			<i>2</i> 17-2-04
10	KURBELGEHÄUSE BE 7817.21÷30	122.078.645/646	16	30	30	Wasser		<i>AMI 2</i> HT
	(26)							

Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden
 Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès
 The above mentioned parts have passed the test with success

Markierung:
 Marquage:
 Marking:

Qualitäts- / Techn. de qualité / Quality Engineering

Inspektor von:
 Inspecteur de
 Inspector from

Datum

Datum

Datum 17-2-04

AMI 2

HT

Nottaris AG

Eisengiesserei/Modellbau
Bahnhofstrasse 2
Postfach
CH-3414 Oberburg b. Burgdorf

Tel. 034 427 07 07
Fax 034 427 07 08
info@nottaris.ch
www.nottaris.ch
MwSt.-Nr. 126 555

SN EN ISO 9001:2000



Nr. / No. / no. 1825

Zeichen des Sachverständigen: W0
Stamp of the expert / Signe d'expert

Herstellerzeichen / Manufacturer's stamp / Marque du manufacturier



ORIGINAL

Abnahmeprüfzeugnis / inspection certificate / Certificat de réception

EN 10 204 3.1.B

Kunde Customer Client	new ambrosetti, Technologies SA, 6928 Manno		
Bestell Nr. Cust Order no. no. de commande	2.003/00000/47	Datum Date date	01.10.03
Unsere Auftrags Nr. Order No. no. de commande	44520	Unsere Abteilung Our department notre référence	QM
Bezeichnung Designation Désignation	Kurbelgehäuse	Modell Nr. Platten No. no. du modèle	122 M 38 493.413
Werkstoff Material Matière	EN-GJS 400-15 U	Lieferbedingung Terms of delivery cond. de livraison	MBV 1004 Rev. I MBV 412 Rev. B

Pos. Item pos	Charge			Anzahl Quantity quantité	Gewicht kg/St. Weight kg/piece poids kg/piece	A %	R _{p0.2} N/mm ²	R _m N/mm ²	A _v J	Brinellharte Brinell hardness dureté Brinell HB
	Sollwert / nominal value / valeur effective					>15	>250	>400		
	Datum Date date	Nr. No. no.	Laufnr consec. No. conséc. no				Ist is est			Ist is est
1	11.12.03	6219 ✓	4	1	462	19.0	370	454		159
2	11.12.03	6225 ✓	3	1	462	18.0	370	459		159

Pos. Item pos.	Chemische Zusammensetzung / Chemical composition / composition chimique									
	% C	% Si	% Mn	% P	% S	% Cu	% Ni	% Mo	% Cr	% Mg
1	3.60	2.28	0.089	0.028	0.015					0.043
2	3.54	2.17	0.087	0.026	0.017					0.033

Pos. Item pos.	Gefüge / structure / structure		
	Matrix / matrix / matrice	Grafitform / forme of graphite / forme du graphite	Grafitgröße / dimension of graphite / grandeur du graphite

① getrennt gegossen / seperatly cast / coulée séparément
angegossen / cast on / éprouvette attenante
aus dem Stück / out of casting / éprouvette tirée de la pièce

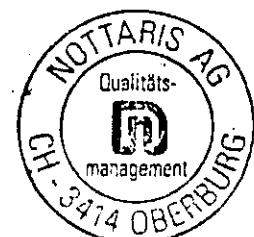
A R_m R_{p0.2} A_v HB
☐ ☐ ☐ ☐ ☐
☒ ☒ ☒ ☐ ☒
☐ ☐ ☐ ☐ ☐

der Werksachverständige
the plant expert
l'expert de l'usine

NOTTARIS AG

Datum / date / date: 19.01.04 / tl.

Form.10.06 3.1b.doc AA 10.11/27.10.03



Bocan 04/28

1-81.

Reg. Nr.									
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test				Aufgegeben von Dat: 6-6-03 Visum: R. L. H.			
Objekt Nr.: No d'objet: Reg. No.		122.138.739		Korn. Nr.: No de corn. Corn. No.		F-Auftr. 6287			
Maschinen Typ: Type de la mach. machine type:						Masch. Nr.: No mach.: Machine No.:			
KundenRef.: Client Ref.: Client Ref.:				Aufstellungsland: Pays d'implantation: Country of install:					
Prüfung durch: Epreuve réalisée par: Test by:				Vorschrift: Spécification: Specifications: GFV.500.027					
Art. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admiss. Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Durst	Prüfmedium Milieu d'essai Testmedium	Bemerkung Remarques Remarks	Qualitätsprüfung Inspection-qualité Quality check	
			bar	bar	min				
9	Zylinder Ø 225 122-138.739		29	44	30	Wasser		HT R. L. H. 6-6-03	
								2X	

Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden
Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès
The above mentioned parts have passed the test with success

Markierung:
Marquage:
Marking:

Qualitätsnachw. / Techn. de qualité / Quality Engineering

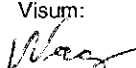
Inspektor von:
Inspecteur de
Inspector from

Datum:

Datum:

Datum:

Reg. Nr.									
GreenField		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test					Aufgegeben von: Dat: 12.04.01 Visum: R. Riegert		
Objekt Nr.: No d'objet: Reg. No.: 122 138 740 001				Kom. Nr.: FAUF001533 No de com.: Com. No.:					
Maschinen Typ: Type de la mach.: CT machine type:				Masch. Nr.: No mach.: Machine No.:					
Kunden/Ref.: Client/Ref.: Client/Ref.:				Aufstellungsland: Pays d'exploitation: Country of install:					
Prüfung durch: Epreuve exécutée par: GRF Test by:				Vorschriften: Spécifications: KV4009 Specifications:					
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admis Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Durat	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks	Qualitätsprüfung Inspection-qualité Quality check	
			bar	bar	min			Dat.	
18 2 10	Zylinderkopf d255X115	1-122.138.740	25	37,5	30	Wasser	 	03. MAL 2001  08.06.01	
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success							Markierung: Marquage: Marking:		
GreenField AG Qualitätstechn. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de: Inspector from:						
Datum:			Datum:				Datum:		
Visum:			Visum:				Visum:		

Reg. Nr. 3							
 Allweier Präzisionsteile GmbH		Bescheinigung über Druck- und Dichtheitsprüfung <i>Certificat d'épreuve de pression et d'étanchéité</i> Certificate of pressure and leaking test				Aufgegeben von: Dat: 27.11.2003 Visum: 	
Objekt Nr.: No d'objet: Reg. No.: 122247729001		Kom. Nr.: BE007634 No de com.: Com. No.:					
Maschinen Typ: Type de la mach.: machine type:					Masch. Nr.: No mach.: Machine No.:		
Kunden/Ref.: Client/Ref.: Client/Ref.:				Aufstellungsland: Pays d'exploitation: Country of install:			
Prüfung durch: Epreuve exécutée par: Allweier Präzisionsteile GmbH Test by:				Vorschriften: Spécifications: GFV.500.027 Specifications:			

Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admis Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Durat	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks	Qualitätsprüfung Inspection-qualité Quality check Dat.
			bar	bar	min			
1	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
2	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
3	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
4	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
5	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
6	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
7	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
8	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
9	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
10	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
11	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
12	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
13	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
14	Zylinderkopf D215/35x106	2-122.247.729	X	165	30	Wasser		A 56
15	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
16	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
17	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
18	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
19	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56
20	Zylinderkopf D215/35x106	2-122.247.729		165	30	Wasser		A 56

Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden <i>Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès</i> The above mentioned parts have passed the test with success		Markierung: Marquage: Marking:
Qualitätstechn. / Techn. de qualité / Quality Engineering	Inspektor von: Inspecteur de: Inspector from:	13.01.04
Datum:	Datum:	Datum:
Visum:	Visum:	Visum: 

Reg. Nr. 6							
 Allweier Präzisionsteile GmbH		Bescheinigung über Druck- und Dichtheitsprüfung <i>Certificat d'épreuve de pression et d'étanchéité</i> Certificate of pressure and leaking test				Aufgegeben von: Dat: 15.12.2003 Visum: <i>Wag</i>	
Objekt Nr.: No d'objet: 122247727001 Reg. No.:		Kom. Nr.: No de com.: BE007752 Com. No.:					
Maschinen Typ: Type de la mach.: machine type:				Masch. Nr.: No mach.: Machine No.:			
Kunden/Ref.: Client/Réf.: Client/Ref.:				Aufstellungsland: Pays d'exploitation: Country of install:			
Prüfung durch: Epreuve exécutée par: Allweier Präzisionsteile GmbH Test by:				Vorschriften: Specifications: GFV.500.027			
Anz. Nbre. Qty.	Bezeichnung Désign. Designation	Z.ichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admis Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Durat	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks
			bar	bar	min		Qualitätsprüfung Inspection-qualité Quality check Dat.
51	Zylinderkopf D215/35x106	2-122.247.727	X	295	30	Wasser	
52	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
53	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
54	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
55	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
56	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
57	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
58	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
59	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
60	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
61	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
62	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
63	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
64	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
65	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
66	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
67	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
68	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
69	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
70	Zylinderkopf D215/35x106	2-122.247.727		295	30	Wasser	
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden <i>Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès</i> ne above mentioned parts have passed the test with success						Markierung: Marquage: Marking:	
Qualitätstechn. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de: Inspector from:			<i>06:0204</i> <i>Guinness</i>	
Datum:			Datum:				
Visum:			Visum:			Visum:	

From: GREENFIELD

061 827 34 80

5

22/03/2004 11:09 #026 P.001/001

DERO Feinmechanik		Bescheinigung über Druck- und Dichtheitsprüfung <i>Certificat d'épreuve de pression et d'étanchéité</i> <i>Certificate of pressure and leaking test</i>				Aufgegeben von: Dat: 02.03.2004 Visum: kd		
Objekt Nr.: No d'objet Reg. No.: 2-122247726d		Kont. Nr.: No de com.: Contr. No.: BE 007751						
Maschinen Typ: Type de la mach.: CT		Masch. Nr.: No mach.: Machine No.:						
Kunden/Ref.: Client/Ref.:		Aufstellungsland: Pays d'installation: Country of instll:						
Prüfung durch: Epreuve exécutée par: DERO		Verschriften: Spécifications: Specifications: GFV.500.027						
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admise max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Dural	Prüfmedium Médium d'éessai Testmedium	Bemerkung Remarque Remarks	Qualitätsprüfung Inspection-qualité Quality check Dat:
			bar	bar	min			
10	Zylinderkopf	Z-122247726d	385	580	30	Wasser		02. März 2004
								V6
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden <i>Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès</i> <i>The above mentioned parts have passed the test with success</i>						Markierung: marquage: Marking: 		
Qualitätsrech. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de: Inspector from:					
Datum:  02. März 2004			Datum:			Datum:		
Visum:			Visum:			Visum:		

Fonderie des Rondez SA

Abnahmeprüfzeugnis /
Inspection certificate
DIN 50 049-3.18

Nr./No. Datum/Date

96-1249 19.03.96

Lieferschein/Delivery note
Nr./No vom/of

22 MAR 1996

SULZER BURCKHARDT AG
Zhd Herrin Tombers
Dornacherstrasse 210
4002 BASEL

Zeichen des Herstellerwerkes/
Marke of the manufacturer :

VR

Zeichen des Sachverständigen/
Stamp of the expert :

326/Sch

Besteller/Purchaser Sulzer-Burckhardt Basel		Bestellung Nr./Order No. 9511592/063		Datum/Date 05.12.95						
Unsere Komm-Nr./Our order-No. 93 100		Unsere Abtlig./Our section Qualitätsservice		Telefon 066/21.12.11						
Prüfgegenstand/Product 33 Zylinderkopf 122 M 38505 400		Lieferbedingungen/Terms of delivery MBV 416 Rev. B								
Werkstoff/Kind of material GG-25		Lieferbedingungen und/oder amtliche Vorschriften Terms of delivery and/or official regulations DIN 1691								
Giessdatum/Date Charge Nr./No.	Anzahl/ Quantity	C	Si	Mn	P	S	Mg	Cr	Ni	Cu
A08036	33	3.27	1.85	0.62	0.14	0.08				0.29
Giessdatum/Date Charge Nr./No.	Zugfestigkeit/ Tensile strength Rm in N/mm2 Min 250	0,2-Dehngrenze/ 0,2-proof stress Rp 0,2 in N/mm2		Bruchdehnung/ Elongation A5 in %		Kerbschlagarbeit/Impact value (...-Probe/Test piece) in Joule			Probe/1) Sample	
A08036	316					1	2	3	X	oC
										9

Wärmebehandlung/Heat treatment

1) getrennt gegossen/separately cast
2) angegossen/cast on
aus dem Stück/out of casting

(Der Werksachverständige/the plant expert)

Reg. Nr.							
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test				Aufgegeben von Ort: AMI Datum: 23.02.04	
Objekt Nr. No d'objet Reg. Nr.		122.136.603 "I"		Kom. Nr. No de com Com. Nr.		BE-Autht. 007647	
Maschinen Typ: Type de machine Machine type				Masch. Nr. No mach. Machine No.			
KundenRef. ClientRef. ClientRef.				Aufstellungsland: Pays d'installation Country of install			
Prüfung durch: Epreuve réalisée par Ex by				Vorschriften: Sociétés Specifications			
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO				GFV.500.027			
Anz. Nbre. Qty.	Bezeichnung Designation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. adms. Max. allow. work pressure	Prüfdruck P d'épreuve Test pressure	Dauer Durée Durt	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks
			bar	bar	min		Qualitätsprüfung In spection-qualité Quality check
50	Führungszylinder φ 170		20	30	30	Wasser	AMI 2 HT 23.02.04
	7647.1 ÷ 50		29 16 23				AMI 2 HT
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success				Markierung: Markierung: Markierung:			
Qualitätszsch. / Team de qualité / Quality Engineering Datum:				Inspektor von: Inspecteur de Inspector from new ambrosetti TECHNOLOGIES SA CH-6928 MANNO			
Datum:				Datum: 22.02.04			

Bescheinigung nach EN 10204

certificate acc. to / certificat selon

über Werkstoffprüfung

of material testing

d'essai des matériaux

3 - 1 B

EN-JL 1040 (GG-25) EN-GJL-250

DIN EN 1561



ALLWEILER

GIESEREITECHNIK

Kennzeichnung: Chargen-Nr. / Herstellerzeichen

Marking: cast-no / Brand of manufacturer

Marquage: coulée-no / Marque de fabricant

Lieferzustand:

State of delivery:

Etat de livraison:

Gußzustand

State of cast

état de fond

Bestellnummer:

number of order

nr. de commande:

Bezeichnung des Gußteils
designation of casted part
désignation du produit coulé

ZYLINDER
263 1100 011

Modell-Nr.
pattern-no.
no de modèle

122M38500.400

Ident - Nr.
i.d.-number

507147

Anzahl quantity nombre	Charge-Nr. cast-no. no. de coulée	C %	Si %	Mn %	P %	S %	Sc-Wert	dD [mm]	F max [N]	HBS 10/3000 Probestab min: 250	Rm [N/mm ²]
22	03 10 15 06	3,21	2,08	0,862	0,046	0,048	0,904	18,90	84100	243	270
34	03 10 15 07	3,22	2,06	0,768	0,046	0,047	0,905	20	84167	232	269
35	03 10 15 08	3,25	2,01	0,81	0,053	0,050	0,910	19,98	83799	237	268
12	03 10 16 08	3,26	2,12	0,735	0,06	0,059	0,923	19,99	84850	226	271
36	03 10 16 09	3,24	2,07	0,748	0,084	0,051	0,915	19,96	86488	226	283
35	03 10 16 010	3,26	2,02	0,741	0,099	0,060	0,917	19,99	84613	223	270
36	03 10 17 07	3,25	2,05	0,720	0,081	0,051	0,916	20,03	91870	230	292
36	03 10 17 08	3,22	2,07	0,724	0,082	0,054	0,910	19,98	98630	242	309
37	03 10 17 09	3,26	2,04	0,895	0,081	0,053	0,918	19,99	87043	219	277

Zugprobentab der getrennt gegossenen Probe nach DIN EN 10 002

épreuve de traction de l'éprouvette de coulée séparée selon DIN EN 10 002

le table test specimen of separate casted sample according to DIN EN 10 002

Datum:

30.03.2004

Werkstachverständiger

Quality Inspector / Expert métroprise

[Signature]

K. 24. 3, 4, 5

3, 4, 5

Zy. 1

new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test			Aufgegeben von AMT 19.11.03	
Objekt Nr. 122.142.101		Kom. Nr. F-Auftr. 007308		Masch. Nr.: No mach. Machine No.		
Maschinen Typ: Type de la mach. machine type:		Aufstellungsland: Pays d'installation: Country of instalt.			Vorschriften: Spécifications: Specifications:	
Kunden/Ref.: Client/Ref.: Cylinderv φ 225		Prüfung durch: Epreuve exécutée par: Test by:			GFV.500.027	
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Max. zulässiger Betriebsdruck Pression de serv. max. admise Max. allow work pressure			Prüfdruck P. d'épreuve Test pressure	
Anz. Nbre. Qty.		Bezeichnung Désignation Designation		Dauer Durée Time		
Zzeichnung Dessin Drawing		bar		min		
6		Cylinderv φ 225 7308.1 ÷ 6		30		
122.142.101		29		44		
Wasser		1.0		AMT 2 HT		
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success		Markierung Marquage Marking:		AMT 2 HT		
Inspektor von: Inspecteur de Inspector from		new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Datum:		
Qualitätsnach / Techn. de qualité / Quality Engineering		Datum:		19.11.03		

Reg. Nr.		2								
GreenField		Bescheinigung über Druck- und Dichtheitsprüfung <i>Certificat d'épreuve de pression et d'étanchéité</i> <i>Certificate of pressure and leaking test</i>					Aufgegeben von: Dat: 14.05.01 Visum: R. Riegert			
Objekt Nr.: No d'objet: Reg. No.:		122142103001			No de com.: Com. No.:		FAUF002553			
Maschinen Typ: Type de la mach.: machine type:		CT					A No mach.: Machine No.:			
Kunden/Ref.: Client/Réf.: Client/Ref.:							Aufstellungsland: Pays d'exploitation: Country of install:			
Prüfung durch: Epreuve exécutée par: Test by:		GRF			Vorschriften: Spécifications: Specifications:		KV4009			
Anz. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admis Max. allow work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Durat	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks	Qualitätsprüfung Inspection-qualité Quality check Dat.		
			bar	bar	min					
3	Zylinder D. 170	1-122,142,103	38	57	30	Wasser	GRF 01	11. OKT. 2001		
6							GRF 02	27. MRZ. 2002		
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden <i>Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès</i> <i>The above mentioned parts have passed the test with success</i>						Markierung: Marquage: Marking:				
GreenField AG Qualitätstechn. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de: Inspector from:							
Datum:			Datum:			Datum: 27. MRZ. 2002				
Visum:			Visum:			Visum: <i>[Signature]</i>				

Zyfl. 3. Stufe

new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test				Aufgegeben von Datum: 15.02.04 Vom:	
Objekt Nr. No d'objet Reg. Nr.		122.142.112"8,		Kom. Nr. No de com. Com. No.		BE-Aufftr. 007759/2	
Maschinen Typ: Type de mach. Machine type				Masch. Nr. No mach. Machine No.			
KundenRef. Clientel Clientel				Aufstellungsland: Pays d'installation Country of install.			
Prüfung durch: Epreuve réalisée par Test by				Vorschriften: Spécifications Specifications			
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO				GFV.500.027			
ANZ. Nbre. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. adms. Max. allow. work pressure	Prüfdruck P d'épreuve Test pressure	Dauer Durée Durt	Prüfmedium Milieu d'essai Testmedium	Bemerkung Remarques Remarks
			bar	bar	min		Qualifizierung Inspection-qualité Quality check AMI 2 HT
30	Zylinder φ 100 7759/2 1-30	122.142.112	75	113	30	Wasser	AMI 2 HT 1-30
(6)							
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success						Markierung: AMI 2 HT	
Qualitätsnachw. / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de: Inspecteur from			new ambrosetti TECHNOLOGIES SA CH-6928 MANNO	
Datum:			Datum:			Datum:	

Reg. Nr.		4					
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO		Bescheinigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test				Aufgezeichnet 4 Dat: 22.10.03	
Objekt Nr. No d'objet Reg. No.		122.143.697		Kom. Nr. No de com. Com. No.		F-Auftr. 001049 F5 FAUF 007140	
Maschinen Typ: Type de la mach. Machine type:				Masch. Nr.: No mach. Machine No.:			
Kunden/Ref.: Client/Ref. Client/Ref. Zylinder φ 58				Aufstellungsland: Pays d'implantation Country of instalt			
Prüfung durch: Epreuve exécutée par: Test by: new ambrosetti TECHNOLOGIES SA CH-6928 MANNO				Vorschriften: Spécifications: Specifications: GFV.500.027			
Anz. Noms. Qty.	Bezeichnung Désignation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. adms Max. allow work pressure	Prüldruck P. d'épreuve Test pressure	Dauer Durée Durst	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarques Remarks
			bar	bar	min		Qualitätsprüfung Inspection-qualité Inspection-qualité AMI 4 HT Dat
26	Zylinder φ 58	122.143.697	181 (5)	272	30	Wasser	AMI 4 HT 1:0
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success						Markierung: Marking: AMI 4 HT	
new ambrosetti TECHNOLOGIES SA CH-6928 MANNO			Inspektion von: Inspection de: Inspection von:		Datum:		
Qualitäts- / Techn. de qualité / Quality Engineering			Datum: 22.10.03		Datum:		
Visum:			Visum:		Datum:		

• Zgl. S. 5. Sc. Fe

Nr. 4742 P. 2

12. Feb. 2004 17:34 NEW AMBROSETTI TECHNOLOGIES SA

Reg. Nr.		Beschleunigung über Druck- und Dichtheitsprüfung Certificat d'épreuve de pression et d'étanchéité Certificate of pressure and leaking test		Aufgegeben von 03.02.04				
new ambrosotti TECHNOLOGIES SA CH-6928 MANNO		Objekt Nr. 122.143.694		Korn. Nr. BE-Autr. 007717				
Maschinen Typ: Type de la mach. Machine type		Masch. Nr. No mach. Machine No.						
KundenRef Clientel Clientel		Aufstellungsland: Pays d'installation Country of install						
Prüfung durch: Epreuve réalisée par Test by		new ambrosotti TECHNOLOGIES SA CH-6928 MANNO		Vorschriften: Spécifications Specifications GFV.500.027				
Art. Nbre. Qty.	Bezeichnung Designation Designation	Zeichnung Dessin Drawing	Max. zulässiger Betriebsdruck Pression de serv. max. admiss. Max. allow. work pressure	Prüfdruck P. d'épreuve Test pressure	Dauer Durée Dural	Prüfmedium Médium d'essai Testmedium	Bemerkung Remarque Remarks	Qualitätsprüfung Inspection-qualité Quality check
			bar	bar	min			BCA 41
20	Zylinder Ø 35 7727.1 ÷ 20	122.143.694	355	533	30	Wasser		BCA 41
Die oben erwähnten Teile haben die Prüfung mit Erfolg bestanden Les pièces mentionnées ci-dessus ont subi l'épreuve avec succès The above mentioned parts have passed the test with success								
Qualifikation / Techn. de qualité / Quality Engineering			Inspektor von: Inspecteur de Inspector from			Markierung: Stampage Stamp		
Datum:			new ambrosotti TECHNOLOGIES SA CH-6928 MANNO			Datum: 03.02.04		
Visum:			Visum:			Visum:		



Integriertes Managementsystem
Bescheinigung Materialprüfung
certificate of material testing
nach DIN EN 10204 according to DIN EN 10204

Ausgabe 24.08.00/LK
FO 03.50
IMS 03.05
Seite 1 von 1
page 1 / 1

- ☐ Werksbescheinigung 2.1
certificate of compliance
☐ Werkszeugnis 2.2
test report
☐ Werksprüfzeugnis 2.3
manufacturer's test certificate

Abnahmeprüfzeugnis ☐ 3.1 A ☒ 3.1 B ☐ 3.1 C
inspection certificate

Abnahmeprotokoll ☐ 3.2 A ☐ 3.2 C
inspection report

Giessereikennzeichen: HO
foundry's identification: HO

Kennzeichnung am Stück: Mod.-Nr. /Mat./Dat.
piece's identification: pattern no. HO/ Ch.Nr.

Kunde customer:	GreenField Base	Ort adress:	4053 Basel
Auftr.-Nr. order no.:	30502	Losgrösse quantity:	6
Bezeichnung designation:	Zylinder	Zeich.Nr. drawing no.:	1-122 142101 Ind. C
Modell-Nr. pattern no.:	122 M 38.786.400	Werkstoff material:	EN-GJL-250
Bestell-Nr. order no.:	BE001188	Norm norm:	DIN EN 1561
Datum date:	02.05.01		

Analysenergebnisse chemical composition

Sollwerte setpoint												
Datum date	Charge cast-no.	C [%]	Si [%]	Mn [%]	P [%]	S [%]	Cu [%]	Mg [%]	Ni [%]	Ti [%]	Sn [%]	Cr [%]
19.06.01	642	3.03	2.14	0.10	0.055	0.044	0.091	0.000	0.043	0.022	0.012	0.157

Mechanische Werte mechanical properties

Art des Probenmaterials: ☐ angegossen cast on ☒ separat gegossen separately cast ☐ aus dem Gussstück out of the casting

Sollwerte <i>setpoint</i>			250							
Datum date	Charge cast-no.	Ø [mm]	R _m [N/mm ²]	R _{p0,2} [N/mm ²]	A [%]	HB	Kerbschlagzähigkeit [Joule] <i>notched-</i> bar impact value			
							Ø/3 [J]	1/3 [J]	2/3 [J]	3/3 [J]
19.06.01	642	20.0	278			194				

Bemerkungen remarks

Wir bestätigen, dass die Lieferung geprüft wurde und den Vereinbarungen bei der Bestellannahme entspricht.
We certify, that the described material has been tested and correspond to the terms of the order.

Oberburg, 28.06.2001

Visum + Stempel:
signature + stamp



J. Herlin
Werkssachverständiger works expert

	Giesserei Hegi AG Eisen - und Alugiesserei Mech. Werkstätte 3414 Oberburg	Formular form Bescheinigung Materialprüfung <i>certificate of material testing</i> nach DIN EN 10204	Nr. 29.01.99/SW Form. 10.01 <i>form 10.01</i>
		according to DIN EN 10204 <i>2.2</i>	Seite 1 von 1 page 1 / 1

- ☐ Werksbescheinigung 2.1 *certificate of compliance*
☐ Werkszeugnis 2.2 *test report*
☐ Werksprüfzeugnis 2.3 *manufacturer's test certificate*
- Abnahmeprüfzeugnis ☐ 3.1 A ☒ 3.1 B ☐ 3.1 C
inspection certificate
 Abnahmeprotokoll ☐ 3.2 A ☐ 3.2 C
inspection report
- Giessereikennzeichen: HO *foundry's identification: HO*
 Kennzeichnung am Stück: Mod.-Nr. /Mat./Dat.
piece's identification: pattern no.

Kunde <i>customer:</i>	GreenField AG	Ort <i>address:</i>	4053 Basel
Auftr.-Nr. <i>order no.:</i>	27885	Losgrösse <i>quantity:</i>	11
Bezeichnung <i>designation:</i>	Zylinder	Zeich.Nr. <i>drawing no.:</i>	1-122 142.103 C
Modell-Nr. <i>pattern no.:</i>	122 M 38.785.400 *komb*	Werkstoff <i>material:</i>	EN-GJL-250
Bestell-Nr. <i>order no.:</i>	108338	Norm <i>norm:</i>	DIN EN 1561
Datum <i>date:</i>	23.10.00		

Analysenergebnisse *chemical composition*

Sollwerte <i>setpoint</i>												
Datum <i>date</i>	Charge <i>cast-no.</i>	C [%]	Si [%]	Mn [%]	P [%]	S [%]	Cu [%]	Mg [%]	Ni [%]	Ti [%]	Sn [%]	Cr [%]
14.11.00	Nr.451	3.08	2.10	0.62	0.065	0.071	0.123	0.001	0.028	0.016	0.009	0.051
14.11.00	Nr.452	3.05	2.12	0.62	0.067	0.069	0.122	0.001	0.028	0.016	0.009	0.050

Mechanische Werte *mechanical properties*

Art des Probematerials: ☐ angegossen *cast on*
☒ separat gegossen *separately cast*
☐ aus dem Gussstück *out of the casting*

Sollwerte <i>setpoint</i>		250									
Datum <i>date</i>	Charge <i>cast-no.</i>	Ø [mm]	R _m [N/mm ²]	R _{p0.2} [N/mm ²]	A [%]	HB	Kerbschlagzähigkeit [Joule] <i>notched-bar impact value</i>				
							Ø/3 [J]	1/3 [J]	2/3 [J]	3/3 [J]	
14.11.00	Nr.451	20.0	296			194					
14.11.00	Nr.452	20.0	291			192					

Bemerkungen *remarks*

Wir bestätigen, dass die Lieferung geprüft wurde und den Vereinbarungen bei der Bestellannahme entspricht.
We certify, that the described material has been tested and correspond to the terms of the order.

Oberburg, 19.12.2000

Visum + Stempel:
signature + stamp



P. Herlin

Werkssachverständiger *works expert*

Bescheinigung nach EN 10204

certificate acc. to / certificat selon
 Werkstoffprüfung
 material testing
 d'essai des matériaux

gefaxt

3. 1 B

16. Okt. 2003

ny 386

ALLWEILER
 GIEßERTECHNIK

Werkstoff:

Zeichnung.....

EN-JL1040 (GG-25)

nach: / acc.to: / selon:

material:

EN-GJL-250

DIN EN 1561

matériaux:

Kennzeichnung:

Chargen-Nr. / Herstellerzeichen

Lieferzustand:

Gußzustand

Marking:

cast-no / Brand of manufacturer

State of delivery:

State of cast

Marquage:

coulée-no / Marque de fabricant

Etat de livraison:

état de fond

Anforderungs-Nr.:

Bestellnummer:

requirement-no.: 01797586 / 01

number of order: 2.003.00000 602

numero de demande:

nr. de commande:

Anzahl quantity nombre	Bezeichnung des Gußteils designation of casted part désignation du produit coulé	Ident - Nr. i.d.-number	Modell-Nr. pattern-no. no de modèle	Charge-Nr. cast-no. no. de coulée	Anforderung requirement demande selon
29	ZYLINDER 263 1100 010	507145	122M38745.400	03 10 06 04	DIN EN 1561

CHEMISCHE ZUSAMMENSETZUNG / CHEMICAL COMPOSITION / COMPOSITION CHIMIQUE [%]

Chargen-Nr. cast-no. no. de coulée	C %	Si %	Mn %	P %	S %	Sc-Wert	
03 10 06 04	3,23	1,93	0,682	0,034	0,052	0,896	

FESTIGKEITSEIGENSCHAFTEN / MECHANICAL PROPERTIES / CARACTÉRISTIQUES MÉCANIQUES

Chargen-Nr. cast-no. no. de coulée	d ₀ [mm]	F _{max} [N]	HBS 10/3000	R _m [N/mm ²]			
Anforderung:	Zugprobekörper der getrennt gegossenen Probe nach DIN EN 10 002			Zugfestigkeit	min.250		
requirement:	tensile test specimen of separate casted sample according to DIN EN 10 002			tensile strength	max.350		
demande:	épreuve de traction de l'éprouvette de coulée séparée selon DIN EN 10 002			résistance traction			
03 10 06 04	20,02	91490	218	291			

Datum:
date:

16.10.2003


 Werksachverständiger
 Quality Inspector / Expert d'entreprise

BEA 03/632

122 R 3 873 P 4 01 4

Einigung nach EN 10204
state acc. to / certificat selon
Werkstoffprüfung
material testing
l'essai des matériaux

3 1 B



Werkstoff: EN-JL1040 (GG-25)
material: EN-GJL-250
matériaux:

nach:
acc.to: DIN EN 1561
selon:

Kennzeichnung: Chargen-Nr / Herstellerzeichen
Marking: cast-no / Brand of manufacturer
Marquage: coulée-no / Marque de fabricant

Lieferzustand: Gußzustand
State of delivery: State of cast
Etat de livraison: état de fond

Anforderungs-Nr.:
requirement-no.: 01770409 / 01
numero de demande:

Bestellnummer:
number of order:
nr.de commande:

Anzahl quantity nombre	Bezeichnung des Gußteiles designation of casted part désignation du produit coulé	Ident - Nr. i.d.-number	Modell-Nr. pattern-no. no de modèle	Charge-Nr. cast-no. no. de coulée	Anforderung requirement demande selon
27	ZYLINDER 263 1100 008	507034	122M38739.401	03 06 02 05	DIN EN 1561

CHEMISCHE ZUSAMMENSETZUNG / CHEMICAL COMPOSITION / COMPOSITION CHIMIQUE [%]

Chargen-Nr. cast-no. no. de coulée	C %	Si %	Mn %	P %	S %	Sc-Wert
03 06 02 05	3,25	1,95	0,71	0,052	0,051	0,905

FESTIGKEITSEIGENSCHAFTEN / MECHANICAL PROPERTIES / CARACTÉRISTIQUES MÉCANIQUES

Chargen-Nr. cast-no. no. de coulée	d ₀ [mm]	F max [N]	HBS 10/3000	Rm [N/mm ²]		
Anforderung:	Zugprobekörper der getrennt gegossenen Probe nach DIN EN 10 002			Zugfestigkeit	min. 250	
requirement:	tensile test specimen of separate casted sample according to DIN EN 10 002			tensile strength	max. 350	
demande:	éprouvette de traction de l'éprouvette de coulée séparée selon DIN EN 10 002			resist à la traction		
03 06 02 05	19,99	93170	237	297		

Datum: 11.06.2003
date:

Werksachverständiger
Quality inspector / Expert d'entreprise

Angabe nach EN 10204

Certificate acc. to / certificat selon
 der Werkstoffprüfung
 / material testing
 / des matériaux

3 1 B

ALLWEILER
GIESSESTECHNIK

EN-JL1040 (GG-25)
 EN-GJL-250

nach:
 acc.to: DIN EN 1561
 selon:

Werkstoff:
 Material:
 Materialien:
 Kennzeichnung: Chargen-Nr. / Herstellerzeichen
 Marking: cast-no / Brand of manufacturer
 marquage: coulée-no / Marque de fabricant

Lieferzustand:
 State of delivery:
 Etat de livraison:
 Gußzustand
 State of cast
 état de fond

Anforderungs-Nr.:
 Requirement-no.: 01796781 / 01
 Numéro de demande:

Bestellnummer:
 number of order: 2.003/00000607
 no. de commande:

Anzahl quantity nombre	Bezeichnung des Gußteiles designation of casted part désignation du produit coulé	Ident - Nr. i.d.-number	Modell-Nr. pattern-no. no de modèle	Charge-Nr. cast-no. no. de coulée	Anforderung requirement demande selon
40	Zylinder / 263 1100 009	507146	122M 38738. 401	03 10 28 05	DIN EN 1561

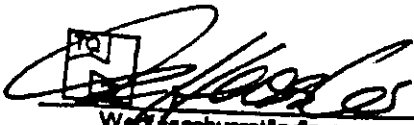
CHEMISCHE ZUSAMMENSETZUNG / CHEMICAL COMPOSITION / COMPOSITION CHIMIQUE [%]

Chargen-Nr. cast-no. no. de coulée	C %	Si %	Mn %	P %	S %	Sc-Wert
03 10 28 05	3,28	1,94	0,8	0,066	0,052	0,913

STIGKEITSEIGENSCHAFTEN / MECHANICAL PROPERTIES / CARACTÉRISTIQUES MÉCANIQUES

Chargen-Nr. cast-no. no. de coulée	d ₀ [mm]	F max [N]	HBS 10/3000	Rm [N/mm ²]		
Anforderung:	Zugprobentab der getrennt gegossenen			Zugfestigkeit	min.250	
requirement:	Probe nach DIN EN 10 002				max.350	
demande:	tensile test specimen of separate casted			tensile strength		
	sample according to DIN EN 10 002			résistance à la traction		
	épreuve de traction de l'éprouvette					
	de coulée séparée selon DIN EN 10 002					
03 10 28 05	19,97	89928	223	287		

Datum: 04.11.2003
 date:


 Werkstoffverständiger
 Quality Inspector / Expert des matériaux

2.003/665



GreenField

IG Station Manual

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Type Test Report
Three-Phase Induction Motors

Nº: PT08783

Date: 10/05/2004

Customer : WEG ELECTRIC MOTORS CORP.

Order : -

Assembly : B3R

Approximate weight : - kg

IDENTIFICATION

Model : 447T
Frequency : 60 Hz
Full Speed : 1780 rpm
Power : 200 HP
Voltage : 460 V
Current : 230 A
II/In : -

Item : -
Design : B
Time rating : S1

Ins. Class : F
Service Factor : 1.15
Enclosure : IP 55
Power Factor 100%: 0.86
Eff. - 75% : 95.0
Eff. - 100% : 95.0
D.T. (K) : 80

TESTS

Resistance Measurement

Resistance : 0.01920 Ohms

Ambient Temp. : 24.70 °C

Connection : Duplo-Delta

No Load Test

Voltage : 460 V

Frequency : 60 Hz

Current : 59.55 A

Losses : 2739.40 W

Locked Rotor Test

Voltage : 460 V

Frequency : 60 Hz

Current : 1527.57 A

Power : 493.70 KW

TI/Tn : 2.60

Full load Torque(Tn): 80.45 mkgf

(1 mkgf or mkp = 9.813 Nm)

Load Test

Voltage : 460 V

Frequency : 60 Hz

% of Full Load	Current (A)	Speed (rpm)	Efficiency (%)	Power Factor
50	121.77	1792	95.0	0.80
75	168.74	1787	95.3	0.86
100	220.69	1782	95.1	0.88

Temperature rise by resistance at 100 % of Full Load = 73.92 K

Break-Down Torque Test

Voltage : 460 V

Frequency : 60 Hz

Tb/Tn : 2.51

High Voltage Test

1.92 kV

for : 60 Seconds

Insulation Resistance

5000.0 MOhms

Ambient Temp. : 25.50 °C

Notes

The values included in this report refer to an unit electrically identical.

High Efficiency

Adolar Friedemann

Approved/Laboratory: WEG

Approved/Witness: CUSTOMER



GreenField

IG Station Manual

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FORM U-1 MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

118

1. Manufactured and Certified by: GreenField Compression, Inc., 909 North Bowser Road, Richardson, TX 75081
 (Name and address of Manufacturer)

2. Manufactured for: Stock
 (Name and address of Purchaser)

3. Location of Installation: Unknown
 (Name and address)

4. Type: Horizontal Slab & Tube H/E 04008 ----- C000-4420-SN04008 202 2004
 (Horiz., vert., or sphere) (Tank, separator, jkt, vessels heat exch., etc.) (Mfg's serial No.) (CRN) (Drawing No.) (Mat'l Bd. No.) (Year built)

5. ASME Code, Section VIII, Div. 1 2001 Edition/2003 A ----- None
 Edition and Addenda (date) Code Case No. Special Service per UG-120(d)

Items 6-11 Incl. to be completed for single wall vessels, jackets of jacketed vessels, shell of heat exchangers, or chamber of multi-chamber vessels.

6. Shell (a) No. of course(s): See U-4 Form (b) Overall length (ft. & in.): See U-4 Form

Course(s)			Material	Thickness		Long Joint (Cat. A)			Circum. Joint(Cat. A, B & C)			Heat Treatment		
No.	Diameter, In.	Length (ft & in.)	Spec./Grade or Type	Nom.	Corr.	Type	Full, Spot	None	Eff.	Type	Full, Spot, None	Eff.	Temp.	Time

7. Heads: (a) See U-4 Form (b) See U-4 Form
 (Mat'l Spec. No., Grade or Type) H.T. -Time & Temp (Mat'l Spec. No., Grade or Type) H.T. -Time & Temp

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A			
		Min	Corr.	Crown	Knuckle					Convex	Concave	Type	Full, Spot	None	Eff.
(a)															
(b)															

If removable, bolts used (describe other fastening) _____
 (Mat'l Spec. No., Grade, size, No.)

8. Type of Jacket _____ Jacket closure _____
 (Describe as ogee & weld, bar, etc.)

If bar, give dimensions _____ If bolted, describing or sketch _____

9. MAWP _____ psi. at max. temp. _____ °F Min. design metal temp. _____ °F at _____ psi.
 (Internal) (external) (Internal) (external)

10. Impact test _____
 (Indicate yes or no and the component(s) Impact tested)

11. Hydro., pneu., or comb test press. _____ Proof test _____

Items 12 and 13 to be completed for tube sections.

12. Tubesheet:

[Stationary (Mat'l Spec. No.)]	_____	_____	_____	_____	_____
(2) SA 516-70N (1 Each End)	_____	3"x4' 11-3/8" SLAB	3"	NONE	See U-4 Form
[Floating (Mat'l Spec. No.)]	_____	_____	_____	_____	_____

13. Tubes:

SA 214	5/8"	.060 MIN.	31 (IC-1,2,3,4)	Bent & Finned (See U-4 Form)
Mat'l Spec. No., Grade or Type	O.D., in.	Nom. Thk., in. or gauge	Number	Type (Straight or U)
SA 210 GRADE C	5/8"	.109 MIN.	5 (AC-5)	Bent & Finned (See U-4 Form)
Mat'l Spec. No., Grade or Type	O.D., in.	Nom. Thk., in. or gauge	Number	Type (Straight or U)

Items 14 -18 Incl. To be completed for inner chambers or jacketed vessels or channels of heat exchangers.

14. Shell (a) No. of course(s): _____ (b) Overall length (ft. & in.): _____

Course(s)			Material	Thickness		Long Joint (Cat. A)			Circum. Joint (Cat. A, B & C)			Heat Treatment		
No.	Diameter, In.	Length (ft & In.)	Spec./Grade or Type	Nom.	Corr.	Type	Full, Spot	None	Eff.	Type	Full, Spot, None	Eff.	Temp.	Time

15. Heads: (a) _____ (b) _____
 (Mat'l Spec. No., Grade or Type) H.T. -Time & Temp (Mat'l Spec. No., Grade or Type) H.T. -Time & Temp

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A			
		Min	Corr.	Crown	Knuckle					Convex	Concave	Type	Full, Spot	None	Eff.
(a)															
(b)															

If removable, bolts used (describe other fastening) _____
 (Mat'l Spec. No., Grade, Size, No.)

16. MAWP See U-4 Form (internal) (external) psi. at max. temp. 450 F (internal) (external) °F Min. design metal temp. -20 °F at See U-4 Form psi.

17. Impact test Impact Exempt Per UCS-66(a)(3)

(Indicate yes or no and the component(s) impact tested)

18. Hydro., pneu., or comb. test press.

Sections IC-1,2,3,4 @ 3000PSI, Section AC-5 @ 7500PSI

Proof test N/A

19. Nozzles, inspection and safety valve openings:

Purpose (inlet, Outlet, Drain, etc.)	No.	Diameter No. or Size	Flange Type	Material		Nozzle Thickness		Reinforcement Material	How Attached		Location (Insp. Open)
				Nozzle	Flange	Nom.	Corr.		Nozzle	Flange	
IC-1A In & Out	2	1-5/8"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-1A Inst	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-1B In & Out	2	1-5/8"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-1B Inst	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-2 In & Out	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-2 Inst	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-3 In & Out	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-3 Inst	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-4 In & Out	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-4 Inst	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
AC-5 In & Out	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
AC-5 Inst	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
Tube Plugs	72	3/4"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
Port Plugs	32	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
Port Plugs	4	1-5/8"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	IC-1 Only

20. Supports: Skirt No (Yes or No.) Lugs N/A (No.) Legs N/A (No.) Others Supported by Frame (Describe) Attached Bolted (Where and How)

21. Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report:
(List the name of part, item number, mfg's name and identifying number)

N/A

22. Remarks: Per UG125, Safety Relief Valves are located elsewhere in system by others.
Non-Corrosive Service

CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1.

U Certificate of Authorization No.

30784

Expires

1/13

2005

Date

6/28/04

Name

GreenField Compression, Inc.

Signed

[Signature]
(Representative)

CERTIFICATE OF SHOP INSPECTION

I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and the State or Province of Texas and employed by OneBeacon America Insurance Co. of Boston, MA have inspected the pressure vessel described in this Manufacturer's Data Report on 628, 2004 and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date

6-28-04

Signed

[Signature]
(Authorized Inspector)

Commissions

NBP 3906 A
(Nat'l Board Incl. Endorsement, State, Province and No.)

CERTIFICATE OF FIELD ASSEMBLY COMPLIANCE

We certify that the statements on this report are correct and that the field assembly construction of all parts of this vessel conforms with the requirements of ASME Code, Section VIII, Division 1. U Certificate of Authorization No. _____ Expires _____

Date

Name

(Assembler)

Signed

(Representative)

CERTIFICATE OF FIELD ASSEMBLY INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province of _____ and employed by _____ of _____, have compared the statements in this Manufacturer's Data Report with the described pressure vessel and state that parts referred to as data items _____, not included in the certificate of shop inspection, have been inspected by me and to the best of my knowledge and belief, the Manufacturer has constructed and assembled this pressure vessel in accordance with the ASME Code, Section VIII, Division 1. The described vessel was inspected and subjected to a hydrostatic test of _____ psi. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property or a loss of any kind arising from or connected with this inspection.

Date

Signed

(Authorized Inspector)

Commissions

(Nat'l Board Incl. Endorsements, State, Province and No.)

2/2

FORM U-4 MANUFACTURER'S DATA REPORT SUPPLEMENTARY SHEET
As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

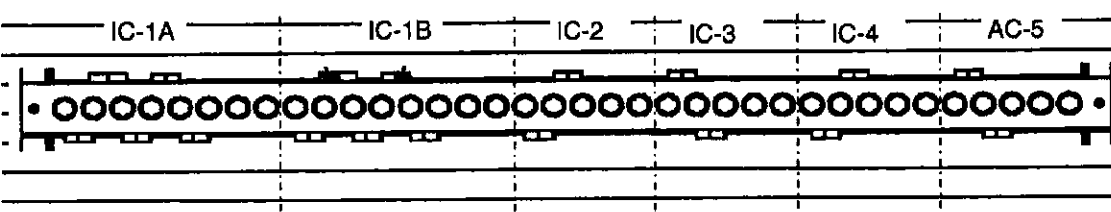
1. Manufactured and certified by GreenField Compression, Inc., 909 North Bowser Road, Richardson, TX 75081
(Name and address of Manufacturer)

2. Manufactured for Stock
(Name and address of Purchaser)

3. Location of Installation Unknown
(Name and address)

4. Type: Horizontal Slab & Tube H/E 04008
(Horiz., vert., or sphere) (Tank, separator, heat exch., etc.) (Mfg's. serial No.)

----- C000-4420-SN04008 202 2004
(CRN) (Drawing No.) (Nat'l. Bd. No.) (Year Built)

Data Report Item Number	Remarks
6 & 12	This is a 5 stage / 5 pass heat exchanger. The heat exchanger consists of two tube-sheets/headers and 36 serpentine tubes. The tube-sheets/headers are made from 3" steel plate, cut to 3"x4' 11-3/8", and cross drilled with threaded ports that intersect with the tube ports. The two tube-sheets/headers are joined together with the serpentine tubes. The tube-sheets/headers are free floating and are not directly fixed to any components.  Length of all tubes is 287"; Overall distance between tube-sheets/headers is 56-3/8".
13	Full length serpentine tube, bent (multiple passes)
16	MAWP Sections IC-1,2,3,4 - 2000 PSI @ 450 deg F / MDMT -20 deg F @ 2000 PSI
	MAWP Section AC-5 - 5000 PSI @ 450 deg F / MDMT -20 deg F @ 5000 PSI

Certificate of Authorization: Type U Certificate No. 30784 Expires 1/13 2005

Date 6/28/04 Name GreenField Compression, Inc. Signed [Signature]
(Manufacturer) (Representative)

Date 6-28-04 Name [Signature] Commission NB5906A
(Authorized Inspector) (Nat'l Board Incl. Endorsement, State, Province and No.)

FORM U-1 MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

112

1. Manufactured and Certified by: GreenField Compression, Inc., 909 North Bowser Road, Richardson, TX 75081
 (Name and address of Manufacturer)
 2. Manufactured for: Stock
 (Name and address of Purchaser)
 3. Location of Installation: Unknown
 (Name and address)

4. Type: Horizontal Slab & Tube H/E 04009 ---- C000-4420-SN04009 203 2004
 (Horiz., vert., or sphere) (Tank, separator, jkt. vessels heat ex., etc.) (Mfg's serial No.) (CRN) (Drawing No.) (Nat'l Bd. No.) (Year built)
 5. ASME Code, Section VIII, Div. 1 2001 Edition/2003 A ---- None
 Edition and Addenda (date) Code Case No. Special Service per UG-120(d)

Items 6-11 Incl. to be completed for single wall vessels, jackets of jacketed vessels, shell of heat exchangers, or chamber of multi-chamber vessels.

6. Shell (a) No. of course(s): See U-4 Form (b) Overall length (ft. & in.): See U-4 Form

Course(s)			Material		Thickness		Long Joint (Cat. A)			Circum. Joint (Cat. A, B & C)			Heat Treatment	
No.	Diameter, in.	Length (ft & in.)	Spec./Grade or Type		Nom.	Corr.	Type	Full, Spot	None	Eff.	Type	Full, Spot, None	Eff.	Temp.

7. Heads: (a) See U-4 Form (b) See U-4 Form
 (Mat'l Spec. No., Grade or Type) H.T. - Time & Temp (Mat'l Spec. No., Grade or Type) H.T. - Time & Temp

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A		
		Min	Corr.	Crown	Knuckle					Convex	Concave	Type	Full, Spot	None
(a)														
(b)														

If removable, bolts used (describe other fastening)

(Mat'l Spec. No., Grade, size, No.)

8. Type of jacket ----- Jacket closure -----
 (Describe as ogee & weld, bar, etc.)

If bar, give dimensions

If bolted, describing or sketch

9. MAWP ----- ----- psi. at max. temp. ----- ----- °F Min. design metal temp. ----- ----- °F at ----- psi.
 (internal) (external) (internal) (external)

10. Impact test -----
 (Indicate yes or no and the component(s) impact tested)

11. Hydro., pneu., or comb test press. ----- Proof test -----

Items 12 and 13 to be completed for tube sections.

12. Tubesheet:
----- [Stationary (Mat'l Spec. No.)] ----- Dia., in. (subject to press.) ----- Nom. thk., in. ----- Corr. Allow., in. ----- Attachment (welded or bolted)
(2) SA 516-70N (1 Each End) 3"x4' 11-3/8" SLAB 3" NONE See U-4 Form
----- [Floating (Mat'l Spec. No.)] ----- Dia., in. (subject to press.) ----- Nom. thk., in. ----- Corr. Allow., in. ----- Attachment (welded or bolted)

13. Tubes: SA 214 5/8" .060 MIN. 31 (IC-1,2,3,4) Bent & Finned (See U-4 Form)
 Mat'l Spec. No., Grade or Type O.D., in. Nom. Thk., in. or gauge Number Type (Straight or U)
SA 210 GRADE C 5/8" .109 MIN. 5 (AC-5) Bent & Finned (See U-4 Form)
 Mat'l Spec. No., Grade or Type O.D., in. Nom. Thk., in. or gauge Number Type (Straight or U)

Items 14 - 18 Incl. To be completed for inner chambers or jacketed vessels or channels of heat exchangers.

14. Shell (a) No. of course(s): ----- (b) Overall length (ft. & in.): -----

Course(s)			Material		Thickness		Long Joint (Cat. A)			Circum. Joint (Cat. A, B & C)			Heat Treatment	
No.	Diameter, in.	Length (ft & in.)	Spec./Grade or Type		Nom.	Corr.	Type	Full, Spot	None	Eff.	Type	Full, Spot, None	Eff.	Temp.

15. Heads: (a) ----- (b) -----
 (Mat'l Spec. No., Grade or Type) H.T. - Time & Temp (Mat'l Spec. No., Grade or Type) H.T. - Time & Temp

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A		
		Min	Corr.	Crown	Knuckle					Convex	Concave	Type	Full, Spot	None
(a)														
(b)														

If removable, bolts used (describe other fastening)

(Mat'l Spec. No., Grade, Size, No.)

16. MAWP See U-4 Form (Internal) (external) psi. at max. temp. 450 F (Internal) (external) °F Min. design metal temp. -20 °F at See U-4 Form psi.

17. Impact test Impact Exempt Per UCS-66(a)(3)
(Indicate yes or no and the component(s) Impact tested)

18. Hydro., pneu., or comb. test press. Sections IC-1,2,3,4 @ 3000PSI, Section AC-5 @ 7500PSI Proof test N/A

19. Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain, etc.)	No.	Diameter No. or Size	Flange Type	Material		Nozzle Thickness		Reinforcement Material	How Attached		Location (Insp. Open)
				Nozzle	Flange	Nom.	Corr.		Nozzle	Flange	
IC-1A In & Out	2	1-5/8"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-1A Inst	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-1B In & Out	2	1-5/8"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-1B Inst	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-2 In & Out	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-2 Inst	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-3 In & Out	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-3 Inst	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-4 In & Out	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
IC-4 Inst	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
AC-5 In & Out	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
AC-5 Inst	2	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
Tube Plugs	72	3/4"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
Port Plugs	32	1-5/16"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	Headers
Port Plugs	4	1-5/8"	N/A	SA 516-70N	N/A	Th'd	None	Inherent	Threaded	N/A	IC-1 Only

20. Supports: Skirt No (Yes or No.) Lugs N/A (No.) Legs N/A (No.) Others Supported by Frame (Describe) Attached Attached Bolted Bolted (Where and How)

21. Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report:
(List the name of part, item number, mfg's name and identifying number)

N/A

22. Remarks: Per UG125, Safety Relief Valves are located elsewhere in system by others.
Non-Corrosive Service

CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1.

U Certificate of Authorization No. 30784 Expires 1/13 2005
Date 6-28-04 Name GreenField Compression, Inc. Signed [Signature]
(Manufacturer) (Representative)

CERTIFICATE OF SHOP INSPECTION

I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and the State or Province of Texas and employed by OneBeacon America Insurance Co. of Boston, MA have inspected the pressure vessel described in this Manufacturer's Data Report on G-28, 20 04 and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 6-28-04 Signed [Signature] Commissions UB5906A
(Authorized Inspector) (Nat'l Board Incl. Endorsement, State, Province and No.)

CERTIFICATE OF FIELD ASSEMBLY COMPLIANCE

We certify that the statements on this report are correct and that the field assembly construction of all parts of this vessel conforms with the requirements of ASME Code, Section VIII, Division 1. U Certificate of Authorization No. 30784 Expires 1/13

Date 6-28-04 Name [Signature] Signed [Signature]
(Assembler) (Representative)

CERTIFICATE OF FIELD ASSEMBLY INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province of Texas and employed by OneBeacon America Insurance Co. have compared the statements in this Manufacturer's Data Report with the described pressure vessel and state that parts referred to as data items G-28, not included in the certificate of shop inspection, have been inspected by me and to the best of my knowledge and belief, the Manufacturer has constructed and assembled this pressure vessel in accordance with the ASME Code, Section VIII, Division 1. The described vessel was inspected and subjected to a hydrostatic test of 450 psi. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property or a loss of any kind arising from or connected with this inspection.

Date 6-28-04 Signed [Signature] Commissions UB5906A
(Authorized Inspector) (Nat'l Board Incl. Endorsements, State, Province and No.)

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FORM U-4 MANUFACTURER'S DATA REPORT SUPPLEMENTARY SHEET
As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

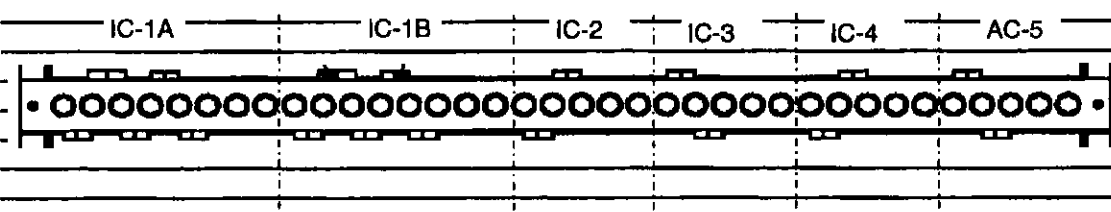
1. Manufactured and certified by GreenField Compression, Inc., 909 North Bowser Road, Richardson, TX 75081
(Name and address of Manufacturer)

2. Manufactured for Stock
(Name and address of Purchaser)

3. Location of Installation Unknown
(Name and address)

4. Type: Horizontal Slab & Tube H/E 04009
(Horiz., vert., or sphere) (Tank, separator, heat exch., etc.) (Mfg's. serial No.)

---- C000-4420-SN04009 203 2004
(CRN) (Drawing No.) (Nat'l. Bd. No.) (Year Built)

Data Report Item Number	Remarks
6 & 12	This is a 5 stage / 5 pass heat exchanger. The heat exchanger consists of two tube-sheets/headers and 36 serpentine tubes. The tube-sheets/headers are made from 3" steel plate, cut to 3"x4' 11-3/8", and cross drilled with threaded ports that intersect with the tube ports. The two tube-sheets/headers are joined together with the serpentine tubes. The tube-sheets/headers are free floating and are not directly fixed to any components.  Length of all tubes is 287"; Overall distance between tube-sheets/headers is 58-3/8".
13	Full length serpentine tube, bent (multiple passes)
16	MAWP Sections IC-1,2,3,4 - 2000 PSI @ 450 deg F / MDMT -20 deg F @ 2000 PSI
	MAWP Section AC-5 - 5000 PSI @ 450 deg F / MDMT -20 deg F @ 5000 PSI

Certificate of Authorization: Type U Certificate No. 30784 Expires 1/13 2005

Date 6/28/04 Name GreenField Compression, Inc. Signed [Signature]
(Manufacturer) (Representative)

Date 6-28-04 Name [Signature] Commission NB530619
(Authorized Inspector) (Nat'l Board Incl. Endorsement, State, Province and No.)



14. EQUIPMENT DRAWINGS

This section includes the following drawings:

GreenField IG

Drawing Number

Description

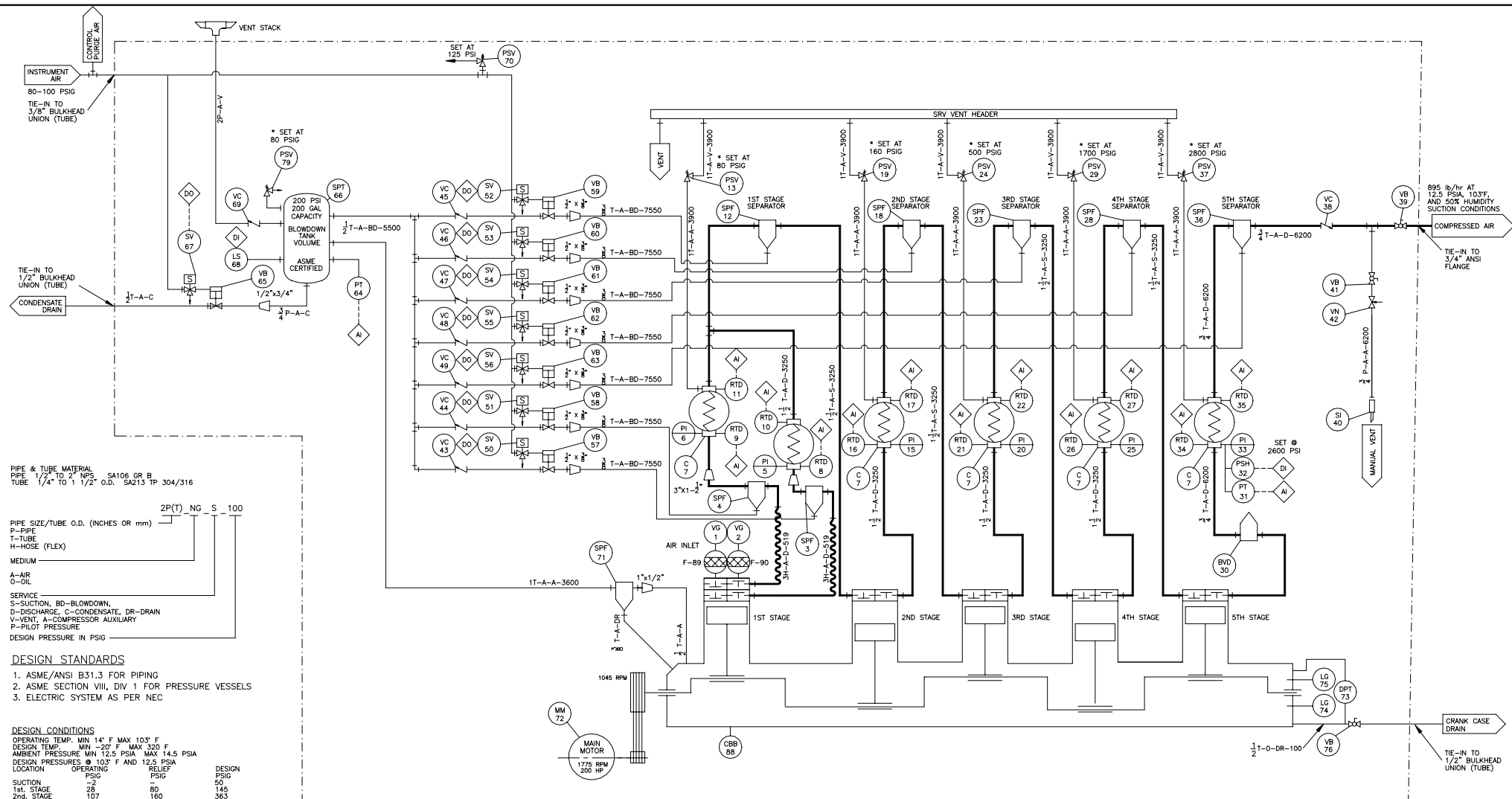
Drawing Number	Description
1. D000-4421	Process and Instrumentation Diagram (P&ID)
2. D000-4451	General Arrangement
3. C000-4531	J-Box Terminal Connections
4. D000-4416-(1-4)	Control Panel Wiring Schematic



GreenField

IG Station Manual

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PIPE & TUBE MATERIAL
PIPE 1/2" TO 2" NPS SA106 GR B
TUBE 1/4" TO 1 1/2" O.D. SA213 TP 304/316

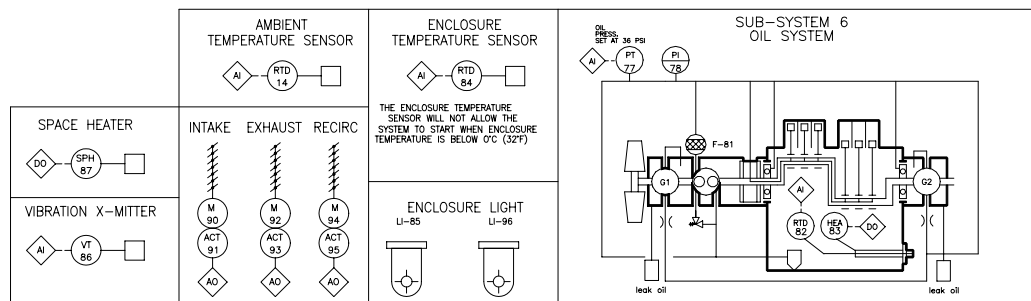
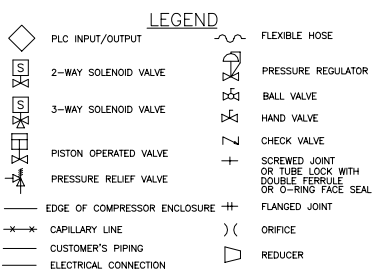
PIPE SIZE/TUBE O.D. (INCHES OR mm)
P-PIPE
T-TUBE
H-HOSE (FLEX)
MEDIUM
A-AIR
O-OIL
SERVICE
S-SUCTION, BD-BLOWDOWN,
D-DISCHARGE, C-CONDENSATE, DR-DRAIN
V-VENT, A-COMPRESSOR AUXILIARY
P-PILOT PRESSURE
DESIGN PRESSURE IN PSIG

DESIGN STANDARDS

1. ASME/ANSI B31.3 FOR PIPING
2. ASME SECTION VIII, DIV 1 FOR PRESSURE VESSELS
3. ELECTRIC SYSTEM AS PER NEC

DESIGN CONDITIONS

OPERATING TEMP. MIN 14° F MAX 103° F
DESIGN TEMP. MIN -20° F MAX 320° F
AMBIENT PRESSURE MIN 12.5 PSIA MAX 14.5 PSIA
DESIGN PRESSURES @ 103° F AND 12.5 PSIA
LOCATION OPERATING PSIG DESIGN PSIG
SUCTION 2 80
1st. STAGE 28 145
2nd. STAGE 107 160
3rd. STAGE 340 500
4th. STAGE 986 1700
5th. STAGE 2500 2000
BLOW DOWN 0 100



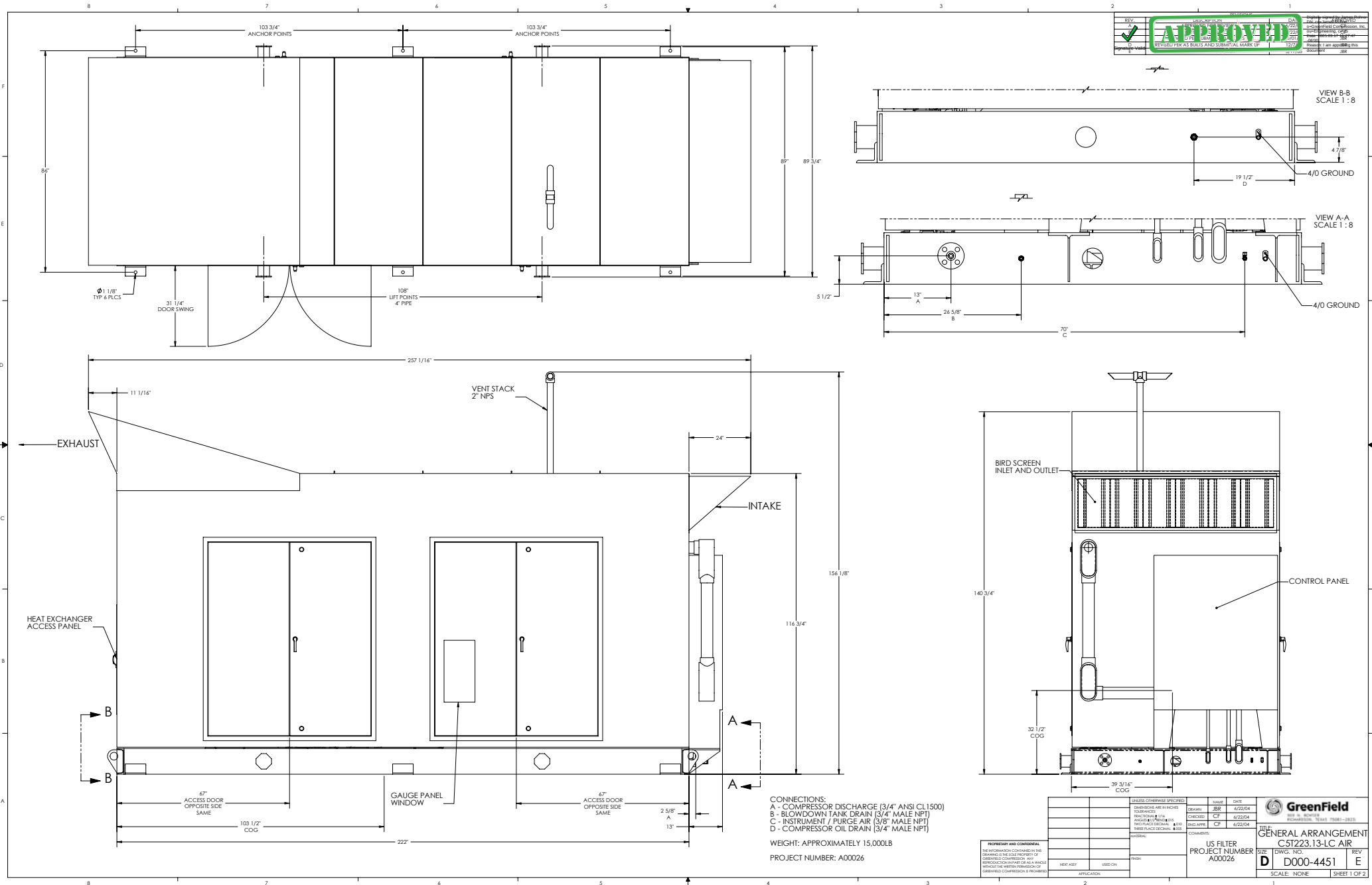
APR 3/16/05		ZERO LOSS BLOWDOWN CHANGES	
APR 12/1/04		ADDED 200 GAL TO TANK DESCRIPTION	
APR 10/14/04		REVISED PER SUBMITTAL MARK UPS	
APR 7/22/04		REVISED TITLE BLOCK	
APR 6/24/04		REMOVED VENT SILENCER	
APR 5/12/04		APPROVED FOR PRODUCTION	
Original	Drawn by: JBR	Chkd. by: JBR	Remarks
Sep. parts list	Date: 5/7/04	Date:	Appd. by:
Original scale: NONE			
© This drawing is entrusted to the recipient personally, but the copyright remains with us. It must not be copied, reproduced or in any way communicated or made accessible to third parties without our written consent.			
PROCESS AIR COMPRESSOR US FILTER PROJECT: A00026			
P&ID S/N IG0344 & 0345 C5T 223.13 LC			
GreenField		Dwg. No.	Rev. No.
		D000-4421	F



GreenField

IG Station Manual

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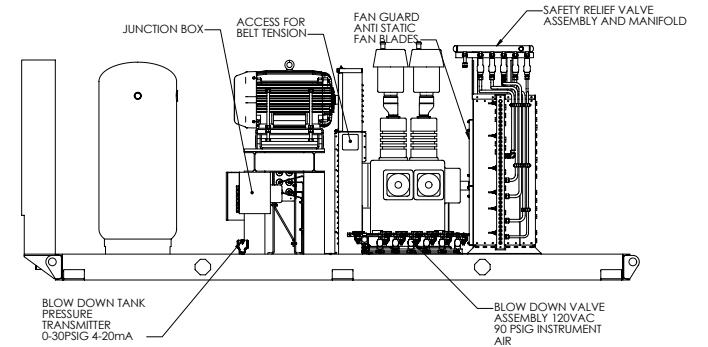
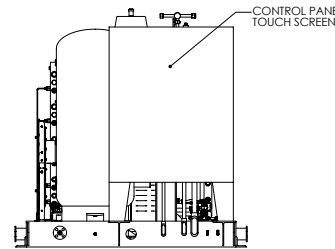
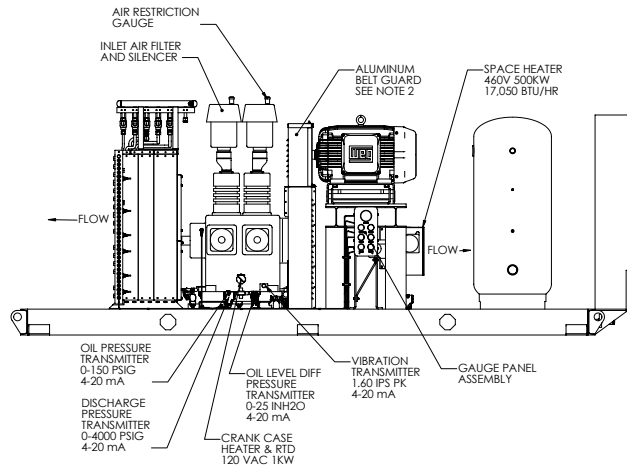
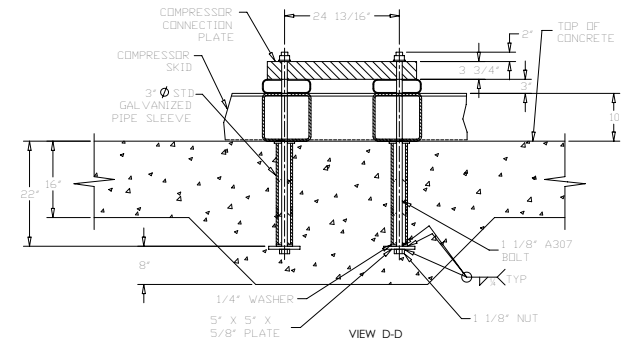
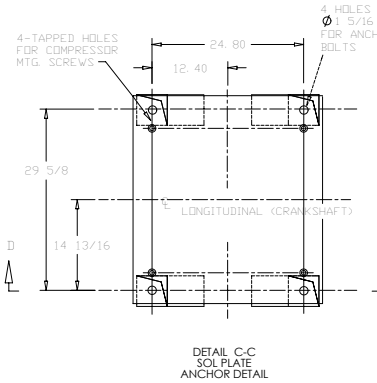
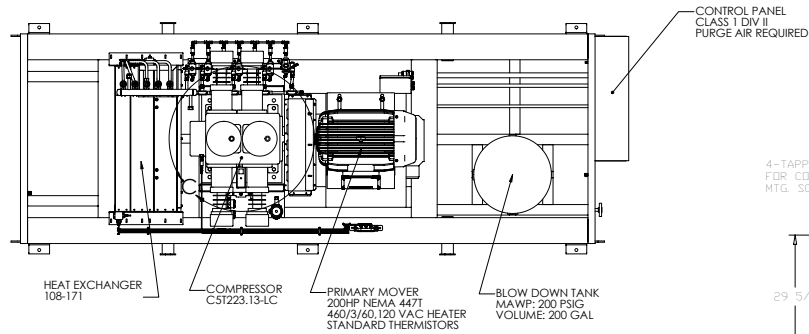
GreenField

IG Station Manual

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NOTES:

1. THE COMPRESSOR PACKAGE NOISE LEVEL WITH WEATHER RESISTANT SOUND ENCLOSURE SHALL BE <85 dB(A) AT THREE (3) FEET IN A FREE FIELD. REF. SPEC NO. A00026-PAC REV 2, §3.1.9 AND §3.3.2.4
2. REMOVE UPPER GAUARD HALF TO ALLOW ACCESS TO SHEAVE AND BELTS. REF. SPEC NO. A00026-PAC REV 2, §3.3.1.3
3. THE INTERSTAGE AND FINAL STAGE MOISTURE SEPARATORS ARE STANDARD FILTER HOUSINGS WHICH DO NOT REQUIRE ASME CODE CERTIFICATION. REF. SPEC NO. A00026-PAC REV 2, §3.3.1.5
4. THE PULSATION DAMPENING HOUSINGS ARE OF THE SAME STYLE AS THE MOISTURE SEPARATORS, WHICH DO NOT REQUIRE ASME CODE CERTIFICATION. REF. SPEC NO. A00026-PAC REV 2, §3.3.1.8
5. RTDs ARE INSTALLED ON THE INLET AND OUTLET OF EACH STAGE OF THE HEAT EXCHANGER. AN ENCLOSURE TEMPERATURE RTD WILL BE LOCATED AT THE J-BOX. REF. SPEC NO. A00026-PAC REV 2, §3.3.1.10.1
6. THE IN LINE MANUAL PROCESS AIR VENT VALVES DISCHARGE TO ATMOSPHERE INSIDE ENCLOSURE THROUGH SILENCER.



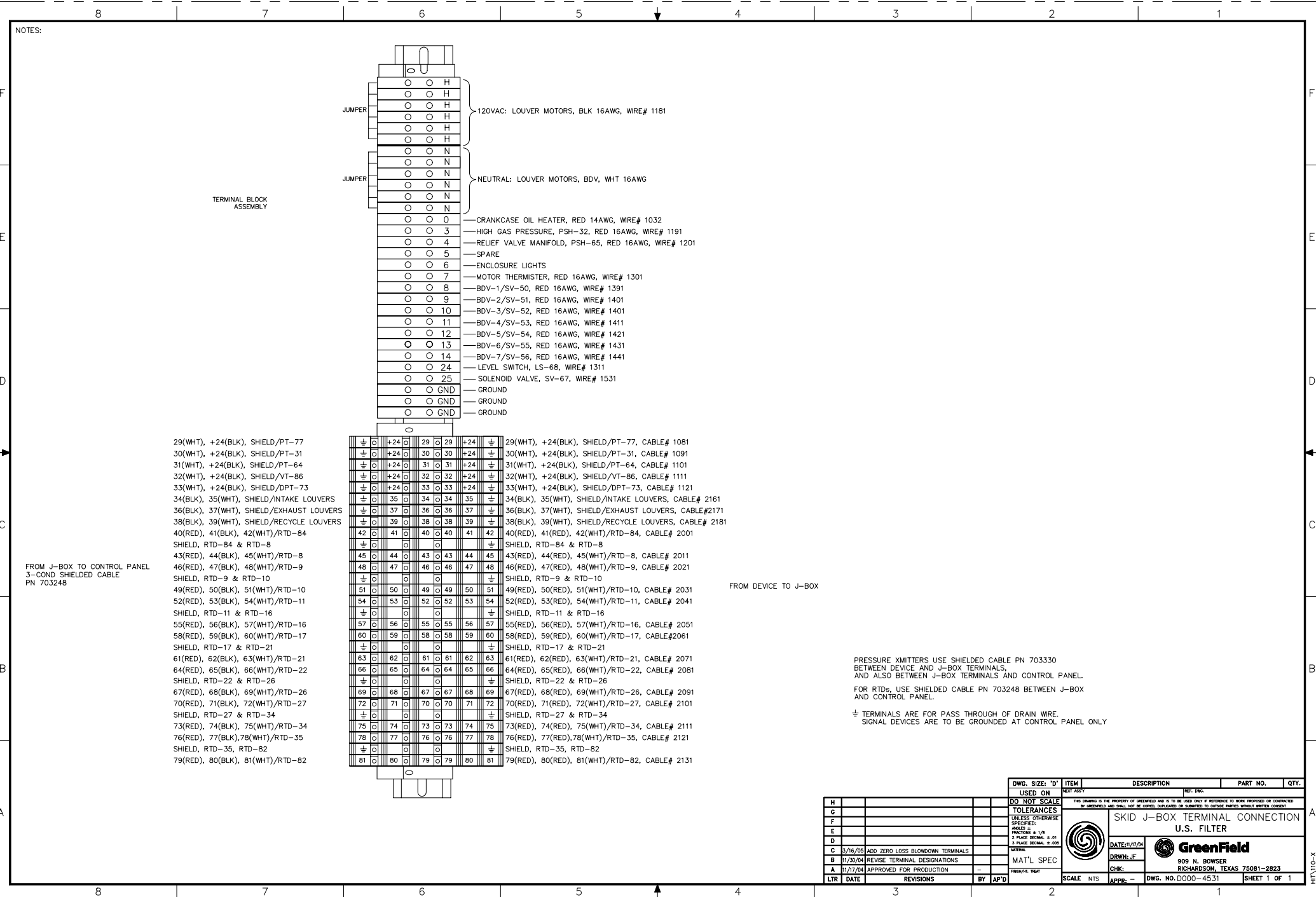
UNLESS OTHERWISE SPECIFIED:		ISSUED	DATE
DRAWINGS ARE IN INCHES	DESIGNED	JBR	6/22/04
TOLERANCES	CHECKED	CF	6/22/04
FRACTIONAL & 1/16"	DESIGNED BY	CF	6/22/04
ANGLES & TUBES & BLS	DESIGNED BY	CF	6/22/04
THREE PLACE DECIMAL	DESIGNED BY	CF	6/22/04
TWO PLACE DECIMAL	DESIGNED BY	CF	6/22/04
ONE PLACE DECIMAL	DESIGNED BY	CF	6/22/04
NO DECIMAL	DESIGNED BY	CF	6/22/04
TITLE			
GENERAL ARRANGEMENT			
CST223.13-LC AIR			
PROJECT NUMBER			
A00026			
SCALE: NONE			
SHEET 2 OF 2			



GreenField

IG Station Manual

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NOTES:

F

E

D

C

B

A

29(WHT), +24(BLK), SHIELD/PT-77
30(WHT), +24(BLK), SHIELD/PT-31
31(WHT), +24(BLK), SHIELD/PT-64
32(WHT), +24(BLK), SHIELD/VT-86
33(WHT), +24(BLK), SHIELD/DPT-73
34(BLK), 35(WHT), SHIELD/INTAKE LOUVERS
36(BLK), 37(WHT), SHIELD/EXHAUST LOUVERS
38(BLK), 39(WHT), SHIELD/RECYCLE LOUVERS
40(RED), 41(BLK), 42(WHT)/RTD-84
SHIELD, RTD-84 & RTD-8
43(RED), 44(BLK), 45(WHT)/RTD-8
46(RED), 47(BLK), 48(WHT)/RTD-9
SHIELD, RTD-9 & RTD-10
49(RED), 50(BLK), 51(WHT)/RTD-10
52(RED), 53(BLK), 54(WHT)/RTD-11
SHIELD, RTD-11 & RTD-16
55(RED), 56(BLK), 57(WHT)/RTD-16
58(RED), 59(BLK), 60(WHT)/RTD-17
SHIELD, RTD-17 & RTD-21
61(RED), 62(BLK), 63(WHT)/RTD-21
64(RED), 65(BLK), 66(WHT)/RTD-22
SHIELD, RTD-22 & RTD-26
67(RED), 68(BLK), 69(WHT)/RTD-26
70(RED), 71(BLK), 72(WHT)/RTD-27
SHIELD, RTD-27 & RTD-34
73(RED), 74(BLK), 75(WHT)/RTD-34
76(RED), 77(BLK), 78(WHT)/RTD-35
SHIELD, RTD-35, RTD-82
79(RED), 80(BLK), 81(WHT)/RTD-82

FROM J-BOX TO CONTROL PANEL
3-COND SHIELDED CABLE
PN 703248

FROM DEVICE TO J-BOX

PRESSURE XMITTERS USE SHIELDED CABLE PN 703330
BETWEEN DEVICE AND J-BOX TERMINALS,
AND ALSO BETWEEN J-BOX TERMINALS AND CONTROL PANEL.

FOR RTDs, USE SHIELDED CABLE PN 703248 BETWEEN J-BOX
AND CONTROL PANEL.

⊕ TERMINALS ARE FOR PASS THROUGH OF DRAIN WIRE.
SIGNAL DEVICES ARE TO BE GROUNDED AT CONTROL PANEL ONLY

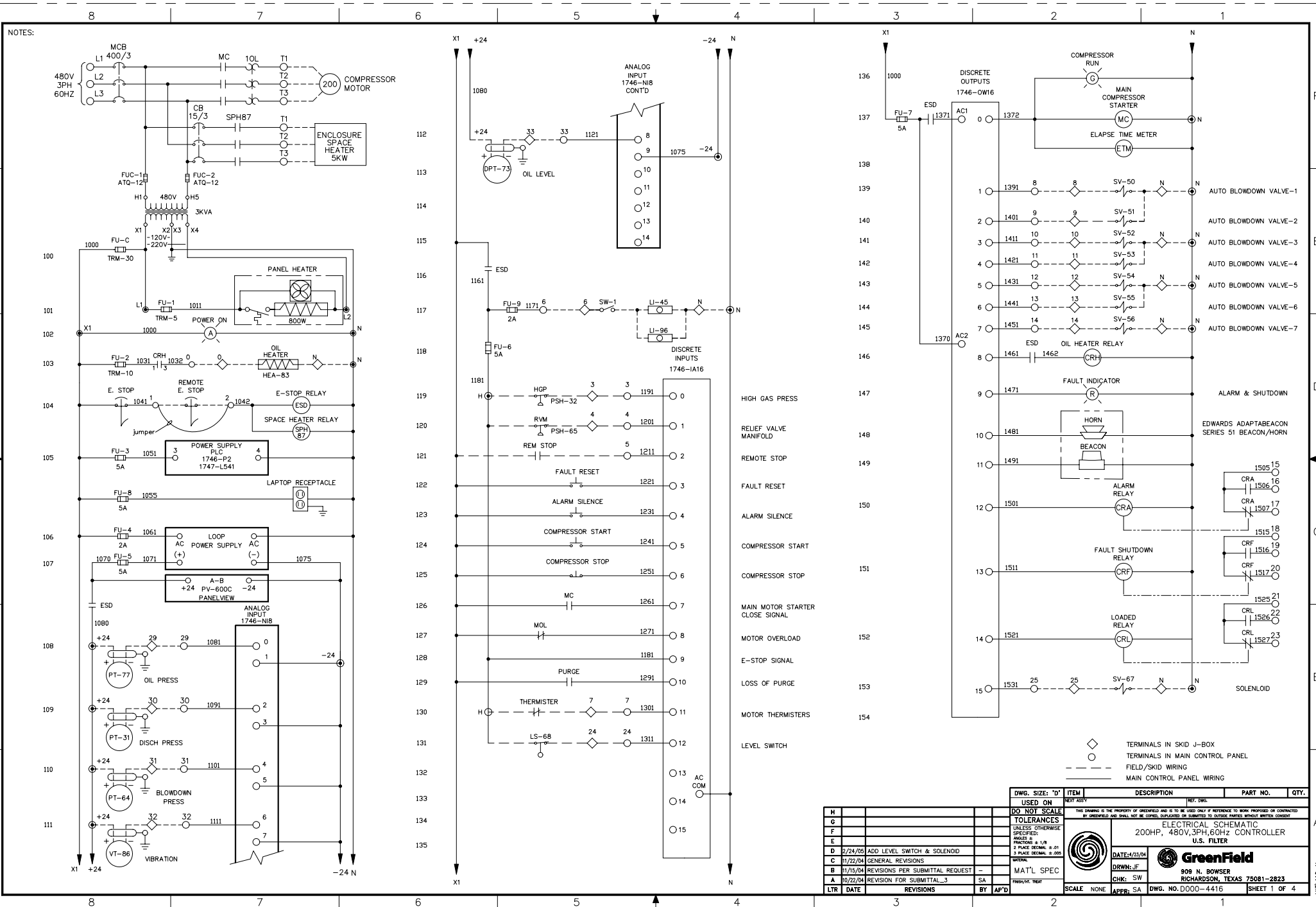
H		G		F		E		D		C		B		A	
DO NOT SCALE		TOLERANCES		UNLESS OTHERWISE SPECIFIED:		FRACTIONS & 1/8"		2 PLACE DECIMAL & 0.01		3 PLACE DECIMAL & 0.005		MATERIAL		FINISH/TREAT	
3/16/05 ADD ZERO LOSS BLOWDOWN TERMINALS		11/20/04 REVISE TERMINAL DESIGNATIONS		11/17/04 APPROVED FOR PRODUCTION		BY AP'D		SCALE		NTS		DATE		REVISIONS	
LTR		DATE		REVISIONS		BY		AP'D		SCALE		NTS		DATE	
ITEM		DESCRIPTION		PART NO.		QTY.		USED ON		NEXT ASSY		DATE		DRAWN	
THIS DRAWING IS THE PROPERTY OF GREENFIELD AND IS TO BE USED ONLY IF REFERRED TO BY WORK PROPOSED OR CONTRACTED BY GREENFIELD AND SHALL NOT BE COPIED, REPRODUCED OR TRANSMITTED IN ANY MANNER WITHOUT WRITTEN CONSENT.		SKID J-BOX TERMINAL CONNECTION		U.S. FILTER		GREENFIELD		809 N. BOWSER		RICHARDSON, TEXAS 75081-2823		CHK:		DWG. NO. 0000-4531	
SCALE		NTS		APPR:		DWG. NO. 0000-4531		SHEET 1 OF 1		HTV10-X					



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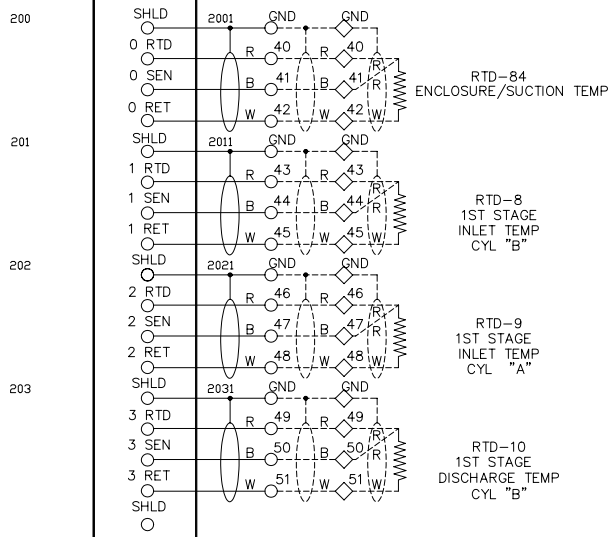
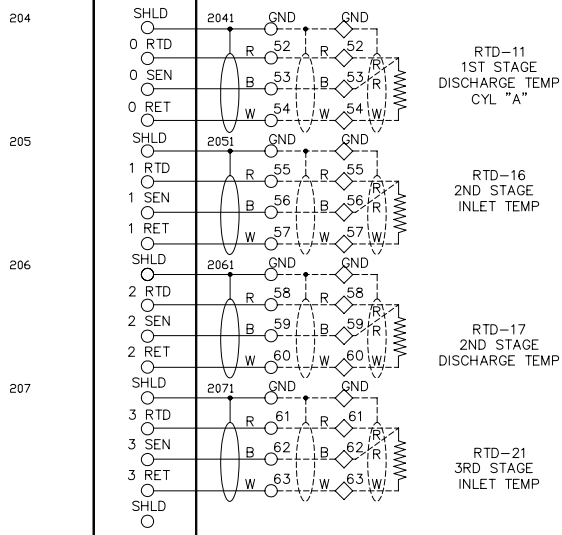
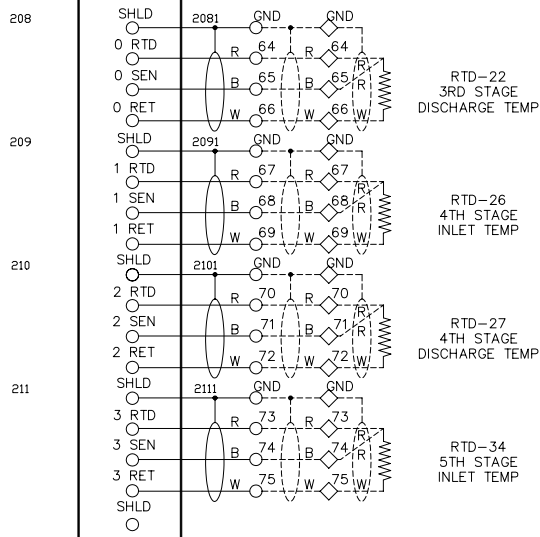
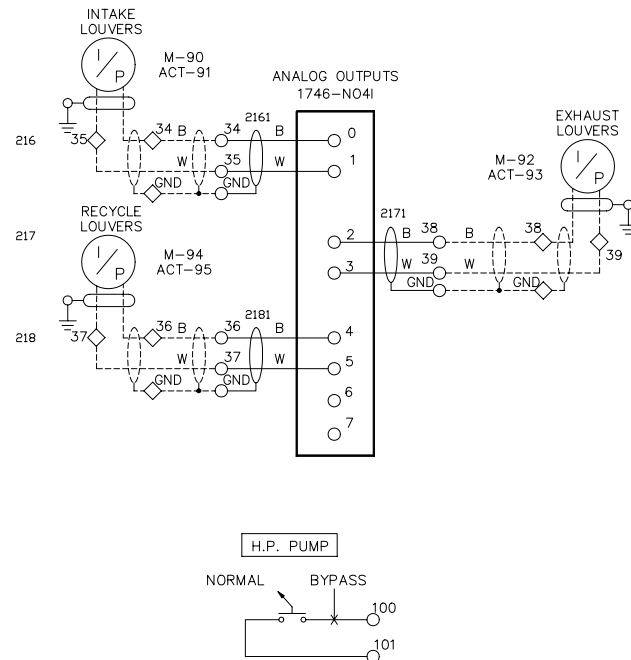
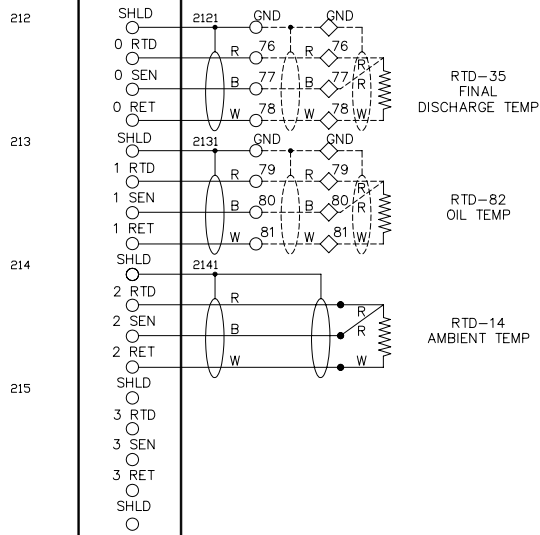


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NOTES:

ANALOG
RTD INPUT
1746-NR4ANALOG
RTD INPUT
1746-NR4ANALOG
RTD INPUT
1746-NR4ANALOG
RTD INPUT
1746-NR4

NOTE: GROUND TERMINALS IN SKID J-BOX
ARE FOR SHIELD PASS THROUGH ONLY

RTD CONNECTIONS USE 3-CONDUCTOR SHIELDED CABLE
G.F. PN 703248

4~20mA CONNECTIONS USE 2-CONDUCTOR SHIELDED CABLE
G.F. PN 703330

- ◇ TERMINALS IN SKID J-BOX
- TERMINALS IN MAIN CONTROL PANEL
- FIELD/SKID WIRING
- MAIN CONTROL PANEL WIRING
- ⊥ GND

DWG. SIZE: "D"		ITEM	DESCRIPTION	PART NO.	QTY.
USED ON		NEXT ASSY	REV. ENG.		
DO NOT SCALE		THIS DRAWING IS THE PROPERTY OF GREENFIELD AND IS TO BE USED ONLY IF REFERENCED TO BY WORK PROPOSED OR CONTRACTED BY GREENFIELD AND SHALL NOT BE COPIED, REPRODUCED OR SUBMITTED TO ANY OTHER PARTY WITHOUT WRITTEN CONSENT			
TOLERANCES		UNLESS OTHERWISE SPECIFIED:			
F		FRACTIONS ± 1/8			
D		3 PLACE DECIMAL ± .003			
C		11/22/04 GENERAL REVISIONS			
B		11/15/04 REVISIONS PER SUBMITTAL REQUEST			
A		10/22/04 REVISION FOR SUBMITTAL_3			
LTR	DATE	REVISIONS	BY	AP'D	DATE
SCALE		NTS	APPB: SA	SHEET 2 OF 4	

		DATE: 4/23/04		Greenfield, Texas	
MATERIAL		MAT'L SPEC		FABRICATE: TREAT	
200HP, 460V, 3PH, 60Hz CONTROLLER		U.S. FILTER		909 N. BOWSER	
RICHARDSON, TEXAS 75081-2823		DWG. NO. 0000-4416		SHEET 2 OF 4	



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A

ITEM	QTY	DESCRIPTION	MFG	MFG PN
35	1	CONTACTOR, 10HP@460V, 3P	SQD	LC1D18G6
36	1	FUSEBLOCK, 3P, 600V, 30A	FERRAZ/SHAW	30323
37	1	PANEL HEATER, 800W, 230VAC	HOFFMAN	D-AH8002B
38	1	ADAPTEABEACON, RED, FLASH, w/ HORN	EDWARDS	51R-N5-40W
39	1	MOUNT KIT, OVERLOAD RELAY	SQ-D	LA7F902
40	1	AUX CONTACT BLOCK, 1-N.O., 1-N.C.	SQ-D	LADN11
41	3	WIRE DUCT, 1X3 WHT	PANDUIT	F1X3WH6
42	3	WIRE DUCT COVER, 1", WHT	PANDUIT	C1WH6
43	2	WIRE DUCT, 2X3, WHT	PANDUIT	F2X3WH6
44	2	WIRE DUCT COVER, 2", WHT	PANDUIT	C2WH6
45	2	CONTROL RELAY, 5-N.O., 120V COIL	SQ-D	CAD50G6
46	3	DIN RAIL, 35X15mm	SQ-D	AMIED-200
47	1	2-POSITION SELECTOR SWITCH	SQ-D	ZB2B02
48	-	-	-	-
49	-	-	-	-
50	-	-	-	-
51	-	-	-	-
52	-	-	-	-
53	-	-	-	-
54	-	-	-	-
55	-	-	-	-
56	-	-	-	-
57	-	-	-	-
58	-	-	-	-
59	-	-	-	-
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62	-	-	-	-
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67	-	-	-	-
68	-	-	-	-

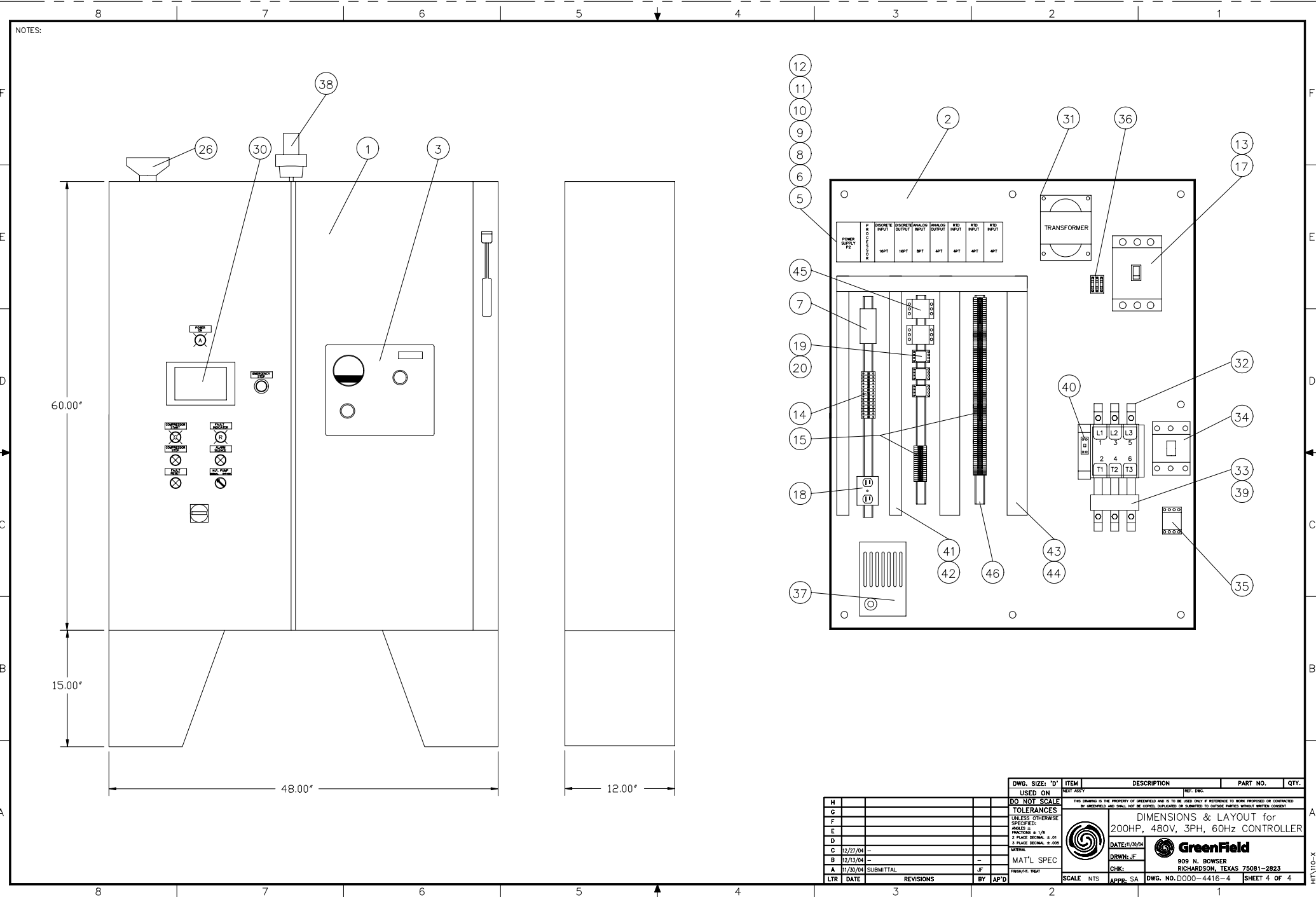
				DWG. SIZE: "D"	ITEM	DESCRIPTION	PART NO.	QTY.
				USED ON	TEST BODY	REF. DWG.		
H				DO NOT SCALE		THIS DRAWING IS THE PROPERTY OF GREENFIELD AND IS TO BE USED ONLY BY REFERENCE TO WORK PROPOSED OR CONTRACTED BY GREENFIELD. NO SHALL BE COPIED OR REPRODUCED WITHOUT WRITTEN CONSENT.		
G				TOLERANCES		BILL OF MATERIAL FOR		
F				UNLESS OTHERWISE SPECIFIED:		200HP, 460V, 3PH, 60HZ CONTROLLER		
E				HOLE FRACCTIONS: 1/8"		 GreenField 908 N. BOWSER RICHARDSON, TEXAS 75081-2823		
D				2 PLACES DECIMAL: 0.01				
C				3 PLACES DECIMAL: 0.000				
B				OTHER: _____				
A	12/13/04	--	--	MAT'L SPEC		DATE: 11/19/04		
	11/30/04	SUBMITAL	JF	FRW/VL TRST		DRWN: JF		
LTR	DATE	REVISIONS	BY	AP'D	SCALE NTS		CHK:	DWG. NO. D000-4416-3
								SHEET 3 OF 4



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NOTES:

DWG. SIZE: "D"		ITEM	DESCRIPTION	PART NO.	QTY.
USED ON		NEXT ASSY	REV. TIME		
DO NOT SCALE			THIS DRAWING IS THE PROPERTY OF GREENFIELD AND IS TO BE USED ONLY IF REFERENCE TO WORK PROPOSED OR CONTRACTED BY GREENFIELD AND SHALL NOT BE COPIED, DUPLICATED OR SUBMITTED TO OUTSIDE PARTIES WITHOUT WRITTEN CONSENT		
TOLERANCES			DIMENSIONS & LAYOUT for 200HP, 480V, 3PH, 60HZ CONTROLLER		
UNLESS OTHERWISE SPECIFIED: FRACTIONS: 1/8, 1/4, 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/8, 1 1/4, 1 3/4, 1 7/8, 2, 2 1/4, 2 1/2, 2 3/4, 3, 3 1/4, 3 1/2, 3 3/4, 4, 4 1/4, 4 1/2, 4 3/4, 5, 5 1/4, 5 1/2, 5 3/4, 6, 6 1/4, 6 1/2, 6 3/4, 7, 7 1/4, 7 1/2, 7 3/4, 8, 8 1/4, 8 1/2, 8 3/4, 9, 9 1/4, 9 1/2, 9 3/4, 10, 10 1/4, 10 1/2, 10 3/4, 11, 11 1/4, 11 1/2, 11 3/4, 12, 12 1/4, 12 1/2, 12 3/4, 13, 13 1/4, 13 1/2, 13 3/4, 14, 14 1/4, 14 1/2, 14 3/4, 15, 15 1/4, 15 1/2, 15 3/4, 16, 16 1/4, 16 1/2, 16 3/4, 17, 17 1/4, 17 1/2, 17 3/4, 18, 18 1/4, 18 1/2, 18 3/4, 19, 19 1/4, 19 1/2, 19 3/4, 20, 20 1/4, 20 1/2, 20 3/4, 21, 21 1/4, 21 1/2, 21 3/4, 22, 22 1/4, 22 1/2, 22 3/4, 23, 23 1/4, 23 1/2, 23 3/4, 24, 24 1/4, 24 1/2, 24 3/4, 25, 25 1/4, 25 1/2, 25 3/4, 26, 26 1/4, 26 1/2, 26 3/4, 27, 27 1/4, 27 1/2, 27 3/4, 28, 28 1/4, 28 1/2, 28 3/4, 29, 29 1/4, 29 1/2, 29 3/4, 30, 30 1/4, 30 1/2, 30 3/4, 31, 31 1/4, 31 1/2, 31 3/4, 32, 32 1/4, 32 1/2, 32 3/4, 33, 33 1/4, 33 1/2, 33 3/4, 34, 34 1/4, 34 1/2, 34 3/4, 35, 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