



OPERATION AND MAINTENANCE PLAN

VOLUME II - APPENDIX B

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APPENDIX B

VENDOR OPERATING & MAINTENANCE INSTRUCTIONS/INFORMATION

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VENDOR OPERATING & MAINTENANCE INSTRUCTIONS/INFORMATION

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APPENDIX B-1

HAND WATER LEVEL METER (SOLINST)

Equipment Check

1. Turn Sensitivity Dial fully clockwise.

Note: • clockwise rotation of sensitivity dial turns meter on and increases sensitivity.

- always set switch to highest sensitivity position, then decrease if necessary.

2. Depress the Battery Test button to test the battery and circuitry (excluding the probe when not in use).
3. Submerge the probe in tap water. This completes the circuit and activates the buzzer and light.

Water Level Measurement

The zero measurement point is:

P2 Probe-tip of the inner sensor pin visible near the centre of the probe

P4 Probe-tip of inner electrode at base of probe.

P5 Probe-exposed electrode at tip of probe.

Using the Tape Guide

1. The tape guide has been designed to:

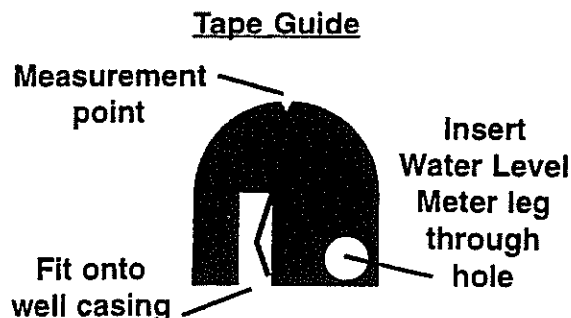
- improve accuracy when reading water levels,
- easily obtain repeatable measurements,
- prevent tape being cut by well casing,
- allow the tape and probe to hang straight from the side of the well.

2. Feed the tape into and out of the well using the groove in the top of the Tape Guide.
3. For ease of operation the tape guide can be used to support the water level meter.

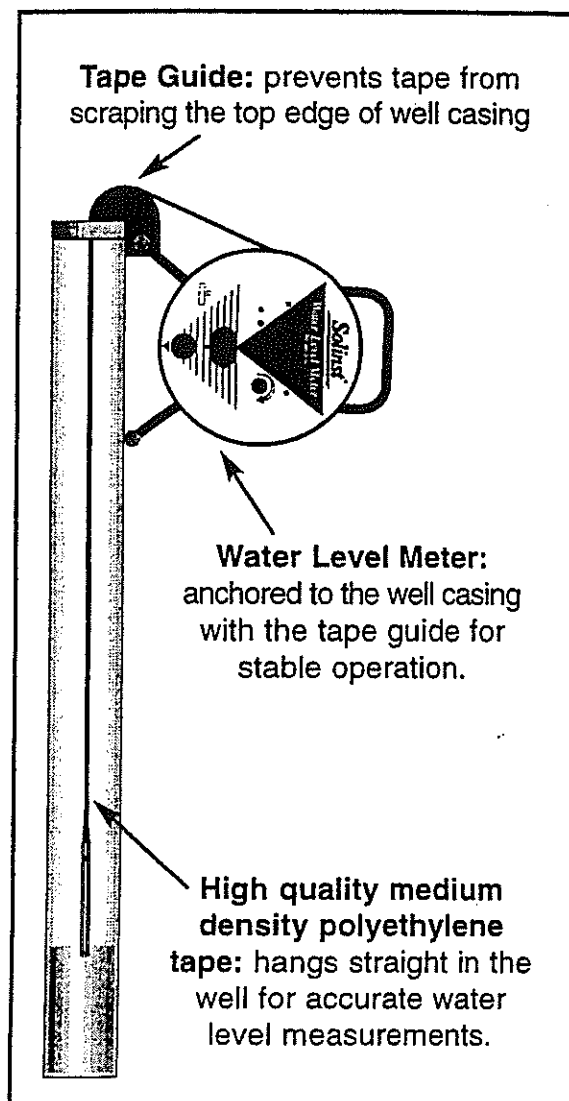
Simply fit the small end of the tape guide onto the edge of the well casing (2" dia. or larger).

Insert the leg of the Water Level Meter into the hole on the Tape Guide and rest the Water Level Meter on the side of the well casing. (see diagram on right).

Note: To store the Tape Guide, simply clip it onto the support bracket located on the back of the Water Level Meter.



Note: When using the tape guide, the measuring point is offset from the top of casing. To adjust your measurements to the top of the casing, simply subtract the amount indicated on the front of the tape guide (ie 6 cm or 2/10 ft.).



Routine Care

1. After the depth to water has been recorded, the tape should be carefully rewound onto the reel, the probe wiped dry and placed into the probe holder.
2. The probe, tape and reel can be cleaned with phosphate free (non-abrasive) detergent and warm water.
3. Use of a Water Level Meter Carrying Bag adds to the service life of the meter.
4. Use of the Tape Guide adds to the life of the tape.

Care of the P4 Probe

Note: Do not remove or twist strain relief pieces at the top of the probe as this will cause damage to the pressure seal. If the pressure seal integrity is in question, please call Solinst for the best repair option.

1. While holding firmly onto the black Delrin section at the top of the probe, turn the P4 sleeve body clockwise slightly and pull down. **Do not twist back and forth.**
2. Remove any dirt and water from inside the sleeve body, the centre electrode and the Teflon® pieces.
3. Carefully pull the coil spring from its recessed area and onto the centre electrode.
4. Clean the recessed area where the coil spring rests and check to see that the exposed wire is in place and clean.
5. Push the coil spring back into place. The cant of the spring must curve clockwise when observing from the bottom of the probe.

6. Remove and clean o-rings. Clean recessed areas and check o-rings for damage. Lightly lubricate and replace o-rings.
7. Turning clockwise slightly, gently push the sleeve body over the electrode to the black Delrin piece.
8. To test, turn the unit on and lower the probe into a glass of water. When the probe touches water, the buzzer will sound and the light will come on.
9. Wipe dry and return to probe holder.

Battery Replacement

- battery type - alkaline, 9 volt.

1. The battery is housed in a convenient battery drawer located in the faceplate of the Water Level Meter.
2. To replace the battery, simply press the drawer in, lift then pull.
3. The battery drawer should slide out of the faceplate enough to pull it out.
4. Note the polarity and place another new battery in the drawer and slide it back into the faceplate.

Replacement Parts

The following parts can be provided should they become lost or damaged.

1. Probes and seal kits
2. Splice kits
3. Lights, switches, etc.
4. Reels
5. Replacement tape with probe (Complete).

SYMPTOM	CAUSE	REMEDY
No sound when probe immersed in water.	Dead battery.	Replace with 9V Alkaline.
	Water conductivity is very low.	Increase sensitivity switch setting (turn clockwise) or call Solinst for assistance.
	Disconnected wires on circuit board.	Check all connections inside hub of reel for loose/disconnected wires - solder or reconnect.
	Broken wire in tape.	Locate break in tape - splice and seal. (Contact Solinst)
	Disconnected wire inside probe.	Contact Solinst to obtain parts/repair instructions.
Instrument continuously sounds after being immersed in water.	Water in probe. Probe may be dirty which could interfere with the circuit connection.	P4 Probe: please follow instructions above. If water is inside the probe, there has been a breach of the probe seal. Inspect the o-rings and replace if necessary. If problem persists, contact Solinst. Other probes: call Solinst for instructions to remove, clean and reseal probe.

Solinst

High Quality Groundwater Monitoring Instrumentation

Meter 29962
Purchased 12/01

Solinst Canada Ltd.

35 Todd Road

Georgetown, ON, L7G 4R8

TEL: (905) 873-2255 or (800) 661-2023

FAX: (905) 873-1992 or (800) 516-9081

E-mail: instruments@solinst.com

Web Site: www.solinst.com

LIMITED WARRANTY

Solinst Canada Ltd. (Solinst) hereby warrants to the user, subject to the conditions outlined herein, that all equipment manufactured by Solinst will be free of defects in **workmanship and materials** for a **period of one year** from the date of shipment from Solinst.

In addition, a special **10 year warranty** will apply to the bladders only on Solinst #407 Integra Bladder Pumps.

Solinst warrants to repair or, at its option, replace any such defective equipment determined to its satisfaction to have a defect in workmanship or original material, upon return of such defective equipment to Solinst with all shipping charges prepaid by the user, provided that written notice and an explanation of the claimed defect is promptly submitted to Solinst.

In no event shall Solinst be liable for any direct, indirect, consequential or special damages, abuse, acts of third parties, environmental conditions, force of nature, or for installation, adjustment or other expenses which may arise in connection with such defective equipment. Further, this warranty shall not apply to damage to the equipment caused by incorrect installation, usage, storage, alteration or inadequate care.

This warranty is expressly in lieu of all other warranties, expressed or implied, whether merchantability or fitness for any particular use, and of all other obligations and liabilities of any kind and character. There are no warranties except as specifically provided in writing herein.

APPENDIX B-2

SUBMERSIBLE PUMPS (GOULDS)

Installation, Operation and Maintenance Instructions

Models 3885, 3886, 3887



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Owner's Information

Model Number: _____

Serial Number: _____

Dealer: _____

Dealer's Phone No. _____

Date of Purchase: _____ Installation: _____

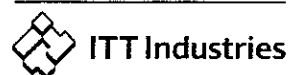
Current Readings at Startup:

Single Phase: _____

Three Phase – 1st Phase: _____

1 Phase: _____ 3rd Phase: _____

Goulds Pumps



ITT Industries

SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.



This is a **SAFETY ALERT SYMBOL**. When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.

⚠ DANGER

Warns of hazards that **WILL** cause serious personal injury, death or major property damage.

⚠ WARNING

Warns of hazards that **CAN** cause serious personal injury, death or major property damage.

⚠ CAUTION

Warns of hazards that **CAN** cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.

⚠ WARNING



Hazardous fluids can cause fire, burns or death.

UNIT NOT DESIGNED FOR USE WITH HAZARDOUS LIQUIDS OR FLAMMABLE GASES. THESE FLUIDS MAY BE PRESENT IN CONTAINMENT AREAS.

NOTICE: INSPECT UNIT FOR DAMAGE AND REPORT ALL DAMAGE TO THE CARRIER OR DEALER IMMEDIATELY.

DESCRIPTION AND SPECIFICATIONS

The Model 3885 is a 2" NPT discharge, ¾" (19 mm) solids handling, submersible effluent pump. The Model 3886 is a 2" (50 mm) solids handling, submersible sewage pump. The Model 3887 is a 2" flanged (standard) 3" flange (optional) discharge, 2" (50 mm) solids handling, submersible sewage pump.

Lifting of Pump

⚠ WARNING



Hazardous voltage can shock, burn or cause death.

DO NOT LIFT, CARRY OR HANG PUMP BY THE ELECTRICAL CABLES. DAMAGE TO THE ELECTRICAL CABLES CAN CAUSE SHOCK, BURNS OR DEATH.

- Lift the pump with an adequately sized chain or cable attached to the lifting handle (458). **DO NOT** damage electrical cables while raising and lowering unit.

Sliderail System

- The **OPTIONAL** Goulds Model A10-20 sliderail system is recommended for proper installation.

NOTICE: FOLLOW THE INSTALLATION AND OPERATION INSTRUCTIONS PROVIDED WITH THE SLIDERAIL SYSTEM.

- Installation of the sliderail system should locate the pump opposite the influent opening, preventing stagnate areas where solids can settle.
- The pit floor **MUST** be flat under the sliderail base and have sufficient loading capacity to support the entire weight of the assembly, including the sliderail base, sliderail guide, pump and all assorted piping.

Piping

- Discharge piping should be no smaller than 2" (51 mm) diameter and kept as short as possible, avoiding unnecessary fittings to minimize friction losses.
- Install an adequately sized check valve (suitable for handling ¾" (19 mm) solids for effluent applications and 2" (50 mm) solids for sewage applications) in the discharge pipe to prevent backflow. Follow the check valve manufacturer's installation instructions.
- Install an adequately sized gate valve **ABOVE** the check valve for pump, plumbing and check valve maintenance.
- To deter air locking, drill a 3/16" (4.8 mm) hole, 2" (50.8 mm) beyond the pump discharge connection.
- All piping must be adequately supported, so as not to impart any piping strain or loads on the pump.

Access Doors

- Access doors can be single or double leaf design. Doors should include a lifting handle and a lock provision for tamper resistant operation. Standard and heavy duty steel or aluminum doors are available.
- The pit access door must be of sufficient size to allow for inspection, maintenance and crane or hoist service.

Liquid Level Controls

- Single float operation can be used on $\frac{1}{3}$ and $\frac{1}{2}$ HP models. Mounting of the float switch must be checked by the installer to insure proper turn on and turn off. The pump may be plugged directly into the piggy back style plug located on the cord of the float switch.
- The recommended float operation sequence used with a control panel requires a three or four float system. In the three float system, the floats are designated SW-1 for the bottom float, SW-2 for the middle float and SW-3 for the top float. In a four float system the fourth float is designated SW-4.
 - Simplex Control – The rising liquid level raises float SW-2, turning on the pump. When the liquid level falls sufficiently, SW-1 will turn the pump off. If the influent is excessive, or if the pump fails to operate correctly, SW-3 will activate an alarm, which will remain on until manually reset.
 - Duplex Control – The duplex control will alternate the two pumps, causing the lead pump to change at each system cycle. When equipped with three floats, the system will cycle the same as the simplex control, described above, except that the SW-1 will cause the lead pump to alternate.
- If the influent is excessive, or if the lead pump fails to operate correctly, the rising level will activate SW-3, turning on the lag pump and the alarm. As before the alarm must be manually reset.
- Four Float Control – The four float system operates the same as the duplex control system, except that float SW-3 will not turn on the alarm. In this system SW-4 turns on the alarm, which again must be manually reset.
- Several different float controls are available from the Goulds Catalog.

NOTICE: POSITION THE FLOATS SO THAT THEY DO NOT SNAG OR TANGLE ON THE PUMP, DISCHARGE PIPING, OR OTHER EQUIPMENT.

- The lower most float turns the unit off and should be set as shown in the “**TYPICAL PLUMBING and INSTALLATION**” drawing provided in this manual.
- Increasing the distance between the SW-1 and SW-2 floats lengthens the running time. One (1) minute is the minimum recommended pump cycle time.

NOTICE: DURING PUMP OPERATION, INSURE THAT THE LIQUID LEVEL DOES NOT DROP BELOW THE PUMP MOTOR FOR EXTENDED PERIODS. THIS CAN CAUSE THE PUMP MOTOR TO OVERHEAT, CAUSING MOTOR DAMAGE AND VOIDING THE WARRANTY.

Pump Motor Control Panels

- Control panels shall be in accordance with local and National Electrical Code requirements.
- Single phase installations shall be equipped with a Goulds’ “SES” or “A” Series panel, or **AS A MINIMUM**, a control panel with a properly sized magnetic contactor and a disconnect switch.
- Three phase installations shall be equipped with a Goulds’ “SES” or “A” Series panel, or **AS A MINIMUM** with a 3 pole circuit breaker, an across the line magnetic starter NEMA rated for the appropriate horsepower, ambient compensated Quick Trip Class 10 overload relays.

Wiring and Grounding

- Use only stranded copper wire to motor and ground. The ground wire must be at least as large as the wires to the motor. Wires should be color coded for ease of maintenance.



Install, ground and wire according to local and National Electrical Code requirements.



Install an all leg disconnect switch near the pump.



Disconnect and lockout electrical power before installing or servicing pump.



Electrical supply **MUST** match pump’s nameplate specifications. Incorrect voltage can cause fire, damage motor and voids warranty.



Single phase motors are equipped with automatic thermal protectors which open the motor’s electrical circuit when an overload exists. This can cause the pump to start unexpectedly and without warning.



Some models are equipped with a 3-prong grounded plug and **MUST** be used in a grounded 3-wire receptacle. **DO NOT** modify the plug or remove the ground prong.

- Where cables must be spliced or connected to the motor leads, splices **MUST** be water tight. Commercially available potting or heat shrink kits may be used, if allowed by local or federal regulations.

**NOTICE: FOLLOW THE SPLICE KIT
MANUFACTURER'S INSTRUCTIONS.**

- Where wire splices are used, follow one of these procedures:
 - Butt join the wires using properly sized and correctly crimped Sta-Kon™, or equivalent, connectors. Insulate and water proof each joint using heat shrink tubing equipped with a self contained sealer. Apply heat evenly from a torch until adequately sealed.

OR

- Use plastic insulators and a neoprene gasket sleeve set with properly sized and correctly crimped Sta-Kon™ connectors. Place a cap and gasket on each wire end, center insulator body over splice, insert the sleeve into the body as far as possible, hand tighten caps.
- In the case of multiple conductors, stagger the joints.



**FAILURE TO PERMANENTLY
GROUND THE PUMP, MOTOR AND
CONTROLS BEFORE CONNECTING
TO ELECTRICAL POWER CAN
CAUSE SHOCK, BURNS OR DEATH.**

Operation

- If the unit has been stored for an extended period, check the oil level in the motor and seal chamber, to insure that they are full, using the following procedures:
 - Motor Cover – With the pump in the upright position, remove the oil fill plug (358E), being careful that nothing enters the motor. The oil level should be above the top of the motor. With the correct oil fill as required. **DO NOT** over fill.
 - Cable Gland Assemblies – Re-torque both the power and sensor cable glands to values given in step 10 of “POWER CABLE REPLACEMENT”.
- Before lowering the pump(s) into the containment area, three phase units should be jogged to insure correct rotation. See the motor rotation arrow on the motor cover (341). Check both pumps in a duplex operation.

NOTICE: MOTOR STARTUP TORQUE, “KICKBACK”, WILL CAUSE THE MOTOR TO TWIST IN THE DIRECTION OPPOSITE ROTATION. INSURE THAT THE PUMP ASSEMBLY IS ADEQUATELY RESTRAINED.



**DO NOT PLACE HANDS IN PUMP
SUCTION WHILE CHECKING
MOTOR ROTATION. TO DO SO
WILL CAUSE SEVERE PERSONAL
INJURY.**

**NOTICE: DO NOT SWITCH PRIMARY POWER LEADS
COMING INTO A THREE PHASE DUPLEX
CONTROL PANEL. THIS WILL REVERSE
ROTATION OF BOTH PUMPS.**

- If the three phase motor(s) rotation is backwards, reverse any two pump power cable leads at the pump control panel.



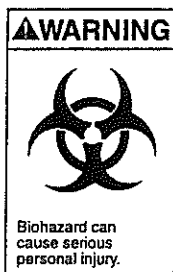
**MOTOR OVERHEAT/OVER
CURRENT SENSING DEVICES
AUTOMATICALLY RESTART THE
MOTOR UNEXPECTEDLY AND
WITHOUT WARNING. THIS CAN
CAUSE SEVERE PERSONAL
INJURY.**

- After installing the pump into the containment area, with adequate submergence, open the discharge valve fully. Start the unit using manual controls. If flow is appreciably less than rated performance, pump may be air bound. To expel trapped air, jog the unit several times, using the manual controls.
- Have a qualified electrician take current measurements on the single or all three phases. Record these readings in the space provided in the “OWNER’S INFORMATION” section of this manual for future reference.
- The unit is now ready for normal operation. Place the controls in the automatic position.

Maintenance



**FAILURE TO DISCONNECT AND
LOCKOUT ELECTRICAL POWER
BEFORE ATTEMPTING ANY
MAINTENANCE CAN CAUSE
SHOCK, BURNS OR DEATH.**



**UNIT MUST BE FLUSHED AND
DISINFECTED, INSIDE AND OUT,
PRIOR TO SERVICING.**

Periodic Maintenance

**NOTICE: ROUTINE PERIODIC INSPECTIONS ARE
REQUIRED AND SHOULD FOLLOW THE
FREQUENCY AND MAINTENANCE
SCHEDULE PROVIDED.**

FREQUENCY	REQUIRED MAINTENANCE
MONTHLY	• Duplex Units – Check for even operating times. Uneven operation times indicate a defective unit, float switch or control. • Unimpeded float operation.

Disassembly/Assembly

▲WARNING

Hazardous
voltage

**FAILURE TO DISCONNECT AND
LOCKOUT ELECTRICAL POWER
BEFORE ATTEMPTING ANY
MAINTENANCE CAN CAUSE
SHOCK, BURNS OR DEATH.**

**NOTICE: FOLLOW ALL SAFETY AND LIFTING
INSTRUCTIONS PROVIDED IN THIS
MANUAL.**

- Following the slide rail instructions, remove the pumping unit from the sewage containment area.

▲WARNING



Biohazard can
cause serious
personal injury.

**UNIT MUST BE FLUSHED AND
DISINFECTED, INSIDE AND OUT,
PRIOR TO SERVICING.**

MECHANICAL SEAL REPLACEMENT

1. Follow **ALL** instructions provided in the “**DISASSEMBLY**” section of this manual.
2. To gain access to the pump impeller and mechanical seal remove the four casing hex cap screws (372D). Remove casing (100) and casing gasket (351); discard the gasket.

▲CAUTION



Hazardous pressure can
cause personal injury or
property damage.

**FAILURE TO REMOVE DRAIN
PLUG CAREFULLY CAN CAUSE
HOT OIL TO ERUPT FROM OIL
RESERVOIR CAUSING PERSONAL
INJURY OR PROPERTY DAMAGE**

3. Removal of the mechanical seal assembly (387) requires draining the special insulating oil from the motor cover. This is accomplished by removing the drain plug and draining the oil into an adequately sized clean receptacle. See “**ENGINEERING DATA**” section for required volume.
4. To remove the impeller (101), it may be necessary to heat the impeller and impeller locknut (304), three phase motors only, with a torch. Use no more heat that is necessary, as excess heat will damage the mechanical seal. Secure the impeller from rotation, and remove the impeller lock nut, by turning the lock nut **COUNTERCLOCKWISE**. Remove the impeller from the motor shaft by holding the motor shaft with a screw driver and turning the impeller **COUNTERCLOCKWISE**.

5. Remove and discard the mechanical seal and stationary seat assembly. **DO NOT** damage the motor shaft or the stationary seat bore.
6. Inspect and wipe clean the stationary seat bore.
7. To install the new stationary seat into the seal housing, lubricate the stationary seat bore and motor shaft with clean motor insulating oil. Using Goulds mechanical seal installation tool (A02A013), slide the stationary seat fully and squarely into the seal housing.
8. With a clean, lint free cloth, wipe the stationary face clean of all lubricating oil or debris. **DO NOT** scratch or otherwise damage the seal face.
9. Lubricate the inside of the rotary elastomer with clean motor insulating oil. Using the Goulds installation tool, slide the seal rotary assembly onto the motor shaft and seat fully against the stationary seat. Remove the seal installation tool.
10. Install the impeller onto the motor shaft by turning the impeller on **CLOCKWISE**, tighten securely. Treat the impeller with Loctite™ #271 and securely install. When provided, securely install the impeller locknut.
11. Fill the motor cover with motor special insulating oil to within 1/2" (13 mm) of the seal chamber housing. Tape drain plug with Teflon™ tape and install plug securely.
12. Reassemble casing and new casing gasket to pump assembly by installing the four casing hex cap screws, torquing in sequence to 35 lbs ft (47 N m).

**NOTICE: FOLLOW THE INSTRUCTIONS PROVIDED
IN THE “WIRING AND GROUNDING” AND
“OPERATION” SECTIONS OF THE
MANUAL AFTER UNIT DISASSEMBLY,
REASSEMBLY.**

POWER CABLE REPLACEMENT

1. To gain access to the motor cover screws follow steps 1 through 6 in the “**MECHANICAL SEAL REPLACEMENT**” section of this manual.
2. Remove the power cable strain relief (484B) assembly from the motor cover and slide up the cable.
3. Remove the four bearing housing socket head screws (371C). Carefully slide the motor cover from the motor assembly. **DO NOT** damage the power cable.
4. Disconnect the power cable wires from the motor assembly (338).

5. Remove cable from motor cover, inspect and replace as required, following the procedures provided.

**NOTICE: DISCARD STRAIN RELIEF ASSEMBLY.
THEY CAN NOT BE REUSED.**

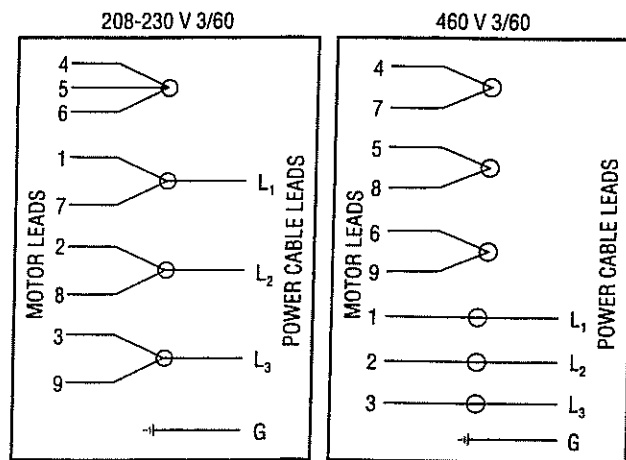
6. Install new motor cable strain relief assembly onto cable, sliding the hex gland on first, then the washer and finally the packing. Insert the cables into the motor cover hole. Pull an appropriate amount of cable through the motor cover to allow for connecting the cable leads. **DO NOT** tighten the strain relief gland.

7. Connect the power cable leads to the motor assembly as follows:

- Single Phase Motors – Connect the **BLACK** wire to motor terminal L₁. Connect the **WHITE** wire to motor terminal L₂. Connect the **GREEN** wire to the motor ground.
- Three Phase Motors – See Figure 1.



FAILURE TO CONNECT POWER AND SENSOR WIRES TO DESIGNATED WIRES CAN CAUSE SHOCK, BURNS OR DEATH.



THREE PHASE MOTOR WIRING DIAGRAM

Figure 1

8. Wire tie the power cable to the motor assembly.
9. Slide the motor cover onto the motor assembly, while carefully pulling the power cable out through the motor cover hole. **DO NOT** damage cables. Install the four seal housing socket head screws, torquing to 90 lbs in (10 N m).
10. Install the power cable strain relief assembly torquing the nylon bushing to 75 lbs in (8.5 N m) and the steel bushing to 100 lbs in (11.3 N m).
11. Continue the assembly following steps 7 through 12 of the **"MECHANICAL SEAL REPLACEMENT"** section of this manual.
12. If the motor cover was replaced, it is necessary to transfer the Goulds nameplate. Using two stainless steel No. 2 round head metallic drive screws, install the Goulds nameplate.

NOTICE: FOLLOW THE INSTRUCTIONS PROVIDED IN THE **"WIRING AND GROUNDING"** AND **"OPERATION"** SECTIONS OF THE MANUAL AFTER UNIT DISASSEMBLY, REASSEMBLY.

START CAPACITOR REPLACEMENT

1. On single phase motors only, to gain access to the motor start capacitor (376), follow steps 1 through 5 in the **"POWER CABLE REPLACEMENT"** section of this manual.

NOTICE: DISCARD STRAIN RELIEF ASSEMBLY. IT CAN NOT BE REUSED.



FAILURE TO DRAIN CAPACITOR OF STORED ELECTRICAL CHARGE BEFORE SERVICE CAN CAUSE A SEVERE SHOCK.

2. Remove the capacitor retaining screw and retaining bracket from the motor assembly. Remove the two wires from the capacitor. Discard the capacitor.
3. Connect the two motor wires to the new capacitor and reassemble with the retaining bracket and retaining screw, tightening securely.
4. Reassemble unit following steps 6 through 12 in the **"POWER CABLE REPLACEMENT"** section of this manual.

NOTICE: FOLLOW THE INSTRUCTIONS PROVIDED IN THE **"WIRING AND GROUNDING"** AND **"OPERATION"** SECTIONS OF THE MANUAL AFTER UNIT DISASSEMBLY, REASSEMBLY.

MOTOR REPLACEMENT

1. To gain access to the motor assembly, follow steps 1 through 5 in the **"POWER CABLE REPLACEMENT"** section of this manual.
- NOTICE:** DISCARD STRAIN RELIEF ASSEMBLY. IT CAN NOT BE REUSED.
2. Remove the four motor thru bolts and carefully pull motor assembly from bearing housing. Further motor service **MUST** be provided by a qualified motor repair facility.
 3. Insert the motor assembly into the bearing housing, visually aligning the motor thru bolts through the lower motor vent openings.
 4. Install the four motor thru bolts, torquing to 35 lbs in (4 N m).
 5. To complete the assembly follow steps 6 through 12 in the **"POWER CABLE REPLACEMENT"** section of this manual.

NOTICE: FOLLOW THE INSTRUCTIONS PROVIDED IN THE **"WIRING AND GROUNDING"** AND **"OPERATION"** SECTIONS OF THE MANUAL AFTER UNIT DISASSEMBLY, REASSEMBLY



Submersible Effluent Pump

MODEL

3885

PROSURANCE AVAILABLE FOR RESIDENTIAL APPLICATIONS.

APPLICATIONS

Specifically designed for the following uses:

- Homes
- Farms
- Trailer courts
- Motels
- Schools
- Hospitals
- Industry
- Effluent systems

SPECIFICATIONS

Pump

- Solids handling capabilities: 3/4" maximum.
- Discharge size: 2" NPT.
- Capacities: up to 140 GPM.
- Total heads: up to 128 feet TDH.
- Temperature: 104°F (40°C) continuous 140°F (60°C) intermittent.
- See order numbers on reverse side for specific HP, voltage, phase and RPM's available.

FEATURES

■ **Impeller:** Cast iron, semi-open, non-clog with pump-out vanes for mechanical seal protection. Balanced for smooth operation. Silicon bronze impeller available as an option.

■ **Casing:** Cast iron volute type for maximum efficiency. 2" NPT discharge.

■ **Mechanical Seal:** SILICON CARBIDE VS. SILICON CARBIDE sealing faces. Stainless steel metal parts, BUNA-N elastomers.

■ **Shaft:** Corrosion-resistant, stainless steel. Threaded design. Locknut on three phase models to guard against component damage on accidental reverse rotation.

■ **Fasteners:** 300 series stainless steel.

■ Capable of running dry without damage to components.

■ Designed for continuous operation when fully submerged.

MOTORS

■ Fully submerged in high-grade turbine oil for lubrication and efficient heat transfer.

■ Class B insulation.

Single phase:

- Built-in overload with automatic reset.
- All single phase models feature capacitor start motors for maximum starting torque.
- 1/2 and 3/4 HP – 16/3 SJTOW with 115, 208 and 230 Volt three prong plug.
- 1/2-2 HP – 14/3 STOW with bare leads.

Three phase:

- Overload protection must be provided in starter unit.
- 1/2-2 HP – 14/4 STOW with bare leads.

■ **Designed for Continuous Operation:** Pump ratings are within the motor manufacturer's recommended working limits, can be operated continuously without damage when fully submerged.

■ **Bearings:** Upper and lower heavy duty ball bearing construction.

■ **Power Cable:** Severe duty rated, oil and water resistant. Epoxy seal on motor end provides secondary moisture barrier in case of outer jacket damage and to prevent oil wicking. 20 foot standard with optional lengths available.

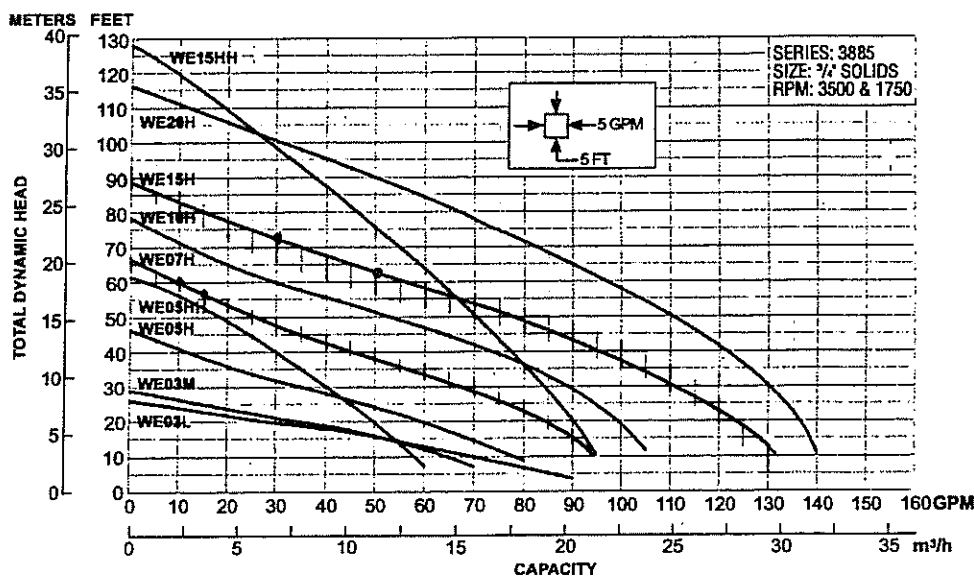
■ **O-ring:** Assures positive sealing against contaminants and oil leakage.

AGENCY LISTINGS



Tested to UL 778 and CSA 22.2 108 Standards By Canadian Standards Association File #LR38549

Goulds Pumps is ISO 9001 Registered.



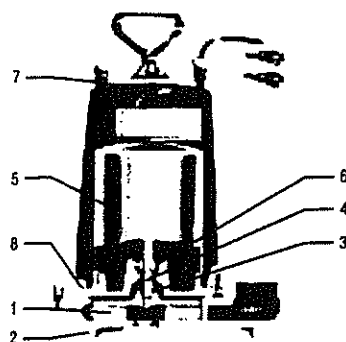
Goulds Pumps





COMPONENTS

Item No.	Description
1	Impeller
2	Casing
3	Silicon carbide vs. silicon carbide Mechanical seal
4	Shaft
5	Motor
6	All Ball bearing heavy duty design
7	Power cable
8	O-ring



Submersible Effluent Pump

MODEL

3885

MODELS

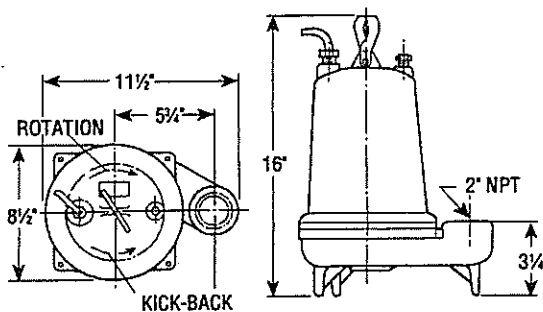
Order No.	HP	Volts*	Phase	Max. Amp.	RPM	Solids	Wt. (lbs.)	Heaters
WE0311L		115		9.8				
WE0318L		208		5.5				
WE0312L	1/2	230		4.9	1750		56	
WE0311M		115		9.8				
WE0318M		208		5.5				
WE0312M		230		4.9				
WE0511H		115		14.5				
WE0518H		208		8.1				
WE0512H		230		7.3				
WE0538H		200		4.1				
WE0532H		230		3.3				
WE0534H		460		1.7				
WE0511HH	1/2	115		14.5			60	
WE0518HH		208		8.1				
WE0512HH		230		7.3				
WE0538HH		200		4.1				
WE0532HH		230		3.6				
WE0534HH		460		1.8				
WE0718H		208		11.0				
WE0712H		230		10.0				
WE0738H	3/4	200		6.2				
WE0732H		230		5.4				
WE0734H		460		2.7				
WE1018H		208		14.0				
WE1012H		230		12.5				
WE1038H		200		8.1				
WE1032H		230		7.0				
WE1034H		460		3.5				
WE1518H		208		17.5				
WE1512H		230		15.7				
WE1538H		200		10.6				
WE1532H		230		9.2				
WE1534H		460		4.6				
WE1518HH	1 1/2	208		17.5			80	
WE1512HH		230		15.7				
WE1538HH		200		10.6				
WE1532HH		230		9.2				
WE1534HH		460		4.6				
WE2012H		230		18.0				
WE2038H		200		12.0				
WE2032H		230		11.6				
WE2034H		460		5.8				

PERFORMANCE RATINGS (gallons per minute)

Order No.	WE03L	WE03M	WE05H	WE07H	WE10H	WE15H	WE05HH	WE15HH	WE20H
HP	1/2	1/2	1/2	3/4	1	1 1/2	1/2	1 1/2	2
RPM	1750	1750	3500	3500	3500	3500	3500	3500	3500
5	86	-	-	-	-	-	-	-	-
10	70	65	78	94	-	-	56	95	140
15	58	58	70	90	103	128	53	93	138
20	30	35	60	85	98	123	50	90	136
25	5	15	48	76	94	117	45	87	133
30	-	-	35	67	88	111	40	84	130
35	-	-	23	57	82	103	35	82	126
40	-	-	12	45	74	95	30	77	121
45	-	-	-	35	64	86	25	74	116
50	-	-	-	25	53	77	18	70	110
55	-	-	-	17	42	67	12	66	104
60	-	-	-	9	30	56	3	63	97
65	-	-	-	-	20	46	-	58	90
70	-	-	-	-	11	35	-	55	83
75	-	-	-	-	4	25	-	51	75
80	-	-	-	-	-	15	-	47	66
90	-	-	-	-	-	-	-	37	51
100	-	-	-	-	-	-	-	28	30
110	-	-	-	-	-	-	-	17	10
120	-	-	-	-	-	-	-	8	-

DIMENSIONS

(All dimensions are in inches. Do not use for construction purposes.)



EFFLUENT EJECTOR SYSTEM

Effluent ejector system offers ease of ordering and installation. A single ordering number specifies a complete system designed for most residential and commercial sump and effluent pump applications.



Package Includes:

Submersible Effluent Pump WE0311L, 12L or WE0311M, 12M, WE0511HH, 12HH
Mechanical Level Control Switch
A2-5 (115V), A2-6 (230V)
Basin and Cover A7-1830P
Check Valve A9-2P
Order No.: SWE0311L, SWE0312L, SWE0311M, SWE0312M, SWE0511HH, SWE0512HH.

Goulds Pumps



Engineering Data

Maximum Diameter Solids			Minimum Pump Submergence—Below Top of Motor Dome	6 in	152 mm
3885	¾ in	19 mm	Minimum Number of Evenly Distributed Starts per Hour	6	
3886 and 3887	2 in	50 mm	Maximum Operating Temperature		
Minimum Casing Thickness	⅝ in	8 mm	Continuous Operation	40° C	104° F
Casing Corrosion Allowance	⅜ in	3 mm	Intermittent Operation	60° C	140° F
Minimum Working Pressure	55 psi	380 kPa	Motor Cover Oil Capacity	4.5 qts.	4.3 L

ELECTRICAL DATA 3885

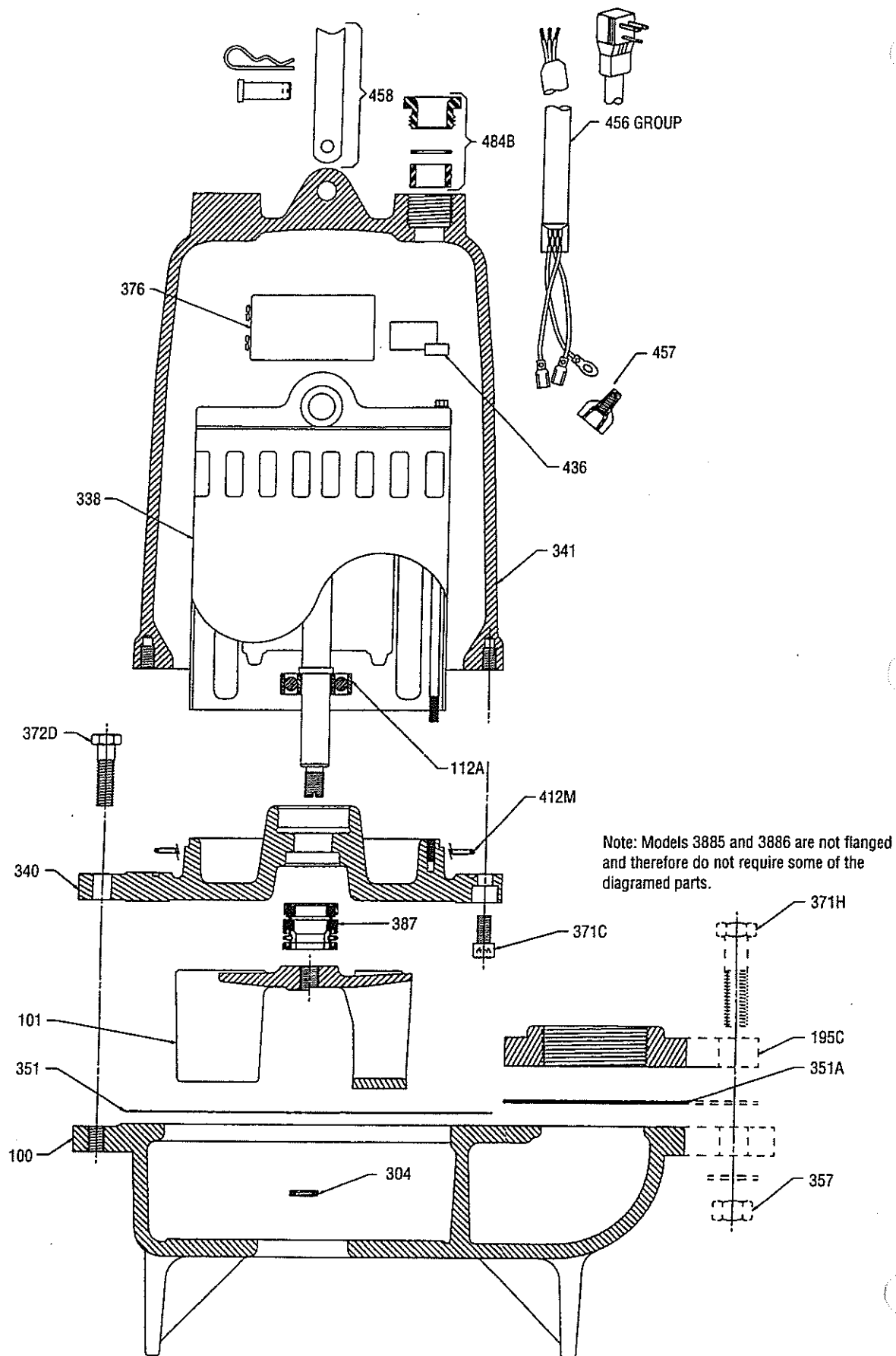
HP	RPM	Voltage	Phase /Hz	Amps	KVA Code	Winding Resistance Line to Line (Ohms)	Power Cable AWG	Fuse/Circuit Breaker Amps
⅓	1725	115	1/60	9.4	M	1.92	16/3	15
⅓	1725	230	1/60	4.7	N	7.58	16/3	10
⅓	3450	115	1/60	14.5	M	1.00	16/3	20
⅓	3450	230	1/60	7.3	M	4.03	16/3	10
½	3450	200	3/60	3.9	R	3.8	14/4	10
½	3450	230/460	3/60	3.4/1.7	R	5.81/23.24	14/4	10/10
¾	3450	230	1/60	10.0	J	2.99	14/3	15
¾	3450	200	3/60	6.2	L	5.7	14/4	10
¾	3450	230/460	3/60	5.4/2.7	L	4.04/16.15	14/4	10/10
1	3450	230	1/60	12.5	J	2.09	14/3	20
1	3450	200	3/60	8.1	M	2.6	14/4	10
1	3450	230/460	3/60	7.0/3.5	L	4.04/16.15	14/4	10/10
1½	3450	230	1/60	15.0	H	1.16	14/3	20
1½	3450	200	3/60	10.6	K	1.9	14/4	15
1½	3450	230/460	3/60	9.2/4.6	K	2.87/11.46	14/4	15/10
2	3450	230	1/60	18.0	F	M-1.1/S-2.2	14/3	20
2	3450	200-230/460	3/60	12.0-11.6/5.8	K	1.66/6.62	14/4	15/10

ELECTRICAL DATA 3886 AND 3887BF

⅓	1725	115	1/60	9.8	M	1.92	16/3	15
⅓	1725	230	1/60	4.9	N	7.58	16/3	10
⅓	1725	115	1/60	14.5	N	1.6	16/3	20
⅓	1725	230	1/60	7.3	K	6.4	16/3	10
½	1725	200	3/60	3.8	K	6.55	14/4	10
½	1725	230/460	3/60	3.3/1.7	K	9.9/39.4	14/4	10/10
¾	1725	230	1/60	9.4	J	5.9	14/3	15
¾	1725	200	3/60	4.1	H	4.3	14/4	10
¾	1725	230/460	3/60	3.6/1.8	J	5.6/22.4	14/4	10/10
1	1725	230	1/60	12.3	H	2.6	14/3	20
1	1725	200	3/60	6.0	H	4.3	14/4	10
1	1725	230/460	3/60	5.8/2.9	J	5.6/22.4	14/4	10/10

ELECTRICAL DATA 3887BHF

⅓	1725	115	1/60	12.4	M	1.00	16/3	15
⅓	1725	230	1/60	6.2	M	4.03	16/3	10
⅓	3450	115	1/60	14.5	M	1.00	16/3	20
⅓	3450	230	1/60	7.6	M	4.03	16/3	10
½	3450	200	3/60	4.1	R	3.8	14/4	10
½	3450	230/460	3/60	3.6/1.8	R	5.81/23.24	14/4	10/10
¾	3450	230	1/60	9.4	J	2.99	14/3	15
¾	3450	200	3/60	6.2	L	5.7	14/4	10
¾	3450	230/460	3/60	5.4/2.7	L	4.04/16.15	14/4	10/10
1	3450	230	1/60	14.5	J	2.1	14/3	20
1	3450	200	3/60	8.6	M	2.6	14/4	10
1	3450	230/460	3/60	7.5/3.8	L	4.0/16.2	14/4	10/10
1½	3450	230	1/60	18.0	F	M-1.1/S-2.2	14/3	20
1½	3450	200-230/460	3/60	10.0-9.6/4.8	K	1.66/6.62	14/4	15/10
2	3450	230	1/60	18.0	F	M-1.1/S-2.2	14/3	20
2	3450	200-230/460	3/60	12.0-11.6/5.8	K	1.66/6.62	14/4	15/10



Model 3885 Repair Parts Table

Item No.	Part Name	Material	Qty. Req'd.	Repair Parts Order Number						Max. Wt. (lbs.)
				1725 RPM	3450 RPM					
				½ HP	½ HP	¾ HP	1 HP	1½ HP	2 HP	
100	Casing – ½ HP "L" model only	Cast Iron	1	1K171	N/A					13.0
	Casing – all others			1K170						
101	Impeller	Cast Iron	1	2K158	2K220	2K219	2K218	2K217	2K840	2.0
	Impeller	Bronze		2K271	2K272	2K273	2K274	2K275	2K841	2.5
	Impeller – high head	Cast Iron		N/A	2K225 HH	N/A	N/A	2K221HH	N/A	3.5
	Impeller – high head	Bronze		N/A	2K276 HH	N/A	N/A	2K277 HH	N/A	4.0
112A	Lower Ball Bearing	Steel	1	4K132					4K384	–
112B	Upper Ball Bearing	Steel	1	4K132						–
218	Insulating Oil (gallon) Gallons required	Turbine Oil – Sunvis 932, Convis 150		4K432 (5 gallons)					7.5 lbs./ gal.	
				1.2 gallons						
304	Impeller Locknut (3 PH only)	AISI 300 series SS	1	13K6					–	
338	Motor	Stainless Steel Short Ext.	1	118-121R	118-1222R	N/A	N/A	N/A	N/A	13.0 to 24.0
				118-122R	118-1223R	118-1232R	118-1233R	118-1334R	120-845R	
				N/A	118-1321R	118-1322R	118-1323R	118-1324R	120-8425R	
				N/A	118-1333R	118-1334R	118-1335R	118-1336R	120-8425R	
340	Bearing Housing	Cast Iron	1	1K167					1K332	10.0
341	Motor Cover	Cast Iron	1	1K207	1K207	1K208	1K208	1K208	1K208	23.0
				1K208						
351	Casing Gasket	Composite	1	5K170					–	
358E	Plug – motor cover ¾" NPT	Steel	1	6K3					–	
371C	Skt. Hd. Screw – brg. housing to motor cover	AISI 300 series SS	2	13K210					–	
372D	Hex Screw – seal housing to casing	AISI 300 series SS	4	13K186					–	
376	Capacitor (1 PH only)	Varies	1	1K197	9K197	9K197	9K197	9K197	275470130	–
				N/A	N/A	N/A	N/A	N/A	279342110	
387	Mechanical Seal – standard	Silicon Carbide	1	10K63 (John Crane Type 6)					10K71	–
	Mechanical Seal – optional	Tungsten Carbide	1	10K30 (John Crane Type 21)					10K72	–
412M	O-ring – motor cover	BUNA-N, AS 568A-166	1	4K252					–	
436	Solid State Switch			N/A					294811980	
456	Power cable		1	See chart below					–	
457	Wire nut	Nylon Housing	4	9K145					–	
	(power cable)		6	9K145					–	
458	Handle Assembly	AISI 300 series SS	1	4K243					–	
484B	Strain Relief Assembly (power cable)	Varies	1	5K113	5K113	5K111	5K111	5K111	5K111	–
			1	N/A	5K111					–
	Loctite #271		1	AL271121					–	

Model 3885 Power and Sensor Cables Description	Type and AWG Size	Standard length*	Optional Lengths			Wt. (lbs./5 ft.)
		20'	30'	50'	100'	
Power Cables						
1 PH: ½ and ½ HP, 115 V; standard with plug, optional with bare leads	SJTOW – 16/3	9K165	9K214	9K215	N/A	0.5
1 PH: ½ and ½ HP, 230 V; standard with plug, optional with bare leads	SJTOW – 16/3	9K164	9K214	9K215	N/A	0.5
1 PH: ¾ – 1½ HP, 230 V with bare leads	STOW – 14/3	9K163	9K216	9K161	9K217	0.9
1 PH: 1½ – 2 HP, 230 V with bare leads	STOW – 14/3	9K266	9K267	9K268	9K269	0.9
3 PH: ½ – 2 HP, 208–230/460 V with bare leads	STOW – 14/4	9K153	9K218	9K154	9K219	1.1

Model 3886 and 3887 Repair Parts Table

Note: The 1K168 is the casing for the 3886 ½ HP. The 1K178 is the casing for the 3887 ½ – 1 HP.

Item No.	Part Name	Material	Qty.	Repair Parts Order Number								Max. Wt. (lbs.)
				1725 RPM				3450 RPM				
				½ HP	½ HP	¾ HP	1 HP	1 HP	1½ HP	2 HP		
100	Casing	Cast Iron	1	1K168 for NPT 3886 1K178 for flanged 3887				1K330		16.5		
101	Impeller	Cast Iron	1	2K268	2K239	2K240	2K241	2K242	2K800	2K798	3.0	
	Impeller	Bronze	1	2K279	2K280	2K281	2K282	2K283	2K801	2K799	3.5	
112A	Lower Ball Bearing	Steel	1	4K132					4K384		—	
112B	Upper Ball Bearing (Not Shown)	Steel	1	4K132							—	
195C	Discharge Flange (2" NPT STD.)	Cast Iron	1	6K76							1.5	
	Discharge Flange (3" NPT OPT.)	Cast Iron	1	A1-3							1.5	
218	Motor Insulating Oil (Approx. 1 Gallon Required)	Turbine Oil	1	4K432							7.5 lbs./gal.	
304	Impeller Locknut (3 PH only)	AISI 300 series SS	1	13K6							—	
338	Motor – 1 Phase, 115V	Stainless Steel	1	118-121R	118-123R	N/A	N/A	N/A	N/A	N/A	13.0 to 24.0	
	118-122R			118-124R	118-1212R	118-1213R	118-1233R	120-844R	120-845R			
	N/A			118-132R	118-1304R	118-134R	118-1323R	N/A	N/A			
	N/A			118-1314R	118-1316R	118-1316R	118-1335R	N/A	N/A			
	N/A			N/A	N/A	N/A	N/A	120-8425R	120-8425R			
340	Bearing Housing	Cast Iron	1	1K167					1K332		10.0	
341	Motor Cover – 1 Phase	Cast Iron	1	1K207	1K207	1K208	1K208	1K208	1K208	1K208	20.0	
	1K208											
351	Casing Gasket	Composite	1	5K170							—	
351A	Discharge Flange Gasket	Composite	1	5K150							—	
357	Hex Nut – discharge flange	AISI 300 series SS	2	13K99							—	
358E	Plug – motor cover ¾" NPT	Steel	1	6K3							—	
371C	Skt. Hd. Screw – brg. housing to motor cover	AISI 300 series SS	4	13K210							—	
371H	Hex Screw – discharge flange	AISI 300 series SS	2	13K153							—	
372D	Hex Screw – bearing housing to casing	AISI 300 series SS	4	13K186							—	
376	Capacitor (1 PH only) Start	Varies	1	9K197	9K197	9K235	9K235	9K197	275469128	275470130	—	
	N/A			N/A	N/A	N/A	N/A	N/A	279342110			
387	Mechanical Seal – standard	Silicon Carbide	1	10K63 (John Crane Type 6)					10K71		—	
	Mechanical Seal – optional	Tungsten Carbide	1	10K30 (John Crane Type 21)					10K72		—	
412M	O-ring – motor cover	Nitrile	1	4K252							—	
436	Solid State Switch (motor)	—	1	N/A					294612982 294811980		—	
456	Power Cable	—	1	See chart below							—	
457	Wire Nut 3 PH, 200/230 V	Nylon Housing	4	9K145							—	
	6		9K145							—		
458	Handle Assembly	AISI 300 series SS	1	4K243							—	
484B	Strain Relief Assembly (power cable)	Varies	1	5K113	5K113	5K111	5K111	5K111	5K111	5K111	—	
			1	N/A	5K111					—		
528	Washer – discharge flange	AISI 300 series SS	2	13K82							—	
	Loctite #271	—	1	AL27121							—	

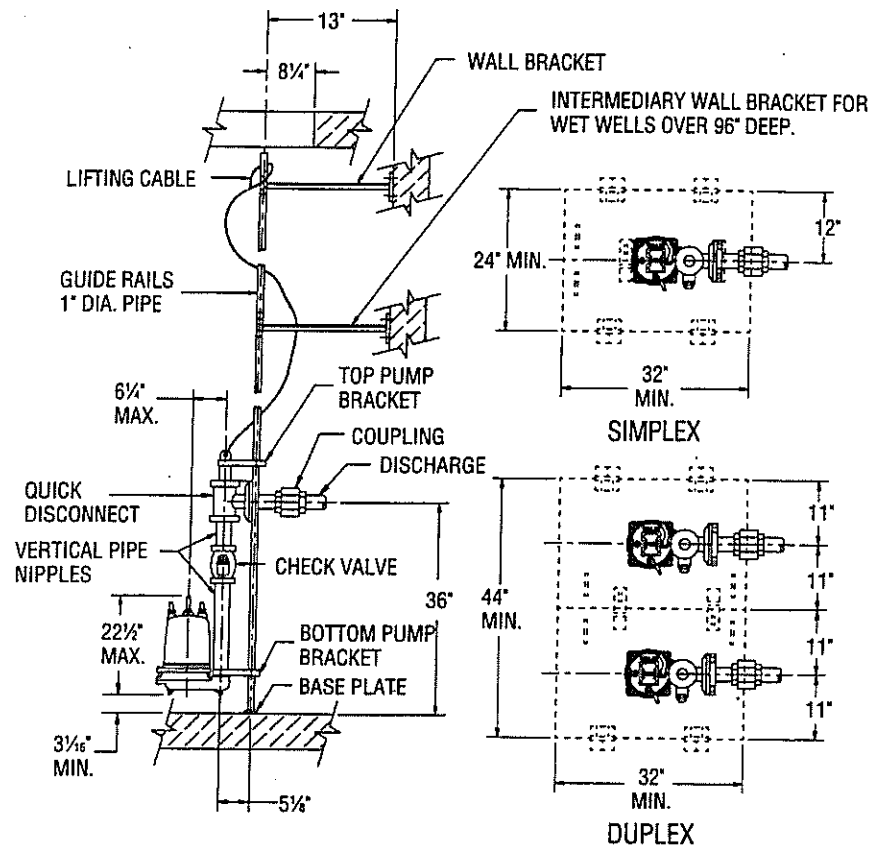
* Consult Factory

Model 3887 Power Cables Description	Type and AWG Size	Standard length*	Optional Lengths				Wt. (lbs./5 ft.)
		20'	30'	50'	100'		
Power Cables							
1 PH: ½and ½ HP, 115 V; standard with plug, optional length with bare leads	SJTOW – 16/3	9K165	9K214	9K215	N/A	0.5	
1 PH: ½and ½ HP, 230 V; standard with plug, optional length with bare leads	SJTOW – 16/3	9K164	9K214	9K215	N/A	0.5	
1 PH: ¾ – 1HP, 230 V with bare leads	STOW – 14/3	9K163	9K216	9K161	9K217	0.9	
1 PH: 1½ – 2 HP, 230 V with bare leads	STOW – 14/3	9K266	9K267	9K268	9K269	0.9	
3 PH: ½ – 2 HP, 208–230/460 V with bare leads	STOW – 14/4	9K153	9K218	9K154	9K219	1.1	

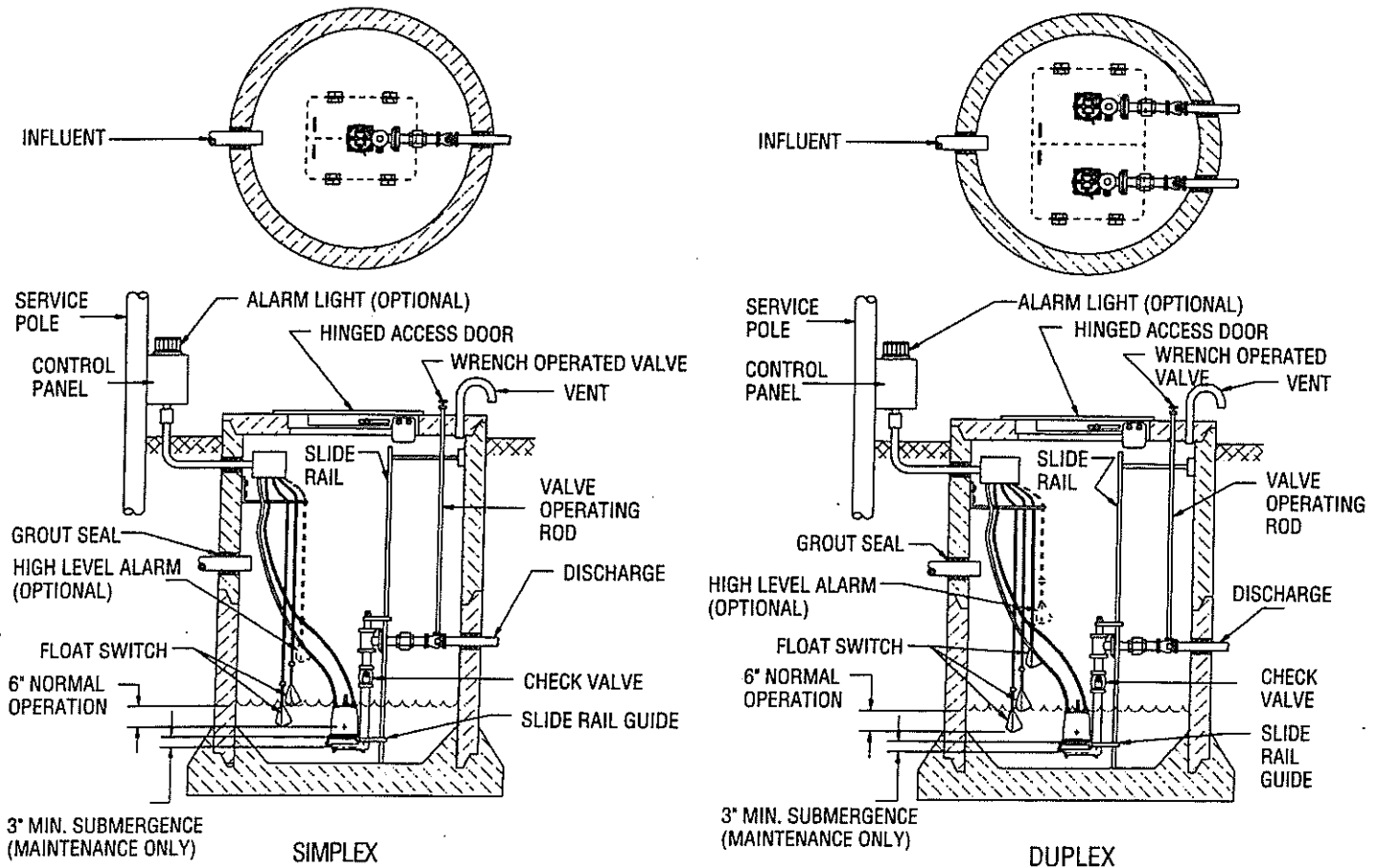
9K197 REF#615996 1 or 624751 1 MFD 110 VAC

9K235 REF#615996 2 189/227 MFD 110 VAC

Typical 2" Slide Rail Installation



Typical Plumbing and Installation



Trouble Shooting

⚠ WARNING

Hazardous
voltage

**FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL
POWER BEFORE ATTEMPTING ANY SERVICE CAN CAUSE
SHOCK, BURNS OR DEATH.**

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
MOTOR NOT RUNNING	Motor thermal protector tripped.	Allow motor to cool. Insure minimum pump submergence. Clear debris from casing and impeller.
NOTE: If circuit breaker "OPENS" repeatedly, DO NOT reset. Call qualified electrician.	Open circuit breaker or blown fuse.	Determine cause, call a qualified electrician.
	Pump impeller binding or jammed.	Check motor amp draw. If two or more times higher than listed in the "DESCRIPTION AND SPECIFICATIONS" section, impeller is locked, motor bearings or shaft is damaged. Clear debris from casing and impeller, consult with dealer.
a) Manual operation	Power cable is damaged.	Resistance between power leads must read as shown in "ENGINEERING DATA". Resistance between power leads and ground should read infinity. If any reading is incorrect, call a qualified electrician.
b) Automatic operation in control panel.	Inadequate electrical connection	Inspect control panel wiring. Call a qualified electrician.
	Defective liquid level switch.	With switch disconnected, check continuity while activating liquid level switch. Replace switch, as required.
NOTE: Check the pump in manual mode first to confirm operation. If pump operates, the automatic controls are at fault. If pump does not operate, see above.	Insufficient liquid level to activate controls.	Allow liquid level to rise 3" to 4" (76 mm - 101 mm) above turn-on level.
	Liquid level cords tangled.	Untangle cords and insure free operation.
PUMP WILL NOT TURN OFF	Liquid level cords tangled.	Untangle cords and insure free operation.
	Pump is air locked.	Shut off pump for approximately one minute, then restart. Repeat until air lock clears. If air locking persists in a system with a check valve pipe, a 0.188" (5 mm) hole may be drilled in the discharge pipe approximately 2" (51 mm) beyond the discharge connection.
	Influent flow is matching pump's discharge capacity.	Larger pump may be required.
LITTLE OR NO LIQUID DELIVERED BY PUMP	Check valve installed backwards, plugged or stuck closed.	Check flow arrow on valve and check valve operation.
	Excessive system head.	Consult with dealer.
	Pump inlet plugged.	Inspect and clear as required.
	Improper voltage or wired incorrectly.	Check pump rotation, voltage and wiring. Consult with qualified electrician.
	Pump is air locked.	See recommended action, above.
	Impeller is worn or damaged.	Inspect impeller, replace as required.
	Liquid level controls defective or improperly positioned.	Inspect, readjust or replace as required.
PUMP CYCLES CONSTANTLY	Discharge check valve inoperative.	Inspect, repair or replace as required.
	Sewage containment area too small.	Consult with dealer.
	Liquid level controls defective or improperly positioned.	Inspect, readjust or replace as required.
	Influent excessive for this size pump.	Consult with dealer.

GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Pumps.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Pumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

- Labor, transportation and related costs incurred by the dealer;
- Reinstallation costs of repaired equipment;
- Reinstallation costs of replacement equipment;
- Consequential damages of any kind; and,
- Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

- "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.
- "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
- "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

PFOHL BROTHERS LANDFILL SITE

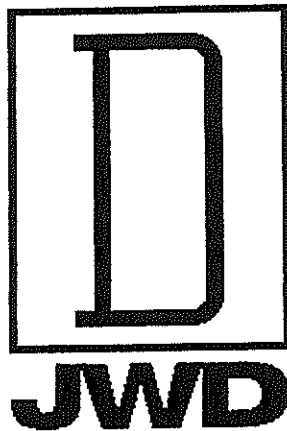
Aero Drive

Cheektowaga, New York 14225

**OPERATING AND MAINTENANCE
MANUALS**

JOHN W. DANFORTH CO. JOB Number 8049

SINCE 1884



**JOHN W. DANFORTH COMPANY
GENERAL CONTRACTORS FOR MECHANICAL
EQUIPMENT**

**1940 FILLMORE AVENUE BUFFALO, NEW YORK 14214
AREA CODE 716 832-1940
FAX NO. 832-2388**

APPENDIX B-3

MECHANICAL

JOHN W. DANFORTH COMPANY

Pfohl Brothers Landfill HVAC

JWD JOB #8049

TABLE OF CONTENTS

Tab	- Contractors
Tab	- Equipment Supplier
Tab	- Guarantee
A	- CPVC Ball & Check Valves
B	- Stainless Steel & Flexible Hoses
C	- Wet Well Pumps/A10-20 Slide Rail System
D	- Schedule 80 CPVC Pipe & Fittings

APPENDIX B-3A

CONTRACTORS

JOHN W. DANFORTH COMPANY

Pfohl Brothers Landfill
HVAC

JWD JOB #8049

Contractors

Mechanical Contractor

John W. Danforth Service Company
1940 Fillmore Avenue
Buffalo, New York 14214
Telephone: (716) 832-2386

C

C

C

APPENDIX B-3B

SUPPLIERS

JOHN W. DANFORTH COMPANY

Pfohl Brothers Landfill
HVAC

JWD JOB #8049

Equipment Suppliers

CPVC Pipe, Valves & Fittings Supplier
Corr Tech Inc.
255 Cooper Avenue
Suite 106
Tonawanda, New York 14150

Pump Supplier
Lee Supply Co., Inc.
PO Box 640335
Pittsburgh, Pennsylvania 15264-0335

A10-20 Rail System Supplier
L.A. Hazard
1695 Overhead Road
Derby, New York 14047

Stainless Steel Hose & Barracuda Hose Supplier
Peerless Mills
79 Perry Street
Buffalo, New York 14203

APPENDIX B-3C

GUARANTEE

SINCE 1884



JOHN W. DANFORTH COMPANY
GENERAL CONTRACTORS FOR MECHANICAL SYSTEMS

Industrial Piping • Power Plants • Heating/Air Conditioning • Plumbing • Air and Water Pollution Control

January 24, 2002

Pfohl Brothers Landfill Site
Aero Drive
Cheektowaga, New York 14225

Re: Pfohl Brothers Landfill Site
JWD Job No. 8049

This revised letter is written to officially notify Pfohl Brothers Landfill Site that the mechanical system installed by John W. Danforth Company has been completed and tested and startup accomplished.

The warranty period for all defects in workmanship, including parts and labor, is from February 1, 2002 to February 1, 2003. Should you encounter any problems please contact our 24-hour service number at (716) 832-2386.

We would like to point out that normal maintenance items such as changing filters, tightening belts, greasing and lubrication are not covered under warranty and are the owner's responsibility. Your operation and maintenance manual prepared by our company lists normal maintenance items in detail.

In closing, we want to express our appreciation for having been selected to install the mechanical system for Pfohl Brothers Landfill Site and look forward to a long association.

Sincerely Yours,



Emmett L. Reilly
President

ELR/drc
cc: Service Department

C

C

C

APPENDIX B-3D

CPVC BALL & CHECK VALVES

JOHN W. DANFORTH COMPANY

Pfohl Brothers Landfill
HVAC

JWD JOB #8049

A

**- CPVC Ball & Check
Valves**

Contents:

1 Page	- Cover Sheet
1 Page	- Ball Valves Features, Specifications, Options, Sample Specification, Weight, Pressure vs Temperature, Dimensions
1 Page	- Check Valves Features, Options, Sample Specification, Parts, Pressure vs Temperature, Dimensions

Supplied By: Corr Tech

SINCE 1884

**John W. Danforth Company**

MAY 03 '01

804

Submittal Data Cover FormJOHN W. DANFORTH CO.
Buffalo, New YorkDate: 3-May-01 Job number: 8049 Extra # _____Project manager: John SamarProject name: Pfohl Brothers LanfillCustomer project number (or contract/po #): E6483021Engineer: CRASubmittal # 8049-001 (job number - item number on submittal schedule ex: 9687-001)Subcontractor: N/ASupplier: Corr TechManufacturer: Asahi/America

Spec section:

Item submitted:

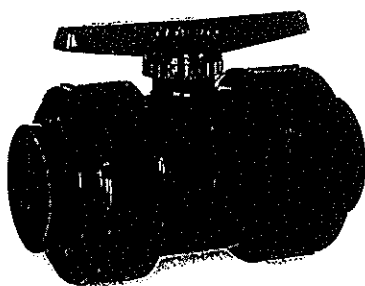
_____	<u>CPVC ball valves</u>
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Notes: Submitting ball valves in lieu of shown gate valves due to pipe material change to CPVC

☐ Mail☒ Hand Deliver by Project Manager

MAY 03 '01

8049



SPECIFICATIONS

SIZES: 1/2" - 6"

X MODELS: (Socket) Threaded, Flanged
(ANSI), Butt

X BODIES: PVC, CPVC, PP, PVDF

X SEATS: Teflon® backed with EPDM or
Mitt®

SEALS: EPDM or Viton® or AFLAS

JOHN W. SANFORTH CO.
SEATTLE, WA

- True Union design permits installation or repair without expanding the pipeline
- Blocks in two directions, upstream and downstream, leaving full pressure on the opposite end of the valve
- Teflon® seats with elastomeric backing cushions ensure bubble-tight shut-off and a low fixed torque, while at the same time compensating for wear
- Eye-ball style in transparent PVC, 1/2" - 2"

- Available with EPDM or Viton® O-rings
- All sizes rated for full vacuum service
- Threaded-in carriers on all sizes and materials through 4"
- Two sets of end connectors (socket and threaded) included with all PVC and CPVC models in 1/2" - 2" sizes
- Valve body guaranteed for two years when used as recommended

OPTIONS (See options under Multiport valves)

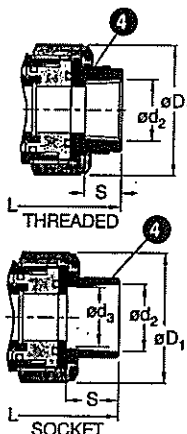
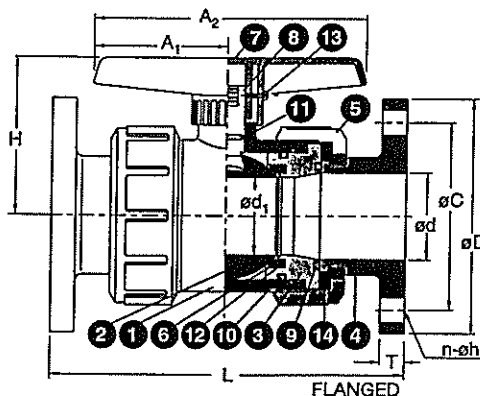
SAMPLE SPECIFICATION

All thermoplastic ball valves in sizes 1/2" through 4" shall be of a True Union design with two-way blocking capability. All True Union ball valves shall have Teflon® seats with elastomeric backing cushions of the same material as the valve seals. True Union ball valves must carry a two-year guarantee, as manufactured by Asahi/America, Inc.

PARTS

No.	Parts	Pcs	Materials
1	Body	1	PVC, CPVC, PP, PVDF
2	Ball	1	PVC, CPVC, PP, PVDF
3	Carrier	2	PVC, CPVC, PP, PVDF
4	Connector	2	PVC, CPVC, PP, PVDF
5	Union Nut	2	PVC, CPVC, PP, PVDF
6	Ball Seat	2	Teflon
7	Handle	1	ABS
8	Stem	1	PVC, CPVC, PP, PVDF
9	Face O-Ring	2	Viton, EPDM
10	Carrier O-Ring	2	Viton, EPDM
11	Stem O-Ring	1	Viton, EPDM
12	Seat Cushion	2	Viton, EPDM
13	Screw	1	Stainless Steel
14	Stop Ring	2	PVDF

Note: PVC and CPVC models 1/2" may be supplied as one-piece capsules.



WEIGHT (LBS)

Size (inches)	Socket/Threaded	Flanged
1/2	0.38	2.00
3/4	0.67	2.25
1	1.00	2.50
1 1/4	1.39	3.25
1 1/2	2.18	4.00

PRESSURE VS TEMPERATURE (PSI, WATER, NON-SHOCK)

Size (inches)	PVC	CPVC				PP			PVDF			
	30° F 120° F	30° F 120° F	121° F 140° F	141° F 175° F	176° F 195° F	-5° F 85° F	86° F 140° F	141° F 175° F	-5° F 140° F	141° F 175° F	176° F 195° F	196° F 210° F
1/2 - 2	150	150	120	85	55	150	85	60	150	120	110	85
2 1/2	150	150	120	85	55	150	75	45	150	120	110	85
3-6	150	150	85	60	45	150	75	45	150	85	85	75

DIMENSIONS (INCHES)

Size	Flanged							Socket *								Threaded			d ₁	D ₁	H	A ₁	A ₂	Cv	
	ANSI 150 lbs							PVC, CPVC				PP, PVDF (IPS)				d ₂	S	L							
	d	D	C	n	h	L	T	d ₂	d ₃	S	L	d ₂	d ₃	S	L										
1/2	0.59	3.50	2.38	4	0.63	5.63	0.47	0.848	0.836	0.688	3.86	0.831	—	0.625	3.89	1/2	-14 NPT	0.59	3.90	0.59	1.89	1.97	1.97	—	14
3/4	0.79	3.86	2.76	4	0.63	6.77	0.55	1.058	1.046	0.719	4.53	1.041	—	1.000	5.11	3/4	-14 NPT	0.67	4.65	0.79	2.36	2.24	2.26	—	29
1	0.98	4.25	3.13	4	0.63	7.36	0.55	1.325	1.310	0.875	5.28	1.305	—	0.815	5.21	1	-11 1/2 NPT	0.79	5.35	0.98	2.76	2.64	2.56	—	47
1 1/4	1.22	4.61	3.51	4	0.63	7.48	0.63	1.670	1.655	0.938	5.83	—	—	—	—	1 1/4	-11 1/2 NPT	0.87	5.87	1.22	3.15	3.07	2.56	—	72
1 1/2	1.57	5.00	3.88	4	0.63	8.35	0.63	1.912	1.894	1.094	6.65	1.889	—	1.250	7.07	1 1/2	-11 1/2 NPT	0.98	6.69	1.57	3.78	3.35	2.95	—	155
2	2.01	5.98	4.74	4	0.75	9.21	0.63	2.387	2.369	1.156	7.56	2.364	—	1.250	7.81	2	-11 1/2 NPT	1.10	7.76	2.01	4.17	3.86	3.35	—	190
2 1/2	2.56	7.01	5.49	4	0.75	10.20	0.71	2.889	2.868	1.750	9.45	—	—	—	—	2 1/2	-8 NPT	1.26	8.46	2.28	5.24	4.65	—	7.09	365
3	3.07	7.52	6.00	4	0.75	11.97	0.71	3.516	3.492	1.875	11.10	3.494	—	1.875	11.60	3	-8 NPT	1.38	10.39	2.70	5.98	5.12	—	8.66	410
4	3.94	9.02	7.50	8	0.75	14.65	0.71	4.518	4.491	2.000	13.90	4.494	—	2.250	14.91	4	8 NPT	1.77	14.17	3.54	8.27	6.54	—	11.02	680

For metric socket dimensions consult factory.

SAHI/AMERICA

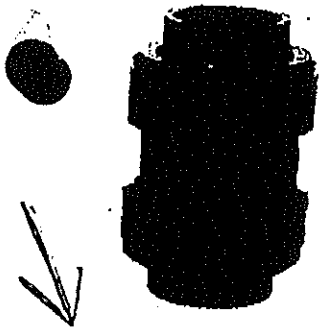
Rev. V-00/A

P.O. Box 653 • 35 Green Street, Malden, MA 02148 • Tel: (800) 343-3618, (781) 321-5409
 Fax: (800) 426-7058 • Internet: <http://www.asahi-america.com> • Email: asahi@asahi-america.com

CHECK VALVES

Attn: John
835-7067

BALL



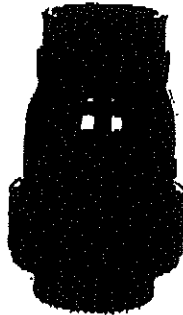
TRUE UNION SPECIFICATIONS

SIZES: 1/2" - 2"

MODELS: Socket, Threaded, Flanged (ANSI), Butt

BODIES: PVC, CPVC, PP, PVDF

SEATS/SEALS: EPDM or Viton®



SINGLE UNION SPECIFICATIONS

SIZES: 3" - 4"

MODELS: Socket, Threaded, Flanged (ANSI), Butt

BODIES: PVC, CPVC, PP, PVDF

SEATS/SEALS: EPDM or Viton®

FEATURES

- Uniseat/seal of EPDM or Viton®
- Ball is the only moving part. It unseats to permit flow in one direction but seals against seat to prevent backflow
- Single union end connector facilitates valve maintenance
- Compact design permits streamlining of piping systems
- May be used either vertically or horizontally
- Excellent flow characteristics
- Minimum shut-off is 5 psi
- All sizes rated for full vacuum service
- Solid thermoplastic ball

OPTIONS

- Teflon® coated Viton® uniseat/seal
- Spring-loaded ball to assist ball in seating faster
- Foot Valve: The Asahi/America ball check valve may be ordered with a high impact, rigid PVC screen assembly which will screen out foreign matter

SAMPLE SPECIFICATION

All ball check valves shall be of a solid thermoplastic construction and shall be designed with an elastomeric uniseat/seal for tight shut-off under pressure. The same seal shall function as both the ball seat and the union seal. Ball check valves shall be rated 150 psi at 120° F, as manufactured by Asahi/America, Inc.

PARTS

No.	Parts	Pcs	Materials
1	Body	1	PVC, CPVC, PP, PVDF
2	Ball	1	PVC, CPVC, PP, PVDF
3	Uniseat/Seal	1	EPDM, Viton
4	End Connector	2*	PVC, CPVC, PP, PVDF
5	Union Nut	2*	PVC, CPVC, PP, PVDF
6	Stop Ring	1	PVC, CPVC, PP, PVDF
7	Face O-Ring	1**	EPDM, Viton
8	Screen (Foot Valve)	1	PVC

* 1- For sizes 3" and 4".

** Not used for sizes 3" and 4".

PRESSURE VS TEMPERATURE (PSI, WATER, NON-SHOCK)

Size (inches)	PVC		CPVC				PP			PVDF			
	30° F 120° F	30° F 120° F	121° F 140° F	141° F 178° F	179° F 195° F	185° F	85° F 140° F	141° F 176° F	140° F	5° F 175° F	141° F 178° F	179° F 195° F	196° F 210° F
1/2-2	150	150	120	85	60	150	80	60	150	125	110	90	
3-4	100	100	90	60	45	75	60	45	100	80	60	45	

DIMENSIONS (INCHES)

Size (In)	d	D	Foot Valve H	Cv	Flanged (ANSI)			Threaded					Socket**										Butt	
					D _{FL}	L	Foot Valve L	d ₁	S	L	Foot Valve L	Wl (lbs)	PVC, CPVC					PP, PVDF (IPS)			Foot Valve L	D ₂	L	
													d ₁	d ₂	S	L	Wl (lbs)	d ₁	S	L				
1/4	0.59	1.89	2.36	8.6	3.50	5.12	5.40	NPT 1/2	0.58	3.38	4.89	0.25	0.848	0.838	0.688	3.43	0.25	0.831	0.826	3.31	4.73	.70	4.00	
3/8	0.79	2.36	2.76	17	3.86	6.10	6.40	NPT 3/4	0.87	4.06	5.52	0.50	1.068	1.046	0.710	3.86	0.50	1.041	1.000	4.43	5.32	.88	4.35	
1	0.98	2.78	3.74	25	4.25	6.50	6.80	NPT 1	0.70	4.45	6.32	0.75	1.325	1.310	0.875	4.37	0.75	1.305	0.816	4.35	6.24	1.26	4.78	
1 1/2	1.57	3.70	5.24	86	5.00	7.68	8.50	NPT 1 1/2	0.98	6.94	8.33	1.75	1.912	1.894	1.084	5.84	1.75	1.889	1.250	5.57	8.33	1.97	6.75	
2	2.01	4.17	6.24	130	5.98	8.43	10.50	NPT 2	1.10	6.97	9.17	2.00	2.387	2.389	1.166	6.77	2.00	2.364	1.250	6.48	8.97	2.48	6.50	
3	3.07	5.98	8.27	280	7.52	12.28	14.80	NPT 3	1.98	8.74	11.80	8.10	3.518	3.492	1.875	9.57	8.10	3.494	1.875	8.69	18.80	—	—	
4	3.94	8.27	10.00	600	9.02	16.63	20.25	NPT 4	1.77	12.08	18.25	13.08	4.618	4.491	2.000	12.20	13.08	4.494	2.250	12.71	18.25	—	—	

outside diameter of flange (not shown). ** For metric socket dimensions consult factory.

P.O. Box 853 • 35 Green Street, Milford, CT 06460

Outside diameter of flange (not shown). ** For metric socket dimensions consult factory.

P.O. Box 853 • 35 Green Street, Malden, MA 02148 • Tel: (800) 343-3618, (781) 321-5409
Fax: (800) 426-7058 • Internet: <http://www.asahi-america.com> • Email: asahi@asahi-america.com

ASAHI/AMERICA
Rev. V-00/A

APPENDIX B-3E

HOSES

JOHN W. DANFORTH COMPANY

Pfohl Brothers Landfill
HVAC

JWD JOB #8049

B

- Stainless Steel & Flexible Hoses

Contents:

- | | |
|---------|--|
| 1 Page | - Cover Sheet |
| 2 Pages | - Masterflex Hose Specification |
| 4 Pages | - Gates Barracuda Water Hose
Suction/Discharge, Slip-On, Slip-On
Raised Face Flange, "King" Turned
Back Hose Nipples for Floating
Flanges, Mulconroy The Holedall
Coupling System |

Supplied By: Peerless Mills

MAY 03 '01

804

SINCE 1884



John W. Danforth Company

JOHN W. DANFORTH CO.
Buffalo, New York

Submittal Data Cover Form

Date: 3-May-01 Job number: 8049 Extra # Project manager: John SamarProject name: Pfohl Brothers LanfillCustomer project number (or contract/po #): E6483021Engineer: CRASubmittal # 8049-002 (job number - item number on submittal schedule ex: 9687-001)Subcontractor: N/ASupplier: Peerless Mill SupplyManufacturer: Gates

Spec section:

Item submitted:

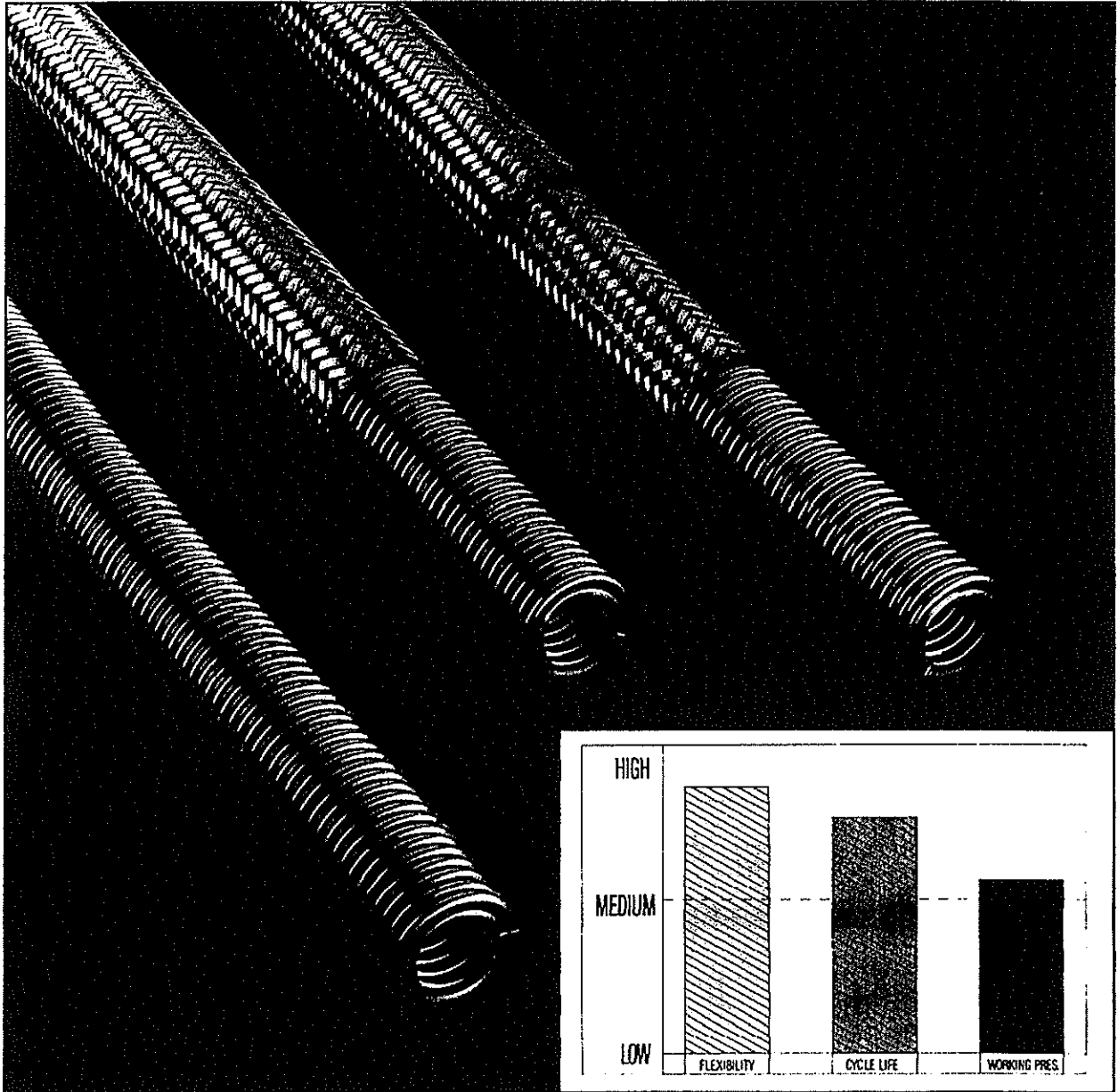
Flexible hoses for manholes

Notes:

☐ Mail☒ Hand Deliver by Project Manager

MASTERFLEX is the most pliable member of the annular family of hydroformed hose. This product, as well as Annuflex, far exceeds international industrial standards for flex cycles. All annular corrugated products are available in T321 and T316L stainless steel. *MASTERFLEX* is stocked in reel lengths up through 2 in. I.D., and standard mill lengths from 2-1/2 in. I.D. and above.*

State-of-the-art fabricating methods, combined with an extensive fitting inventory, enable **Hose Master** to effectively supply any quantity of assemblies. This system has been developed to serve either as a primary or secondary source of assemblies to our distributor network.



Metal hose is used when temperature extremes, corrosive media, or permeation preclude the use of rubber, PTFE, or plastic hose.

MASTERFLEX is ideally suited for header and manifold systems in the following applications: bulk lube oil, caster cut-off torch, petroleum bottom loading, and chemical barge transfer. Other applications include LPG loading, vapor systems, and mono/duo flow rotary union connections.

*See Hose-on-Reel specification sheet for diameters and lengths available.

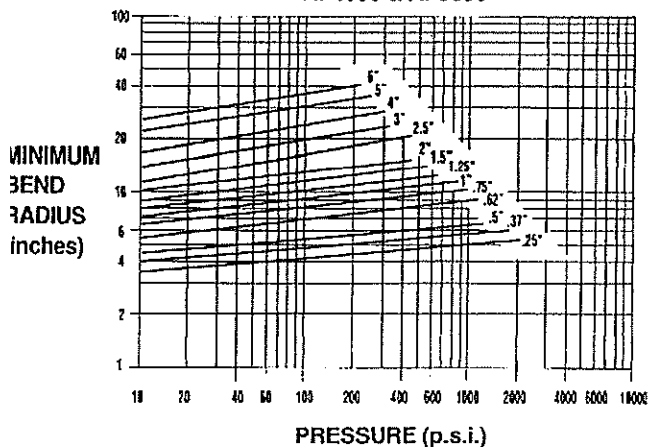
AF 5
Mat'l Code Braid Code

Material Codes
4 - T321 Stainless Steel
5 - T316L Stainless Steel

Braid Codes
00 - Unbraided
50 - T304 Single Braided
55 - T304 Double Braided

INSIDE DIAMETER (in.)	NUMBER OF BRAIDS (#)	OUTSIDE DIAMETER (in.)	STATIC MIN. BEND RADIUS (in.)	DYNAMIC MIN. BEND RADIUS (in.)	WORKING PRESSURE (p.s.i.)	BURST PRESSURE (p.s.i.)	WEIGHT PER FOOT (lbs.)
1/4	0	0.42	0.9	3.7	90	7233 9100	0.07
	1	0.48			1800		0.14
	2	0.54			2700		0.21
3/8	0	0.65	1.0	4.0	70	6230 9345	0.20
	1	0.71			1558		0.30
	2	0.77			2336		0.40
1/2	0	0.77	1.2	4.4	70	4743 7115	0.22
	1	0.83			1186		0.33
	2	0.89			1779		0.44
5/8	0	0.96	1.4	5.6	57	4820 7230	0.31
	1	1.02			1205		0.47
	2	1.08			1808		0.63
3/4	0	1.16	1.7	6.4	43	3591 5387	0.33
	1	1.22			898		0.51
	2	1.28			1347		0.69
1	0	1.47	2.1	7.1	43	2872 4308	0.45
	1	1.53			718		0.69
	2	1.59			1077		0.93
1-1/4	0	1.75	2.5	7.9	43	2581 3872	0.56
	1	1.83			645		0.88
	2	1.91			968		1.20
1-1/2	0	2.08	3.1	8.7	28	2125 3188	0.82
	1	2.16			531		1.20
	2	2.24			797		1.58
2	0	2.61	4.0	10.3	14	1797 2696	0.95
	1	2.69			449		1.47
	2	2.77			674		1.99
2-1/2	0	3.40	5.4	12.8	14	1669 2504	1.29
	1	3.50			417		2.09
	2	3.60			626		2.89
3	0	3.88	6.3	14.5	14	1384 2076	1.84
	1	3.98			346		2.72
	2	4.08			519		3.60
4	0	4.96	7.7	17.4	14	1194 1791	2.33
	1	5.06			299		3.39
	2	5.16			448		4.45
5	0	6.00	10.0	21.9	14	1099 1649	3.64
	1	6.13			275		5.07
	2	6.25			412		6.50
6	0	7.01	11.6	25.0	11	839 1259	4.16
	1	7.14			210		5.91
	2	7.26			315		7.66

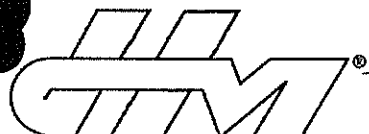
AF4550 & AF5550



NOTES: The minimum bend radius is measured from the center line of the hose.
The minimum bend radius increases with pressure (see chart).
The working pressure decreases with temperature (obtain derating factor from the technical section).

DISTRIBUTED BY:

Technical data is meant to be used as a guide. If more specific information is required, please contact the factory.



Hose Master Inc.

1233 East 222nd Street • Cleveland, OH 44117
(216) 481-2020 • 800-221-2319 • FAX: (216) 481-7557



Barracuda™

(Specification 4686AT)

Water Hose – Suction/Discharge

Nom. I.D.	Nom. O.D.	Max. W.P.	Section	Min. Bend Radius	Wt. Per Ft.	Standard	Gates
(In.)	(In.)	(Psi)	(In. Hg)	(In.)	(Lbs.)	Pack	Item No.
1/4	1.33	150	30.0	5.0	.52	100 ft.	4686-0203
1/2	1.61	150	30.0	6.0	.61	100 ft.	4686-0204
2	1.86	150	30.0	8.0	.78	100 ft.	4686-0200
2 1/2	2.38	150	30.0	10.0	1.02	100 ft.	4686-0206
3	2.93	150	30.0	14.0	1.58	100 ft.	4686-0201
4	3.54	150	30.0	18.0	2.08	100 ft.	4686-0202
6	4.54	150	30.0	28.0	3.72	20 ft.	4686-0207
6	6.68	150	30.0	28.0	3.72	25 ft.	4686-0208

RECOMMENDED FOR: Medium to light duty water suction/discharge for agricultural, construction and industrial applications. EPDM tube designed to handle a variety of liquids including Lasso®, Lasso II® and Freedom®.

TEMPERATURE: -40°F to +180°F (-40°C to +82°C).

CONSTRUCTION: Tube: Type P (EPDM). Black.
Reinforcement: Synthetic, high tensile textile with steel wire helix.
Cover: Type P (EPDM). Black with green spiral stripe.

BRANDING: Continuous spiral transfer label. Example: "Barracuda™ Water Suction/Discharge 150 PSI (1.03MPa) WP Made in U.S.A."



Shark™

(Specification 4686AR)

Water Hose – Suction Heavy Duty

Nom. I.D.	Nom. O.D.	Max. W.P.	Suction	Min. Bend Radius	Wt. Per Ft.	Standard	Gates
(In.)	(In.)	(Psi)	(In. Hg)	(In.)	(Lbs.)	Pack	Item No.
1	1.46	150	30.0	5.0	.52	100 ft.	4686-0701
1 1/4	1.71	180	30.0	6.0	.61	100 ft.	4686-0702
1 1/2	1.96	150	30.0	8.0	.78	100 ft.	4686-0703
2	2.46	150	30.0	10.0	1.00	100 ft.	4686-0704
2 1/2	3.02	150	30.0	12.0	1.44	100 ft.	4686-0705
3	3.61	150	30.0	15.0	1.96	100 ft.	4686-0706
4	4.61	150	30.0	20.0	2.50	100 ft.	4686-0707
5	5.75	150	30.0	25.0	3.85	100 ft.	4686-0708
6	6.76	150	30.0	30.0	4.79	100 ft.	4686-0709

RECOMMENDED FOR: Suction hose used to convey water, detergents, phosphate ester hydraulic fluids and dilute solutions of acids, alkalis and glycols.

TEMPERATURE: -40°F to +180°F (-40°C to +82°C) continuous service.

CONSTRUCTION: Tube: Type P (EPDM). Black.
Reinforcement: Synthetic, high tensile textile with steel wire helix.
Cover: Type D (SBR). Black with green spiral stripe.

PACKAGING: 100' length coiled and wrapped in polyethylene.

REMNANT LENGTHS: Remnant lengths are sometimes available in popular sizes at a discount. Contact Denver Industrial Hose Marketing for pricing, order requirements and availability.

Submitted for Approval

JOB#

MAY 03 '01

8049

JOHN W. DANFORTH CO.
Buffalo, New York

SLIP-ON

Size	CS Part #	Price	SS Part #	Price
1 1/2"	SO150	\$15.70	SOR150	\$63.75
2"	SO200	16.35	SOR200	80.00
2 1/2"	SO250	23.20		
3"	SO300	26.80	SOR300	121.00
4"	SO400	37.00	SOR400	166.00
5"	SO500	48.00		
6"	SO600	52.40	SOR600	263.00
8"	SO800	84.50		
10"	SO1000	138.70		
12"	SO1200	249.00		

Square Shoulder with Raised Face

NPT THREADED

Size	CS Part #	Price	SS Part #	Price
1 1/4"	T125	\$11.00		
1 1/2"	T150	20.50	TR150	\$77.00
2"	T200	21.20	TR200	95.00
2 1/2"	T250	28.00		
3"	T300	31.90	TR300	145.00
4"	T400	45.35	TR400	199.00
5"	T500	64.00		
6"	T600	63.80	TR600	342.00
8"	T800	113.85		
10"	T1000	361.65		
12"	T1200	475.80		

LAP-JOINT

Size	CS Part #	Price
1 1/2"	LJ150	\$16.90
2"	LJ200	18.80
2 1/2"	LJ250	25.75
3"	LJ300	28.00
4"	LJ400	38.40
5"	LJ500	46.45
6"	LJ600	54.10
8"	LJ800	84.50
10"	LJ1000	150.00
12"	LJ1200	238.00

Raised Shoulder with NO Raised Face. The "Lap Joint" flange is commonly called a "Van Stone" or a "Floating" flange.

GASKETS

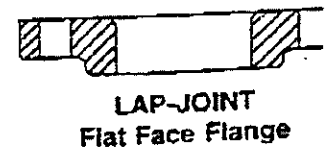
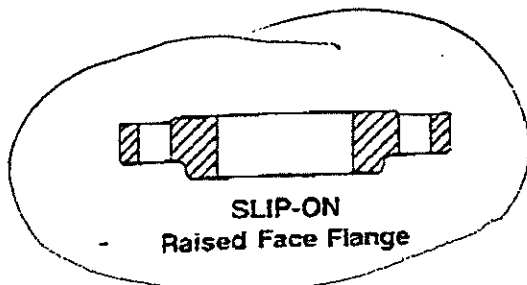
NEOPRENE KLINGER

Size	Part #	Price	Part #	Price
1 1/2"	NG20	\$1.15	AG20	2.25
2"	NG25	1.20	AG25	2.35
2 1/2"	NG30	1.75	AG30	2.90
3"	NG35	1.35	AG35	3.75
4"	NG40	2.25	AG40	4.50
6"	NG60	2.95	AG60	7.00
8"	NG80	4.75	AG80	10.00

Standard "drop-ring" type all 1/16" thick.

Flange Bolt Hole layout: 1 1/2" - 3" have 4 holes; 4" - 8" have 8 holes; 10" & 12" have 12 holes.

FLANGE PROFILES



For additional dimensional information and diagrams, see pages 304 and 305.

NOTCHED TURNED BACK NIPPLES

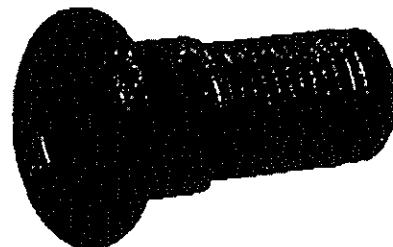
The New Investment Cast "NO" 316 Stainless Steel Turned Back Nipples incorporates Dixon's notched shank design. When used with an appropriate "NO" ferrule, these fittings can be swaged or crimped onto hose, thereby providing improved shank retention.

The stem can be removed from a damaged hose by cutting away the ferrule, without necessarily damaging the fitting. After inspection to determine its suitability for reuse, it can be reinstalled into another hose by using a new ferrule.

"King" Turned Back Nipples.

Notched Turned Back Nipples let you use the same Ferrules used with the Notched (NO) Cam & Groove. This lets you maximize your inventory usage and reduce costs. Fittings can be swaged-on or crimped-on; consult the Factory for specifications.

Size	Fits Hose O.D.		Stem Part #	Price	Ferrule Part #	Price
	From:	To:				
1 1/2"	1 15/16"	2 3/16"	RN150NO	\$75.00	GAS2334NO	\$23.00
1 1/2"	2 1/16"	2 11/32"	RN150NO	75.00	GAS2370NO	24.00
2"	2 15/32"	2 11/16"	RN200NO	88.50	GAS2709NO	18.25
2"	2 21/32"	2 27/32"	RN200NO	88.50	GAS2885NO	40.00
3"	3 15/32"	3 23/32"	RN300NO	140.00	GAS3760NO	30.50
3"	3 47/64"	3 27/32"	RN300NO	140.00	GAS3885NO	44.00
4"	4 5/8"	4 47/64"	RN400NO	190.00	GAS5010NO	128.00



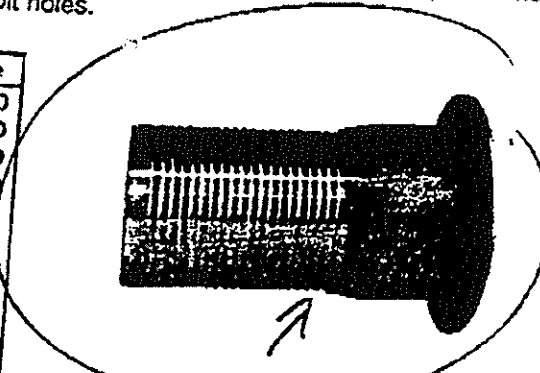
For use with Slip-On and Lap Joint flanges shown on page 258.

"KING" TURNED BACK HOSE NIPPLES FOR FLOATING FLANGES

A Turned Back Nipple, when used in a Floating Flange assembly, allows the flange to be aligned without stressing (twisting) the hose. This generally increases the hose's service life by eliminating a common cause of premature hose failure. It also makes the connection easier for the installer, since no twisting or turning of the hose is required in order to line up the bolt holes.

Plated Carbon Steel

Size	Part #	Price
3/4"	N5	\$25.00
1"	N10	45.00
1 1/4"	N15	45.00
1 1/2"	N20	55.00
2"	N25	51.20
2 1/2"	N30	77.00
3"	N35	70.00
4"	N40	102.00
6"	N60	160.00
8"	N80	250.00
10"	N100	405.00
12"	N120	625.00



For use with Slip-On and Lap Joint flanges shown on page 258.

#316 Stainless Steel

Size	Part #	Price
3/4"	RN5	\$80.00
1"	RN10	98.25
1 1/4"	RN15	108.00
1 1/2"	RN20	110.00
2"	RN25	132.00
2 1/2"	RN30	180.00
3"	RN35	220.00
4"	RN40	315.00
6"	RN60	670.00
8"	RN80	1150.00
10"	RN100	POR
12"	RN120	POR

"KING" TURNED BACK WELD-TO-METAL HOSE NIPPLES

Length	Plain Carbon Steel Schedule 40 Pipe		#304 Stainless Steel Schedule 10 Pipe			
	Part #	Price	Part #	Price	Part #	Price
2"	NW5	\$18.00	GNW5	\$24.00	GNWP5	\$11.50
2"	NW10	18.00	GNW10	23.50	GNWP10	13.30
2"	NW15	26.00	GNW15	35.70	GNWP15	24.00
2"	NW20	26.00	GNW20	37.00	GNWP20	16.00
2 1/2"	NW25	27.00	GNW25	47.00	GNWP25	19.50
2 1/2"	NW30	37.00	GNW30	58.50	GNWP30	40.00
2 1/2"	NW35	37.00	GNW35	64.00	GNWP35	32.00
3"	NW40	51.00	GNW40	78.00	GNWP40	37.50
3 1/2"	NW60	77.00	GNW60	175.00	GNWP60	97.00
4"	NW80	95.00	GNW80	280.00	GNWP80	195.00
5"	NW100	177.00	GNW100	350.00	GNWP100	225.00
6"	NW120	270.00	GNW120	500.00	GNWP120	380.00

Phono Finish Face



NEW
FOR
2001

MSS Type C, for use with Slip-On and Lap Joint flanges shown on page 258



The Holedall Coupling System

The Holedall coupling system provides outstanding strength, durability and safety.

The Holedall system is a method of attaching couplings to hose utilizing a draw-type progressive swage. The patented Holedall couplings include a Holedall stem and a specially engineered ferrule. The hydraulic swaging of the coupling to the hose is accomplished by pushing the ferrule through a die which reduces the ferrule O.D. The ferrule penetrates the hose wall, providing a 360° uninterrupted compression band around the hose.

A special hydraulic ram called a Mulcoram is the only piece of machinery necessary to accomplish

the coupling. Available in five different sizes from 10 ton to 150 ton, these rams will accommodate dies and pushers of various sizes so that hoses up to 20 inches in diameter may be coupled.

This multi-purpose, high pressure coupling system requires no bolts and results in a clean coupling with no protrusions. The swaging operation is fast and hose of various lengths and different styles can be coupled. Ease of operation, flexibility and economy make the Holedall method an unequalled assembly system.

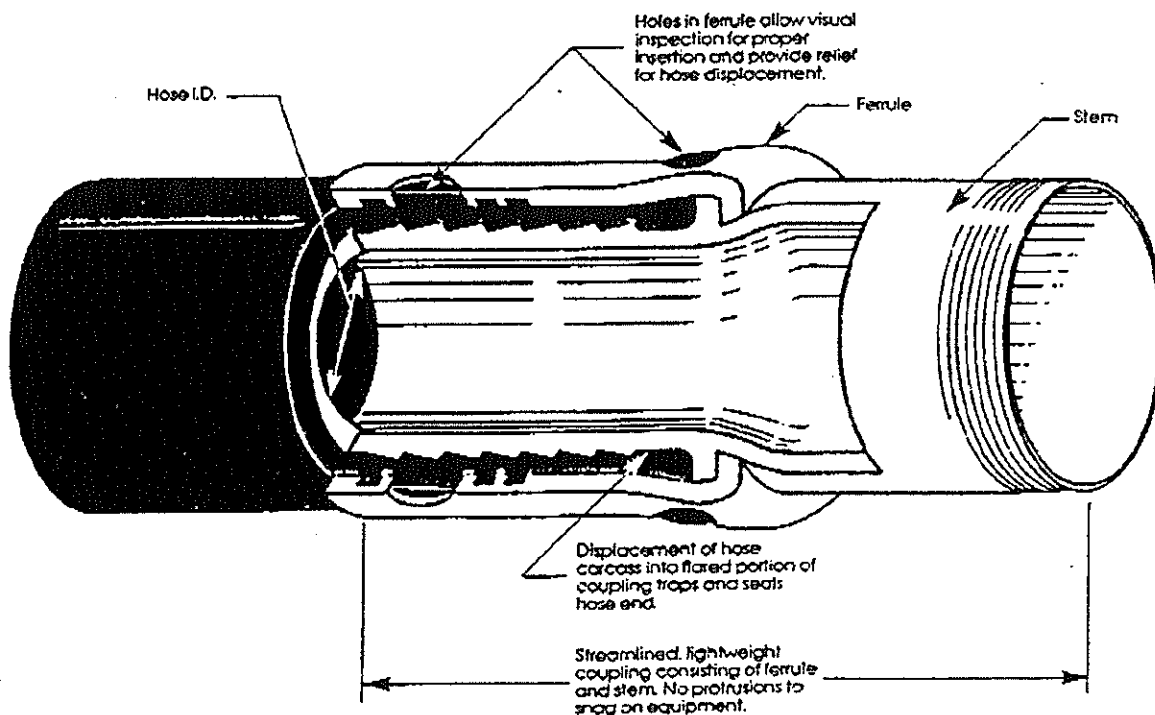
The Holedall coupling - the most adaptable coupling available

For almost half a century Holedall couplings have provided long-lasting efficiency and safety unmatched by any other industrial hose fitting. Dixon has these couplings in stainless steel, brass or aluminum, in addition to stocking standard carbon steel.

Couplings are furnished with pipe thread, plain end, victaulic grooved, or flanged ends of all types and ratings.

Holedall Coupling after Swaging

AVAILABLE IN CARBON STEEL & 316 STAINLESS



AVAILABLE IN SIZES 1 1/4", 1 1/2", 2", 2 1/2", 3" & 4"

APPENDIX B-3F

SLIDE RAILS

JOHN W. DANFORTH COMPANY

Pfohl Brothers Landfill HVAC

JWD JOB #8049

C

- Wet Well Pumps/ A10-20 Slide Rail System

Contents:

3 Pages

- Cover Sheets

6 Pages

- Submersible Effluent Pump Model
3885 Applications, Specifications,
Features, Motors, Agency Listings,
Components, Models, Effluent Ejector
System, Performance Ratings,
Dimensions, General, Qualifications,
Pump Design, Mechanical Shaft
Seals, Impeller, Casing, Major Casting
Materials, Corrosion Protection,
Motor, Power Cable, Pump Options,
Goulds Limited Warranty

2 Pages

- Effluent and Sewage Pump
Disconnect Rail System Features

1 Page

- Effluent and Sewage Pipe Fittings Ball
Check Valves

1 Pages

- Effluent and Sewage Stainless Steel
Slide Rail Systems 1 ¼ and 2"
Discharge Slide Rail Systems, Basic
Slide Rail Assembly Includes, Simplex
System Ordering Information

- Installation and Operation Manual

Supplied By: Lee Supply & L.A. Hazard

SINCE 1884

**John W. Danforth Company****Submittal Data Cover Form**

MAY 03 '01

8049

JOHN W. DANFORTH CO.
Buffalo, New YorkDate: 3-May-01 Job number: 8049 Extra # Project manager: John SamarProject name: Pfohl Brothers LanfillCustomer project number (or contract/po #): E6483021Engineer: CRASubmittal # 8049-004 (job number - item number on submittal schedule ex: 9687-001)Subcontractor: N/ASupplier: Lee Supply CoManufacturer: Goulds

Spec section:

Item submitted:

Wet well pumps

Notes:

☐ Mail☒ Hand Deliver by Project Manager

SUMITTAL DATA

FOR

PFOHL BROTHERS LANDFILL

PROJECT

Submitted for Approval

JOB#

MAY 03 '01

8049

JOHN W. DANFORTH CO.
Buffalo, New York

RECEIVED



MAY 02 2001



JOHN W. DANFORTH CO.

EQUIPMENT LIST

FOR THE

PFOHL BROTHERS LANDFILL

PROJECT

Note: Only the equipment as described below will be provided.

- 4 Goulds 3885 submersible pump
Model #WE1534HH 1-1/2HP, 460 VAC, 3 phase motor
with 20' of cable**
- 4 Goulds 3885 submersible pump
Model #WE0734H 3/4HP, 460 VAC, 3 phase motor with
20' of cable**
- 6 Goulds Model #APD20 guide rail/disconnect system
(guide rail pipe not included)**
- 1 Intermediate guide rail bracket for Well #WW5 (over
20') Part Number-IGRB3**
- 6 Goulds A9-2B check valve**



Submersible Effluent Pump

MODEL

3885

PROSURANCE AVAILABLE FOR RESIDENTIAL APPLICATIONS.

APPLICATIONS

Specifically designed for the following uses:

- Homes
- Farms
- Trailer courts
- Motels
- Schools
- Hospitals
- Industry
- Effluent systems

SPECIFICATIONS

Pump

- Solids handling capabilities: 3/4" maximum.
- Discharge size: 2" NPT.
- Capacities: up to 140 GPM.
- Total heads: up to 128 feet TDH.
- Temperature: 104°F (40°C) continuous 140°F (60°C) intermittent.
- See order numbers on reverse side for specific HP, voltage, phase and RPM's available.

FEATURES

- **Impeller:** Cast iron, semi-open, non-clog with pump-out vanes for mechanical seal protection. Balanced for smooth operation. Silicon bronze impeller available as an option.
- **Casing:** Cast iron volute type for maximum efficiency. 2" NPT discharge.
- **Mechanical Seal:** SILICON CARBIDE VS. SILICON CARBIDE sealing faces. Stainless steel metal parts, BUNA-N elastomers.

- **Shaft:** Corrosion-resistant, stainless steel. Threaded design. Locknut on three phase models to guard against component damage on accidental reverse rotation.

- **Fasteners:** 300 series stainless steel.

- Capable of running dry without damage to components.

- Designed for continuous operation when fully submerged.

MOTORS

- Fully submerged in high-grade turbine oil for lubrication and efficient heat transfer.

- Class B insulation.

Single phase:

- Built-in overload with automatic reset.
- All single phase models feature capacitor start motors for maximum starting torque.
- 1/2 and 1/2 HP – 16/3 SJTOW with 115, 208 and 230 Volt three prong plug.
- 3/4-2 HP – 14/3 STOW with bare leads.

Three phase:

- Overload protection must be provided in starter unit.
- 1/2-2 HP – 14/4 STOW with bare leads.

- **Designed for Continuous Operation:** Pump ratings are within the motor manufacturer's recommended working limits, can be operated continuously without damage when fully submerged.

- **Bearings:** Upper and lower heavy duty ball bearing construction.

- **Power Cable:** Severe duty rated, oil and water resistant. Epoxy seal on motor end provides secondary moisture barrier in case of outer jacket damage and to prevent oil wicking. 20 foot standard with optional lengths available.

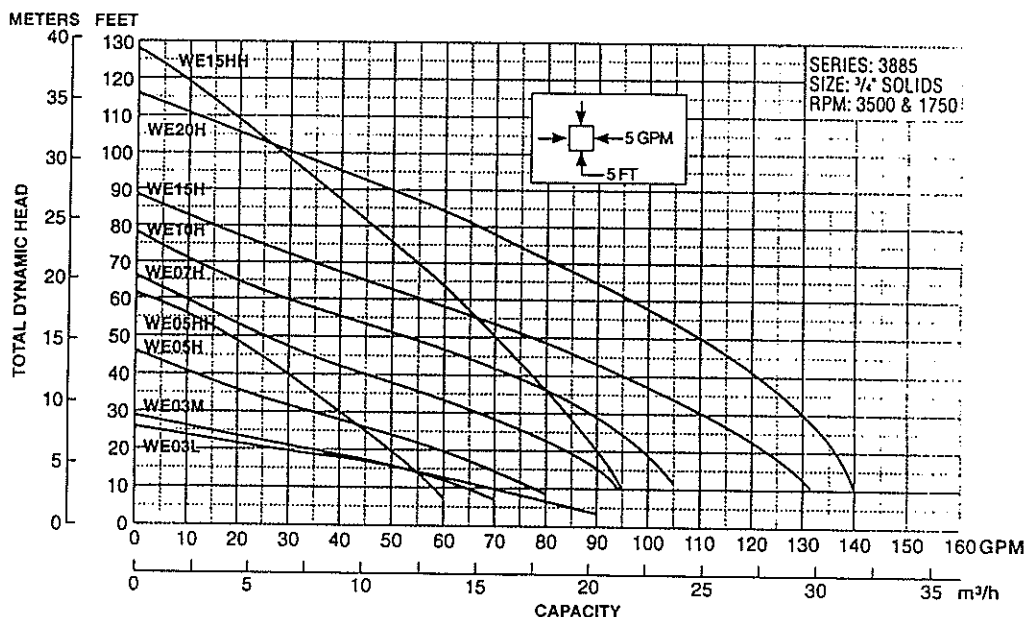
- **O-ring:** Assures positive sealing against contaminants and oil leakage.

AGENCY LISTINGS



Tested to UL 778 and CSA 22.2 108 Standards By Canadian Standards Association File #LR38549

Goulds Pumps is ISO 9001 Registered.



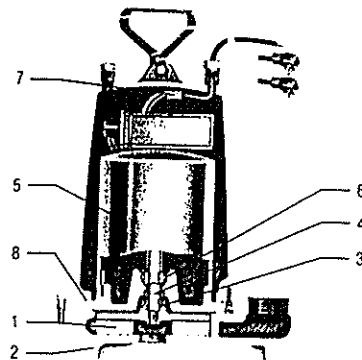
Goulds Pumps



ITT Industries

COMPONENTS

Item No.	Description
1	Impeller
2	Casing
3	Silicon carbide vs. silicon carbide Mechanical seal
4	Shaft
5	Motor
6	All Ball bearing heavy duty design
7	Power cable
8	O-ring



Submersible Effluent Pump

MODEL

3885

MODELS

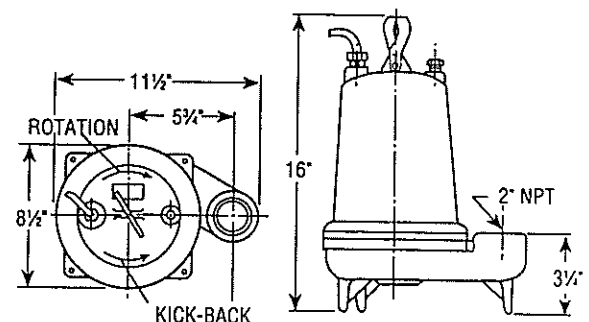
Order No.	HP	Volts*	Phase	Max. Amp.	RPM	Solids	Wt. (lbs.)	Heaters
WE0311L	1/8	115	1	9.8	1750	3/4"	56	N/A
WE0318L		208		5.5				
WE0312L		230		4.9				
WE0311M		115		9.8				
WE0318M	1/4	208	1	5.5	1750	3/4"	60	N/A
WE0312M		230		4.9				
WE0511H		115		14.5				
WE0518H		208		8.1				
WE0512H	1/2	230	3	7.3	3500	3/4"	60	K34
WE0538H		200		4.1				
WE0532H		230		3.3				
WE0534H		460		1.7				
WE0511HH	3/4	115	1	14.5	3500	3/4"	60	K32
WE0518HH		208		8.1				
WE0512HH		230		7.3				
WE0538HH		200		4.1				
WE0532HH	1	230	3	3.6	3500	3/4"	70	K23
WE0534HH		460		1.8				
WE0718H		208	1	11.0				
WE0712H		230		10.0				
WE0738H	1 1/2	200	3	6.2	3500	3/4"	80	K49
WE0732H		230		5.4				
WE0734H		460		2.7				
WE1018H		208	1	14.0				
WE1012H	2	230		12.5	3500	3/4"	83	K39
WE1038H		200		8.1				
WE1032H		230		7.0				
WE1034H		460	3	3.5				
WE1518H	3	208		17.5	3500	3/4"	80	K28
WE1512H		230		15.7				
WE1538H		200		10.6				
WE1532H		230	1	9.2				
WE1534H	4	460		4.6				
WE1518HH		208		17.5				
WE1512HH		230		15.7				
WE1538HH	5	200	3	10.6	3500	3/4"	83	K54
WE1532HH		230		9.2				
WE1534HH		460		4.6				
WE2012H		230	1	18.0				
WE2038H	6	200		12.0	3500	3/4"	83	K55
WE2032H		230		11.6				
WE2034H		460		5.8				

PERFORMANCE RATINGS (gallons per minute)

Order No.	WE03L	WE03M	WE05H	WE07H	WE10H	WE15H	WE05HH	WE15HH	WE20H
HP	1/8	1/4	1/2	3/4	1	1 1/2	3	5	7 1/2
RPM	1750	1750	3500	3500	3500	3500	3500	3500	3500
5	86	-	-	-	-	-	-	-	-
10	70	65	78	94	-	-	56	95	140
15	58	58	70	90	103	128	53	93	138
20	30	35	60	85	98	123	50	90	136
25	5	15	48	76	94	117	45	87	133
30	-	-	35	67	88	111	40	84	130
35	-	-	23	57	82	103	35	82	126
40	-	-	12	45	74	95	30	77	121
45	-	-	-	35	64	86	25	74	116
50	-	-	-	25	53	77	18	70	110
55	-	-	-	17	42	67	12	66	104
60	-	-	-	9	30	56	3	63	97
65	-	-	-	-	20	46	-	58	90
70	-	-	-	-	11	35	-	55	83
75	-	-	-	-	4	25	-	51	75
80	-	-	-	-	-	15	-	47	66
90	-	-	-	-	-	-	-	37	51
100	-	-	-	-	-	-	-	28	30
110	-	-	-	-	-	-	-	17	10
120	-	-	-	-	-	-	-	8	-

DIMENSIONS

(All dimensions are in inches. Do not use for construction purposes.)



EFFLUENT EJECTOR SYSTEM

Effluent ejector system offers ease of ordering and installation. A single ordering number specifies a complete system designed for most residential and commercial sump and effluent pump applications.



Package Includes:
 Submersible Effluent Pump WE0311L, 12L or WE0311M, 12M, WE0511HH, 12HH
 Mechanical Level Control Switch A2-5 (115V), A2-6 (230V)
 Basin and Cover A7-1830P
 Check Valve A9-2P
 Order No.: SWE0311L, SWE0312L, SWE0311M, SWE0312M, SWE0511HH, SWE0512HH.

3885**Submersible Effluent
Pumps****GENERAL**

- Furnish and install 4 Goulds Pumps, Model 3885, submersible effluent pump(s), 1 1/2 HP, 3 phase, 460 volts, 60 Hz, pump(s) rated for _____ GPM, at _____ Ft. Total Dynamic Head.
- Pump(s) shall be Goulds Pumps, Order No: WE1534HH

QUALIFICATIONS

All pump manufacturers must be pre-qualified by the engineer in order to qualify as acceptable manufacturers. Pre-qualification shall be no later than two (2) weeks prior to published bid date for this project. Failure to pre-qualify will be grounds for disqualification after the bid opening date. All decisions of qualification shall reside with the engineer of record at time of bidding.

PUMP DESIGN

Pump(s) shall have 2 inch NPT integral vertical discharge and shall be capable of handling effluent containing non-abrasive 3/4 inch maximum solids.

MECHANICAL SHAFT SEALS

The motor shall be protected by a mechanical shaft seal mounted on the pump shaft. The mechanical seal shall be constructed of a silicon carbide vs. silicon carbide sealing faces. The upper mechanical seal shall be, tensioned by an independent spring system constructed of series 300 stainless steel metal components and BUNA-N elastomers.

IMPELLER

The impeller shall be semi-open with ejector (pump out) vanes on the top of the impeller for protection of the lower mechanical seal and hydraulic balance. Due to design, only single plane spin balancing shall be required for smooth operation.

The impeller shall be threaded to the solid series 400 stainless steel shaft. Pumps provided for three phase service shall be secured by a thread-locking feature which will prevent the impeller from loosening during short periods of reverse rotation as might occur when rotation direction is being verified outside the installation.

CASING

The casing shall be cast from ASTM A48 class 25 gray cast iron of sufficient thickness to withstand 1.5 times the shut off pressure generated by the largest impeller available for this model in accordance with current revision of the Hydraulic Institute Standards. The discharge connection shall be a standard 2 inch NPT suitable for direct connection to the station piping, without the use of any external fittings or adapters for vertical orientation of the discharge direction. Integral feet of cast iron shall be made a part of the casing for accurately positioning the pump suction opening at the correct elevation off the sump floor for good pump down capability.

MAJOR CASTING MATERIALS

The impeller, casing, bearing/seal housing and motor cover shall be of ASTM A48 Class 25 high quality cast iron for strength and long life. Bronze impeller shall be cast iron from ASTM B584 CA836 when ordered as an option.

CORROSION PROTECTION

The pump/motor shaft wetted-end shall be series 400 stainless steel. Both inner and outer surfaces of cast iron shall be electrocoat-painted with thermo-setting Acrylic Enamel baked 20 minutes at 350 degrees F., after castings are completely machined.

Goulds Pumps



3885**Submersible Effluent
Pumps****GENERAL**

- Furnish and install 4 Goulds Pumps, Model 3885, submersible effluent pump(s), 3/4 HP, 3 phase, 460 volts, 60 Hz, pump(s) rated for _____ GPM, at _____ Ft. Total Dynamic Head.
- Pump(s) shall be Goulds Pumps, Order No: WEO739H

QUALIFICATIONS

All pump manufacturers must be pre-qualified by the engineer in order to qualify as acceptable manufacturers. Pre-qualification shall be no later than two (2) weeks prior to published bid date for this project. Failure to pre-qualify will be grounds for disqualification after the bid opening date. All decisions of qualification shall reside with the engineer of record at time of bidding.

PUMP DESIGN

Pump(s) shall have 2 inch NPT integral vertical discharge and shall be capable of handling effluent containing non-abrasive 3/4 inch maximum solids.

MECHANICAL SHAFT SEALS

The motor shall be protected by a mechanical shaft seal mounted on the pump shaft. The mechanical seal shall be constructed of a silicon carbide vs. silicon carbide sealing faces. The upper mechanical seal shall be, tensioned by an independent spring system constructed of series 300 stainless steel metal components and BUNA-N elastomers.

IMPELLER

The impeller shall be semi-open with ejector (pump out) vanes on the top of the impeller for protection of the lower mechanical seal and hydraulic balance. Due to design, only single plane spin balancing shall be required for smooth operation.

The impeller shall be threaded to the solid series 400 stainless steel shaft. Pumps provided for three phase service shall be secured by a thread-locking feature which will prevent the impeller from loosening during short periods of reverse rotation as might occur when rotation direction is being verified outside the installation.

CASING

The casing shall be cast from ASTM A48 class 25 gray cast iron of sufficient thickness to withstand 1.5 times the shut off pressure generated by the largest impeller available for this model in accordance with current revision of the Hydraulic Institute Standards. The discharge connection shall be a standard 2 inch NPT suitable for direct connection to the station piping, without the use of any external fittings or adapters for vertical orientation of the discharge direction. Integral feet of cast iron shall be made a part of the casing for accurately positioning the pump suction opening at the correct elevation off the sump floor for good pump down capability.

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Goulds Pumps



ITT Industries

3885**Submersible Effluent
Pumps****MOTOR**

The integral motor shall be completely sealed from the environment by use of a circular cross section o-rings accurately fitted into machined grooves which shall provide designed compression of metal to metal fits. Designs which require a specific torque on the casing bolts or which require rectangular gaskets or sealing rings shall not be allowed. The motor shall be rated for continuous duty under full nameplate load while at full submergence in the station. The motor shall be provided at the specific site conditions of 115, 208 or 230 V, single phase or 200, 230, 460 or 575 V, three phase as required, all shall be at 60 Hz. Single phase motors: shall be capacitor-start. All single phase motors shall be provided with thermal protection. Single phase motors shall have an on winding sensor with automatic reset. Three phase motors shall be protected by ambient compensated quick-trip heaters, or, adjustable motor circuit protectors provided in control. The stator winding shall be open type with class B insulation suitable for operation in clean dielectric oil for efficient heat transfer and lubrication of the ball bearings. The stator shall be a register fit into the bearing housing to ensure positive alignment, and bolted for ease of serviceability. The motor shall be provided with ball type anti-friction bearings which shall support the heavy duty rotor shaft and to handle all radial and axial loads imposed by the impeller while limiting shaft deflection at the mechanical seal faces. Sleeve type bearings shall not be considered equal and, therefore, shall not be allowed. The ball bearings shall be designed for a B-10 life of 30,000 hours minimum. The motor shall be designed and tested to withstand an 18 day locked-rotor operation without damage.

POWER CABLE

The power cable shall be sealed at the motor end as it enters the motor casing by a two part barrier to moisture intrusion. The first line of defense shall be the compression of the oil and chemical resistant grommet which shall seal the outer jacket of the power cord. In the event that the outer jacket of the power cord should become damaged, then the second line of defense shall be the epoxy poured isolated conductors within the jacketed cable itself. The insulation shall be removed from the individual conductors and the epoxy shall be allowed to form a leak-proof seal against wicking of the power cable between the outer jacket and the insulation of the individual conductors. The outer jacket of the power cord shall be oil resistant and water resistant. The power cable shall be rated for NEC severe service "S", type "SJTOW" or "STOW".

PUMP OPTIONS

1. Bronze impeller
2. Mechanical seal faces of tungsten carbide material
3. Power cable of various lengths
4. Refer to the factory for items not listed.

Goulds Pumps



ITT Industries

GOULDS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Customer Service Department.

The warranty excludes:

- (a) Labor, transportation and related costs incurred by the dealer;
- (b) Reinstallation costs of repaired equipment;
- (c) Reinstallation costs of replacement equipment;
- (d) Consequential damages of any kind; and,
- (e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

- (1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds and the dealer in purchases, consignments or contracts for sale of the subject pumps.
- (2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
- (3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

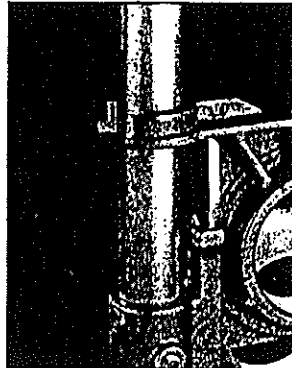
THIS WARRANTY EXTENDS TO THE DEALER ONLY.

Pump Disconnect Rail System

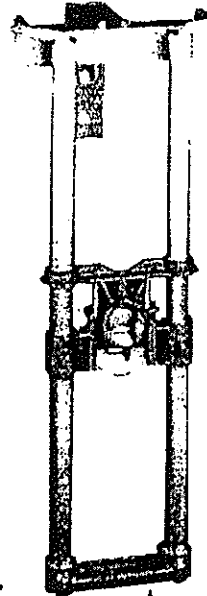
FEATURES

1¼, 1½ and 2" bronze disconnect and bottom brackets are non-sparking and corrosion resistant. Top bracket is vinyl-coated steel. The 60° cut-out allows removable half of disconnect to be removed from the guide rails without removing the top bracket. (System will accept ¼" PVC, stainless steel, or galvanized steel guide rails.)

(Not supplied by Goulds Pumps).

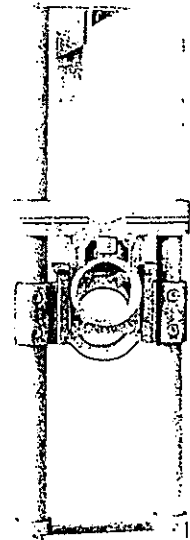


Pump Discharge Size	Part No.
1¼"	APD12
1½"	APD15
2"	APD20



↑ (2) ¾" THROUGH HOLES

1½" to 2" Bracket



3" Bracket

3" Bronze disconnect is built to satisfy the greater demands of 3" pumps. System accepts 1¼" PVC, stainless steel, or galvanized steel guide rails.

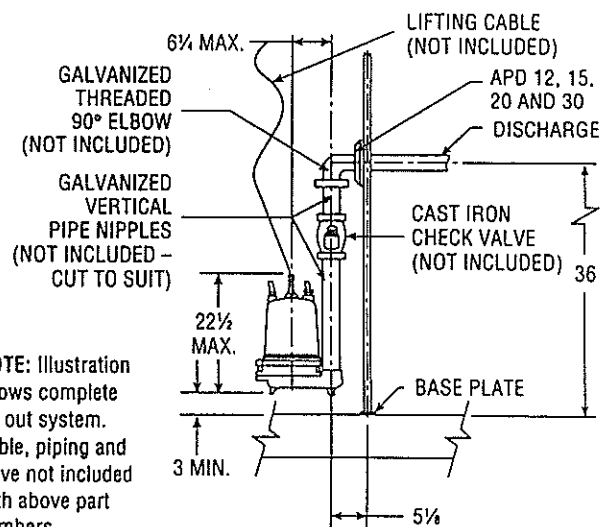
(Not supplied by Goulds Pumps).

Pump Discharge Size	Part No.
3"	APD30

TEFLON O-RINGS FOR QUICK DISCONNECT SYSTEMS

(APD and AF series)

Size	Order No.
1¼"	AR32T
1½"	AR35T
2"	AR33T
3"	AR36T



NOTE: Illustration shows complete lift out system. Cable, piping and valve not included with above part numbers.

Goulds Pumps



IGRB3

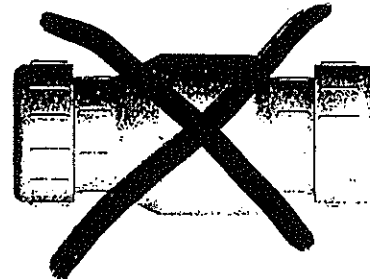
Pipe Fittings

CHECK VALVES

PLASTIC CHECK VALVES

- Ideal for horizontal installation.
- Compression seal connection for easy installation.
- Swing design flapper prevents clogging.
- Available for pipe size 1¼", 1½", 2", 3".

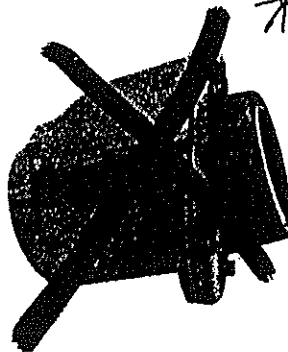
Pipe Size	Order No.
1¼"	A9-12P
1½"	A9-15P
2"	A9-28P
3"	A9-38P



CAST IRON CHECK VALVE

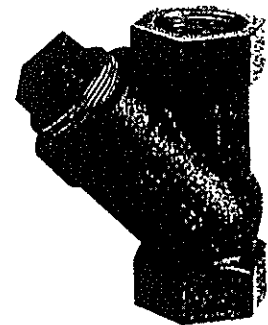
- Ideal for horizontal installation.
- Heavy duty cast iron construction.
- Swing design flapper prevents clogging.
- Available in 2" and 3" NPT threaded connections.

Pipe Size	Order No.
2" NPT	A9-12B
3" NPT	A9-15B



BALL CHECK VALVES

- Ideal for vertical mounting.
- Heavy duty cast iron or plastic construction.
- Natural rubber ball.
- Clean-out port and plug.
- Available in 1¼", 1½", 2" and 3" NPT threaded connections.
- Also available in 4" flanged (125#).



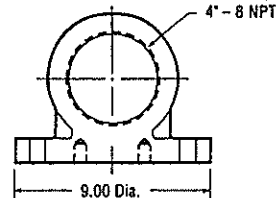
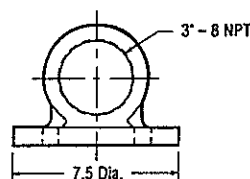
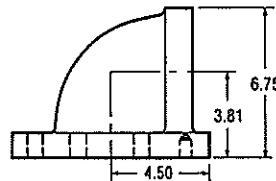
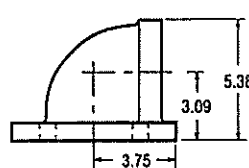
Pipe Size	Order No.
1¼" NPT	A9-12B
1½" NPT	A9-15B
2" NPT	A9-28B
3" NPT	A9-38B
4" Flanged	A9-4BCF
4" Flanged	A9-4BCT

Plastic Pipe Size	Order No.
1¼"	A9-12BPT
1½"	A9-15BPT
2"	A9-28BPT

PIPE CONNECTORS

SHORT RADIUS ELBOW

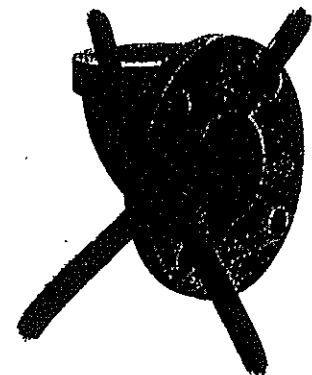
- Cast iron construction.
- 125 lb. ANSI rated flange at pump end.
- 3" NPT or 4" NPT threaded connection for discharge pipe.



A1-5

A1-6

Flange Size	Order No.	Used With
3"	A1-5	3888D3
4"	A1-6	3888D4



Goulds Pumps

Stainless Steel Slide Rail Systems

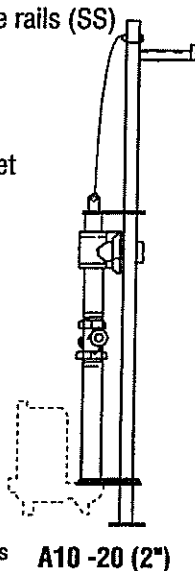
1 1/4" AND 2" DISCHARGE SLIDE RAIL SYSTEMS

- Provides easy means of removing pump from wet-well by utilizing a quick disconnect and guide assembly. Eliminates need to enter wet-well.
- Corrosion resistant design includes: Stainless steel rails, Cross brace, Quick disconnect plate, Base plate, Lift cable, Bronze quick disconnect.
- Adaptable to all 1 1/4" and 2" NPT vertical discharge effluent and sewage pumps.
- Designed for use with horizontal discharge systems.

BASIC SLIDE RAIL ASSEMBLY INCLUDES:

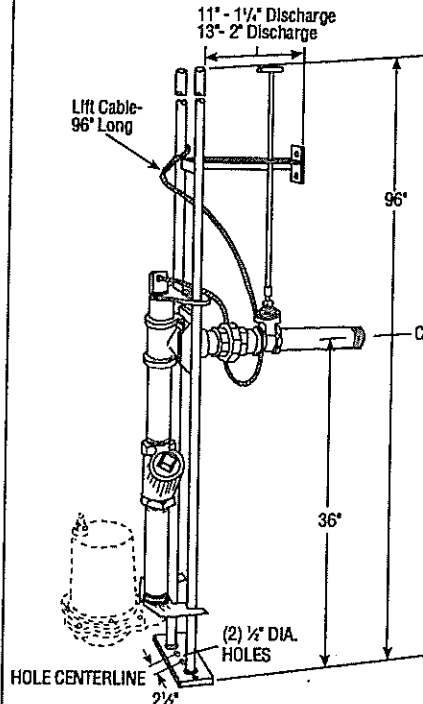
- 2 Pc. 96" Long guide rails (SS)
- Wall bracket (SS)
- Top pump bracket
- Quick disconnect adapter (bronze)
- Bottom pump bracket
- Base plate (SS)
- Lifting cable (SS)
- Check valve
- Vertical pipe nipples – galvanized
- Tee handle(s)
- Guide rail extension available

NOTE: Standard overall length of piping is 96" ... can be cut down to 48" minimum length. If rail length longer than 96" is required. Order rail extensions from price book.



A10-20 (2")

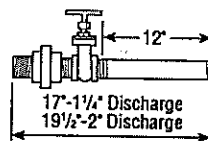
SIMPLEX



Simplex system consists of:
1-Slide rail
1-Simplex discharge piping

Simplex Discharge Piping:

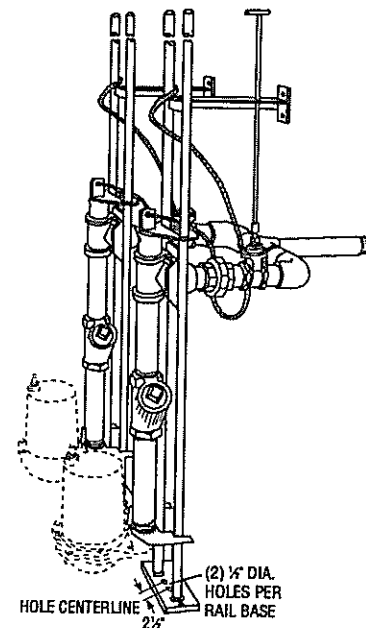
H12S, 1 1/4"
H20S, 2"



Simplex includes:

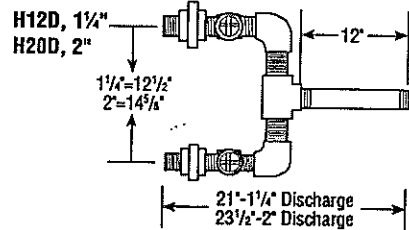
- Union
- Pipe nipples
- Gate valve

DUPLEX



Duplex system consists of:
2-Slide rails
1-Duplex discharge piping

Duplex Discharge Piping:



Duplex includes:

- Pipe nipples
- Gate valves
- Elbows
- Unions
- Pipe tee

Ordering Information	Simplex System				For Use With Pump Model
	Size	Qty.	Order No.	Description	
	1 1/4"	1	A10-12	Slide Rail	
		1	H12S	Disch. Piping	RGS2012
	2"	1	A10-20	Slide Rail	3885
		1	H20S	Disch. Piping	3886
					3887

See Price List for Rail Extensions.

Duplex System			
Size	Qty.	Order No.	Description
1 1/4"	2	A10-12	Slide Rail
	1	H12D	Disch. Piping
2"	2	A10-20	Slide Rail
	1	H20D	Disch. Piping

Goulds Pumps

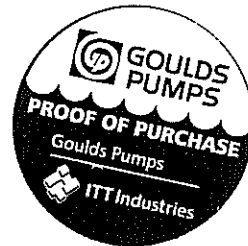


ITT Industries

Waste Water Pumps

Dewatering, Effluent and Sewage

Installation and Operation Manual



Owner's Information

Pump Model Number: _____

Pump Serial Number: _____

Control Model Number: _____

Dealer: _____

Dealer Phone No. _____

Date of Purchase: _____ Installation: _____

Current Readings at Startup:

1Ø	3Ø	L1-2	L2-3	L3-1
Amps: _____	Amps: _____	_____	_____	_____
Volts: _____	Volts: _____	_____	_____	_____

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FEB 11 2002



JOHN W. DANFORTH CO.

Goulds Pumps



ITT Industries

SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.



This is a **SAFETY ALERT SYMBOL**. When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.



DANGER Warns of hazards that **WILL** cause serious personal injury, death or major property damage.



WARNING Warns of hazards that **CAN** cause serious personal injury, death or major property damage.



CAUTION Warns of hazards that **CAN** cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.



WARNING All electrical work must be performed by a qualified technician. Always follow the National Electrical Code (NEC), or the Canadian Electrical Code, as well as all local, state and provincial codes. Code questions should be directed to your local electrical inspector. Failure to follow electrical codes and OSHA safety standards may result in personal injury or equipment damage. Failure to follow manufacturer's installation instructions may result in electrical shock, fire hazard, personal injury or death, damaged equipment, provide unsatisfactory performance, and may void manufacturer's warranty.



WARNING Standard units are not designed for use in swimming pools, open bodies of water, hazardous liquids, or where flammable gases exist. These fluids and gases may be present in containment areas. Tank or wetwell must be vented per local codes.

Only pumps specifically Listed for Class 1, Division 1 are allowable in hazardous liquids and where flammable gases may exist. *See specific pump catalog bulletins or pump nameplate for all agency Listings.*



WARNING Disconnect and lockout electrical power before installing or servicing any electrical equipment. Many pumps are equipped with automatic thermal overload protection which may allow an overheated pump to restart unexpectedly.



CAUTION All three phase (3Ø) control panels for submersible pumps must provide Class 10, quick-trip, overload protection.

PRE-INSTALLATION CHECKS

Open all cartons and inspect for shipping damage. Report any damage to your supplier or shipping carrier immediately.

Important: Always verify that the pump nameplate Amps, Voltage, Phase, and HP ratings match your control panel and power supply.

Many of our sewage pumps are oil-filled. If there are any signs of oil leakage or if the unit has been stored for an extended period check the oil level in the motor dome and the seal housing, if so equipped.

Check the motor cover oil level through the pipe plug on top of the unit. The motor chamber oil should just cover the motor. Do not overfill, leave room for expansion!

To check the seal housing oil level, where used, lay the unit on its side with the fill plug at 12 o'clock. Remove the plug. The oil should be within 1/2" (13mm) of the top. If low, refill with an ASTM 150 turbine oil. Replace the plug.

Oil is available in 5 gallon cans through our distributors. You can also source oil locally at motor repair shops. Typical oil brands are: Shell Turbo 32, Sunoco Sunvis 932, Texaco Regal R&O 32, Exxon Nuto 32 and Mobil DTE Light.

Check the strain relief nut on power cable strain assemblies. Power cables should be torqued to 75 in. lbs. for #16 cables and 80 in. lbs. for all other cable assemblies. Seal/heat sensor cables, where used, should be torqued to 75 in. lbs.

Warranty does not cover damage caused by connecting pumps and controls to an incorrect power source (voltage/phase supply).

Record the model numbers and serial numbers from the pumps and control panel on the front of this instruction manual for future reference. Give it to the owner or affix it to the control panel when finished with the installation.

LIFTING OF PUMP



DO NOT LIFT, CARRY OR HANG PUMP BY THE ELECTRICAL CABLES. DAMAGE TO THE ELECTRICAL CABLES CAN CAUSE SHOCK, BURNS OR DEATH.

Lift the pump with an adequately sized chain or cable attached to the lifting eye bolt. **DO NOT** damage electrical and sensor cables while raising and lowering unit.

OPTIONAL SLIDE RAIL OR LIFT-OUT SYSTEM

In many effluent and sewage basins or lift stations it is advisable to install the pump on a slide rail system or on a lift-out adapter to facilitate installation and removal for inspection and/or service. Most codes do not allow personnel to enter a wetwell without the correct protective equipment and training. Slide rails are designed to allow easy removal of the pump without the need for entry into the wetwell or need to disturb piping. The slide rail or lift-out adapter should locate the pump opposite the influent

opening preventing stagnate areas where solids can settle. The basin or pit must be capable of supporting the weight of the pump and slide rail. The pit floor must be flat.

NOTICE: FOLLOW THE INSTRUCTIONS THAT ARE PROVIDED WITH THE SLIDE RAIL ASSEMBLY.

PIPING

Discharge piping should be no smaller than the pump discharge diameter and kept as short as possible; avoiding unnecessary fittings to minimize friction losses.

Install an adequately sized check valve matched to the solids handling capability of the pump to prevent fluid backflow. Backflow can allow the pump to "turbine" backwards and may cause premature seal and/or bearing wear. If the pump is turning backwards when it is called on to start the increased torque may cause damage to the pump motor and/or motor shaft and some single-phase pumps may actually run backwards.

Install an adequately sized gate valve **AFTER** the check valve for pump, plumbing and check valve maintenance.

Important – Before pump installation. Drill a $\frac{3}{16}$ " (4.8mm) relief hole in the discharge pipe. It should be located within the wetwell, 2" (51mm) above the pump discharge but below the check valve. The relief hole allows any air to escape from the casing. Allowing liquid into the casing will insure that the pump can start when the liquid level rises. Unless a relief hole is provided, a bottom intake pump could "air lock" and will not pump water even though the impeller turns.

All piping must be adequately supported, so as not to impart any piping strain or loads on the pump.

The pit access cover must be of sufficient size to allow for inspection, maintenance and crane or hoist service.

WIRING AND GROUNDING

Important notice: Read Safety Instructions before proceeding with any wiring.

 Use only stranded copper wire to pump/motor and ground. The ground wire must be at least as large as the power supply wires. Wires should be color coded for ease of maintenance and troubleshooting.

 Install wire and ground according to the National Electrical Code (NEC), or the Canadian Electrical Code, as well as all local, state and provincial codes.

 Install an all leg disconnect switch where required by code.

 Disconnect and lockout electrical power before performing any service or installation.

 The electrical supply voltage and phase must match all equipment requirements. Incorrect voltage or phase can cause fire, motor and control damage, and voids the warranty.

 All splices must be waterproof. If using splice kits follow manufacturer's instructions.

 **WARNING** Select the correct type and NEMA grade junction box for the application and location. The junction box must insure dry, safe wiring connections.

WARNING

Seal all controls from gases present which may damage electrical components.

WARNING

Hazardous voltage

FAILURE TO PERMANENTLY GROUND THE PUMP, MOTOR AND CONTROLS BEFORE CONNECTING TO POWER CAN CAUSE SHOCK, BURNS OR DEATH.

SELECTING AND WIRING

PUMP CONTROL PANELS AND SWITCHES

FLOAT SWITCH TYPES

There are two basic float switch designs; single-action and wide-angle. Single-action switches operate over a range of 15° so they open and close quickly. Wide-angle floats operate over a 90° swing with the tether length between the float body and the pivot point controlling the On-Off range. The design determines how many floats are required with different systems or controls.

Floats may be normally open (NO) for pump down applications or to empty a tank. Normally closed (NC) switches are used to pump up or to fill a tank.

A single-action control switch may be used only with a control panel, never direct connected to a pump.

The wide-angle, pump down switches may be used as direct connected pump switches or as control switches.

SETTING THE FLOAT SWITCHES

There are no absolute rules for where to set the float switches, it varies from job to job.

Suggested Rules to Follow:

All floats should be set below the Inlet pipe!

Off Float: Best: set so the water level is always above the top of the pump (motor dome). **Next Best:** set so the water level is not more than 6" below the top of the pump.

On Float: set so the volume of water between the On and Off floats allows pumps of 1½ HP and under to operate for 1 minute minimum. Two (2) HP and larger pumps should run a minimum of 2 minutes. Basin literature states the gallons of storage per inch of basin height.

Lag/Alarm Float(s): should be staggered above the Off and On floats. Try to use most of the available storage provided by the basin, save some space for reserve storage capacity. *See Diagrams and Charts in Float Switch Chart Section.*

PANEL WIRING DIAGRAMS

Our control panels are shipped with instructions and wiring diagrams. Use those instructions in conjunction with this IOM. Electrical installation should be performed only by qualified technicians. Any problem or questions pertaining to another brand control must be referred to that control supplier or manufacturer. Our technical people have no technical schematics or trouble shooting information for other companies' controls.

ALARMS

We recommend the installation of an alarm on all Waste Water pump installations. Many standard control panels come equipped with alarm circuits. If a control panel is not used, a stand alone high liquid level alarm is available. The alarm alerts the owner of a high liquid level in the system so they can contact the appropriate service personnel to investigate the situation.

SINGLE PHASE PUMPS

Single phase (1Ø) pumps may be operated using a piggyback or hard wired float switch, a contactor, or a Simplex or Duplex control panel. *See Figures 1, 2 and 5.*

All 1/3 and 1/2 HP, 115 or 230 volt pumps, and some 3/4 and 1 HP pumps, are supplied with plug style power cords. They may be plugged into piggyback float switches for simple installations. It is allowable to remove the plugs in order to hardwire or connect to a Simplex or Duplex controller. Removing the plug neither voids the warranty nor violates the agency Listings. *See Figure 5.*

⚠ WARNING



PLUG-CONNECTED UNITS MUST BE CONNECTED TO A PROPERLY GROUNDED, GROUNDING TYPE RECEPTACLE.

ON NON-PLUG UNITS, DO NOT REMOVE CORD AND STRAIN RELIEF. DO NOT CONNECT CONDUIT TO PUMP.

Pumps with bare lead power cords can be hard-wired to a float switch, wired to a 1Ø contactor, a Simplex controller or a Duplex controller. Always verify that the float switch is rated for the maximum run amperage, maximum starting amperage, and the HP rating on the pump. Single-phase waste water pumps contain on-winding overloads, unless noted on the pump nameplate. *See Figures 1 and 2.*

THREE PHASE PUMPS:

As a Minimum a 3Ø pump requires a 3 pole circuit breaker/fused circuit, an across the line magnetic starter rated for the pump HP, and ambient compensated Quick Trip Class 10 overloads.

SINGLE AND THREE PHASE CONTROL PANELS:

Control panels are available as Simplex (controls 1 pump) or Duplex (controls 2 pumps). Our standard SES Series Panels are available with many standard features and can be built with our most popular options. We also custom build panels which offer many more design options than the SES panels. Custom control panels are available in many different configurations. Custom panel quote requests may be forwarded to Customer Service through any authorized distributor.

Our "SES" Duplex panels feature a solid-state printed circuit board design with standard high level alarm circuits. Other standard features are: an auxiliary dry alarm contact for signaling a remote alarm and float switch position indicator lights. Our 3Ø panels have built-in, adjustable, Class 10 overloads. The adjustable overloads on all our 3Ø panels mean less labor for the installer and no need to order specific overloads. Most SES panels are in stock for immediate delivery.

On pumps equipped with seal fail and/or heat (high temperature) sensors it is recommended that you use our control panel with the appropriate options. The pump sensors do not function without a seal fail relay or terminal connection in the control panel and a warning device such as a bell, horn or light.

Seal Failure Circuit - Some dual seal pumps are equipped with a standard, built-in seal failure circuit, which may also be called a moisture detection circuit. This circuit must be connected to a control panel with an optional seal fail relay. The panel must be special ordered with the seal fail relay and alarm. There are also stand alone seal fail panels

such as the A4-3 or A4-4 available as standard items. The pumps can be identified by an extra control cable exiting the motor cover. The cable contains two wires, a black wire, connects to panel "terminal" going to "probe"; and a white wire, connects to the panel "terminal" going to the relay ground. Do not connect to the panel ground screw. *Follow the wiring instructions supplied with the panel.*

Heat Sensor and Seal Failure Circuit - Some pumps are equipped with a seal fail and normally closed, on-winding high temperature thermostats (heat sensors). The pumps have a control cable with four (4) leads, black (probe) and green (relay ground) for the seal fail circuit and red and white for the high temperature circuit. Connect the high temperature (heat sensor) circuit to the panel terminal strip as indicated on the panel drawing using the red and white wires. The high temperature panel circuit is also an optional item which you must specifically order when you order your control panel. The high temperature circuit is different from the Class 10 overloads which are always required on three phase pumps. *Follow the wiring instructions supplied with the panel.*

INSTALLATION

Connect the pump(s) to the slide rail pump adapters or to the discharge piping. Slide rail bases should be anchored to the wetwell floor.

Complete all wiring per the control panel wiring diagrams and NEC, Canadian, state, provincial and/or local codes. This a good time to check for proper rotation of the motors/impellers.

⚠ DANGER



DO NOT PLACE HANDS IN PUMP SUCTION WHILE CHECKING MOTOR ROTATION. TO DO SO WILL CAUSE SEVERE PERSONAL INJURY.

Always verify correct rotation. Correct rotation is indicated on the pump casing. Three phase motors are reversible. It is allowable to bump or jog the motor for a few seconds to check impeller rotation. It is easier to check rotation before installing the pump. Switch any two power leads to reverse rotation.

Lower the pump(s) into the wetwell.

Check to insure that the floats will operate freely and not contact the piping.

OPERATION

Once the piping connections are made and checked you can run the pumps.

Piggyback Switch Operation - Plug the piggyback switch into a dedicated grounded outlet and then plug the pump into the switch. Test the pump by filling the wetwell until the pump goes On. If the pumps run but fail to pump, they are probably air locked, drill the relief holes per the instructions in the Piping Section.

Check the operating range to insure a minimum one minute run time and that the pump goes Off in the correct position.

Control Panel Operation - Fill the wetwell with clear water.

Use the pump H-O-A (Hand-Off-Automatic) switches in Hand to test the pumps. If they operate well in Hand proceed to test Automatic operation. If the pumps run but fail to pump, they are probably air locked, drill the relief holes per the instructions in the Piping Section.

Place Control Panel switch(es) in Automatic position and thoroughly test the operation of the ON, OFF, and Alarm floats by filling the wetwell with clear water. **Important:** Failure to provide a Neutral from the power supply to a 1Ø, 230 volt Control Panel will not allow the panel control circuit to operate. The Neutral is necessary to complete the 115 volt control circuit.

Check voltage and amperage and record the data on the front of this manual for future reference. Compare the amperage readings to the pump nameplate maximum amperage. If higher than nameplate amperage investigate

cause. Operating the pump off the curve, i.e. with too little head or with high or low voltage will increase amperage. The motor will operate properly with voltage not more than 10% above or below pump nameplate ratings. Performance within this range will not necessarily be the same as the published performance at the exact rated nameplate frequency and voltage. Correct the problem before proceeding. Three phase unbalance is also a possible cause. *See Three Phase Power Unbalance and follow the instructions.*

Reset the Alarm circuit, place pump switch(es) in the Automatic position and Control Switch in ON position. The system is now ready for automatic operation.

Explain the operation of the pumps, controls and alarms to the end user. Leave the paperwork with the owner or at the control panel if in a dry, secure location.

FLOAT SWITCH AND PANEL CHART

The purpose of this chart is to show the required switch quantities and the function of each switch in a typical waste water system. The quantities required vary depending on the switch type, single-action or wide-angle. Switch quantities also vary by panel type: simplex with and without alarms, and duplex with alarms.

Duplex Panels using single-action switches:

Three Float Panel Wiring

SW1	Bottom	Pumps Off
SW2	Middle	1st Pump On
SW3	Top	2nd Pump & Alarm On

Four Float Panel Wiring ②

SW1	Bottom	Pumps Off
SW2	2nd	1st Pump On
SW3	3rd	2nd Pump On
SW4	Top	Alarm On

Duplex Panels using wide-angle switches:

Three Float Panel Wiring

SW1	Bottom	1st Pump On/Both Off
SW2	Top	2nd Pump & Alarm On

Four Float Panel Wiring

SW1	Bottom	1st Pump On/Both Off
SW2	Middle	2nd Pump On
SW3	Top	Alarm On

Simplex Panel using single-action switches:

Simplex Panel with Alarm ①

SW1	Bottom	Pump Off
SW2	Middle	Pump On
SW3	Top	Alarm On/Off

Simplex Panel with No Alarm

SW1	Bottom	Pump Off
SW2	Top	Pump On

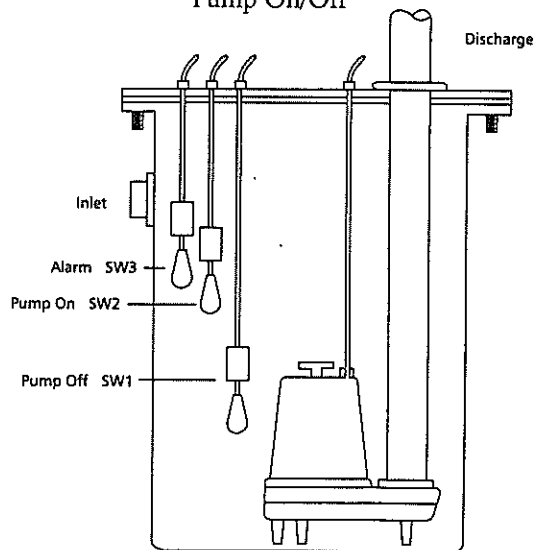
Simplex Panel using wide-angle switches:

Simplex Panel with Alarm

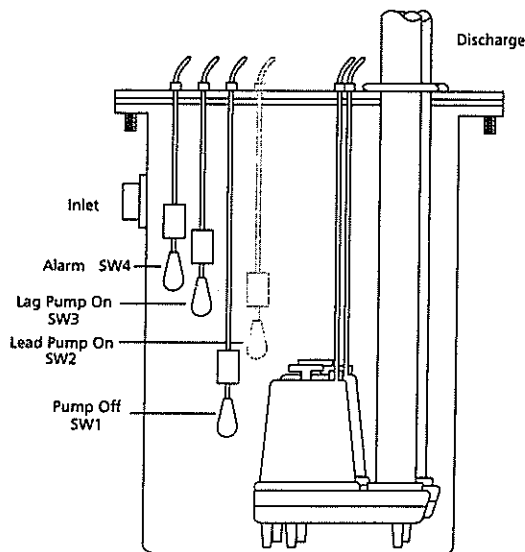
SW1	Bottom	Pump On/Off
SW2	Top	Alarm On/Off

Simplex Panel with No Alarm

SW1	Pump On/Off
-----	-------------



Simplex ①



Duplex ②

THREE PHASE POWER UNBALANCE

A full three phase supply consisting of three individual transformers or one three phase transformer is recommended. "Open" delta or wye connections using only two transformers can be used, but are more likely to cause poor performance, overload tripping or early motor failure due to current unbalance.

Check the current in each of the three motor leads and calculate the current unbalance as explained below.

If the current unbalance is 2% or less, leave the leads as connected.

If the current unbalance is more than 2%, current readings should be checked on each leg using each of the three possible hook-ups. Roll the motor leads across the starter in the same direction to prevent motor reversal.

To calculate percent of current unbalance:

A. Add the three line amp values together.

	Hookup 1			Hookup 2			Hookup 3		
Starter Terminals	L1	L2	L3	L1	L2	L3	L1	L2	L3
	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$
Motor Leads	R	B	W	W	R	B	B	W	R
	T3	T1	T2	T2	T3	T1	T1	T2	T3

Example:

T3-R = 51 amps
 T1-B = 46 amps
 T2-W = 53 amps
 Total = 150 amps
 $\div 3 = 50$ amps
 $- 46 = 4$ amps
 $4 \div 50 = .08$ or 8%

T2-W = 50 amps
 T3-R = 48 amps
 T1-B = 52 amps
 Total = 150 amps
 $\div 3 = 50$ amps
 $- 48 = 2$ amps
 $2 \div 50 = .04$ or 4%

T1-B = 50 amps
 T2-W = 49 amps
 T3-R = 51 amps
 Total = 150 amps
 $\div 3 = 50$ amps
 $- 49 = 1$ amps
 $1 \div 50 = .02$ or 2%

B. Divide the sum by three, yielding average current.

C. Pick the amp value which is furthest from the average current (either high or low).

D. Determine the difference between this amp value (furthest from average) and the average.

E. Divide the difference by the average. Multiply the result by 100 to determine percent of unbalance.

Current unbalance should not exceed 5% at service factor load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the power source.

Contact your local power company to resolve the imbalance.

INSULATION RESISTANCE READINGS

Normal Ohm and Megohm Values between all leads and ground

Condition of Motor and Leads	Ohm Value	Megohm Value
A new motor (without drop cable).	20,000,000 (or more)	20 (or more)
A used motor which can be reinstalled in well.	10,000,000 (or more)	10 (or more)
Motor in well. Readings are for drop cable plus motor.		
New motor.	2,000,000 (or more)	2 (or more)
Motor in good condition.	500,000 - 2,000,000	.5 - 2
Insulation damage, locate and repair.	Less than 500,000	Less than .5

Insulation resistance varies very little with rating. Motors of all HP, voltage and phase ratings have similar values of insulation resistance.

Insulation resistance values above are based on readings taken with a megohmmeter with a 500V DC output. Readings may vary using a lower voltage ohmmeter, consult factory if readings are in question.

This table was reprinted through the courtesy of Franklin Electric.

ENGINEERING DATA

Engineering data for specific models may be found in your catalog and on our website (address is on the cover).

Control panel wiring diagrams are shipped with the control panels. Please use the control panel drawings in conjunction with this instruction manual to complete the wiring.

PUMP CONSTRUCTION

Minimum Submergence		Maximum Fluid Temperature	
Continuous Duty	Fully Submerged	Continuous Operation	104° F 40° C
Intermittent Duty	6" Below Top of Motor	Intermittent Operation	140° F 60° C

Pumpmaster and Pumpmaster Plus - Hard Wired

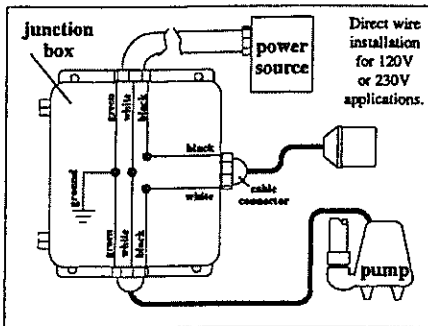


Fig. 1

Single-Action Float Switch
"Typical" Installation

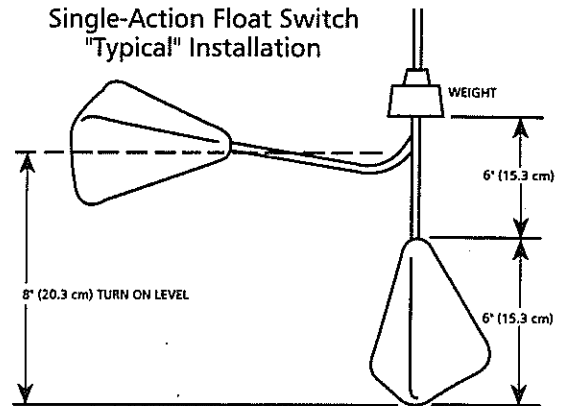


Fig. 4

Double Float - Hard Wired

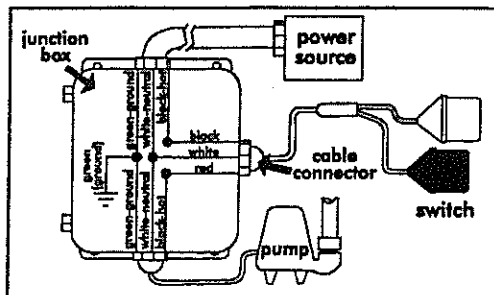


Fig. 2

Wide-Angle Float Switch

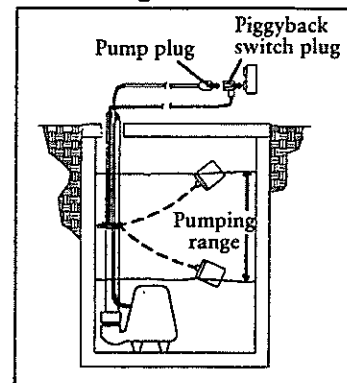


Fig. 5

Determining Pumping Range

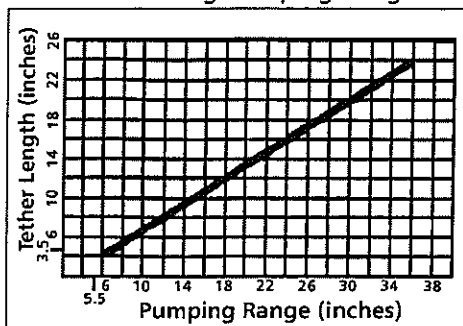


Fig. 3

Three Phase Connection Diagram

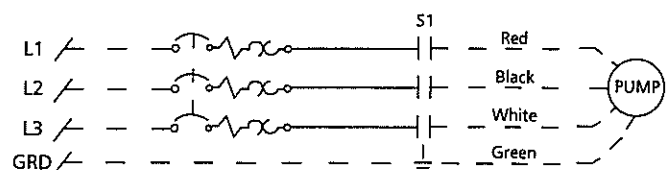
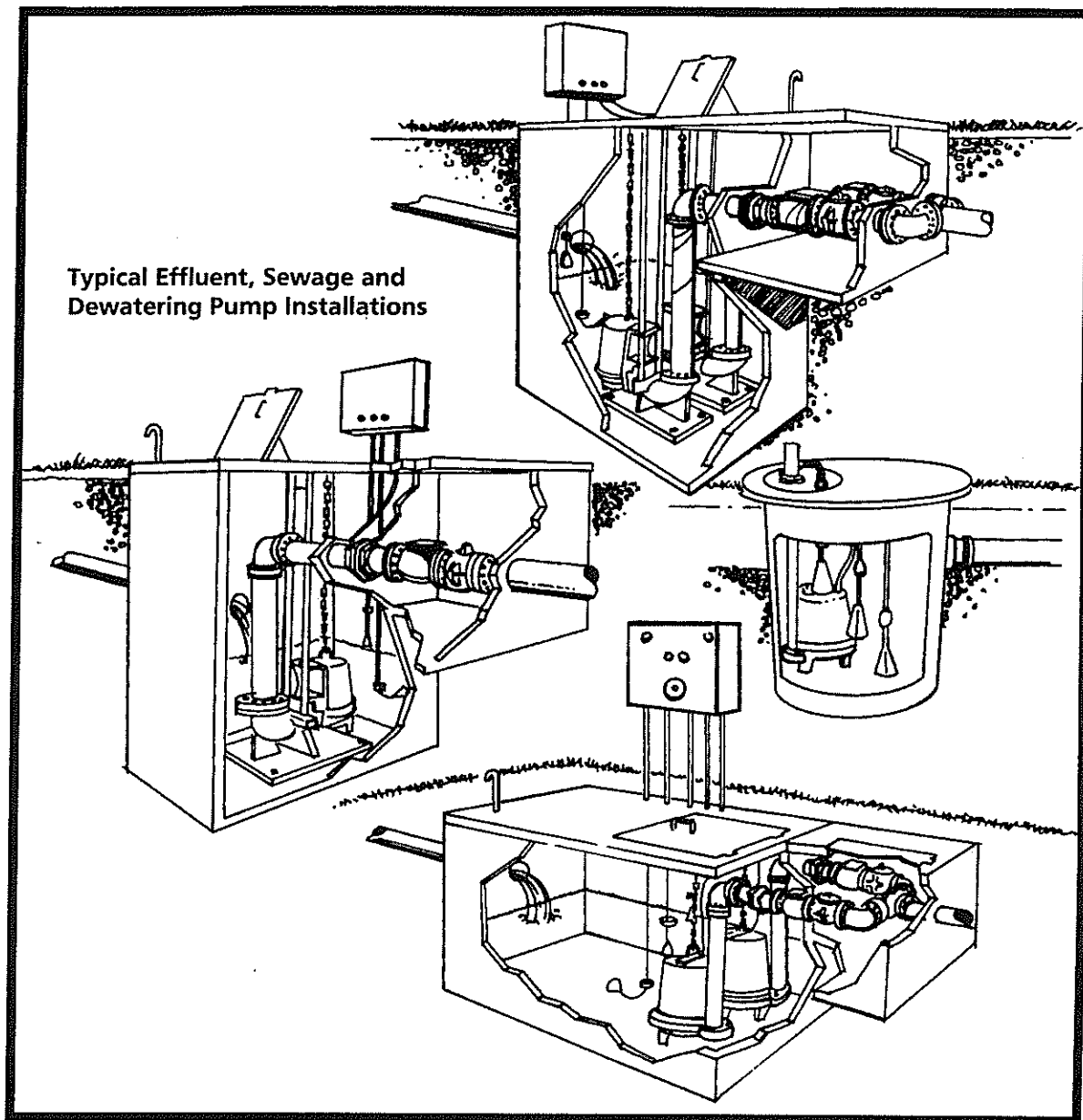


Fig. 6



TROUBLE SHOOTING

⚠ WARNING

Hazardous
voltage

**FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL
POWER BEFORE ATTEMPTING ANY SERVICE CAN CAUSE
SHOCK, BURNS OR DEATH.**

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
MOTOR NOT RUNNING NOTE: If circuit breaker “OPENS” repeatedly, DO NOT reset. Call qualified electrician. a) Manual operation b) Automatic operation NOTE: Check the pump in manual mode first to confirm operation. If pump operates, the automatic control or wiring is at fault. If pump does not operate, see above.	Motor thermal protector tripped.	Allow motor to cool. Insure minimum pump submergence. Clear debris from casing and impeller.
	Open circuit breaker or blown fuse.	Determine cause, call a qualified electrician.
	Pump impeller binding or jammed.	Check motor amp draw. If two or more times higher than listed on pump nameplate, impeller is locked, motor bearings or shaft is damaged. Clear debris from casing and impeller, consult with dealer.
	Power cable is damaged.	
	Inadequate electrical connection in control panel.	Resistance between power leads and ground should read infinity. If any reading is incorrect, call a qualified electrician.
	No neutral wire connected to control panel.	Inspect control panel wiring. Call a qualified electrician.
	Inadequate electrical connection in control panel.	
	Defective liquid level switch.	With switch disconnected, check continuity while activating liquid level switch. Replace switch, as required.
	Insufficient liquid level to activate controls.	Allow liquid level to rise 3" to 4" (76 mm - 101 mm) above turn-on level.
	Liquid level cords tangled.	Untangle cords and insure free operation.
PUMP WILL NOT TURN OFF	Liquid level cords tangled.	Untangle cords and insure free operation.
	Pump is air locked.	Shut off pump for approximately one minute, then restart. Repeat until air lock clears. If air locking persists in a system with a check valve, a 1/16" (4.8 mm) hole may be drilled in the discharge pipe approximately 2" (51 mm) above the discharge connection.
	Influent flow is matching pump's discharge capacity.	Larger pump may be required.
LITTLE OR NO LIQUID DELIVERED BY PUMP	Check valve installed backwards, plugged or stuck closed.	Check flow arrow on valve and check valve operation.
	Excessive system head.	Consult with dealer.
	Pump inlet plugged.	Inspect and clear as required.
	Improper voltage or wired incorrectly.	Check pump rotation, voltage and wiring. Consult with qualified electrician.
	Pump is air locked.	See recommended action, above.
	Impeller is worn or damaged.	Inspect impeller, replace as required.
PUMP CYCLES CONSTANTLY	Liquid level controls defective or improperly positioned.	Inspect, readjust or replace as required.
	Discharge check valve inoperative.	Inspect, repair or replace as required.
	Sewage containment area too small.	Consult with dealer.
	Liquid level controls defective or improperly positioned.	Inspect, readjust or replace as required.
	Influent excessive for this size pump.	Consult with dealer.

GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Pumps.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Pumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

- (a) Labor, transportation and related costs incurred by the dealer;
- (b) Reinstallation costs of repaired equipment;
- (c) Reinstallation costs of replacement equipment;
- (d) Consequential damages of any kind; and,
- (e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

- (1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.
- (2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
- (3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

Goulds Pumps and the ITT Engineered Blocks Symbol are registered trademarks and tradenames of ITT Industries.

Goulds Pumps



ITT Industries

Bombas para aguas residuales, para extracción de agua, para efluente y para alcantarillado

Manual de instalación y funcionamiento

Información del propietario

Número de modelo de la bomba: _____

Número de serie de la bomba: _____

Número de modelo del control: _____

Agente: _____

No. telefónico del agente: _____

Fecha de compra: _____ Instalación: _____

Lecturas actuales en el momento de la puesta en marcha:

1Ø	3Ø	L1-2	L2-3	L3-1
Amperios: _____	Amperios: _____	_____	_____	_____
Voltios: _____	Voltios: _____	_____	_____	_____

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Goulds Pumps



INSTRUCCIONES DE SEGURIDAD

PARA EVITAR LESIONES PERSONALES GRAVES O AÚN FATALES Y SERIOS DAÑOS MATERIALES, LEA Y SIGA TODAS LAS INSTRUCCIONES DE SEGURIDAD EN EL MANUAL Y EN LA BOMBA.

ESTE MANUAL HA SIDO CREADO COMO UNA GUÍA PARA LA INSTALACIÓN Y OPERACIÓN DE ESTA UNIDAD Y SE DEBE CONSERVAR JUNTO A LA BOMBA.



Éste es un **SÍMBOLO DE ALERTA DE SEGURIDAD**. Cuando vea este símbolo en la bomba o en el manual, busque una de las siguientes palabras de señal y esté alerta a la probabilidad de lesiones personales o daños materiales.

▲ PELIGRO

Advierte los peligros que **CAUSARÁN** graves lesiones personales, la muerte o daños materiales mayores.

▲ ADVERTENCIA

Advierte los peligros que **PUEDEN** causar graves lesiones personales, la muerte o daños materiales mayores.

▲ PRECAUCIÓN

Advierte los peligros que **PUEDEN** causar lesiones personales o daños materiales.

AVISO: INDICA INSTRUCCIONES ESPECIALES QUE SON MUY IMPORTANTES Y QUE SE DEBEN SEGUIR.

EXAMINE BIEN TODAS LAS INSTRUCCIONES Y ADVERTENCIAS ANTES DE REALIZAR CUALQUIER TRABAJO EN ESTA BOMBA.

MANTENGA TODAS LAS CALCOMANÍAS DE SEGURIDAD.

▲ ADVERTENCIA

Todo el trabajo eléctrico debe ser realizado por un técnico calificado. Siempre siga el Código Eléctrico de EE.UU. (NEC) o el Código Eléctrico Canadiense, además de todos los códigos locales, estatales y provinciales. Las preguntas acerca del código deben ser dirigidas al inspector eléctrico local. Si se hace caso omiso a los códigos eléctricos y normas de seguridad de OSHA, se pueden producir lesiones personales o daños al equipo. Si se hace caso omiso a las instrucciones de instalación del fabricante, se puede producir electrochoque, peligro de incendio, lesiones personales o aún la muerte, daños al equipo, rendimiento insatisfactorio y podría anularse la garantía del fabricante.

▲ ADVERTENCIA

Las unidades estándar no están diseñadas para usarse en albercas, masas abiertas de agua, líquidos peligrosos o donde existan gases inflamables. Estos fluidos y gases podrían estar presentes en áreas de contención. El tanque o pozo debe ser ventilado de acuerdo con los códigos locales.

En lugares con líquidos inflamables o donde pudiese haber gases inflamables sólo deben usarse bombas específicamente clasificadas para áreas de Clase 1, División 1. *Consulte los boletines de catálogos de bombas específicas o la placa de identificación de la bomba con respecto a las listas de agencias.*

▲ ADVERTENCIA

Desconecte y bloquee la corriente eléctrica antes de instalar o dar servicio a cualquier equipo eléctrico. Muchas bombas están equipadas con protección automática contra la sobrecarga térmica, la cual podría permitir que una bomba demasiado caliente re arranque inesperadamente.

▲ PRECAUCIÓN

Todos los paneles de control trifásicos (3Ø) para bombas sumergibles deben incluir protección contra sobrecarga de Clase 10, de disparo rápido.

VERIFICACIONES PRELIMINARES A LA INSTALACIÓN

Abra todas las cajas e inspeccione el equipo para determinar si se ocasionaron daños durante el envío. Notifique cualquier daño a su proveedor o a la compañía de transporte de inmediato.

Importante: Siempre verifique que las clasificaciones de corriente, tensión, fase y potencia en la placa de identificación de la bomba correspondan con las del panel de control y fuente de alimentación.

Muchas de nuestras bombas para alcantarillado están llenas con aceite. Si hay alguna señal de fuga de aceite o si la unidad estuvo almacenada durante largo tiempo, verifique el nivel de aceite en la cúpula del motor y la caja del sello, en caso de haberla.

Verifique el nivel de aceite de la cubierta del motor a través del tapón de la tubería en el extremo superior de la unidad. El aceite en la cámara del motor debe cubrir apenas el motor. ¡No llene en exceso, deje espacio para expansión!

Para verificar el nivel de aceite de la caja del sello, en caso que se use, coloque la unidad de lado con el tapón de llenado en la posición de las 12:00 horas. Retire el tapón. El aceite debe estar a menos de ½ pulg. (13 mm) del borde superior. Si el nivel está bajo, agregue aceite para turbinas ASTM 150. Reinstale el tapón.

Puede obtenerse aceite en latas de 5 galones de nuestros distribuidores. También puede obtener aceite a nivel local en talleres de reparación de motores. Las marcas típicas de aceite son: Shell Turbo 32, Sunoco Sunvis 932, Texaco Regal R&O 32, Exxon Nuto 32 y Mobil DTE Light.

Inspeccione la tuerca de alivio de tensión en los conjuntos de protección contra tirones de los cables de alimentación. Torsión de los cables de alimentación: 75 pulg.-lbs. para cables #16 y 80 pulg.-lbs. para todos los otros tipos de cable. La torsión de los cables de sensores de sello/calor, cuando se usen, debe ser de 75 pulg.-lbs.

La garantía no cubre daños causados por conectar bombas y controles a la fuente de energía incorrecta (fuente de tensión/fase).

Anote los números de modelos y números de serie de las bombas y del panel de control en la sección delantera de este manual de instrucciones para referencia futura. Entregue el manual al propietario o adjúntelo al panel de control una vez finalizada la instalación.

LEVANTAMIENTO DE LA BOMBA

▲ ADVERTENCIA



La tensión peligrosa puede causar electrochoque, quemaduras o la muerte.

NO LEVANTE NI TRANSPORTE NI CUELQUE LA BOMBA DE LOS CABLES ELÉCTRICOS. EL DAÑO A LOS CABLES ELÉCTRICOS PUEDE PRODUCIR ELECTROCHOQUE, QUEMADURAS O AÚN LA MUERTE.

Levante la bomba con una cadena o cable de tamaño adecuado conectado al perno de ojo de levantamiento. **NO** dañe los cables eléctricos o de los sensores al subir y bajar la unidad.

RIEL CORREDIZO O SISTEMA DE LEVANTAMIENTO OPCIONAL

En muchos estanques de efluente y aguas negras o estaciones de levantamiento se recomienda instalar la bomba en un sistema de riel corredizo o sobre un adaptador de levantamiento para facilitar la instalación y retiro para inspección y/o servicio. La mayoría de los códigos no permiten que el personal entre al pozo sumidero sin el equipo de protección y la capacitación correctos. Los rieles corredizos están diseñados para facilitar el retiro de la bomba sin necesidad de entrar al pozo o perturbar la tubería. El riel corredizo o el adaptador de levantamiento debe situar la bomba opuesta a la abertura para el líquido de entrada, evitando las áreas estancadas donde pudiesen asentarse sólidos. El estanque o fosa debe ser capaz de soportar el peso de la bomba y del riel de deslizamiento. El piso de la fosa debe ser plano.

AVISO: SIGA LAS INSTRUCCIONES INCLUIDAS CON EL CONJUNTO DEL RIEL CORREDIZO.

TUBERÍAS

La tubería de descarga no debe ser más pequeña que el diámetro de descarga de la bomba y debe mantenerse lo más corta posible, evitando los accesorios innecesarios para reducir al mínimo las pérdidas por fricción.

Instale una válvula de retención de tamaño adecuado que corresponda con la capacidad de manejo de sólidos de la bomba para evitar el contraflujo de fluido. El contraflujo puede hacer que la bomba "gire" en dirección inversa, produciendo un desgaste prematuro del sello y/o del cojinete. Si la bomba gira en sentido inverso al arrancar, el aumento de torsión puede dañar el motor y/o el eje del motor de la bomba y algunas bombas monofásicas hasta podrían funcionar en sentido inverso.

Instale una válvula de compuerta de tamaño adecuado **DESPUÉS** de la válvula de retención para facilitar el mantenimiento de la bomba, las tuberías y la válvula de retención.

Importante – antes de instalar la bomba. Perfore un orificio de alivio de $\frac{3}{16}$ pulg. (4.8 mm) en la tubería de descarga. Debe situarse dentro del pozo, a 2 pulg. (51 mm) sobre la descarga de la bomba, pero debajo de la válvula de retención. El orificio de alivio permite el escape de aire de la carcasa. Al permitir que entre líquido a la carcasa se asegura que la bomba pueda arrancar cuando el nivel de líquido aumente. A menos que se proporcione un orificio de alivio, una bomba de toma inferior podría "obstruirse con aire" y no bombear agua, a pesar de que el impulsor gire.

Todas las tuberías deben estar apoyadas correctamente, de modo que no se apliquen esfuerzos o cargas de las tuberías a la bomba.

La cubierta de acceso a la fosa debe ser de tamaño suficiente para permitir realizar el servicio de inspección, mantenimiento y levantamiento con grúa o montacargas.

CABLEADO Y CONEXIÓN A TIERRA

Aviso importante: Lea las instrucciones de seguridad antes de proseguir con el cableado.

 Use únicamente alambre trenzado de cobre para la bomba/motor y la conexión a tierra. El alambre de conexión a tierra debe ser al menos del mismo tamaño que los alambres de la fuente de alimentación. Los alambres deben codificarse con colores para facilitar el

mantenimiento y la identificación y resolución de problemas.

 Instale los cables y la conexión a tierra de acuerdo con el Código Eléctrico de EE.UU. (NEC) o el Código Eléctrico Canadiense, además de los códigos locales, estatales y provinciales.

 Instale un desconector de todos los circuitos donde el código lo requiera.

 Desconecte y bloquee la corriente eléctrica antes de instalar o dar servicio.

 La tensión y fase de la fuente de alimentación debe corresponder con todos los requerimientos del equipo. La tensión o fase incorrecta puede producir incendio, daño al motor o a los controles y anula la garantía.

 Todos los empalmes debe ser impermeables. Si utiliza juegos de empalme, siga las instrucciones del fabricante.

 **ADVERTENCIA** Seleccione una caja de conexiones NEMA del tipo correcto para la aplicación y ubicación. La caja de conexiones debe garantizar conexiones de cableado seguras y secas.

 **ADVERTENCIA** Selle todos los controles de los gases presentes que pudiesen dañar los componentes eléctricos.

 **ADVERTENCIA** **Tensión peligrosa**
LA FALLA DE CONECTAR A TIERRA PERMANENTEMENTE LA BOMBA, EL MOTOR Y LOS CONTROLES, ANTES DE CONECTAR LA CORRIENTE ELÉCTRICA, PUEDE CAUSAR ELECTROCHOQUE, QUEMADURAS O LA MUERTE.

SELECCIÓN Y CABLEADO DE LOS INTERRUPTORES Y PANELES DE CONTROL DE LA BOMBA

TIPOS DE INTERRUPTORES DE FLOTADOR

Hay dos tipos de diseños de interruptor de flotador: de acción simple y de ángulo amplio. Los interruptores de acción simple funcionan en un rango de 15°, de manera que pueden abrirse y cerrarse con rapidez. Los flotadores de ángulo amplio funcionan con un giro de 90° con el largo de la traba entre el cuerpo del flotador y el punto de pivote controlando al rango de encendido-apagado. El diseño determina cuántos flotadores se requieren con los diferentes sistemas o controles.

Los flotadores pueden estar normalmente abiertos (NO) para aplicaciones de reducción de nivel o para vaciar un tanque. Los interruptores normalmente cerrados (NC) se utilizan para aumentar el nivel o para llenar un tanque.

Un interruptor de control de acción simple sólo puede usarse con un panel de control, pero nunca directamente conectado a una bomba.

Los interruptores de ángulo ancho de reducción de nivel pueden usarse como interruptores directamente conectados a la bomba o como interruptores de control.

INSTALACIÓN DE LOS INTERRUPTORES DE FLOTADOR

No hay reglas absolutas acerca de dónde instalar los interruptores de flotador, varía de trabajo a trabajo.

Reglas sugeridas a seguir:

¡Todos los flotadores deben instalarse debajo de la tubería de entrada!

Flotador de apagado: Primera preferencia: instálelo de manera que el nivel del agua quede siempre sobre el extremo superior de la bomba (cúpula del motor). Segunda preferencia: instálelo de manera que el nivel del agua quede a no más de 6 pulg. por debajo del extremo superior de la bomba.

Flotador de encendido: instálelo de manera que el volumen de agua entre los flotadores de encendido y apagado permita bombas de 1½ HP y menores funcionar al menos 1 minuto. Las bombas de dos (2) HP y mayores deben funcionar al menos 2 minutos. La literatura sobre estanques establece los galones de almacenaje por pulgada de altura del estanque.

Flotador(es) de retardo/alarma: deben escalonarse sobre los flotadores de apagado y encendido. Trate de utilizar la mayoría del almacenaje disponible ofrecido por el estanque, ahorre espacio para la capacidad de almacenaje de reserva. *Consulte los diagramas y tablas en la Sección de Tablas de Interruptores de Flotador.*

DIAGRAMAS DE CABLEADO DEL PANEL

Nuestros paneles de control se envían con instrucciones y diagramas de cableado. Utilice dichas instrucciones en conjunto con este manual de instrucciones (IOM). La instalación eléctrica debe ser realizada por técnicos calificados únicamente. Cualquier problema o preguntas con respecto al control de otras marcas debe dirigirse a ese proveedor o al fabricante del control. Nuestro personal técnico no tiene diagramas esquemáticos técnicos o información de identificación y resolución de problemas de los controles de otras compañías.

ALARMAS

Recomendamos la instalación de una alarma en todas las bombas para aguas residuales. Muchos paneles de control estándar vienen equipados con circuitos de alarma. Si no se usa un panel de control, se ofrece una alarma por alto nivel de líquido independiente. La alarma alerta al propietario acerca de una situación de alto nivel de líquido en el sistema, de manera que pueda comunicarse con el personal de servicio apropiado para que investigue la situación.

BOMBAS MONOFÁSICAS

Las bombas monofásicas (1Ø) pueden operarse utilizando un interruptor de flotador en tándem o de conexión directa, un contactador o un panel de control simple o doble. *Ver las Figuras 1, 2 y 5.*

Todas las bombas de ⅓ y ½ HP, de 115 ó 230 voltios y algunas bombas de ¾ y de 1 HP están equipadas con cables de alimentación estilo enchufe. Pueden enchufarse a interruptores de flotador en tándem para instalaciones sencillas. Se permite quitar los enchufes para conectar directamente o conectar a un controlador simple o doble. El retiro del enchufe no anula la garantía ni viola las aprobaciones de las agencias. *Ver la figura 5.*



LAS UNIDADES CON ENCHUFE DEBEN CONECTARSE A UN TOMACORRIENTES TIPO TIERRA CONECTADO CORRECTAMENTE A TIERRA.

EN EL CASO DE UNIDADES SIN ENCHUFE, NO quite el cable ni el protector contra tirones. NO CONECTE EL TUBO-CONDUCTO A LA BOMBA.

Las bombas con cables de alimentación con conductores desnudos pueden conectarse directamente a un interruptor de flotador, cablearse a un contactador de 1 fase, a un controlador simple o doble. Siempre verifique que el interruptor de

flotador esté clasificado para el amperaje de funcionamiento máximo, amperaje de arranque máximo y la capacidad nominal de potencia de la bomba. Las bombas monofásicas para aguas residuales contienen sobrecargas de devanado de encendido, a menos que se especifique lo contrario en la placa de identificación de la bomba. *Ver las Figuras 1 y 2.*

BOMBAS TRIFÁSICAS:

Como mínimo, una bomba trifásica requiere un cortacircuitos/circuito con fusible trifásico, un arrancador magnético en la línea clasificado para la potencia de la bomba y sobrecargas Clase 10, de disparo rápido y compensación ambiental.

PANELES DE CONTROL MONOFÁSICOS Y TRIFÁSICOS:

Los paneles de control pueden ser simples (controlan 1 bomba) o dobles (controlan 2 bombas). Nuestros paneles Serie SES se ofrecen con muchas características estándar y pueden construirse con nuestras opciones más populares. También construimos paneles de acuerdo con las especificaciones del cliente, los cuales ofrecen muchas más opciones que los paneles SES. Los paneles de control contruidos de acuerdo con las especificaciones del cliente se ofrecen en muchas configuraciones diferentes. Las solicitudes de cotizaciones para paneles a la medida pueden enviarse a Servicio a los Clientes mediante nuestro distribuidor autorizado.

Nuestros paneles "SES" dobles presentan un diseño de tablero de circuito impreso de estado sólido con circuitos de alarmas de alto nivel estándar. Otras características estándar son: un contacto de alarma seco auxiliar para señalar una alarma remota y luces indicadoras de posición del interruptor de flotador. Nuestros paneles trifásicos tienen sobrecargas Clase 10 incorporadas y ajustables. Las sobrecargas ajustables en todos nuestros paneles trifásicos significa menos trabajo para el instalador y la eliminación de la necesidad de ordenar sobrecargas específicas. La mayoría de los paneles SES se mantienen en inventario para entrega inmediata.

En el caso de bombas equipadas con sensores de falla de sello y/o sensores de calor, se recomienda que use su panel de control con las opciones apropiadas. Los sensores de la bomba no funcionan sin un relé de falla de sello o una conexión terminal en el panel de control y un dispositivo de alarma tal como una campana, bocina o luz.

Circuito de falla de sello – Algunas bombas de sello doble están equipadas con un circuito de falla de sello que también se denomina circuito de detección de humedad. Este circuito debe estar conectado a un panel de control con un relé de falla de sello opcional. El panel debe ordenarse especialmente con el relé de falla de sello y la alarma. También hay paneles de falla de sello independientes como los A4-3 o A4-A disponibles como artículos estándar. Las bombas pueden identificarse por un cable de control adicional que sea de la tapa del motor. El cable contiene dos alambres, un alambre negro que se conecta al "terminal" del panel que va a la "sonda", y un alambre blanco que se conecta al "terminal" del panel que va a la tierra del relé. No los conecte al tornillo de tierra del panel. *Siga las instrucciones de cableado incluidas con el panel.*

Sensor de calor y circuito de falla de sello – Algunas bombas están equipadas con termostatos de falla de sello y de alta temperatura, de devanado de encendido, normalmente cerrados (sensores de calor). Las bombas tienen un cable de control con cuatro (4) conductores: negro (sonda) y verde (tierra del relé) para el circuito de falla del sello y rojo y blanco para el circuito de alta temperatura. Conecte el circuito de alta temperatura (sensor de calor) a la regleta de terminales del panel, tal como se indica en el dibujo del panel, con los

alambres rojo y blanco. El circuito del panel de alta temperatura también es un artículo opcional que debe ordenar específicamente cuando ordene su panel de control. El circuito de alta temperatura es diferente de las sobrecargas Clase 10 que son siempre requeridas en las bombas trifásicas. *Siga las instrucciones de cableado incluidas con el panel.*

INSTALACIÓN

Conecte la(s) bomba(s) a los adaptadores de riel corredizo o a la tubería de descarga. Las bases del riel corredizo deben anclarse al piso del pozo.

Todas las conexiones deben realizarse de acuerdo con los diagramas de cableado del panel de control, el código eléctrico de EE.UU., el código canadiense y los códigos estatales, provinciales y/o locales. Éste es un buen momento para verificar la rotación apropiada de los motores/impulsores.



NO COLOQUE LAS MANOS EN LA SUCCIÓN DE LA BOMBA MIENTRAS VERIFICA LA ROTACIÓN DEL MOTOR. EL HACERLO PRODUCIRÁ GRAVES LESIONES PERSONALES.

Siempre verifique la rotación correcta. La rotación correcta se indica en la carcasa de la bomba. Los motores trifásicos son reversibles. Se permite arrancar brevemente o en marcha lenta el motor durante unos segundos para verificar la rotación del impulsor. Es más fácil verificar la rotación antes de instalar la bomba. Intercambie dos de los conductores de potencia cualquiera para invertir la rotación.

Baje la(s) bomba(s) al pozo sumidero.

Inspeccione para verificar que los flotadores funcionen libremente y que no hagan contacto con la tubería.

OPERACIÓN

Una vez que se hayan hecho y verificado las conexiones de las tuberías, se pueden poner en funcionamiento las bombas.

Operación de interruptor en tándem – Enchufe el interruptor en tándem a un tomacorrientes dedicado conectado a tierra y luego enchufe la bomba al interruptor. Pruebe la bomba llenando el pozo hasta que la bomba se active. Si las bombas funcionan pero no bombean, probablemente estén obstruidas con aire; perfore los orificios de alivio de acuerdo con las instrucciones en la Sección de Tuberías.

Verifique el intervalo de operación para asegurar un tiempo de funcionamiento mínimo de un minuto y que la bomba se apague en la posición correcta.

Operación del panel de control – Llene el pozo con agua limpia.

Utilice los interruptores H-O-A (manual – apagado – automático) de la bomba en la posición manual para probar las bombas. Si funcionan bien en la posición manual, pruebe la posición automática. Si las bombas funcionan pero no bombean, probablemente estén obstruidas con aire; perfore los orificios de alivio de acuerdo con las instrucciones en la Sección de Tuberías.

Coloque el (los) interruptor(es) del panel de control en la posición automática y pruebe minuciosamente el funcionamiento de los flotadores de ENCENDIDO, APAGADO y alarma llenando el pozo con agua limpia.

Importante: Si no se proporciona un neutro desde la fuente de alimentación a un panel de control monofásico de 230 voltios, el circuito de control del panel no operará. Es necesario el neutro para completar el circuito de control de 115 voltios.

Verifique la tensión y la corriente y anote los datos en la sección delantera de este manual para referencia futura. Compare las lecturas de amperaje con el amperaje máximo indicado en la placa de identificación de la bomba. Si es más alto que el amperaje de la placa de identificación, investigue la causa. Si la bomba se hace funcionar fuera de la curva; es decir, con demasiado poca carga o con tensión alta o baja, aumentará el amperaje. El motor funcionará correctamente con tensión no más de un 10% por encima o por debajo de las clasificaciones en la placa de identificación de la bomba. El rendimiento dentro de este rango no será necesariamente igual al rendimiento publicado a la frecuencia y tensión exactas indicadas en la placa de identificación. Corrija el problema antes de continuar. También es posible que la causa sea un desbalance trifásico. *Consulte la sección de Desbalance de potencia trifásica y siga las instrucciones.*

Reposicione el circuito de alarma, coloque el (los) interruptor(es) de la bomba en posición automática y el interruptor de control en la posición de encendido. Ahora la unidad está lista para la operación automática.

Explique la operación de las bombas, controles y alarmas al usuario final. Entregue la documentación al propietario o déjela en un lugar seco y seguro en el panel de control.

TABLA DEL PANEL E INTERRUPTORES DE FLOTADOR

El propósito de esta tabla es mostrar las cantidades de interruptores requeridas y la función de cada interruptor en un sistema de aguas residuales típicas. Las cantidades requeridas varían dependiendo del tipo de interruptor: de acción simple o de ángulo amplio. Las cantidades de interruptores varían también de acuerdo con el tipo de panel: simple con y sin alarmas y doble con alarmas.

Paneles dobles utilizando interruptores de acción simple:

Cableado del panel de tres flotadores

SW1	Fondo	Bombas apagadas
SW2	Medio	Primera bomba del medio encendida
SW3	Extremo superior	Segunda bomba y alarma encendidas

Cableado del panel de cuatro flotadores ②

SW1	Fondo	Bombas apagadas
SW2	Segundo	Primera bomba encendida
SW3	Tercero	Segunda bomba encendida
SW4	Extremo superior	Alarma encendida

Paneles dobles utilizando interruptores de ángulo amplio:

Cableado del panel de tres flotadores

SW1	Fondo	Primera bomba encendida/ ambas apagadas
SW2	Extremo superior	Segunda bomba y alarma encendidas

Cableado del panel de cuatro flotadores

SW1	Fondo	Primera bomba encendida/ ambas apagadas
SW2	Medio	Segunda bomba encendida
SW3	Extremo superior	Alarma encendida

Paneles simples utilizando interruptores de acción simple:

Panel simple con alarma ①

SW1	Fondo	Bomba apagada
SW2	Medio	Bomba encendida
SW3	Extremo superior	Alarma encendida/apagada

Panel simple sin alarma

SW1	Fondo	Bomba apagada
SW2	Extremo superior	Bomba encendida

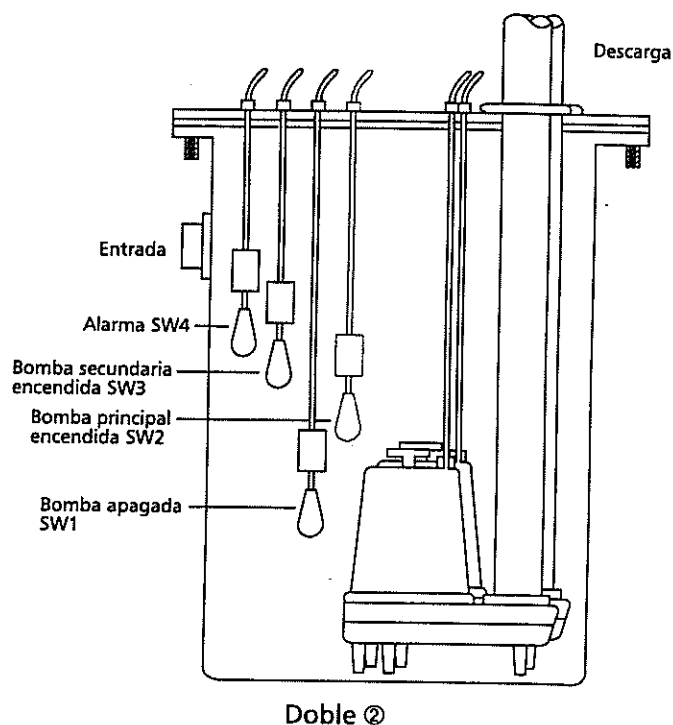
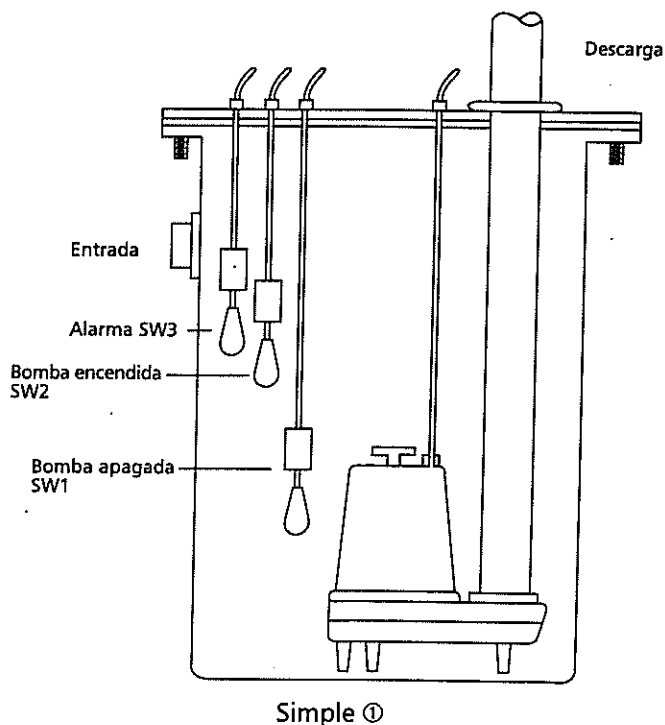
Paneles simples utilizando interruptores de ángulo amplio:

Panel simple con alarma

SW1	Fondo	Bomba encendida/apagada
SW2	Extremo superior	Alarma encendida/apagada

Panel simple sin alarma

SW1		Bomba encendida/apagada
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DESBALANCE DE POTENCIA TRIFÁSICA

Se recomienda un suministro trifásico completo incluyendo tres transformadores individuales o un transformador trifásico. Se pueden usar conexiones en estrella o en triángulo "abierto" empleando sólo dos transformadores, pero hay más posibilidad de que produzcan un rendimiento inadecuado, disparo por sobrecarga o falla prematura del motor debido al desbalance de corriente.

Mida la corriente en cada uno de los tres conductores del motor y calcule el desbalance de corriente en la forma que se explica abajo.

Si el desbalance de corriente es del 2% o menos, deje los conductores tal como están conectados. Si el desbalance de corriente es de más del 2%, hay que verificar las lecturas de corriente en cada derivación empleando cada una de las tres conexiones posibles. Enrolle los conductores del motor en el arrancador en la misma dirección para evitar una inversión del motor.

Para calcular el porcentaje de desbalance de corriente:

A. Suma los tres valores de corriente de línea.

B. Divida la suma por tres, con lo cual se obtiene la corriente promedio.

C. Seleccione el valor de corriente más alejado de la corriente promedio (ya sea alto o bajo).

D. Determine la diferencia entre este valor de corriente (más alejado del promedio) y el promedio.

E. Divida la diferencia por el promedio. Multiplique el resultado por 100 para determinar el porcentaje de desbalance.

El desbalance de corriente no debe exceder el 5% con la carga del factor de servicio o el 10% con la carga de entrada nominal. Si el desbalance no puede corregirse enrollando los conductores, la causa del desbalance debe determinarse y corregirse. Si, en las tres conexiones posibles, la derivación más alejada del promedio está en el mismo conductor de potencia, entonces la mayoría del desbalance proviene de la fuente de potencia.

Contacte a la compañía de electricidad local para solucionar el desbalance.

	Conexión 1			Conexión 2			Conexión 3		
Terminales del arrancador	L1	L2	L3	L1	L2	L3	L1	L2	L3
	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$
Conductores del motor	R	B	W	W	R	B	B	W	R
	T3	T1	T2	T2	T3	T1	T1	T2	T3

Ejemplo:

T3-R = 51 amps
T1-B = 46 amps
T2-W = 53 amps
Total = 150 amps
÷ 3 = 50 amps
— 46 = 4 amps
4 ÷ 50 = .08 or 8%

T2-W = 50 amps
T3-R = 48 amps
T1-B = 52 amps
Total = 150 amps
÷ 3 = 50 amps
— 48 = 2 amps
2 ÷ 50 = .04 or 4%

T1-B = 50 amps
T2-W = 49 amps
T3-R = 51 amps
Total = 150 amps
÷ 3 = 50 amps
— 49 = 1 amps
1 ÷ 50 = .02 or 2%

LECTURAS DE RESISTENCIA DEL AISLAMIENTO

Valores normales en ohmios y megaohmios entre todos los conductores y tierra

Condición del motor y los conductores	Valor en ohmios	Valor en Megaohmios
Un motor nuevo (sin cable de bajada).	20,000,000 (o más)	20 (o más)
Un motor usado que puede reinstalarse en el pozo.	10,000,000 (o más)	10 (o más)
Motor en el pozo. Las lecturas son para el cable de bajada más el motor.		
Motor nuevo.	2,000,000 (o más)	2 (o más)
El motor está en buenas condiciones.	500,000 - 2,000,000	.5 - 2
Daño de aislamiento, localícelo y repárelo.	Menos de 500,000	Menos de 0.5

La resistencia del aislamiento varía muy poco con la clasificación. Los motores de todas las clasificaciones de potencia, tensión y fase tienen valores similares de resistencia de aislamiento.

Los valores de resistencia de aislamiento anteriores están basados en lecturas obtenidas con un megaohmiómetro con salida de 500 V CC. Las lecturas pueden variar utilizando un ohmiómetro de tensión más baja; consulte con la fábrica si tiene dudas acerca de las lecturas.

Esta tabla se reimprimió como cortesía de Franklin Electric.

Los datos de ingeniería para modelos específicos pueden encontrarse en su catálogo y en nuestro sitio Web (dirección en la cubierta).

Los diagramas de cableado del panel de control se envían con los paneles de control. Utilice los dibujos del panel de control junto con este manual de instrucciones para completar el cableado.

CONSTRUCCIÓN DE LA BOMBA

Sumersión mínima		Temperatura máxima del fluido	
Servicio continuo	Sumergida totalmente	Operación continua	104° F 40° C
Servicio intermitente	6 pulg. por debajo del extremo superior del motor	Operación intermitente	140° F 60° C

Pumpmaster y Pumpmaster Plus - Cableado directo

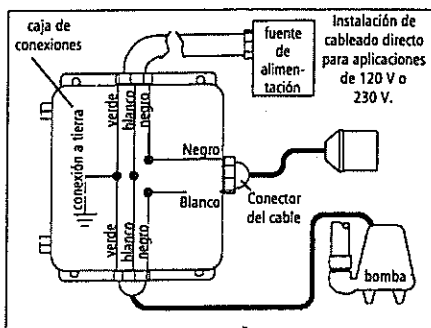


Fig. 1

Interrupor de flotador de acción simple Instalación "típica"

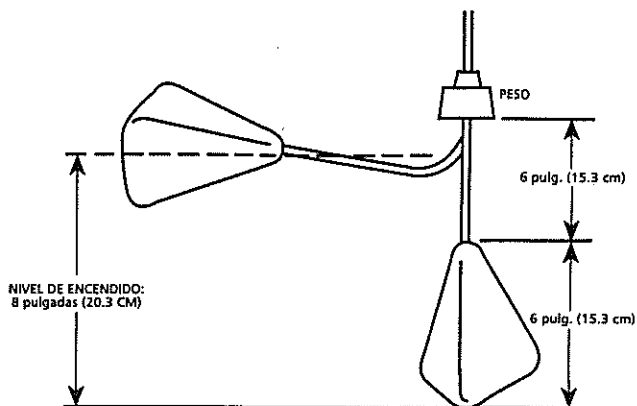


Fig. 4

Flotador doble - de cableado directo

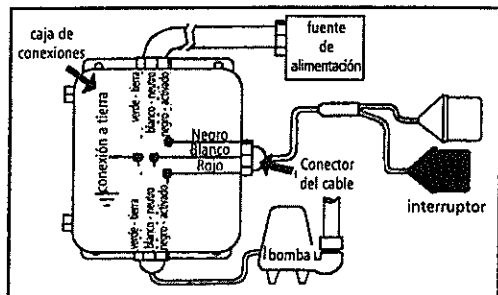


Fig. 2

Interrupor de flotador de ángulo amplio

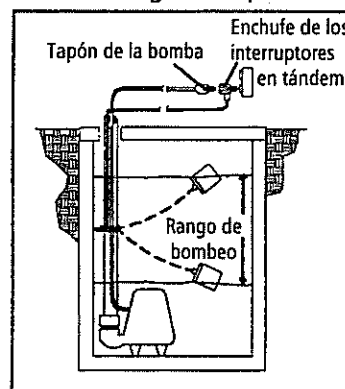


Fig. 5

Determinación del rango de bombeo

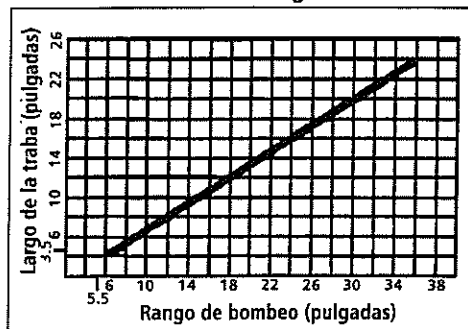


Fig. 3

Diagrama de conexión trifásica

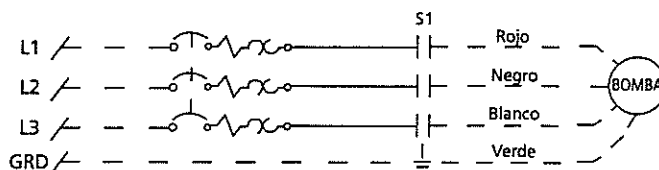


Fig. 6

IDENTIFICACIÓN Y RESOLUCIÓN DE PROBLEMAS

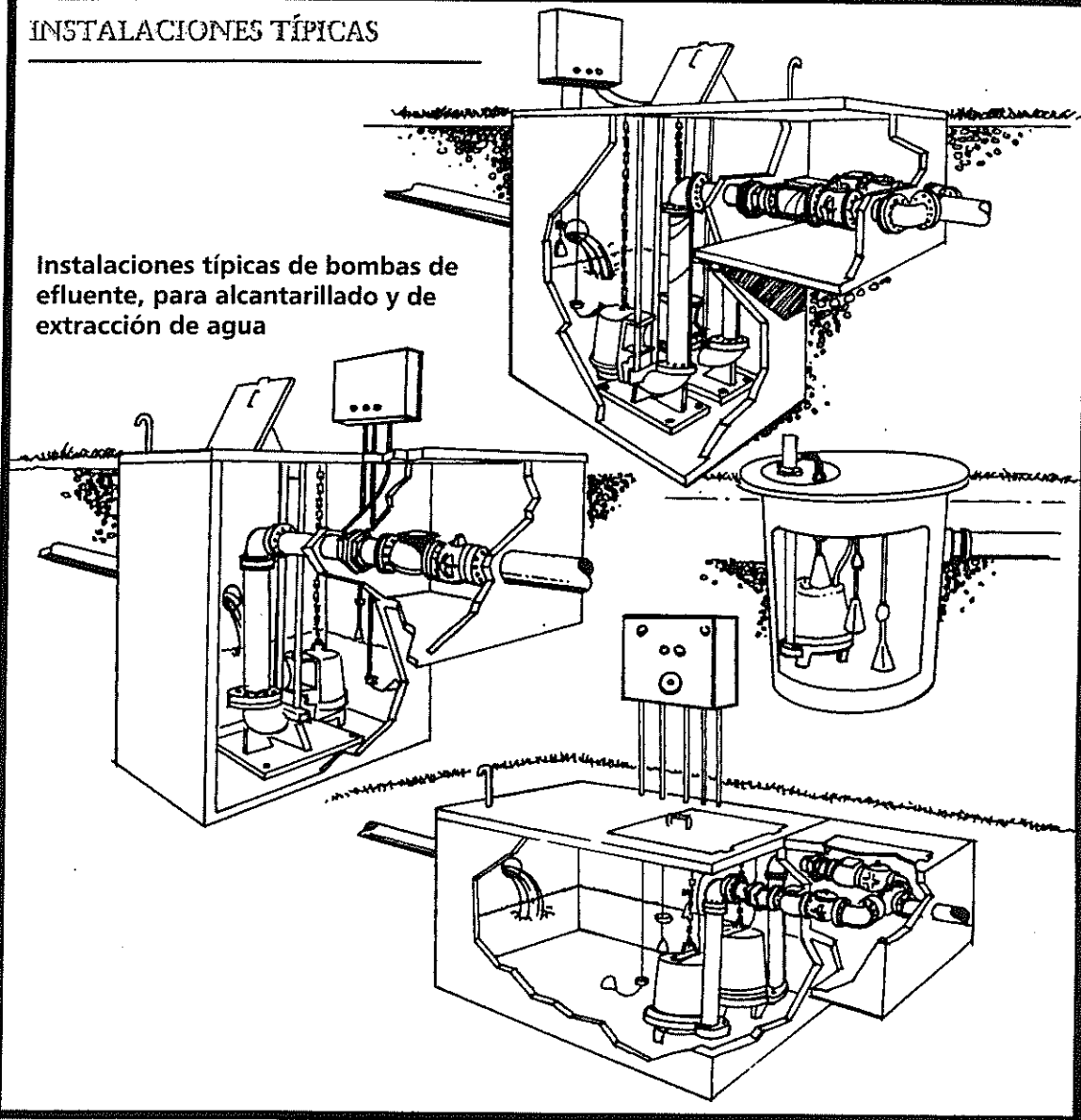


LA FALLA DE DESCONECTAR Y BLOQUEAR LA CORRIENTE ELÉCTRICA ANTES DE INTENTAR CUALQUIER SERVICIO, PUEDE CAUSAR ELECTROCHOQUE, QUEMADURAS O LA MUERTE.

SÍNTOMA	CAUSA PROBABLE	ACCIÓN RECOMENDADA
EL MOTOR NO ESTÁ FUNCIONANDO	Se disparó el protector térmico del motor	Deje que se enfríe el motor. Asegure la sumersión mínima de la bomba. Limpie los residuos de la carcasa y el impulsor.
NOTA: Si el cortacircuitos se "ABRE" repetidamente, NO lo reposicione. Llame a un electricista calificado.	Cortacircuitos abierto o fusible quemado.	Determine la causa, llame a un electricista calificado.
a) Operación manual	Impulsor de la bomba rozando o atascado.	Determine el consumo de corriente del motor. Si es dos veces más alto que el indicado en la placa de identificación de la bomba, el impulsor está trabado, los cojinetes del motor o el eje está dañado. Limpie los residuos de la carcasa y el impulsor, consulte con el agente.
	El cable de alimentación está dañado.	La resistencia entre los conductores de alimentación y tierra debe indicar infinito. Si alguna lectura es incorrecta, llame a un electricista calificado.
	Conexiones eléctricas inadecuadas en el panel de control.	Inspeccione las conexiones del panel de control. Llame a un electricista calificado.
b) Operación automática	No hay alambre neutro conectado al panel de control.	Con el interruptor desconectado, verifique la continuidad mientras activa el interruptor de nivel de líquido. Reemplace el interruptor, según se requiera.
	Conexiones eléctricas inadecuadas en el panel de control.	Deje que el nivel de líquido aumente de 3 a 4 pulgadas (76 mm -101 mm) sobre el nivel de activación.
NOTA: Inspeccione la bomba en modo manual primero para confirmar el funcionamiento. Si la bomba funciona, el control automático o el cableado está defectuoso. Si la bomba no funciona, vea arriba.	Interruptor de nivel de líquido defectuoso para activar los controles.	Desenrede los cordones y asegure el funcionamiento libre.
	Nivel de líquido insuficiente para activar los controles.	
	Cordones de los sensores de nivel de líquido enredados.	
LA BOMBA NO SE APAGA	Cordones de los sensores de nivel de líquido enredados.	Desenrede los cordones y asegure el funcionamiento libre.
	La bomba está atascada con aire.	Apague la bomba durante aproximadamente un minuto y arránquela nuevamente. Repita hasta que se despeje la obstrucción de aire. Si la obstrucción de aire persiste en un sistema con tubo con válvula de retención, puede perforarse un agujero de 3/16 pulg. (4.8 mm) en el tubo de descarga aproximadamente a 2 pulgadas (51 mm) de la conexión de descarga.
	El flujo de líquido entrante coincide con la capacidad de descarga de la bomba.	Podría requerirse una bomba más grande.
LA BOMBA ENTREGA POCO O NADA DE LÍQUIDO	La válvula de retención está instalada invertida, está obstruida o atascada en posición cerrada.	Verifique la flecha de flujo en la válvula y verifique el funcionamiento de ésta.
	Carga excesiva del sistema.	Consulte con el agente.
	Entrada a la bomba obstruida.	Inspeccione y despeje, según sea requerido.
	Tensión incorrecta, o conectada incorrectamente.	Verifique la rotación, la tensión y las conexiones de la bomba. Consulte con un electricista calificado.
	La bomba está atascada con aire.	Consulte la acción recomendada, arriba.
	El impulsor está gastado o dañado.	Inspeccione el impulsor, reemplácelo según sea necesario.
	Los controles de nivel de líquido están defectuosos o instalados incorrectamente.	Inspeccione, reajuste o reemplace, según sea requerido.
LA BOMBA CICLA CONSTANTEMENTE	La válvula de retención de la descarga no funciona.	Inspeccione, repare o reemplace, según sea requerido.
	El área de contención de aguas negras es demasiado pequeña.	Consulte con el agente.
	Los controles de nivel de líquido están defectuosos o instalados incorrectamente.	Inspeccione, reajuste o reemplace, según sea requerido.
	Cantidad excesiva de líquido entrante para una bomba de este tamaño.	Consulte con el agente.

INSTALACIONES TÍPICAS

Instalaciones típicas de bombas de efluente, para alcantarillado y de extracción de agua



GARANTÍA LIMITADA DE GOULDS PUMPS

Esta garantía es aplicable a todas las bombas para sistemas de agua fabricadas por Goulds Pumps. Toda parte o partes que resultaren defectuosas dentro del período de garantía serán reemplazadas, sin cargo para el comerciante, durante dicho período de garantía. Tal período de garantía se extiende por doce (12) meses a partir de la fecha de instalación, o dieciocho (18) meses a partir de la fecha de fabricación, cualquiera se cumpla primero.

Todo comerciante que considere que existe lugar a un reclamo de garantía deberá ponerse en contacto con el distribuidor autorizado de Goulds Pumps del cual adquiriera la bomba y ofrecer información detallada con respecto al reclamo. El distribuidor está autorizado a liquidar todos los reclamos por garantía a través del Departamento de Servicios a Clientes de Goulds Pumps.

La presente garantía excluye:

- (a) La mano de obra, el transporte y los costos relacionados en los que incurra el comerciante;
- (b) los costos de reinstalación del equipo reparado;
- (c) los costos de reinstalación del equipo reemplazado;
- (d) daños emergentes de cualquier naturaleza; y
- (e) el reembolso de cualquier pérdida causada por la interrupción del servicio

A los fines de esta garantía, los términos "Distribuidor", "Comerciante" y "Cliente" se definen como sigue:

- (1) "Distribuidor" es aquel individuo, sociedad, corporación, asociación u otra persona jurídica que opera en relación legal entre Goulds Pumps y el comerciante para la compra, consignación o contratos de venta de las bombas en cuestión.
- (2) "Comerciante" es todo individuo, sociedad, corporación, asociación u otra persona jurídica que en el marco de una relación legal realiza negocios de venta o alquiler-venta (leasing) de bombas a clientes.
- (3) "Cliente" es toda entidad que compra o que adquiere bajo la modalidad de leasing las bombas en cuestión de un comerciante. El término "cliente" puede significar un individuo, sociedad, corporación, sociedad de responsabilidad limitada, asociación o cualquier otra persona jurídica con actividades en cualquier tipo de negocios.

LA PRESENTE GARANTÍA SE EXTIENDE AL COMERCIANTE ÚNICAMENTE.

Pompes à eaux usées

Assèchement, effluents et eaux d'égout

Manuel d'installation et d'utilisation

Informations pour le propriétaire

Numéro de modèle de la pompe : _____

Numéro de série de la pompe : _____

N° de modèle du tableau de commande : _____

Détaillant : _____

N° de téléphone du détaillant : _____

Date d'achat : _____ d'installation : _____

Courant mesuré au démarrage :

1 Ø	3 Ø	L1-2	L2-3	L3-1
A: _____	A: _____	_____	_____	_____
V: _____	V: _____	_____	_____	_____

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Goulds Pumps



ITT Industries

CONSIGNES DE SÉCURITÉ

AFIN DE PRÉVENIR LES BLESSURES GRAVES OU MORTELLES ET LES DOMMAGES MATÉRIELS IMPORTANTS, LIRE ET SUIVRE TOUTES LES CONSIGNES DE SÉCURITÉ FIGURANT DANS LE MANUEL ET SUR LA POMPE.

LE PRÉSENT MANUEL A POUR BUT DE FACILITER L'INSTALLATION ET L'UTILISATION DE LA POMPE ET DOIT ÊTRE CONSERVÉ PRÈS DE CELLE-CI.



Le symbole ci-contre est un **SYMBOLE DE SÉCURITÉ** employé pour signaler les mots-indicateurs dont on trouvera la description ci-dessous. Sa présence sert à attirer l'attention afin d'éviter les blessures et les dommages matériels.



DANGER Préviens des risques qui **VONT** causer des blessures graves, la mort ou des dommages matériels importants.



AVERTISSEMENT Préviens des risques qui **PEUVENT** causer des blessures graves, la mort ou des dommages matériels importants.



ATTENTION Préviens des risques qui **PEUVENT** causer des blessures ou des dommages matériels.

AVIS : SERT À ÉNONCER LES DIRECTIVES SPÉCIALES DE GRANDE IMPORTANCE QUE L'ON DOIT SUIVRE.

LIRE SOIGNEUSEMENT CHAQUE DIRECTIVE ET AVERTISSEMENT AVANT D'EFFECTUER TOUT TRAVAIL SUR LA POMPE.

N'ENLEVER AUCUNE DÉCALCOMANIE DE SÉCURITÉ.



AVERTISSEMENT L'installation électrique doit être entièrement effectuée par un technicien qualifié. Il faut toujours suivre les prescriptions du code provincial ou national de l'électricité et les règlements locaux. Adresser toute question relative au code à un inspecteur en électricité. Le non-respect du code et des politiques de santé et de sécurité au travail peut entraîner des blessures et des dommages matériels. L'inobservation des directives d'installation fournies par le fabricant peut se traduire par un choc électrique, un incendie, des blessures ou la mort, ainsi que par des dommages matériels, des performances non satisfaisantes et l'annulation de la garantie du fabricant.



AVERTISSEMENT Les pompes standard ne sont pas conçues pour les piscines, l'eau libre, les liquides dangereux ni les endroits pouvant contenir des gaz inflammables. Ces fluides peuvent être présents dans les installations de confinement (puits collecteurs, réservoirs ou fosses humides). On doit aérer ces installations suivant les codes locaux.

Seules les pompes de classe 1, division 1, peuvent servir dans les liquides dangereux et les endroits pouvant contenir des gaz inflammables. *Le nom des organismes de normalisation pertinents figure sur la plaque signalétique de la pompe ou dans les feuillets du catalogue décrivant les pompes en question.*



AVERTISSEMENT Verrouiller la source de courant en position ouverte avant de procéder à l'installation ou

à l'entretien de tout dispositif électrique. Le protecteur thermique de certains moteurs de pompe coupe le courant lorsqu'il y a surcharge thermique et le rétablit automatiquement, redémarrant ainsi la pompe inopinément.



ATTENTION Chaque tableau de commande triphasé pour pompe submersible doit assurer une protection rapide de classe 10 contre la surcharge.

VÉRIFICATIONS AVANT INSTALLATION

Ouvrir tous les cartons et vérifier si le matériel est endommagé. Signaler immédiatement tout dommage au fournisseur ou au transporteur.

Important : on doit toujours vérifier si les valeurs nominales inscrites sur la plaque signalétique (intensité, tension, puissance et nombre de phases) conviennent au tableau de commande et à la source de courant.

Le compartiment moteur d'un bon nombre de nos pompes à eaux d'égout est rempli d'huile isolante. S'il y a des traces d'huile sur la pompe ou si cette dernière a été entreposée longtemps, vérifier le niveau d'huile du compartiment et, si la pompe en est dotée, du logement de garniture.

Enlever le bouchon de l'orifice de remplissage du compartiment moteur (sur le dessus de celui-ci), puis vérifier le niveau d'huile par l'orifice. L'huile devrait seulement recouvrir le moteur. Ne pas trop en mettre pour que l'huile puisse se dilater !

Pour vérifier le niveau d'huile du logement de garniture, mettre la pompe sur le côté, le bouchon de remplissage en haut, puis enlever le bouchon. Le niveau de l'huile devrait être à tout au plus 13 mm (½ po) du haut. Au besoin, utiliser de l'huile pour turbines ASTM 150, puis remettre le bouchon.

On peut se procurer de l'huile isolante en contenants de 5 gallons US chez nos distributeurs. On peut aussi en acheter chez un réparateur de moteurs électriques. Les marques d'huiles types sont : Shell Turbo 32, Sunoco Sunvis 932, Texaco Regal R&O 32, Exxon Nuto 32 et Mobil DTE Light.

Vérifier si l'écrou presse-garniture du serre-câble d'alimentation est suffisamment serré. Le couple de serrage est de 75 lbf-po pour les câbles de calibre 16 et de 80 lbf-po pour tout autre câble. Il est cependant de 75 lbf-po pour les câbles de capteur de chaleur ou d'humidité.

La garantie ne couvre pas les dommages dus au branchement de la pompe et du tableau de commande à une source de courant dont la tension ou le nombre de phases sont inappropriés.

Inscrire à titre documentaire les numéros de modèle et de série de la pompe ainsi que le numéro de modèle du tableau de commande dans les Informations pour le propriétaire. Une fois l'installation achevée, remettre le manuel au propriétaire ou l'attacher au tableau de commande.

LEVAGE DE LA POMPE



NE PAS LEVER, TRANSPORTER NI SUSPENDRE LA POMPE PAR LE CÂBLE D'ALIMENTATION : L'ENDOMMAGEMENT DU CÂBLE POURRAIT CAUSER UN CHOC ÉLECTRIQUE, DES BRÛLURES OU LA MORT.

Lever la pompe par son boulon à œil ou sa poignée avec un filin ou une chaîne de grosseur appropriée. **NE PAS** endommager le câble d'alimentation ni celui des capteurs durant la manutention de la pompe.

SYSTÈME DE LEVAGE OPTIONNEL À RAIL DE GUIDAGE OU À ADAPTATEUR COULISSANT

Dans le cas de bon nombre de cuves à effluents et de postes de relèvement d'eaux d'égout, il est conseillé de monter la pompe sur un rail de guidage ou avec un adaptateur coulissant pour pouvoir descendre, retirer, inspecter et entretenir celle-ci plus facilement. La plupart des codes n'autorisent pas le personnel à entrer dans une fosse humide sans la formation ni l'équipement protecteur appropriés. Le rail et l'adaptateur sont conçus pour faciliter la mise en place et la sortie de la pompe, et ce, sans disjoindre la tuyauterie. Le rail et l'adaptateur devraient être placés de façon à ce que la pompe soit face à l'orifice d'arrivée de l'influent pour empêcher la formation de zones de stagnation et, ainsi, de dépôts. Le fond du puits collecteur ou de la cuve doit être plat et suffisamment résistant pour supporter le poids de la pompe et du rail de guidage.

AVIS : SUIVRE LES DIRECTIVES FOURNIES AVEC LE RAIL DE GUIDAGE.

TUYAUTERIE

Afin de réduire les pertes de charge (par frottement) au minimum, la tuyauterie de refoulement devrait être aussi courte que possible et dépourvue d'accessoires et de raccords superflus. Son diamètre devrait être au moins égal à celui de l'orifice de refoulement de la pompe.

Prévenir le retour du liquide : poser sur le tuyau de refoulement un clapet de non-retour de calibre convenant à la grosseur des solides que la pompe peut laisser passer. Le retour du liquide peut faire tourner la pompe en sens inverse, provoquant ainsi l'usure prématurée des garnitures mécaniques et des roulements. S'il y a « rotation en sens inverse » au moment du démarrage, le couple accru produit peut abîmer le moteur ou l'arbre de pompe, ou les deux, et même forcer certaines pompes monophasées à continuer à tourner en sens inverse.

Poser **EN AVANT** (après) du clapet de non-retour un robinet-vanne de calibre approprié pour permettre l'entretien de la pompe, de la tuyauterie et du clapet.

Important : avant d'installer la pompe et afin de prévenir la formation de poches d'air dans celle-ci, percer un trou-purgeur d'air de 4,8 mm ($\frac{3}{16}$ po) dans le tuyau de refoulement, à environ 51 mm (2 po) au-dessus de l'orifice de refoulement de la pompe, mais avant le clapet de non-retour et à l'intérieur de la fosse humide. On permettra ainsi au liquide d'entrer dans la pompe par gravité, surtout si l'orifice d'aspiration est situé en dessous, et prévient la

formation de poches d'air qui empêcheraient le pompage du liquide même si la roue de la pompe tourne.

La tuyauterie doit être supportée correctement pour n'appliquer sur la pompe aucune charge pouvant la déformer.

Couvercles et trappes de visite doivent être assez grands pour permettre l'inspection et l'entretien de la pompe ainsi que l'emploi d'un dispositif de levage.

CÂBLAGE ET MISE À LA TERRE

Avis important : lire les Consignes de sécurité avant de procéder au câblage.

! N'utiliser que du fil torsadé en cuivre pour la mise à la terre et l'alimentation du moteur. Le calibre du fil de terre doit être au moins égal à celui des fils d'alimentation du moteur, et les fils devraient tous être chromocodés pour faciliter l'entretien et le diagnostic des anomalies.

! Poser le fil de terre et les autres fils suivant les prescriptions du code provincial ou national de l'électricité.

! Installer un sectionneur tout conducteur si le code l'exige.

! Verrouiller la source de courant en position ouverte avant de procéder à l'installation ou à l'entretien de la pompe.

! Le nombre de phases et la tension d'alimentation doivent convenir à tout l'équipement. Un nombre de phases et une tension inappropriés annulent la garantie et peuvent causer un incendie et des dommages au moteur et au tableau de commande.

! Chaque jonction de fils doit être étanche. Si l'on emploie un nécessaire de jonction (« kit »), suivre les directives du fabricant.

AVERTISSEMENT Choisir la boîte de jonction du type et de la classe NEMA convenant au type et au lieu d'utilisation. La boîte doit assurer une jonction de fils sûre et étanche.

AVERTISSEMENT Étancher les commandes afin d'empêcher les gaz d'en détériorer les composants.

AVERTISSEMENT **Tension dangereuse**
OMETTRE LA MISE À LA TERRE PERMANENTE DE LA POMPE, DU MOTEUR ET DES COMMANDES AVANT LE BRANCHEMENT À LA SOURCE DE COURANT PEUT CAUSER UN CHOC ÉLECTRIQUE, DES BRÛLURES OU LA MORT.

SÉLECTION ET CÂBLAGE DES CONTACTEURS ET DES TABLEAUX DE COMMANDE

TYPES DE CONTACTEURS À FLOTTEUR

Deux types de contacteurs à flotteur sont normalement utilisés : à simple effet ou à grand déplacement angulaire. Le type détermine le nombre de contacteurs requis avec les différents systèmes et tableaux de commande. Les contacteurs à simple effet fonctionnent dans un angle de 15° et s'ouvrent et se ferment donc rapidement. La longueur du câble (la distance entre le point pivot du câble et le boîtier du contacteur) des contacteurs à grand

déplacement angulaire (90°) régit les niveaux démarrage-arrêt de la pompe.

Les contacteurs à flotteur peuvent être du type normalement ouvert (NO) pour le vidage (fosses ou réservoirs) et du type normalement fermé (NF) pour le remplissage.

Les contacteurs à simple effet doivent être connectés seulement aux tableaux de commande, jamais directement aux pompes.

Les contacteurs à grand déplacement angulaire pour le vidage peuvent être branchés aux pompes comme aux tableaux de commande.

RÉGLAGE DES CONTACTEURS À FLOTTEUR

Il n'existe pas de règle absolue pour le réglage des contacteurs à flotteur, lequel peut varier d'une installation à l'autre.

Règles suggérées :

Tous les contacteurs à flotteur devraient être placés sous l'orifice d'arrivée de l'influent !

Contacteur d'arrêt : (1^{er} choix) — le régler pour que le niveau du liquide soit toujours au-dessus du compartiment moteur. **(2^e choix)** — le régler pour que le niveau du liquide ne puisse être à plus de 6 po sous le dessus du compartiment moteur.

Contacteur de démarrage : le régler pour que la plage de pompage permette aux pompes de 1½ hp ou moins de fonctionner pendant au moins une (1) minute. Les pompes de 2 hp et plus devraient fonctionner durant au moins deux (2) minutes. Le catalogue donne la capacité de chaque cuve en gallons US par pouce de hauteur.

Contacteur(s) de pompe secondaire et d'alarme : s'il n'y en a qu'un, le placer plus haut que les contacteurs d'arrêt et de démarrage, et, s'il y en a deux, on devrait en outre les décaler (v. les illustrations dans la section *Tableaux de commande et fonction des contacteurs à flotteur*). Essayer d'utiliser tout l'espace de stockage disponible de la cuve, mais prévoir un espace de réserve.

SCHÉMAS DE CÂBLAGE DES TABLEAUX DE COMMANDE

Des directives et des schémas de câblage sont fournis avec nos tableaux de commande. Utiliser les directives en question conjointement avec celles du présent manuel. L'installation électrique ne doit être effectuée que par des techniciens qualifiés. Adresser toute question relative aux autres marques de tableau de commande au fournisseur ou au fabricant de ces marques. Notre personnel technique ne dispose pas des schémas ni des informations de dépannage des autres marques.

DISPOSITIFS D'ALARME

Il est recommandé de poser un dispositif d'alarme dans toute installation à pompe(s) à eaux usées. De nombreux tableaux de commande standard en sont munis. S'il n'y a pas de tableau de commande, on peut employer un dispositif d'alarme niveau haut, autonome, qui se déclenchera si le liquide atteint un niveau trop élevé, avertissant ainsi le personnel d'entretien, qui apportera alors les correctifs appropriés.

POMPES MONOPHASÉES

Les pompes monophasées peuvent être utilisées avec un contacteur à flotteur simple ou double à fiche-prise ou à raccordement fixe, avec un contacteur ordinaire ou avec un

tableau de commande pour pompe simple ou double. Voir les fig. 1, 2 et 5.

Toutes les pompes de 1/3 et de 1/2 hp (115 ou 230 V), ainsi que certaines pompes de 3/4 et de 1 hp, sont munies d'un cordon d'alimentation à fiche pouvant être branchée sur la fiche-prise du contacteur à flotteur s'il s'agit d'une installation à pompe simple. On peut enlever la fiche du cordon d'alimentation et connecter celui-ci par raccordement fixe à un tableau de commande pour pompe simple ou double. L'enlèvement de la fiche n'annulera pas la garantie ni l'enregistrement auprès des organismes de normalisation pertinents. Voir la fig. 5.



LES POMPES CONNECTÉES PAR FICHE DOIVENT L'ÊTRE À UNE PRISE AVEC TERRE MISE À LA TERRE CORRECTEMENT.

S'IL S'AGIT D'UNE POMPE SANS FICHE, NE PAS ENLEVER LE CORDON D'ALIMENTATION NI SON SERRE-CÂBLE NI CONNECTER UN CONDUIT À LA POMPE.

Les pompes dont le bout des fils du cordon d'alimentation est dénudé peuvent être branchées par raccordement fixe à un contacteur à flotteur, à un contacteur ordinaire monophasé ou à un tableau de commande pour pompe simple ou double. On doit toujours s'assurer que le contacteur à flotteur convient à l'intensité de marche, à l'intensité maximale au démarrage et à la puissance nominales de la pompe. Sauf indication contraire sur la plaque signalétique, les pompes monophasées pour eaux usées sont munies d'une protection d'enroulement contre les surcharges. Voir les fig. 1 et 2.

POMPES TRIPHASÉES

Les pompes triphasées nécessitent au moins un démarreur magnétique à branchement direct convenant à la puissance nominale de la pompe, un circuit à fusible(s) ou à disjoncteur tripolaire, ainsi que des limiteurs de surcharge rapides de classe 10 compensés en fonction des conditions ambiantes.

TABLEAUX DE COMMANDE MONOPHASÉS ET TRIPHASÉS

Les tableaux de commande viennent en deux versions : pour pompe simple ou pour pompe double. Nos tableaux de la série SES offrent de nombreuses fonctions standard auxquelles on peut ajouter nos options les plus populaires. En outre, nous fournissons des tableaux sur demande dont les fonctions sont beaucoup plus nombreuses que celles de la série SES. Les tableaux faits sur demande sont offerts en versions variées. On peut adresser toute demande de prix pour ce type de tableau au service à la clientèle (*Customer Service*) par l'entremise d'un distributeur agréé.

Nos tableaux de commande pour pompe double de la série SES possèdent un circuit imprimé muni d'un circuit d'alarme niveau haut standard. Il existe d'autres accessoires standard : contacts d'alarme secs auxiliaires signalant les alarmes à distance et voyants indicateurs de position pour contacteurs à flotteur. Des limiteurs de surcharge réglables de classe 10 sont intégrés dans nos tableaux de commande triphasés, éliminant ainsi du travail pour l'installateur et l'obligation de commander des limiteurs particuliers. La plupart des tableaux de la série SES sont en stock et prêts à livrer.

Avec les pompes à capteurs de chaleur et d'humidité (décèle les défaillances de garniture), il est recommandé d'utiliser notre tableau de commande et les accessoires optionnels appropriés. Ces capteurs ne fonctionneront pas si le tableau de commande n'est pas équipé du relais, du bornier et de l'avertisseur (sonnerie ou voyant) appropriés.

Circuit de détection des défaillances de garniture — certaines pompes à double garniture comportent un circuit de détection intégré pour les défaillances de garniture, décelées par un capteur d'humidité. Il faut relier le circuit au relais en option monté dans le tableau de commande. On doit commander le tableau expressément avec le relais et l'avertisseur précités. Il existe aussi des tableaux standard (A4-3 et A4-4) séparés pour la détection des défaillances de garniture. Les pompes à capteur d'humidité se distinguent par le câble de capteur supplémentaire sortant de l'enveloppe de moteur. Le câble possède deux conducteurs, à brancher dans le tableau : le noir à la borne réservée au capteur (« *probe* ») et le blanc à la borne terre (« *ground* ») destinée au relais (pas sur la vis de terre du tableau). *Suivre les directives de câblage fournies avec le tableau.*

Circuits de détection de chaleur et des défaillances de garniture — des pompes sont munies d'un circuit de détection des défaillances de garniture à capteurs d'humidité, ainsi que d'un circuit de détection de chaleur à thermostats (capteurs de chaleur) normalement fermés pour hautes températures montés sur l'enroulement. Ces pompes ont un câble à quatre (4) conducteurs, à brancher dans le tableau : le noir à la borne pour le capteur (« *probe* ») et le vert à celle de terre (« *ground* ») du relais du circuit du capteur d'humidité ; et le rouge et le blanc aux bornes pour le circuit du capteur de chaleur, selon le schéma de câblage du tableau. Comme le circuit du capteur de chaleur est optionnel, on doit le commander expressément avec le tableau, et il fonctionne différemment des limiteurs de surcharge de classe 10 qui sont toujours requis sur les pompes triphasées. *Suivre les directives de câblage fournies avec le tableau.*

INSTALLATION

Fixer à la ou aux pompes le raccord rapide pour le rail de guidage, l'adaptateur coulissant ou la tuyauterie de refoulement. Le pied d'assise du rail devrait être assujéti au fond de la fosse humide par des boulons d'ancrage.

Effectuer le câblage selon les schémas de câblage des tableaux de commande, les prescriptions du code provincial ou national de l'électricité et les règlements locaux. À ce stade-ci, il est suggéré de vérifier le sens de rotation de l'arbre de moteur ou de la roue.



ÉVITER LES BLESSURES GRAVES : NE PAS S'INTRODUIRE LES DOIGTS DANS L'ORIFICE D'ASPIRATION DE LA POMPE PENDANT LA VÉRIFICATION DU SENS DE ROTATION.

On doit toujours vérifier si la pompe tourne dans le sens indiqué sur le corps de pompe, ce qui est plus facile à faire avant l'installation de la pompe. Les moteurs triphasés peuvent tourner dans les deux sens. Il est donc permis de les mettre en marche, puis de les arrêter immédiatement tout en observant le

sens de rotation. Pour inverser celui-ci, intervertir deux des fils d'alimentation du moteur.

Descendre la ou les pompes dans la fosse humide.

S'assurer que les contacteurs à flotteur peuvent bouger librement, mais sans pouvoir atteindre la tuyauterie.

MISE EN MARCHÉ

Une fois le raccordement de la tuyauterie achevé et vérifié, on peut mettre la ou les pompes en marche.

Vérification du fonctionnement des contacteurs à flotteur à fiche-prise — brancher d'abord la fiche-prise du contacteur sur une prise de courant indépendante mise à la terre, puis la prise de la pompe sur la fiche-prise du contacteur. Essayer la pompe en remplissant d'eau la fosse humide jusqu'à ce que la pompe démarre. Si le débit de la pompe est faible ou nul, c'est qu'il y a probablement présence d'air dans la pompe. Percer alors un trou-purgeur d'air selon les indications de la section Tuyauterie.

Vérifier la durée de fonctionnement de la pompe pour s'assurer qu'elle est d'au moins une minute et que la plage de pompage est correcte.

Vérification du fonctionnement du tableau de commande — remplir d'eau la fosse humide.

Essayer d'abord la pompe en mode manuel en plaçant le commutateur « *Hand-Off-Auto* » (manuel-arrêt-automatique) du tableau de commande à *Hand*. Si la pompe fonctionne bien, l'essayer en mode automatique. Si le débit de la pompe est faible ou nul, c'est qu'il y a probablement présence d'air dans la pompe. Percer alors un trou-purgeur d'air selon les indications de la section Tuyauterie.

Faire fonctionner la pompe en mode automatique (*Auto*) et vérifier minutieusement le fonctionnement des contacteurs de démarrage, d'arrêt et d'alarme en remplissant d'eau la fosse humide. **Important :** omettre de brancher le fil neutre de la source de courant à tout tableau de commande alimenté en courant monophasé de 230 V empêchera le circuit de commande du tableau de fonctionner. Le neutre est nécessaire pour alimenter (115 V) le circuit de commande.

Mesurer l'intensité et la tension du courant au démarrage et les inscrire à titre documentaire dans les Informations pour le propriétaire. Comparer l'intensité mesurée à l'intensité maximale indiquée sur la plaque signalétique de la pompe. Si l'intensité mesurée est supérieure, en chercher la cause. L'utilisation de la pompe hors de sa courbe de performances, c.-à-d. à une hauteur de charge trop faible ou à une tension trop basse ou trop haute, augmentera l'intensité du courant. Le moteur fonctionnera correctement si sa tension d'alimentation se situe dans les limites suivantes : tension nominale (plaque signalétique) $\pm 10\%$. Les performances obtenues dans ces limites ne seront pas forcément identiques à celles de la courbe de performances correspondant aux valeurs de courant nominales inscrites sur la plaque signalétique. Apporter les correctifs nécessaires avant de continuer. Le déséquilibre du courant triphasé peut en outre altérer les performances. *Si c'est le cas, suivre les directives de la section Déséquilibre du courant triphasé.*

Réarmer le dispositif d'alarme, puis mettre la pompe en mode automatique (*Auto*) et le circuit de commande du tableau sous tension (interrupteur « *Control On-Off* » à *On*). Le système est maintenant prêt à fonctionner automatiquement.

Expliquer le fonctionnement de la pompe et des dispositifs de commande et d'alarme à l'utilisateur, puis lui laisser la documentation ou l'attacher au tableau de commande s'il est installé dans un endroit sec, fermé.

TABLEAUX DE COMMANDE ET FONCTION DES CONTACTEURS À FLOTTEUR

L'objet de la présente section est d'indiquer le nombre de contacteurs à flotteur requis et le rôle de chacun dans les systèmes d'évacuation des eaux usées types. Le nombre varie selon le type de contacteur : à simple effet ou à grand déplacement angulaire, mais aussi selon le type de tableau de commande : pour pompe simple avec ou sans alarme ou pour pompe double avec alarme.

Tableaux de commande pour pompe double à contacteurs à simple effet :

Trois contacteurs à flotteur

SW1	Inférieur	Pompes hors fonction
SW2	Intermédiaire	1 ^{re} pompe en fonction
SW3	Supérieur	2 ^e pompe et alarme en fonction

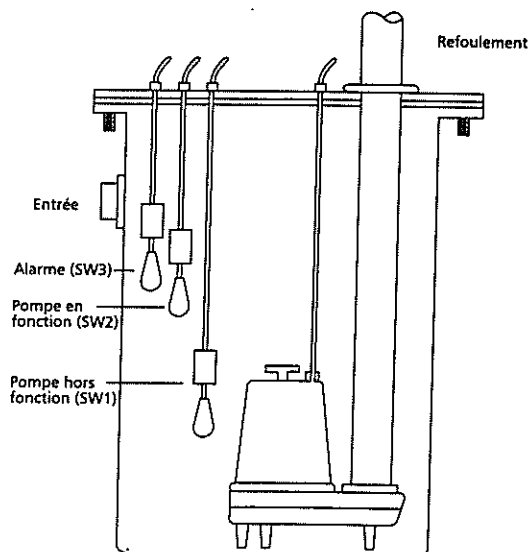
Quatre contacteurs à flotteur ②

SW1	Inférieur	Pompes hors fonction
SW2	Deuxième (du bas)	1 ^{re} pompe en fonction
SW3	Troisième (du bas)	2 ^e pompe en fonction
SW4	Supérieur	Alarme en fonction

Tableaux de commande pour pompe double à contacteurs à grand déplacement angulaire :

Trois contacteurs à flotteur

SW1	Inférieur	1 ^{re} pompe en fonction ou les deux hors fonction
SW2	Supérieur	2 ^e pompe et alarme en fonction



Système à pompe simple ①

Quatre contacteurs à flotteur

SW1	Inférieur	1 ^{re} pompe en fonction ou les deux hors fonction
SW2	Intermédiaire	2 ^e pompe en fonction
SW3	Supérieur	Alarme en fonction

Tableaux de commande pour pompe simple à contacteurs à simple effet :

Trois contacteurs à flotteur avec alarme ①

SW1	Inférieur	Pompe hors fonction
SW2	Intermédiaire	Pompe en fonction
SW3	Supérieur	Alarme en fonction ou hors fonction

Deux contacteurs à flotteur sans alarme

SW1	Inférieur	Pompe hors fonction
SW2	Supérieur	Pompe en fonction

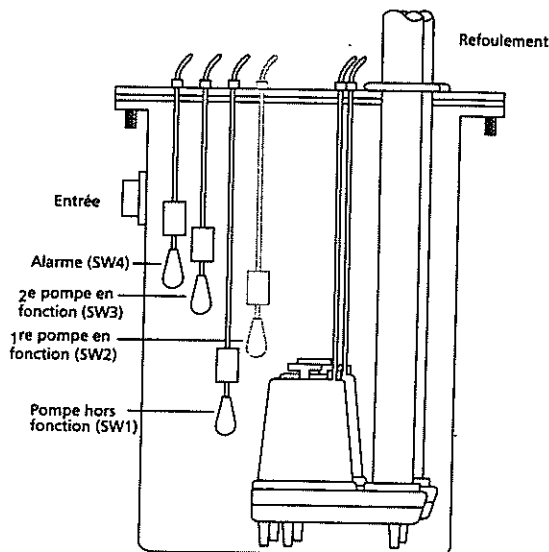
Tableaux de commande pour pompe simple à contacteurs à grand déplacement angulaire :

Deux contacteurs à flotteur avec alarme

SW1	Inférieur	Pompe en fonction ou hors fonction
SW2	Supérieur	Alarme en fonction ou hors fonction

Un contacteur à flotteur sans alarme

SW1	Pompe en fonction ou hors fonction
-----	------------------------------------



Système à pompe double ②

DÉSÉQUILIBRE DU COURANT TRIPHASÉ

Un circuit d'alimentation électrique entièrement triphasé est recommandé. Il peut être constitué de trois transformateurs distincts ou d'un transformateur triphasé. On peut aussi utiliser deux transformateurs montés en étoile ou en triangle « ouverts », mais il est possible qu'un tel montage crée un déséquilibre de courant se traduisant par des performances médiocres, le déclenchement intempestif du limiteur de surcharge et la défaillance prématurée du moteur.

Vérifier l'intensité du courant sur chacun des trois fils de moteur, puis calculer le déséquilibre du courant.

Si le déséquilibre est de 2 % ou moins, ne pas changer la connexion des fils.

S'il dépasse 2 %, on devrait vérifier l'intensité du courant sur chaque conducteur, dans les trois montages possibles ci-dessous. Afin de maintenir le sens de rotation du moteur, suivre l'ordre numérique indiqué dans chaque montage pour la connexion des fils de moteur.

Pour calculer le pourcentage de déséquilibre du courant :

A. Faire l'addition des trois intensités de courant de ligne mesurées.

- Diviser le total par 3 pour obtenir l'intensité moyenne.
- Prendre l'écart d'intensité le plus grand par rapport à la moyenne.
- Soustraire cet écart de la moyenne.
- Diviser la différence par la moyenne, puis multiplier le résultat par 100 pour obtenir le pourcentage de déséquilibre.

Le déséquilibre de courant ne devrait pas excéder 5 % en charge avec facteur de surcharge et 10 % en charge d'entrée nominale. Si l'on ne peut éliminer le déséquilibre en connectant les fils de moteur dans l'ordre numérique indiqué, on doit en trouver la cause et la rectifier. Si, dans les trois montages, l'écart d'intensité le plus grand par rapport à la moyenne est toujours sur le même conducteur, la cause du déséquilibre vient surtout de la source de courant.

On s'adressera alors à la société d'électricité pour rectifier le déséquilibre de courant.

1^{er} montage

Bornes de démarreur	L1	L2	L3
	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$
Fils de moteur	R	B	W
	T3	T1	T2

2^e montage

Bornes de démarreur	L1	L2	L3
	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$
Fils de moteur	W	R	B
	T2	T3	T1

3^e montage

Bornes de démarreur	L1	L2	L3
	$\frac{1}{T}$	$\frac{1}{T}$	$\frac{1}{T}$
Fils de moteur	B	W	R
	T1	T2	T3

Exemples :

$$\begin{aligned}
 T3-R &= 51 \text{ A} \\
 T1-B &= 46 \text{ A} \\
 T2-W &= \underline{53 \text{ A}} \\
 \text{Total} &= 150 \text{ A} \\
 \div 3 &= 50 \text{ A} \\
 - 46 \text{ A} &= 4 \text{ A} \\
 4 \div 50 &= 0,08 \text{ ou } 8 \%
 \end{aligned}$$

$$\begin{aligned}
 T2-W &= 50 \text{ A} \\
 T3-R &= 48 \text{ A} \\
 T1-B &= \underline{52 \text{ A}} \\
 \text{Total} &= 150 \text{ A} \\
 \div 3 &= 50 \text{ A} \\
 - 48 \text{ A} &= 2 \text{ A} \\
 2 \div 50 &= 0,04 \text{ ou } 4 \%
 \end{aligned}$$

$$\begin{aligned}
 T1-B &= 50 \text{ A} \\
 T2-W &= 49 \text{ A} \\
 T3-R &= \underline{51 \text{ A}} \\
 \text{Total} &= 150 \text{ A} \\
 \div 3 &= 50 \text{ A} \\
 - 49 \text{ A} &= 1 \text{ A} \\
 1 \div 50 &= 0,02 \text{ ou } 2 \%
 \end{aligned}$$

VALEURS DE RÉSISTANCE D'ISOLEMENT DU MOTEUR

Valeurs normalement mesurées en ohms et en mégohms entre chaque fil et le fil de terre

État du moteur et des fils	Valeurs en ohms	Valeurs en mégohms
Moteur neuf sans câble d'alimentation	20 000 000 (et plus)	20 (et plus)
Moteur usagé réutilisable en fosse	10 000 000 (et plus)	10 (et plus)
Moteur en fosse — valeurs mesurées : câble d'alimentation plus moteur		
Moteur neuf	2 000 000 (et plus)	2 (et plus)
Moteur en bon état	500 000 à 2 000 000	0,5 à 2
Isolation endommagée (la réparer)	Moins de 500 000	Moins de 0,5

La valeur de résistance d'isolement varie très peu d'un moteur à l'autre, peu important la puissance, la tension d'alimentation et le nombre de phases du moteur.

Les valeurs de résistance d'isolement ci-dessus sont tirées de mesures prises avec un mégohmmètre et une tension de sortie de 500 V c.c. Les valeurs mesurées peuvent varier si l'on utilise un ohmmètre avec une tension moindre. Communiquer avec le personnel technique de l'usine en pareil cas.

Cette table a été publiée avec l'aimable autorisation de Franklin Electric.

On trouvera les données techniques sur des modèles particuliers dans le catalogue et à l'adresse du site Web inscrite au bas de la première page.

Les schémas de câblage des tableaux de commande sont fournis avec ces derniers. S'en servir conjointement avec les directives du présent manuel pour effectuer le câblage.

CONDITIONS DE SERVICE DE LA POMPE

Hauteur d'immersion minimale		Température maximale du liquide	
Service continu	Immersion totale	Service continu	40 °C (104 °F)
Service intermittent	6 po sous le dessus du compartiment moteur	Service intermittent	60 °C (140 °F)

Raccordement fixe des contacteurs à flotteur Pumpmaster et Pumpmaster Plus

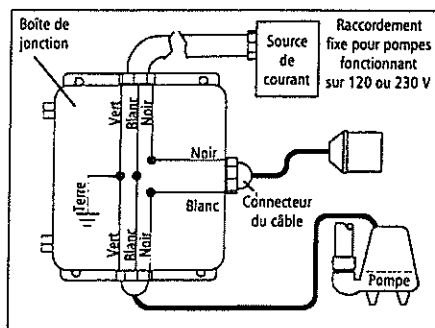


Fig. 1

Installation type à contacteur à flotteur à simple effet

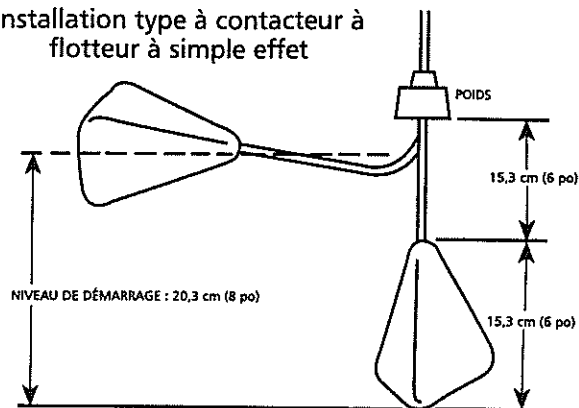


Fig. 4

Raccordement fixe pour contacteur à flotteur double

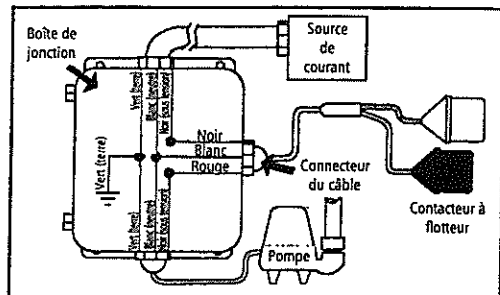


Fig. 2

Contacteur à flotteur à grand déplacement angulaire

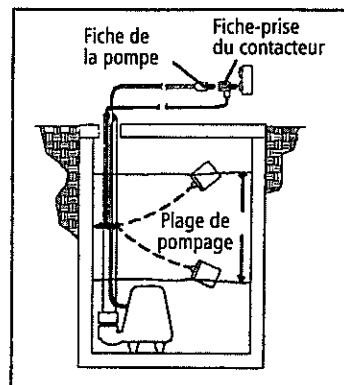


Fig. 5

Détermination de la plage de pompage

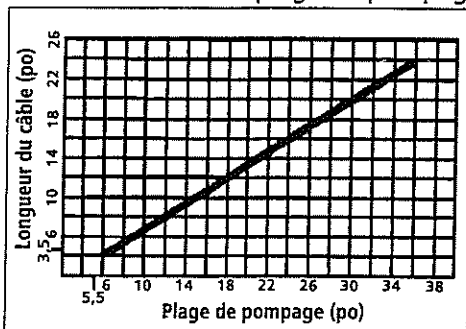


Fig. 3

Schéma de câblage triphasé

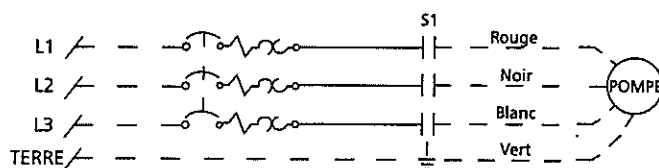
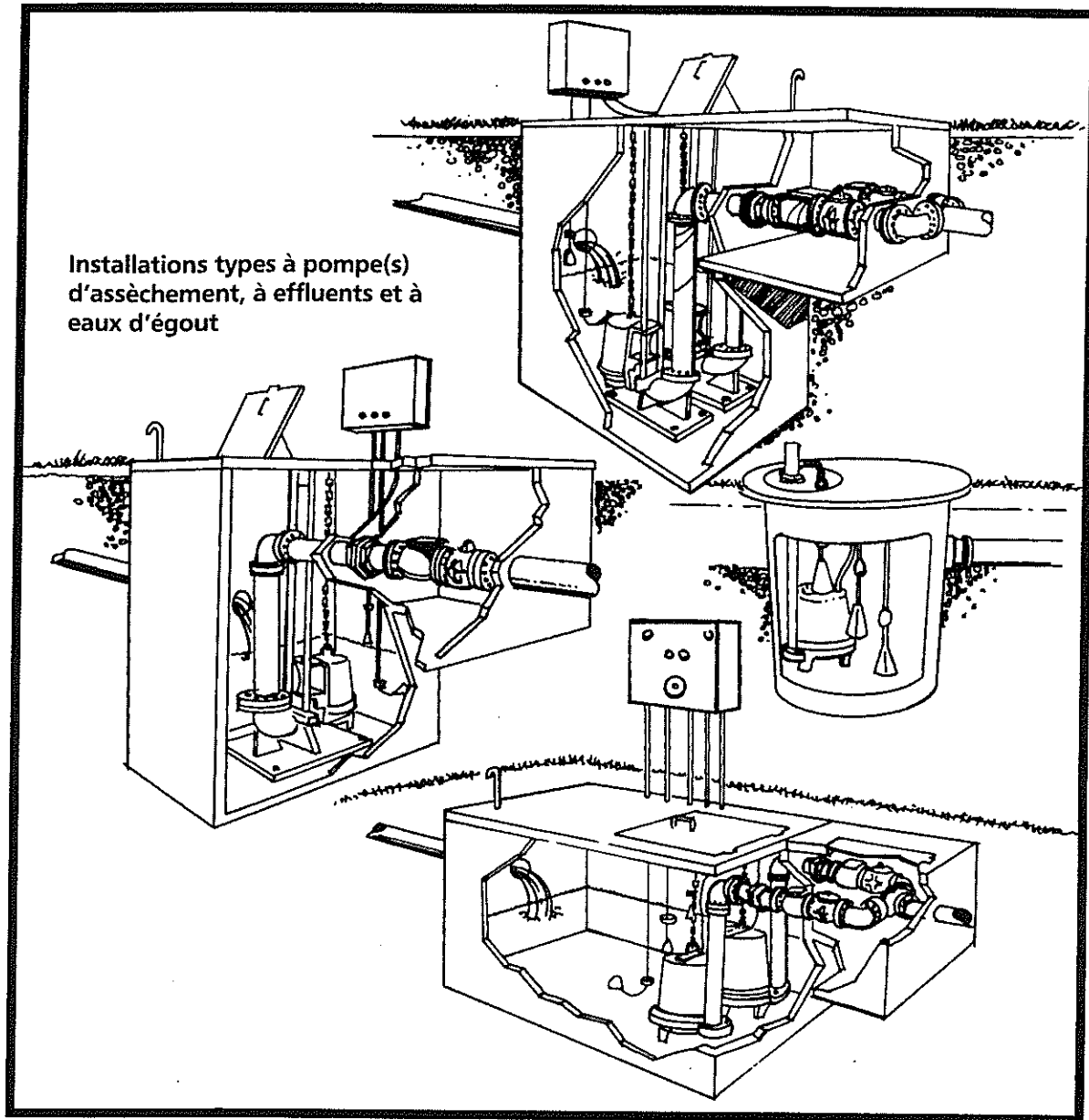
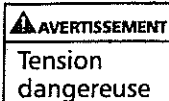


Fig. 6



DIAGNOSTIC DES ANOMALIES



OMETTRE DE VERROUILLER LA SOURCE DE COURANT EN POSITION OUVERTE AVANT D'EFFECTUER TOUT TRAVAIL D'ENTRETIEN SUR LA POMPE PEUT CAUSER UN CHOC ÉLECTRIQUE, DES BRÛLURES OU LA MORT.

ANOMALIES	CAUSES PROBABLES	CORRECTIFS RECOMMANDÉS
NON-FONCTIONNEMENT DU MOTEUR NOTA : si le disjoncteur ne cesse de s'« OUVRIR », NE PLUS le réarmer. S'adresser à un électricien.	Protecteur thermique du moteur déclenché Disjoncteur ouvert ou fusible sauté Roue bloquée ou grippée	Laisser le moteur refroidir. Vérifier si la hauteur d'immersion est suffisante. Enlever les débris du corps de pompe et de la roue. En déterminer la cause et s'adresser à un électricien.
a) Mode manuel	Câble d'alimentation endommagé Mauvaise connexion dans le tableau de commande	Mesurer le courant (A) consommé par le moteur. Si l'intensité est au moins deux fois plus élevée que celle qui figure sur la plaque signalétique de la pompe, la roue est grippée, ou bien les roulements ou l'arbre du moteur sont endommagés. Enlever les débris du corps de pompe et de la roue. Consulter le détaillant.
b) Mode automatique	Fil neutre non connecté au tableau de commande Mauvaise connexion dans le tableau de commande Contacteur à flotteur défectueux	La valeur de résistance mesurée entre les fils d'alimentation et le fil de terre devrait être infinie. Si elle n'est pas appropriée, appeler un électricien. Inspecter le câblage du tableau de commande. Appeler un électricien.
NOTA : vérifier si la pompe peut fonctionner en mode manuel d'abord. Si oui, la commande automatique ou le câblage sont défectueux. Dans la négative, voir les indications ci-dessus.	Liquide trop bas pour actionner les commandes Câbles de contacteur à flotteur enchevêtrés	Débrancher le contacteur à flotteur et en vérifier la continuité en l'actionnant. Le remplacer au besoin.
NON-ARRÊT DE LA POMPE	Câbles de contacteur à flotteur enchevêtrés Poche d'air dans la pompe Débit de l'influent égal à celui de la pompe	Laisser le liquide monter de 76 à 101 mm (3 à 4 po) au-dessus du niveau de démarrage. Démêler les câbles de contacteur à flotteur et s'assurer que les contacteurs peuvent bouger librement. Démêler les câbles de contacteur à flotteur et s'assurer que les contacteurs peuvent bouger librement. Arrêter la pompe pendant environ une minute, puis la remettre en marche. Répéter l'opération jusqu'à ce que la poche d'air s'élimine. Si le problème persiste et que le tuyau de refoulement comporte un clapet de non-retour, on peut percer un trou-purgeur d'air de 4,8 mm (3/16 po) de diamètre dans le tuyau à environ 51 mm (2 po) en aval de l'orifice de refoulement de la pompe. Il faut peut-être une pompe plus puissante.
DÉBIT DE REFOULEMENT FAIBLE OU NUL	Clapet de non-retour posé à l'envers, obstrué ou coincé en position fermée Hauteur de charge trop élevée du système Entrée de pompe obstruée Connexions ou tension inappropriées Poche d'air dans la pompe Roue usée ou endommagée Contacteurs à flotteur défectueux ou mal placés	Vérifier l'orientation de la flèche sur le clapet de non-retour et le fonctionnement de ce dernier. Consulter le détaillant. Inspecter et dégager l'entrée au besoin. Vérifier le sens de rotation de la pompe, la tension et le câblage. Consulter un électricien. Voir le correctif recommandé pertinent ci-dessus. Inspecter la roue et la remplacer au besoin. Inspecter, régler ou remplacer les contacteurs au besoin.
CYCLE DE FONCTIONNEMENT RÉPÉTÉ SANS ARRÊT	Clapet de non-retour défectueux Installation de confinement des eaux d'égout trop petite Contacteurs à flotteur défectueux ou mal placés Débit de l'influent supérieur à celui de la pompe	Inspecter, réparer ou remplacer le clapet au besoin. Consulter le détaillant. Inspecter, régler ou remplacer les contacteurs au besoin. Consulter le détaillant.

GARANTIE LIMITÉE DE GOULDS PUMPS

La présente garantie s'applique à chaque pompe de système d'alimentation en eau fabriquée par Goulds Pumps.

Toute pièce se révélant défectueuse sera remplacée sans frais pour le détaillant durant la période de garantie suivante expirant la première : douze (12) mois à compter de la date d'installation ou dix-huit (18) mois à partir de la date de fabrication.

Le détaillant qui, aux termes de cette garantie, désire effectuer une demande de règlement doit s'adresser au distributeur Goulds Pumps agréé chez lequel la pompe a été achetée et fournir tous les détails à l'appui de sa demande. Le distributeur est autorisé à régler toute demande par le biais du service à la clientèle de Goulds Pumps.

La garantie ne couvre pas :

- (a) les frais de main-d'œuvre ni de transport ni les frais connexes encourus par le détaillant ;
- (b) les frais de réinstallation de l'équipement réparé ;
- (c) les frais de réinstallation de l'équipement de remplacement ;
- (d) les dommages indirects de quelque nature que ce soit ;
- (e) ni les pertes découlant de la panne.

Aux fins de la présente garantie, les termes ci-dessous sont définis comme suit :

- (1) « Distributeur » signifie une personne, une société de personnes, une société de capitaux, une association ou autre entité juridique servant d'intermédiaire entre Goulds Pumps et le détaillant pour les achats, les consignations ou les contrats de vente des pompes en question.
- (2) « Détaillant » veut dire une personne, une société de personnes, une société de capitaux, une association ou autre entité juridique dont les activités commerciales sont la vente ou la location de pompes à des clients.
- (3) « Client » signifie une entité qui achète ou loue les pompes en question chez un détaillant. Le « client » peut être une personne, une société de personnes, une société de capitaux, une société à responsabilité limitée, une association ou autre entité juridique se livrant à quelque activité que ce soit.

CETTE GARANTIE SE RAPPORTE AU DÉTAILLANT SEULEMENT.

APPENDIX B-3G

CPVC PIPE

JOHN W. DANFORTH COMPANY

Pfohl Brothers Landfill HVAC

JWD JOB #8049

D

- Schedule 80 CPVC Pipe & Fittings

Contents:

1 Page

- Cover Sheet

1 Page

- Eslon Piping Products Chlorinated Poly (Vinyl Chloride) CPVC, Basic Material Data

2 Pages

- Thermoplastic Pipe Features, Eslon Pipe Availability Guide, Weights and Dimensions, PVC and COVC Schedule 40 and SDR Pressure Pipe, Pressure Conversion Factors

2 Pages

- Manufacturer's Product Specification Schedule 40 & 80 CPVC Industrial Pipe Scope, CPVC Materials, Dimensions, Marking, Sample Specification, Manufacturer's Product Specification Schedule 80 CPVC Fittings Scope, CPVC Materials, Dimensions, Marking, Sample Specification

3 Pages

- Schedule 80 CPVC Fittings Tees, Reducing Tees, 45 Degree Elbows, 90 Degree Elbows, Reducing Couplings, Socket Flanges

1 Page

- PVC & CPVC Schedule 80 Fittings, 150 Series Unions & Tank Adapters 45 Degree Street Ell, Cross

Supplied By: Corr Tech

SINCE 1884

**John W. Danforth Company**

MAY 03 '01

8041

Submittal Data Cover FormJOHN W. DANFORTH CO.
Buffalo, New YorkDate: 3-May-01 Job number: 8049 Extra # Project manager: John SamarProject name: Pfohl Brothers LanfillCustomer project number (or contract/po #): E6483021Engineer: CRASubmittal # 8049-003 (job number - item number on submittal schedule ex: 9687-001)Subcontractor: N/ASupplier: Corr TechManufacturer: Elson/Spears

Spec section:

Item submitted:

Schedule 80 CPVC Pipe and fittings

Notes:

☐ Mail☒ Hand Deliver by Project Manager

ESLON PIPING PRODUCTS

ESLON
THERMOPLASTICS

Physical Properties of PVC and CPVC

Poly(Vinyl Chloride) PVC

This thermoplastic material is the largest volume member of the vinyl family. It is the most widely used material for plastic pipe, valves, and fittings.

PVC has many advantages over conventional piping materials. Just a few are:

Corrosion Resistance - outstanding chemical resistance to nearly all acids, alkalis, alcohols, halogens and many other corrosive materials.

Fluid Friction - less friction loss as compared to metals. Lower pressure drop = smaller pumps = less electricity.

Thermal - lower thermal conductivity than for metallics. Less moisture condensation, reduced heat loss, and more uniform fluid temperature. (Insulation is usually not required.)

Electrical - a non-conductor of electricity. Eliminates galvanic or electrolytic corrosion that causes expensive repairs.

Other - weather resistant, high strength-to-weight ratio, dent resistant, non-toxic, maintains properties over long periods of time, easy to install, maintenance-free.

Chlorinated Poly(Vinyl Chloride) CPVC

An industrial thermoplastic piping material which can be used for higher temperature applications. It is a specialty polymer with a higher glass transition point, which means advantages over regular PVC pipe and fittings while retaining the excellent chemical resistant properties of PVC.

CPVC retains its mechanical strength at higher temperatures.

CPVC = 200°F Max.

PVC = 140°F Max.

Eslon PVC and CPVC pipe and fittings compounds are blended according to strict industry guidelines. Specifications and requirements are set forth by agencies such as the American Society for Testing and Materials (ASTM) and NSF International (NSF). Compliance with these standards assures the customer that they are receiving products manufactured from materials that will perform the tasks for which they are designed.

PHYSICAL PROPERTIES

BASIC MATERIAL DATA

	PVC	CPVC
• Base Resin	Poly(vinyl chloride) Homopolymer	Chlorinated Poly(vinyl chloride)
• Commercial Classification of Rigid Compound *	Type I, Grade 1 PVC 1120	Type IV, Grade 1 CPVC 4120
• Class Designation	12454-B	23447

* Rigid Material is also known as Un-Plasticized (U-PVC)

Submitted for Approval

JOB#

MAY 03 '01

8049

JOHN W. DANFORTH CO.
Buffalo, New York

THERMOPLASTIC PIPE



Features

■ Full range of IPS sizes in 1/4" through 14" Schedule 80 PVC, 1/2" through 12" SDR and 1/2" through 16" Schedule 40 PVC; plus CPVC, 1/2" through 12".

■ Handles commercial and industrial applications in which metal pipe will not withstand the reactive effects of chemicals or other corrosive materials.

■ Choice of plain, belled or roll-grooved ends for PVC SDR and PVC Schedule 40. PVC Schedule 80 available with plain, roll-grooved or thread ends. CPVC, plain ends only.

Note: For size/end treatment combinations see Pipe Availability Guide below.

■ Manufactured In U.S.A. to ASTM material and dimensional standards.

■ NSF certified for potable water service.

■ 1 1/4" through 12" PVC Schedule 40 dual marked for DWV applications.

Note: 2 1/2" and 5" excluded.

■ Light weight facilitates installation with conventional tools and piping techniques.

■ Minimal maintenance requirements with uniform, smooth fluid flow ensures very long service periods.

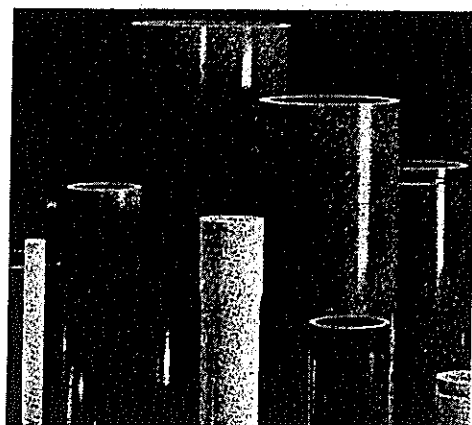
SPECIFICATIONS

Eslon thermoplastic pipe is manufactured to the following standard specifications:

Type Pipe	Standard Specifications	
	Material	Dimensions
PVC SDR (Plain End)	ASTM D-1784	ASTM D-2241
PVC SDR (Belled End)	ASTM D-1784	ASTM D-2672
PVC Schedule 40	ASTM D-1784	ASTM D-1785
PVC Schedule 40 (DWV)	ASTM D-1784	ASTM D-2665
PVC Schedule 40 (Belled End)	ASTM D-1784	ASTM D-2672
PVC Schedule 80	ASTM D-1784	ASTM D-1785
CPVC Schedule 40 and 80	ASTM D-1784	ASTM F-441

WARNING

Eslon Thermoplastics does not recommend its products for use in compressed air or gas systems.



Eslon Pipe Availability Guide

Nominal Pipe Size ⁽¹⁾ (Dia. in)	Type Plastic And Specification											
	PVC SDR 26/PR 160 ⁽²⁾		PVC SDR 21/PR 200 ⁽³⁾		PVC Schedule 40 ⁽⁴⁾		PVC Schedule 80 ⁽⁶⁾				CPVC Schedule 40 & 80	
	Plain End	Belled End	Plain End	Belled End	Plain End	Belled End	Plain End	Belled End	Threaded Both Ends	Roll Grooved	Plain End	Belled End
1/4	—	—	—	—	—	—	—	—	—	—	—	—
3/8	—	—	—	—	—	—	●	—	—	—	—	—
1/2	—	—	Δ ⁽⁵⁾	● ⁽⁵⁾	●	●	●	—	●	—	●	—
3/4	—	—	Δ	●	●	●	●	—	●	—	●	—
1	—	—	Δ	●	●	●	●	—	●	—	●	—
1 1/4	Δ	●	Δ	●	●	●	●	—	●	—	●	—
1 1/2	Δ	●	Δ	●	●	●	●	—	●	—	●	—
2	Δ	●	Δ	●	●	●	●	●	●	●	●	—
2 1/2	Δ	●	Δ	●	●	●	●	●	—	●	●	—
3	Δ	●	Δ	●	●	●	●	●	—	●	●	●
4	Δ	●	Δ	●	●	●	●	●	—	●	●	●
5	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	—	Δ	Δ	Δ
6	Δ	●	Δ	Δ	●	●	●	●	—	●	●	●
8	Δ	Δ	Δ	Δ	●	●	●	●	—	●	●	●
10	Δ	Δ	Δ	Δ	●	●	●	●	—	●	●	●
12	Δ	Δ	Δ	Δ	●	●	●	●	—	●	●	●
14	—	—	—	—	●	●	●	●	—	Δ	—	—
16	—	—	—	—	●	●	—	—	—	—	—	—

Standard lengths - 20 feet.

Roll-grooved on request, 2-inch through 8-inch diameters.

Roll-grooved on request, 2-inch through 6-inch diameters.

(4) Roll-grooved on request, 2-inch through 12-inch diameters.

(5) SDR 13.5/PR315.

(6) Belled end on request, 1/2-inch through 12-inch diameters.

● Stock Standard

Δ Available On Request

THERMOPLASTIC PIPE

ESLON
THERMOPLASTICS

Weights and Dimensions

PVC AND CPVC SCHEDULE 80 PIPE

Nominal Pipe Size in. (mm)	Outside Diameter in.	Min. Wall Thickness in.	Max. Working Pressure PSI @ 73°F		Approx. Weight lbs./ft.	
			Plain End	Threaded	PVC	CPVC
1/4 (6.35)	0.540	0.119	1130	570	0.101	—
3/8 (9.53)	0.675	0.126	920	460	0.139	—
1/2 (12.7)	0.840	0.147	850	420	0.208	0.228
3/4 (19.05)	1.050	0.154	690	340	0.280	0.308
1 (25.4)	1.315	0.179	630	320	0.411	0.453
1 1/4 (31.75)	1.660	0.191	520	260	0.569	0.624
1 1/2 (38.1)	1.900	0.200	470	240	0.690	0.760
2 (50.8)	2.375	0.218	400	200	0.957	1.050
2 1/2 (63.5)	2.875	0.276	420	210	1.460	1.602
3 (76.2)	3.500	0.300	370	190	1.950	2.146
4 (101.6)	4.500	0.337	320	160	2.844	3.126
5 (127)	5.563	0.375	290	"Threading Pipe Above 4" Is Not Recommended"	3.953	—
6 (152.4)	6.625	0.432	280		5.433	6.077
8 (203.2)	8.625	0.500	250		8.251	9.263
10 (254)	10.750	0.593	230		12.243	13.886
12 (304.8)	12.750	0.687	230		16.831	18.536
14 (355.6)	14.000	0.750	220		19.960	—
16 (406.4)	16.000	0.843	220		25.550	—

PVC AND CPVC SCHEDULE 40 AND SDR PRESSURE PIPE

Nominal Pipe Size in. (mm)	Outside Diameter in.	PVC and CPVC Schedule 40				SDR 26/PR 160 160 PSI @ 73°F		SDR 21/PR 200 200 PSI @ 73°F		SDR 13.5/PR 315 315 PSI @ 73°F	
		Min. Wall Thickness in.	Max. W.P. PSI @ 73°F	Approx. Weight lbs./ft. *		Min. Wall Thickness in.	Approx. Weight lbs./ft.	Min. Wall Thickness in.	Approx. Weight lbs./ft.	Min. Wall Thickness in.	Approx. Weight lbs./ft.
				CPVC	PVC						
1/2 (12.7)	0.840	0.109	600	.177	0.162					0.062	0.101
3/4 (19.05)	1.050	0.113	480	.236	0.219			0.060	0.122		
1 (25.4)	1.315	0.133	450	.350	0.320			0.063	0.162		
1 1/4 (31.75)	1.660	0.140	370	.474	0.431	0.064	0.210	0.079	0.260		
1 1/2 (38.1)	1.900	0.145	330	.569	0.519	0.073	0.270	0.090	0.330		
2 (50.8)	2.375	0.154	280	.763	0.693	0.091	0.421	0.113	0.521		
2 1/2 (63.5)	2.875	0.203	300	1.246	1.133	0.110	0.633	0.137	0.761		
3 (76.2)	3.500	0.216	260	1.586	1.455	0.135	0.923	0.167	1.131		
4 (101.6)	4.500	0.237	220	2.254	2.050	0.173	1.520	0.214	1.870		
5 (127)	5.563	0.258	190	—	2.780	0.214	2.330	0.265	2.854		
6 (152.4)	6.625	0.280	180	3.981	3.615	0.255	3.300	0.316	4.052		
8 (203.2)	8.625	0.322	160	5.980	5.436	0.332	5.600	0.410	6.851		
10 (254)	10.750	0.365	140	8.558	7.713	0.413	8.686	0.511	10.640		
12 (304.8)	12.750	0.406	130	11.220	10.195	0.490	12.214	0.606	14.949		
14 (355.6)	14.000	0.438	130	—	11.81						
16 (406.4)	16.000	0.500	130	—	15.14						

- Standard pipe length = 20 feet.
- Working pressures based on water at 73°F (23°C). See page 50.
- If operating temperature is above 73°F, working pressure must be de-rated. See page 50.
- **WARNING:** Eslon Thermoplastics does not recommend its products for use in compressed air or gas systems.

*CPVC Schedule 40 pipe will be slightly heavier than PVC Schedule 40. Consult factory for exact weights.

Pressure Conversion Factors

To Obtain	Multiply
Kgf/cm ²	PSI × 14.223
BAR	PSI × 14.5
1 Inch of Hg	PSI × 0.4912
1 Ft of Head	PSI × 2.309
1 PSI	Ft of Head × 0.433

MANUFACTURER'S PRODUCT SPECIFICATION

Schedule 40 & 80 CPVC Industrial Pipe



Scope:

This specification sheet covers the manufacturer's requirements for CPVC Schedule 40 and 80 IPS pressure pipe. This pipe meets or exceeds the industry standards set forth by the American Society for Testing and Materials and the National Sanitation Foundation.

CPVC Materials:

Rigid CPVC (chlorinated polyvinyl chloride) used in the extrusion of Schedule 40 and 80 pipe is of Type IV, Grade 1 compound as stated in ASTM D-1784. Raw material used in extrusion shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

Dimensions:

Physical dimensions and tolerances of CPVC Schedule 40 and 80 pipe meet the requirements of ASTM standard specification F-441.

Marking:

CPVC Schedule 40 and 80 pipe is marked as prescribed in ASTM F-441 to indicate the manufacturer's name or trademark, material designation code, the nominal pipe size, the Schedule size with the pressure rating in PSI for water at 73°F, the ASTM designation number F-441 and the NSF seal for potable water.

Sample Specification:

All CPVC Schedule 40 and 80 pipe shall conform to ASTM F-441. Schedule 80 **socket** fittings shall conform to ASTM F-439 and ASTM F-437 for **threaded** Schedule 80 fittings. Both pipe and fittings shall be the product of one manufacturer, as manufactured by Eslon Thermo-plastics, Charlotte, North Carolina, 1-800-578-7681, or approved equal.

ASTM
MEMBER



MANUFACTURER'S PRODUCT SPECIFICATION

Schedule 80 CPVC Fittings



Scope:

This specification sheet covers the manufacturer's requirements for CPVC Schedule 80 pipe fittings. These fittings meet or exceed the standards set by the American Society for Testing and Materials and the National Sanitation Foundation.

CPVC Materials:

Rigid CPVC (chlorinated polyvinyl chloride) used in the manufacture of Schedule 80 fittings is Type IV, Grade 1 compound as stated in ASTM D-1784. Raw material used in molding shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

Dimensions:

Physical dimensions and tolerances of CPVC Schedule 80 IPS fittings meet the requirements of ASTM standard specification F-439 for socket-type fittings and ASTM F-437 for threaded fittings. Threaded fittings have Taper Pipe Threads in accordance with ANSI/ASME B1.20.1.

Marking:

CPVC Schedule 80 fittings are marked as prescribed in ASTM F-437 and F-439 to indicate the manufacturer's name or trademark, material designation, the NSF mark, size of fitting, and ASTM designation F-437 (threaded) or F-439 (socket).

Sample Specification:

All CPVC Schedule 80 **socket** fittings shall conform to ASTM F-439, and ASTM F-437 for threaded fittings. Both pipe and fittings shall be the product of one manufacturer, as manufactured by Eslon Thermoplastics, Charlotte, North Carolina, 1-800-578-7681, or approved equal.

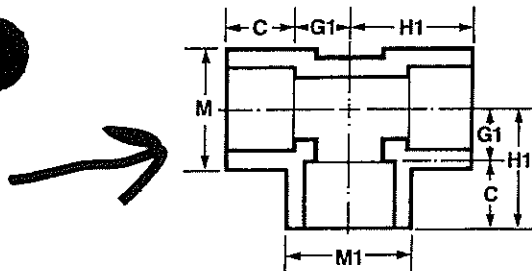
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SCHEDULE 80 CPVC FITTINGS

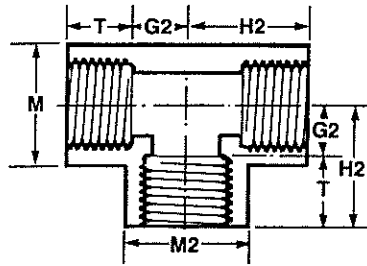


Tees



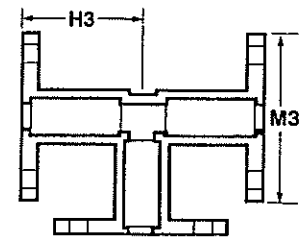
NSF-pw

S X S X S
FIG. 501



NSF-pw

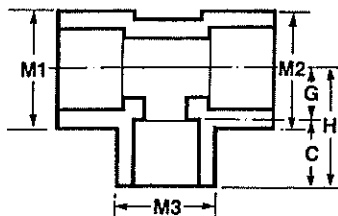
T X T X T
FIG. 502



FLG X FLG X FLG
FIG. 522

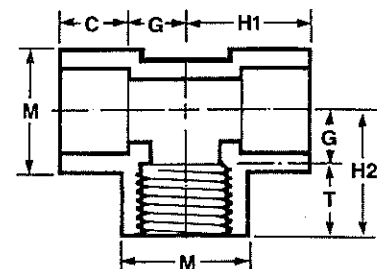
Nom. Pipe Size	Max. O.D. Dim. M1	SOCKET - FIG. 501					Max. O.D. Dim. M2	THREADED - FIG. 502					Max. O.D. Dim. M3	FLANGED - FIG. 522		
		Part No.	C	H1	G1	Approx. Wt. (lb)		Part No.	T	H2	G2	Approx. Wt. (lb)		Part No.	H3	Approx. Wt. (lb)
1/2	1 13/64	5021	57/64	1 13/32	33/64	.120	1 19/32	5031	7/8	1 1/4	3/8	.160	—	—	—	—
3/4	1 7/16	5022	1	1 19/32	19/32	.170	1 1/2	5032	3/4	1 5/16	9/16	.180	—	—	—	—
1	1 3/4	5023	1 1/64	1 7/32	45/64	.270	1 3/8	5033	1	1 5/8	5/8	.350	4 1/2	5330	3 3/8	1.725
1 1/4	2 1/64	5024	1 17/64	2 5/32	57/64	.420	2 1/64	5034	69/64	1 7/8	57/64	.445	4 5/8	5331	3 3/4	2.432
1 1/2	2 3/8	5025	1 25/64	2 19/32	1 1/64	.545	2 1/2	5035	3 1/32	2 3/4	1 5/64	.635	5	5332	4	3.290
2	2 13/16	5026	1 19/16	2 19/16	1 1/4	.940	3 1/32	5036	1 1/4	2 15/32	1 13/32	.885	6	5333	4 1/2	6.037
2 1/2	3 39/64	5020	1 25/32	3 11/32	1 9/16	1.510	—	—	—	—	—	—	—	—	—	—
3	4 7/8	5027	1 7/8	3 7/8	2	2.335	4 11/32	5037	1 7/8	3 11/32	1 13/16	2.195	7 1/2	5334	5 5/8	8.900
4	5 5/16	5028	2 1/4	4 5/8	2 3/8	3.920	5 1/16	5038	1 19/32	3 29/32	2 5/16	3.910	9	5335	6 1/4	17.687
6	7 5/8	5029	3 1/64	6 35/64	3 17/32	10.370	—	—	—	—	—	—	11	5336	8 3/4	31.080
8	9 13/16	5030	4 1/64	8 17/32	4 33/64	19.920	—	—	—	—	—	—	13 1/2	5337	10 3/4	63.181

Reducing Tees



NSF-pw

S X S X S
FIG. 403



NSF-pw

S X S X T
FIG. 402

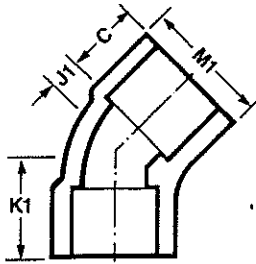
Nom. Pipe Size	Max. O.D. Dim.			S X S X S - FIG. 403					Nom. Pipe Size	Max. O.D. Dim. M	THREADED - FIG. 402						
	M1	M2	M3	Part No.	C	H	G	Approx. Wt.			Part No.	T	C	H1	H2	G	Wt.
3/4 x 3/4 x 1/2	1 3/8	1 3/8	1 1/8	5380	7/8	1 1/2	9/32	.160	1/2	1 19/32	5431	7/8	7/8	1 3/8	1 5/8	1/2	.150
1 x 1 x 3/4	1 3/4	1 3/4	1 3/8	5382	1 1/16	1 1/4	1/16	.265	3/4	1 1/2	5432	1 1/32	1 1/8	1 5/8	1 5/8	9/32	.215
1 1/2 x 1 1/2 x 1	2 3/8	2 3/8	1 3/4	5385	1 5/32	2 5/32	1	.485	1	1 25/32	5433	1 5/32	1 5/32	1 7/8	1 7/8	1 1/16	.320
2 x 2 x 1	2 7/8	2 7/8	1 3/4	5388	1 5/32	2 5/32	1 1/32	.630	—	—	—	—	—	—	—	—	—
2 x 2 x 1 1/2	2 7/8	2 7/8	2 3/8	5389	1 13/32	2 5/32	1 1/4	.770	—	—	—	—	—	—	—	—	—
3 x 3 x 2	4	4	2 3/4	5390	1 1/2	3 3/32	1 25/32	1.730	—	—	—	—	—	—	—	—	—
4 x 4 x 3	5 1/16	5 1/16	4	5392	1 7/8	4 3/16	2 5/16	3.225	—	—	—	—	—	—	—	—	—
6 x 6 x 4	7 9/16	7 9/16	5 1/4	5395	2 1/4	6	3 3/4	7.860	—	—	—	—	—	—	—	—	—
8 x 8 x 6	9 3/4	9 3/4	7 19/32	5396	3 1/8	7 1/32	4 17/32	17.030	—	—	—	—	—	—	—	—	—

NOTES: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings. CPVC material meets ASTM Standard D-1784.
All dimensions are in inches unless otherwise specified.
Dimensions are subject to change without notice. Contact factory for certification.
As of this printing, ASTM F-439 does not include 8" CPVC fittings (consult factory).

SCHEDULE 80 CPVC FITTINGS

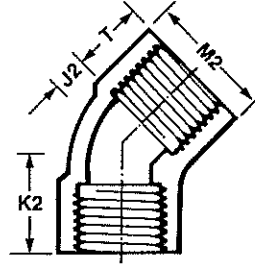
ESLON
THERMOPLASTICS

45° Elbows



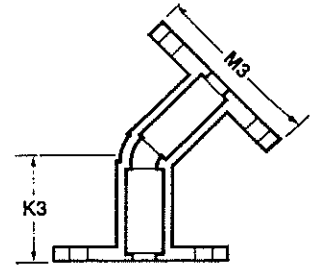
NSF-pw

S X S
FIG. 503



NSF-pw

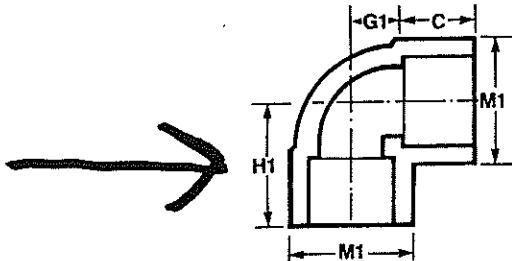
T X T
FIG. 504



FLG X FLG
FIG. 524

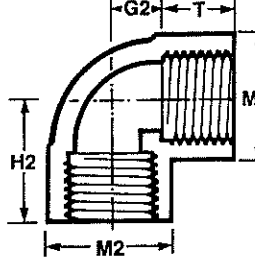
Nom. Pipe Size	Max. O.D. Dim. M1	SOCKET - FIG. 503					Max. O.D. Dim. M2	THREADED - FIG. 504					Max. O.D Dim. M3	FLANGED - FIG. 524		
		Part No.	K1	C	J1	Approx. Wt.(lb)		Part No.	K2	T	J2	Approx. Wt.(lb)		Part No.	K3	Approx. Wt.(lb)
1/2	1 1/8	5001	1 1/16	5/16	7/8	.065	1 9/32	5011	7/8	1 1/16	3/16	.085	—	—	—	—
3/4	1 3/8	5002	1 3/32	1 1/16	1 1/32	.100	1 1/2	5012	1 1/8	1 1/16	2 1/16	.115	—	—	—	—
1	1 7/8	5003	1 1/2	1 1/16	5/8	.160	1 13/16	5013	1 5/32	7/8	9/32	.170	4 1/2	5350	2 3/16	1.097
1 1/4	2 1/8	5004	1 5/8	1 5/16	5/8	.230	2 1/4	5014	1 13/32	7/8	5 1/64	.275	4 5/8	5351	3 1/8	1.496
1 1/2	2 3/8	5005	1 7/8	1 7/16	29/64	.305	2 1/2	5015	1 7/8	29/32	1 19/32	.365	5	5352	3 25/64	1.934
2	2 7/8	5006	2 1/8	1 7/32	9/32	.500	3	5016	1 5/8	1 1/32	49/64	.580	6	5353	3 1/16	2.977
2 1/2	3 1/8	5007	2 3/16	1 7/8	1 1/4	.900	—	—	—	—	—	—	—	—	—	—
3	4 1/8	5008	2 13/16	2 1/8	1 5/16	1.220	4 1/8	5017	2 1/32	1 1/2	3 1/32	1.475	7 1/2	5354	4 3/8	6.213
4	5 1/8	5009	3 5/8	2 3/4	1 3/8	2.055	5 1/32	5018	2 29/32	1 9/16	1 11/32	2.590	9	5355	5 1/8	10.782
6	7 5/8	5009	4 13/16	3	1 25/32	6.100	—	—	—	—	—	—	11	5356	6 3/8	20.517
8	9 3/4	5010	6 1/4	4	3 1/4	11.600	—	—	—	—	—	—	13 1/2	5357	8 3/8	40.431

90° Elbows



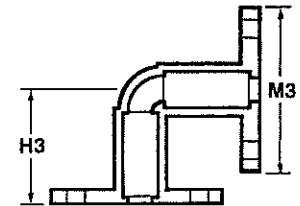
NSF-pw

S X S
FIG. 505



NSF-pw

T X T
FIG. 506



FLG X FLG
FIG. 523

Nom. Pipe Size	Max. O.D. Dim. M1	SOCKET - FIG. 505				Max. O.D. Dim. M2	THREADED - FIG. 506				Max. O.D. Dim. M3	FLANGED - FIG. 523				
		Part No.	C	H1	G1		Approx. Wt.(lb)	Part No.	T	H2		G2	Approx. Wt.(lb)	Part No.	H3	Approx. Wt.(lb)
1/2	1 1/8	5041	57/64	1 11/32	39/64	.085	1 5/16	5051	7/8	1 19/32	13/32	.095	—	—	—	
3/4	1 3/8	5042	1 1/32	1 39/64	37/64	.120	1 7/8	5052	7/8	1 23/64	31/64	.125	—	—	—	
1	1 7/8	5043	1 5/8	1 1/8	23/32	.200	1 7/8	5053	1	1 19/32	19/32	.210	4 1/2	5340	3 5/32	1.240
1 1/4	2 1/8	5044	1 9/32	2 1/64	45/64	.310	2 1/4	5054	1 1/8	1 7/8	7/8	.320	4 5/8	5341	3 1/4	1.696
1 1/2	2 3/8	5045	1 25/64	2 25/64	1	.410	2 1/2	5055	1 3/32	2 25/64	1 5/64	.430	5	5342	3 25/64	2.220
2	2 7/8	5046	1 1/2	2 3/4	1 1/2	.655	3 1/8	5056	1 1/16	2 7/16	1 1/8	.655	6	5343	4 1/16	4.147
2 1/2	3 5/8	5040	1 25/32	3 5/16	1 17/32	1.145	3 5/8	5059	1 7/16	2 5/8	1 35/64	1.145	—	—	—	
3	4 1/8	5047	1 7/8	3 3/4	1 1/8	1.565	4 5/16	5057	1 1/2	3 1/32	1 27/32	1.670	7 1/2	5344	5 1/8	6.560
4	5 1/8	5048	2 17/64	4 39/64	2 11/32	2.930	5 7/16	5058	1 19/32	3 5/16	2 11/32	2.775	9	5345	6 1/8	11.560
6	7 5/8	5049	3	6 11/16	3 11/16	7.935	—	—	—	—	—	—	11	5346	8 3/16	22.280
8	9 3/4	5050	4	8 5/8	4 5/8	14.640	—	—	—	—	—	—	13 1/2	5347	10 3/16	43.668

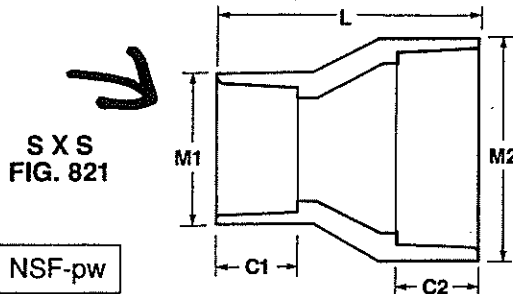
NOTES: 1 Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
CPVC material meets ASTM Standard D-1784.
All dimensions are in inches unless otherwise specified.
Dimensions are subject to change without notice. Contact factory for certification.
As of this printing, ASTM F-439 does not include 8" CPVC fittings (consult factory).

DIMENSIONS - FITTINGS

SCHEDULE 80 CPVC FITTINGS

ESLON
THERMOPLASTICS

Reducing Couplings



Nom. Pipe Size*	Part No.	M1	M2	C1	C2	L	Approx. Wt. (lb)
3/4 x 1/2	5532	1 1/64	1 29/64	29/32	13/64	2 5/64	.080
1 x 1/2	5533	1 11/64	1 45/64	29/32	15/32	2 3/8	.110
1 x 3/4	5534	1 29/64	1 45/64	11/32	15/32	2 3/8	.120
1 1/4 x 1/2	—	—	—	—	—	—	—
1 1/4 x 3/4	—	—	—	—	—	—	—
1 1/4 x 1	5536	1 45/64	2 5/64	15/32	19/32	2 43/64	.170
1 1/2 x 1/2	—	—	—	—	—	—	—
1 1/2 x 3/4	—	—	—	—	—	—	—
1 1/2 x 1	5538	1 45/64	2 11/32	15/32	113/32	3 3/64	.215
1 1/2 x 1 1/4	5539	2 5/64	2 11/32	119/64	113/32	3 3/64	.240

Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings.

As of this printing, ASTM F-439 does not include 8" CPVC fittings (consult factory).

Nom. Pipe Size*	Part No.	M1	M2	C1	C2	L	Approx. Wt. (lb)
2 x 1/2	—	1 11/64	2 27/32	29/32	117/32	3 33/64	—
2 x 3/4	—	1 29/64	2 27/32	11/32	117/32	3 33/64	—
2 x 1	5541	1 45/64	2 27/32	15/32	117/32	3 33/64	.300
2 x 1 1/4	—	2 5/64	2 27/32	119/64	117/32	3 33/64	—
2 x 1 1/2	5543	2 11/32	2 27/32	119/32	117/32	3 33/64	.345
2 1/2 x 1/2	—	—	—	—	—	—	—
2 1/2 x 3/4	—	—	—	—	—	—	—
2 1/2 x 1	—	—	—	—	—	—	—
2 1/2 x 1 1/4	—	—	—	—	—	—	—
2 1/2 x 1 1/2	—	—	—	—	—	—	—
2 1/2 x 2	—	2 27/32	2 57/64	117/32	1 25/32	3 11/16	—
3 x 1	—	—	—	—	—	—	—
3 x 1 1/4	—	—	—	—	—	—	—
3 x 1 1/2	—	—	—	—	—	—	—
3 x 2	5544	2 27/32	4 9/64	117/32	1 25/32	4 9/32	.760
3 x 2 1/2	—	3 15/32	4 9/64	1 25/32	1 25/32	4 9/32	—
4 x 2	5545	2 27/32	5 7/32	117/32	2 29/32	5 3/32	1.355
4 x 2 1/2	—	3 15/32	5 7/32	1 25/32	2 29/32	5 3/32	—
4 x 3	5546	4 9/64	5 7/32	1 25/32	2 29/32	5 3/32	1.455
6 x 4	5548	5 7/32	7 35/64	2 29/32	3 1/32	6 23/32	3.410
8 x 6	—	—	—	—	—	—	—

*Consult factory for dimensions — all sizes.

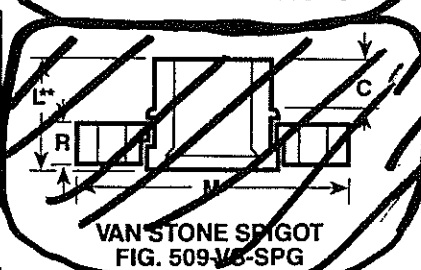
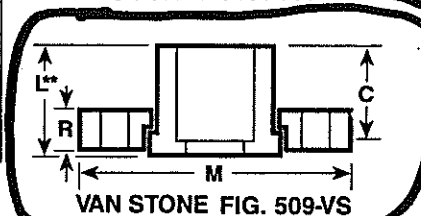
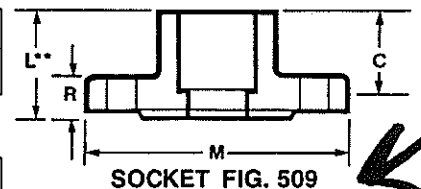
Socket Flanges-150 Lb.

Nom. Pipe Size	Max. O.D. Dim. M	Part No.	Dimensions	No. Bolt Holes	Bolt Hole Dia.	Bolt Circle Dia.	Approx. Wt. (lb)
ONE PIECE FLANGES*			FIG. 509				
			L** C† R				
1/2	3 1/2	5081	1 11/16 29/32 15/32	4	5/8	2 3/8	.210
3/4	3 7/8	5082	1 13/16 1 1/2 2 1/2	4	5/8	2 3/4	.280
1	4 1/2	5083	1 15/16 1 5/32 9/16	4	5/8	3 1/8	.380
1 1/4	4 5/8	5084	1 11/8 1 1/4 5/8	4	5/8	3 1/2	.485
1 1/2	5	5085	1 1 1/2 1 3/8 3/32	4	5/8	3 3/8	.610
2	6	5086	1 1 1/16 1 1/2 3/4	4	3/4	4 3/4	.970
VAN STONE STYLE FLANGES*			FIG. 509-VS				
			L** C† R				
3	7 1/2	5087	2 1 7/8 2 29/32	4	3/4	6	1.685
4	9	5088	2 1/2 2 1/4 3 13/32	8	3/4	7 1/2	2.665
6	11	5089	3 5/8 3 1/2 4 1/4	8	7/8	9 1/2	3.980
8	13 1/2	5090	4 9/16 4 1/4 5 1/8	8	7/8	11 3/4	7.800
10	15 1/2	5471	6 3/8 5 25/32 6 15/8	12	1	14 1/4	12.505
12	19 1/16	5472	7 9/16 7 7/16 12 1/32	12	1	17	19.450
VAN STONE STYLE SPIGOT FLANGES			FIG. 509-VS-SPG				
			I L** C† R				
3	7 1/2	5467	3 5/64 3 5/32 1 7/8 2 29/32	4	3/4	6	2.025
4	9	5468	3 9/16 3 21/32 2 1/4 3 13/32	8	3/4	7 1/2	3.170
6	11	5469	4 13/32 4 1/2 3 1 1/4	8	7/8	9 1/2	5.145
8	13 1/2	5470	5 5/64 5 5/64 4 1 1/2	8	7/8	11 3/4	9.370

*One piece style flanges in 3, 4, 6, 8, 10, and 12 inch sizes have been discontinued.

**Includes seal ring height (length overall).

† C dimension is socket depth or spigot length.



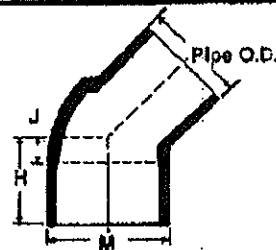
NOTES:
Flange bolt hole patterns meet ANSI B16.5.
CPVC material meets ASTM Standard D-1784.
All dimensions are in inches unless otherwise specified.
Dimensions are subject to change without notice. Contact factory for certification.

NSF-pw SE



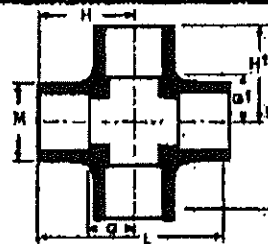
PVC & CPVC SCHEDULE 80 FITTINGS, 150 SERIES, UNIONS & TANK ADAPTERS

45° STREET ELL (Spig x Soc)



Part Number		Size	M	H	J	Approx. Wt (Lbs.)	
PVC	CPVC					PVC	CPVC
827-020	827-D20C	2	2-7/8	2-1/8	5/8	.46	.50

CROSS (Soc x Soc x Soc x Soc)



Part Number		Size	M	H	H'	G	G'	L	L'	Approx. Wt (Lbs.)	
PVC	CPVC									PVC	CPVC
820-002	820-002C	1/4	11/16	1-1/32	1-1/32	13/32	13/32	2-1/16	2-7/16	.05	.07
820-007	820-007C	3/4	1-7/16	1-21/32	1-21/32	5/8	5/8	3-5/16	3-5/16	.20	.21
820-010	820-010C	1	1-3/4	2-1/16	2-1/16	7/8	7/8	4-1/8	4-1/8	.42	.46
820-012	820-012C	1-1/4	2-1/8	2-3/8	2-3/8	1-1/16	1-1/16	4-3/4	4-3/4	.81	.85
820-015	820-015C	1-1/2	2-3/8	2-5/8	2-5/8	1-3/16	1-3/16	5-1/4	5-1/4	.80	.85
820-020	820-020C	2	3	3	3	1-1/2	1-1/2	6	6	1.15	1.42
820-025	820-025C	2-1/2	3-1/2	3-15/32	3-15/32	1-3/4	1-3/4	6-15/16	6-15/16	2.00	2.20
820-030	820-030C	3	4-1/8	3-31/32	3-31/32	2-1/16	2-1/16	7-15/16	7-15/16	2.90	3.10
820-040	820-040C	4	5-3/16	4-7/8	4-7/8	2-19/32	2-19/32	9-3/4	9-3/4	5.20	5.70
820-060F	—	6	7-1/2	10-3/4	10-3/4	7-1/2	7-1/2	21-1/2	21-1/2	21.73	—
—	820-060CF	6	7-3/16	9-3/8	9-3/4	6-1/8	6-1/2	18-3/4	19-7/16	—	14.81
—	820-060CF	6	7-1/2	10-1/2	10-1/2	7-1/4	7-1/4	21	21	—	28.18
820-080F	—	8	9-5/8	12-1/8	12-1/8	7-7/8	7-7/8	24-1/4	24-1/4	38.33	—
—	820-080CF	8	9-3/8	11-3/8	11-1/2	7-1/8	7-1/4	22-3/4	23	—	28.08
—	820-080CF	8	9-5/8	12-3/8	12-3/8	8-1/8	8-1/8	24-3/4	24-3/4	—	50.83
820-100F	—	10	11-15/16	14-1/2	14-1/2	9-1/4	9-1/4	29	29	58.02	—
—	820-100CF	10	11-1/2	13-1/4	13-3/4	8	8-1/2	26-1/2	27-1/2	—	43.24
—	820-100CF	10	12	14-3/8	14-3/8	9-1/8	9-1/8	28-3/4	28-3/4	—	88.80
820-120F	—	12	14-1/8	16-3/8	16-3/8	10-1/8	10-1/8	32-7/8	32-7/8	97.81	—
—	820-120CF	12	13-5/8	15-3/4	16	9-1/2	9-3/4	31-1/2	32	—	65.33
—	820-120CF	12	14-1/4	16-3/8	16-3/8	10-1/8	10-1/8	32-3/4	32-3/4	—	134.75
820-140F	—	14	15-1/2	18-1/2	18-1/2	12-1/4	12-1/4	38-1/2	38-1/2	165.00	—
820-160F	—	16	17-3/4	21-1/8	21-1/8	13-1/8	13-1/8	42-1/4	42-1/4	212.00	—
820-180F	—	18	19-7/8	23-3/4	23-1/2	14-3/4	14-1/2	47	47-1/2	318.20	—

APPENDIX B-4

LEVEL TRANSMITTERS (K-TEK)



K-TEK
18321 Swamp Road
Prairieville, LA 70769

Tel: 225 673 6100
Fax: 225 673 2525

MT2000
INSTRUCTION MANUAL

MT2000-0200-1 Rev B
09/18/00

1) STORAGE INFORMATION:

If required, storage prior to installation should be indoors at ambient temperature, not to exceed the following:

Temperature range: -40 to 150 degrees F.

Humidity: 0 to 100% R.H. non-condensing.

2) DESCRIPTION & PRINCIPLE OF OPERATION:

The MT2000 is a 4-20mA loop powered Smart Level Transmitter, which is microprocessor based and is available with HART or Honeywell DE digital output. It uses very low power microwave energy to determine the level of the product being measured. In order to obtain optimum performance, it is important to understand the basic principle of operation. The electronics housing is typically fitted with a special adapter "Coupler" serving as a process connection and seal, and holding a solid rod or a cable. The rod or cable "Probe" hangs into the vessel and acts as a wave-guide, i.e. the microwave energy stays concentrated around the probe and along its length, instead of being dispersed in a cone, as it would be if there was no probe.

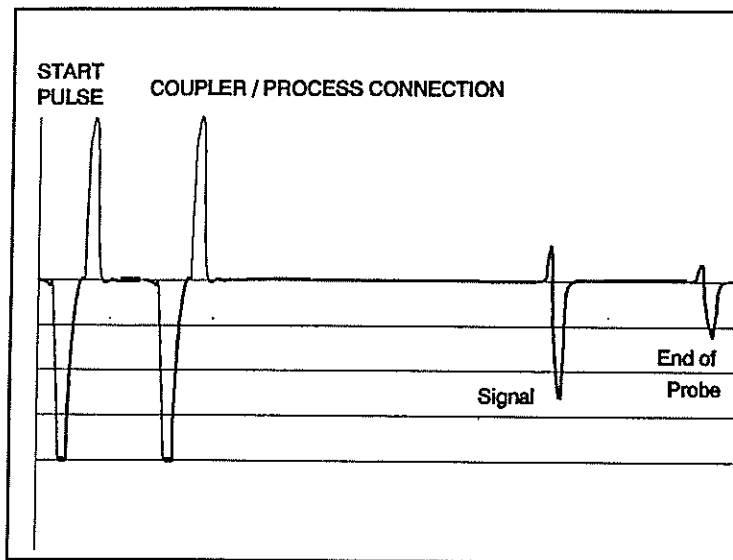
A measurement cycle consists of the following:

- A very short "Impulse" of microwave energy is applied at the coupler, to the Probe.
- The impulse travels along the length of the probe and when it encounters a discontinuity which is a dielectric constant change, such as the product surface, some of the energy is reflected and travels back towards the coupler.
- When the reflected impulse reaches the coupler, it is sensed by the electronics. By measuring the time elapsed between the initial impulse and the reflected one, the electronics can calculate the product level.
- Since the microwave energy travels at the speed of light, one complete measurement cycle is made up of several thousands of Impulses. The electronics uses a sampling technique to reconstruct a waveform duplicating the actual real time signal, but at a much lower speed, so that it can be processed by the microprocessor. This process can be compared to using the stroboscope effect as when observing a piece of machinery turning at high speed with a strobe light.
- The measurement cycles are made 10 times per second and processed by special filtering techniques, before generating a current output proportional to the level of the product.

The probe signals are as follow:

- Start pulse.
- Coupler discontinuity reflection.
- Signal from product level
- Signal from end of probe

The measurement principle is based essentially on the fact that a dielectric constant discontinuity will yield a negative pulse having a certain amplitude below the baseline. The greater the dielectric constant difference is, the greater the negative amplitude of the return signal. This means that a signal will show up on the baseline if there is a substantial change from a nozzle diameter to an open tank, for example, as seen the signal plot at the process connection. This fact needs to be taken into account in order to configure the MT2000 properly on startup (Consult the section on commissioning).



3) INSTALLATION:

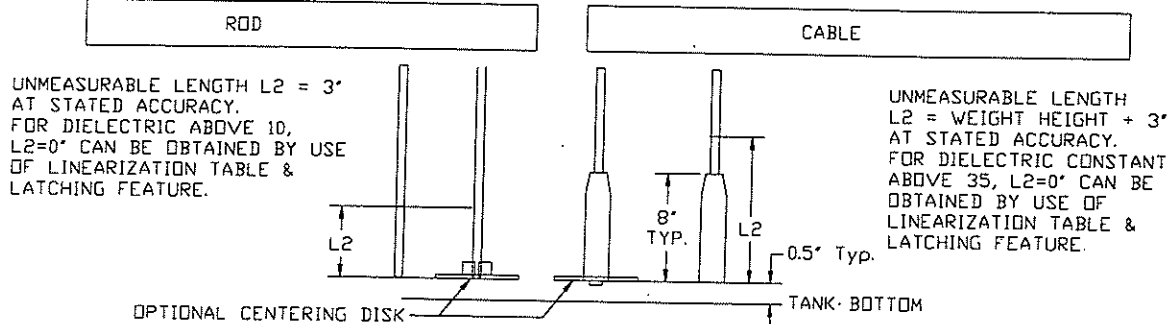
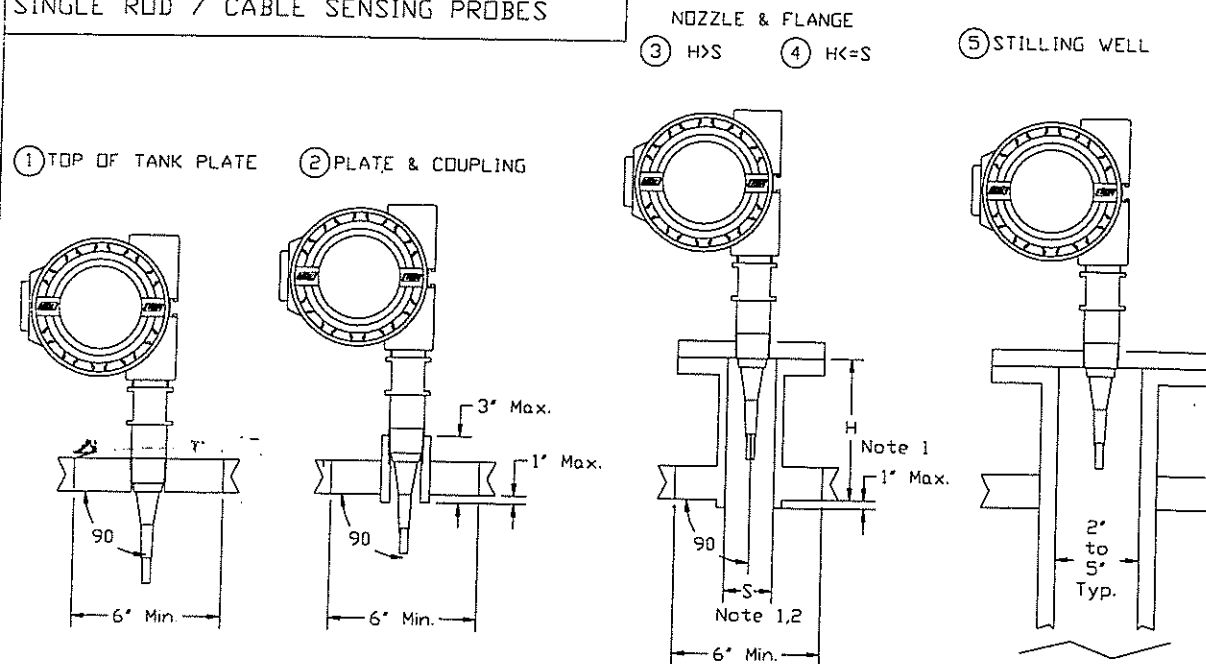
3.1) MOUNTING REQUIREMENTS:

IMPORTANT: In order to obtain the best return signal from the product level, it is recommended to mount the MT2000 coupler directly into the top of the vessel, if the vessel material is metal, or into a metal plate, if the vessel is non metallic. A flat metal surface perpendicular to the probe acts as a "launch plate", minimizing the loss of the microwave energy from dispersion. This configuration is not always possible and the MT2000 can be installed in flanged nozzles as long as the following considerations are taken into account.

Refer to the following two pages for recommended mounting information:

MT2000 INSTRUCTION MANUAL

MT2000 RECOMMENDED MOUNTING DIMENSIONS SINGLE ROD / CABLE SENSING PROBES



PROBE TYPE, MOUNTING	MAX. LENGTH/D.C. Note 3 & 4	MAX. LENGTH/D.C. Note 3 & 4	MAX. LENGTH/D.C. Note 3 & 4	MAX. LENGTH/D.C. Note 3 & 4
SINGLE ROD/CABLE, #1	—	20' / >3	40' / >10	100' / >35
SINGLE ROD/CABLE, #2	—	20' / >35	40' / >10	100' / >35
SINGLE ROD/CABLE, #3	—	20' / >4	40' / >10	100' / >35
SINGLE ROD/CABLE, #4	—	20' / >35	40' / >10	100' / >35
SINGLE ROD/CABLE, #5	15' / >17	30' / >3	50' / >10	50' / >35

Note 3: DC = DIELECTRIC CONSTANT

Note 4: DIFFERENT PROBE TYPES ALSO HAVE LIMITED LENGTH PER PROBE SELECTION TABLE

MT2000 INSTRUCTION MANUAL

MT2000 RECOMMENDED MOUNTING DIMENSIONS DUAL ROD / CABLE SENSING PROBES

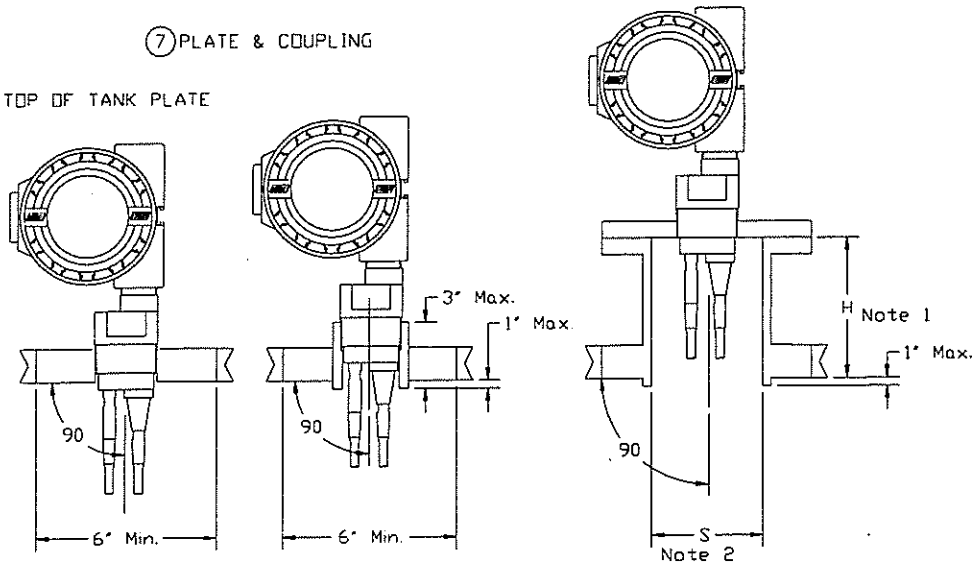
NOZZLE & FLANGE

⑧ H>S

⑨ H<S

⑦ PLATE & COUPLING

⑥ TOP OF TANK PLATE



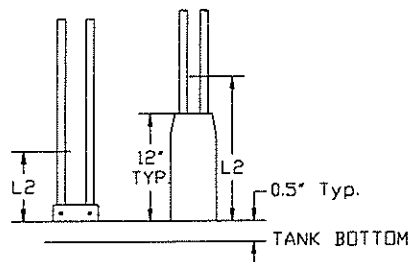
Note 1: IF $H > S$: A ONE TIME STARTUP ADJUSTMENT WILL BE REQUIRED TO CANCEL THE EFFECT OF THE NOZZLE (REFER TO COMMISSIONING INSTRUCTIONS)

Note 2: SELECT MINIMUM NOZZLE SIZE PER DATA SHEET COUPLER INFORMATION

ROD

CABLE

$L2 = 3'$ MIN. AT STATED ACCURACY. FOR DIELECTRIC ABOVE 10, $L2=0'$ CAN BE OBTAINED BY USE OF LINEARIZATION TABLE & LATCHING FEATURE.



$L2 = \text{WEIGHT HEIGHT} + 3'$ AT STATED ACCURACY. $L2 = \text{WEIGHT HEIGHT}$ IF USING LINEARIZATION TABLE

PROBE TYPE, MOUNTING	MAX. LENGTH/D.C. Note 3 & 4	MAX. LENGTH/D.C. Note 3 & 4
DUAL ROD/CABLE, #6	20' / >1.7	MAX ROD LENGTH = 20' @ D.C.>4 MAX. CABLE LENGTH = 50' @ D.C.>4
DUAL ROD/CABLE, #7	20' / >2.5	
DUAL ROD/CABLE, #8	20' / >2.5	
DUAL ROD/CABLE, #9	20' / >3.5	

Note 3: D.C. = DIELECTRIC CONSTANT

Note 4: DIFFERENT PROBE TYPES ALSO HAVE LIMITED LENGTH PER PROBE SELECTION TABLE

3.2) SHORTENING OF THE PROBE:

The MT2000 single rod and cable probe can be cut to length upon installation. The MT2000 default factory configuration provides a measurement in engineering units with a 0 referenced to the top of the sensing probe. The end of the probe yields a measurement equal to the probe length (Refer to the Calibration section for details).

3.3) AMBIENT TEMPERATURE:

The MT2000 electronics temperature may not exceed 170 F (77 C). For higher ambient temperatures, a high temp option extension or a remote option is required. The probe process temperature shall not exceed the temperature stated in the specifications for a given probe coupler.

3.4) WIRING:

Install conduit to 1/2" NPT port, and run 18 Gauge twisted shielded pair to housing. Please refer to attached wiring diagram ELE1002.

- Apply loop power to transmitter as follow.

Terminal Block +: +14 Vdc MIN to +36 Vdc MAX

Terminal Block -: COMMON

Ground screw: GROUND

Note: The "+ Meter" and "- Meter" terminals are available to hook up a mA meter to monitor the loop current.

4) COMMISSIONING:

The transmitter factory default configuration provides an engineering unit readout referenced to the coupler front face at the top of the sensing probe (i.e. readout is 0 at top, and equal to the probe length, at the bottom of the probe). If required, the transmitter can be configured to measure from some other known reference, like the bottom tip of the sensing probe or cable, or the bottom of the measured tank. (Refer to menu operation and Appendix A for details on the sensor trim).

CAUTION: The housing cover can only be removed when the unit is installed in a non-hazardous or intrinsic safe area, or when power is removed from the transmitter.

4.1) INITIAL CONFIGURATION:

Depending on the intended use and mounting configuration, the default factory setup may need to be modified as follow:

Lower Range Value, LRV, and Upper Range Value, URV:

The LRV and URV are the values in engineering units at which the output will be respectively at 4 and 20mA.

- If using the default factory setup, which is referenced with 0 at the top of the sensing probe, proceed as follow:

Access the CAL menu and scroll down to LRV. Set LRV to the value in engineering units, which will result in a 4mA output.

Scroll down to URV and set the value in engineering units, which will result in a 20mA output.

- If the measurement needs to be referenced with 0 at the bottom of the probe, then proceed to the sensor trim instructions per appendix A.

Range Setting parameter, RS:

For measuring range below 100 ft, keep the factory default RS=1 and proceed to next step.

For range greater than 100 ft, set RS=2 by accessing the factory setup menu (Refer to menu chart).

Blanking parameter, BLK:

For mounting configuration #1,2,5,6 or 7, keep the factory default BLK and skip to next step.

The following information assumes that the default factory setup is being used and that engineering units read 0 at the top of the sensing rod and a higher value when the product level goes down.

BLK is used to ignore an extended nozzle, which would otherwise cause a reflected signal towards the top of the probe and result in a high level reading even with no product in the vessel. BLK can be changed by accessing SET followed by the CFG menu (Refer to menu chart). If the MT2000 is installed in an extended nozzle or some other configuration where the top of the tank is farther than 1 inch from the probe coupler, then set BLK as follow:

If RS=1 (probe length <100 ft) , add 4 to BLK value for every inch of tank nozzle.
 If RS=2 (Probe length >= 100ft), add 2 to BLK value for every inch of tank nozzle.

The verification of the correct setting can be done, by moving the level up and down at the top of the vessel. With the MT2000 powered up, proceed to CFG menu and scroll down to RC, Raw Count value display. RC will decrease as the level rises, and increase as the level lowers.

- If RC stays at a fixed low value while the level changes, BLK is set to low and needs to be incremented.
- Raise the level and stop when RC stops decreasing or the top of the vessel is reached, whichever comes first. If RC stops decreasing, before the top level is reached, then reduce BLK.

Typical BLK factory settings:

Range Setting	Transmitter Configuration from Model Number	
	/L or /LW Local Option	/R or /RW Remote Option
probe <100 ft , RNG = 1	BLK = 200	-
probe >100 ft , RNG = 2	BLK = 100	-

Threshold Level parameter, THV, and Gain Setting, GS:

For products with dielectric constant above 10, keep the factory default settings THV = 1.5, GS = 2, and skip to next step.

The threshold level and gain setting are used to improve the detection of product with low dielectric constant. Typical values for THV are between 1.0 and 1.9, and GS can be set to 1, 2, 3, or 4, where 4 is the highest gain (for lower dielectric constants).

The following values should be used as starting points:

	GS	THV
Dielectric Constant greater than 35	1	1.50
Dielectric Constant greater than 10 and less than 35	2	1.50
Dielectric Constant greater than 3 and less than 10	3	1.60
Dielectric Constant greater than 1.7 and less than 3	4	1.40

Assuming that the 4mA point is set towards the bottom end of the probe and that the 20mA point is set towards the top, for a given GS setting, if THV is set too high, the output will either read high or spike high. If THV is set too low, the output will either read low or spike low. Adjust THV as needed to obtain a steady output reflecting the actual level, over the usable measuring range.

4.2) 4 & 20 mA CALIBRATION USING THE PUSHBUTTONS:

Once the transmitter is configured properly, a manual calibration of the 4 and 20mA points can be done as follow:

Note: In the following instructions, if it is not possible to calibrate the instrument with a tank level, calibration can be done on the bench as follow: If the probe is a rod, position the rod so that it stands clear of any objects (with at least 6" of separation). If support is needed, only use very low dielectric material, such as styrofoam blocks. If the probe is a cable, hang the cable vertically in open space, or place it under tension between the coupler and the cable end. A hand palm can be used as a target if placed perpendicular to the probe and with the probe passing between two fingers. Use the front of the hand as the measuring reference.

Manually Setting the 4 and 20 mA points:

- 1) Enter the calibration mode by pressing the UP & DOWN buttons together for 1 second.

Establish a tank level of 0% (i.e. 4.00 ma) and press the DOWN button for 1 second to set the output at 4.00mA.

2) Enter the calibration mode by pressing the UP & DOWN buttons together for 1 second.

Establish a tank level of 100% (i.e. 20.00 ma) and press the UP button for 1 second to set the output at 20.00 mA.

Note: steps 1 and 2 can be repeated as many times as needed.

Reversing the output action:

If required, the transmitter output can be reversed, by following these steps (Note: this only reverses the 4-20 mA output, not the Engineering Unit Readout):

- Bring the level to 50% ($\pm 10\%$).
- Enter the calibration mode by pressing the UP & DOWN buttons together for 1 second and press the DOWN button for 1 second to set the output at 4.00 mA.
- Bring the level to the new SPAN point.
- Enter the calibration mode by pressing the UP & DOWN buttons together for 1 second and press the UP button for 1 second to set the output at 20.00 mA.
- Bring the level to where the ZERO needs to be set.
- Enter the calibration mode by pressing the UP & DOWN buttons together for 1 second and press the DOWN button for 1 second to set the output at 4.00 mA.
- Bring the level to the new SPAN point.
- Enter the calibration mode by pressing the UP & DOWN buttons together for 1 second and press the Up button for 1 second to set the output at 20.00 mA.

Setting the output damping:

The output damping can be changed as follow:

- Pressing the SELECT and UP buttons together for 1 second, doubles the damping value.
- Pressing the SELECT and DOWN buttons together for 1 second, divides the damping value by 2.

Note: Damping values can range from .1 Sec to 36 Sec.

4.3) CALIBRATION USING THE LCD SETUP MENU:

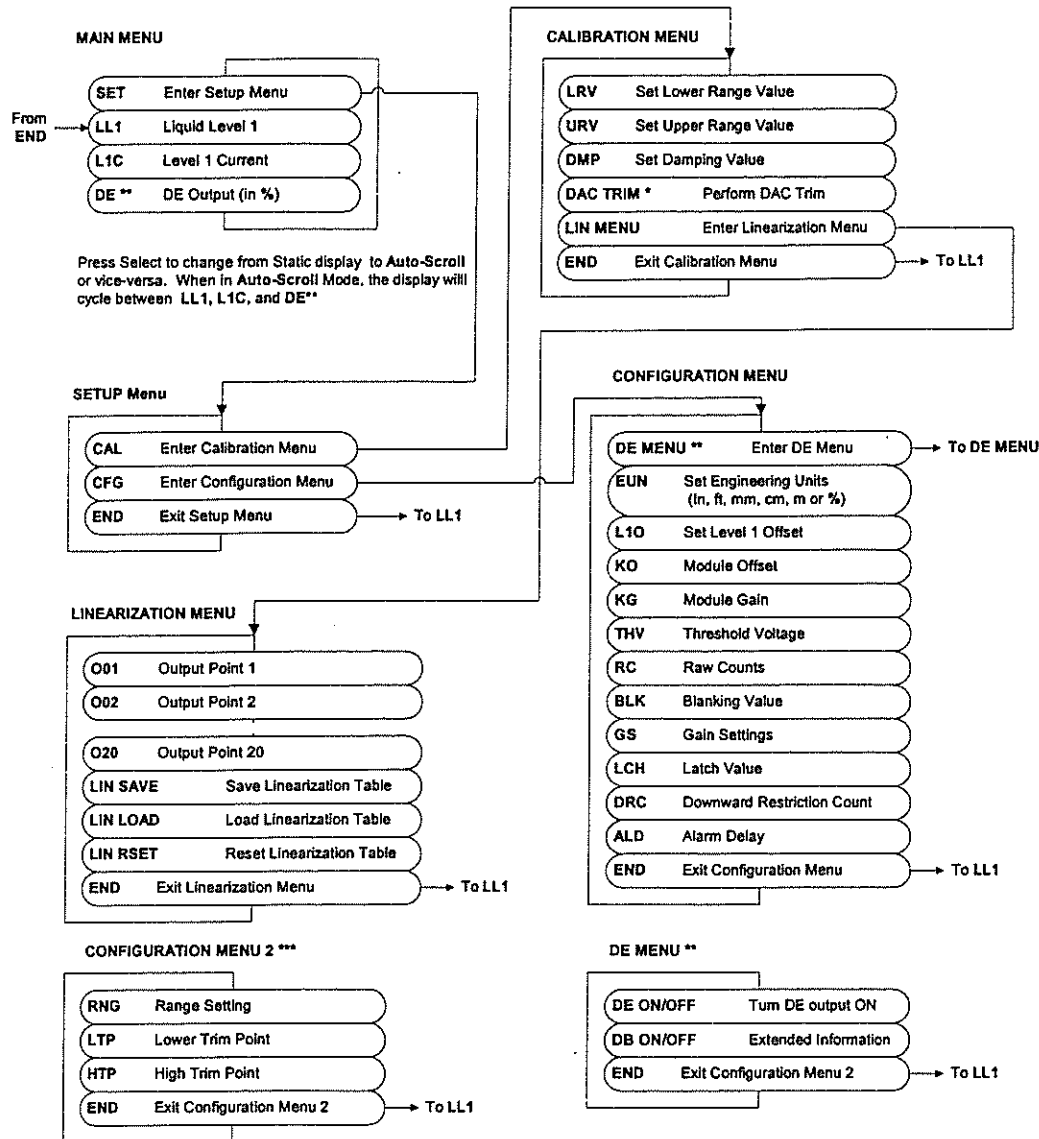
The LCD Display option offers a menu driven SETUP which uses the UP, DOWN and SELECT pushbuttons, as indicated in the following table:

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MT2000 LCD OPTION MENU FLOW CHART:

- Notes:
- Press "UP" or "DOWN" to scroll through menu options.
 - Press "SELECT" to Select a menu option.
 - When changing a variable, press "SELECT" to move between sign or digits, and press "UP" or "DOWN", to modify sign or digit. All digits flashing, means invalid entry, press "SELECT" to continue.

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* Press DOWN & SELECT together for 4mA trim
UP & SELECT together for 20mA trim

** Available on DE output models only

*** Refer to Appendix B for Instructions

4.4) DIP SWITCH SETTINGS:

The dip switches located on the top of the electronic module can be setup as follow:
Please refer to attached wiring diagram ELE1002.

- ALARM: (Left jumper)

Placing the jumper to the lower position causes the output to go to 21.00mA when there is a loss of signal or transmitter malfunction.

Placing the jumper to the upper position causes the output to go to 3.62mA when there is a loss of signal or transmitter malfunction.

NOTE: For the change to go into effect, transmitter power needs to be cycled, OFF and ON.

The alarm output works in conjunction with the alarm delay 'ALD' setting available in the configuration 'CFG' menu. The output will go to alarm state only if there is a loss of signal, which last at least the duration of the alarm delay. The alarm delay default value is 2 seconds. This means that the output will hold the last measured value, if there is loss of signals lasting less than 2 seconds, and will go to the alarm condition if the loss of signal exceeds 2 seconds.

- WRITE PROTECT (right jumper):

This switch setting is used so that the transmitter configuration cannot be changed manually or with a handheld communicator, when the jumper is in the lower position.

5) HART PROTOCOL INTERFACE OPTION:

The MT2000 transmitter is available with a HART Protocol Option. In order to obtain proper communications, a minimum 250ohm load in series with the loop wiring is required. The HART protocol option allows for the use of the following communicators (Note: other communicators and Hart protocol interfaces can also be used, subject to there capabilities of supporting the GENERIC mode):

5.1) With the 268 ROSEMOUNT Communicator:

Since the MT2000 transmitter is not a known ROSEMOUNT product, the 268 will come up in the GENERIC mode. This mode allows a limited number of commands.

The main commands available are:

- READ OR WRITE OUTPUT UPPER RANGE & LOWER RANGE VALUES.
- READ OR WRITE OUTPUT DAMPING VALUE.
- READ OR WRITE TRANSMITTER TAG, DESCRIPTION, MSG, DATE.
- PERFORM OUTPUT DIGITAL TRIM.
- TEST LOOP OUTPUT.
- SET POLLING ADDRESS.

5.2) With the 275 ROSEMOUNT Communicator:

A 275 which is not loaded with a DEVICE DESCRIPTION for the K-TEK products, will default to the GENERIC mode. In this mode, the commands available are the same as when using a 268 Communicator.

Consult the factory for Device Description availability.

6) HONEYWELL DE OUTPUT OPTION:

6.1) INTEROPERABILITY AND CONFORMANCE CLASS:

The DE option uses the Honeywell proprietary Digitally Enhanced Protocol for Smart Transmitters.

The conformance class support is as follow:

The DCS configuration should be set for Class0, 4 byte Mode.

Class 0: Continuous broadcast, in burst mode, of the following parameters:

PV1: Primary Variable; Level #1 in %

PV status: Ok, Critical or Bad PV

6.2) OPERATING MODES:

The MT2000 transmitter with DE option can be operated in two ways, which can be selected using the setup menu on the instrument.

a) DE Digital mode: In this mode the transmitter output is strictly digital and uses the Honeywell DE Protocol which modulates the loop current On and Off to transmit digital information per above Class Conformance definition.

b) Analog Output Mode: Selecting the Analog Output Mode disables the Honeywell DE Digital Output and places the transmitter in a standard 4-20 mA Output mode. In this mode, no digital communications are available.

NOTE: The current MT2000 Honeywell DE does not support database information. Insure that the 'DB' parameter in the DE menu is set to 'OFF'.

7) TROUBLESHOOTING INFORMATION:

Use a mA meter to measure the output current. When power is applied, the output will go to 4.00 mA for at least 1 second, and then to either the measured level or an alarm condition output. If this does not happen, the transmitter may not be receiving enough power, or the main electronic is defective. Excessive current above 21 mA is also an indication of improper power-up or defective electronics.

7.1) Valid Current Loop Outputs:

- | | |
|----------------|--|
| 21.0 mA | If the top board jumper is set to HI ALARM, a loss of signal, a problem with the configuration, or a malfunction will cause the output to be set to the alarm condition of 21.0 mA. |
| 20.6 mA | When the level increases above the 20 mA point, the output will continue up to 20.6 mA and then latch at that value until the level comes back down again. |
| 20.0 mA | Normal output range between 3.8 and 20.6 mA. |
| 4.0 mA | |
| 3.8 mA | When the level decreases below the 4 mA point, the output will continue down to 3.8 mA and then latch at that value, until the level comes back up again. |
| 3.6 mA | If the top board jumper is set to LO ALARM, a loss of signal or a problem with the configuration or a malfunction, will cause the output to be set to the alarm condition of 3.6 mA. |

Output spiking up or down will usually result from improper THV or BLK settings. Refer to the commissioning section for details.

If a module fails to communicate, verify from the model number that the particular communication option is included.

7.2) ELECTRONIC MODULE REPLACEMENT:

A defective electronic module can be replaced as follow:

- Before installing the new module, write down the KO and KG numbers for future reference (The numbers are marked on the side of the module in the following format: 1-KO-KG, 2-KO-KG).
- Remove the existing module by unscrewing the 2 flat screws holding the module in the housing.
- Note orientation of module and unplug from the housing base.
- Carefully unplug the coax cable connector from side of module.
- Plug the coax cable into the new module.
- Install the new module using the 2 flat head screws.
- Power the unit and using the LCD display, go to the CFG menu to KO and KG and enter the numbers written down from the side of the new module.

The MT2000 is now ready for use without further calibration.

APPENDIX A

SENSOR TRIM:

The engineering unit measurement can be set with a zero reference at any point on the probe or with zero referenced to the bottom of the tank. This is done as follow:

Low Trim Point LTP and High Trim Point HTP are the points used to define the measuring range of the unit. The linear value (in engineering units) and the corresponding counts are stored in the module for each point. After this is done, the module is then able to extrapolate any measurement on the sensing probe based on the trim points.

CAUTION: Changing LTP or HTP will clear the linearization table points since it consists of re-ranging the instrument.

To access the Sensor Trim menu, press the 'UP' and 'DOWN' buttons together, when the LCD display is on 'END', at the end of the CFG menu

Performing the Sensor Trim:

1. With the unit powered up, bring the product to a known level about 6 inches below the maximum level.
2. Using the LCD menu, access **HTP**. Use the "Select" and 'UP and 'DOWN' buttons to set the value to the engineering value of the actual level in the current units.
3. Bring the product to a known level about 6 inches above the minimum level.
4. Using the LCD menu, access **LTP**. Use the "Select" and 'UP and 'DOWN' buttons to set the value to the engineering value of the actual level in the current units.

The sensor trim is now complete and the LRV has been set to equal 0 and URV has been set to the value of HTP. If other LRV and URV are desired, then proceed to the CAL menu and change LRV and URV accordingly.

APPENDIX B

LINEARIZATION:

The MT2000's multi-point linearization system allows improved measurement accuracy along the length of the probe. In particular, this feature can be used to correct non-linearity, which can be seen, typically close to the top and close to the bottom of the sensing probe. In most application, linearization is not required.

The MT linearization uses a table of points set up by the user. For every point, there is an input measurement, provided by the instrument, and an output measurement, provided by the user. As the detected level travels the probe length, the measurement output is calculated from each segment of the table. The table points are used to map sensor measurement to sensor output.

To access the linearization table:

- Access the CAL menu and use 'UP ARROW' to scroll to LIN TABL, then press "Select".

To clear the linearization table

- Access the linearization table and scroll up to LIN RSET, then press "Select" to clear the table.

Setting up Linearization Table Points:

For each point in the table:

- Establish a known level. Enter the engineering value that should be read at that point. A measurement sample will be taken when "Select" is pressed on the last digit, setting the input measurement and its corresponding output measurement as a new table point.
- Scroll down to the next point and repeat as needed for additional points.

Selecting table points:

Due to the nature of the measurement and the construction of the instrument, most of the non-linearity is observed in the bottom 12 inches and the top 12 inches of the probe. Since there is 20 points available in the table, typical linearization points should be selected as follow:

Probe Length	Table Points
24" Probe	0.1", 0.5", 1", 1.5", 2.0", 3.0", 4.0", 6", 12.0", 18", 19", 20", 21", 23"
48" Probe	0.1", 1", 2", 3", 4, 6", 12", 24", 36", 42", 43", 44", 45", 46", 47"
120" Probe	.5", 3", 6", 12", 24", 36", 48", 60", 72", 84", 96", 108", 114", 117", 119"

Notes on Linearization Table Usage:

- 1) A point may be removed ("zeroed out") from the table by entering "0" for its value. If a point is zeroed out, it is ignored when measurement output is calculated.
- 2) For all points in the table, all points must be increasing in increasing in measurement, with the exception of zeroed points; therefore, it is recommended that when setting up the table, points should be set up sequentially from lowest to highest measurement.
- 3) A zeroed point may be set again, provided it is increasing with respect to the previous points in the table list.

Saving/Loading a Linearization Table:

Because setting up the linearization table can be a time-consuming process, it is recommended to save a copy of the table, to allow reloading of the table from a previous save.

To save the current linearization table:

Under the CAL menu:

- 1) Scroll to LIN TABL, then press "Select".
- 2) Scroll up to LIN SAVE, then press "Select".

To load a saved linearization table:

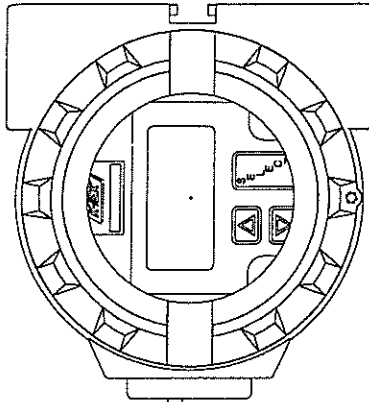
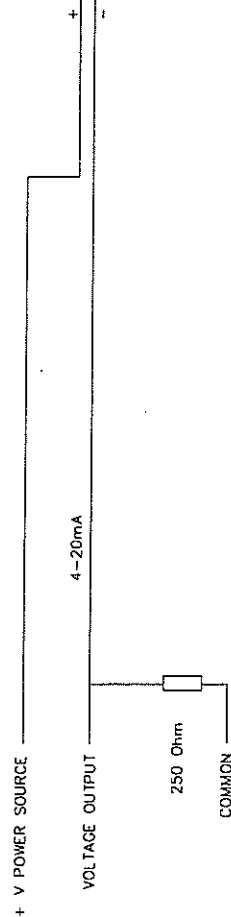
Under the CAL menu:

- 1) Scroll to LIN TABL, then press "Select".
- 2) Scroll up to LIN LOAD, then press "Select".

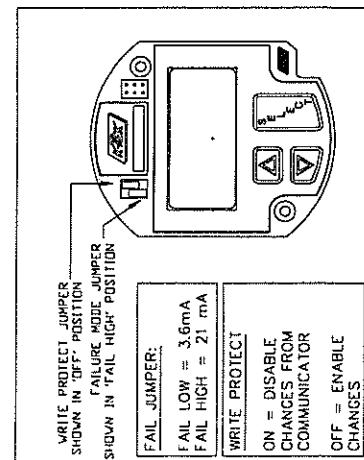
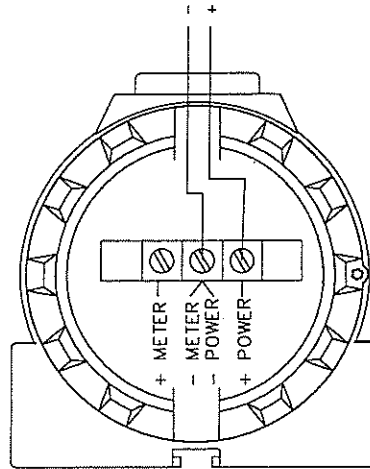
MT2000 INSTRUCTION MANUAL

REV	REASON	APPROVAL	DATE
N.C.	FIRST RELEASE	E.F.	11-20-97
A	ADD HOOKUP	E.F.	8-04-98
B	ADD MT2000	E.F.	04-07-00

TYPICAL LOOP WIRING DIAGRAM



REAR VIEW



K-TEK	K-TEK CORPORATION 18321 SWAMP ROAD PRAIRIEVILLE, LA 70769 USA
LOOP POWERED TX HOOKUP DUAL COMPARTMENT HOUSING	
DRAWN BY: E.F.	SCALE: NONE
FILE: NCDM-ELE1002A	
DOCUMENT: ELE1002	PAGE 1 OF 1

NOTE: THIS DRAWING APPLICABLE TO:
AT100, AT100S, AT100P
AT200, AT200P, MT2000 SERIES

APPENDIX B-5

FLOWMETERS (TOSHIBA)

TOSHIBA

6F8A0751

ELECTROMAGNETIC FLOWMETER

MODEL LF413/LF403

INSTRUCTION MANUAL

TOSHIBA CORPORATION

NOTICE

This Manual is designed to assist in installing, operating, and maintaining the LF413/LF403 combined type electromagnetic flowmeter. For safety reasons, and to obtain the optimum performance from the flowmeter, read this Manual thoroughly before working with the product. Keep the Manual within easy reach for reference whenever needed.

The flowmeter to which this Manual refers is NOT designed for applications in which the functioning of this product is critical to human safety, such as:

- Main control systems of nuclear power plants; safety systems in nuclear facilities or other critical control lines directly affecting human safety.
- Control systems of medical equipment, including life support machines.

NOTES

1. The reproduction of the contents of this Manual in any form, whether wholly or in part, is not permitted without explicit prior consent and approval.
2. The information contained in this Manual is subject to change or review without prior notice.
3. Be sure to follow all safety, operating and handling precautions described in this Manual and the regulations in force in the country in which this product is to be used.

HART is a registered trademark of the HART Communication Foundation.
Teflon is a registered trademark of the DuPont Company.

First Edition
January, 1998

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SAFETY PRECAUTIONS

Safety signs and labels affixed to the product and/or described in this manual give important information for using the product safely. They help prevent damage to property and obviate hazards for persons using the product.

Make yourself familiar with signal words and symbols used for safety signs and labels. Then read the safety precautions that follow to prevent an accident involving personal injury, death or damage to property.

Explanation of signal words

The signal word or words are used to designate a degree or level of hazard seriousness.

The signal words used for the product described in this manual are **WARNING** and **CAUTION**.

 WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
 CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injuries or in property damage.

Safety symbols

The following symbols are used in safety signs and labels affixed to a product and/or in the manual for giving safety instructions.

	Indicates an action that is prohibited. Simply DON'T do this action. The prohibited action is indicated by a picture or text inside or next to the circle
	Indicates an action that is mandatory. DO this action. The mandatory action is indicated by a picture or text inside or next to the circle.
	Indicates a potential hazard. The potentially hazardous situation is indicated by a picture or text inside or next to the triangle.

SAFETY PRECAUTIONS (continued)**Safety Precautions for Installation and Wiring**

 WARNING	
■ Do not remove cover while circuits are live to prevent ignition of explosive atmospheres..  Live part of electric circuit or a high temperature department can cause explosion. DON'T	
■ Do not modify or disassemble the enclosure.  Strength degradation and defects of enclosure can cause explosion. DON'T	
■ Do not use parts of other products.  Explosionproof performance degradation can cause explosion. DON'T	
■ Do not live circuits While assembly of all component is not over.  Explosionproof performance degradation can cause explosion. DON'T	

 CAUTION	
■ Turn off mains power before working on pipes.  Working on pipes while power is applied can cause electric shock. DO	■ Use an appropriate device to carry and install the LF413/LF403.  If this product falls to the ground, injury, or malfunction of or damage to the product, can be caused. DO
■ Install a switch and fuse to isolate the LF413/LF403 from mains power.  Power supply from mains power can cause electric shock or circuit break-down. DO	■ Do not modify or disassemble the LF413/LF403 unnecessarily.  Modifying or disassembling this product can cause electric shock, malfunction of or damage to this product. DON'T

SAFETY PRECAUTIONS (continued)**Safety Precautions for Maintenance and Inspection**

 CAUTION	
■ Turn off mains power before conducting wiring work.  Wiring while power is applied can cause electric shock. DO	■ Ground the LF413/LF403 independently from power equipment.  Operating this product without grounding can cause electric shock or malfunction. DO
■ Do not conduct wiring work with bare hands.  Remaining electric charge even if power is turned off can still cause electric shock. DON'T	■ Use crimped terminal lugs for the terminal board and GND terminal.  Loose connections can cause electric shock, fire from excessive current or system malfunction. DO
■ Do not work on piping and wiring with wet hands.  Wet hands may result in electric shock. DON'T	The label shown left is placed near the terminal board for power input. (A black border and symbol on yellow triangle) Be alert to electric shock. 
■ Do not touch the LF413/LF403 main body when high temperature fluid is being measured.  The fluid raises the main body temperature and can cause burns when touched. DON'T	■ Do not conduct wiring work when power is applied.  Wiring while power is applied can cause electric shock. DON'T
■ Do not conduct wiring work with wet hands.  Wet hands may result in electric shock. DON'T	The label shown left is placed near the terminal board for power input. (A black border and symbol on yellow triangle) Be alert to electric shock. 
■ Do not use a fuse other than the one specified.  Using a fuse other than the one specified can cause system failure, damage or malfunction. DON'T	Use a rated fuse as follows depending on the power specifications. • Fuse rating: 1A/250V for 100 to 240 V ac, or 2A/250V for 24 V dc • Dimensions: Diameter 5.2 mm × 20 mm

Disclaimer

Toshiba does not accept liability for any damage or loss, material or personal, caused as a direct or indirect result of the operation of this product in connection with, or due to, the occurrence of any event of force majeure (including fire or earthquake) or the misuse of this product, whether intentional or accidental.

Handling Precautions

- To obtain the optimum performance from the LF413/LF403 flowmeter for years of continuous operation, observe the following precautions.

- (1) Do not store or install the flowmeter in:
 - places where there is direct sunlight. If this is unavoidable, use an appropriate sunshade.
 - places where excessive vibration or mechanical shock occurs.
 - places where high temperature or high humidity conditions obtain.
 - places where corrosive atmospheres obtain.
 - places submerged under water.

To put the flowmeter temporarily on the floor, place it carefully with something to support it so that the flowmeter will not topple over.
- (2) Execute wiring securely and correctly.
- (3) Seal the cable thoroughly at the cable gland so that the cable is kept airtight.
- (4) Ground the flowmeter with 100 ohm or less ground resistance. Avoid a common ground used with other equipment where earth current may flow. An independent ground is preferable.
- (5) The converter housing covers and the cable glands are tightened securely at the time of shipment. Do not remove these covers or glands unless it is necessary to wire new cables or replace old ones. Otherwise, gradual deterioration of circuit isolation or damage to this product can be caused. Tighten the covers or cable glands securely again if they have been removed.
- (6) Make sure the fluid to be measured will not freeze in the detector pipe. This can cause damage to the detector pipe.
- (7) Select appropriate wetted materials suited for the process fluid to be measured. Otherwise, fluid leakage due to corrosion can be caused.
- (8) Observe the following precautions when you open the converter housing cover:
 - Do not open the cover in the open air unprotected against rain or wind. This can cause electric shock or cause damage to the flowmeter electronics.
 - Do not open the cover under high ambient temperature or high humidity conditions or in corrosive atmospheres. This can cause deterioration of system accuracy or cause damage to the flowmeter electronics.
- (9) This product may cause interference to radio and television sets if they are used near the installation site. Use metal conduits etc. for cables to prevent this interference.

Handling Precautions (continued)

(10) Radio transmitters such as transceivers or cellular phones may cause interference to the flowmeter if they are used near the installation site. Observe the following precautions when using them:

- Do not use a transceiver whose output power is more than 5 W.
- Move the antenna of a transceiver or a cellular phone at least 50 cm away from the flowmeter and signal cables when using it.
- Do not use a radio transmitter or a cellular phone near the flowmeter while it is operating online. The transmitter or cellular phone's output impulse noise may interfere with the flowmeter.
- Do not install a radio transmitter antenna near the flowmeter and signal cables.

(11) For reasons of flowmeter failure, inappropriate parameters, unsuitable cable

- connections or poor installation conditions, the flowmeter may not operate properly. To prevent any of these problems causing a system failure, it is recommended that you have preventive measures designed and installed on the flowmeter signal receiving side.

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1. Product Inspection and Storage

Upon arrival of the product package, open the package and check the items contained inside. If you do not intend to install the product soon after opening the package, store the product and other related items in a place such as described in 1.2 below.

1.1 Product Inspection

The LF413/LF403 electromagnetic flowmeter is shipped in a cardboard container filled with shock-absorbing materials. Open the package carefully and check as follows:

- Make sure the following items are included in the package.

(1) Model LF413/LF403 Electromagnetic Flowmeter.....	1
(2) Instruction Manual	1

- Inspect the flowmeter for indications of damage that may have occurred during shipment.
- Make sure the type and specifications of the flowmeter are in accordance with the ordered specifications.

If you cannot find the items listed above or any problem exists, contact your nearest Toshiba representative.

1.2 Storage

To store the LF413/LF403 flowmeter after opening the package, select a storing place as follows and keep it under the conditions described below:

- (1) Avoid places where there is direct sunlight, rain or wind.
- (2) Store the product in a well-ventilated place. Avoid places of extremely high humidity or extremely high or low temperature. The following environment is recommended:
 - Humidity range: 10 to 90% RH (no condensation)
 - Storage temperature: -15 to +65° C
- (3) Avoid places where vibrations or mechanical shock occur.
- (4) Do not leave the converter housing cover open . Open the cover only when you actually start wiring cables. Leaving the cover open can cause gradual deterioration of circuit isolation.
- (5) To put the flowmeter temporarily on the floor, place it carefully with something to support it so that the flowmeter will not topple over

2. Overview

The LF413/LF403 electromagnetic flowmeter can be used in Class I, Division 1, Groups B, C and D, Class II, Division 1, Groups E, F and G hazardous (classified) locations.

The device measures the volumetric flow rates of electrically conductive materials on the basis of Faraday's Law of electromagnetic induction. The device consists of two units: the LF413 detector, through which the fluid to be measured flows, and the LF403 converter, which receives the electromotive force signals from the detector, then converts the signals into the 4–20 mA dc signal. These two units for the LF413/LF403 are integrally mounted.

Features

Every type of electromagnetic flowmeter has the following features:

- Fluid flow is not obstructed and pressure loss is negligible.
- The process fluid's temperature, pressure, density or flow conditions has no effect on the accuracy of the flowmeter.
- The flowmeter output is directly proportional to the process flow rate, thus it is easy to read its output.

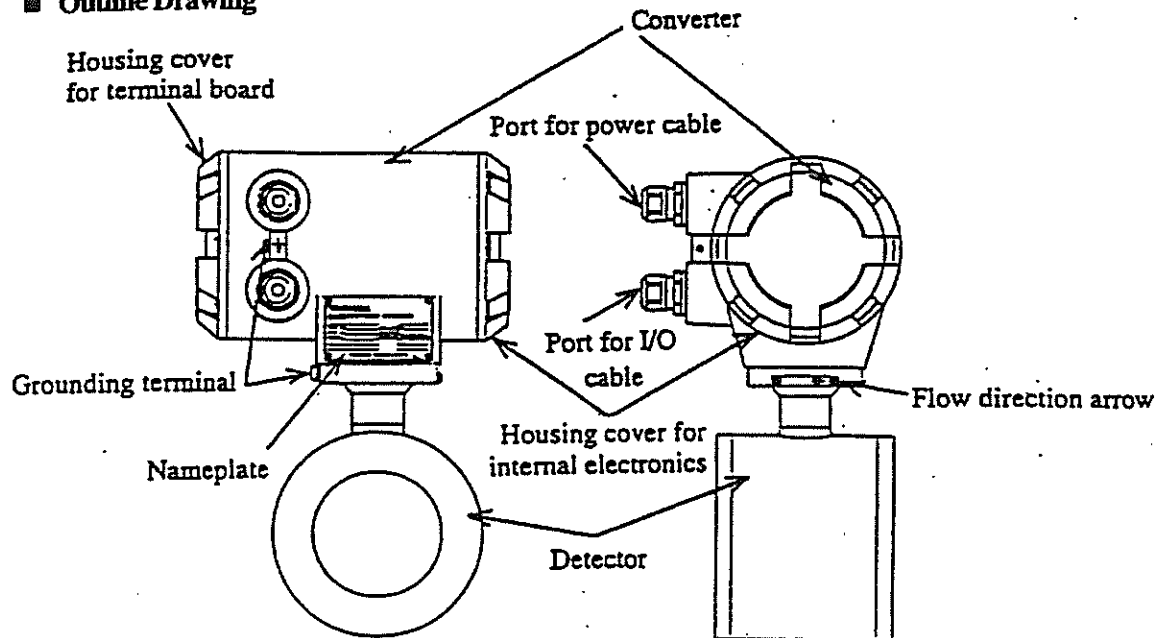
The LF413/LF403 electromagnetic flowmeter has the following additional features:

- (1) High accuracy, $\pm 0.5\%$ of rate is possible for 0.3–10 m/s velocity range. 0.1 to 0.3 m/s range is available optionally.
- (2) The flowmeter can be used to measure fluids with solids (such as sludge or slurries) for the reasons stated below:
 - Ceramic is used for the detector pipe for meter sizes 15 mm to 100 mm.
 - Toshiba's original noise-suppression circuit with signal processing capabilities ensures a stable output.
- (3) The flowmeter has various flow measurement output and control functions as standard specifications and the optional LCD display for convenient parameter settings.
 - These functions can be selected with control keys on the panel.
- (4) Intelligent functions
 - The widely used HART protocol communications system is used as a standard feature. HART (Highway Addressable Remote Transducer) is a communications protocol for industrial sensors recommended by HCF (HART Communication Foundation).
- (5) An easy-to-read LCD display (2-line $\times$ 16-character display) (optional)
The backlit LCD display can be read even under poor lighting conditions.

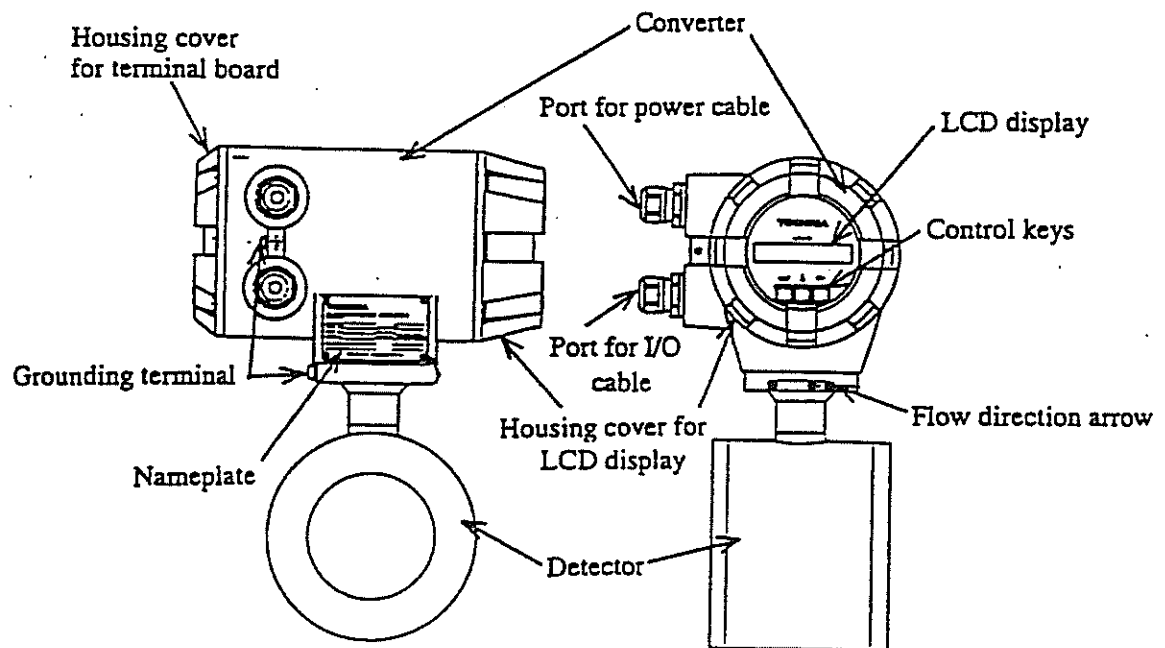
3. Names of Parts

The outline drawing of the LF413/LF403 flowmeter is shown in Figure 3.1 and the internal views of the LF403 converter are shown in Figures 3.2 and 3.3.

■ Outline Drawing



LF413/LF403 without LCD display (standard)



LF413/LF403 with LCD display (optional)

Figure 3.1 Outline drawing of LF413/LF403 Flowmeter

■ Terminal Board of LF403 Converter

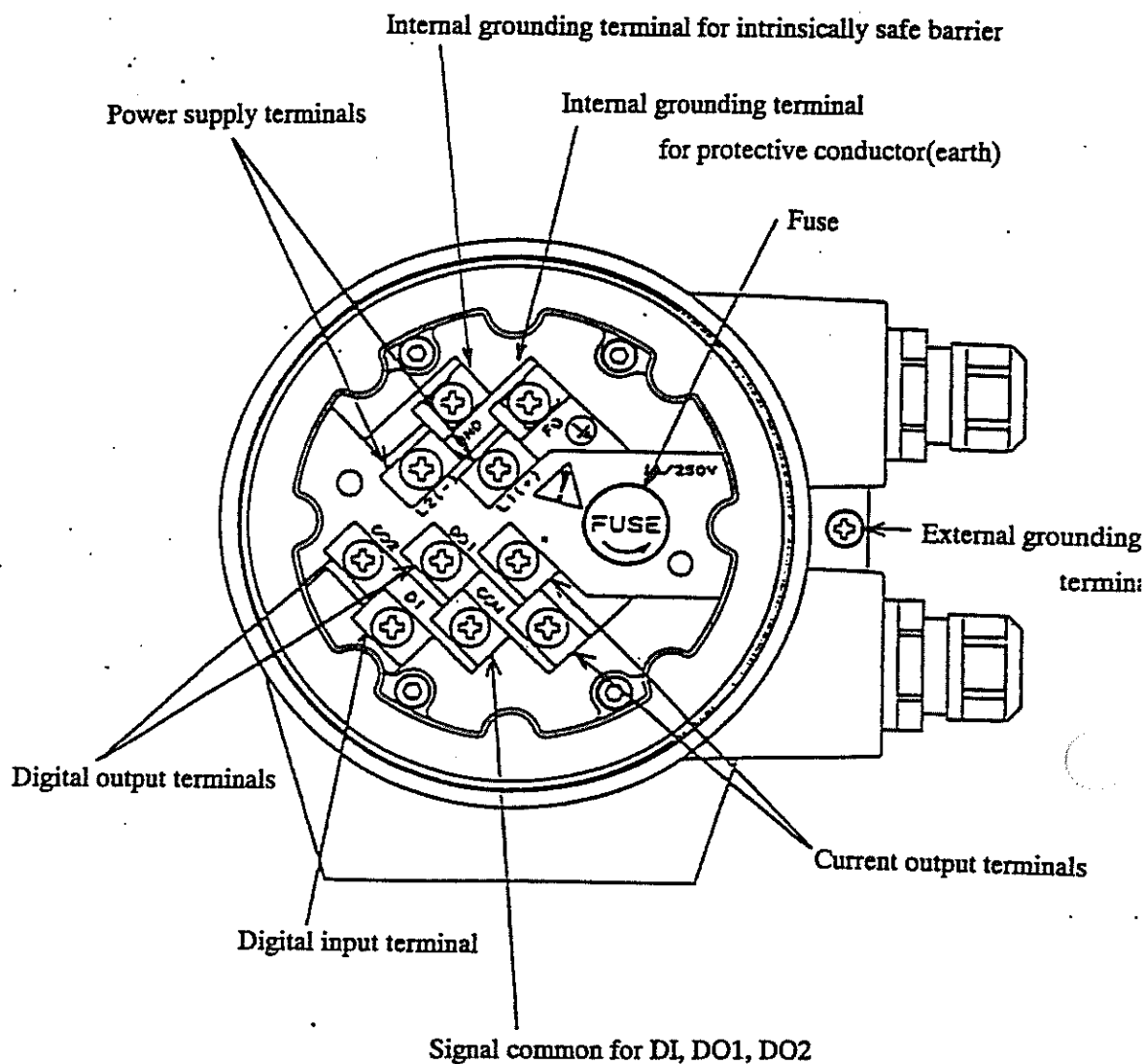


Figure 3.2 Terminal Board of LF403 Converter

■ Control switch or keys of LF403 Converter

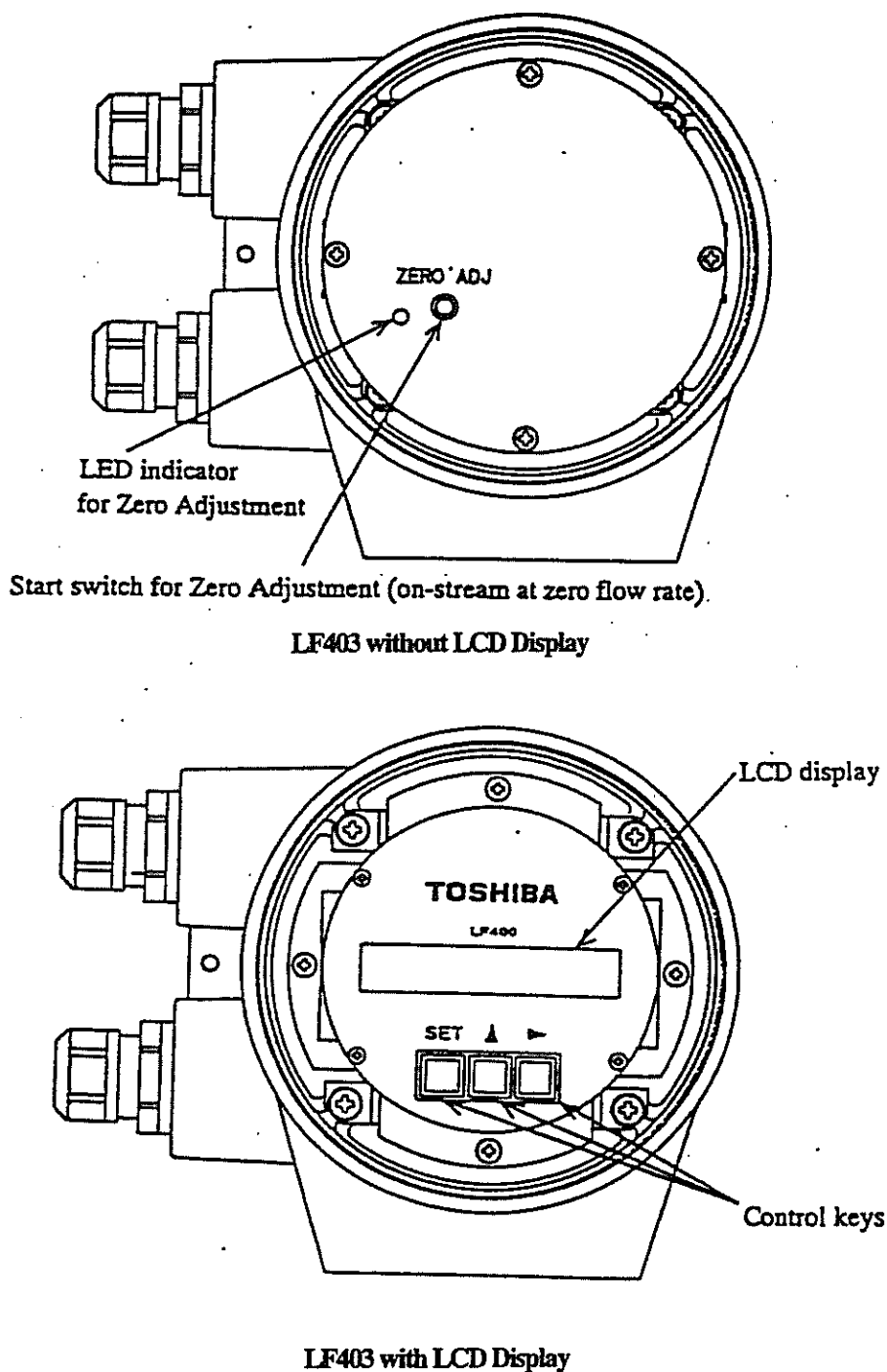


Figure 3.3 Control switch or keys of LF403 Converter

4. Installation

Safety Precautions for Installation

 WARNING	
■ Do not live circuits under environment of explosive atmospheres.	
 DON'T	Live part of electric circuit or a high temperature department can cause explosion.
■ Do not use parts of other products.	
 DON'T	Explosionproof performance degradation can cause explosion.
■ Do not live circuits While assembly of all component is not over.	
 DON'T	Explosionproof performance degradation can cause explosion.

 CAUTION	
■ Install a switch and fuse to isolate the LF413/LF403 from main power.	■ Use an appropriate device to carry and install the LF413/LF403.
 DO	 DO
Power supply from main power can cause electric shock or circuit breakdown.	If his product falls to the ground, injury, or malfunction of or damage to the product, can be caused.
■ Do not modify or disassemble the LF413/LF403 unnecessarily.	■ Ground the LF413/LF403 independently from power equipment.
 DON'T	 DO
Modifying or disassembling this product can cause electric shock, malfunction or damage to this product.	Operating this product without grounding can cause electric shock or malfunction.
■ Do not work on piping and wiring with wet hands.	
 DON'T	
Wet hands may result in electric shock	The label shown left is placed near the terminal board for power input. (A black border and symbol on yellow triangle) Be alert to electric shock.

4.1 Location

To select the installation site, follow the precautions described below:

- Avoid places where fluid runs in a pulsating form.
- Avoid places within the immediate proximity of equipment producing electrical interference (such as motors, transformers, radio transmitters, electrolytic cells, or other equipment causing electromagnetic or electrostatic interference).
- Avoid places where excessive pipe vibration occurs.
- Avoid places where there is direct sunlight. If this is unavoidable, use an appropriate shade
- Avoid places where corrosive atmospheres or high humidity conditions obtain.
- Avoid places of too great an elevation or constricted areas where clearance for installation or maintenance work is not provided.
- Design piping so that the detector pipe is always filled with fluid, whether the fluid is flowing or not.
- The LF413 detector has no adjustable piping mechanism. Install an adjustable short pipe where needed.
- Chemical injections should be conducted on the downstream side of the flowmeter.

4.2 Mounting Procedure

 CAUTION	
■ Use an appropriate device to carry and install the LF413/LF403.  DO If his product falls to the ground, injury, of malfunction of or damage to the product, can be caused.	■ Turn off mains power before working on pipes.  Working on pipes while power is applied can cause electric shock. DON'T

To mount the LF413/LF403, place it between the upstream and downstream pipe flanges and tighten it with flange bolts and nuts. See Figure 4.1 and follow the procedure below:

1. Insert two lower mounting bolts through the clearance holes in the upstream (or downstream) pipe flange.
2. Install a packing next to the upstream (or downstream) flange face and the other packing next to the downstream (or upstream) pipe flange. The two mounting bolts can now be guided through the clearance holes in the downstream packing and flange.
3. Place the LF413/LF403 flowmeter between the two flange packings, with the flowmeter detector body above the two bolts. The flowmeter must be oriented in accordance with the flow direction arrow.
4. Install the two upper mounting bolts through the clearance holes in the upstream and downstream packings and flanges. Then install the remaining mounting bolts depending on the flange pattern used.

5. Thread nuts on both ends of the 4 (or more) mounting bolts, finger tight.
6. While centering the flowmeter with the longitudinal axis of the pipeline, tighten the nuts with a wrench diagonally across in even increments.

Note that the flowmeter detector pipe axis must be aligned with the pipeline axis on both upstream and downstream sides. This is essential to have stable characteristics of flow measurement (especially for flowmeters with meter sizes of 50 mm or less).

IMPORTANT

When high-temperature fluid is being measured, radiant heat from the detector pipe surface and adjoining pipes may cause the ambient temperature of the converter to go above 60 °C. If the ambient temperature goes above 60° C, try to lower the temperature by measures such as wrapping heat-insulating materials over the detector pipe and adjoining pipes.

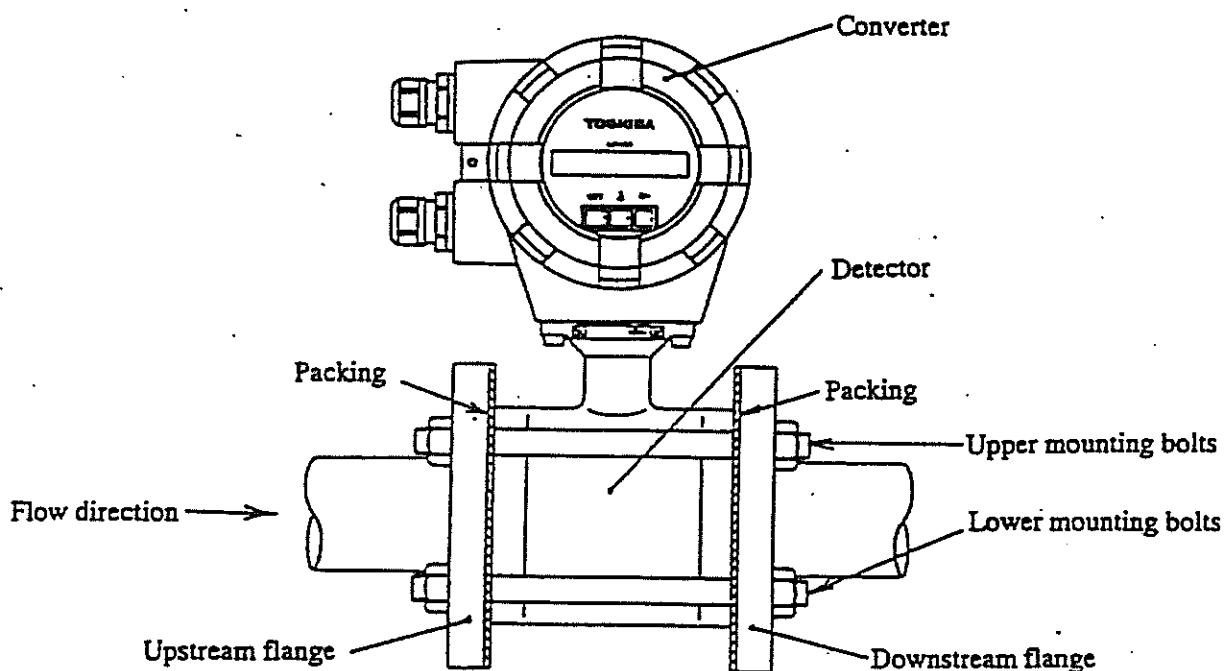


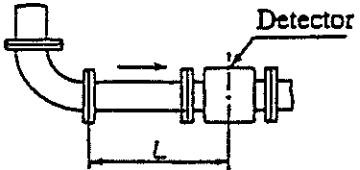
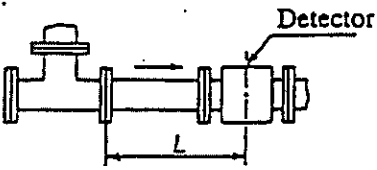
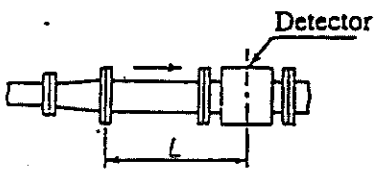
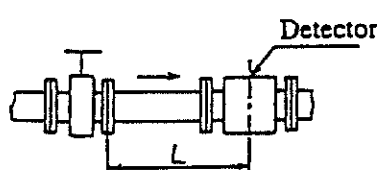
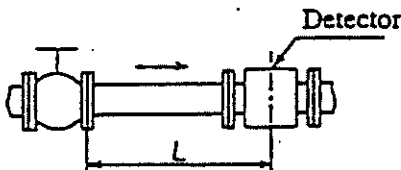
Figure 4.1 LF413/LF403 flowmeter piping connections

4.3 Piping Connections

(1) Required Pipe Length

If various joints are used upstream of the detector outlet, the straight pipe length as shown in Table 4.2 is required.

Table 4.2 Required straight pipe length on the upstream side

$L = 5D$	$L = 10D$
(1) 90° bent  (2) Tee  (3) Diffuser  (4) Fully opened sluice valve 	5. Other valves (not fully opened) 

L: Required straight pipe length—straight pipe length plus half length of the detector.

D: Nominal bore size (diameter)

NOTES

1. The length of a reducer, if connected, can be counted as a part of the straight pipe length.
2. No straight pipe length is needed on the downstream side. If a butterfly valve is installed downstream of the detector, do not let the valve plate protrude into the pipe of the detector.

(2) Pipe Orientation

The detector may be installed in horizontal, vertical or sloping pipe runs as shown in Figure 4.2. However, except for horizontal installation, fluid should flow from lower to upper directions. See Figure 4.2.

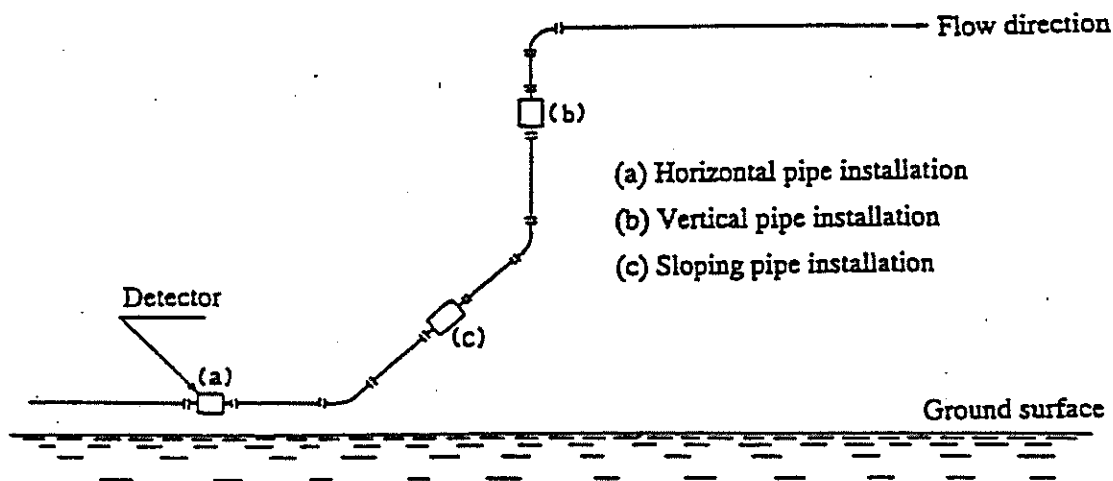


Figure 4.2 Detector Piping Orientation

The electrodes should be positioned horizontally against the ground surface in any piping installation. See Figure 4.3.

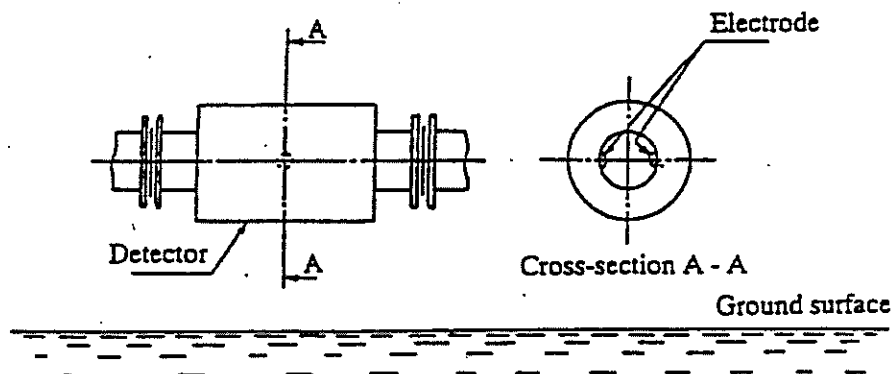


Figure 4.3 Installation position of the detector

(3) Flow Direction

Install the detector in accordance with the flow direction arrow on the detector. See Figure 4.4. If the actual flow runs opposite to the specified flow direction, the following display and output appears. (For bidirectional multi-range measurement, see 10.3, "Multi-range Functions.").

- **LCD display (optional):** Instantaneous flow rate—indicates negative values,
Totalized flow—no counts added.
- **Output:** Current output—4.0 mA output; Pulse output—No pulses

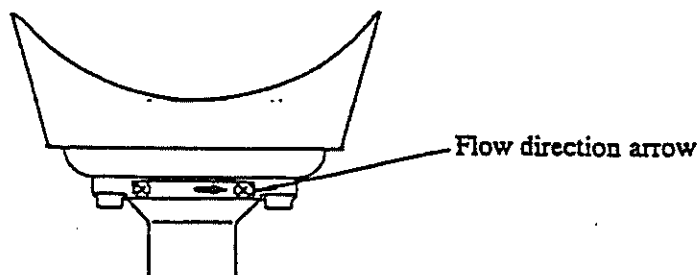


Figure 4.4 Flow direction arrow on the detector

(4) Preventing an Empty Pipe Condition

Design an upright pipe run (Figure 4.5) or sufficient head pressure (Fig. 4.6) at the downstream detector outlet if there is a possibility of the detector pipe becoming emptied.

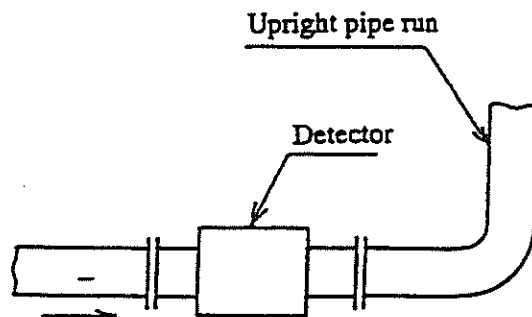


Figure 4.5 Detector with an upright pipe run at downstream outlet

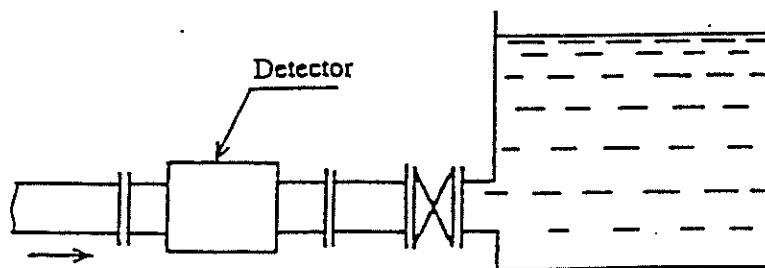


Figure 4.6 Detector with sufficient head pressure at downstream outlet

5. Wiring

Safety Precautions for Wiring

 WARNING	
 DON'T	■ Do not live circuits under environment of explosive atmospheres. Live part of electric circuit or a high temperature department can cause explosion.
 DON'T	■ Do not live circuits While assembly of all component is not over. Explosionproof performance degradation can cause explosion.

 CAUTION	
Do not work on piping and wiring with wet hands.  DON'T Wet hands can cause system failure.	■ Ground the LF413/LF403 properly.  DO Operating this product without a grounding can cause system malfunction.
■ Do not modify or disassemble the LF413/LF403 unnecessarily.  DON'T Modifying or disassembling this product can cause electric shock, malfunction of or damage to this product.	 The label shown left is placed near the terminal board for power input. Be alert to electric shock.

Flowmeter accuracy may be affected by the way wiring is executed. Proceed with wiring taking the following precautions:

- (1) Select the cable runs away from electrical equipment (motors, transformers, or radio transmitters) which causes electromagnetic or electrostatic interference.
- (2) Deterioration of flowmeter circuit insulation occurs if the converter interior or cable ends get wet or humidified. This in turn causes malfunction of the flowmeter or noise problems. Avoid a rainy day if the flowmeter is to be installed outdoors. Even indoors, prevent water from splashing over the flowmeter. Try to finish the wiring as quickly as possible
- (3) The converter has a surge-absorbing barrier installed inside. Therefore, do not conduct a withstand voltage test for the converter. To check the insulation of the converter, use a voltage of 250 V dc or less.

5.1 Cables

Use the kind of cables shown in Table 5.1 to wire the converter.

Table 5.1 Cables

Name	Cable type	Nominal cross-sectional area	Overall diameter
Power cable	Three-wire sheathed cable (Note)	2 mm ²	11 to 13 mm
I/O cable	The number of wires for the output cable depends on the system specifications. Use a shielded cable with nominal cross-sectional area of 1.25 mm ² and overall diameter of 11 to 13 mm.		

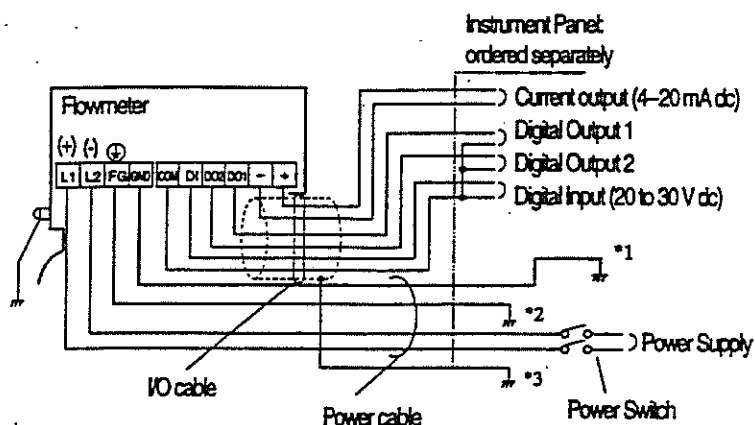
Note: Use a four-wire cable if the arresters are to be used. See Figure 5.1 below.

5.2 External Device Connections and Grounding

The terminal board connections of the LF413/LF403 flowmeter are shown in Figure 5.1.

Proceed with wiring as described in Section 5.4, "Wiring Procedure."

If power supply is specified as DC, use L1 as positive (+) and L2 as negative (–) terminals.



*1 Separate grounding conductor for intrinsical safety from other grounding conductor.

And, the grounding connection shall be sized to no less than No. 12 AWG(3.3 mm²).

*2 Grounded with 100 Ω or less ground resistance.

*3 Locate an external double-pole power switch on the power lone near the flowmeter and within easy operation. Mark on the switch as the disconnecting device for the flowmeter.

Use the proper switch as follows.

Recommended switch rating;	Rating	250Vac or more
	Inrush current	15A or more

Figure 5.1 Terminal Board Connections

IMPORTANT

- (1) The grounding terminal of the LF413/LF403 flowmeter should be grounded with 100 ohm or less ground resistance. Use a heavy copper braid or wire (cross-sectional area 5.5 mm^2 minimum) to ground the terminal and make it as short as possible. The terminal is M4 size and an M4-size crimped ring lug should be used to connect the wire to the terminal. Avoid a common ground where earth current may flow. An independent ground is preferable. See Figure 5.2. for a conductive pipeline grounding and non-conductive pipeline grounding procedures.
- (2) To prevent a two-point grounding, ground the shielded cable on the receiving instrument side.

■ If connection pipe is conductive:

- (1) Connect between the grounding terminal and both ends of the mating flanges with a heavy copper braid or wire (cross-section 5.5 mm^2 minimum).
- (2) If the conductive pipe is not grounded to a good earth ground, use the same type of copper braid or wire to ground the terminal with 100 ohm or less ground resistance.

■ If connection pipe is non-conductive:

- (1) Use a heavy copper braid or wire (cross-section 5.5 mm^2 minimum) to ground the terminal with 100 ohm or less ground resistance.

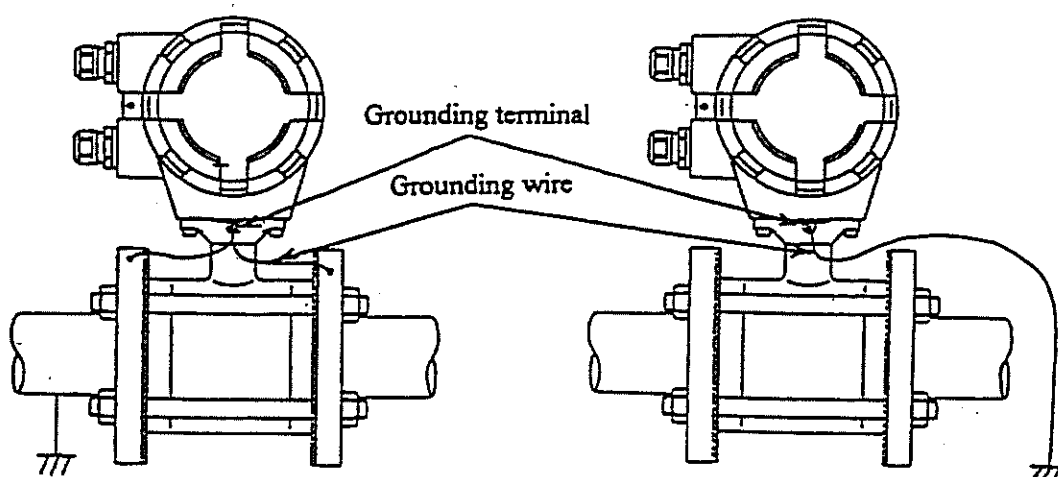


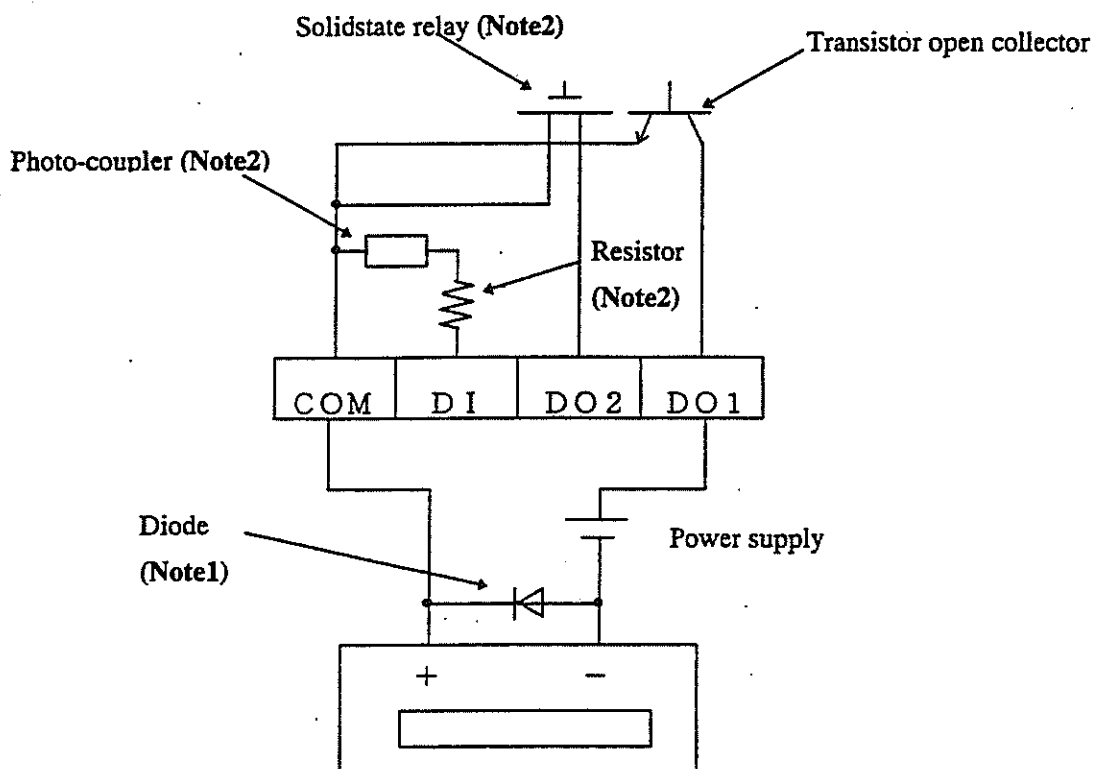
Figure 5.2 Grounding Procedure

5.3 Digital I/O Connections

Digital I/O terminals consist of contact output terminals (standard DO1 and optional DO2), voltage signal input terminal (DI, optional), and signal common terminal (COM). Each terminal (DO1, DO2 and DI) is isolated from internal circuits. Terminal (COM) is the signal common for the other three terminals (DO1, DO2 and DI).

Functions can be assigned for each terminal with the LCD control keys (option). See Chapter 10, "Digital I/O Functions."

To connect an electromagnetic relay or counter to the contact output terminal (DO1 or DO2), put a surge-absorbing diode into the input circuit of the relay or counter. See Figure 5.3 for an example of electromagnetic counter connection.



Note1: Use a diode (current rating 1A minimum and voltage rating 200 V minimum).

Note2: LF403 has no Solidstate relay, Photo-coupler and Resistor. Do not wiring the DO2, DI terminal.

Figure 5.3 Electromagnetic Counter Connection Example

5.4 Wiring Procedure

Cable termination and cable connections are described below.

5.4.1 Cable Termination

 CAUTION	
■ Do not conduct wiring work when power is applied.  Wiring while power is applied can cause electric shock. DON'T	■ Do not work on piping and wiring with wet hands.  Wet hands may result in electric shock. DON'T

Use cables as specified in Table 5.1. Remove about 30 mm of the end of cable sheath to expose the two coated wires and then strip the wires about 10 mm. Then attach an M4-size crimped ring-lug to the end of each wire using a compression tool. The crimped ring-lug should be of the kinds with insulated sleeve to prevent shorts between adjacent terminals. The overall length of the wire with the M4-size ring-lug attached should be about 35 mm. See Figure 5.4.

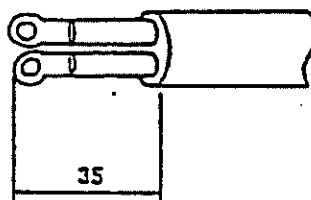


Figure 5.4 Termination of cables

5.4.2 Cable Connections

Connect the terminated cable wires to the terminal board as described below.

IMPORTANT

Connect the wires securely to the terminal board. A loose connection may result in unsatisfactory flowmeter performance. Make sure the wires are securely connected.

- (1) Remove the housing cover for the terminal board shown in Figure 3.1. The terminal board is located inside the converter as shown in Figure 3.2. Connect the crimped terminal of each wire to the specified pin of the terminal board. See Figure 5.1 for the terminal board configuration. Tighten each crimped terminal to the terminal board with a screw using a Phillips screwdriver as shown in Figure 5.6. Loose connection may result in unsatisfactory flowmeter performance. Make sure the wire is securely connected.

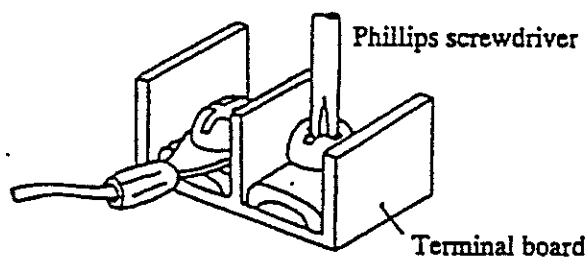


Figure 5.6 Terminal board connections

NOTE

The appropriate torque for tightening the terminal board screws is 1.2 Nm (12 kgf-cm).

- (2) After the terminal board connection, pull the cable a little so that the cable runs straight from the terminal board without unnecessary winding.
Trade size of the conduit opening is NPT 1/2 thread. At the conduit openings, use the cable glands or the connection parts for explosionproof.
- (3) Attach the terminal cover and screw the housing cover for the terminal board. To keep the housing seal, tighten securely the cover, using a tool fitting with the groove on the cover.

6. Operation

⚠ CAUTION

- Do not touch the LF413/LF403 main body when high temperature fluid is being measured.



DON'T

The fluid raises the main body temperature and can cause burns when touched.

6.1 Preparatory check

Follow the procedure described below to prepare before starting the flow measurement.

System Check

- Check the wiring between the converter and related instruments.
- Make sure all the bolts of connection flanges on which the flowmeter is mounted securely tightened.
- Make sure the direction of flow arrow is in accordance with actual flow.
- Make sure the flowmeter is grounded with 100 ohm or less ground resistance.
- Make sure the converter housing covers are securely tightened.

Placing System On-Stream

- Let the fluid go through the detector pipe. When the detector is filled with the fluid, stop the fluid and keep it still in the detector pipe.

Supplying Electric Power

- Make sure the power supply is as specified.

Checking Converter Parameters

- Check the configuration parameter settings. Refer to Chapter 7, "LCD Display and Controls," Chapter 8, "Configuration Parameter Setting," and Chapter 11, "Communications Function."

Zero Adjustment

- Wait for 30 minutes to warm up the flowmeter. Then making sure the fluid holds still in the detector pipe, starts the zero adjustment. Refer to 6.2, "Zero Adjustment."

On-line measurement

After checking the items and conducting the zero adjustment as listed above, let the fluid go through the detector pipe. Output (4–20 mA dc) directly proportional to the flow rate can be obtained.

6.2 Zero Adjustment

To conduct zero adjustment of the flowmeter, the fluid in the detector pipe must be held still. There are three different ways to start the zero adjustment: 1) Pressing the zero adjustment switch for the model without LCD display, 2) Pressing a combination of control keys for the model with LCD display (see 8.2.8, "Zero Adjustment"), or 3) Sending a command signal from a HART communications device (such as the AF100 hand-held terminal). The following is the procedure for starting the zero adjustment for the model without LCD display.

- Press the zero adjustment switch for more than 3 seconds.

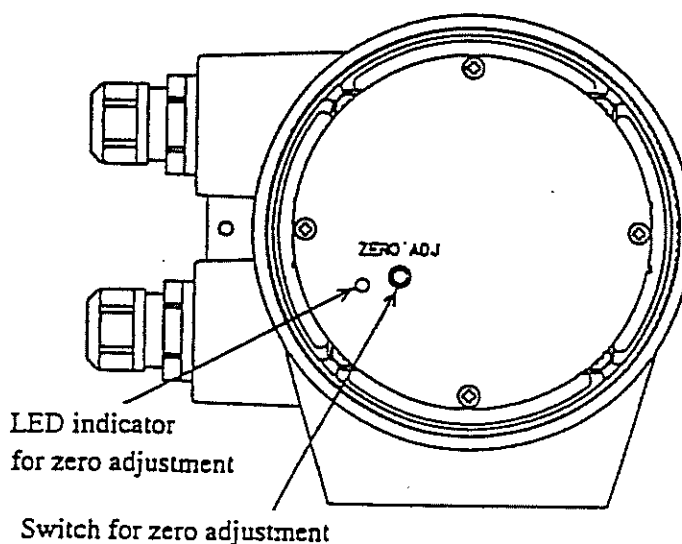
(Note that once the zero adjustment is started, there is no way to cancel the zero adjustment sequence.)

Then the LED indicator lights and the zero adjustment sequence will start. The zero adjustment sequence lasts about 3 to 6 seconds. (Zero adjustment duration depends on the excitation current frequency. It takes about 3 seconds for 24 Hz setting and about 6 seconds for 12 Hz and 6 Hz settings.)

When the zero adjustment sequence ends, the LED indicator goes off.

To conduct the zero adjustment, it is necessary to open the converter housing cover and press the switch. Observe the following precautions when you open the housing cover:

- (1) Do not open the cover in the open air unprotected against rain or wind. If you adjust the flowmeter in the rain, this can cause electric shock or damage to the flowmeter electronics. If wind blows against the internal circuitry of the converter, output may fluctuate and fail to indicate correct measuring values.
- (2) Do not conduct the zero adjustment when the ambient humidity is high. By opening the cover in high humidity conditions, the measuring accuracy may be reduced or damage caused to the flowmeter electronics.



7. LCD Display and Controls (option)

You can select the operation mode, change the configuration parameters or execute operation-specific functions using the control keys on the panel. How to operate these keys is described in this chapter.

7.1 Outline

The LF403 Converter has an optional LCD display. The LCD display can be used to set and indicate various configuration parameters. Figure 7.1 shows the front view of LCD display.

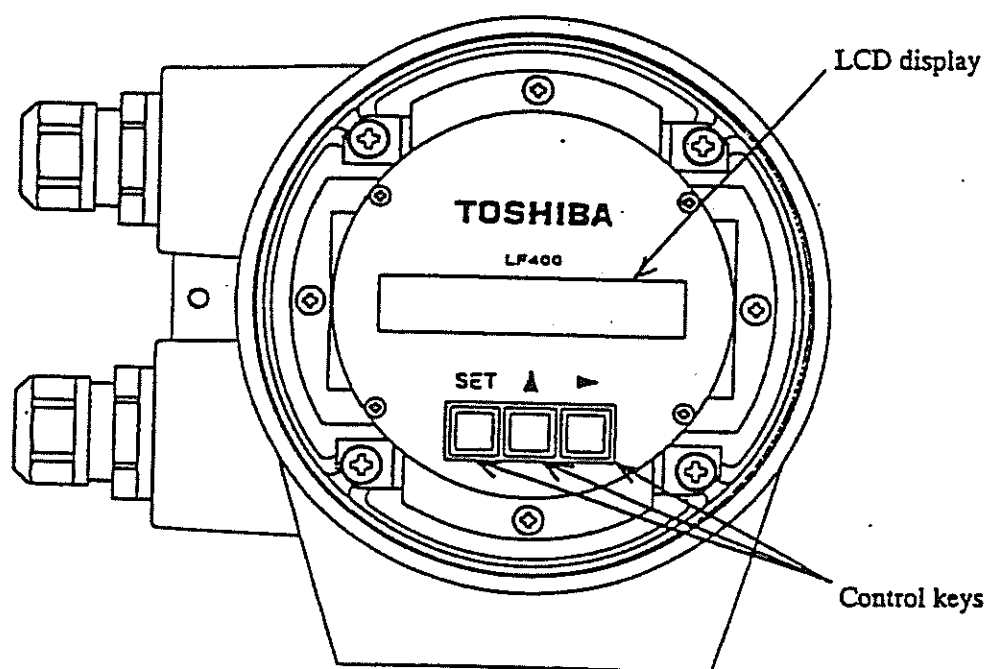


Figure 7.1 LF403 Converter with LCD display

■ LCD display

A 2-line × 16-character liquid crystal display. The backlit display enables an easy-to-read indication even under poor lighting conditions. Instantaneous flow rates or totalized flow in the measurement mode, or configuration parameters in the setting mode can be displayed.

■ Control Keys

Changing the operation mode, checking or changing parameters can be done with these keys.

To operate these keys, you have to open the converter housing cover. Observe the following precautions when you open the housing cover:

- (1) Do not open the housing cover in the open air unprotected against rain or wind. If you open the housing cover in the rain, it can cause electric shock or damage to the flowmeter electronics. If wind blows against the internal circuitry of the converter, output may fluctuate and fails to indicate correct measuring values.
- (2) Do not open the housing cover when the ambient humidity is high. By opening the cover in high humidity conditions, the measuring accuracy may be reduced or damage caused to the flowmeter electronics.

Functions of each control key when pressed are shown in the table below.

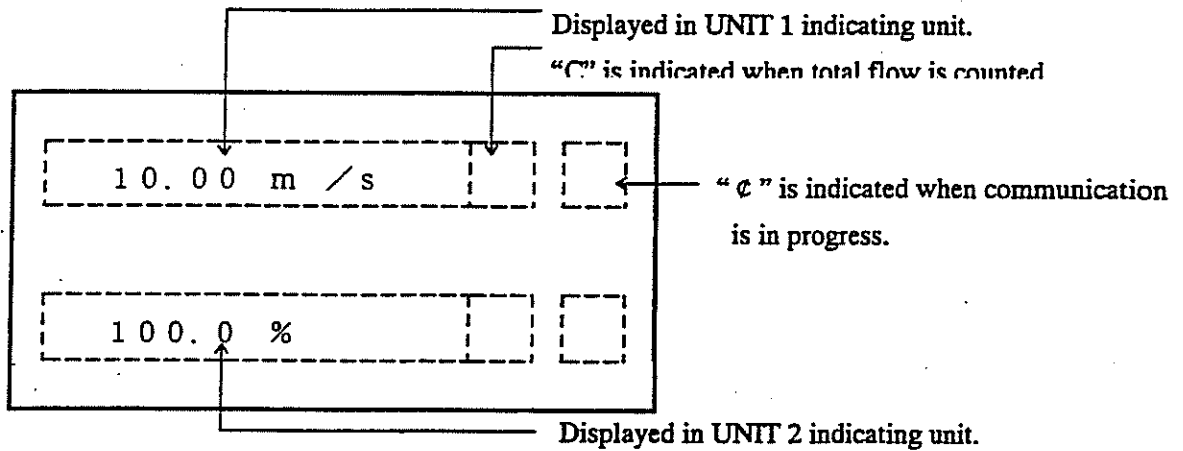
Control keys	Basic functions of control keys
SET	■ Goes into the items selection sequence.
	■ Goes into the detailed-item specifying sequence for each selected item in measurement, setting or calibration modes.
	■ Stores the selected data in the setting mode.
△	■ Changes items (alphabet letter and number) in the items selection sequence, and changes parameters (numbers and/or units) in the detailed-item specifying sequence in measurement, setting or calibration modes.
	■ Starts and stops the totalizer in the measurement mode. (Note)
▷	■ Changes digits (alphabet letter and number) in the items selection sequence, and starts the detailed-item specifying sequence by indicating the left-most digit with the cursor.
	■ Moves the cursor from left to right (from the right end reverts to the left end) in the above sequence.
	■ Resets the totalizer in the measurement mode. (Note)

Note: To operate the totalizer, it is preferable to set the indicating unit (UNIT 1 and/or UNIT 2) to one of the units appropriate for totalization just to make sure it is operating correctly. See 10.2, "Totalizer and Pulse Output."

7.2 Display Format

In the measurement mode, measured data are displayed in UNIT 1 (primary indicating unit) and UNIT 2 (secondary indicating unit). As to indicating units, see 8.2.4, "Indicating Unit."

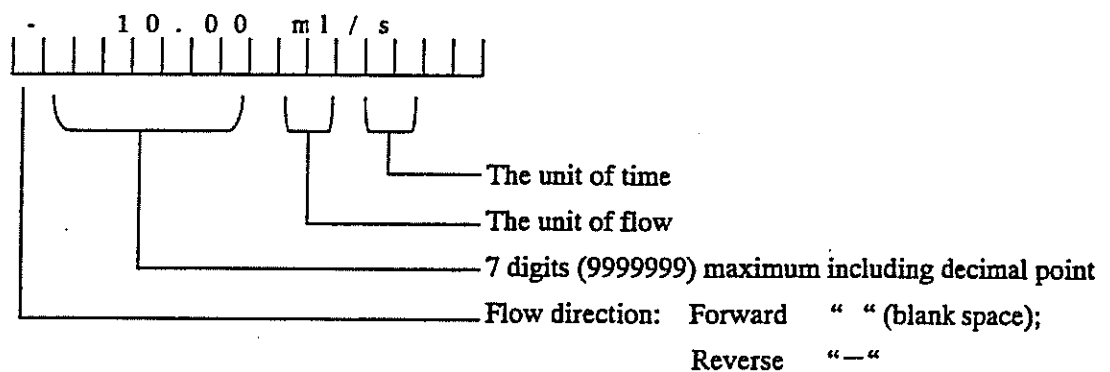
Display Format

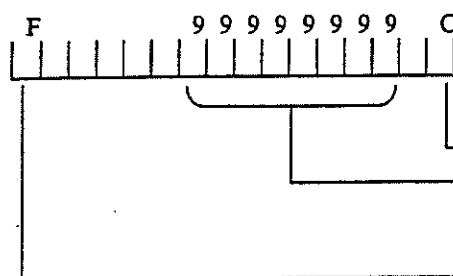


■ Measured Value Display Format

(1) Flow rate

Upper 4 digits maximum are effective (for the selected span)



(2) Totalizer

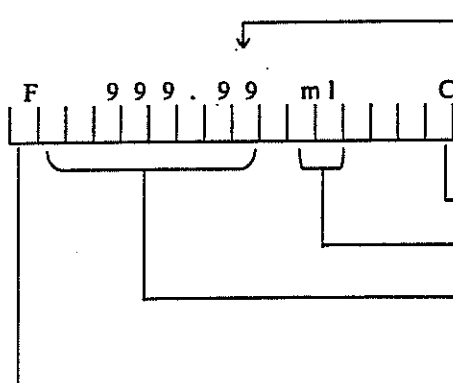
"C" is indicated when totalized flow is counted.

Increments per counting rate. Refer to 8.2.10,

"Counting Rate."

Wraps around after 99999999.

"F" for forward and "R" for reverse direction flow

(3) Volumetric flow

Displays down to the smallest digit of counting rate.

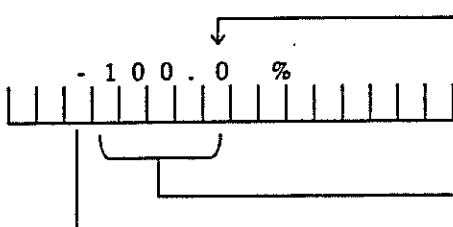
"C" is indicated when volumetric flow is counted.

The unit of flow

8 digits (99999999) maximum including decimal point

If the flow count exceeds 99999999, wraps around.

"F" for forward and "R" for reverse direction flow
will not displayed.

(4) % display

Displayed down to 0.1 %.

Displays up to 125.0 %.

Flow direction: Forward " " (blank space);

Reverse "—"

7.3 Basic operations

Flow measurement in the measurement mode, checking or changing configuration parameters in the setting mode and a converter unit check in the calibration mode are the basic operations of the LF403 converter.

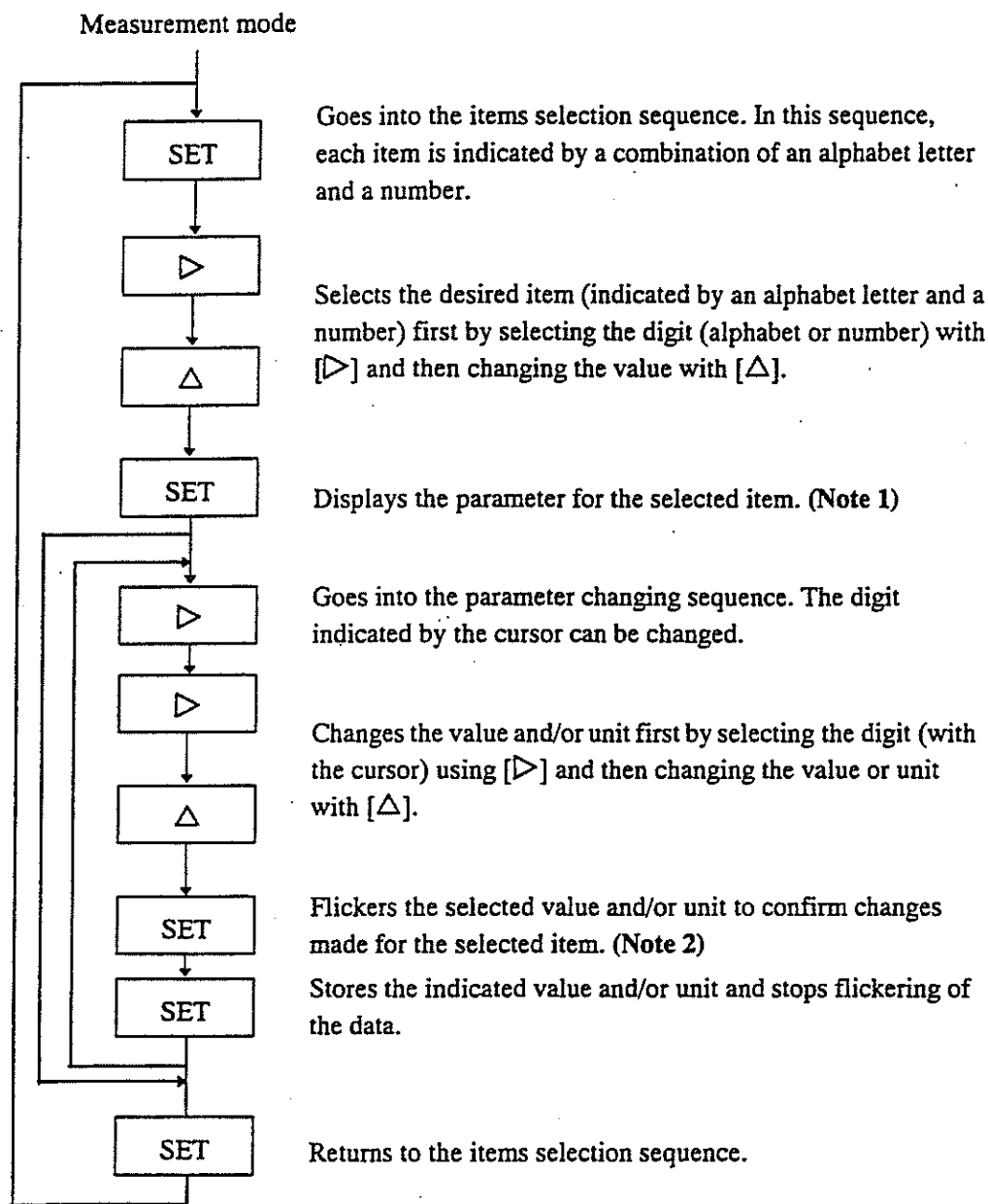
7.3.1 Mode Change

The LF403 converter has three operation modes: measurement, setting and calibration. The system stays in the measurement mode after the power is turned on. To change the mode to the setting or calibration mode, press [SET] and select the desired item using [▷] and [△] keys. To return to the measurement mode, select "0" (MEASURE MODE) for the number column of configuration items (such as A0 or B0) . See 7.4, "Configuration Items Selection Table."

- **Measurement mode:** measures the process flow and displays and outputs the measured process values. The flowmeter can measure the flow velocity, flow rates, or totalized flow. The flowmeter first goes into this mode when power is turned on.
- **Setting mode:** used to check or change various configuration parameters used in the measurement mode. These parameter values are displayed while checking or changing these values but the flowmeter outputs the measured process values as in the measurement mode. See 7.4, "Configuration Items Selection Table" and 8.2, "Checking or Changing Parameters" for details. Configuration items are from A1, A2, A3 to M1.
- **Calibration mode:** used to check the converter internal circuits. The internally generated simulation signal is used to check the measuring span and excitation current value. The current output of the flowmeter changes in accordance with the simulation signal. The status of each digital output is held to the value just before the system moved into the calibration mode. See 7.4, "Configuration Items Selection Table" and Chapter 9, "Calibration" for details. Configuration items are from N1 to N4.

7.3.2 Configuration Parameter Selection in Setting and Calibration Modes

Follow the procedure described below to select configuration items in the setting and calibration modes. The key on the left should be pressed to start each sequence described on the right.



Notes

1. To return to the measurement mode, select "0" (MEASURE MODE) for the number column of any items (such as A0 or B0).
2. To return to the parameter changing sequence, press [△].

7.4 Configuration Items Selection Table

In the setting and calibration modes, configuration items can be selected as shown below. For example, the excitation current can be selected by the item A1. To change the parameters for the selected items, see the following chapters. To return to the measurement mode, select "0" for the number (such as A0).

Setting mode items (A1, A2, A3 to M1): See Chapter 8, "Configuration Parameter Setting."

Calibration mode item (N1 to N4): See Chapter 9, "Calibration."

	0	1	2	3	4	5	6
A	*	Excitation Current	Meter Size	Excitation Frequency			
B	*	Indicating Unit 1	Indicating Unit 2				
C	*	Range Type	Range 1	Range 2	Range 3	Range 4	Range Hysteresis
D	*	Damping Constant	Low Cutoff				
E	*	Zero Adjustment					
F	*	DO1 Function	DO2 Function	DI Function			
G	*	Counting Rate	Pulse Width				
H	*	Preset Count					
I	*	High Alarm Set	High Alarm Value	Low Alarm Set	Low Alarm Value		
J	*	Empty Pipe Alarm					
K	*	Rate-of-change Limit	Control Limit Time				
L	*	Fixed-value Output	Fixed-current Output	Fixed-pulse Output			
M	*	Zero Offset Adjustment					
N	*	Flow Rate Cal 0%	Flow Rate Cal 50%	Flow Rate Cal 100%			

* Returns to the measurement mode.

8. Configuration Parameter Setting

8.1 Configuration Items

To check or change parameters, first select the desired configuration item as described in 7.3.2. The configuration items are listed below. See each section for detailed procedure.

Section	Configuration item	Display example		Page
8.2.1	Excitation Current	A1: EX. CURR.	0.2100 A	37
8.2.2	Meter Size	A2: METER SIZE	50 mm	38
8.2.3	Excitation Frequency	A3: EX. FREQ.	24 Hz	39
8.2.4	Indicating unit	B1: UNIT 1	m/s	41
8.2.5	Range Type	C1: RANGE TYPE	1: SINGLE	43
	Span (range)	C2: RANGE 1	01.000 m/s	
	Hysteresis	C3: RANGE HYST	05.0 %	
8.2.6	Damping Constant	D1: DAMPING	05.0 SEC	48
8.2.7	Low Cutoff	D2: LOW CUT	05.0 %	49
8.2.8	Zero Adjustment	E1: ZERO ADJUST	00.1 %	50
8.2.9	Digital I/O	F1: DO1 FUNC.	1: H ALM	51
8.2.10	Counting Rate	G1: COUNT RATE	6.00E-11	53
	Pulse Width	G2: PLS. EIDTH	020 m/s	
8.2.11	Preset Count	H1: PRESET	009000	55
8.2.12	High/Low Alarm	I1: H. ALARM SET	ON	56
	Alarm Limit Value	I2: H. ALARM VAL	+100.0 %	
8.2.13	Empty Pipe Alarm	J1: EMPTY ALM	ON	59
8.2.14	Rate-of-change Limit	K1: LIMIT RATE	05.5 %	60
	Control Limit Time	K2: LIMIT TIME	01 SEC	
8.2.15	Fixed-value Output	L1: FIXED OUT	OFF	62
8.2.16	Zero Offset Adjustment	M1: MANUAL ZERO	-000.1 %	65

8.2 Checking or Changing Parameters

8.2.1 Excitation Current

Proceed as follows to check or change the excitation current setting value.

■ To check the exciting current setting value:

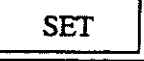
Key operation	Display example	Description
	A1: EX. CURR. 0. 2100A	Press [SET] first to start the items selection sequence and select A1: EX. CURR. from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the exciting current setting value.
	A1: EX. CURR.	Pressing [SET], the system returns to the items selection sequence.

■ To change the excitation current setting value:

IMPORTANT

The exciting current value is factory set when shipped. Do not change the value unless the value differs from that written on the nameplate of the flowmeter.

The following example shows how to change the excitation current setting value from 0.1900A to 0.2150A.

Key operation	Display example	Description
	A1: EX. CURR. 0. 1900A	Press [SET] first to start the items selection sequence and select A1: EX. CURR. from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the excitation current setting value (0.1900 A in this example).
	A1: EX. CURR. 0. 1900A	Pressing [▷], the cursor appears. Then press [▷] as many times as necessary to move the cursor to the digit to be changed.
	A1: EX. CURR. 0. 2900A 0. 2100A 0. 2150A	Change the value by pressing [△]. Then move the cursor to another digit by pressing [▷] and change the value. In this example repeat this process until the display shows "0.2150A." (Note)
	A1: EX. CURR. 0. 2150A	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to save the value.
	A1: EX. CURR.	Pressing [SET], the system returns to the items selection sequence.

Note: The valid range is from 0.0500A to 0.2300A. If you try to set the value above 0.2300A, the error message * H. OVER SPEC appears. Set the value within the valid range.

8.2.2 Meter Size

Proceed as follows to check or change the meter size of the detector.

■ To check the meter size:

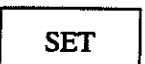
Key operation	Display example	Description
	A2: METER SIZE 50 mm	Press [SET] first to start the items selection sequence and select A2: METER SIZE from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current meter size.
	A2: METER SIZE	Pressing [SET], the system returns to the items selection sequence.

■ To change the meter size:

IMPORTANT

Meter size is factory set when shipped. Do not change the meter size unless it differs from the specified value.

The following example shows how to change the meter size from 50 mm to 100 mm.

Key operation	Display example	Description
	A2: METER SIZE 50 mm	Press [SET] first to start the items selection sequence and select A2: METER SIZE from among the configuration items using [▷] and [△] keys. Press [SET] again to display the current meter size (50 mm in this example).
	A2: METER SIZE 50 mm	Pressing [▷], the cursor appears.
	A2: METER SIZE 100 mm	Select "100 mm" by pressing [△] as many times as necessary. (Note)
	A2: METER SIZE 100 mm	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to save the value.
	A2: METER SIZE	Pressing [SET], the system returns to the items selection sequence.

Note: The meter size is changed as shown below by pressing [△]. However, select a size in the range between 15 mm (0.5 in) and 100 mm (4 in).

→ 2.5 mm ··· 15 mm → 100 mm ··· 400 mm → 0.1 in ··· 0.5 in → 4 in ··· 16 in →

If the meter size has been changed, other setting values (such as span and counting rate) will be affected depending on the measuring unit used. Therefore, check those setting values if you have changed the meter size.

8.2.3 Excitation Frequency

Proceed as follows to check or change the excitation frequency.

■ To check the excitation frequency:

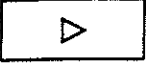
Key operation	Display example	Description
SET	A3: EX. FREQ. 24 Hz	Press [SET] first to start the items selection sequence and select A3: EX. FREQ. from among the configuration items using [>] and [Δ] keys. Then press [SET] again to display the current excitation frequency.
SET	A3: EX. FREQ.	Pressing [SET], the system returns to the items selection sequence.

■ To change the excitation frequency:

The excitation frequency can be selected from 6 , 12 and 24 Hz. The characteristics of the flowmeter change in accordance with the selected frequency as shown below. 24 Hz is the default setting when shipped from the factory.

Excitation frequency	6 Hz	12 Hz	24 Hz
Zero point stability	Good.		
Response time			Good
Fluid noise resistant			Good

The following example shows how to change the excitation frequency from 24 Hz to 12 Hz.

Key operation	Display example	Description
	A3: EX. FREQ. 24 Hz	Press [SET] first to start the items selection sequence and select A3: EX. FREQ. from among the configuration items using [▷] and [△] keys. Press [SET] again to display the current excitation frequency (24 Hz in this example).
	A3: EX. FREQ. 24 Hz	Pressing [▷], the cursor appears.
	A3: EX. FREQ. 12 Hz	Select "12 Hz" by pressing [△] twice. The excitation frequency changes as follows: 
	A3: EX. FREQ. 12 Hz	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to save the value.
	A3: EX. FREQ.	Pressing [SET], the system returns to the items selection sequence.

8.2.4 Indicating Unit

You can select one of the 16 engineering units listed below as an indicating unit.

- **Flow velocity:** m/s, (ft/s)
- **Flow rate:** m³/s, m³/min, m³/h
l/s, l/min, l/h
ml/s, ml/min, ml/h
(gal/s), (gal/min), (gal/h)
- **Volumetric flow:** m³, l, ml, (gal)
(totalized flow)
- **Other units:** %, COUNT (totalized flow without a unit), RANGE (1 to 4)

Notes

1. Units in parentheses, such as "gal" and "ft" are shown only when the meter size is selected in inches. They are not shown when the meter size is selected in mm.
2. If COUNT or RANGE is selected, the display is shown as follows:
COUNT: displays totalized flow counts (8 digits) without a unit.
RANGE: displays the range number (1 to 4).

Two indicating units (primary unit: UNIT 1, secondary unit: UNIT 2) can be selected.

Proceed as follows to check or change these two indicating units.

■ To check the indicating units:

Key operation	Display example	Description
	B1: UNIT 1 %	Press [SET] first to start the items selection sequence and select B1: UNIT 1 from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current primary indicating unit.
	B1: UNIT 1	Pressing [SET], the system returns to the items selection sequence.

Primary indicating unit and secondary indicating unit can be selected by the following configuration items:

- B1: UNIT 1 primary indicating unit
B2: UNIT 2 secondary indicating unit

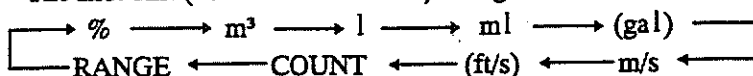
■ To change the indicating unit:

The following example shows how to change the primary indicating unit from % to ml/s.

Key operation	Display example	Description
	B1: UNIT 1 %	Press [SET] first to start the items selection sequence to select B1: UNIT 1 from among the configuration items using [▷] and [△] keys Then press [SET] again to display the current primary indicating unit (% in this example).
	B1: UNIT 1 % _	Pressing [▷], the cursor appears.
	B1: UNIT 1 ml	Select "ml" as the first unit of primary indicating unit by pressing [△] as many times as necessary. (Note1)
	B1: UNIT 1 ml _	Pressing [▷], the cursor moves to the second unit (time unit) of primary indicating unit.
	B1: UNIT 1 ml/s	Select "s" as the second unit (time unit) of primary indicating unit by pressing [△] as many times as necessary. (Note 2)
	B1: UNIT 1 ml/s	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to save the unit.
	B1: UNIT 1	Pressing [SET], the system returns to the item selection sequence.

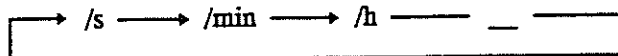
Notes

1. The first unit (volumetric units etc.) changes as shown below:



Units in parentheses, such as "gal" and "ft" are shown only when the meter size is selected in inches. They are not shown when the meter size is selected in mm.

2. The second unit (time unit) changes as shown below:



8.2.5 Span (range)

You can set the following constants in this setting item:

1. Range type
2. Span
3. Unit of span (can be changed only in range 1)
4. Hysteresis

(1) Range type

You can select a single range or multiple ranges. Select one from five types shown below:

Range type	Description
1. SINGLE	Single range
2. 4F-0R	Unidirectional flow, automatic selection of multiple ranges
3. 2F-2R	Bidirectional flows, automatic selection of multiple ranges
4. EXT.2F-0R	Unidirectional flow, multiple ranges selected by external signal
5. EXT.2F-2R	Bidirectional flows, multiple ranges selected by external signal

(2) Span (range)

- Span can be set and displayed as follows for flow velocity and flow rates:

- Flow velocity: 01.000 m/s (three digits after the decimal point)
- Flow rates: 2.83E+3 m³/H (three digits and exponential)

- Valid range of span is 0.1 m/s to 10 m/s in terms of flow velocity.

If you try to set the span outside of this range, one of the following messages appears:

- * H. OVER SPEC. (if the set value exceeds 10 m/s)
- * L. OVER SPEC. (if the set value is less than 0.1 m/s)

Try again to set the span within the specified range.

- When multiple ranges are used, the following must be observed:

- Range 1 > Range 2 > Range 3 > Range 4 (unidirectional flow, multiple ranges)
- Range 1 > Range 2, Range 3 > Range 4 (bidirectional flows, multiple ranges)

If you try to set the ranges not conforming to the above, the following message appears:

- * MULTI RNG ERR

Try again to set the ranges as specified above.

- Totalization counting rate

If you have changed the span while the counting rate is set for totalization, the counting rate for 100% output may have exceeded the maximum counting capacity. In this kind of event, the following message appears and the system goes to the counting rate setting sequence.

- * H. OVER C RATE or L. OVER C RATE

Set the counting rate for the newly set span.

(3) Unit of span

You can select one of the following 10 engineering units as a unit for the span. The unit is set for the range 1 and the same unit applies automatically to other ranges—range 2, range 3 and range 4.

- Flow velocity: m/s, (ft/s)
- Flow rate: m³/s, m³/min, m³/h
l/s, l/min, l/h
ml/s, ml/min, ml/h
(gal/s), (gal/min), (gal/h)

Units in parentheses, such as “gal” and “ft” are shown only when the meter size is selected in inches. They are not shown when the meter size is selected in mm.

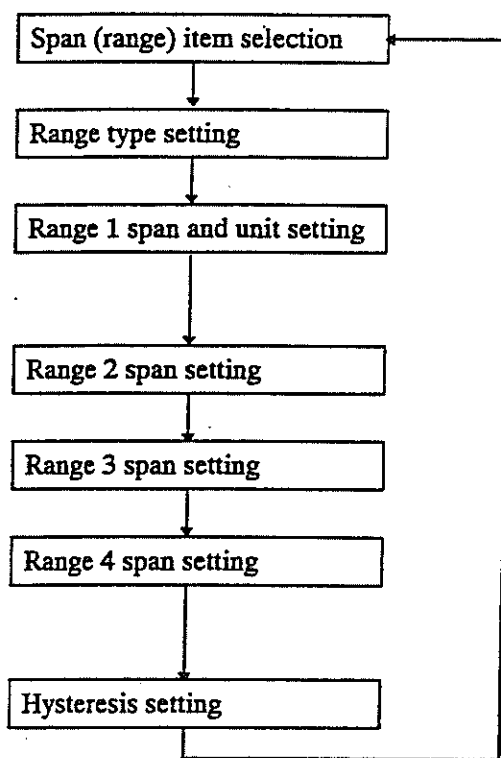
If you change the unit, the new span based on the newly set unit will be automatically displayed.

(4) Hysteresis

The hysteresis is the dead band used when multiple ranges are switched. The hysteresis can be set from 0 to 25% in increments of 0.1%. The hysteresis setting is needed only when automatic selection of multiple ranges is used.

[The setting sequence]

The following is the setting sequence of span (range).



If a single range is selected, range 2 to range 4 and hysteresis settings will be bypassed.

Proceed as follows to check or change each constant.

■ To check each constant:

Key operation	Display example	Description
	C2: RANGE 1 02.000 m/s	Press [SET] first to start the items selection sequence and select C2: RANGE 1 from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current span for Range 1.
	C2: RANGE 1	Pressing [SET], the system returns to the items selection sequence.

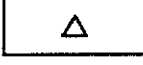
Range type, Span, Hysteresis can be selected by the configuration items as follows:

Range type C1: RANGE TYPE
 Span of Range 1 C2: RANGE 1
 Span of Range 2 C3: RANGE 2
 Span of Range 3 C4: RANGE 3
 Span of Range 4 C5: RANGE 4
 Hysteresis C6: RANGE HYST

■ To change the range type:

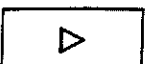
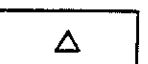
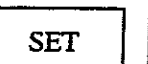
Range type should be changed before changing the span.

The following example shows how to change the range type from 1 to 3.

Key operation	Display example	Description
	C1: RANGE TYPE 1: SINGLE	Press [SET] first to start the items selection sequence and select C1: RANGETYPE from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current range type.
	C1: RANGE TYPE 1: SINGLE	Pressing [▷], the cursor appears.
	C1: RANGE TYPE 3: 2F-2R	Select Range type 3 (3: 2F-2R) by pressing [△] twice.
	C1: RANGE TYPE 3: 2F-2R	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to store the changed type.
	C1: RANGE TYPE	Pressing [SET], the system returns to the items selection sequence.

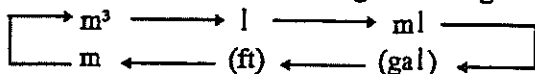
■ To change the span (range):

The following example shows how to change the span of Range 1 from 2.0 m/s to 100 l/min.

Key operation	Display example	Description
	C2: RANGE 1 02.000 m/s	Press [SET] first to start the items selection sequence and select C2: RANGE 1 from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current span of Range 1 (2.0 m/s in this example).
	C2: RANGE 1 02.000 m/s	Pressing [▷], the cursor appears. Then press [▷] as many times as necessary to move the cursor to the position for the measuring unit.
	C2: RANGE 1 3.93E+0 l/s 2.36E+2 l/min	Select "l" as the first unit of the measuring unit by pressing [△] as many times as necessary. (Note1) Similarly, pressing [▷] to move the cursor to the second unit (time unit), select "min." (Note 2) (The displayed span automatically changes in accordance with the newly selected unit.)
	C2: RANGE 1 2.36E+2 l/min	Press [▷] as many times as necessary to move the cursor to the digit of span to be changed.
	C2: RANGE 1 1.36E+2 l/min 1.00E+2 l/min	Change the value by pressing [△]. Then move the cursor to another digit by pressing [▷] and change the value. In this example repeat this process until the display shows "1.00E+2" (=100) l/m.
	C2: RANGE 1 1.00E+2 l/min	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to store the changed span and unit.
	C2: RANGE 1	Pressing [SET], the system returns to the items selection sequence.

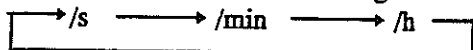
Notes

1. The first unit of the measuring unit changes as shown below:



Units in parentheses (ft and gal) are shown only when the meter size is selected in inches.

2. The second unit of the measuring unit changes as shown below:

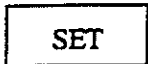
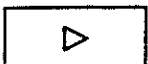


However, the following first and second unit combinations cannot be selected:
m/min, m/h, ft/min, ft/h.

■ To change the hysteresis:

The hysteresis is set at 3% (default) when shipped from the factory.

The following example shows how to change the hysteresis from 3% to 5%.

Key operation	Display example	Description
	C6: RANGE HYST 03.0 %	Press [SET] first to start the items selection sequence and select C6: RANGE HYST from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current hysteresis (3.0% in this example).
	C6: RANGE HYST 03.0 %	Pressing [▷], the cursor appears.
	C6: RANGE HYST 03.0 %	Press [▷] to move the cursor to the desired digit to change.
	C6: RANGE HYST 05.0 %	Change the value to "5" by pressing [△] twice. (if necessary, move the cursor to another digit and change the value).(Note)
	C6: RANGE HYST 05.0 %	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to store the changed hysteresis.
	C6: RANGE HYST	Pressing [SET], the system returns to the item selection sequence.

Note: If you try to set the hysteresis above 25.0 %, an error message "* H. OVER SPEC." appears. Try again to set the value within the specified range.

8.2.6 Damping Constant

The damping constant is used to moderate output fluctuations. (The larger the damping constant, the more the output is averaged. But the response to an input change will be slower.) The damping constant can be set as follows:

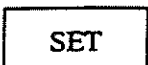
0.0 sec, 0.5 sec and 1 to 60 sec (in increments of 1 second)

Note: 0.0 sec setting will work as equal to 0.1 sec damping constant.

Setting value exceeding 60 sec will be automatically set to 60 sec.

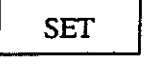
Proceed as follows to check or change the damping constant.

■ To check the damping constant:

Key operation	Display example	Description
	D1: DAMPING 02.0 S	Press [SET] first to start the items selection sequence and select D1: DAMPING from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current damping constant.
	D1: DAMPING	Pressing [SET], the system returns to the items selection sequence.

■ To change the damping constant:

The following example shows how to change the damping constant from 0.5 sec to 10 sec.

Key operation	Display example	Description
	D1: DAMPING 00.5 S	Press [SET] first to start the items selection sequence and select D1: DAMPING from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current damping constant (0.5 S).
	D1: DAMPING 00.5 S	Pressing [▷], the cursor appears. (If necessary, press [▷] to move the cursor to the digit to be changed.)
	D1: DAMPING 10.5 S 10.0 S	Change the value to "1" by pressing [△]. Then move the cursor to another digit by pressing [▷] and change the value. In this example repeat this process until the display shows "10.0 S." (Note)
	D1: DAMPING 10.0 S	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to store this data..
	D1: DAMPING	Pressing [SET], the system returns to the items selection sequence.

8.2.7 Low Cutoff

The low cutoff is the value set just above 0% flow rate. Flow rates below this level are treated as 0% and subsequent outputs as 0% current output. The low cutoff can be set from 0 to 10% of the span and in increments of 0.1%.

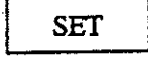
Proceed as follows to check or change the low cutoff value.

■ **To check the low cutoff value:**

Key operation	Display example	Description
	D2: LOW CUT 01.0 %	Press [SET] first to start the items selection sequence to select D2: LOW CUT from among the configuration items using [▷] and [△] keys. Press [SET] again to display the current low cutoff value.
	D2: LOW CUT	Pressing [SET], the system returns to the items selection sequence.

■ **To change the low cutoff value:**

The following example shows how to change the low cutoff value from 1.0 % to 3.0 %.

Key operation	Display example	Description
	D2: LOW CUT 01.0 %	Press [SET] first to start the items selection sequence and select D2: LOW CUT from among the configuration items using [▷] and [△] keys. Press [SET] again to display the current low cutoff value (1.0% in this example).
	D2: LOW CUT 0 <u>1</u> .0 %	Pressing [▷], the cursor appears. Then press [▷] to move the cursor to the digit to be changed.
	D2: LOW CUT 0 <u>3</u> .0 %	Change the value to "3" by pressing [△] twice. (Note) (If necessary, move the cursor to another digit by pressing [▷] and change the value.)
	D2: LOW CUT 03.0 %	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to store the value.
	D2: LOW CUT	Pressing [SET], the system returns to the items selection sequence.

Note: If you try to set the low cutoff value above 10 % of the span, an error message

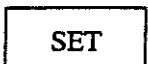
* H. OVER SPEC appears. Set the value within the specified range.

8.2.8 Zero Adjustment

To conduct the zero adjustment of the flowmeter, the fluid in the detector pipe must be held still. (If the fluid cannot be stilled by any means, see 8.2.16, "Zero Offset Adjustment.")

To start the zero adjustment, follow the procedure described below.

The zero adjustment for models without LCD display can be conducted with the switch in the converter. See 6.2, "Zero Adjustment" for details.

Key operation	Display example	Description
	E1: ZERO ADJUST 01.0 %	Press [SET] first to start the items selection sequence and select E1: ZERO ADJUST from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current flow rate (1.0% in this example).
	ADJUST READY 01.1 %	Pressing [▷], "ADJUST READY" appears as shown left and the system is ready for zero adjustment. (Note 1)
	* ZERO ADJUST	Pressing [SET], "* ZERO ADJUST" appears as shown left and the system starts the zero adjustment. The zero adjustment takes about 3 to 6 seconds. (Note 2)
	E1: ZERO ADJUST 00.0 %	Newly adjusted zero point appears.
	E1: ZERO ADJUST	Pressing [SET], the system returns to the items selection sequence.

Notes

1. To cancel the zero adjustment, press [△]. The system returns to the point where zero point is displayed.
2. Zero adjustment duration depends on the excitation frequency (24 Hz: 3 sec, 12 Hz and 6 Hz: 6 sec).

8.2.9 Digital I/O

You can select the various digital I/O functions shown below. See Chapter 10, "Digital I/O Functions." for details.

■ Digital Output Functions (DO1 is standard and DO2 is optional)

DO1, DO2 items	Digital output functions
0: NO USE	Not used
1: H ALM	High limit alarm output
2: L ALM	Low limit alarm output
3: EMPTY ALM	Empty pipe alarm output
4: RNG SIG 1	Multi-range output No. 1
5: RNG SIG 2	Multi-range output No. 2
6: PRESET	Preset point output
7: CONV. ALM	Converter failure alarm output
8: PULSE OUT	Pulse output (Note)

Note: Pulse output can be chosen only for DO1.

■ Digital Input Function (optional)

DI function	Digital input function
0: NO USE	Not used
1: C STA/STP	Totalizer Start/Stop
2: C RES/STA	Totalizer Reset/Start
3: RANGE SW	Remote selection of multi-range
4: ZERO ADJ.	Zero adjustment start
5: FIXED OUT	Fixed-value output control

Proceed as follows to check or change the digital I/O functions.

■ To check the digital I/O functions:

Key operation	Display example	Description
	F1: DO1 FUNCT. 1:H ALM	Press [SET] first to start the items selection sequence and select F1: DO1 FUNCT. from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current DO1 function.
	F1: DO1 FUNCT.	Pressing [SET], the system returns to the items selection sequence.

Digital output 1 (DO1), digital output 2 (DO2) and digital input (DI) can be selected by the configuration items as follows:

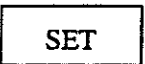
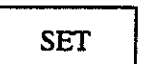
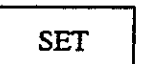
Digital output 1 (DO1) F1: DO1 FUNCT.

Digital output 2 (DO2) F2: DO2 FUNCT.

Digital input (DI) F3: DI FUNCT.

■ To change the digital I/O functions:

The following example shows how to change the DO1 function from No. 1 to No. 3.

Key operation	Display example	Description
	F1: DO1 FUNCT. 1:H ALM	Press [SET] first to start the items selection sequence and select F1: DO1 FUNCT. from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current DO1 function (1: H ALM in this example).
	F1: DO1 FUNCT. <u>1</u> :H ALM	Pressing [▷], the cursor appears.
	F1: DO1 FUNCT. <u>3</u> :EMPTY ALM	Change the value to "3" by pressing [△] twice.
	F1: DO1 FUNCT. 3:EMPTY ALM	Pressing [SET], the cursor disappears and the new DO1 function display flickers. Press [SET] again to save the new function.
	F1: DO1 FUNCT.	Pressing [SET], the system returns to the items selection sequence.

8.2.10 Counting Rate (pulse rate)

When the totalizer is used for total flow measurement, per-count (pulse) value is the counting rate. Pulse output is also available for external totalization. In this item, the counting rate and the pulse width for pulse output can be checked or changed. The counting rate is set using three digits and exponential quotient.

For example, $\frac{0.123 \text{ m}^3}{(1.23 \times 10^{-1} \text{ m}^3)} \rightarrow 1.23\text{E}-1 \text{ m}^3$

Proceed as follows to check or change the counting rate.

■ To check the counting rate and pulse width:

Key operation	Display example	Description
SET	G1: COUNT RATE 1.00E-2m ³	Press [SET] first to start the items selection sequence and select G1: COUNT RATE from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current counting rate.
SET	G1: COUNT RATE	Pressing [SET], the system returns to the items selection sequence.

Counting rate and pulse width can be selected by the configuration items as follows:

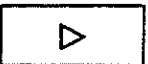
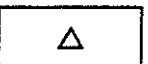
Counting rate G1: COUNT RATE
Pulse width G2: PLS. WIDTH

NOTES

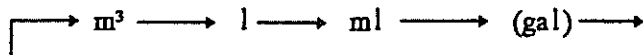
1. The counting rate should be set so that its rate for 100% flow rate output is within the range from 3.6 to 3600000 pulses/h. If you try to set the counting rate outside of this range, an error message * H. OVER SPEC or * L. OVER SPEC appears.
Set the counting rate within the specified range.
2. The pulse width should be set to less than half of the pulse rate for 100% flow rate output. If the pulse width is set exceeding that limit, the same error message as above appears. If the pulse width is set to 0 (zero), it will automatically be set to half of the pulse rate for 100% flow rate output.
3. To operate the totalizer, it is preferable to set the indicating unit (UNIT1 and/or UNIT 2) to one of the units appropriate for totalization just to make sure it is operating correctly.

■ To change the counting rate:

The following example shows how to change the counting rate from 0.01 m^3 to 0.9 l .

Key operation	Display example	Description
	G1: COUNT RATE $1.00\text{E}-2\text{m}^3$	Press [SET] first to start the items selection sequence and select G1: COUNT RATE from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current counting rate ($1.00\text{E}-2\text{m}^3 = 0.01 \text{ m}^3$).
	G1: COUNT RATE <u>1</u> .00E-2m ³	Pressing [▷], the cursor appears. Then press [▷] as many times as necessary to move the cursor to of measuring unit.
	G1: COUNT RATE 1.00E-2 <u>l</u> 9.00E- <u>1</u> l	Select "l" as the measuring unit by pressing [△]. (Note) Then move the cursor to the desired digit by pressing [▷] and change the value. In this example repeat this process until the display shows "9.00E-1l."
	G1: COUNT RATE 9.00E-1l	Pressing [SET], the cursor disappears and the new counting rate display flickers. Press [SET] again to store the new counting rate.
	G1: COUNT RATE	Pressing [SET], the system returns to the items selection sequence.

Note: The unit changes as shown below by pressing [△].



The unit in parentheses (gal) is shown only when the meter size is selected in inches.

8.2.11 Preset Count Value

The preset count value is used to preset the totalizer. The preset count value can be set from 0 to 99999999.

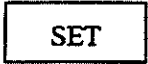
NOTE

Totalizer counting is effective only for the specified direction flow.

To operate the totalizer, it is preferable to set the indicating unit (UNIT 1 and/or UNIT 2) to one of the units appropriate for totalization just to make sure it is operating correctly.

Proceed as follows to check or change the preset count value.

■ To check the preset count value:

Key operation	Display example	Description
	H1: PRESET 00000300	Press [SET] first to start the items selection sequence and select H1: PRESET from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the preset count value.
	H1: PRESET	Pressing [SET], the system returns to the items selection sequence.

■ To change the preset count value:

The following example shows how to change the preset count value from 500 to 1000.

Key operation	Display example	Description
	H1: PRESET 00000500	Press [SET] first to start the items selection sequence and select H1: PRESET from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the preset count value (500 in this example).
	H1: PRESET 00000 <u>5</u> 00	Pressing [▷], the cursor appears. Then press [▷] as many times as necessary to move the cursor to the desired digit to be changed.
	H1: PRESET 00001500 00001 <u>0</u> 00	Change the value by pressing [△]. Then move the cursor to another digit by pressing [▷] and change the value. In this example repeat this process until the display shows "1000."
	H1: PRESET 00001000	Pressing [SET], the cursor disappears and the new preset count value display flickers. Press [SET] again to save the new preset count value.
	H1: PRESET	Pressing [SET], the system returns to the items selection sequence.

8.2.12 High and Low Limit Alarms

The high and low limit alarms can be set to output an alarm signal when the flow rate exceeds the high or low limit set value. When this alarm occurs, a H. ALARM or L. ALARM message appears. This high and low limit alarm function can each be enabled or disabled in this item. The high and low limit values can be set from -10% to 110% of the span of the range (Range 1) in increments of 0.5%.

Proceed as follows to check or change the high and low limit values.

■ To check the high and low limit values:

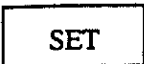
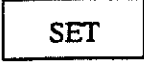
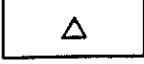
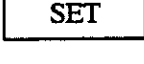
Key operation	Display example	Description
SET	I1: H. ALARM SET ON	Press [SET] first to start the items selection sequence and select I1: H ALARM SET from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the high limit alarm enable/disable status.
SET	I1: H. ALARM SET	Pressing [SET], the system returns to the items selection sequence.

High/low limit alarm enable/disable status and high/low limit value can be selected by the configuration items as follows:

High limit alarm enable/disable status	I1: H. ALARM SET
High limit value	I2: H. ALARM VAL
Low limit alarm enable/disable status	I3: L. ALARM SET
Low limit value	I4: L. ALARM VAL

■ To change the high/low limit alarm status and its alarm limit value:

The following example shows how to change the high limit alarm enable/disable status from OFF to ON and change the high limit value from +100 % to +105 %.

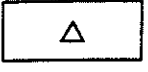
Key operation	Display example	Description
	I1: H. ALARM SET OFF	Press [SET] first to start the items selection sequence and select I1: H. ALARM SET from among the configuration items using [$\triangleright$] and [$\triangle$] keys. Then press [SET] again to display the high limit alarm enable/disable status (OFF at this point).
	I1: H. ALARM SET OFF	Pressing [$\triangleright$], the cursor appears.
	I1: H. ALARM SET ON	Change the status by pressing [$\triangle$]. (Note 1)
	I2: H. ALARM VAL +100.0%	Pressing [SET], the cursor disappears and the changed status flickers. Press [SET] again to save the status. Then the system goes to the item I2: H. ALARM VAL , and displays the current high limit value (+100.0%).
	I2: H. ALARM VAL +100.0%	Move the cursor to the digit to be changed.
	I2: H. ALARM VAL +105.0%	Change the value to "5" by pressing [$\triangle$] five times. (Note 2) (If necessary, move the cursor to another digit by pressing [$\triangleright$] and change the value.)
	I2: H. ALARM VAL +105.0%	Pressing [SET], the cursor disappears and the changed high limit value display flickers. Press [SET] again to save the value.
	I2: H. ALARM VAL	Pressing [SET], the system returns to the items selection sequence.

Notes:

1. If the high limit alarm enable/disable status is set to OFF, the subsequent high limit value setting sequence will not come out.
2. If you try to set the value above +110% or below -10% of the span, the error messages *H. OVER SPEC or *L. OVER SPEC, respectively, appear. Set the high or low limit value within the specified range.

■ To change the high/low limit value:

The following example shows how to change the high limit value from +105 % to +103 %.

Key operation	Display example	Description
	I2: H. ALARM VAL +105.0%	Press [SET] first to start the items selection sequence and select I2: H. ALARM VAL from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current high limit value (+105.0% in this example).
	I2: H. ALARM VAL +105.0%	Pressing [▷], the cursor appears. Then press [▷] as many times as necessary to move the cursor to the digit to be changed.
	I2: H. ALARM VAL +10 <u>3</u> .0%	Change the value to "3" by pressing [△] as many times as necessary. (Note) (If necessary, move the cursor to another digit by pressing [▷] and change the value.)
	I2: H. ALARM VAL +103.0%	Pressing [SET], the cursor disappears and the changed high limit value display flickers. Press [SET] again to save the value.
	I2: H. ALARM VAL	Pressing [SET], the system returns to the items selection sequence.

Note: If you try to set the value above +110% or below -10% of the span, the error messages *H. OVER SPEC or *L. OVER SPEC, respectively appear. Set the high limit value within the specified range.

8.2.13 Empty Pipe Alarm

The empty pipe alarm is used to notify that the detector pipe is not filled with fluid. If an empty pipe condition occurs, a message * EMPTY appears. You can enable or disable this function here.

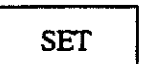
Proceed as follows to check or change the empty pipe alarm enable/disable status.

■ To check the empty pipe alarm enable/disable status:

Key operation	Display example	Description
	J1: EMPTY ALM ON	Press [SET] first to start the items selection sequence and select J1: EMPTY ALM from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current empty pipe alarm enable/disable status.
	J1: EMPTY ALM	Pressing [SET], the system returns to the items selection sequence.

■ To change the empty pipe alarm enable/disable status:

The following example shows how to disable the empty pipe alarm enable status.

Key operation	Display example	Description
	J1: EMPTY ALM ON	Press [SET] first to start the items selection sequence and select J1: EMPTY ALM from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current empty pipe alarm enable/disable status. (In this example ON will be displayed.)
	J1: EMPTY ALM <u>ON</u>	Pressing [▷], the cursor appears.
	J1: EMPTY ALM OFF	Select "OFF" by pressing [△].
	J1: EMPTY ALM OFF	Pressing [SET], the cursor disappears and the selected status display flickers. Press [SET] again to save the status.
	J1: EMPTY ALM	Pressing [SET], the system returns to the items selection sequence.

8.2.14 Rate-Of-Change Limit

The rate-of-change limit is used to eliminate high electrical noise contained in the process flow signal. To check electrical noise, two parameters are defined: rate-of-change limit (set in percent value of the span) and control limit time (set in units of seconds). Normally the flowmeter produces the analog output signal by sampling the flow rate signal at 1/24 (or 1/12) of a second sampling rate. If the sampled value exceeds the set rate-of-change limit value based on the averaged flow rate value up until the sampled time, the system will reject that sampled value and instead the averaged value including the rate-of-change limit value in place of the rejected sampled value will be output. However, if the limit-exceeding sampled value continues for the same flow direction for more than the preset control limit time, that data will be used as the output signal. The setting ranges for these two parameters are as follows:

- **Rate-of-change limit**

0 to 30 %/sampling rate (in increments of 0.5 %)

where the sampling rate is either 1/24, 1/12 or 1/6 of a second depending on the excitation frequency as shown below:

Excitation frequency	Sampling rate
24 Hz	1/24 sec
12 Hz or 6 Hz	1/12 sec

- **Control limit time:** 0 to 20 sec (in increments of 1 second)

NOTE

If "0" is set in either of these parameters, the rate-of-change limit function is disabled.

Proceed as follows to check or change the rate-of-change limit value and the control limit time.

■ **To check the rate-of-change limit value and the control limit time:**

Key operation	Display example	Description
	K1: LIMIT RATE 05.0 %	Press [SET] first to start the items selection sequence and select K1: LIMIT RATE from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current rate-of-change limit time.
	K1: LIMIT RATE	Pressing [SET], the system returns to the items selection sequence.

Rate-of-change limit value and control limit time can be selected by the configuration items as follows:

Rate-of-change limit value	K1: H. LIMIT RATE
Control limit time	K1: H. LIMIT TIME

■ To change the rate-of-change limit value:

The following example shows how to change the rate-of-change limit value from 10.0 % to 15.0 %.

Key operation	Display example	Description
	K1: LIMIT RATE 10.0 %	Press [SET] first to start the items selection sequence and select K1: LIMIT RATE from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current rate-of-change limit value (10.0 % in this example).
	K1: LIMIT RATE 10.0 %	Pressing [▷], the cursor appears. Then press [▷] as many times as necessary to move the cursor to the digit to be changed.
	K1: LIMIT RATE 15.0 %	Change the value to "5" by pressing [△] five times. (Note) (If necessary, move the cursor to the next digit to be changed by pressing [▷], and change the value.).
	K1: LIMIT RATE 15.0 %	Pressing [SET], the cursor disappears and changed rate-of-change limit value display flickers. Press [SET] again to save the value.
	K1: LIMIT RATE	Pressing [SET], the system returns to the items selection sequence.

Note: If you try to set the value outside the valid range, an error message * H. OVER SPEC appears. Set the value within the specified range.

To change the control limit time, select the item K2: LIMIT TIME.

8.2.15 Fixed-Value Output

The fixed-value output is used to output a fixed current and a fixed pulse output independent of the flow rate signal. (The fixed pulse output is available only when DO1 is used for PULSE OUT function.) The fixed-value output can be set in the ranges described below.

(Current output and pulse output can be set and output at the same time.)

- **Fixed current output:** 3 to 24 mA (in increments of 0.1 mA)
- **Fixed pulse output:** 0 to 1000 pps (in increments of 1 pps)

If you have disabled this function (set to OFF), you do not have to set the subsequent current and pulse output values.

When this function is enabled (set to ON), the measured data is displayed with the primary indicating unit only on the first line of the display and the fixed current output is displayed on the second line of the display. Other data output and display conditions are as follows:

- **Current output:** User-set current output
- **Pulse output:** Pulse output with a user-set counting rate
- **Digital output(s):** Previous status is retained (excluding pulse output).
- **Data Display:** Instantaneous flow rates and flow velocity (no totalization)

Display example: 1.000 m/s ← Primary indicating unit
 * FIX. OUT 20.0 mA

This fixed-value output function does not work in the calibration mode.

Proceed as follows to check or change the enable/disable status of the fixed-value output and its output values.

- To check the enable/disable status of the fixed-value output and its output values:

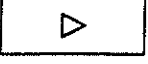
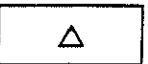
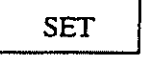
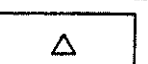
Key operation	Display example	Description
SET	L1: FIXED OUT ON	Press [SET] first to start the items selection sequence and select L1: FIXED OUT from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the fixed-value output enable/disable status.
SET	L1: FIXED OUT	Pressing [SET], the system returns to the items selection sequence.

Fixed-value output enable/disable status, fixed current output and fixed pulse output can be selected by the configuration items as follows:

Fixed-value enable/disable status	L1: FIXED OUT
Fixed current output	L2: FIX. CURR.
Fixed pulse output	L3: FIX. PULSE

■ To change the enable/disable status of the fixed-value output and its output values:

The following example shows how to enable the fixed-value output function and to set its fixed current output to 20 mA DC.

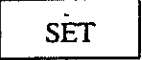
Key operation	Display example	Description
	L1: FIXED OUT OFF	Press [SET] first to start the items selection sequence and select L1: FIXED OUT from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current fixed-output enable/disable status (OFF in this example).
	L1: FIXED OUT OFF	Pressing [▷], the cursor appears
	L1: FIXED OUT ON	Select "ON" by pressing [△].
	L2: FIX. CURR. 10.0 mA	Pressing [SET], the selected status (ON) flickers. Press [SET] again to save the status. Then the system goes to the fixed current value setting sequence.
	L2: FIX. CURR. 10.0 mA	Move the cursor to the digit to be changed.
	L2: FIX. CURR. 20.0 mA	Change the value to "2" by pressing [△] twice. (If necessary, move the cursor to another digit by pressing [▷] and change the value.) (Note 1)
	L3: FIX. PULSE 100 PPS	Pressing [SET], the cursor disappears and the changed value display flickers. Press [SET] again to save the value. Then the system goes to the fixed pulse output setting sequence. (Note 2)
	L3: FIX. PULSE 100 PPS	Pressing [SET], the cursor disappears and the fixed pulse output value flickers. Press [SET] again to save the value.
	L3: FIX. PULSE	Pressing [SET], the system returns to the items selection sequence.

Notes:

1. If you try to set the fixed-value output above the allowable range, an error message * H. OVER SPEC appears. Try to set the value within the specified range.
2. If PULSE OUT is not selected for digital output, the subsequent pulse output setting sequence will not be displayed.

■ To change the fixed pulse output value:

The following example shows how to change the fixed pulse output value from 50 pps to 100 pps.

Key operation	Display example	Description
	L3: FIX. PULSE 050 PPS	Press [SET] first to start the items selection sequence and select L3: FIX. PULSE from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current fixed pulse output value (50 pps in this example).
	L3: FIX. PULSE 050 PPS	Pressing [▷], the cursor appears. (if necessary, move the cursor by pressing [>] to the digit to be changed.)
	L3: FIX. PULSE 150 PPS 100 PPS	Change the value to "1" by pressing [△]. Then move the cursor to another digit to change and change the value. In this example repeat this process until the display shows "100 pps."
	L3: FIX. PULSE 100 PPS	Pressing [SET], the cursor disappears and the changed value display flickers. Press [SET] again to save the value.
	L3: FIX. PULSE	Pressing [SET], the system returns to the items selection sequence.

Fixed current output value can be changed by selecting the configuration item L2: FIX. CURR.

8.2.16 Zero Offset Adjustment

Zero offset can be applied to make the flowmeter outputs comparable to process values measured by other instruments. If the zero adjustment described in 6.2 requiring a zero flow rate condition can be performed, this zero offset adjustment is not needed. When the zero adjustment is completed, zero offset will be automatically cleared to zero. Zero offset can be set in the range described below:

Zero offset: ± 0.125 m/s (± 1.25 % of 10 m/s—maximum range) maximum

Proceed as follows to check or change the zero offset value.

■ To check the zero offset value:

Key operation	Display example	Description
	M1: MANUAL ZERO +002.5 %	Press [SET] first to start the items selection sequence and select M1: MANUAL ZERO from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current zero offset value
	M1: MANUAL ZERO	Pressing [SET], the system returns to the items selection sequence.

■ To change the zero offset value:

Calculate the zero offset value with the following equation:

$$\text{Zero offset value (\%)} = \{(\text{actual flow rate}) - (\text{LF403 measured value})\}$$

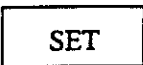
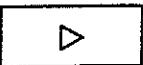
The zero offset value should be calculated in percent value for Range 1. See the following example.

(Example)

Measured condition	Flow rate	% in measuring span
Actual flow rate obtained from other instrument.	10.0 m ³ /min	50 %
LF403 measured value	10.5 m ³ /min	52.5 %
Zero offset	_____	-2.5 %

If zero offset is set to -2.5 %, the LF403 converter will output 50.0 % flow rate instead of 52.5%.

The following example shows how to change the zero offset value from +1.0% to -2.5%.

Key operation	Display example	Description
	M1: MANUAL ZERO +001.0%	Press [SET] first to start the items selection sequence and select M1: MANUAL ZERO from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the current zero offset value.
	M1: MANUAL ZERO +001.0%	Pressing [▷], the cursor appears. (If necessary, press [▷] as many times as necessary to move the cursor to the desired digit to change.)
	M1: MANUAL ZERO -001.0% -002.0% -002.5%	Change the sign code (“+” to “-”) by pressing [△]. Then move the cursor to another digit by pressing [▷] and change the value. In this example repeat this process until the display shows “-002.5 %.” (Note)
	M1: MANUAL ZERO -002.5%	Pressing [SET], the cursor disappears and the changed value display flickers. Press [SET] again to save the value.
	M1: MANUAL ZERO	Pressing [SET], the system returns to the setting items selection sequence.

Note: If you try to set the value above +0.125 m/s or below -0.125 m/s, the error messages * H. OVER SPEC or * L. OVER SPEC, respectively, appears. Set the value within ±0.125 m/s.

9. Calibration

9.1 Calibration Items

You can conduct the following in the calibration mode:

- Checks or calibrates the zero and span of the LF403 converter by using a simulation signal.
- Checks of the excitation current.

To change the mode to the calibration mode, see 7.3.1, "Mode Change."

IMPORTANT

To check or change the zero and span of the converter, follow the procedure described below. However, these are already checked and calibrated when shipped from the factory. Do not change these settings unless it is necessary to calibrate in the field.

Calibration items are listed below. See each section for detailed procedure.

Section	Configuration item	Display example		Page
9.2.1	0 % flow rate calibration	N1:FLOW CAL 0%	0.0 %	67
9.2.2	50 % flow rate calibration	N2:FLOW SIG. 50%	50.0 %	68
9.2.3	100 % flow rate calibration	N3:FLOW CAL100%	100.0 %	69
9.2.4	Excitation current	N4:EX. CURR. DSP.	0.2100 A	70

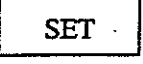
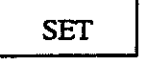
9.2 Calibration Using Converter Signal Source

9.2.1 0 % Flow Rate Calibration

■ To check the zero point of flow measurement:

Key operation	Display example	Description
	N1:FLOW CAL 0% 0.0 %	Press [SET] first to start the items selection sequence and select N1: FLOW CAL 0% from among the configuration items using [▷] and [△] keys. Then press [SET] again to go into the calibration mode and calculate and display zero point using a simulation signal.
	N1:FLOW CAL 0%	Pressing [SET], the system returns to the items selection sequence.

■ To change the zero and span of the converter:

Key operation	Display example	Description
	N1:FLOW CAL 0% 0.1 %	Press [SET] first to start the items selection sequence and select N1: FLOW CAL 0% from among the setting items using [▷] and [△] keys. Then press [SET] again to go into the calibration mode and calculate and display zero point using a simulation signal.
	ADJUST READY 0.1 %	Pressing [▷], "ADJUST READY" appears as shown left and the system goes into a calibration-ready condition. (Note 1)
	N1:FLOW CAL 0% * CAL. 0% ADJ.	Pressing [SET], "** CAL. 0% ADJ." appears as shown left and the system starts the zero calibration. The zero calibration takes about 3 to 6 seconds. (Note 2)
	N1:FLOW CAL 0% 0.0 %	Newly calibrated zero point appears.
	N1:FLOW CAL 0%	Pressing [SET], the system returns to the items selection sequence.

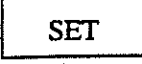
Notes:

1. To cancel zero calibration, press [△]. The system returns to the point where the zero point display appears.
2. Calibration time depends on the excitation frequency (24 Hz: 3 sec, 12 Hz and 6 Hz: 6 sec).

9.2.2 50 % Flow Rate Calibration

Using the converter's internal calibration circuit, the system can calibrate the 50% flow rate point. The 50% flow rate point calibration must be executed after conducting the 100% flow rate (span) calibration. The 50% flow rate calibration may differ depending on the 100% flow rate calibration result.

- To check the 50% flow rate point of flow measurement:

Key operation	Display example	Description
	N2:FLOW CAL 50% 50.1 %	Press [SET] first to start the items selection sequence and select N2: FLOW CAL 50% from among the configuration items using [▷] and [△] keys. Then press [SET] again to go into the calibration mode and calculate and display 50% flow rate point using a simulation signal.
	N2:FLOW CAL 50%	Pressing [SET], the system returns to the items selection sequence.

- To change the 50% flow rate point of the converter:

Key operation	Display example	Description
	N2:FLOW CAL 50% 50.1 %	Press [SET] first to start the items selection sequence and select N2: FLOW CAL 50% from among the configuration items using [▷] and [△] keys. Then press [SET] again to go into the calibration mode and calculate and display 50% flow rate point using a simulation signal.
	ADJUST READY 50.1 %	Pressing [▷], "ADJUST READY" appears as shown left and the system goes into a calibration-ready condition. (Note 1)
	N2:FLOW CAL 50% * CAL. 50% ADJ.	Pressing [SET], "* CAL. 50% ADJ." appears as shown left and the system starts the 50% calibration. The zero calibration takes about 3 to 6 seconds. (Note 2)
	N2:FLOW CAL 50% 50.0 %	Newly calibrated 50% flow rate point appears.
	N2:FLOW CAL 50%	Pressing [SET], the system returns to the items selection sequence.

Notes:

1. To cancel 50% flow rate calibration, press [△]. The system returns to the point where 50% flow rate is displayed.
2. Calibration time depends on the excitation frequency (24 Hz: 3 sec, 12 Hz and 6 Hz: 6 sec).

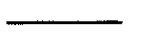
9.2.3 100 % Flow Rate (Span) Calibration

Using the converter's internal calibration circuit, the system can calibrate the 100% flow rate point (hereafter called span).

■ To check the span of the converter:

Key operation	Display example	Description
	N3:FLOW CAL100% 100.1 %	Press [SET] first to start the items selection sequence and select N3: FLOW CAL100% from among the configuration items using [▷] and [△] keys. Then press [SET] again to go into the calibration mode and calculate and display the span using a simulation signal.
	N3:FLOW CAL100%	Pressing [SET], the system returns to the items selection sequence.

■ To change the span of the converter:

Key operation	Display example	Description
	N3:FLOW CAL100% 100.1 %	Press [SET] first to start the items selection sequence and select N3: FLOW CAL100% from among the configuration items using [▷] and [△] keys. Then press [SET] again to go into the calibration mode and calculate and display 100% flow rate point using a simulation signal.
	ADJUST READY 100.1 %	Pressing [▷], "ADJUST READY" appears as shown left and the system goes into a calibration-ready condition. (Note 1)
	N3:FLOW CAL100% * CAL. 100% ADJ.	Pressing [SET], "* CAL. 100% ADJ." appears as shown left and the system starts the 100% calibration. The zero calibration takes about 3 to 6 seconds. (Note 2)
	N3:FLOW CAL100% 100.0 %	Newly calibrated 100% flow rate point appears.
	N3:FLOW CAL100%	Pressing [SET], the system returns to the items selection sequence.

Notes:

1. To cancel the span calibration, press [△]. The system returns to the point where 100% flow rate is displayed.
2. Calibration time depends on the excitation frequency (24 Hz: 3 sec, 12 Hz and 6 Hz: 6 sec).

9.2.4 Checking the Excitation Current Value

You can monitor the exciting current value. The excitation current value is factory adjusted when shipped. Contact your nearest Toshiba representative if any change is necessary.

■ To check the exciting current value:

Key operation	Display example	Description
SET	N4:EX. CURR. DSP. 0.2100 mA	Press [SET] first to start the items selection sequence and select N4: EX. CURR. DSP. from among the configuration items using [▷] and [△] keys. Then press [SET] again to display the excitation current value.
SET	N4:EX. CURR. DSP.	Pressing [SET], the system returns to the items selection sequence.

10. Digital I/O Functions

The LF403 converter has one standard digital output (DO1) terminal. This terminal can be used in various ways, such as a pulse output, or an alarm output terminal. One more digital output (DO2) and one digital input (DI) are optionally available.

Digital I/O functions described below can be assigned for DO1, DO2 and DI.

Functions	Description
Totalization	■ The converter totalizes volumetric flow values. ■ The totalized flow can be output as a pulse signal (DO1 only) scaled by a user-specified factor (counting rate). ■ The totalizer and pulse signal (DO1 only) can be controlled (starts, stops and resets) with an external signal (DI).
Multiple Ranges	■ Multiple measuring ranges can be switched according to the process flow rates either automatically or by an external signal (DI).
Forward and Reverse flow measurements	■ Forward and reverse flows can be measured. The forward and reverse flow measurements can be used together with multiple range switching function.
High and Low Limit Alarms	■ Outputs an alarm signal (DO1 or DO2) when the process signal exceeds or stays below the limit values.
Empty Pipe Alarm	■ The detector pipe must be filled with fluid all the time. When it is not filled with fluid, the converter outputs an alarm signal (DO1 or DO2).
Totalizer Preset Point	■ When the totalized flow reaches its preset count value, the converter outputs a contact output signal (DO1 or DO2).
Remote Zero Adjustment	■ Zero adjustment (on-stream at zero flow rate) can be started by an external signal (DI).
Fixed-value Output	Fixed current output and fixed pulse output can be used to check a process loop circuit. An external signal (DI) can also be used to control this fixed-value output.
Converter Failure Alarm	■ The converter outputs an alarm signal (DO1 or DO2) if an error such as memory error or excitation circuit error occurs.

10.1 Digital I/O Specifications

Digital I/O specifications for the LF403 converter are described below:

■ Digital Output 1(DO1) (standard)

Output type: Transistor open collector

Number of outputs: One point

Capacity: 30 V dc, 200 mA maximum

■ Digital Output 2(DO2) (option)

Output type: Solidstate relay (no polarity)

Number of outputs: One point

Capacity: 150 V dc, 150 mA maximum; 150 V ac (peak), 100 mA maximum

■ Digital Input (DI) (option)

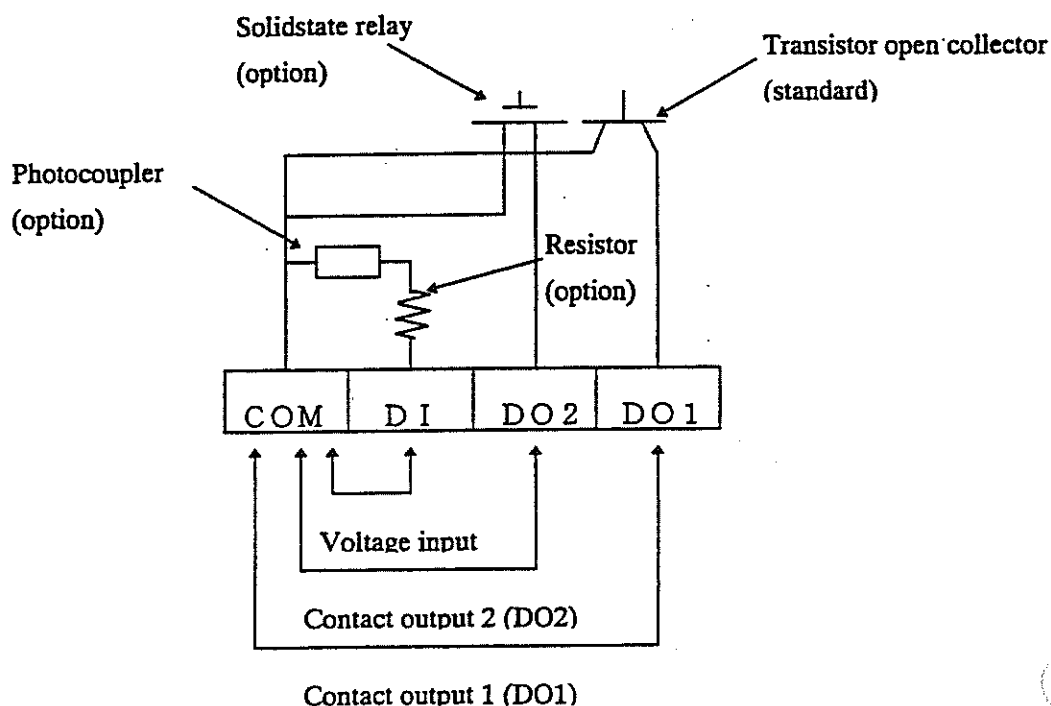
Input signal: 20 to 30 V dc voltage signal

- High input level—20 to 30 V dc
- Low input level—2 V dc maximum

Input resistance: Approximately 2.7 k Ω

Number of inputs: One point

- Each I/O terminal can be used as a specified function terminal when selected.
- Terminal COM is the signal COMMON for the other three terminals (DO1, DO2 and DI).
- Each terminal is isolated from the internal circuits. (The output terminals are not isolated from each other.)



10.2 Totalizer and Pulse Output

To use the totalizer and pulse output for external use, proceed as follows.

Counting Rate and Pulse Width Settings

- Set the counting rate (flow volume per count) and the pulse width. Refer to 8.2.10, "Counting Rate." Set the pulse width in accordance with response time of receiving instruments. If the pulse output is not used, pulse width setting is not needed.

DO function setting

- Set DO1 as a pulse output contact signal. Refer to 8.2.9, "Digital I/O Functions." This is not needed if the pulse output is not used.

DI function setting (Note1)

- Set one of the DI functions. Refer to 8.2.9, "Digital I/O Functions." If the type of the flowmeter which has no optional digital input, Type Specification Code LF403***1 (Ninth column; "1"), select the DI function according to the way shown in the Note 1.

Indicating Unit Setting

- Select an indicating unit for UNIT 1 and/or UNIT 2 among units for totalization (m^3 , l, ml or COUNT). (Note 2)

Measurement Mode

- Set the operation mode of the system to the measurement mode. Refer to 7.3.1, "Mode Change."

Clear (reset) the totalizer.

- Clear (reset) the totalizer by pressing [$\triangleright$] key.
If you have changed the counting rate, clear (reset) the totalizer before you start the totalizer.

Start the totalizer.

- Start the totalizer by pressing [$\triangle$] key and make sure "C" is shown on the display. (Note 3)

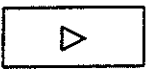
Notes:

1. When the flowmeter has no optional digital input function (ninth column of Type Specification Code; '1'), the movement of the totalizer and pulse output after power on is decided by setting contents of optional digital input (DI).
Set the DI function according to use method by all means as follows;
 - When let start automatically after power on
Set the digital input (DI) as "2: RES/STA ".
The totalizer and the pulse output starts after power on.
When the totalizer or the pulse output are used continuously, set DI as this function.
 - When let stop after power on
Set the digital input (DI) as "1: STA/STP ".
The totalizer and the pulse output stops after power on.
To let them start, operate the control keys on the panel (Option) according to **Totalizer Operation** in the next page.
2. It is preferable to set the indicating unit (UNIT 1 and/or UNIT 2) to one of the units appropriate for totalization just to make sure it is operating correctly.
3. If the indicating unit (UNIT 1 and/or UNIT 2) is not the one for totalization, "C" does not appear on the display.

Totalizer Operation

■ Using control keys on the panel (option)

To start, stop or clear (reset) the totalizer, follow the procedure described below:

Key operation	Display example	Description
	F 1 C 1. 2300 m/s	Starts the totalizer (and pulse output). "C" for counting will be displayed and either "F" for forward or "R" for reverse flow direction will also be displayed.
	F 123 1. 23000 m/s	Stops the totalizer (and pulse output). "C" shown on the display disappears.
	F 0 1. 23000 m/s	Clears (resets) the totalizer (and pulse output)

NOTES

- When a bidirectional (forward and reverse) multi-range is selected, the display shows either forward or reverse flow counts depending on the selected flow direction range.
When [] is pressed, the flow counts for both directions will be cleared to zero.
When a unidirectional flow (forward or reverse) is selected, the totalizer does not count the opposite direction flow counts.
- Non-volatile memory is used to store the totalizer counter value. Therefore, the value will be retained in the memory even if the power is cut off.

■ Using the optional DI signal

Remote operations for the totalizer and pulse output can be conducted using the optional DI signal. The following functions in the table can be performed. See 8.2.9, "Digital I/O" to select these functions.

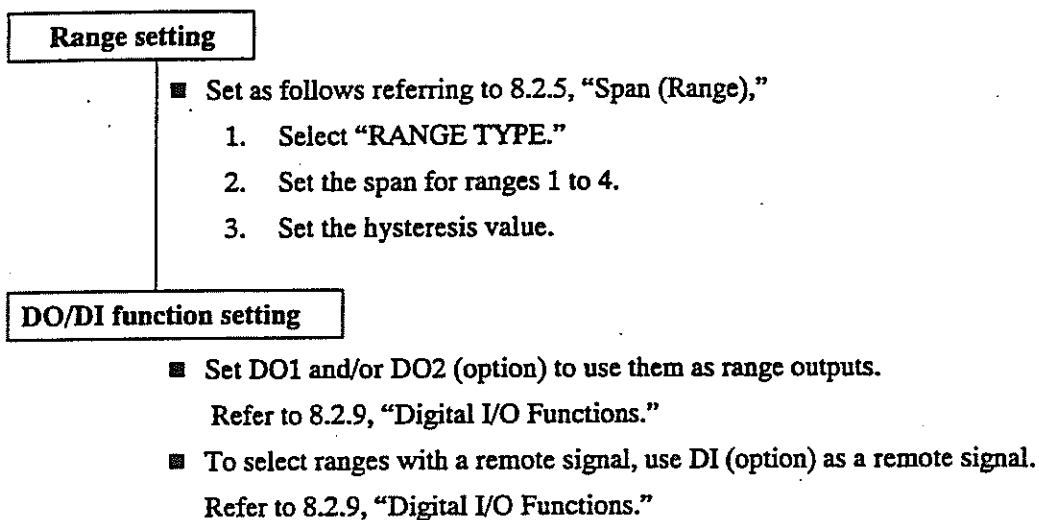
Digital input (DI) Functions	DI voltage level	Totalizer and pulse output
Totalizer	L	Stops the totalizer and the pulse output.
Start/Stop	H	Starts the totalizer and the pulse output.
Totalizer	H	Stops and clears (resets) the totalizer.
Reset/Start	L	Starts the totalizer and the pulse output.

10.3 Multi-range Functions

Multi-range functions can be set under the configuration item "RANGE TYPE." Refer to 8.2.5, "Span (Range)." Four types of multi-range configurations are available as shown below:

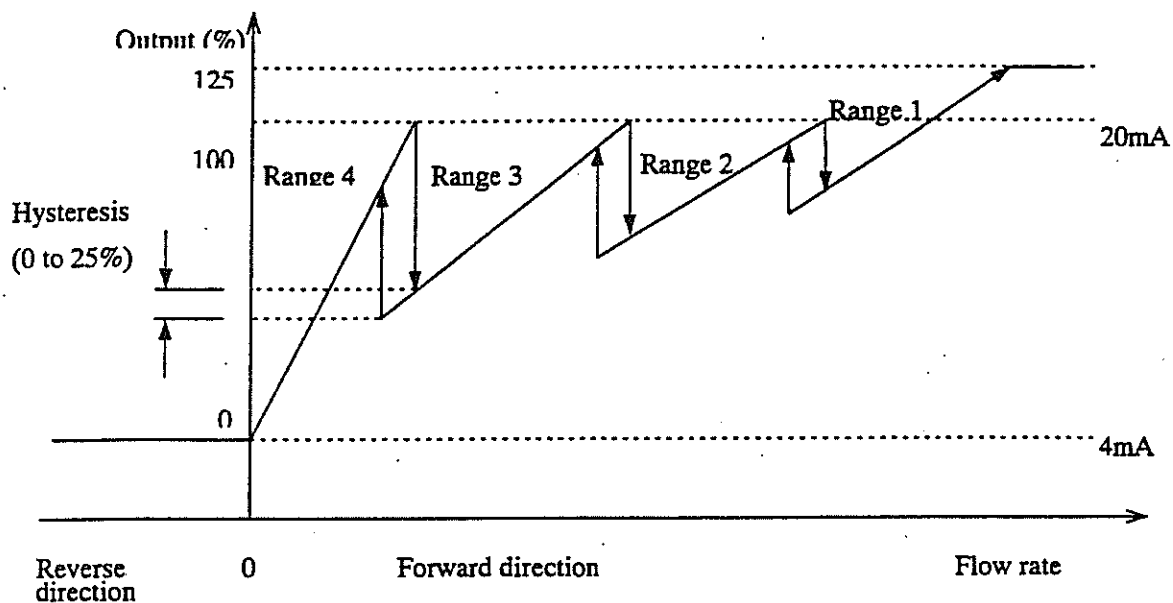
- (1) Automatic selection of unidirectional flow multi-range
- (2) Automatic selection of bidirectional flows multi-range
- (3) Remote selection of unidirectional flow multi-range with an external signal
- (4) Remote selection of bidirectional flows multi-range with an external signal

Proceed as follows to use the multi-range functions.



■ Output performance of multi-range functions

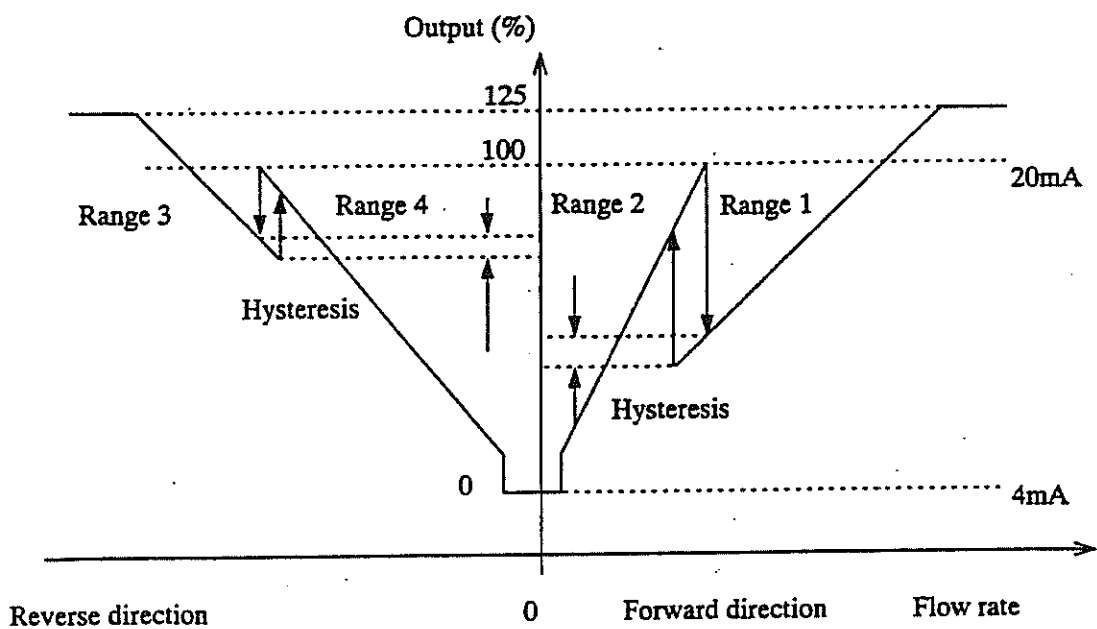
(1) Automatic selection of unidirectional flow multi-range



Range output	Output status			
No. 1	ON	OFF	ON	OFF
No. 2	ON	ON	OFF	OFF

Note: The current output for opposite direction flow is 4 mA.

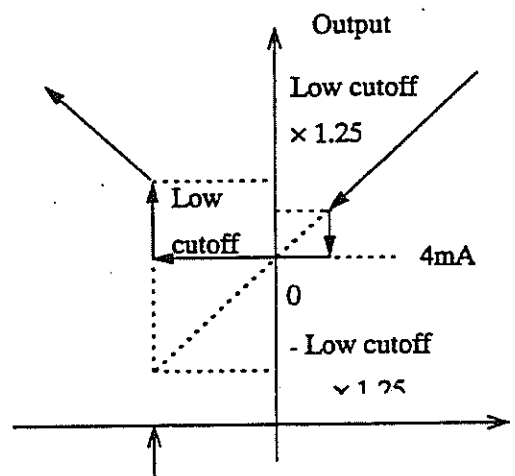
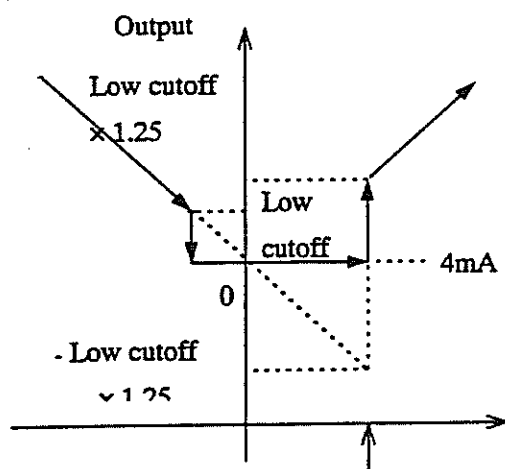
(2) Automatic selection of bidirectional flows multi-range



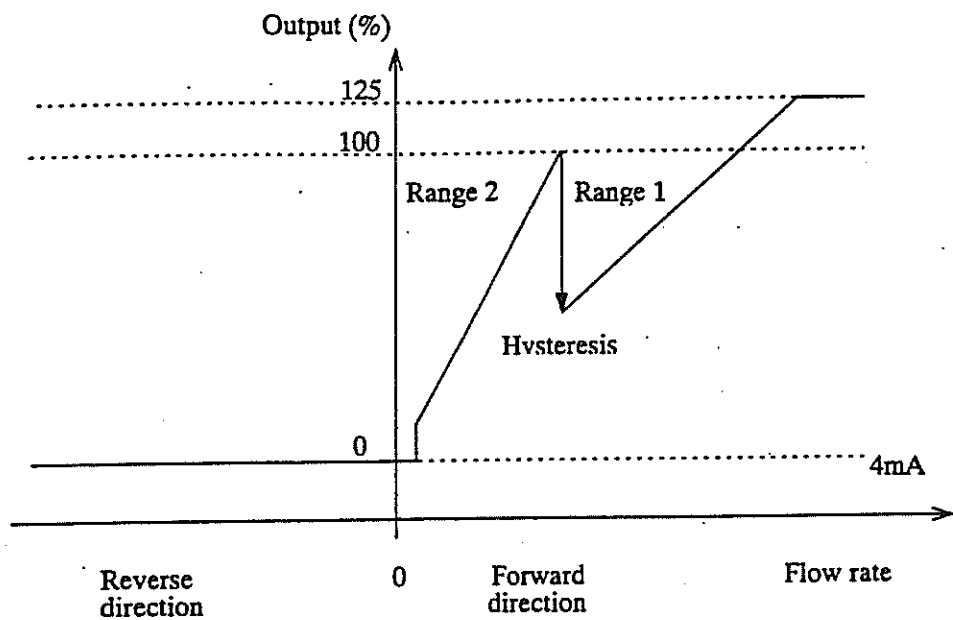
Range output	Output status	
No. 1	OFF / ON	ON / OFF
No. 2	ON / OFF	

■ Reverse to Forward direction change

■ Forward to Reverse direction change



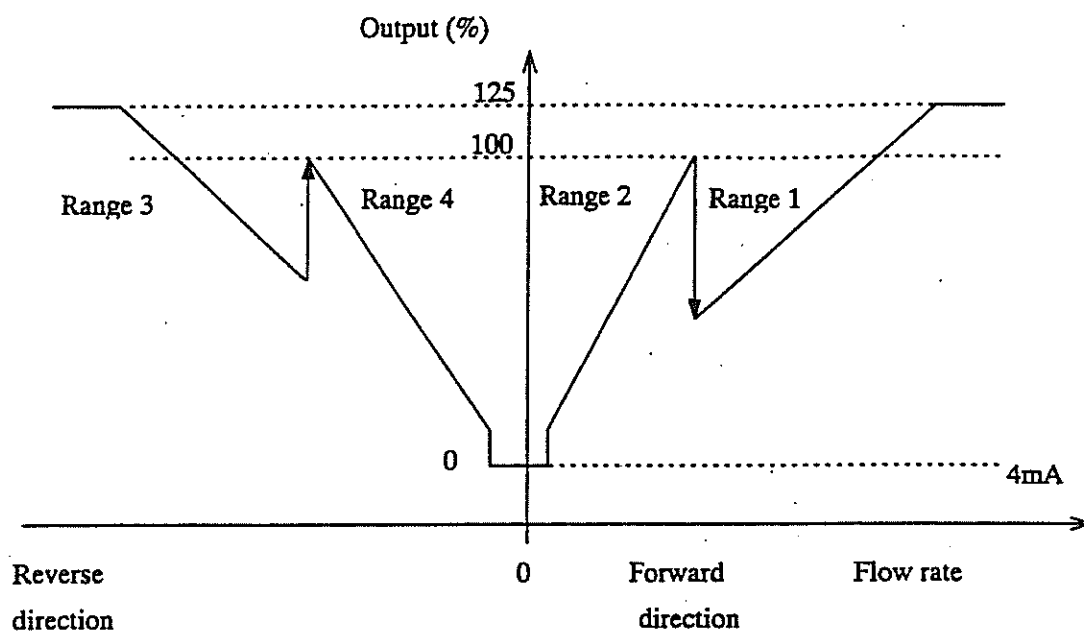
(3) Remote selection of unidirectional flows multi-range with an external signal



External signal	H level input	L level input
Range output No. 1	ON	OFF

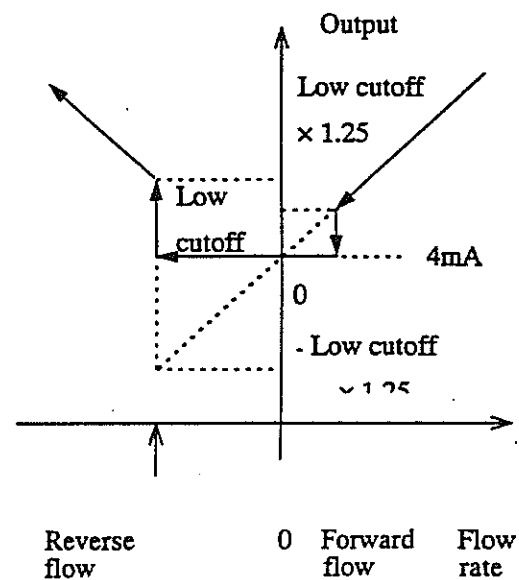
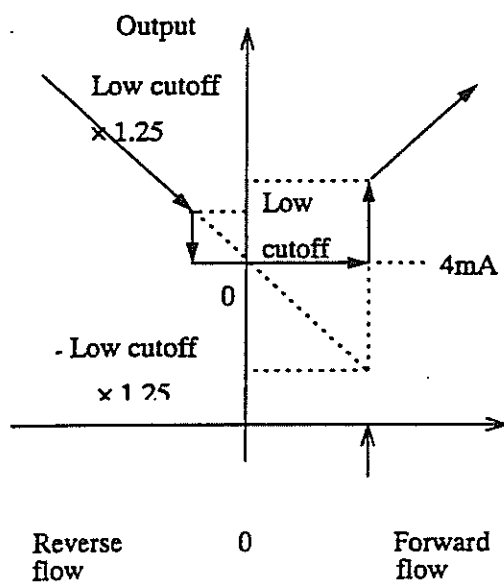
Note: The current output for opposite direction flow is 4 mA.

(4) Remote selection of bidirectional flows multi-range with an external signal



External signal	L level	H level	H level	L level
Range output No. 1	OFF	ON	ON	OFF
Range output No. 2	ON		OFF	

■ Reverse to Forward direction change ■ Forward to Reverse direction change



10.4 High and Low Limit Alarms

Proceed as follows to use the high and low limit alarms:

High and Low limit value setting

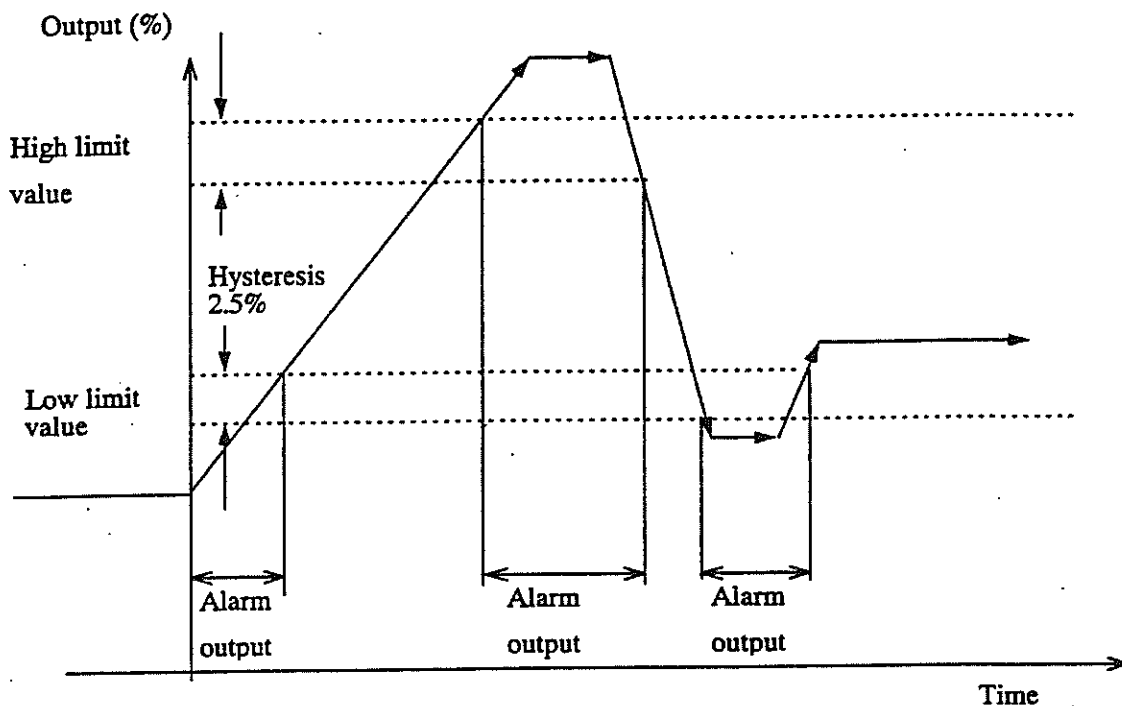
- Set the high and/or low limit alarm enable/disable status to ON and set the limit value for high and/or low alarm. See 8.2.12, "High and Low Limit Alarms." To disable the high or low limit alarm, set its enable/disable status to OFF.

DO function setting

- Set DO1 and/or DO2 (option) as high and/or low limit alarm outputs. See 8.2.9, "Digital I/O Functions."

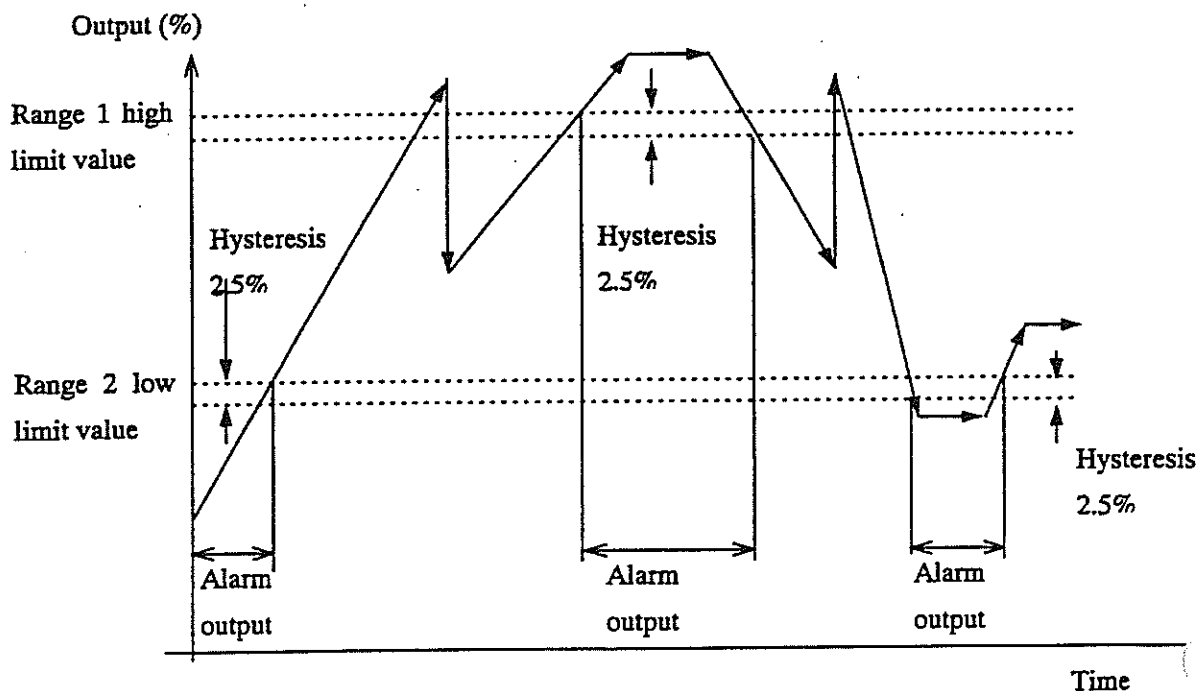
■ High and Low Limit Alarm Output Performance

(1) Single range performance



(2) Multi-range performance

In an example shown below, a low limit alarm is set for the Range 2 and a high limit alarm is set for the Range 1.



Note: Alarm output is an ON signal (contact closed) when an alarm occurs.

10.5 Empty Pipe Alarm

Proceed as follows to use the empty pipe alarm output.

Alarm output setting

- Set the empty alarm enable/disable status to ON. See 8.2.13, "Empty Pipe Alarm."

DO function setting

- Set DO1 or DO2 (option) as the empty pipe alarm output. See 8.2.9, "Digital I/O Functions." If you use the empty pipe alarm function but not an external output, this setting is not needed.

■ Output conditions when an empty pipe alarm occurs:

- 4–20 mA output: 4 mA
- Totalizer and pulse output: Totalizer and pulse output are stopped.
- Measured data display: Zero is indicated for instantaneous flow rate.
- Alarm output: ON (for DO1 and contact closed for DO2)

See Chapter 12, "Self-Diagnostics and Warning Functions." to use the empty pipe alarm function.

10.6 Preset Point Output

Using this preset point output function, you can output a contact signal when the totalized flow reaches its preset value. Proceed as follows to use this function.

Totalizer setting

- Set necessary parameters and selections to use the totalizer.
See 10.2, "Totalizer and Pulse Output."

Preset value setting

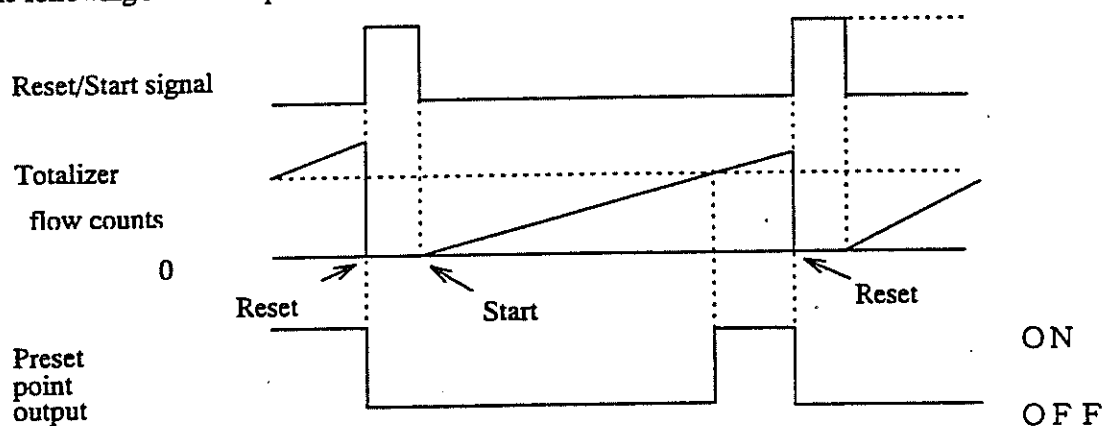
- Set the desired preset value. See 8.2.11, "Preset Count Value."

DO/DI function setting

- Set DO1 or DO2 for use as a preset point output.
See 8.2.9, "Digital I/O Functions."
- To clear (reset) the totalizer with an external signal, set DI as a Reset/Start signal. If you use the control keys on the panel (optional) to clear (reset) the totalizer, this setting is not needed.

■ Preset point output performance

The following is an example in which the totalizer is reset with an external signal.



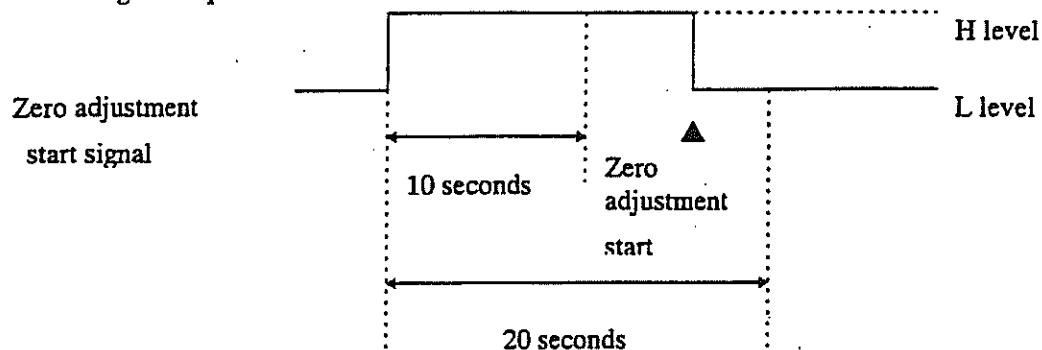
Input/Output signal time chart

- When the Reset/Start signal is in H level, the totalizer is reset to zero and stops counting.
- When the Reset/Start signal goes to L level, the totalizer starts counting.
- The preset point output goes ON when the totalizer counts reaches the preset point and the output goes OFF when the totalizer is reset to zero.

10.7 Remote Zero Adjustment

On-stream zero adjustment in a zero flow rate condition can be started with an external signal. To do this, set DI as a zero adjustment start signal. See 8.2.2.9, "Digital I/O Functions."

■ Start signal requirements:

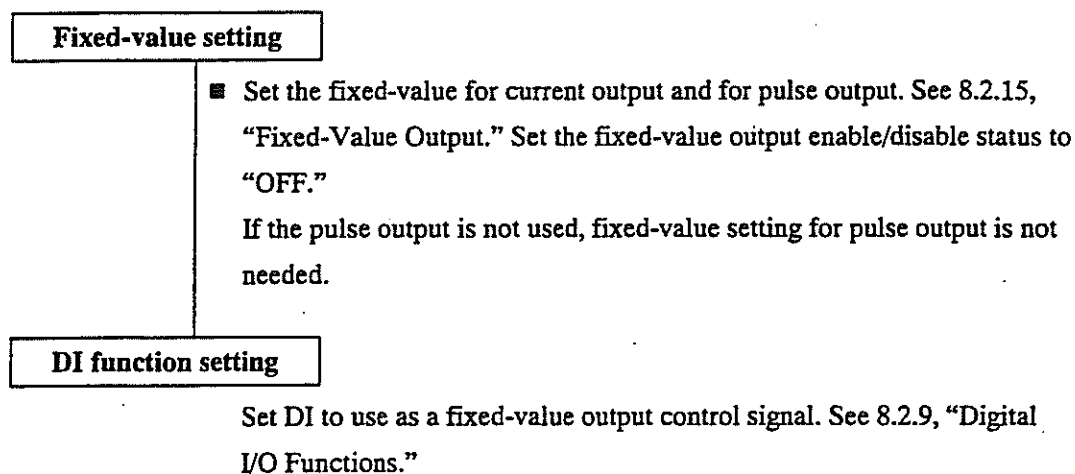


The start signal must be set to H level first, then it must go to L level after the passage of more than 10 seconds but not more than 20 seconds, as shown above. (If the signal does not go to L level within this specified period, it will be ignored.) As soon as the signal goes to L level, zero adjustment sequence starts.

10.8 Remote Selection of Fixed Value Output

A user-specified current output and pulse output can be selected with a DI signal.

Proceed as follows to use this function:



Control signal input conditions:

Control signal input level	4~20 mA and pulse output
L level	Outputs the measured value.
H level	Outputs the fixed-value.

10.9 Converter Failure Alarm

When one or more of the following converter errors occur in a self-diagnostics sequence, an alarm signal can be output. To use this function, set DO1 or DO2 to use as an alarm output signal. See Chapter 12, "Self-Diagnostics and Warning Functions" for details of each alarm status.

■ Self-diagnostics errors

Self-diagnostics error (LCD display)	Error contents
* ROM ERROR *	ROM error
* RAM ERROR *	RAM error
PARAMETER FAIL	System parameter error
EX. CURR. OPEN	Excitation circuit open
EX. CURR ERROR	Excitation current error
ADC. ERROR	ADC error
INVALID TOTAL	Invalid totalizer counts

■ Output conditions

- Turns ON (contact closed) when an error occurs.
- Turns OFF (contact open) when power is cut off.

11. Communications Function

The LF403 converter uses the HART protocol to transmit digital signals over the 4-20 mA output line. The AF100 hand-held terminal is used to communicate with the LF403 using the HART protocol. You can check or change configuration parameters, calibrate the flowmeter or monitor the flowmeter measuring value from a remote place.

See the instruction manual for the AF100 hand-held terminal (6F8A0699) for details.

11.1 Connections with the AF100 Terminal

 WARNING	
■ Do not remove cover while circuits are live to prevent ignition of explosive atmospheres..	
	Live part of electric circuit or a high temperature department can cause explosion.
DON'T	

Connect the probe cable of the AF100 terminal in parallel with the load resistance which is wired from the current output terminals (+ and -). Use points such as pins of terminal board or junction terminal to connect with the clip of the probe. See Figure 11.1. These current output terminals are polarized (positive and negative) but you can connect the probe to these terminals without considering their polarity.

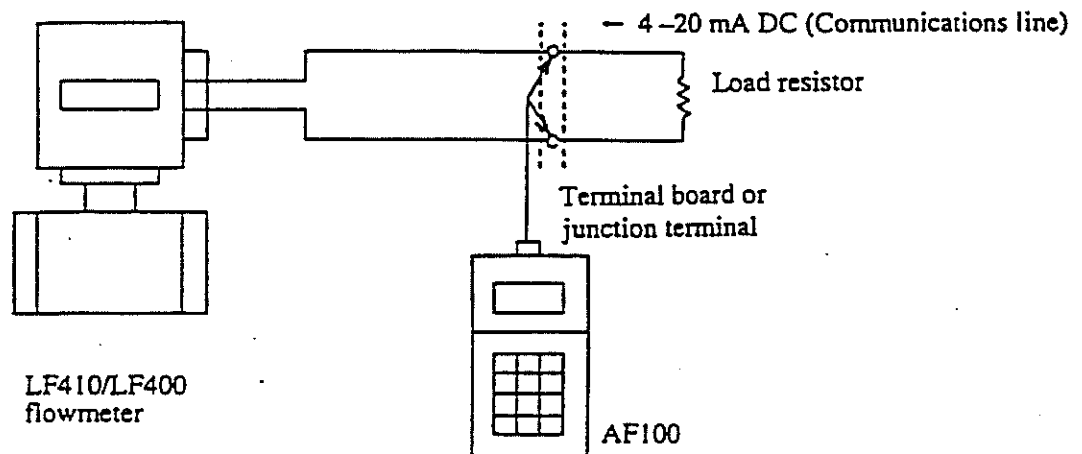
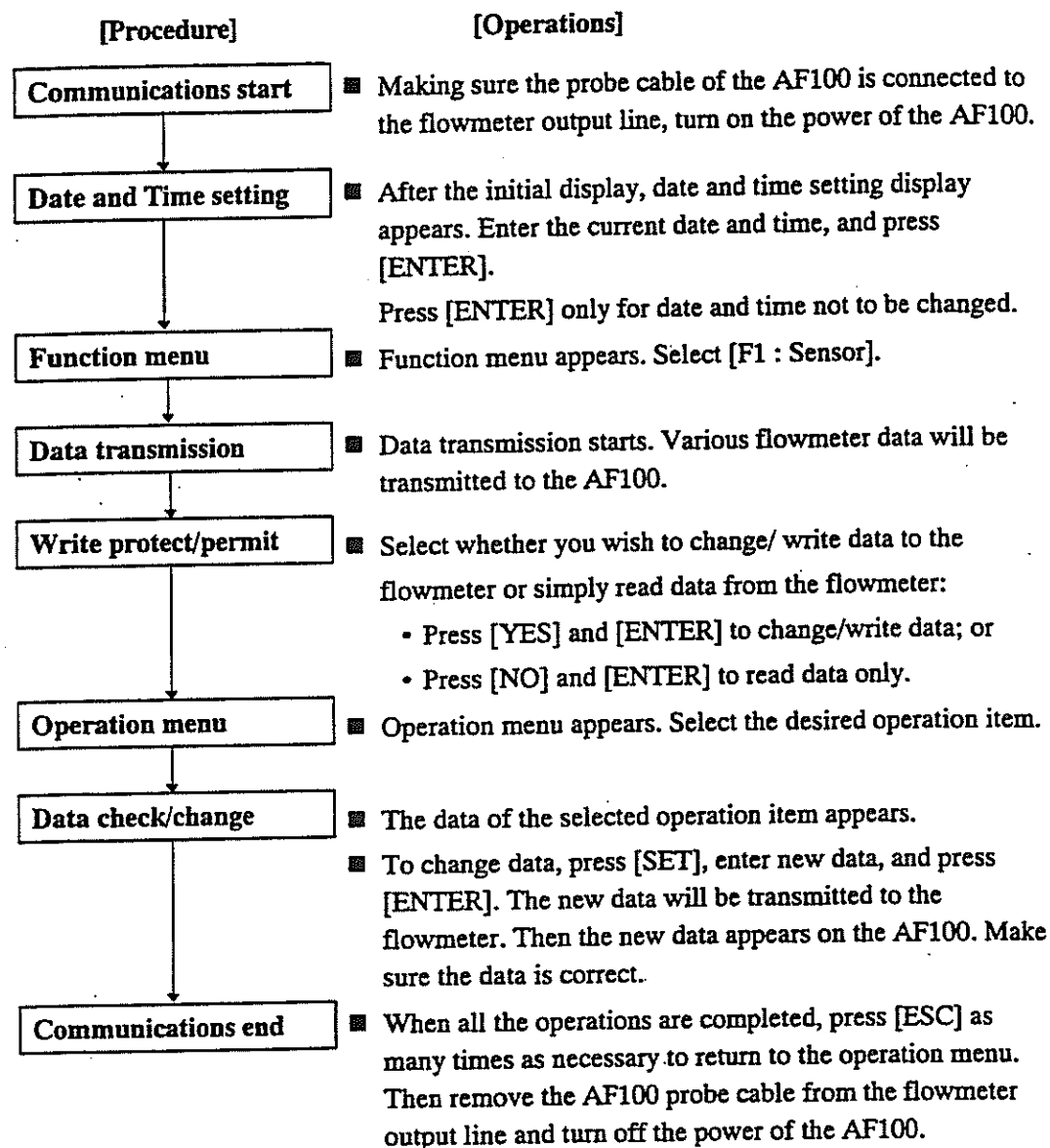


Figure 11.1 Connections to the current output line

11.2 Communications Procedure

Basic operations of the AF100 terminal are as follows. See the instruction manual of the AF100 terminal for details.



NOTES

1. Pressing [ESC] continuously, the system goes back to "Write protect/permit."
2. Pressing [HOME] continuously, the system goes back to "Function menu."

11.3 Cautionary Notes on Communications

Observe the following notes and limitations when you use the communications function.

■ Current output load

Load resistance: 240 to 1 k Ω (including communications line resistance)

Load capacitance: 0.22 μ F maximum (including communications line capacitance)

Load inductance: 4mH maximum (including communications line inductance)

Cable length: 2 km maximum (approximate value when 1.25 mm² shielded cable is used under standard operating conditions.)

■ Wiring cable

Use a shielded output cable as specified in Table 5.1.

■ Interference on 4-20 mA current signal

To communicate with the flowmeter, a digital signal (amplitude 0.4 to 0.8 V in the case of 500 Ω load resistance) with a frequency of 1.2 to 2.2 kHz is superimposed on the 4-20 mA current signal. If a high-response receiving instrument is connected to the current output line, the superimposed communications signal may interfere with the instrument.

To prevent this interference, put a low-pass filter with a time constant of about 100 ms into the input circuit of the receiving instrument.

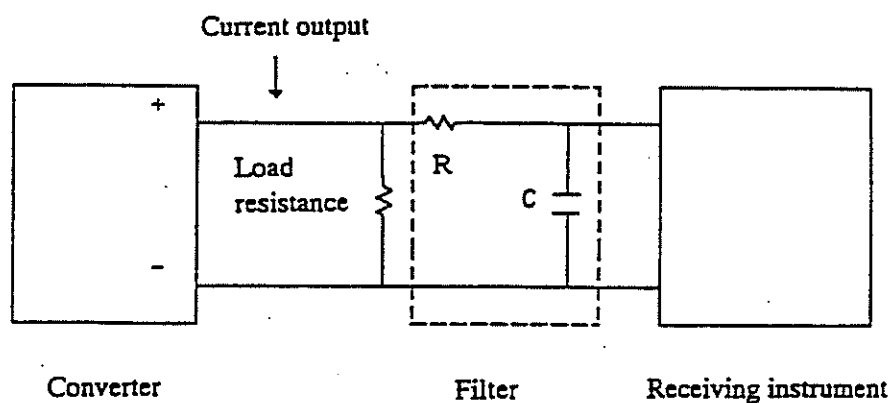


Figure 11.3 Filter connection example

12. Self-Diagnostics and Alarms

Self-diagnostic items and their error or alarm messages are described below.

12.1 Self-diagnostics

The LF403 converter has a self-diagnostics function to detect such problems as setting error, I/O error or converter hardware failure and shows the resulting error or alarm messages on the LCD display (optional) or on the AF100 hand-held terminal through the HART protocol communications. The error or alarm messages and their corrective actions are described below.

■ Setting error

If you try to set the value or measuring unit out of the range specified for each item, one of the following error messages appears.

Error message	Description	Corrective action
* H. OVER SPEC.	Setting value exceeds the allowable high limit.	Try to set the value within the specified range.
* L. OVER SPEC.	Setting value goes below the allowable low limit.	
* H. OVER C RATE	Counting rate exceeds the allowable high limit.	
* L. OVER C RATE	Counting rate goes below the allowable low limit.	
* MULTI RNG ERR	Span is not appropriate for multi-range configuration.	Try to set the span as specified.

■ High and low limit alarms

If the flow rate reading goes out of the set range, one of the following messages appears. If the high or low limit alarm enable/disable status is set to OFF, its alarm function (high or low) is disabled. See 8.2.12, "High and Low Limit Alarms."

Alarm message	Description	Corrective action
H. ALARM	Flow rate reading exceeds the high limit.	Arrange so that the reading stays below the high limit.
L. ALARM	Flow rate reading goes below the low limit.	Arrange so that the reading stays above the low limit.

■ Empty pipe alarm

If the detector pipe is not filled with fluid, the following message appears.

Design piping so that the detector pipe is always filled with the fluid to be measured. If the empty alarm enable/disable status is set to OFF, this function is disabled. See 8.2.13, "Empty Pipe Alarms."

Alarm message	Description	Corrective action
EMPTY	Detector pipe is not filled with fluid.	Arrange piping so that the detector pipe is always filled with fluid.

Precautionary notes on using the empty pipe alarm

- (1) The flowmeter detects an empty pipe condition by monitoring the impedance and signal level between the flow signal lines connected to a pair of electrodes. Therefore, the following factors may trigger an erroneous empty pipe alarm:
 - Opening or loose connection of flow signal lines
 - The fluid to be measured carrying a lot of bubbles
 - Contamination of the electrode with non-conductive deposits
- (2) If the flowmeter is not grounded properly or if it is in an environment where high electrical noise exists, the empty pipe alarm may not function properly. Under these conditions, the reliability of flowmeter accuracy itself is not high. Try to ground the flowmeter securely to an independent good ground and relocate the cable runs to prevent noise from entering into the flowmeter circuit.
- (3) If the fluid still remains in the detector pipe or the internal wall of the detector pipe is contaminated with electrically conductive deposits, the impedance between the signal lines will not go high and the empty pipe alarm may not work. In this kind of event, try to use other means to detect an empty pipe condition (such as a pump stop signal or a signal from a valve).

■ Converter hardware failure

The system checks the internal circuitry at the time of power-up for all error items and checks continuously for the specified items as described below. If an error is detected, one of the messages shown in the table below will be displayed.

If multiple errors occur, their messages will be displayed cyclically. The diagnostics items concerning the excitation cable and excitation circuit are detected using the ADC circuit. Thus, if the ADC fails, No. 4 (excitation cable) and No. 5 (excitation circuit) errors cannot be detected correctly. Further, this entire checking system is based on the CPU in the flowmeter. Therefore, if the CPU fails, no accurate diagnostics or error message display can be obtained.

No.	Error message	Description	Corrective action
1	* ROM ERROR *	ROM error	Internal components or printed-circuit board must be repaired or replaced. Contact your nearest Toshiba representative.
2	* RAM ERROR *	RAM error	
3	PARAMETER FAIL	System parameter error	
4	EX. CURR. OPEN	Excitation cables are not connected.	Connect the excitation cables correctly.
5	EX. CURR. ERROR	An error occurred in the excitation circuit.	Internal components or printed-circuit board must be repaired or replaced. Contact your nearest Toshiba representative.
6	ADC. ERROR	ADC error	
7	INVALID TOTAL	Totalizer data was destroyed due to external noise. (No message appears if totalization is not used.)	The error message disappears if you press the reset key.

NOTES

- Errors No. 1 to No. 3 can be detected only at the time of power-up. The flowmeter does not start measurement if any one of these errors is detected. If these errors occur after power-up, the flowmeter cannot detect these errors, and thus may indicate and output incorrect data.
- Errors No. 4 to No. 6 may not be detected even if the errors result in incorrect flowmeter accuracy, because of characteristic differences in components used to detect these errors.
- CPU error cannot be detected. If the CPU stops, the watchdog timer resets the internal circuits and the flowmeter starts again from the initial power-up condition. Depending on CPU condition, the flowmeter may not indicate and output correct data.

12.2 Output Status for Errors and Alarms

The flowmeter data display, current and pulse outputs will become as follows if an error or alarm occurs.

Error or alarm message	Data display	Current output (4–20 mA)	Totalizer and pulse output	Remarks
ROM ERROR (Note 1)	———	4 mA	Stopped	After power-up, no measurement starts.
RAM ERROR	———	4 mA	Stopped	
PARAMETER FAIL	Zero	4 mA (Note 2)	Stopped	———
EX. CURR OPEN	Zero	4 mA	Stopped	Zero adjustment (on-stream at zero flow rate) cannot be conducted.
EX. CURR ERROR	Measured data	Measured data	Measured data	———
ADC. ERROR	Zero	4 mA	Stopped	———
INVALID TOTAL	Measured data	Measured data	Measured data	The error message disappears if you clear (reset) the totalizer.
EMPTY	Zero	4 mA	Stopped	Zero adjustment (on-stream at zero flow rate) cannot be conducted.

Notes

1. The display and output may not be as indicated depending on the nature of the ROM error.
2. If parameters related to the current output are defective, the current output may not be exactly 4 mA.

13. Maintenance and Troubleshooting

 WARNING	
■ Do not remove cover while circuits are live to prevent ignition of explosive atmospheres..  Live part of electric circuit or a high temperature department can cause explosion. DON'T	
■ Do not modify or disassemble the enclosure.  Strength degradation and defects of enclosure can cause explosion. DON'T	
■ Do not use parts of other products.  Explosionproof performance degradation can cause explosion. DON'T	
■ Do not live circuits While assembly of all component is not over.  Explosionproof performance degradation can cause explosion. DON'T	

 CAUTION	
■ Do not conduct wiring work when power is applied.  Wiring while power is applied can cause electric shock. DON'T	Do not touch the LF413/LF403 main body when high temperature fluid is being measured.  The fluid raises the main body temperature and can cause burns. DON'T

13.1 Maintenance

■ Calibration

The LF403 converter has a reference signal generating circuit. This reference signal can be used to check the zero and span of the converter for the purpose of instrumentation maintenance or periodical inspection. See Chapter 9, "Calibration."

■ Fuse

The fuse can be taken out by unscrewing the cap of the fuse holder. Check that the fuse is not damaged. The fuse has to be replaced periodically. The recommended replacement period is 3 years.

Type of fuse used:	Glass tube fuse	1 piece
Rating:	1A, 250 V for 80 to 264 V ac power supply or 2A, 250 V for 20.4 to 28.8 V dc.	
Dimensions:	Diameter 5.2 mm × 20 mm	

■ LCD display (optional)

If the characters displayed on the LCD are dimmed or blurred, the LCD display should be replaced. To extend the life of the flowmeter, replace the LCD early. To check and replace the LCD display, contact your nearest Toshiba representative.

■ Power supply unit

Electronic components deteriorate faster when the ambient temperature is high. The life of the power supply unit in the converter is 9 to 10 years if the ambient temperature is 40° C, and 5 to 6 years if it is 50° C. To extend the life of the flowmeter, we recommend you replace the power supply unit early. Contact your nearest Toshiba representative for a flowmeter inspection or unit replacement.

IMPORTANT

- (1) It is recommended that the detector pipe be cleaned once a year.
- (2) Use always new packing when mounting the flowmeter detector in the pipeline.

■ Cleaning the inside of the detector

If the fluid to be measured contains a high concentration of electrically conductive solids, the solids may accumulate as deposits on the internal wall of the detector pipe. The deposits cause a reduction of flowmeter measuring output. If the measuring output is lower than the actual process value, check for deposits on the internal wall of the detector pipe. If found, remove the deposits using a soft brush. Clean the inside of the detector periodically if measuring this kind of fluid.

■ Operative life

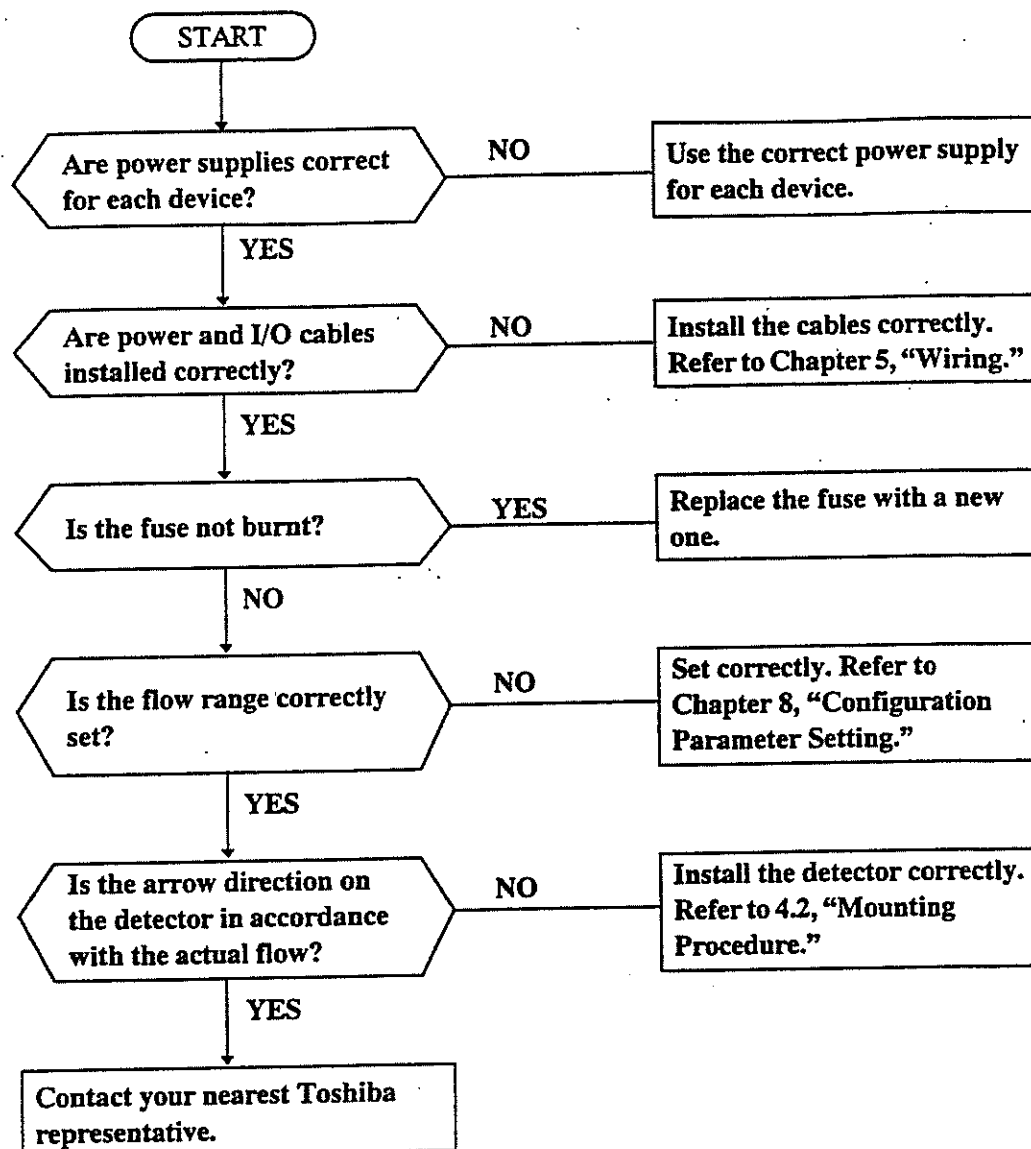
The operative life of this flowmeter is 10 years from the date of shipment. The life of the flowmeter differs depending on the environmental conditions and the way it was used. To extend the life of the flowmeter, inspect the flowmeter periodically and clean or replace components if necessary.

13.2 Troubleshooting

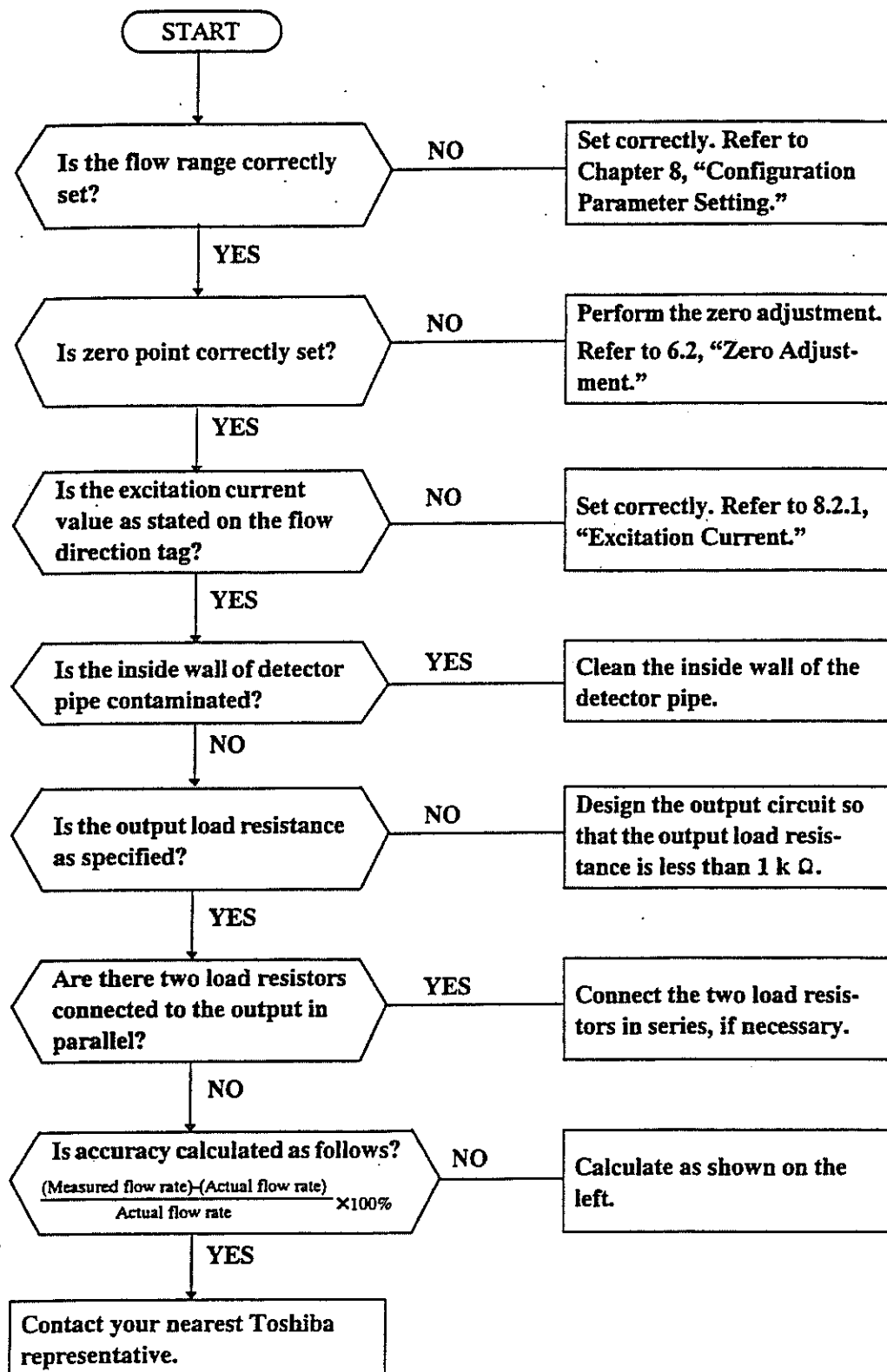
If a problem occurs while using the LF413/LF403, follow the flowcharts described below.

You may find a way to solve the problem. The flowcharts are based on three symptoms (1) to (3). If you cannot solve the problem, contact your nearest Toshiba representative.

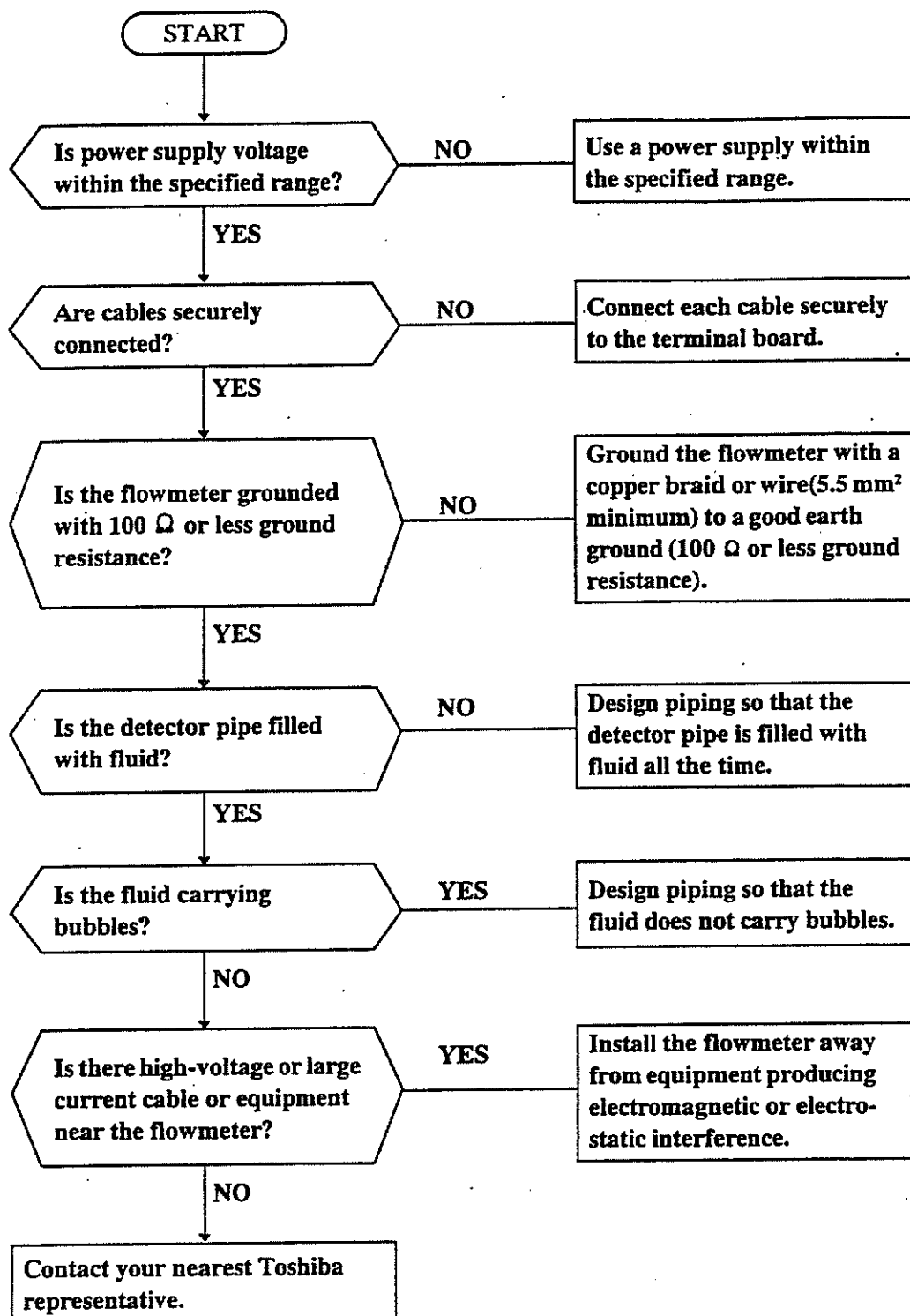
(1) Flow rate is not indicated.



(2) Flow rate indication is not correct.



(3) Flow rate indication is not stable.



14. Principle of Operation

The operating principle of the electromagnetic flowmeter is based on Faraday's Law of electromagnetic induction and it is designed to measure the volumetric flow rate of fluid. An insulated pipe of diameter D is placed vertically to the direction of a magnetic field with flux density B (see Figure 14.1). When an electrically conductive fluid flows in the pipe, an electrode voltage E is induced between a pair of electrodes placed at right angles to the direction of magnetic field. The electrode voltage E is directly proportional to the average fluid velocity V .

The following expression is applicable to the voltage.

$$E = K \times B \times D \times V \text{ [V]} \dots\dots\dots (\text{Eq. 14.1})$$

E = induced electrode voltage [V]
 K = constant
 B = magnetic flux density [T]
 D = meter pipe diameter [m]
 V = fluid velocity [m/s]

Volumetric flow rate Q [m^3/s] is:

$$Q = \frac{\pi \times D^2}{4} \times V \dots\dots\dots (\text{Eq. 14.2})$$

Using the Equation 14.1 and 14.2

$$E = K \times B \times D \times \frac{4}{\pi \times D^2} \times Q$$

$$E = \frac{4 \times K \times B}{\pi \times D} \times Q \dots\dots\dots (\text{Eq. 14.3})$$

Therefore, volumetric flow rate is directly proportional to the induced voltage.

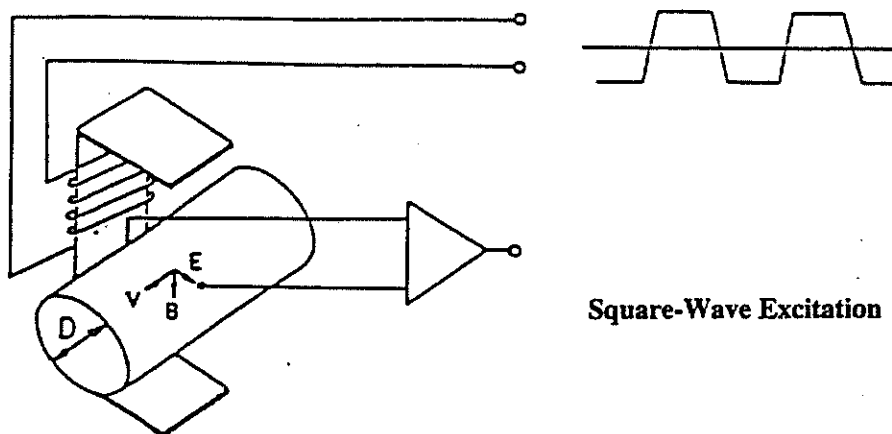


Figure 14.1 Principle of Operation

The LF413/LF403 electromagnetic flowmeter uses the square-wave excitation method, which provides long-term stable operation. With square-wave excitation, the LF413/LF403 offers reliable measurement without being affected by electrostatic or electromagnetic interference, or electrochemical polarization between the electrodes and the fluid to be measured.

15. Specifications

The flowmeter specifications and the type specification code used when ordering the flowmeter are described in this chapter.

15.1 Flowmeter Specifications

■ Overall Specifications

Hazardous locations certification: FM approvals

Explosionproof for Class I, Division 1, Groups B, C, and D.

Dust-Ignition proof for Class II, Division 1, Groups E, F, and G.

Suitable for Class III, Division 1, indoor and outdoor (NEMA 4).

Structure:

NEMA 4X (IP 67) Watertight

Measurement range in terms of flow velocity:

0–0.3 m/s to 0–10 m/s (0–0.1 m/s to 0–0.3 m/s range is available optionally)

System accuracy: See the following table.

Table 12.1 System accuracy

Flow rate as a percentage of range	Accuracy		
	0.1–1.0 m/s	0.3 – 1.0 m/s	1.0–10 m/s
0 to 20%	_____		±0.1% FS
20 to 100%	_____		±0.5% of rate
0 to 50%	±0.25% of FS		_____
50 to 100%	±0.5% of rate		_____

Note: The accuracy above is measured under standard operating conditions at Toshiba's calibration facility.

Fluid conductivity: 5 μ S/cm minimum

Fluid temperature: –10 to +120 °C

Ambient temperature: –10 to +60 °C

Dimensions and Mass: See Chapter 16, "Outline Dimensions."

■ LF413 Detector

Meter size: 15, 25, 40, 50, 80 and 100 mm

Fluid pressure: –0.1 MPa {–1 kgf/cm²} to the pressure limited by the connection flange

Heat shock resistance:—for ceramic tube detector

Heating: $\Delta T \leq 150\text{ °C}/0.5\text{ s}$ (Note)

Cooling: $\Delta T \leq 100\text{ °C}/0.5\text{ s}$ (Note)

Note: Meaning that the ceramic tube detector withstands the shock of sudden heating (temperature difference 150 °C or less per 0.5 seconds) or sudden cooling (temperature difference 100 °C or less per 0.5 seconds).

Connection flange standard: See Table 15.3 Type Specification Code.

Principal materials:

Case—Stainless steel (for meter sizes 25 to 100 mm),

Carbon steel (for meter size 15 mm)

Lining—Ceramic (standard) or Teflon PFA (option)

Electrodes—316L stainless steel (standard)

Grounding rings—316 stainless steel (standard)

See Table 15.5 Type Specification Code for optional materials and other related information.

Coating: No coating (for meter sizes 25 to 100 mm),

Phthalic acid resin coating, pearl-gray colored (standard for meter size 15 mm)

■ **LF403 Converter**

Input signal:

Digital input DI (option)

Signal type: 20 to 30 V dc voltage signal

Input resistance: 2.7 k Ω

Number of inputs: One point

Output signals:

Current output: 4 to 20 mA dc (load resistance 0 to 1 k Ω)

Digital outputs — One point (standard). One more point is optionally available.

Digital output DO1 (standard):

Output type: Transistor open collector

Number of outputs: One point

Output capacity: 30 V dc, 200 mA maximum

Digital output DO2 (option):

Output type: Solidstate relay

Number of outputs: One point

Output capacity: 150 V dc, 150 mA maximum; or
150 V ac, 100 mA (peak) maximum

DI function — One of the following functions can be assigned for the optional DI signal.

Range switching — Selects one of two ranges in the 2-range setting or selects either the higher or lower range in the bidirectional 2-range setting.

Totalizer control — Starts and stops the totalizer.

Fixed-value outputs — Outputs fixed-values for current output and pulse output.

Zero adjustment — Starts zero adjustment (on-stream at zero flow rate).

DO1 and DO2 functions — One of the following functions can be assigned for DO1 (standard) and/or DO2 (option).

- **Pulse output (available only for DO1)**

Pulse rate: 3.6 to 3600000 pulses/hour

Pulse width: 0.5 to 100 ms (but less than half of the period for 100% flow rate)

- **Multi-range selection outputs**

One output used: (1) 2-range switching for unidirectional flow
(DO1 or DO2) (2) Forward/Reverse flow range switching

Two outputs used: (1) 4-range switching for unidirectional flow
(DO1 and DO2) (2) 2-range switching for Forward and Reverse flows

- **High and/or low limit alarms outputs** — Outputs an alarm signal if the process flow rate goes above or below the set limits.

Setting range: -10 to 110% of the span (range)

Output status: Contact ON (closed)

- **Empty pipe alarm output** — Outputs an alarm signal when the detector pipe is not filled with fluid.

Output status: Contact ON (closed)

- **Preset point output** — Outputs a signal when the totalized flow reaches the preset value.

Setting range: 1 to 99999999 counts

Output status: Contact ON (closed)

- **Converter failure alarm** — Outputs a signal if an error occurs when self-diagnostics is conducted.

Output status: Contact ON (closed)

Communications output:—a small digital signal is superimposed on 4-20 mA current signal (conformed to HART protocol)

Load resistance: 240 to 1 k Ω

Load capacitance: 0.25 μ F maximum

Note: HART (Highway Addressable Remote Transducer) is a communications protocol for industrial sensors recommended by HCF (HART Communication Foundation).

Damping: 0.5 to 60 seconds (selectable in increments of 1 second)

Parameter setting: — Parameters can be set as follows depending on whether the LCD display is provided or not.

LF403 with LCD display: Three control keys are provided to set configuration parameters.

LF403 without LCD display: The AF100 hand-held terminal is needed to set parameters.

Zero and span calibration:

Built-in calibration signal source allows converter unit check.

Zero adjustment:

Zero point adjustment can be started by pressing the switch in the converter.

Conditions when power fails:

The outputs and display will become as follows when power fails. Parameter setting values are stored in non-volatile memory and the values will be restored when the power returns to normal condition.

Current output: 0 mA dc

Digital output: OFF

LCD display: No display

Power supply:

100 to 240 Vac (Allowable voltage 80 to 250 Vac), 50/60 Hz (standard) or

24 Vdc (Allowable voltage 20.4 to 28.8 Vdc) or

110 Vdc (Allowable voltage 98 to 121 Vdc)

Maximum voltage:

250 Vac, 50/60 Hz

Note: Maximum voltage that can be applied to the non-intrinsically safe connection facilities of associated apparatus without invalidating intrinsic safety.

Power consumption:

Approx. 10 W (Approx. 17 VA)

Arrester: Arresters are installed in the power supply and current signal output circuit.

Housing: Aluminum alloy

Coating: Acrylic resin-baked coating, pearl-gray colored

Conduit opening: NPT 1/2 thread

Vibration resistance:

No resonance to the following levels of vibration:

- 10 to 60 Hz, amplitude 0.07 mm;
- 60 to 150 Hz with acceleration of 9.8 m/s^2 .

No problem occurs after application of 30 Hz, 29.4 m/s vibration in any axis for four 4 hours.

Note: Avoid using the flowmeter in an environment with constant vibration.

15.2 Type Specification Code

Table 15.3 Type Specification Code (Model LF413 Detector)

Model					Specification Code										Description
1	2	3	4	5	6	7	8	9	10	11	12	13	14		
L	F	4	1	3											LF413 Detector
					D E F G H J										Meter size 15 mm 25 mm 40 mm 50 mm 80 mm 100 mm
						A									Mounting Structure FM Approval LF413/LF403 Combined type
							C D E F G H J K L Z								Connection flange standard ANSI 150 ANSI 300 BS 4504 Table 10 BS 4504 Table 16 DIN PN 10 DIN PN 16 JIS 10K JIS 16K JIS 20K other
								B C D E F Z							Electrode Material 316L stainless steel (standard) Ti (titanium) Pt-Ir (platinum/iridium) Ta (tantalum) Hastelloy C other
									A B C						Lining and Sealing Material Alkali-resistant ceramic (alumina) (standard) (Note 1) Acid-resistant ceramic (alumina) (Note 1) Teflon (PFA)
										C D E F Z					Grounding Ring Material 316 stainless steel (standard) 316L stainless steel Ti (titanium) Ta (tantalum) other
											A B C				Flow velocity range and Calibration velocity range 0.3 to 10 m/s (standard range calibration) 0.3 to 10 m/s (specified range calibration) 0.1 to 10 m/s (specified range calibration)
												A			Dedicated Preformed Cable Not provided
													A B		Coating no coating (for meter sizes 25–100 mm) (standard) phthalic acid resin coating, pearl-grav colored. (Note 2)

Notes:

- Example of fluid:
Alkaline fluid: Caustic soda, Ammonia, etc.
Acidic fluid: Hydrochloric acid, Sulfuric acid, etc.
- Phthalic acid resin coating is standard for the flowmeter with meter size of 15 mm.

Table 15.4 Type Specification Code (Bolts, Nuts and Packings)

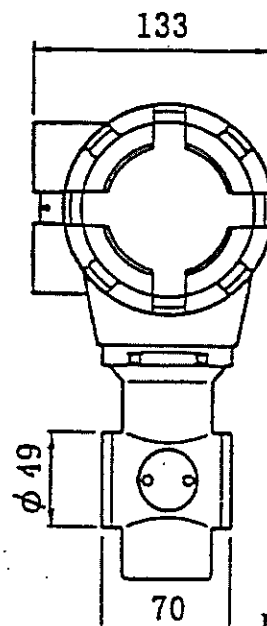
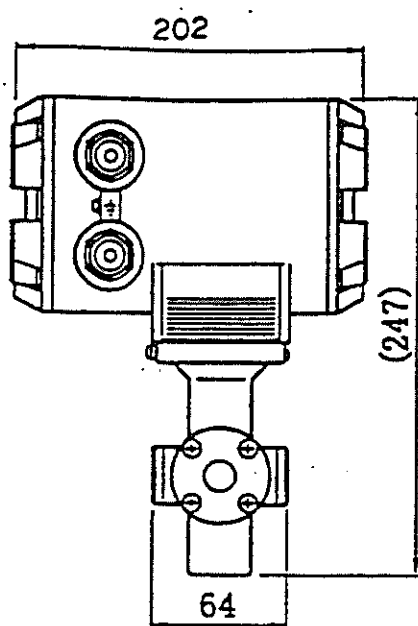
Model			Specification Code							Description
1	2	3	4	5	6	7	8	9	10	
B	N	P								Bolts, Nuts and Packings
			C							Wafer type
				S	1	5				Meter size
				S	2	5				15 mm
				S	4	0				25 mm
				S	5	0				40 mm
				0	0	8				50 mm
				0	1	0				80 mm
										100 mm
							C			Pipe flange rating
							D			ANSI 150
							E			ANSI 300
							F			BS 4504 Table 10
							G			BS 4504 Table 16
							H			DIN PN 10
							J			DIN PN 16
							K			JIS 10K
							L			JIS 16K
							Z			JIS 20K
										other
								A		Bolt and Nut Material
								B		Carbon steel SS400 (standard)
								C		304 stainless steel
								Z		not provided
										other
										Packing Material
								A		Chloroprene rubber (standard)
								B		Teflon-enclosed gasket
								C		not provided
								Z		other

Table 15.5 Type Specification Code (Model LF403 Converter)

Model					Specification Code										Description
1	2	3	4	5	6	7	8	9	10	11	12	13	14		
L	F	4	0	3										LF403 Converter	
					F									Purpose FM Approval	
						A								Structure Detector-converter combined type	
							A							Display not provided (standard) LCD display provided	
							B								
								1						Output 4–20 mA dc output and pulse output (standard) with digital I/O provided	
								2							
									1					Communications function HART protocol communications provided	
										1				Power supply 100 to 240 V ac, 50/60 Hz 24 V dc 110 V dc	
											1				
											2				
												3			
											A			Coating Acrylic resin-baked coating, pearl-gray colored	
												A	B	Standard	

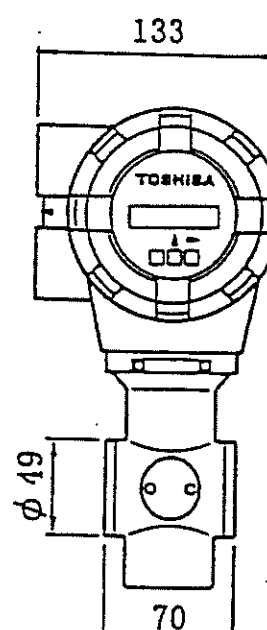
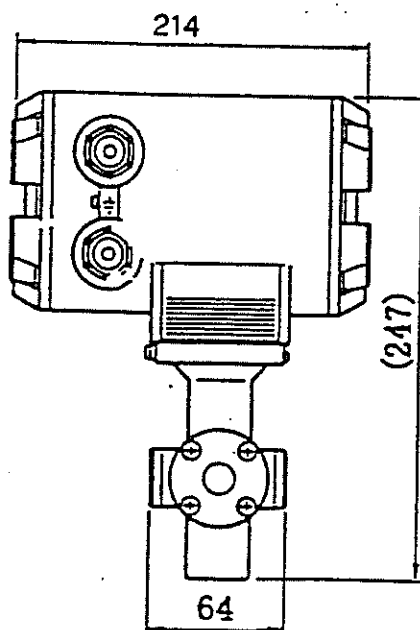
16. Outline Dimensions

■ Meter size 15 mm



Unit: mm

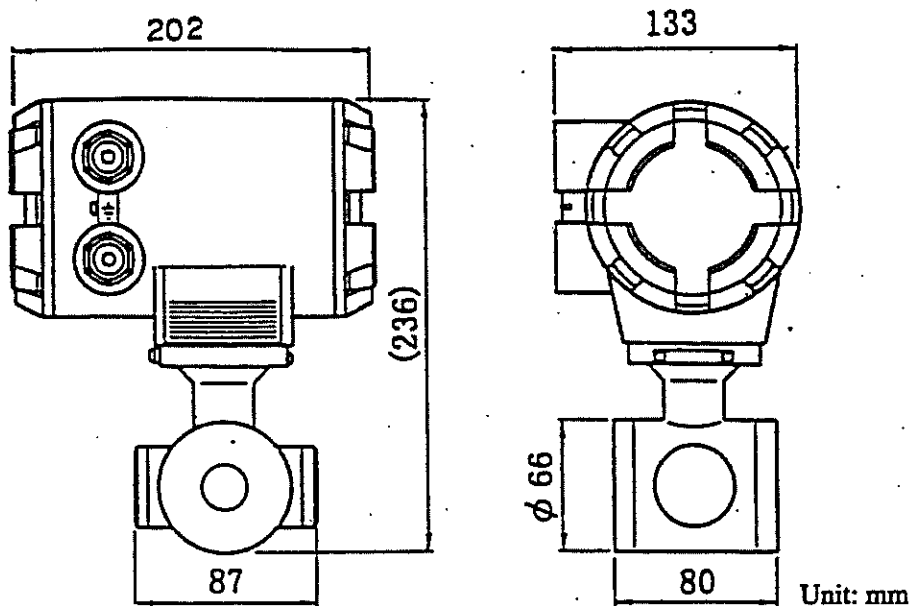
Model LF413/LF403 without LCD Display Mass: 4.5kg



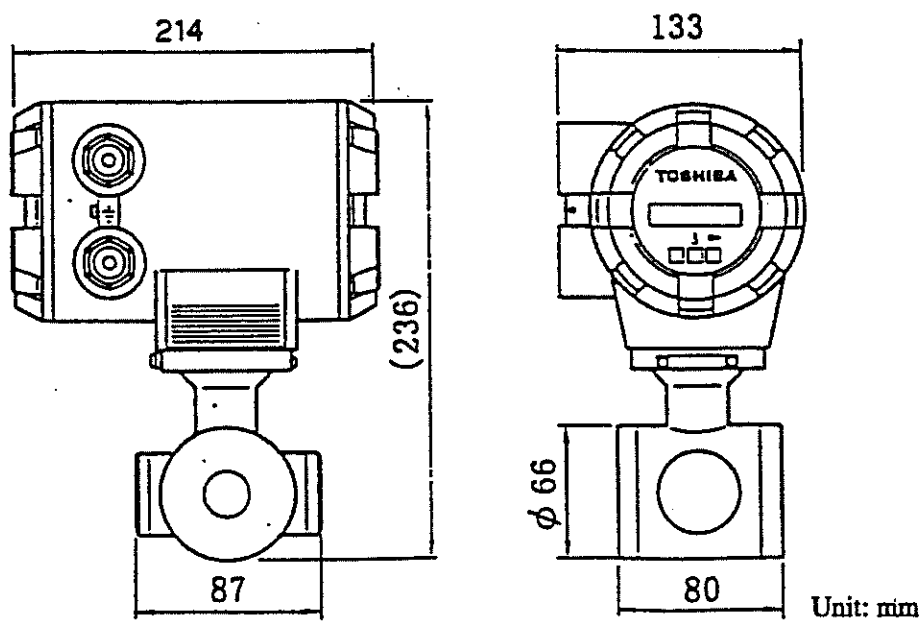
Unit: mm

Model LF413/LF403 with LCD Display Mass: 5.0 kg

■ Meter size 25 mm

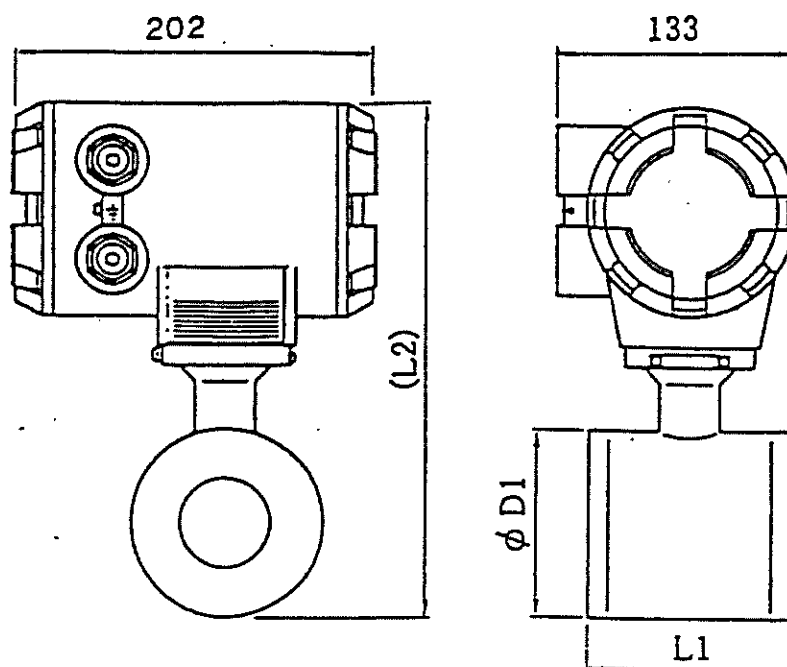


Model LF413/LF403 without LCD Display Mass: 5.0 kg



Model LF413/LF403 with LCD Display Mass: 5.5 kg

■ Meter sizes 40 to 200 mm

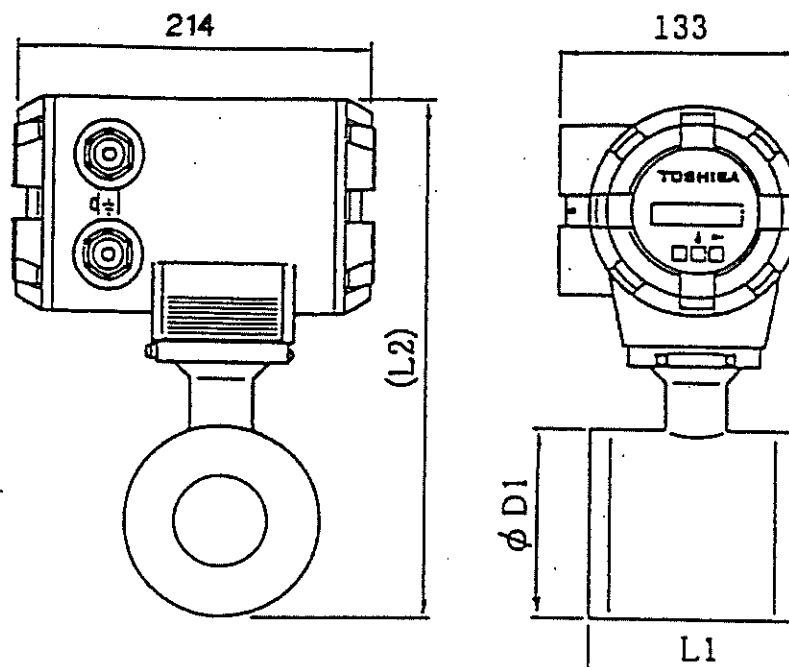


Unit: mm

Meter size (mm)	Dimensions			Mass (kg)
	L1 (mm)	L2 (mm)	D1 (mm)	
40	100	240	85	approx. 6.5 kg
50	110	257	102	approx. 7.0 kg
80	120(110)	282	127	approx. 8.5 kg
100	130(120)	314	159	approx. 10.5 kg
150	230	390	216	approx. 23.0 kg
200	300	441	267	approx. 37.5 kg

note: Numeric value in () shows a case of ceramics lining.

Model LF413/LF403 without LCD Display



Unit: mm

Meter size (mm)	Dimensions			Mass (kg)
	L1 (mm)	L2 (mm)	D1 (mm)	
40	100	240	85	approx. 7.0 kg
50	110	257	101.6	approx. 7.5 kg
80	120(110)	282	127	approx. 9.0 kg
100	130(120)	314	159	approx. 11.0 kg
150	230	390	216	approx. 23.5 kg
200	300	441	267	approx. 38.0 kg

note: Numeric value in () shows a case of ceramics lining.

Model LF413/LF403 with LCD Display

Appendix 1**Hazardous Area Classification****Factory Mutual (FM) Approval**

Electromagnetic Flowmeter LF413/LF403 have been approved by Factory Mutual Research on Report job Identification No. 2D8A4.AE.

XP-IS / I / 1 / BCD / T4 Ta=60°C ; DIP / II,III / 1 / EFG / T4 Ta=60°C ; Type 4X, IP67

Explosionproof	Class I , Division 1, Groups B, C, and D
Dust-ignitionproof	Class II,III, Division 1, Groups E, F, and G
Intrinsically safe electrodes	Class I , Division 1, Groups B, C, and D

Appendix 2

Electromagnetic Compatibility and Low Voltage Safety

Electromagnetic Flowmeter LF413/LF403 has been confirmed to comply with the requirements of the EMC directive 89/336/EEC and the low voltage directive 93/68/EEC.

EMC directive

This device has been tested in a typical configuration in accordance with the following standards in an industrial environment.

• Generic emission standard	EN50081-2
Conducted RF emissions	EN55011
Radiated RF emissions	EN55011
• Generic immunity standard	EN50082-2
Conducted RF immunity	ENV50141
Radiated RF immunity	ENV50140/ENV50204
Electrostatic discharge	EN61000-4-2
Fast transient burst	EN61000-4-4

The above EMC tests have been carried out with the flowmeter installed properly in accordance with this instruction manual. However, there is no guarantee that interference will not occur in a particular installation.

To reduce interference to or from other equipment, please check the following installation points.

- (1) Use shielded cables for all I/O cables. When the flowmeter is the separated type, the signal cable and excitation cable for the connection between the detector and the converter are supplied by Toshiba. To improve immunity, pass each cable through a thick steel conduit tube.
- (2) If this device is installed in an area where RFI exists, deviation of the current output signal may be caused. In this case, ferrite cores will be required on each I/O cable. Please contact Toshiba or the agency if required.
- (3) This device is designed to be used in an industrial environment and may cause reception interference to radio, television or wireless communications. In this case, relocate the receiving antenna.
- (4) The use of a transceiver or wireless equipment near this device may cause interference to the accurate measurement. If deviation of the output signal appears during use of a radio, increase the distance between the converter or the signal cable and the antenna.

Low voltage directive

- Low voltage standards EN61010-1

Environmental conditions:

Installation category II

Pollution degree 2

Altitude Up to 2000 m

Other conditions are specified in Chapter 15, "Specifications."

**USER'S FORM
NOTES**

Unit purchased from	
Name	_____
Title	_____
Company	_____
Address	_____
City/State or Province	_____
Country	_____
Tel	_____
Fax	_____
Model/Specification Code LF413/LF403 _____	
Serial No.	_____

Industrial Equipment Department
1-1, Shibaura 1-chome, Minato-ku, Tokyo, 105, Japan
Tel.: (03)3457-4900 Fax.: (03)5444-9268

TOSHIBA

TEST RECORD

FOR MESSRS.	SUBJECT ELECTROMAGNETIC FLOWMETER	MFG. NO. 7213028 JL 0001
		SERIAL NO. 014030139
DETECTOR CAT. CODE LF413GACBBCAAA	SETTING FLOW RATE (m ³ /h) 0 ~ 300 gal/min	POWER SUPPLY VOLTAGE 100 (V) AC
CONVERTER CAT. CODE LF403FAB211AAB	OUTPUT 4 ~ 20 (mA) DC	TAG. NO. (DETECTOR / CONVERTER) ____ / _____

Item	Requirements	Evaluation
Appearance and dimensions	The appearance, lining, dimensions and construction should be normal.	Certify
Resistance of detector against hydraulic pressure	The detector subjected to a hydrostatic pressure of 4 MPa applied to its interior for 15 minutes should be free of water leakage or any other abnormality.	
Airtightness of detector	The detector subjected to an air pressure of 0.05 MPa applied from the housing for terminals should be free of air leakage or any other abnormality.	
Insulation resistance of detector	The insulation resistance to the detector as measured with a DC 500V megger should be 50MΩ or more. Between electrode terminals (A,B) and outer housing. Between excitation terminals (X,Y) and outer housing.	
Insulation resistance of converter	The insulation resistance of the converter as measured with a DC 500V megger should be 50MΩ or more. Between power terminal and outer housing.	
Dielectric strength of detector	The detector subjected to AC 1500V should stay normal for one minute. Between excitation terminals (X,Y) and outer housing.	
Dielectric strength of converter	The converter subjected to AC 1000V should stay normal one minute. Between power terminal and outer housing.	
Power supply voltage fluctuations	The output fluctuations should be within $\pm 0.5\%$ of F.S. when the power supply voltage changes within a range of AC 100V $\pm 10\%$	
Checking of flow	$\pm 0.5\%$ of rate more than 20%, $\pm 0.1\%$ of F.S. less than 20%.	

DATE OF TEST Aug. - 09 - 2001	APPROVED BY <i>M. Taga</i>	TESTED BY <i>M. Matsumoto</i>
----------------------------------	-------------------------------	----------------------------------

TEST SHEET OF ACTUAL FLOW RATE

Converter No.	014030139	Bore size	50 (mm)	Power supply	AC 100 V
Detector No.	014030139				
Range of flow rate	25.00 (m ³ /h)			Standard flow meter zero point	0.9992 (V)
Setting range	3.537 (m/s)	Exciting current	0.1667 (A)	Zero point	0.9997 (V)

(1) Test of actual flow rate

Standard flow meter output voltage (V)	3.0079	3.0059	4.9774	4.9771		
Standard flow meter flow rate (Q1) (m ³ /h)	12.549	12.537	24.859	24.857		
Electro magnetic flow meter output voltage (V)	3.0113	3.0087	4.9771	4.9775		
Electro magnetic flow meter flow rate (Q2) (m ³ /h)	12.571	12.554	24.857	24.859		
Error = (Q2-Q1)/(flow rate) × 100 (%)	0.085	0.070	-0.008	0.010		
Ratio of fullscale (%)	50.2	50.1	99.4	99.4		

(2) Power supply voltage fluctuations

Power supply voltage (V)	AC 80V	AC 100V	AC 250V
Output voltage (V)	0.9996	0.9997	0.9996
Error (%)	-0.002	—	-0.002

Remarks

STANDARD

Aug. - 09 - 2001

Tested by M. Matsumoto



**CONESTOGA-ROVERS
& ASSOCIATES**

2055 Niagara Falls Blvd., Suite #3
Niagara Falls, New York 14304
Telephone: (716) 297-6150 Fax: (716) 297-2265
www.CRAworld.com

TRANSMITTAL

DATE: October 9, 2002

REFERENCE NO.: 01979-000

PROJECT NAME: Pfohl Bros. Landfill Site

To: Bill Pugh
Town of Cheektowaga
Engineering Dept
275 Alexander Avenue
Cheektowaga, New York 14211

Sanitary Sewer Discharge
Flowmeter Certification

Please find enclosed: ☐ Draft ☒ Final
☐ Originals ☐ Other
☐ Prints

Sent via: ☒ Mail ☐ Same Day Courier
☐ Overnight Courier ☐ Other

QUANTITY	DESCRIPTION
1 ea	Flowmeter Certification Test Record for Meter F-107 (Meter Chamber)

☒ As Requested ☐ For Review and Comment
☒ For Your Use ☐ For Approval
☐

Copy to: Jim Kruszka, [REDACTED]

Completed by: Tom Christopher
[Please Print]

Signed: Tom Christopher

Filing: Correspondence File

02-09-20 12:59

トウシバ・フチュウコウシヨウ MESEN

0423-40-8106

T-529 P.02

TOSHIBA TEST RECORD

FOR MESSRS.	SUBJECT ELECTROMAGNETIC FLOWMETER	MFG. NO. 7212490 JL 0004
		SERIAL NO. 004080129
DETECTOR CAT. CODE LF413HACBBCAAA	SETTING FLOW RATE (m ³ /h) 0 ~ 650 gal/min	POWER SUPPLY VOLTAGE 100 (V) AC
CONVERTER CAT. CODE LF403FAB211AAB	OUTPUT 4 ~ 20 (mA) DC	TAG. NO. (DETECTOR / CONVERTER) ____ / ____

Item	Requirements	Evaluation
Appearance and dimensions	The appearance, lining, dimensions and construction should be normal.	<i>Certify</i>
Resistance of detector against hydraulic pressure	The detector subjected to a hydrostatic pressure of 4 MPa applied to its interior for 15 minutes should be free of water leakage or any other abnormality.	
Airtightness of detector	The detector subjected to an air pressure of 0.05 MPa applied from the housing for terminals should be free of air leakage or any other abnormality.	
Insulation resistance of detector	The insulation resistance to the detector as measured with a DC 500V megger should be 50MΩ or more. Between electrode terminals (A,B) and outer housing. Between excitation terminals (X,Y) and outer housing.	
Insulation resistance of converter	The insulation resistance of the converter as measured with a DC 500V megger should be 50MΩ or more. Between power terminal and outer housing.	
Dielectric strength of detector	The detector subjected to AC 1500V should stay normal for one minute. Between excitation terminals (X,Y) and outer housing.	
Dielectric strength of converter	The converter subjected to AC 1000V should stay normal one minute. Between power terminal and outer housing.	
Power supply voltage fluctuations	The output fluctuations should be within ±0.5% of P.S. when the power supply voltage changes within a range of AC 100V ± 10%	
Checking of flow	± 0.5 % of rate more than 20%. ± 0.1 % of P.S. less than 20%.	

DATE OF TEST
Sep. - 12 - 2000

APPROVED BY
T. Sumazaki

TESTED BY
K. Tanaka

02-09-20 13:00

トウシバ アチュウコウシ ョウ MEサン

0423-40-8106

T-529 P.03

TOSHIBA
TEST RECORD

P - 1

TEST SHEET OF ACTUAL FLOW RATE

Converter No.	004030129	Bore size	80 (mm)	Power supply	AC 100 V
Detector No.	004030129				
Range of flow rate	60.00 (m ³ /h)			Standard flow meter zero point	0.9996 (V)
Setting range	3.316 (m/s)	Exciting current	0.1446 (A)	Zero point	0.9996 (V)

(1) Test of actual flow rate

Standard flow meter output voltage (V)	3.0223	3.0230	4.9500	4.9482		
Standard flow meter flow rate (Q1) (m ³ /h)	30.335	30.345	59.250	59.223		
Electro magnetic flow meter output voltage (V)	3.0199	3.0199	4.9510	4.9502		
Electro magnetic flow meter flow rate (Q2) (m ³ /h)	30.299	30.299	59.265	59.253		
Error = (Q2-Q1)/(flow rate) × 100 (%)	-0.060	-0.078	0.025	0.050		
Ratio of fullscale (%)	50.6	50.6	98.8	98.7		

(2) Power supply voltage fluctuations

Power supply voltage (V)	AC 80V	AC 100V	AC 250V
Output voltage (V)	0.9994	0.9996	0.9994
Error (%)	-0.005	—	-0.005

Remarks

STANDARD

Sep. - 12 - 2000

Tested by *K. Tanaka*

APPENDIX B-6

ALARM SYSTEM (ADEMCO)

Pfohl Brothers Landfill Site

Remote Dialing Instructions

Procedure to Turn Pumps Off:

1. Dial Control System Phone Number 716 - 630 1649
2. Enter Phone code: 9*
3. Enter system code: [REDACTED] "Fault zone 07 **POWER CLOSED**" means system is **on**
4. Wait for system code now prompt and then enter : [REDACTED] turns pumps off
"Fault zone 08 **POWER OPEN**" means system is **off**

Procedure to Turn pumps ON

1. Dial Control System Phone Number 716 - 630 1649
2. Enter Phone code: 9*
3. Enter system code: [REDACTED]
4. Wait for system code now prompt and then enter [REDACTED] turns pumps on

Pfohl Brothers Landfill Site

Remote Dialing Instructions

Procedure to Turn Pumps Off:

1. Dial Control System Phone Number 716 - 630 1649
2. Enter Phone code: 9*
3. Enter system code: [REDACTED] "Fault zone 07 **POWER CLOSED**" means system is **on**
4. Wait for system code now prompt and then enter : [REDACTED] turns pumps off
"Fault zone 08 **POWER OPEN**" means system is **off**

Procedure to Turn pumps ON

1. Dial Control System Phone Number 716 - 630 1649
2. Enter Phone code: 9*
3. Enter system code: [REDACTED]
4. Wait for system code now prompt and then enter : [REDACTED] turns pumps on

Pfohl Brothers Landfill Site

To Enter/Exit Building Security System

To Enter:

1. Use Building key to enter, you have 30 seconds to disarm the security system
2. On North wall to the left of the entry door is the alarm panel
3. Open keypad on alarm box and enter [REDACTED]

To Exit:

1. On keypad enter [REDACTED] the panel will start beeping, you have 60 seconds to exit
2. Exit and lock door
3. Check that latch has caught before the 60 second time is up

Message Alarm Conditions

"Fault Zone 07 Power Closed " means power is on to the pumps

"Fault zone 08 Power Open " means power is off to the pumps

"Fault zone ?? Processor Alarm" means the the control system has had an alarm
needs to be looked at

Pfohl Brothers Landfill Site

To Enter/Exit Building Security System

To Enter:

1. Use Building key to enter, you have 30 seconds to disarm the security system
2. On North wall to the left of the entry door is the alarm panel
3. Open keypad on alarm box and enter [REDACTED]

To Exit:

1. On keypad enter [REDACTED], the panel will start beeping, you have 60 seconds to exit
2. Exit and lock door
3. Check that latch has caught before the 60 second time is up

Message Alarm Conditions

"Fault Zone 07 Power Closed " means power is on to the pumps

"Fault zone 08 Power Open " means power is off to the pumps

"Fault zone ?? Processor Alarm" means the the control system has had an alarm
needs to be looked at

CRA SERVICES

PROJECT No.: _____

PROJECT NAME: _____

DATE: _____

DESIGNED BY: _____

CHECKED BY: _____

PAGE _____ OF _____

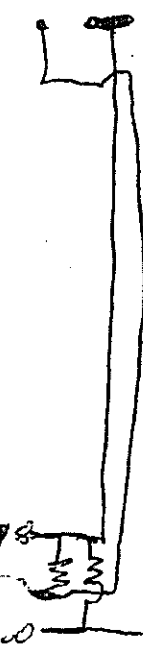
Security Panel

ZONE

Dialer

7 PUMP ON COM 8 PUMP OFF

1 + 1 COM



Pumps on
Pumps off

94
95

94 Red
95 Green
98 shield
99 white
100 Black

47 Corn

49 Pump Toggle

For Use With Control/Communicators Supporting
Relay Module Connection Via Keypad Lines

INSTALLATION INSTRUCTIONS

GENERAL INFORMATION

The 4204 Relay Module adds from one to four dry, form C (SPDT) relay outputs to compatible control/communicators. It interfaces to the control's keypad wiring.

The 4204 can be mounted inside the control's cabinet or mounted remotely.

If mounted remotely, the 4204 has two forms of protection. First, the 4204 has a built-in tamper switch which allows it to detect and report the removal of its cover to the control. Second, communication to the 4204 is supervised so that it cannot be disconnected from the keypad wiring without detection by the control. If the wiring is cut, a tamper or alarm signal will result, to indicate that this device (and possibly other devices connected to the keypad wiring) has become inoperative.

INSTALLATION

For UL Installations:

When used with controls which do not support cover tamper or supervise communications wiring to the 4204, mount the 4204 inside the control's cabinet.

When used with controls which support cover tamper and supervise communications wiring to the 4204, the 4204 may either be mounted inside the control's cabinet or mounted remotely.

When mounted inside the control's cabinet, some controls allow the 4204 to be mounted horizontally as follows: insert the self-tapping screws (provided) in two adjacent raised tabs on the back of the cabinet. Leave the heads projecting 1/8". Hang the 4204 on the screw heads via two of the slotted holes on the back of its housing. The 4204's cover need not, in this case, be tamper-protected. If the DIP switch is set with its position 1 "ON" (see the table below), the cover can be left off. See the control's instructions for additional information.

When the 4204 is mounted remotely, holes on its back permit it to be mounted horizontally or vertically. Wires can exit from the side or via the breakout on the back of its housing. The DIP switch must be set with its position 1 "OFF" and when the installation is completed, the unit's tamper-protected cover must be replaced.

Affix the connections label that accompanies the 4204 to the inside of the 4204's cover (if the cover is used) or to the inside of the control's cover.

CONNECTIONS AND SETTINGS

Select and set an address for the 4204, using its DIP switch as shown in the table below. Each 4204 used with the control must be assigned a unique address so the control can identify the 4204 and communicate with it properly. The address to be set is determined by the particular control to be used, and the control's installation instructions must be consulted. As shipped, the DIP switch is set for an address of "0".

Connections to the 4204's four relays are made via 12-position terminal block TB2. Refer to the control's installation instructions for specific information on how to program the control's various activation options for the relays.

Connections to the control's keypad wiring points can be made via 4-position terminal block TB1, the 4-pin plug, or both (wire color connections are the same). See the diagram on the other side of this page.

SPECIFICATIONS

Physical 6-7/16" W x 4-1/4" H x 1-1/4" D
(163mm x 108mm x 32mm)

Electrical

Input Voltage: 12VDC nominal (10-14VDC), from control's remote keypad connection points

Input Current: 15mA standby + 40mA per active relay

Contact Rating: 2A max. at 28VDC/AC (resistive loads)

DIP SWITCH SETTINGS

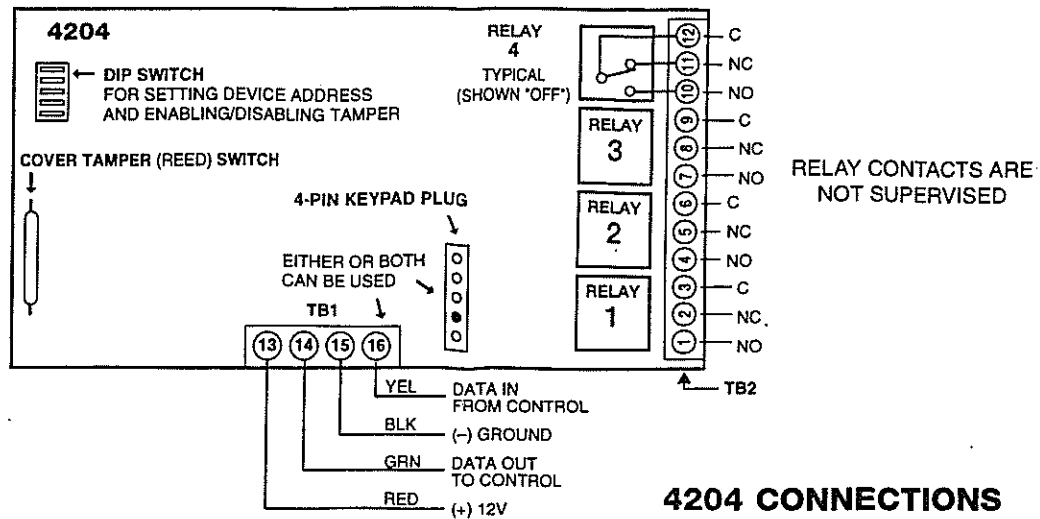
OFF ← → ON

SWITCH POSITION ↓	4204 ADDRESS SETTINGS ("—" means "OFF")															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	ON	—	ON	—	ON	—	ON	—	ON	—	ON	—	ON	—	ON	—
3	ON	ON	—	—	ON	ON	—	—	ON	ON	—	—	ON	ON	—	—
4	ON	ON	ON	ON	—	—	—	—	ON	ON	ON	—	—	—	—	—
5	ON	ON	ON	ON	ON	ON	ON	ON	—	—	—	—	—	—	—	—

DIP SWITCH: (WHITE AREAS DENOTE SWITCH HANDLES)

POSITIONS 2-5: DETERMINE 4204's ADDRESS.
CONSULT CONTROL'S INSTRUCTIONS FOR ADDRESS TO USE.
SHOWN SET (AS SHIPPED) FOR ADDRESS = 0.

POSITION 1: DETERMINES COVER TAMPER RESPONSE.
ON = DISABLED (SHOWN, AS SHIPPED)
OFF = ENABLED (COVER IS TAMPER-PROTECTED)



REFER TO THE INSTALLATION INSTRUCTIONS FOR THE CONTROL WITH WHICH THIS DEVICE IS USED FOR DETAILS REGARDING THE LIMITATIONS OF THE ENTIRE ALARM SYSTEM.

ADEMCO LIMITED WARRANTY

Alarm Device Manufacturing Company, a Division of Pittway Corporation, and its divisions, subsidiaries and affiliates ("Seller"), 165 Eileen Way, Syosset, New York 11791, warrants its products to be in conformance with its own plans and specifications and to be free from defects in materials and workmanship under normal use and service for 24 months from the date stamp control on the product or, for products not having an Ademco date stamp, for 12 months from date of original purchase unless the installation instructions or catalog sets forth a shorter period, in which case the shorter period shall apply. Seller's obligation shall be limited to repairing or replacing, at its option, free of charge for materials or labor, any product which is proved not in compliance with Seller's specifications or proves defective in materials or workmanship under normal use and service. Seller shall have no obligation under this Limited Warranty or otherwise if the product is altered or improperly repaired or serviced by anyone other than Ademco factory service. For warranty service, return product transportation prepaid, to:

Ademco Factory Service, 165 Eileen Way, Syosset, New York 11791.

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Seller does not represent that the products it sells may not be compromised or circumvented; that the products will prevent any personal injury or property loss by burglary, robbery, fire or otherwise; or that the products will in all cases provide adequate warning or protection. Customer understands that a properly installed and maintained alarm may only reduce the risk of a burglary, robbery, fire or other events occurring without providing an alarm, but it is not insurance or a guarantee that such will not occur or that there will be no personal injury or property loss as a result. CONSEQUENTLY, SELLER SHALL HAVE NO LIABILITY FOR ANY PERSONAL INJURY, PROPERTY DAMAGE OR OTHER LOSS BASED ON A CLAIM THE PRODUCT FAILED TO GIVE WARNING. However, if Seller is held liable, whether directly or indirectly, for any loss or damage arising under this Limited Warranty or otherwise, regardless of cause or origin, Seller's maximum liability shall not in any case exceed the purchase price of the product, which shall be the complete and exclusive remedy against Seller. This warranty replaces any previous warranties and is the only warranty made by Seller on this product. No increase or alteration, written or verbal, of the obligations of this Limited Warranty is authorized.

**ADEMCO
GROUP**

165 Eileen Way, Syosset, New York 11791

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**Addendum To: Installation Instructions
for
VISTA-20SE Family of Controls**

Subject: Addition Of Dynamic Signaling Feature

These control panels now feature **Dynamic Signaling Delay (DSD)** and **Dynamic Signaling Priority (DSP)** message reporting when Long Range Radio is used. This is achieved by the addition of two new data fields, *54 and *55. This feature is designed to reduce the number of redundant reports sent to the central station.

The new feature offers you the following options:

- **Dynamic Signaling Delay (DSD)**
You can select the time the panel should wait for acknowledgment from the first reporting destination before it attempts to send a message to the second destination. Delays can be selected from 0 to 225 seconds, in 15-second increments. This choice is made in field *54. *This delay is per message.*
- **Dynamic Signaling Priority (DSP)**
You can select the initial reporting destination for messages, Primary Dialer or Long Range Radio. This choice is made in field *55.

The chart below will provide a concise explanation of how the Dynamic Signaling feature functions.

If Priority (*55) is ...	And message is ...	Then ...
Primary Phone No. ("0" entered)	Acknowledged before delay expires	Message is removed from queue and no message is sent to LRR.
	Not acknowledged before delay expires	Message is sent to both the Primary Phone No. and LRR.
Long Range Radio ("1" entered)	Acknowledged before delay expires	Message is removed from queue and no message is sent to primary dialer.
	Not acknowledged before delay expires	Message is sent to both the Primary Phone No. and LRR.

NOTE: You must enable field *29, OUTPUT TO LONG RANGE RADIO, if this feature is to function.

New Fields:

- *54 DYNAMIC SIGNALING DELAY (DSD)** ☐ [0]
0–15 times a 15-second delay. e.g., 1 = 15 seconds, 2 = 30 seconds, etc.
Default is "0" (no delay). You must enter "0" for UL installations.
Note: If "0" is entered in this field, the control panel will send redundant reports to both Primary Dialer and LRR.
- *55 DYNAMIC SIGNALING PRIORITY (DSP)** ☐ [0]
0 = Primary dialer first; 1 = Long Range Radio (LRR) first.
Default is "0" (primary dialer)

**ADEMCO
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165 Eileen Way, Syosset, New York 11791

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A Division of Pittway
3825 Ohio Avenue, St. Charles, Illinois 60174
1-800-SENSOR2, FAX: 630-377-6495

2112/24S and 2112/24TS Photoelectronic Smoke Detectors

Specifications

Diameter:	5.5 inches (140 mm)
Height (including mounting bracket):	1.9 inches (48 mm)
Weight:	5.3 oz. (150 g)
Operating Temperature Range	
Model 2112/24S:	32° to 120°F (0° to 50°C)
Model 2112/24TS:	32° to 100°F (0° to 38°C)
Operating Humidity Range:	10% to 93% Relative Humidity, Noncondensing
Latching Alarm:	Reset by momentary power interruption
Heat Sensor (2112/24TS only):	135°F Fixed Temperature Electronic Thermistor

Electrical Ratings

System Voltage (nominal):	12 or 24 VDC
Minimum:	8.5 VDC
Maximum:	35 VDC
Maximum Ripple Voltage:	30% of nom. Voltage (peak to peak)
Standby Current:	50 μ A maximum
Alarm Current:	17 mA typical, 23 mA max. at 12V 19 mA typical, 25 mA max. at 24V
Reset Voltage:	0.8 VDC minimum
Reset Time:	0.3 seconds maximum
Start-up Time:	30 seconds maximum (after 60 sec. reset)
EOL Relay:	A77-716B, 12/24 Volt
Alarm Initiation Contact Ratings	
Resistive or Inductive Load (60% power factor)	
Form A:	0.5A @ 30 VAC/DC

Before Installing

Please thoroughly read the System Sensor manual I56-407, *Guide for Proper Use of System Smoke Detectors*, which provides detailed information on detector spacing, placement, zoning, wiring, and special applications. Copies of this manual are available at no charge from System Sensor.

NOTICE: This manual shall be left with the owner/user of this equipment.

IMPORTANT: This detector must be tested and maintained following NFPA 72 requirements. The detector should be cleaned at least once a year.

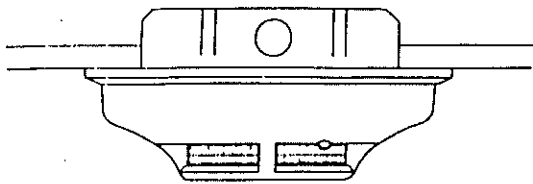
General Description

Model 2112/24S is a 4-wire photoelectronic smoke detector that uses a state-of-the-art optical sensing chamber. This detector is designed to provide open area protection. Model 2112/24TS features a restorable, built-in, fixed-temperature (135°F) thermal detector.

Installation of these detectors is simplified by the use of a mounting bracket and a plug-in screw terminal block that can be prewired to the system, allowing the detector to be easily installed or removed for cleaning. The detector's sensitivity can be tested in place using the MOI400R Test Module.

An LED on the detector provides a local visual indication of the detector's status. If power is applied to the detector, and it is functioning normally in standby mode within the listed sensitivity ranges, the status LED blinks once every ten seconds. The LED also provides a visual indication that maintenance is required. If the LED stops blinking, the detector is either not powered, out of the listed sensitivity range, and/or unable to function properly. The test switch will not operate if the detector is below the insensitive limit. The LED will also latch on when the detector is in alarm.

Figure 1. Surface mounting of 2112/24S smoke detector on 3 1/2-inch and 4-inch octagonal box:



A78 2561 00

Mounting

Each 2112/24S and 2112/24TS detector is supplied with a mounting bracket that permits the detector to be mounted:

1. To a single gang box, or
2. Directly to a 3 1/2-inch or 4-inch octagonal box, or
3. To a 4 inch square electrical box by using a plaster ring,
4. Directly to the ceiling using drywall anchors, if permitted by local codes and/or the authority having jurisdiction.

Tamper-resistant Feature

This detector includes a tamper-resistant feature that prevents its removal from the bracket without the use of a tool. To make the detector tamper-resistant, remove the smaller tab by breaking it at the scribed line on the tamper resistant tab on the detector mounting bracket (see Figure 2), then install the detector. To remove the detector from the bracket once it has been made tamper resistant, use a small screwdriver to depress the tamper-resistant tab, located in the slot on the mounting bracket, and turn the detector counterclockwise.

Wiring Installation Guidelines

All wiring must be installed in compliance with the National Electrical Code, applicable local codes, and any special requirements of the local authority having jurisdiction. Proper wire gauges should be used. The conductors used to connect smoke detectors to control panels and accessory devices should be color-coded to reduce the likelihood of wiring errors. Improper connections can prevent a system from responding properly in the event of a fire.

The screw terminal block accepts 14 – 22 gauge wire. For best system performance, all wiring should be installed in

separate grounded conduit. Do not mix fire system wiring in the same conduit as any other electrical wiring. Twisted pair may be used to provide additional protection against electrical interference.

Smoke detectors and alarm system control panels have specifications for allowable loop resistance. Consult the control panel specifications for the total loop resistance allowed for the control panel being used before wiring the detector loops.

Wire connections are made by stripping about 1/4 inch of insulation from the end of the feed wire, inserting the wire into the appropriate terminal, and tightening the screw to secure the wire in place.

Installation

⚠ WARNING

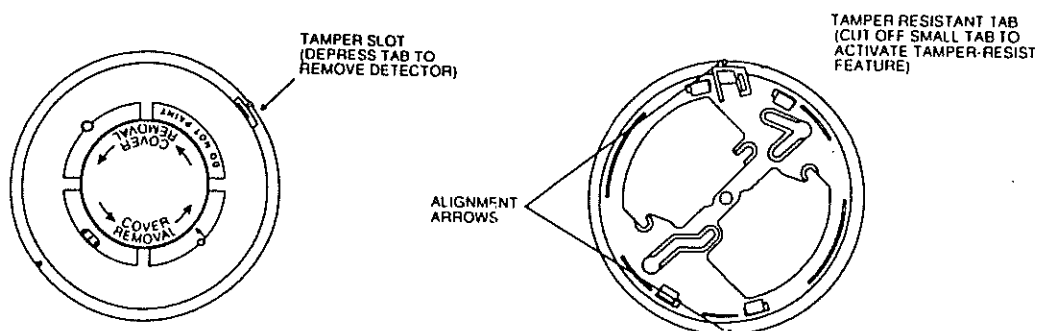
Remove power from the control unit or initiating device circuits before installing detectors.

1. Wire the plug-in screw terminal block per Figure 3 and plug the terminal block into the detector.
2. Align the arrows on the detector with the arrows on the mounting bracket.
3. Turn the detector clockwise in the mounting bracket until it clicks into place.
4. After all detectors have been installed, apply power to the control unit or initiating device circuits.
5. Test the detector as described in **TESTING**. (See page 3.)
6. Reset the detector at the system control panel.
7. Notify the proper authorities the system is in operation.

⚠ CAUTION

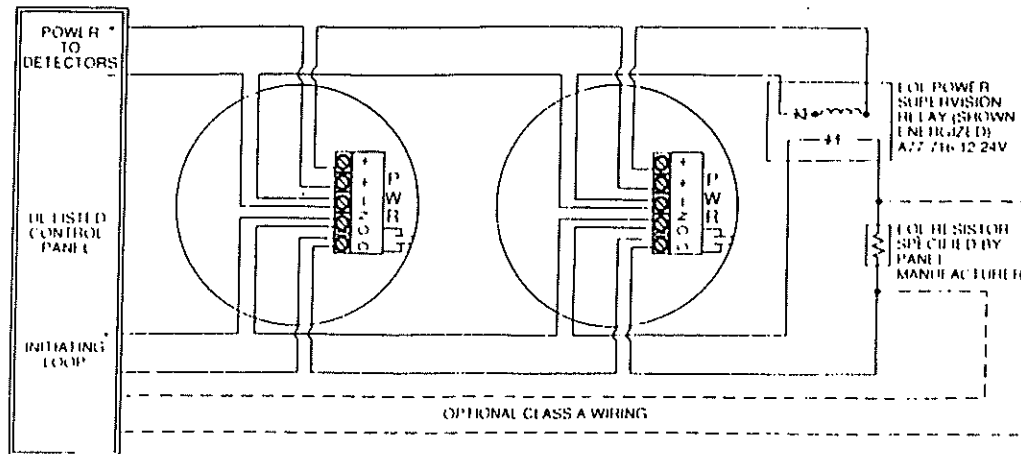
Dust covers are an effective way to limit the entry of dust into smoke detector sensing chambers. However, they may not completely prevent airborne dust particles from entering the detector. Therefore, System Sensor recommends the removal of detectors before beginning construction or other dust producing activity. Be sure to remove dust covers from any sensors that were left in place during construction as part of returning the system to service.

Figure 2. 2112/24S and 2112/24TS smoke detector mounting bracket:



A78 2333 01

Figure 3. Wiring diagram for the 2112/24S and 2112/24TS detector:



A78 2346-01

Testing

NOTE: Before testing, notify the proper authorities that the smoke detector system is undergoing maintenance and will be temporarily out of service. Disable the zone or system undergoing maintenance to prevent unwanted alarms.

Detectors must be tested after installation and following periodic maintenance. Test the 2112/24S as follows:

A. Test Switch

1. A recessed test switch is located on the detector housing (See Figure 4).
2. Press and hold the recessed test switch with a 0.18 inch maximum diameter tool such as an allen wrench or small screwdriver.
3. The detector's LED should light within 5 seconds.

B. Test Module (System Sensor Model No. MOD400R)

The MOD400R test module can be used with a DMM or analog voltmeter to check the detector sensitivity as described in the test module's manual.

C. Smoke Entry Test

Hold a smoldering punk stick or cotton wick at the side of the detector and gently blow smoke through the detector until the unit alarms.

D. Direct Heat Method (Model 2112/24TS only - Hair dryer of 1000-1500 watts)

Direct the heat toward either of the side thermistors.

Hold the heat source about 12 inches from the detector in order to avoid damage to the plastic. The detector will reset only after it has had sufficient time to cool and the power source has been momentarily interrupted.

Both smoke and heat detection testing are recommended for verifying system protection capability.

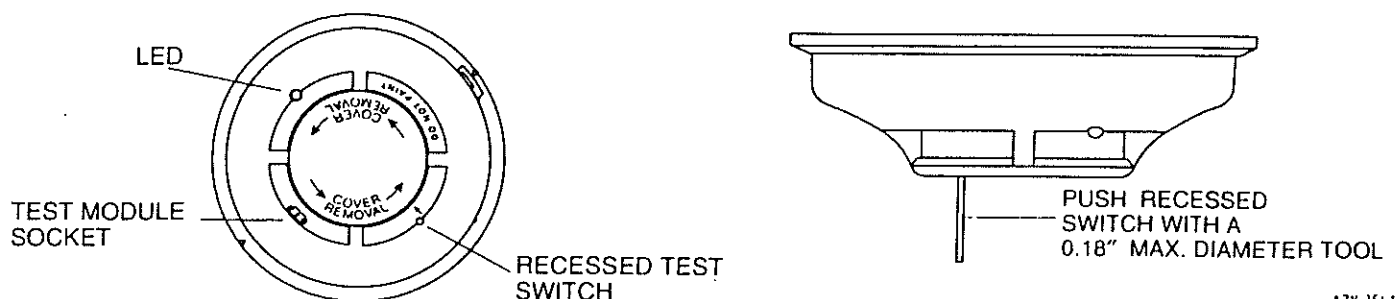
A detector that fails to activate with any of the above tests should first be cleaned as outlined in **MAINTENANCE**. If the detector still fails to activate, return it for repair.

Notify the proper authorities the system is back in operation.

Maintenance

NOTE: Before removing the detector, notify the proper authorities that the smoke detector system is undergoing maintenance and will be temporarily out of service. Disable the zone or system undergoing maintenance to prevent unwanted alarms.

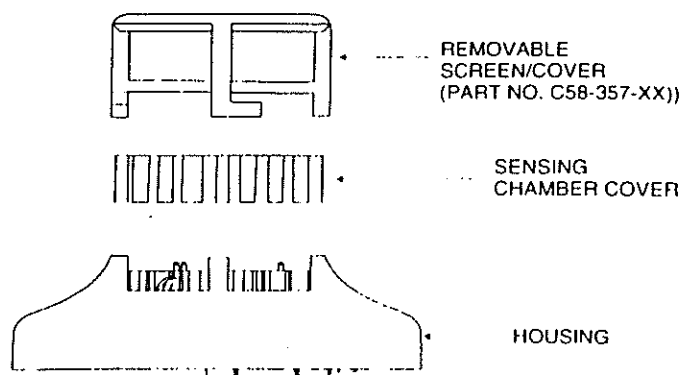
Figure 4. Top and side views showing position of test switch:



A78 2564-05

1. Remove cover by turning counter clockwise in direction of arrow.
2. Vacuum the cover carefully (See Figure 5).
3. Remove the sensing chamber cover.
4. Clean the sensing chamber by vacuuming or blowing out dust and particles.
5. Replace the sensing chamber cover, aligning the arrow on the top of the chamber cover with the arrow on the housing.
6. Replace the cover by placing over the sensing chamber cover and twisting until it snaps into place.
7. Reinstall the detector.
8. Notify the proper authorities that the system is back in operation.

Figure 5. Removal of cover and screen for cleaning:



A/B 2565-07

Please refer to insert for the Limitations of Fire Alarm Systems

Three-Year Limited Warranty

System Sensor warrants its enclosed smoke detector to be free from defects in materials and workmanship under normal use and service for a period of three years from date of manufacture. System Sensor makes no other express warranty for this smoke detector. No agent, representative, dealer, or employee of the Company has the authority to increase or alter the obligations or limitations of this Warranty. The Company's obligation of this Warranty shall be limited to the repair or replacement of any part of the smoke detector which is found to be defective in materials or workmanship under normal use and service during the three year period commencing with the date of manufacture. After phoning System Sensor's toll free number 800 SENSOR2 (736 7622) for a Return Authorization number, send defective units postage prepaid to: System Sensor, Repair Department,

RA # , 3825 Ohio Avenue, St. Charles, IL 60174. Please include a note describing the malfunction and suspected cause of failure. The Company shall not be obligated to repair or replace units which are found to be defective because of damage, unreasonable use, modifications, or alterations occurring after the date of manufacture. In no case shall the Company be liable for any consequential or incidental damages for breach of this or any other Warranty, expressed or implied whatsoever, even if the loss or damage is caused by the Company's negligence or fault. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This Warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

APPENDIX B-7

DIALER (ADEMCO)

4286 VIP

Vista Interactive Phone Module

User Guide

®ADEMCO



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For conventional operation of the security system,
refer to the security system's User's Manual.

For information regarding the limitations of the
entire security system, also refer to the security
system's User's Manual.

**THIS DEVICE COMPLIES WITH FCC RULES, PART 68.
FCC REGISTRATION No. AC3USA-74659-KX-N
RINGER EQUIVALENCE: 1.0B**



General Information

ADEMCO's VIP (VISTA Interactive Phone) Module permits you to control your security system via a Touch-tone phone (either on premises or by a call-in when away). With this module you can do the following:

- Receive synthesized voice reports regarding your security system status over the phone
- Arm and disarm the security system and perform most function commands using the telephone keypad. Voice comments or confirmation tones are provided over the phone as confirmation after any function command is entered
- Option to have synthesized voice reports routed to an external speaker
- Monitor and/or change thermostat settings over phone line
- Turn certain lights/appliances on and off via the telephone (Relay Command Mode), if your system includes this feature.

Type of Telephone Required

The phone used for phone access must have Touch-tone capability.

An off-premises phone that does not have Touch-tone service and uses Pulse for dialing may not permit switching to Touch-tone after dialing; in such a case, system access from that phone will not be possible.

Phone Access Code

Your installer has assigned a special 2-digit phone code to enable you to access the security system via a phone. This code consists of a number from 1-9, followed by a * or #.

Operating Instructions

Introduction

The instructions that follow describe how to access your security system via a Touch-tone phone, either on or off the premises, and describe how to perform system commands via the phone. Also provided is a detailed explanation of the status report that will be heard immediately following phone access to the system, and other helpful information regarding the various operating features of this phone system.

For your convenience, two operating overviews (accessing the system from an on-premises phone, and from an off-premises phone) are provided in easy-to-follow charts on pages 3 and 5. These charts are followed by step-by-step operating instructions which provide more detail.

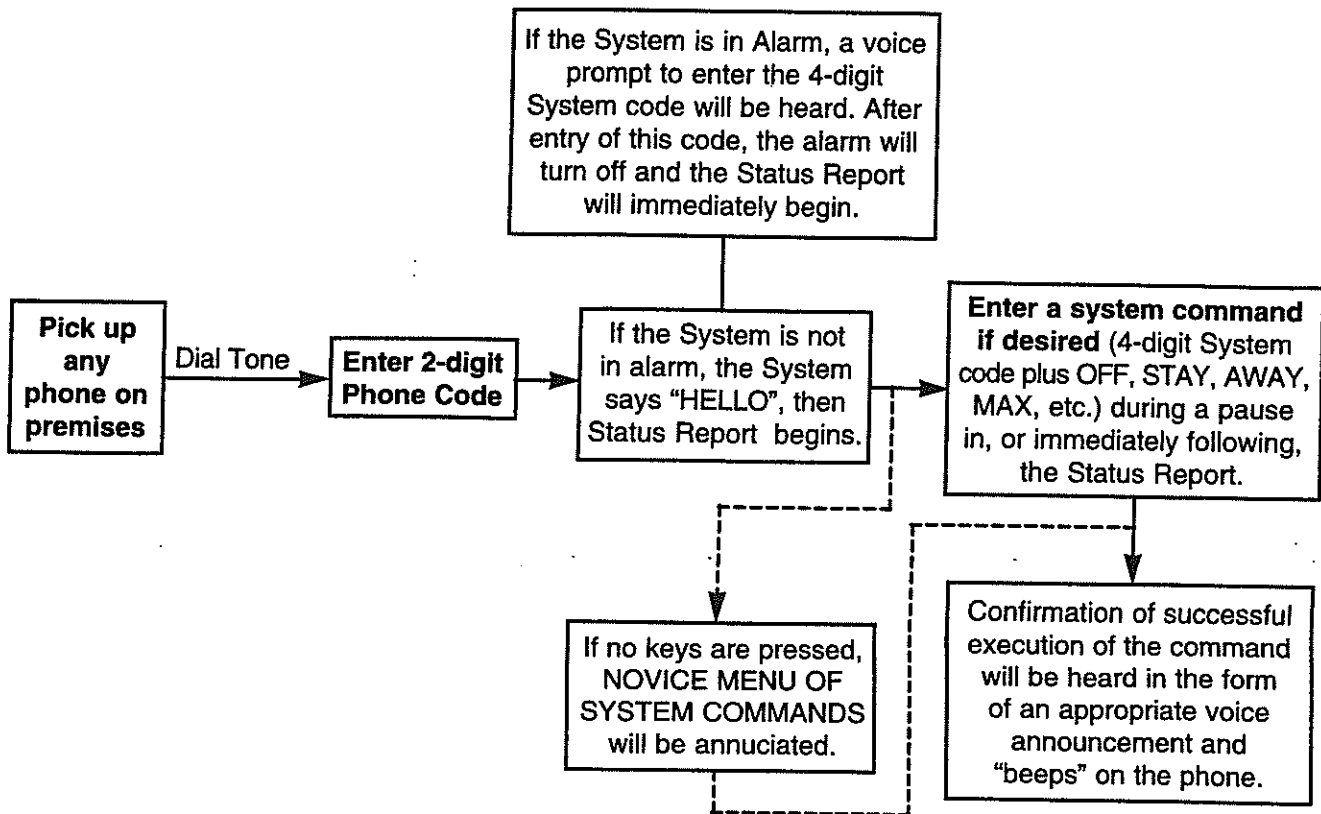
If you encounter any difficulty with the operation of the phone access system, refer to the section entitled, **"If You Have Difficulty With The Phone System"** on page 27 for help.

Summary

When attempting to access the security system from a phone that is on premises, you must enter your assigned 2-digit phone code; when accessing the system from outside the premises, phone prompts will ask you to enter your 2-digit phone code *and* your 4-digit system code. Successful access to the security system will be possible only after correct entry of the requested codes.

After accessing the security system via the phone, an automatic status report on the system is provided by the phone module. During this report, or immediately following it, you can execute virtually any system command via the keypad on the phone, using the same key entries normally performed at the wired keypad. Confirmation of each successful command entry is also provided over the phone.

Operating Overview from an On-Premises Phone



TYPICAL TELEPHONE KEYPAD WITH EQUIVALENT COMMAND FUNCTIONS

OFF 1	AWAY ABC 2	STAY DEF 3
MAX GHI 4	TEST† JKL 5	BYPASS MNO 6
INST PRS 7	CODE TUV 8	CHIME WXY 9
READY *	OPER 0	QUICK-ARM* #

†ON-PREMISES ONLY
*IF PROGRAMMED

* In some systems, a voice prompt for entry of the 4-digit System code will not occur. To turn the alarm off, enter an OFF command (System code + OFF) during a pause in, or immediately following, the Status Report.

Accessing the Security System Using an On-Premises Phone

Step-by-Step Procedure

To access the security system from on-premises, proceed as follows:

1. **Pick up the phone and listen for dial tone.**
2. **Enter your 2-digit phone code** via the telephone keypad to access the system. 2*

If the security system happens to be in alarm, a phone prompt to enter your 4-digit system code will be heard ("**Enter System Code**"). If so, enter your system code at this time – this will automatically cause the alarm to turn off. *

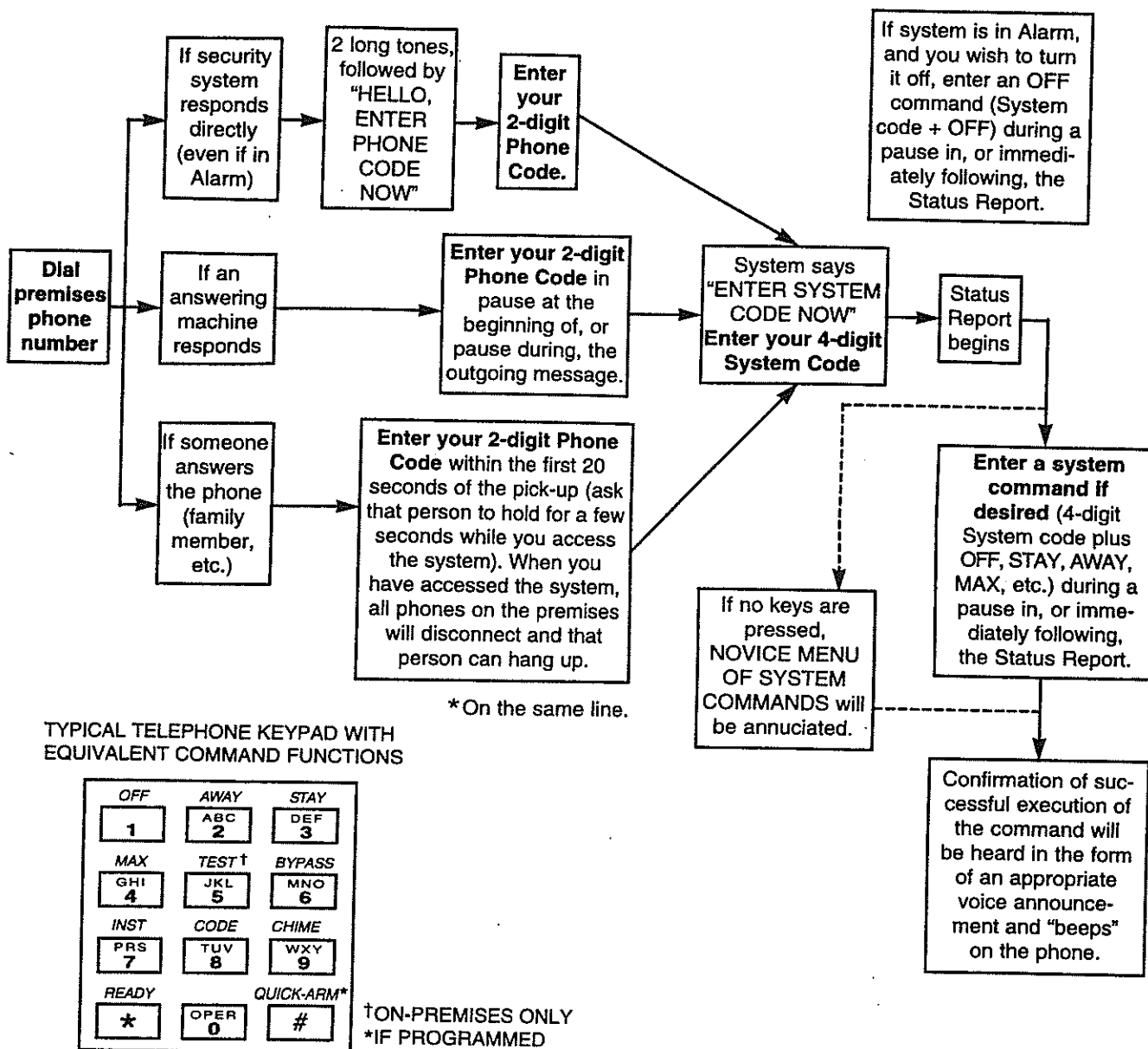
There is a 20-second time limit in which to enter the system code.

*In some systems, a phone prompt for system code will not be heard, and you should enter an **OFF** command (your 4-digit system code plus OFF) to turn the alarm off, as indicated in step 4.

3. **Listen to the Status Report.** A status report will be heard on the phone, starting with the word "**HELLO**", and followed automatically by a description of the status of the security system. A detailed description of the status report begins on page 15.
4. **Enter the System Command.** During a pause in, or immediately following, the status report, you can execute system commands (such as arm, disarm, etc.) using the keypad on the phone. See **Executing System Commands Via The Phone** on page 8 for more detailed information. **DO NOT PRESS ANY KEYS DURING THE SYNTHESIZED VOICE ANNOUNCEMENTS.**
5. **Hang up the phone when finished.**

 **If The On-Premises Phone System Does Not Subscribe To Touch-Tone Service:** For access to the security system, the on-premises phone system need not subscribe to Touch-tone service, **provided the phone is Touch-tone-capable** (i.e. the phone is equipped with TONE/PULSE switching). Switchable phones should be set for TONE prior to attempting phone access, **and then returned to the PULSE position** when the phone access session is completed.

Operating Overview from an Off-Premises Phone



Accessing the Security System Using an Off-Premises Phone

The security system can be accessed from any outside Touch-tone phone, provided remote access has not been turned off. If turned off, the following words will be heard when accessing your security system via the phone: **"CALL IN TO SYSTEM OFF."**

Step-by-Step Procedure

To access the security system from off-premises, proceed as follows:

1. Dial the premises phone number.

A	B	C
If the security system answers the call directly (even if the system is in alarm). You will hear 2 long tones followed by a "click," and then the words "HELLO, ENTER PHONE CODE NOW." Enter your 2-digit phone code.	If an answering machine responds to the call. Enter your 2-digit phone code during a pause at the beginning of, or during a pause in the outgoing message. NEVER enter the phone code <i>after</i> the machine starts recording.	If someone answers the phone (a family member for example). Enter your 2-digit phone code within the first 20 seconds of the pick-up. Notify that person that you are about to access the security system and that they should hold on for a few seconds while you enter your 2-digit phone code. When you have accessed the system that phone* will disconnect and can be hung up. * Also all others on the same line.

2. When you have entered your 2-digit phone code, the words **"ENTER SYSTEM CODE NOW"** will be heard.
3. **Enter your 4-digit system code.** As a safety feature, only up to three attempts are allowed in which to enter each code (phone code and system code), after which time the call-in will be aborted.

Accessing the Security System Using an Off-Premises Phone (cont'd)

4. If both codes (phone code and system code) were entered correctly, the system will be accessed and will automatically provide a status report of the security system. See **System Status Reports** on page 15.

If either code was entered incorrectly, the system will wait for the correct entry of each code, as before. If the key input limit is exceeded, there will be a disconnect.

Once the system is accessed successfully and the status report begins, you can then execute system commands (such as arm, disarm, etc.) using the keypad on the phone. See **Executing System Commands Via the Phone** that follows on page 8.

Telephone Systems Equipped with Answering Machines

The 2-digit phone code should be entered during a pause* in the outgoing message on the answering machine. In some cases, it may be necessary to re-record the outgoing message on the answering machine to allow a pause of about 2 seconds at its beginning to permit entry of your 2-digit phone code when calling in from outside. The person who installed your security system should have instructed you in the proper procedure.

- * The reason for entry during a pause is that touch tones (produced by entry of the 2-digit phone code) might not be received by the security system while an answering machine's outgoing phone message is on the phone line. Also, the 2-digit phone code should be entered *before* the answering machine starts recording to prevent the phone code tones from being recorded, and later played back if the answering machine has a remote message playback feature.

Executing System Commands Via the Phone

General

After accessing the security system, and at any point during, or immediately after* automatic system status reporting by the Phone Module, it is possible to execute most system commands via the keypad on the Touch-tone phone. You would use the same key entries normally performed at the wired security keypad; **typically your 4-digit system code followed by a command key.**

Refer to the security system's User Guide for specific key entries required (also see the **TYPICAL SYSTEM COMMAND ENTRIES** table on page 10).

*Command entries can be made during the pauses that occur between each of the individual status reports, or during the pause immediately following the complete report.

DO NOT PRESS ANY KEYS DURING SYNTHESIZED VOICE REPORTING.



If the status report annunciates that the system is "**Disarmed, Not Ready to Arm.**" a condition exists (such as an open zone) which will make it impossible to arm the system unless that zone is made intact or bypassed during the arming procedure. If not already announced, pressing the * key during a pause in the status report will cause the phone system to announce the particular zones that are faulted (which door or window is open, for example).

Following your entry of a system command, wait for phone and sound confirmation of the command from the phone system, as indicated on page 11.

The keys on wired keypads are labeled with command functions, but telephone keypads are obviously not. The diagram that follows shows a typical telephone keypad with each of its keys identified as to its command function.

Telephone Keypad Command Functions

OFF 1	AWAY ABC 2	STAY DEF 3
MAX GHI 4	TEST † JKL 5	BYPASS MNO 6
INST PRS 7	CODE TUV 8	CHIME WXY 9
READY *	QUICK-ARM* OPER 0	#

Tel. Key Function

- 1 = OFF
- 2 = AWAY
- 3 = STAY
- 4 = MAXIMUM
- 5 = TEST †
- 6 = BYPASS
- 7 = INSTANT
- 8 = CODE
- 9 = CHIME
- * = READY

† ON-PREMISES ONLY

* IF PROGRAMMED

System Commands That May Be Executed Via the Phone

The following are typical system commands that may be executed via the Touch-tone phone once you have obtained access to the security system:

- **ARM STAY, AWAY, INSTANT, or MAXIMUM**
- **BYPASS BY ZONE and QUICK BYPASS**
- **DISARM**
- **PANIC ALARM**
- **ENTER OR DELETE TEMPORARY USER CODES***
- **TURN CHIME MODE ON OR OFF**
- **ENTER TEST MODE** (on-premises phone only).

* This function cannot be performed via the phone in some systems. Check with your installer.

Typical System Command Entries

	Command Function	Entry To Be Keyed On Phone
QUICK-ARM FEATURE AVAILABLE *	To arm STAY	System Security code + key [3].
	To arm AWAY	System Security code + key [2].
	To arm INSTANT	System Security code + key [7].
Yes No ☐ ☐	To arm MAXIMUM	System Security code + key [4].
	To BYPASS by specific zone	System Security Code + key [6] + zone # to be bypassed (01, 02, 03, etc.).
Yes No ☐ ☐	To QUICK BYPASS all open zones	Refer to your system's User Guide.
	To enable SPEAKER OUTPUT	Press [# 97]. Phone menu follows requesting a [1] or [0] to enable types of speaker response.
	To trigger PANIC alarm	At any on-premises phone: Enter 2-digit phone code followed by at least 6 ones [1]'s until the panic alarm occurs.
ENTRY AND DELETION OF TEMPORARY CODES VIA THE PHONE AVAILABLE Yes No ☐ ☐	To DISARM	System Security Code + key [1].
	To enter a TEMPORARY CODE **	Master Security Code + key [8] + User No. + Temporary Code.
	To delete a TEMPORARY CODE **	Master Security Code + key [8] + User No. + Master Security Code.
	To Turn CHIME mode on	System Security Code + key [9].
	To Turn CHIME mode off	System Security Code + key [9] again.
	To enter TEST mode	System Security Code + key [5]. (on-premises phone only)
	To exit TEST mode	System Security Code + key [1].

* The "Quick-Arm" feature, if programmed by your installer (see boxes at upper left in above table), will permit the use of the # key in place of your 4-digit system security code when arming the system.

** This function cannot be performed via the phone with some systems. See boxes at lower left in above table— your installer should have indicated whether your system can perform this function.

Confirmation of Successful System Command Entries

Commands entered via the phone will be confirmed by the same number of "beeps" as those produced by the keypad for confirmation of that function (e.g., if armed STAY, 3 beeps will be heard through the phone). This will be followed by phone confirmation of successful entry of the command, using words similar to those displayed on an Alpha keypad (e.g., "**ARMED STAY, EXIT NOW**").

For those commands where the Phone module's vocabulary does not permit annunciation (e.g., TEST, etc.), the system will beep (as appropriate) after a successful entry, and annunciate the words "**SEE SYSTEM KEYPAD.**"

The following is a list of confirmation sounds and phone announcements that will be heard after successful command entries.

System Command Function Performed	Sound	CONFIRMATION VIA PHONE
		Voice Announcement
Armed AWAY	2 beeps	" ARMED AWAY, EXIT NOW*
Armed MAXIMUM	2 beeps	" ARMED MAX, EXIT NOW**
Armed STAY	3 beeps	" ARMED STAY, EXIT NOW " *
Armed INSTANT	3 beeps	" ARMED INSTANT, EXIT NOW**
Disarmed	1 beep	" DISARMED, READY TO ARM " or " DISARMED, NOT READY TO ARM "
Zone Bypass	1 beep	" BYPASS, (descriptor), ZONE # "
Enter CHIME mode	1 beep	" CHIME ON or CHIME OFF "
Enter/Erase temporary User Code**	1 beep	No phone announcement

* The words "**EXIT NOW**" simply means that you may exit during the Exit Delay period, if desired.

** Entering or erasing temporary user codes via the phone is not possible with some systems. Refer to the previous page.



Example of a Call-In From Outside

The following is an example of a complete sequence for a call-in from outside to make sure that the security system was armed **AWAY** before leaving the premises.

Assume that the 2-digit Phone Code is 7 *, and that the system security code is 1-2-3-4.

No answering machine is connected in the following example.

1. Caller dials the premises phone number. After a programmed number of rings, the caller will hear 2 long tones followed by a "click", and then the words, "**HELLO, ENTER PHONE CODE NOW.**"
2. Caller then enters the Phone Code: 7 + *.
3. The words "**ENTER SYSTEM CODE NOW**" will be heard.
4. Caller then enters the system 4-digit system security code:

1 + 2 + 3 + 4

5. The system will now start to annunciate a status report. If, when the Arming Status is annunciated, the caller hears the words "**DISARMED READY TO ARM,**" the caller knows that the system was not armed.
6. The status report may be interrupted at this point to enter an arming command. * This must be done during a 1-second pause placed by the Phone Module between each phone message. Do **NOT** make entries while the system is speaking.
- * The command can also be entered immediately following the status report.

To arm the system **AWAY**, the caller enters the 4-digit system security code, then presses key 2 (**AWAY**) .

7. If arming **AWAY** was successful, the caller will hear 2 confirmation beeps, followed by the words: "**ARMED AWAY... EXIT NOW.**"
8. The caller may hang up now, or wait approximately 20 seconds, at which time the word "**GOODBYE**" will be heard to signify termination of the phone access session.

On-Premises Phone Access Restrictions

The system cannot be accessed from an on-premises phone under the following conditions:

- Phone line is busy
- Phone is ringing
- Downloading is in progress*
- Phone line is out of order.

* Downloading is the process of remote programming of your security system by the central monitoring station over the phone lines, using their computer.

However, there are some conditions under which you can still access the system from an on-premises phone, even though the phone line is in use. These are:

- If you are on the phone during the entry delay period:

The system may be accessed if you are on an on-premises phone during the entry delay period (for example, the system is armed, you are talking on the phone, and a family member enters through an entry/exit door).

During this period, the system may be disarmed without hanging up by entering your 2-digit phone code, followed by the **DISARM** command sequence. There will be no phone confirmation of the command, and you will have to listen for confirmation "beeps" from the nearest wired keypad. Phone disconnect will not occur, and the conversation can be continued after the **DISARM** command has been keyed.



The person at the other end could possibly record the touch tones as they are being entered (your phone code could then be ascertained from the sound of the tones). If there is any concern in this regard, the phone conversation should be terminated first, or the system disarmed in the conventional way via the wired keypad while keeping the person on hold.

- If the System is Communicating with the Alarm Monitoring Company (such as when your security system is reporting an alarm):

Although the phone line is in use during this period, and therefore no dial tone will be present when the on-premises phone is picked up, the system will annunciate the following phone message: "**SYSTEM DIALING CALL TO CENTRAL STATION**" (repeated periodically). It is possible to access the system at this time by entering your 2-digit phone code during the pause between annunciations of the above message.

Off-Premises Phone Access Restrictions

The following restrictions apply when attempting to attain access to the security system from an off-premises phone:

- You cannot access the system from off-premises when the phone line is busy.
- If calling from outside and someone answers, you must enter the phone code within 20 seconds following pick-up; otherwise, you cannot access the system.
- You cannot access the system from off-premises if you have turned off remote phone access (see **Turning Remote Phone Access On or Off** on page 21).
- An outside caller requesting remote access will be allowed 3 attempts to correctly enter each code (the 2-digit phone code and 4-digit system security code). Thereafter, the system will hang up. The system will also hang up if no key is pressed for 20 seconds.

System Status Reports

NA

A System status report is provided automatically following phone access to the system. (System status is also reported through an optional warning speaker by pressing * * on the installer designated security keypad(s).) The system status report includes the following:

- Alarm warning sounds (if any). Not provided in some systems.
- Fire alarms (if any).
- Burglary and other alarms (if any).
- Checks (if any).
- Power status (an AC power loss or low battery condition exists).
- Arming status (plus Bypasses, if any).
- Remote access (only when Off).
- Chime sounds (if chime mode is on and door or window is opened). Not provided in some systems.
- Zone faults (if any). If not annunciated in your system, press * key to hear zones that are faulted.

*

Note: Silent (panic) alarms will be annunciated as faults.

There is a 1-second pause between each individual status report. A system command may be entered during these pauses, or immediately following the end of the report.

Alarm Warning Sounds

If a Fire or Burglary alarm is in progress (or in alarm memory), the status report will commence with a short burst of either a Fire alarm sound ("bell" sound), or Burglary sound (2-tone siren sound).

Note: Alarm warning sounds may not be provided over the phone with your particular system.

Fire Alarm

The word "**FIRE**" will then be annunciated, followed by a zone description* (for instance, "**UPSTAIRS BEDROOM**") and a 2-digit zone number (zones below 10 will be annunciated with a leading zero).

* If programmed by your installer.

System Status Reports (cont'd)

Burglary and other Alarms

A status report for a Burglary or other alarm such as Panic or Emergency (current or in alarm memory) will be the same format as for a Fire Alarm above except that the word "**ALARM**" will be annunciated instead of **FIRE**.

Checks

A status report for a **CHECK** (trouble) condition will be the same format as for a Fire Alarm above, except that the word "**CHECK**" will be annunciated instead of **FIRE**.

Power Status

Annunciation of power status will take place only if a problem exists, as follows: If the system battery is low or is missing, "**SYSTEM LOW BATTERY**" will be annunciated.

If AC power is absent, "**SYSTEM POWER OFF**" will be annunciated.

Arming Status

This report will indicate if the system is armed, the arming mode, and if armed with any bypasses, or if the system is disarmed and whether it is ready or not ready to arm.

Annunciations when the system is in an armed state would be one of the following:

"ARMED STAY", "ARMED AWAY", "ARMED INSTANT", or "ARMED MAXIMUM."

If any bypasses are in effect, the word "**BYPASS**" will be added to the armed message.



If the security system is reported as being armed and the Entry delay is active, the words "**DISARM NOW**" will also be annunciated; if the Exit delay is active, the words "**EXIT NOW**" will be annunciated.

Annunciations when the system is in the disarmed state are:

"DISARMED, READY TO ARM" or **"DISARMED, NOT READY TO ARM"***

* If the message **"DISARMED, NOT READY TO ARM"** is heard, and the **"Zone Faults"** report is not annunciated later (see **Zone Faults** below), simply press the * key to hear the particular zones that are faulted.

Remote Access

If Remote Access has been turned off, the words **"CALL-IN TO SYSTEM OFF"** will be annunciated. If Remote Access is on, no announcement will be made.

Chime Mode

If the security system is in the **CHIME** mode during the status reporting session and a door or window is opened, a 2-note chime sound will be heard over the phone. **

** In some systems, chime sounds will not be heard when the system has been accessed from an outside phone.

Zone Faults



If there is a zone fault (example, a door or window open), the word **"FAULT"** will be annunciated, followed by a zone descriptor*** (for example, **"UPSTAIRS BEDROOM"**) and a 2-digit zone number (zones below 10 will be annunciated with a leading zero). **If zone faults are not annunciated in your system, press * key to hear zones that are faulted.**

Note: Silent alarms will be annunciated as faults.

*** If programmed by your installer.

System Status Reports Not Annunciated

Certain system status messages are displayed on a keypad only, such as:

- **Transmitter Low Battery**
- **Test Mode**
- **Call Alarm Company**
- **Comm Failure.**

These messages will produce "beeps" (if appropriate) over the phone similar to those from the wired keypad. The VIP Module will annunciate "***SEE SYSTEM KEYPAD***" under these conditions.

Conditions that Terminate a Phone Access Session

The phone access session may be terminated at any time by the user hanging up. Phone access will also be terminated under the following conditions:

- If no touch tones have been entered and the system has made no announcements for 20 seconds.
- Phone access sessions are limited to 5 minutes or a sequence of 250 key presses, after which the system will end the session with the word "**GOODBYE**" (time permitting).
- A remote access session (call-in) will be terminated immediately if an alarm dialer report is triggered in the system. This ensures immediate notification of the alarm to the alarm monitoring station. A remote access session may also be terminated if the valid phone and system security codes had not already been entered when other types of dialer reports are triggered.



If a user hangs up to terminate a phone session, they should wait approximately 2 minutes prior to calling for phone access again otherwise they may receive a busy signal.

Protection Against Outside Tampering

In addition to counting the input attempts for the phone code and the system code, some control panels also prevent attempts by an unauthorized person to access the system from an outside phone. After 4 unsuccessful calls are made (including "access attempts" within an armed or disarmed period), remote phone access will be automatically turned off, and can only be turned on again from within the premises.

Whenever remote access is turned off due to tampering, you will be warned of the tampering instead of a prompt for codes on a call-in. The system will announce "**CALL-IN TO SYSTEM OFF, SEE SYSTEM KEYPAD**", and ignore all key depressions thereafter, until hang-up. The system's wired keypad may also beep approximately every 20 seconds, with an Alpha keypad displaying **CALL-IN TAMPER**, and a fixed-word keypad displaying "CI."



Before remote phone access can be turned on again after a tamper message, the system must be cleared by keying an OFF sequence (system security code plus OFF) **twice**.

What To Do In Case of Repeated Tamper Messages

Remote Phone Access will be turned off automatically as a result of possible tampering such as would be caused by improper keying of codes on a call-in from outside. If this occurs repeatedly over a short space of time, exercise caution if the improper keying was not caused by you or a family member. Some unauthorized person may be attempting to access your security system from outside, and you should consider **NOT** turning Remote Access on again for a period of time.

Turning Remote Phone Access On or Off

Remote telephone access to the security system can be turned on and off via the on-premises phone* (or via the wired keypad), as follows:

Enter: Master 4-digit system code + # + 9 + 1 .

A phone response and/or "beeps" will then indicate whether remote access is on or off, as follows:

"CALL-IN TO SYSTEM ON" (2 beeps) or,

"CALL-IN TO SYSTEM OFF" (1 beep).

To reverse the existing condition (from ON to OFF or from OFF to ON), simply enter your 4-digit system code + # + 9 + 1 again.

* An off-premises phone can be used to turn Remote Access off, but not to turn it on.

Using the Relay Command Mode

General Information

Your system may be set up so that certain lights or other devices can be turned on or off from a telephone keypad.

If your system has the **#70 Voice Response Relay Command Mode**, follow the procedure below.

For systems **NOT** having the **#70** interactive mode, refer to the User Guide for the system or ask your installer for specific information on the relay command feature, if available. Systems not having the **#70** mode, but equipped with relay output devices, may provide no phone feedback when a relay command is entered via the phone.

Using the Voice Response #70 Relay Command Mode

☐ Ask your installer if this mode is available in your system. If it is, place a check in this box as a reminder.

To activate devices via the telephone, access the security system using your 2-digit phone access code. When the system acknowledges the access, enter your 4-digit system security code + [#] + 70. The following phone prompts will begin:

Voice Prompt: **"ENTER DEVICE CODE NOW"**

Enter the 2-digit number of the device to be activated.

Voice Prompt: **"(Voice Descriptor), DEVICE ## ON/OFF."**

***"For Voice Descriptor ON, ENTER 2,
for Voice Descriptor OFF, ENTER 1."***

"##" represents the 2-digit device number, and (Voice Descriptor) is the relay phone descriptor programmed by the installer for that device (for example, HALL LIGHT).

Voice Prompt: **"(Voice Descriptor), DEVICE ## ON/OFF. TO EXIT, ENTER 00 NOW"**

Enter **00** to exit, or enter the next device number to be programmed. The current on/off state of that device will be annunciated as described above. Alternatively, if 6 seconds elapses with no key depression, the phone module will annunciate the **"ENTER DEVICE CODE NOW"** message.

Using the Phone Panic Feature

Any on-premises touch-tone phone properly wired to the security system can be used as a panic station, providing your installer has programmed your security system for this feature.

To generate a phone panic alarm:

1. Pick up a premises phone.
2. Enter your two-digit phone code.
3. Press the "1" key (at least six times) until you hear dial tone, followed by silence on the line. This initiates a [*] + [#] keypad panic (or the [B] key panic) on your alarm system keyboard.



Be sure to test each phone on the premises periodically and always when new phone wiring is installed to ensure proper operation. Notify your alarm company before performing this test.

Using the Novice Voice Menu

If you do not enter a Touch-tone command to the system within 5 seconds after the last status message was announced, it will be assumed that help is needed, and the system will enter a "novice mode." You will then be prompted to enter the 4-digit system code. If there is no response to the system code request, the message will be repeated two more times at 5-second intervals. At this point, the system will end the session by saying "**GOOD-BYE,**" and disconnect from the phone line.

If the system code was entered, a phone menu of the more common user commands, (**Disarm, Arm-Away, Arm-Stay, Relay Control,** and **Thermostat Control**) will be provided. Again, if you do not enter a command, the menu will be repeated two more times at 5-second intervals. At this point, the system will end the session by saying "**GOOD-BYE,**" and disconnect from the phone line.



If the system code is not entered correctly, the system will not respond to the commands. After a 5-second pause, you will again be prompted to "**ENTER SYSTEM CODE NOW.**" At this time, you may enter the correct system code.

If the system code was correctly entered, the system will respond with a status message as it usually does. The "novice mode" will be re-entered 5 seconds later.

Programming Speaker Output Mode

About the Speaker Output

Pressing “* *” on the monitored keypad will trigger a status announcement from the speaker output (except if you have selected the **MUTE** speaker control menu selection). User command confirmation for Entry/Exit, Alarm, and other warnings can also be provided.

If your installer connected an external speaker to the control you must program the speaker output. To do this:

1. Obtain phone access with phone code/user code, as required. Be sure to wait for arming status announcement to end before continuing.
2. Press # 97 on phone keypad.

A menu will be announced, which is shown below. Press “1” or “0” in response to the prompt. The prompt will be repeated after several seconds without a key being pressed in response. To exit speaker control programming, complete all required entries or hang up the phone. If the phone is hung up before the Phone Module announces “Exiting”, then any changes made will be lost. If a key other than “1” or “0” is pressed, a buzzer sound will be generated in the phone handset, and the menu request will be repeated.

Voice Menu for Programming Speaker Output Mode:

SPEAKER CONTROL CATEGORIES	DESCRIPTION
MUTE: 1 = Yes, 0 = No	Disables all possible speaker output including those sounds listed below. It will also disable the status announcement provided when the “*” key is pressed twice on the monitored keypad. It will not mute certain panel synthesized phone commands that the control directs to the speaker, such as transmitter learn mode speaker output. If “1” is pressed, the system will announce “ <i>Exiting</i> ,” and exit speaker output mode.
ALL ON: 1 = Yes, 0 = No	Enables all sound categories. If “1” is pressed, the system will announce “ <i>Exiting</i> ,” and exit speaker output mode.

Programming Speaker Output Mode (cont'd)

SPEAKER CONTROL CATEGORIES	DESCRIPTION
WARNINGS: 1 = Yes, 0 = No	Controls all sounds initiated by the control panel, not directly as a result of a user command. This category includes AC loss, system low battery, checks, test mode beeps and other control panel system messages. Exceptions are alarms, chime and entry/exit delay sounds, which are controlled separately.
CHIME: 1 = Yes, 0 = No	If enabled, the speaker will echo chime sounds from the monitored keypad address. If disabled, other beeping sounds such as those initiated in test mode will also be disabled.
ALARMS: 1 = Yes, 0 = No	Controls speaker announcement of alarms and fire alarms. Always set to Yes ("1"). NOTE: This will not trigger a speaker announcement of a silent alarm. Silent alarms are never announced. Silent alarms are treated as faults as with keypads.
MAIN KEYPAD: 1 = Yes, 0 = No	Controls arming and other user command confirmations when the monitored keypad has been used to key in the command.
ENTRY/EXIT DELAY: 1 = Yes, 0 = No	Allows slow beep entry/exit sound and phone announcements to be controlled. . NOTE: Arming messages are controlled separately from this setting.
KEYS and OTHER DEVICES: 1 = Yes, 0 = No	Will control speaker output when the applicable partition is armed or disarmed by devices other than the monitored keypad. Wireless keys, wireless keypads, scheduled arming (if available), and arming from a remote PC all fall into this category.

The categories of control shown in the table above will apply in most cases. When multiple events occur in the system at the same time, one of the categories may take priority, resulting in speaker output even though some of the categories may have been disabled. To completely disable the speaker in all cases, use the **MUTE** command.



The speaker output is for auxiliary use only and is not intended to replace the system's primary sounder or siren.



When using an outside speaker, announcements made by the speaker will be limited. All faults that exist may not be announced when status is called for. This will prevent lengthy voice reports through the output speaker that some users may find objectionable.

If You Have Difficulty with Phone Access to the Security System

THE SECURITY SYSTEM CANNOT BE ACCESSED FROM AN ON-PREMISES PHONE.

- System cannot be accessed by phone and wired keypad displays **87** (or other Tamper message). This indicates a problem with the Phone module – **CALL FOR SERVICE**. In the meantime, use a wired keypad for all system operations.
- Entry of 2-digit phone code may be incorrect. Verify phone code and try again.
- Generally, the system cannot be accessed when the phone line is busy, such as when the alarm-monitoring agency is communicating with your system and you are engaged in a phone conversation. Exceptions: during an Entry Delay period, or when the phone is ringing. Always allow at least 12 seconds after the last ring before attempting phone access.

The system cannot be accessed if the phone line is out of service.

- If you cannot access the security system by phone, contact your alarm installer and have them verify that your phone(s) were properly wired to the security system.

NO TONES FROM TOUCH-TONE PHONE.

- If no tones are heard from the touch-tone phone when keys are pressed, be sure that the phone being used is Touch-tone capable. If the phone is a switchable type (has a **TONE-PULSE** switch), make sure the phone is switched to **TONE**.

THE SECURITY SYSTEM CANNOT BE ACCESSED FROM AN OFF-PREMISES PHONE.

- Either the 2-digit phone code or the system security code may have been entered incorrectly. Verify both codes and try again.
- Remote access from an outside phone may have been turned **OFF**. If so, remote phone access can only be turned **ON** again from an on-premises phone.
- At the on-premises phone, enter your 2-digit Phone Code to access the security system. Listen to the status report that will tell you whether remote access has been turned off. If turned off, key the following:

Your 4-digit master system security code + [#] + [9] + [1].

Note: If a **TAMPER** message was displayed on your keypad (see item 2 on the next page), you must first clear the system by keying an **OFF** sequence (**CODE + OFF**) **twice**.

REMOTE PHONE ACCESS KEEPS TURNING OFF AUTOMATICALLY.

Improper keying (or tampering) from an outside phone has automatically turned remote phone access off (the keypad will display a tamper message).

If You Have Difficulty with Phone Access to the Security System (cont'd)

THE SYSTEM HAS BEEN ACCESSED AND STATUS REPORT ANNUNCIATED, BUT A COMMAND CANNOT BE EXECUTED.

If the command has been keyed, but confirmation is not heard, check as follows:

- Keying of entry may have been too rapid – make key entries slowly and firmly.
- You may have keyed entries while the system was speaking. Make your key entries only during pauses in annunciations by the system.
- The System Security code entered may be incorrect.
- Certain command functions have restrictions. For example, the PANIC function cannot be initiated via the phone if the control is in the programming mode and the TEST mode can only be initiated from an on-premises phone.
- Also, assigning temporary user codes via the phone is not possible with some systems – check with your installer.

'See System Keypad' Phone Message Is Annunciated.

This message will be annunciated during any of the following conditions:

1. **If the security system is in the TEST mode.** In this mode, a fixed-word keypad will only display the normal **NOT READY** message, while an Alpha keypad will display **TEST IN PROGRESS** in some systems, unless a zone is faulted, in which case the zone number (and description if an Alpha keypad) of that zone will be displayed.

1. **Tampering** has caused **"CALL-IN TO SYSTEM OFF, SEE SYSTEM KEYPAD"** message to be annunciated. Four or more unsuccessful attempts have been made to access the system from off-premises, causing Remote Phone Access to be turned off automatically. If the system is in the disarmed mode, an Alpha keypad will display **CALL-IN TAMPER** and a fixed-word keypad will display **CI**. However, if the system is in the armed mode, only the normal **SYSTEM ARMED** message will be displayed.
2. **Low battery in a Wireless Transmitter.** If the system is in the disarmed state, a "Low Battery" message will be displayed. If the system is in the armed state, this display message may not appear until the system is disarmed (depending on how the system was programmed).
3. **Downloading is in progress** (your alarm monitoring station is sending data to your security system over the phone lines). During this period, an Alpha keypad will display **MODEM COMM** and a fixed-word keypad will display **CC**.
4. **There has been a failure of the system to communicate with the central alarm monitoring station.** If the system has attempted to send a report to the central alarm monitoring station and has failed an Alpha keypad will display **COMM FAILURE** and a Fixed-word keypad will display **"FC."**

If You Have Trouble with Your Regular Telephone Service

In the event of trouble with your regular telephone service, disconnect the security system from the telephone line by removing the plug from the RJ31X (CA38A in Canada) telephone wall jack (you should have been shown how to do this by your installing company). **DO NOT ATTEMPT TO REMOVE THE TELEPHONE LINE CONNECTION IN THE CONTROL CABINET OR AT THE PHONE MODULE - THIS WILL CAUSE COMPLETE DISRUPTION OF REGULAR TELEPHONE SERVICE.**

If the regular phone service works correctly after the plug has been disconnected from the RJ31X wall jack, the security system has a problem and you should call your installing company for service immediately. If, upon

disconnection of the security system from the RJ31X wall phone jack, there is still a problem with telephone service, notify the telephone company that they have a problem and request prompt repair service.

Important:

If the phone service is at fault in this test, re-insert the plug immediately; if the security system is at fault, re-insert the plug as soon as the security system is repaired. **Remember that the security system relies on this connection for communication with your alarm monitoring station.**

The user may not under any circumstances (in or out of warranty) attempt any service or repairs to the security system.

FEDERAL COMMUNICATIONS COMMISSION (FCC) PART 15 STATEMENT

This equipment has been tested to FCC requirements and has been found acceptable for use. The FCC requires the following statement for your information:

This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- If using an indoor antenna, have a quality outdoor antenna installed.
- Reorient the receiving antenna until interference is reduced or eliminated.
- Move the receiver away from the security control.
- Move the antenna leads away from any wire runs to the security control.
- Plug the security control into a different outlet so that it and the receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions.

The user or installer may find the following booklet prepared by the Federal Communications Commission helpful:

"Interference Handbook."

This booklet is available from the U.S. Government Printing Office, Washington, DC 20402.

The user shall not make any changes or modifications to the equipment unless authorized by the Installation and Setup Guide or User Guide. Unauthorized changes or modifications could void the user's authority to operate the equipment.

FEDERAL COMMUNICATIONS COMMISSION (FCC) PART 68 STATEMENT

This equipment complies with Part 68 of the FCC rules. On the front cover of this equipment is a label that contains, among other information, the FCC registration number and ringer equivalence number (REN) for this equipment. If requested, this information must be provided to the telephone company.

This equipment uses the following jacks: RJ31X is used to connect this equipment to the telephone network.

The REN is used to determine the quantity of devices that may be connected to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of the RENs should not exceed five (5.0). To be certain of the number of devices that may be connected to the line, as determined by the total RENs, contact the telephone company to determine the maximum REN for the calling area.

If this equipment causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. If advance notice is not practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe necessary.

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advance notice in order for you to make the necessary modifications in order to maintain uninterrupted service.

If trouble is experienced with this equipment, please contact the manufacturer for repair and warranty information. If the trouble is causing harm to the telephone network, the telephone company may request you remove the equipment from the network until the problem is resolved.

There are no user serviceable components in this product, and all necessary repairs must be made by the manufacturer. Other repair methods may invalidate the FCC registration on this product.

This equipment cannot be used on telephone company-provided coin service. Connection to Party Line Service is subject to state tariffs.

This equipment is hearing-aid compatible.

When programming or making test calls to emergency numbers, briefly explain to the dispatcher the reason for the call. Perform such activities in the off-peak hours; such as early morning or late evening.

NOTES

NOTES

LIMITED WARRANTY

Alarm Device Manufacturing Company, a Division of Pittway Corporation, and its divisions, subsidiaries and affiliates ("Seller"), 165 Eileen Way, Syosset, New York 11791, warrants its products to be in conformance with its own plans and specifications and to be free from defects in materials and workmanship under normal use and service for 18 months from the date stamp control on the product or, for products not having an ADEMCO date stamp, for 12 months from date of original purchase unless the installation and setup guide or catalog sets forth a shorter period, in which case the shorter period shall apply. Seller's obligation shall be limited to repairing or replacing, at its option, free of charge for materials or labor, any product which is proved not in compliance with Seller's specifications or proves defective in materials or workmanship under normal use and service. Seller shall have no obligation under this Limited Warranty or otherwise if the product is altered or improperly repaired or serviced by anyone other than ADEMCO factory service. For warranty service, return product transportation prepaid, to an authorized ADEMCO Distributor. THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. IN NO CASE SHALL SELLER BE LIABLE TO ANYONE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES FOR BREACH OF THIS OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, OR UPON ANY OTHER BASIS OF LIABILITY WHATSOEVER, EVEN IF THE LOSS OR DAMAGE IS CAUSED BY THE SELLER'S OWN NEGLIGENCE OR FAULT.

Seller does not represent that the products it sells may not be compromised or circumvented; that the products will prevent any personal injury or property loss by burglary, robbery, fire or otherwise; or that the products will in all cases provide adequate warning or protection. Customer understands that a properly installed and maintained alarm may only reduce the risk of a burglary, robbery, fire or other events occurring without providing an alarm, but it is not insurance or a guarantee that such will not occur or that there will be no personal injury or property loss as a result. CONSEQUENTLY, SELLER SHALL HAVE NO LIABILITY FOR ANY PERSONAL INJURY, PROPERTY DAMAGE OR OTHER LOSS BASED ON A CLAIM THE PRODUCT FAILED TO GIVE WARNING. HOWEVER, IF SELLER IS HELD LIABLE, WHETHER DIRECTLY OR INDIRECTLY, FOR ANY LOSS OR DAMAGE ARISING UNDER THIS LIMITED WARRANTY OR OTHERWISE, REGARDLESS OF CAUSE OR ORIGIN, SELLER'S MAXIMUM LIABILITY SHALL NOT IN ANY CASE EXCEED THE PURCHASE PRICE OF THE PRODUCT, WHICH SHALL BE THE COMPLETE AND EXCLUSIVE REMEDY AGAINST SELLER. This warranty replaces any previous warranties and is the only warranty made by Seller on this product. No increase or alteration, written or verbal, of the obligations of this Limited Warranty is authorized.

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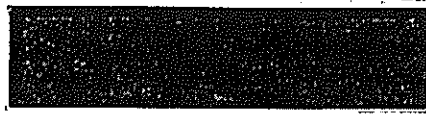


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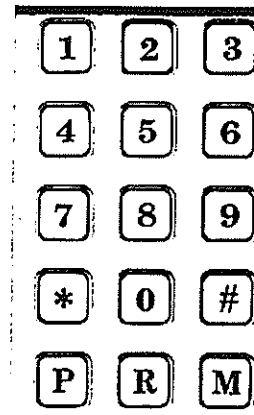
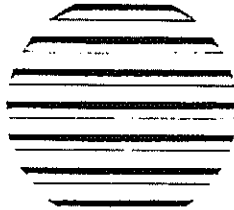
MODEL AD-2000

Automatic Voice/Pager Dialer System with Verification

Not just the next generation...it's the next millennium!



 **United
Security
Products, Inc.**



AD-2000

Automatic Voice/Pager Dialer

645 7492

Versatile * Full-featured * Easy to Program

2-way Listen in Verification

Operates with all alarm systems

Ideal stand-alone dialer

Provides reliable emergency notification 24 hours a day



**United
Security
Products, Inc.**

PLEASE READ THIS MANUAL BEFORE PROGRAMMING AND USING THE UNIT.

IMPORTANT: SAVE THESE INSTRUCTIONS

MODEL AD-2000

Owner's Manual and Operating Instructions The Automatic Voice/Pager Dialer System *For The Next Millennium*

Congratulations!

Thank you for purchasing United Security Products, Inc.'s Model AD-2000 - the "smartest", most comprehensive automatic voice/pager security dialer available. Representing an exciting new level of achievement, the AD-2000 combines technologically advanced features, ease of programming and reliable operation in a compact, unobtrusive dialer completely compatible with any security alarm system. Installation and hookup are quick and easy, whether installed in conjunction with normally open, normally closed dry contact or voltage activation sensors. The unit can also function as a stand-alone device, by simple connection to an ordinary telephone jack. The keypad cover glides on and off for added attractiveness and security.

How It Works

The AD2000 dialer features busy-line and no-answer detection to ensure prompt transmission of up to 4 prerecorded messages delivered sequentially to as many as 8 standard telephones, cellular phones, voice and/or numeric pagers. Messages to both local and long-distance calls can be transmitted. When activated, the dialer instantly begins calling the numbers in sequence, delivering each message 1 to 3 times in a row, in accordance with the pre-selected number of dialing attempts.

The AD-2000 is extensively programmable, offering personalized customization to fulfill virtually any residential or business requirement. Plain-English prompts walk the user through the process in a timely manner.

Programming options abound, allowing the user to:

- Store up to 8 telephone/pager numbers.
- Choose 1- 9 calling efforts for the numbers dialed.
- Select 1-3 message repeats.
- Record a variable combination (maximum: 7) of instructional outgoing messages (total elapsed time: 51 seconds).

Program up to 4 separate input channels with individually enable/disable, entry/exit delay and activation options (Normally Open (N.O.), Normally Closed (N.C.)

(dry contact or voltage activation) including momentary and continuous activation for each).

Further individualize each channel by selecting the delay times, telephone/pager numbers to be dialed and the specific outgoing messages to be played.

Please Familiarize Yourself With These Instructions Before Installation/Operation. This guide describes how to program and operate the dialer. We strongly recommend that you read the entire manual before attempting to use the unit.

To enhance ease of programming and operation, this guide includes:

- A Programming Sample/Quick Setup review on page 13 with a corresponding Program Planner.
- A Blank Program Planner on page 14. One copy of this Planner should be kept in a safe place by the end user. A separate copy should also be retained by the installer.

We are happy to provide a full measure of security reassurance and peace of mind with the Model AD-2000. For information about other innovative United Security Products equipment, call (800) 227-1592.

For Technical Service And Support: Call (619) 597-6677 * Fax (619) 455-0036

E-mail usp@ix.netcom.com

Monday - Friday * 7:30 AM - 4:00 PM PST

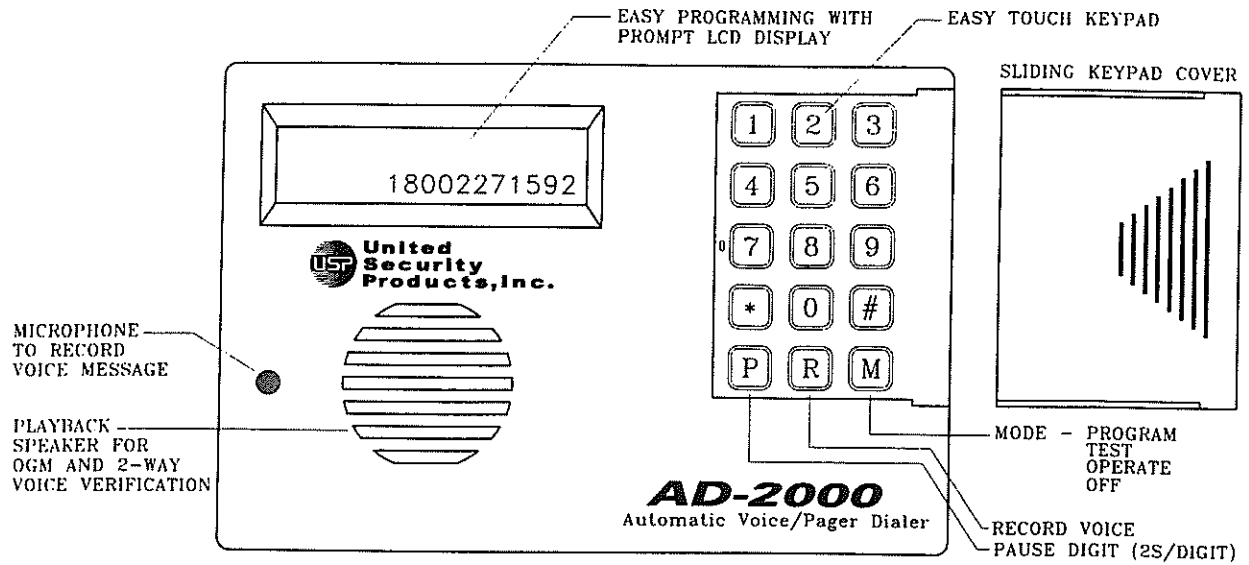
THIS PACKAGE CONTAINS:

1 ea. MODEL AD-2000
1 ea. PHONE CABLE
1 ea. INSTRUCTION MANUAL
4 ea. 1K RESISTORS

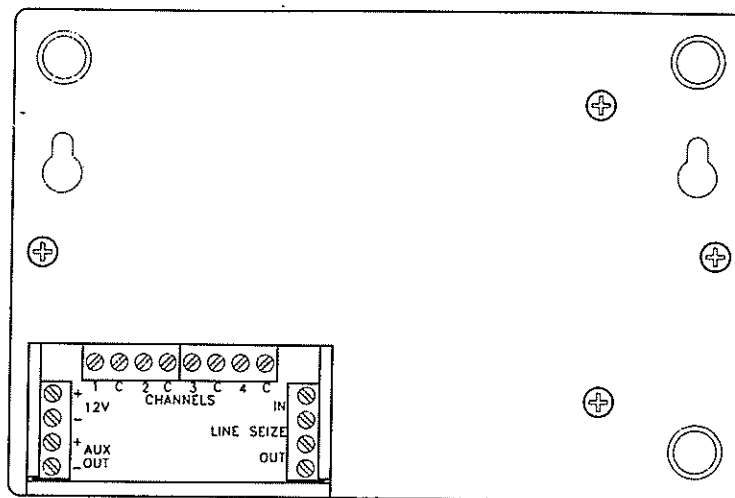
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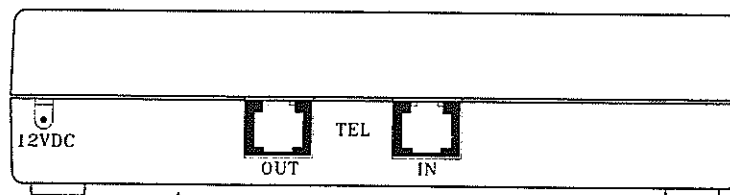
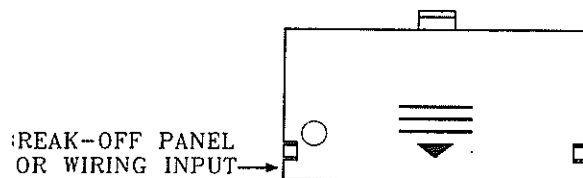
PANEL DISPLAYS



AD-2000 FRONT VIEW



AD-2000 BACK VIEW

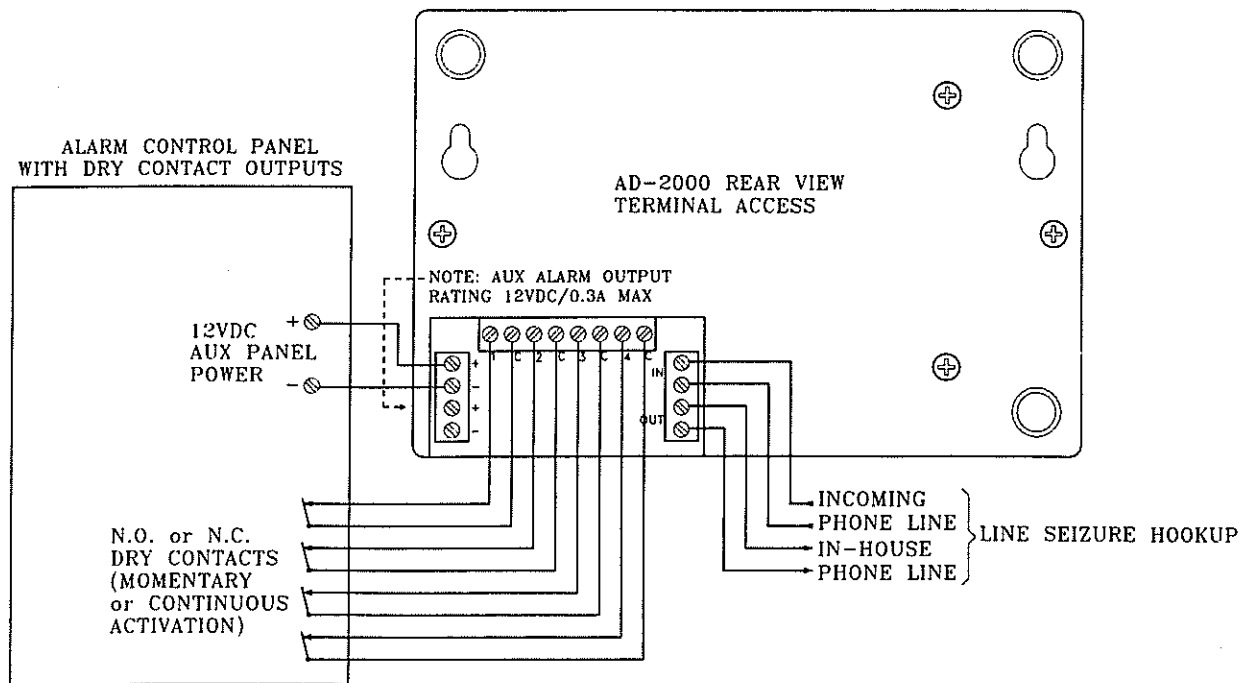


TERMINAL ACCESS ON BACK

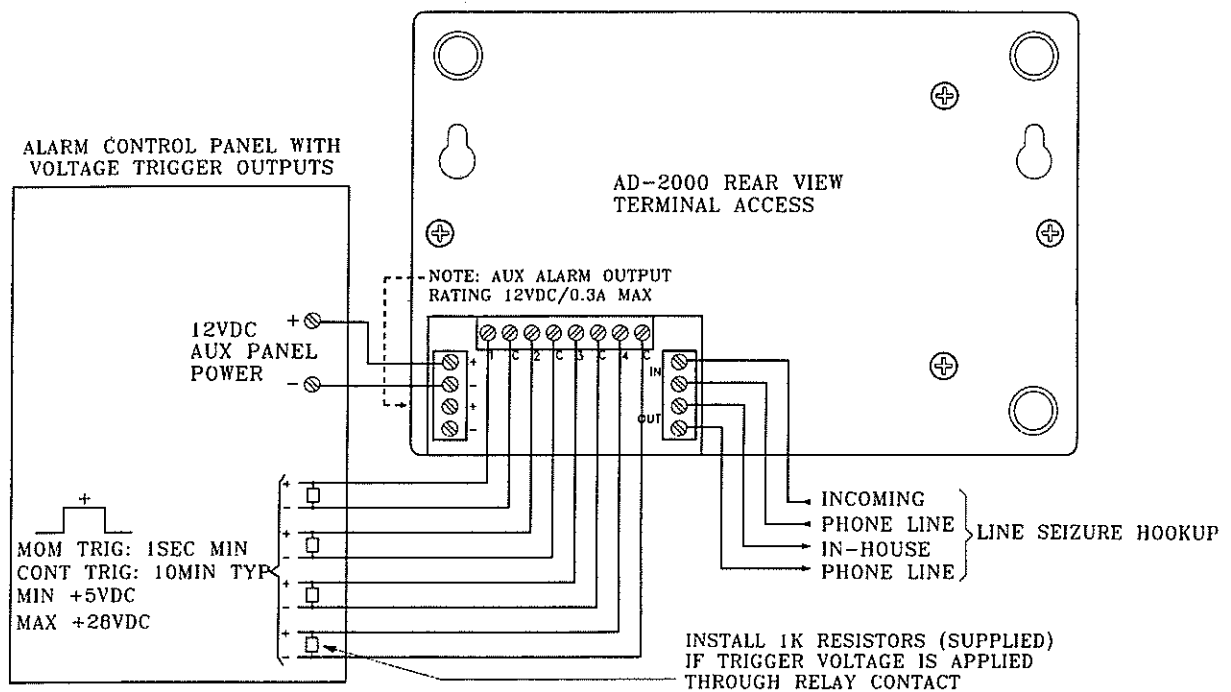
AD-2000 TOP VIEW

AD-2000 INSTALLATION HOOKUPS

Alarm Panel



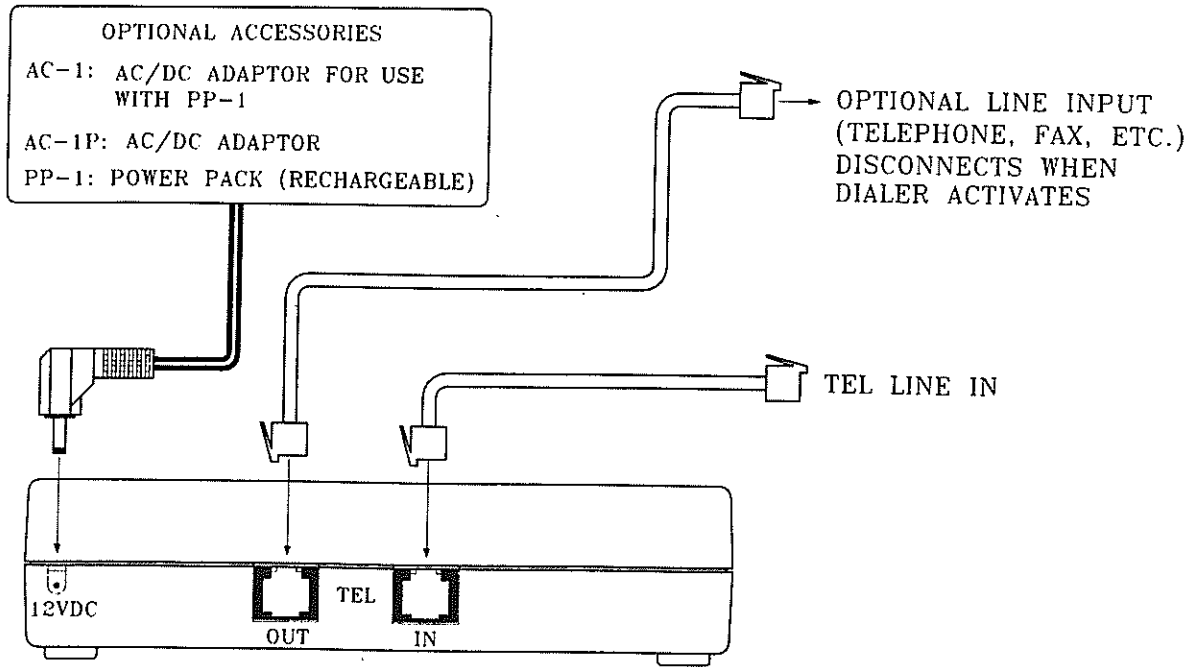
DRY CONTACT ALARM PANEL INTERFACE



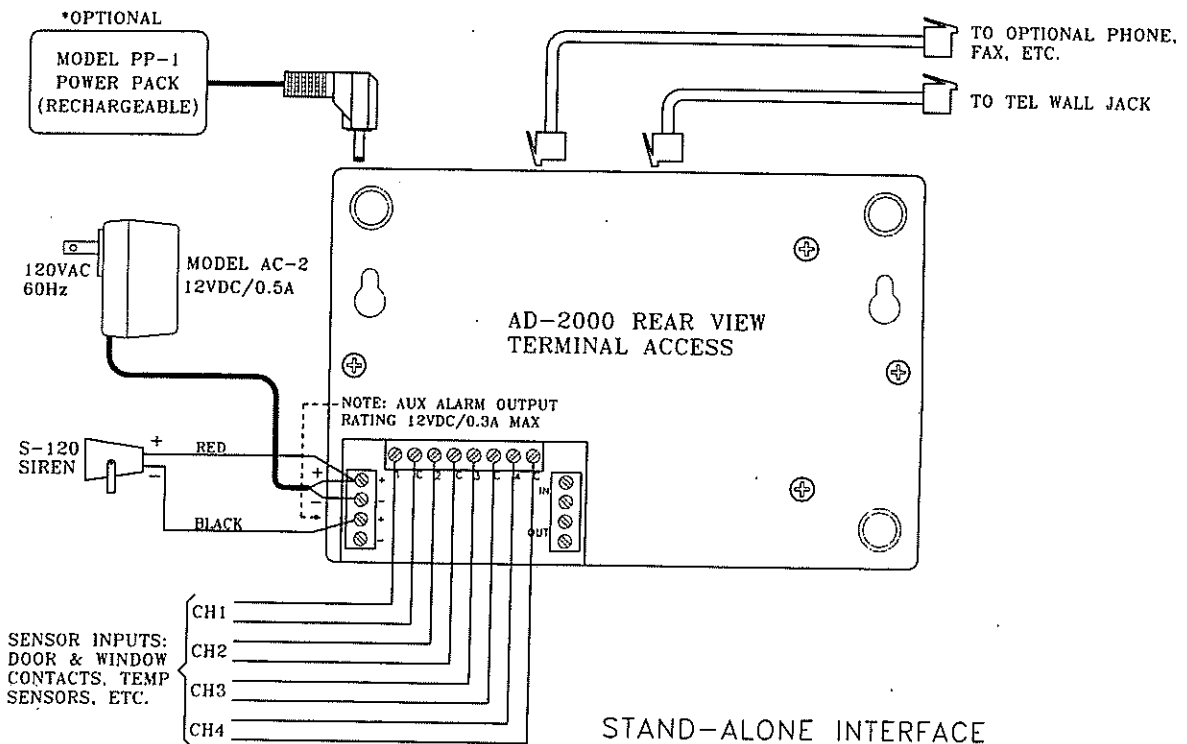
VOLTAGE TRIGGER ALARM PANEL INTERFACE

AD-2000 INSTALLATION HOOKUPS

Stand Alone



POWER & TELEPHONE LINE INTERFACE



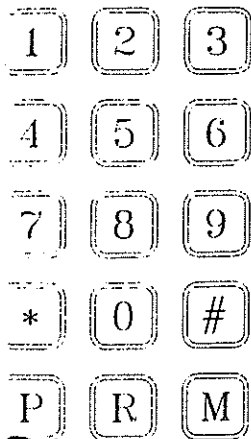
STAND-ALONE INTERFACE

PROGRAMMING THE DIALER

Overview

Please study this section thoroughly before beginning to program the dialer, referring to the Sample Program Planner on page 13. Then, select from among the options for each feature, listing each choice in pencil on the blank Program Planner on page 14. Once the dialer is correctly programmed, list each choice in ink. One copy of the Planner should be kept by the installer; one copy should remain with the end user.

A look At The Keypad



- **CALLOUT FOR NUMERALS:**

Press these keys to enter telephone numbers and other programming information as specified in this manual. A maximum of 50 digits can be input in each phone/pager location.

- **CALLOUT FOR P:**

Press this key to program in a pause. Each "P" provides a 2-second pause.

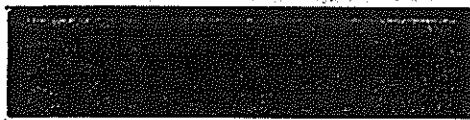
- **CALLOUT FOR R:**

Press this key to record the combination of identification and directional outgoing messages (OGMs). The total elapsed OGM time cannot exceed 51 seconds.

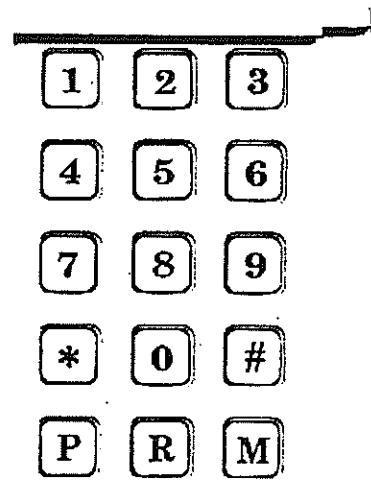
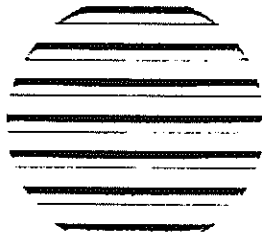
- **CALLOUT FOR M:**

Press this key to change the Mode of the dialer, in sequence:
PROGRAM TEST OPERATE OFF.

Once the unit has been programmed, removing power or placing the dialer in the OFF mode will not affect the programming.



 **United
Security
Products, Inc.**



AD-2000

Automatic Voice/Pager Dialer

PROGRAMMING THE DIALER

First Time Installation to Initialize Dialer Follow Steps 1 & 2.

STEP 1 Apply power to the unit.
The LCD will read:
NOT PROGRAMMED
PRESS KEYPAD #1

STEP 2 Press 1.
The LCD will change to read:
USP AD2000 X.X
then: PROGRAM: NUMBERS
then: SELECT: 1-8
0(DONE)

Programming Telephone And/Or Pager Numbers

You are now ready to begin programming the dialer. All programming can be input before connecting the dialer to a telephone line. Check the unit's LCD as you program numbers in the dialer to ensure accuracy. Please complete all programming instructions before attempting to operate the unit.

Before programming your dialer to call the police, fire department or 9-1-1 directly, you must check with these agencies for their approval.

A maximum of 50 digits (including pauses) can be programmed in at each location.

***PROGRAM: NUMBERS SELECT: 1-8**
1(YES) 2(NO) 0(DONE)

*This prompt will appear after a number has been programmed and this section has been exited.

STEP 1 Press location number 1-8 to program the first number. This can be any location 1-8. You do not have to program locations in sequence. For example, you can program numbers in locations 3 and 5. When you are done programming all the desired telephone and/or pager numbers, press "0" to exit this section.

The LCD will read: **PAGER**
1(YES) 2(NO)

STEP 2 Press "1" if you wish to program in a numeric pager number (step 3A). Press "2" if you wish to program in a telephone number (step 3B), cellular phone number (step 3B), or a voice pager (step 3C).

STEP 3A- NUMERIC PAGERS

NOTE: WHEN PROGRAMMING NUMERIC PAGERS, YOU MUST PROGRAM IN ONE OR MORE PAUSES. EACH "P" PROVIDES A 2-SECOND PAUSE. BEFORE PROGRAMMING IN A PAGER, CALL THE NUMBER TO DETERMINE THE NUMBER OF 2-SECOND PAUSES TO BE PROGRAMMED IN.

If you pressed "1" to program in a numeric pager... Press the digits of the pager to be called. The numbers will appear on the LCD, as will the following key designations. Press "P" one or more times in accordance with the number of seconds needed to accommodate the pager.
(Remember, each "P" provides a 2-second pause).

Press the digits of the numeric pager code.
NOTE: SOME PAGER SERVICES REQUIRE A "#" SIGN FOR SEPARATION OF THE NUMERIC CODE OR AT THE END OF THE NUMERIC CODE FOR PROPER TRANSMISSION.

Press "*" to store the sequence.

Example: To store numeric pager number 555-1212, a 4-second Pause and code 3456:

Press

5 5 5 1 2 1 2 P P 3 4 5 6 *

STEP 3B – TELEPHONE NUMBERS

If you pressed "2" and wish to program in a telephone number... Press the digits of the number to be dialed. For long-distance numbers, first press "1" followed by the area code and then the number. The number will appear on the LCD.

Press "*" to store the sequence.

Example: Store telephone number 1-800-555-1212:

Press:

1 8 0 0 5 5 5 1 2 1 2 *

REMEMBER/NOTE: Before programming your dialer to call the police, fire department or 9-1-1 directly, you must check with these agencies for their approval.

STEP 3C – VOICE PAGERS

If you pressed "2" and wish to program in a voice pager...

Press the digits of the pager to be called.

Press "P" one or more times in accordance with the number of seconds needed to accommodate the pager.
(Remember each "P" provides a 2-second pause).

Press "*" to store the sequence. The number will appear on the LCD.

Example: To store voice pager 555-1212 and a 4-second pause:
Press:

5 5 5 1 2 1 2 P P *

STEP 4 Repeat steps 1-3 for each number to be programmed in each location. Select any of 8 location numbers in Step 1 (SELECT: 1-8) for each number to be programmed.

STEP 5 When you are done programming all desired telephone and/or pager numbers, press "0" to exit this section.

NOTE: IF YOU ENTER THE WRONG CHOICE, PRESS "M" KEY REPEATEDLY AND RETURN TO THE "PROGRAM MODE". THEN SELECT THE SECTION TO CHANGE ("1" ACCEPT SECTION, "2" FOR NEXT SECTION). THEN ENTER CORRECT INFORMATION.

PROGRAMMING THE DIALER

Programming Auxiliary Information

The dialer is preset at the factory to typical telephone line (T-LINE), PBX, Dialing Attempts and Message Repeat options. If you choose to accept the following default prompts, simply press "2" to scroll to the next section. **If your phone system requires dialing a digit to get an outside line or dial tone, similar to PBX, then turn PBX on and enter digit to program.**

PRESETS

T-LINE.....TONE
PBX.....OFF
ATTEMPTS.....2
MESSAGE.....2

To change the presets, follow these steps.

T-LINE

The LCD will display: **PROGRAM: T-LINE**
1(YES) 2(NO)

Press "1" to program T-LINE.

Press "2" to scroll to the next section.

The LCD will display: **PROGRAM: T-LINE**
1(TONE) 2(PULSE)

Press "1" for TONE. Press "2" for PULSE.

The LCD will display: **PROGRAM: PBX**
1(ON) 2(OFF)

Step 1: Press "1" for ON. Press "2" for OFF.

Step 2: If "1" is entered, the LCD will display:

PROGRAM: PBX
ENTER PBX NUMBER

Enter PBX number (1 digit).

ATTEMPTS

ATTEMPTS refers to the number of times the dialer will call each designated number. Both successful and unsuccessful (busy or no answer) call are considered attempts.

The LCD will display: **PROGRAM: ATTEMPTS**
ENTER 1-9 3

Step 1: Press the digit (1-9) corresponding to the number of times you wish the dialer to call each number.

MESSAGE

MESSAGE refers to the number of times each message will be delivered to each designated number. 2

The LCD will display: **PROGRAM: MESSAGE**
REPEAT ENTER 1-3

Step 1: Press the digits (1-3) corresponding to the number of times you wish the message(s) to be delivered.

After selecting the number of message repeats, the dialer will automatically exit this section.

Structuring Your Outgoing Messages

The AD-2000 dialer was designed with optimum versatility and functionality in mind. Nowhere is this more apparent than in the matrix of outgoing messages (OGMs). The user's ability to "mix and match" OGMs allows complete system customization and provides ultimate efficiency.

Total OGM time is 51 seconds.

A beginning identification (ID) message of up to 15 seconds can be programmed in (options #4, #6, and #8). Your ID message should clearly state your name, address and other pertinent emergency information.

Typically, each OGM will have a specific purpose. For instance OGM 1 can alert the person notified to contact the fire department while OGM 2 can alert the person to contact the police department. Typically the dialer is programmed to notify family friends or another responsible party. Before programming you dialer to call the police, fire department or 9-1-1 directly, you must check with these agencies for their approval.

- OPTION #1** No OGM. Select this option if you do not wish to record any outgoing messages.
- OPTION #2** 1 OGM. Select this option if you wish to record one OGM, which may be as long as 51 seconds.
- OPTION #3** 2 OGMs. Select this option if you wish to record two OGMs, each of which may be as long as 25.5 seconds.
- OPTION #4** ID plus 2 OGMs. Select this option if you wish to record one ID of up to 15 seconds in length, and two OGMs, each of which may be as long as 18 seconds.*
- OPTION #5** 3 OGMs. Select this option if you wish to record three OGMs, each of which may be as long as 17 seconds.
- OPTION #6** ID plus 3 OGMs. Select this option if you wish to record one ID of up to 15 seconds in length, and three OGMs, each of which may be as long as 12 seconds.*
- OPTION #7** 4 OGMs. Select this option if you wish to record four OGMs, each of which may be as long as 12.75 seconds.
- OPTION #8** ID plus 4 OGMs. Select this option if you wish to record one ID of up to 15 seconds in length, and four OGMs, each of which may be as long as 9 seconds.*

*If your ID message is less than 15 seconds in length, the remaining time will be evenly divided among the OGMs.

Example: OPTION #4: ID plus 2 OGMs.

If the ID is 10 seconds, then each OGM can be (51 minus 10 equals 41 divided by 2 equals) 20.5 seconds in length.

PROGRAMMING THE DIALER

Programming And Recording Your Outgoing Messages

Follow these steps to program and record your outgoing messages. Skip this portion if you have programmed in only numeric pagers, which rely on coded DTMF messages. As with all AD-2000 programming, the unit need not be connected to a phone line when information is programmed in. Remember that "OPT" on the LCD stands for option; "OGM" stands for outgoing message.

NOTE: IF YOU ENTER THE WRONG CHOICE, PRESS "M" KEY REPEATEDLY AND RETURN TO THE "PROGRAM MODE". THEN SELECT THE SECTION TO CHANGE ("1" ACCEPT SECTION, "2" FOR NEXT SECTION). THEN ENTER CORRECT INFORMATION.

STEP 1 Decide which of the eight options you prefer.

STEP 2 Before programming in this option, write down all your messages. Time them carefully, changing them if necessary to fit the allotted time frame. Practice saying them, clearly enunciating each message for maximum clarity in case of an emergency. Keep a final recording script.

STEP 3 Program your option.

A) The LCD will read: **PROGRAM: OGMS**
1(YES) 2(NO)

B) Press "1" to program your OGMS. Press "2" to scroll to the next section.

C) Press "1" to select the option (#1- #8) displayed or press "2" to scroll to the desired option.

STEP 4 After selecting your option as explained above, record your message.

A) The word RECORD will appear in the upper left corner of the LCD, above the instruction: PRESS R. The option selected will appear in the upper right corner. For instance, if you selected option #2, the LCD will read:

RECORD OGM1
PRESS R

B) Speak 6-12 inches away from the microphone. Referring to your script and speaking in a normal voice, press and hold R (the word RECORDING will be displayed), releasing the key after you have completed enunciating your messages. The word DONE will appear on the LCD when the maximum allotted time has been reached.

C) The LCD will read: **PLAY OGM(S)**
1(YES) 2(NO)

Press "1" to play back your recording

D) The LCD will read: **ACCEPT**
1(YES) 2(NO)

Press "1" to accept the recorded OGM(s). Press "2" if you wish to re-record the messages, beginning with Step 4.

Changing The OGMS

After your system is up and operating, you may change one or more of the recorded OGMS and/or choose a completely different option. To do so, simply scroll to the programming section on your display: **PROGRAM: OGMS**

1(YES) 2(NO)

Select the option, then begin again from Step 3 above to record your new message(s).

Programming The Channels

The AD-2000 is designed to be adaptable to a complete set of personalized applications. Each of the four input channels can be programmed individually for full system customization. In addition to setting enable/disable options, entry/exit delays and type of activation (N.O., N.C., & momentary or continuous), each user can specify which emergency messages will be delivered and which numbers will be dialed. The first channel activated will be the priority channel. Numbers programmed to that channel will be completed before the dialer moves on to the next channel(s). Although comprehensive in scope, the system is easy to program. Just follow these simple steps.

NOTE: IF YOU ENTER THE WRONG CHOICE, PRESS "M" KEY REPEATEDLY AND RETURN TO THE "PROGRAM MODE". THEN SELECT THE SECTION TO CHANGE ("1" ACCEPT SECTION, "2" FOR NEXT SECTION). THEN ENTER CORRECT INFORMATION.

STEP 1 The LCD will read: **PROGRAM: CHANNELS**
1(YES) 2(NO)

Press "1" to begin programming the channels.

STEP 2 The LCD will read: **SELECT: 1-4**
0(DONE)

Enter the channel you wish to program (1-4).

Enable/Disable

STEP 3 The LCD will read: **CH X: ENABLE**
1(YES) 2(NO)

("CH X" being the channel selected)

Press "1" to enable the channel. Press "2" to disable the channel.

Exit/Entry Delays

Capable of programming up to a maximum of 3 minutes and 12 seconds each.

STEP 4 The LCD will read: **CH X: EXIT DELAY**
1(YES) 2(NO)

Proceed with A) if you wish to program an exit delay.
Proceed with B) if you do not.

A) To program exit delay, press "1".
The LCD will read: **ENTER 0-199 THEN**
PRESS *

Enter the digits corresponding to the number of seconds you wish to install. (For example, press "120" then press "*", you wish to install a 120-second exit delay).

B) If you do not wish to program an exit delay, press "2".

STEP 5 The LCD will read: **CH X: ENTRY DELAY**
1(YES) 2(NO)

Proceed with A) if you wish to program an entry delay.
Proceed with B) if you do not.

A) To program an entry delay, press "1".
The LCD will read: **ENTER 0-199 THEN**
PRESS *

Press "1" to program a delay. Then enter the digit corresponding to the number of seconds you wish to install. (For example, press "90" then press "*", if you wish to install a 90-second delay).

B) If you do not wish to program an entry delay, press "2".

PROGRAMMING THE DIALER

Normally Open/Normally Closed

STEP 6 The LCD will read:

CH X: N.O./N.C.
1(N.O.) 2(N.C.)

- A) Press "1" to select a normally open channel.
- B) Press "2" to select a normally closed channel.

Momentary/Continuous Activation

STEP 7 The LCD will read:

CH X: MOM/CONT
1(MOM) 2(CONT)

- A) Press "1" to select a momentary trigger.
- B) Press "2" to select continuous activation.

Numbers Dialed/Outgoing Messages

Following these steps allows you to choose which OGM(s) will be delivered and which numbers will be dialed for each channel.
NOTE: Dialer LCD will only show programmed numbers and OGM options.

STEP 8 The LCD will read:

CH X: DIAL #X
1(YES) 2(NO)

("Dial #X" being the number in phone/pager location 1-8)

- A) Press "1" to dial phone/pager #X to be dialed when the selected channel is activated. Press "2" if you do not wish this number to be dialed.

- B) Continue the above procedure for each of the up to eight phone/pager numbers programmed in.

STEP 9 The LCD will read:

CH X: OGM X
1(YES) 2(NO)

("OGM X" being the OGM recorded in OGM options #2 - #8)

- A) Press "1" to deliver OGM X when the channel is activated. Press "2" if you do not wish this OGM to be delivered.
- B) Continue the above procedure for each Channel/OGM. If you have programmed in and recorded an ID message as one of your OGM options, this ID will be delivered to all channels. It will not appear in the Channel display.

NOTE: ID AND OGM(S) WILL ONLY BE DELIVERED TO TELEPHONE NUMBERS, CELLULAR NUMBERS, AND VOICE PAGERS.

Completing The Programming

Once you have programmed in all dialing and OGM options for each channel, the LCD will read:

ACCEPT
1(YES) 2(NO)

STEP 10 Press "1" to accept the Channel programming. Press "2" to re-program or to revert to previously programmed setting.

You are now ready to review your programming and test the system.

PRESS "M" TO EXIT PROGRAMMING MODE.

TESTING YOUR SYSTEM

Test your system before an emergency occurs.

Do not neglect to review programmed information and verify all elements of your system thoroughly before relying on the dialer to deliver the necessary information to the desired parties accurately and completely.

We strongly recommend testing the system in test mode before connecting to a telephone line. The test mode tests the stored information, not the full functionality of the dialer. To test the full functionality of the dialer, the unit must be tested in the operate mode. In the test mode, the dialer will not make more than one attempt per number dialed or play any OGM more than once.

NOTE: IF YOU ENTER THE WRONG CHOICE, PRESS "M" KEY REPEATEDLY AND RETURN TO THE "PROGRAM MODE", THEN SELECT THE SECTION TO CHANGE ("1" ACCEPT SECTION, "2" FOR NEXT SECTION). THEN ENTER CORRECT INFORMATION.

STEP 1 Press the "M" Mode key until the LCD reads:

TEST: T-LINE
1(YES) 2(NO)

STEP 2 Press "1" to display the T-Line configuration.

The data will scroll through all selections.
Press "2" to scroll to the next section.

STEP 3 The LCD will read:

TEST: CHANNEL(S)
1(YES) 2(NO)

Press "1" to test channels.

Press "2" to scroll to the next section.

STEP 4 The LCD will read:

SELECT: 1-4
5(ALL) 0(DONE)

Select the channel you wish to test (1-4). Press "5" to test "all" Channels. Once a channel is selected (or "all") the programmed channel information will be displayed on the LCD. Verify data accuracy as the LCD scrolls through by comparing the information displayed with that specified on your Program Planner. Listen to your recorded message(s) to ensure that the correct OGM (if programmed) is delivered. Press "0" to exit testing.

STEP 5 Now connect your dialer to the telephone line you will be using and test the system again, to determine if it functions correctly in an actual emergency situation.

Make sure you notify the receiving party of your intent to call them, and tell them it is just a test.

STEP 6 To test the operation of your entire system, set Mode to OPERATE and proceed as explained in the next section: Operating Your System.

Test your system on a regular basis, at least once a week.

OPERATING YOUR SYSTEM

You are now ready to begin operating your system, relying on the AD-2000 to work in conjunction with your alarm system to provide 24-hour security reassurance and peace of mind.

When in the operating mode, the system will monitor all the enabled channels, initiating dialing when a valid alarm condition occurs. Upon activation the dialer will begin calling each phone/pager number selected, in sequence, for the pre-selected number of attempts. During each successful attempt, the voice message will be delivered 1, 2, or 3 times, in accordance with the option selected (**numeric messages will only be delivered one time**). In unsuccessful attempts, the dialer will move on to the next phone/pager number after receiving 8 busy or 8 rings without an answer. The dialer will not allow voice messages to be delivered to programmed numeric pager locations.

If you send a message to a phone attached to an answering machine, it will consider this a successful attempt. Make sure you designate the maximum number of message repeats to be sure that a complete message will be left on the answering machine, because part or all of your emergency message may be "lost" while the answering machine delivers its greeting message.

Placing your system in OPERATE can also be used as a final test of the full functionality of each channel's exit/entry delay, activation, momentary/continuous trigger, phone numbers and OGM. Although serving as a test, this mode reflects actual operation; therefore the OGM(s) will not be heard through your dialer's speaker but only by each party called.

To begin operating your system, simply press the "M" Mode key until the word OPERATE appears on the LCD. To disarm the dialer, switch the mode to OFF by pressing the same key. All programming information will be retained.

System Notations

Here are a few explanations to help you better understand how your AD-2000 dialer operates. For specific information on the AD-2000 unit alone, call United Security Products, Inc.'s Customer Service Department during normal business hours at (619) 597-6677.

Channel Activation

Each of the dialer's four channels can be activated by any of the following: a normally open dry contact, normally closed dry contact or positive 5-28VDC voltage activation.

Under a momentary activation, a single violation of a channel will cause the dialer to initiate delivering all pre-selected OGMs to all programmed numbers associated with the channel. Under continuous activation, the dialer will initiate the process, terminating it if/when the activated channel is restored to a non-alarm state. Once an alarm has occurred and all attempts satisfied, the dialer will continue to monitor any remaining enabled channel(s). Once the activated channel has been restored to a non-alarm state, it will then be re-armed and ready for the next alarm.

Exit/Entry Delays

If a channel is activated during a pre-selected exit delay, the alarm condition will be ignored until the delay has expired. If an alarm occurs, the entry delay will cause the dialer to wait before starting the dialing process. **To de-activate the dialer during the entry wait period, simply press "M" to return to the OFF Mode.** Both exit and entry delay time can be pre-selected to range from 1-199 seconds.

Additional features

The dialer offers three innovative features that enhance the utility of the entire system.

Listen-In

While receiving an OGM on a touch-tone phone, the called party can press "1" to listen in to the activity at the other end of the line for one minute. Pressing "1" again restarts the minute increment period and can be repeated indefinitely. When "1" is pressed the OGM will stop playing and the listen in period will start.

Two-Way

After the called party is listening-in, that party can press "2" to begin a two-way conversation lasting for one minute. This procedure also can be repeated indefinitely by pressing "2" again to restart the minute. Once you are in two-way mode you cannot go back to Listen-In.

Remote Turn-Off

The called party can remotely terminate the activated channel any time during the OGM by pressing "1" then "#" twice within one second. The dialer will continue to monitor the remaining channel(s). Once the terminated channel is restored to a non-alarm state, it will re-arm. If in listen-in or two-way, simply press "#" twice in one second, for remote turn-off.

Sample Program Planner

AD2000 PROGRAM PLANNER

Date: 11/9/97

PROGRAM: NUMBERS

NUMBER	PAGER		TELEPHONE NUMBER (exclude PBX digit, include numeric pager code)	NAME OF PARTY TO BE REACHED
	YES	NO		
1		✓	2345678	John Johnson's house
2				
3				
4				
5	✓		3456789PP4455#	John Johnson's pager - burglary code
6	✓		3456789PP5544#	John Johnson's pager - fire code
7				
8				

PROGRAM: T-LINE

TONE	PULSE	PBX		ATTEMPTS	MESSAGE REPEAT
		ON	OFF	1 THROUGH 9	1 THROUGH 3
✓		NUMBER	✓	2	2

PROGRAM: OGMs

OPTION	STYLE	BRIEFLY DESCRIBE TYPE OF VOICE MESSAGE(S)			
1	NO OGM				
2	1 OGM				
3	2 OGMs				
✓ 4	ID + 2 OGMs	ID: My name is Mary Smith and I need help.	OGM1: Call the police department.	OGM2: Call the fire department.	
5	3 OGMs				
6	ID + 3 OGMs				
7	4 OGMs				
8	ID + 4 OGMs				

PROGRAM: CHANNELS

CH	ENABLE		EXIT DELAY(SEC)			ENTRY DELAY(SEC)			ACTIVATION				DIAL NUMBER								PLAY OGM			
	YES	NO	YES	NO	0-199	YES	NO	0-199	NO	NC	MOM	CONT	1	2	3	4	5	6	7	8	1	2	3	4
1	✓		✓		30	✓		15		✓	✓		✓				✓				✓			
2		✓																						
3		✓																						
4	✓			✓	0		✓	0	✓			✓	✓				✓				✓			

Programming Example for Quick Setup

Before programming the dialer, study the example shown on this page. This "quick setup" example programs in one telephone number, two numeric pager numbers, two attempts, two repeats, an ID plus two additional OGMs, and channels 1 and 4.

Once you understand the setup, use the blank Program Planner on page 14 to begin programming your dialer. We recommend making several blank copies of the Planner before beginning the process. It is also advisable to fill in the Planner in pencil initially.

STEP 1 Press "1".

STEP 2 When the LCD reads SELECT 1-8, press "1" to install the first phone number in location 1 press "2" to indicate no pager; then press, in sequence, (fictitious) phone number "2345678" followed by the "*" sign to store the programming process for that number.

STEP 3 Press "5" to install the second phone number in location 5; press "1" to indicate numeric pager; then press, in sequence, "3456789PP4455#" followed by the "*" sign. The first seven digits represent the pager number dialed; each P stands for a 2-second pause; the next four digits followed by the # sign represent the pager code and the * stores the programming process for that number.

Now press "6" to install the third phone number in location 6; press "1" to indicate numeric pager; then press, in sequence, "3456789PP5544#" followed by the "*" sign.

STEP 4 Press "0" to exit PROGRAM NUMBERS.

STEP 5 At the PROGRAM: T-LINE prompt, press "1" to choose tone; press "2" to indicate no PBX; press "2" to program in two dialer attempts per emergency number called; press "2" to program in two message repeats for each call.

STEP 6 Press "1" to PROGRAM OGM(S). Press "2" three times to roll to option #4; press "1" to program in an ID message and two

specific outgoing messages (OGMs).

STEP 7 Using a prepared script and speaking six-to-eight inches from the dialer's microphone on the front of the unit, press "R" when you are ready to enunciate your 15-second identification message and your two 18-second messages. Dialer automatically prompts to next OGM. Make OGM1 a message telling the receiving party to call the police department. Make OGM2 a message to call the fire department.

STEP 8 Press "1" to play back all recorded messages; press "1" again to accept. (NOTE: DIALER LCD WILL ONLY SHOW PROGRAMMED NUMBERS AND OGM OPTIONS).

STEP 9 Press "1" to PROGRAM CHANNELS.

STEP 10 Press "1" to program Channel 1. Press "1" to ENABLE. Press "1" then enter "30" then press "*" for a 30-second EXIT delay; press "1" then enter "15" then press "*" for a 15-second entry delay. Now press "2" for NORMALLY CLOSED and then "1" for MOMENTARY activation. Press "1" to select phone/pager number 1 to be dialed. Press "1" again to select phone/pager number 5 to be dialed. Press "2" to not select phone/pager number 6 to be dialed. Press "1" to select OGM1 to be delivered and press "2" to not select OGM2 to be delivered. Press "1" to accept the channel configuration.

STEP 11 Press "4" to program Channel 4. Press "1" to ENABLE. Press "2" twice to indicate no EXIT or ENTRY delay. Now press "1" for NORMALLY OPEN and the "2" for CONTINUOUS activation. Press "1" to select phone/pager number 1 to be dialed. Press "2" to not select phone/pager 5 to be dialed. Press "1" to select phone/pager number 6 to be dialed. Press "2" to not select OGM1 to be delivered and press "1" to select OGM2 to be delivered. Press "1" to accept the channel configuration.

STEP 12 Press "0" to exit PROGRAM: CHANNELS. Press "M" to exit programming mode.

Fill out this Program Planner in pencil initially

AD2000 PROGRAM PLANNER

Date: _____

PROGRAM: NUMBERS

NUMBER	PAGER		TELEPHONE NUMBER (exclude PBX digit, include numeric pager code)	NAME OF PARTY TO BE REACHED
	YES	NO		
1		☒		
2				
3				
4				
5				
6				
7				
8				

PROGRAM: T-LINE

TONE	PULSE	PBX		ATTEMPTS	MESSAGE REPEAT
		ON	OFF	1 THROUGH 9	1 THROUGH 3
		NUMBER _____	☒	3	2

PROGRAM: OGMs

OPTION	STYLE	BRIEFLY DESCRIBE TYPE OF VOICE MESSAGE(S)
1	NO OGM	
2	1 OGM	
3	2 OGMs	
4	ID + 2 OGMs	
5	3 OGMs	
6	ID + 3 OGMs	
7	4 OGMs	
8	ID + 4 OGMs	

PHOL BROTHERS LAND FILL
SECURITY OR FIRE ALARM
PUMPING SYSTEM ALARM
PUMPS ARE ON
PUMPS ARE OFF

PROGRAM: CHANNELS

CH	ENABLE		EXIT DELAY(SEC)		ENTRY DELAY(SEC)		ACTIVATION				DIAL NUMBER								PLAY OGM						
	YES	NO	YES	NO	0-199	YES	NO	0-199	NO	NC	MOM	CONT	1	2	3	4	5	6	7	8	1	2	3	4	
1	☒			☒			☒						☒									☒			
2	☒						☒						☒									☒			
3	☒						☒						☒									☒			
4	☒						☒						☒									☒			

AD2000 PROGRAM PLANNER

Date: _____

PROGRAM: NUMBERS

NUMBER	PAGER		TELEPHONE NUMBER (exclude PBX digit, include numeric pager code)	NAME OF PARTY TO BE REACHED
	YES	NO		
1				
2				
3				
4				
5				
6				
7				
8				

PROGRAM: T-LINE

TONE	PULSE	PBX		ATTEMPTS	MESSAGE REPEAT
		ON	OFF	1 THROUGH 9	1 THROUGH 3
		NUMBER _____			

PROGRAM: OGMs

OPTION	STYLE	BRIEFLY DESCRIBE TYPE OF VOICE MESSAGE(S)
1	NO OGM	
2	1 OGM	
3	2 OGMs	
4	ID + 2 OGMs	
5	3 OGMs	
6	ID + 3 OGMs	
7	4 OGMs	
8	ID + 4 OGMs	

PROGRAM: CHANNELS

CH	ENABLE		EXIT DELAY(SEC)		ENTRY DELAY(SEC)		ACTIVATION				DIAL NUMBER								PLAY OGM					
	YES	NO	YES	NO	0-199	YES	NO	0-199	NO	NC	MOM	CONT	1	2	3	4	5	6	7	8	1	2	3	4
1																								
2																								
3																								
4																								

After thoroughly testing your system, redo your Program Planner in ink.
 One copy should be kept in a safe place by the end user; one copy should be retained by the installer.

SPECIFICATIONS

Dimensions

Power source:	9-18VDC
Current (OPERATE mode – standby):	28mA typical.
Current (OPERATE mode – dialing):	100mA max.
Activation:	1) N.C. Activation: dialer activates when an “open” is detected 2) N.O. Activation: dialer activates when a “close” is detected 3) Voltage Activation: N.C. (applied voltage: Min. +5VDC, Max. +28VDC) N.O. (loss of continuous voltage: Min. 0VDC, Max. 0.25VDC)
Max. digits for outgoing numbers:	50
Operating temperature range:	-18 to 55 C (0 to 130 F)
Dimensions (inches):	6 x 4 x 1.5 in
Weight (ounces):	10 oz
Mounting:	Wall or Flat Surface
Case Material:	ABS
Color:	White
Warranty:	1 Year

Note: Design and specifications subject to change without notice.

DIALER ACCESSORIES

Power Source



AC/DC Adaptor

Plugs into regular 110VAC outlet to provide the dialer with the required primary power.

AC-2: AC/DC Adaptor

12VDC/0.5A for stand alone with siren use.

PP-1: Power (Rechargeable)

Provides 24 (est.) hours of backup standby power.

AC-1P: AC/DC Adaptor For Use With PP-1

Plugs into regular 110VAC outlet to provide the dialer with the required primary power and additional input for PP-1 interface.

IR-1: Isolation Relay

Converts alarm output voltage to N.C. to provide clean input trigger to dialer.

Industrial/Residential Sensors

F20: Temperature Supervisory Switch <40 F

HTS: High Temperature Switch

LTS: Low Temperature Switch

CSS: Cold Storage Switch

WLS: Water Level Sensor

RTS: Adjustable Temperature Controller, N.O., N.C.

PLS: Power Loss Sensor (110VAC)

Sensors

Magnetic Contacts – Door and Window

Glass Break Detectors

Hold Up Buttons/Emergency Switches

Pressure Mats – Sealed and Under Carpet

Motion Detectors



Siren

S-120: 2" Mini Siren, 12VDC @ 120 mA typical

Additional Options

Data logger: AD-2001-DL

Retains in memory log of alarm events for later retrieval and review.

Wireless: AD-2000/W

Wireless version AD-2000 dialer includes wireless pendant transmitter.

24V Application: AD-2000/F

For this option the dialer is configured to operate at 24VDC to 32VDC max. All other specifications apply.

Wireless and 24V Applications: AD-2000/W/F

The AD-2000/W/F incorporates both the wireless feature and 24VDC application. See WIRELESS AND 24V APPLICATION for further details.

NOTE: CALL UNITED SECURITY PRODUCTS FOR ADDITIONAL INFORMATION AND DEVICES NOT LISTED HERE.

Wireless Upgrade:

The standard AD-2000 can be upgraded for wireless link-up with RF-activated mag contacts, motion sensors, pendant, etc., by installing a new back cover containing a pre-tested RF assembly and swivel antenna. The receiver is connected to the main board via a 4-pin interface connector already included in the standard configuration. See WIRELESS for further details.

NOTE: SYSTEMS ALREADY INSTALLED CAN BE UPGRADED WITHOUT REPLACING OR RE-WIRING THE DIALER.

IMPORTANT INFORMATION

Care And Precautions

LOCATION

Place the dialer on a flat level surface or mount the unit on the wall, away from extreme cold or heat, direct sunlight, excessive humidity and away from equipment that generate strong magnetic fields. Avoid placing near large metal objects and areas that produce smoke, dust and mechanical vibrations.

CARE

Clean the housing with a soft cloth lightly moistened with water or mild detergent solution. Never use solvents such as alcohol or thinner. Do not allow liquids to spill into the unit.

OPTIONAL BACKUP

To ensure continuous operation during power outages, hookup to a 12VDC backup battery pack is recommended. (PP-1) Available from United Security Products.

CAUTION

Do not use the dialer if a gas leak is suspected or during lightning.

PROBLEMS

If liquid or a foreign object penetrates the unit, disconnect it immediately and contact your installer or other qualified technician.

Before calling USP, please make sure...

- You have read this manual and understand how to operate the dialer.
- Your phone line is working.
- You check out the entire system, including external hook-up wiring and sensors attached.

If you still have questions or concerns, call our USP Technical Service Department between the hours of 7:30 AM and 4:00 PM, PST, Monday through Friday.

Federal Communications Commission Radio And Television Interference Statement For A Class 'B' Device

This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance

with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class 'B' computing device in accordance with the specifications in Subpart B of FCC Rules and Regulations (as outlined in the Code of Federal Regulation, Title 47), which are designed to provide reasonable protection against such interference in a residential installation.

User Instructions

If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off, then on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate radio or television.
- Increase the separation between the equipment and receiver.
- Connect the equipment into a different outlet so that the equipment and receiver are on different branch circuits.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by United Security Products, Inc. could void the user's authority to operate the equipment.

AD2000 SERIES FAQ SHEET

1. Can the dialer be used as a stand-alone unit?
Yes. Purchase USP part# PB12P to provide both main power and battery backup. The PB12P plugs right into the 12vdc input jack on top of the dialer. USP's warranty does not cover reverse polarity or lightning strikes and other acts of God. When using electrical devices, we recommend using surge protection for any voltage feeding into this unit, i.e. phone line, power source, etc.
2. Can the dialer be programmed to isolate certain phone numbers to one or more inputs?
Yes. By programming your channel inputs, you can determine which numbers you want to be called out when a channel is activated.
3. Can the dialer call my numeric pager?
Yes. Depending on the pager service, a delay may have to be inserted between the pager number and the pager code followed by a #, before entering the*. The pager number can be programmed for multiple pauses (each 1 pause is 2 seconds long) for a longer delay. For cellular phones it is recommended to add six pauses after the number before pressing *. Numbers can be programmed for multiple "pauses" (each "pause" is 2 seconds long) for a longer delay. See manual for more information on programming numbers.
4. How do I program the dialer for use with a PBX system?
Simply program the T-LINE for PBX ON and enter the digit that will acquire the outside line. This PBX number is universal for all programmed numbers. Once the dialer is activated, the dialer will issue the PBX number 50ms after connecting to the line, then wait for a dial tone and begin dialing.
5. How do I incorporate line seizure into my hookup?
You can use either the RJ11 jacks or the IN/OUT terminals inside the dialer. Connect the main telephone line to the LINE IN (RJ11) jack or IN terminals, then connect the phone to the LINE OUT (RJ11) or OUT terminals.
6. Why does my message sound garbled or muffled?
When you record your OGM, be sure to position yourself no closer than 2 inches but no farther than 15 inches away from the dialer. Try to eliminate any background noise.
7. How can I erase phone numbers or change voice messages from the dialer memory?
Program over the existing phone number or do not select that phone number when programming the channels. For voice, choose option #1 in the OGM options or record over the existing message.
8. How do I activate my dialer?
The dialer can be activated by a momentary or continuous input, a N.C. or N.O. dry contact (that either opens or closes in an alarm condition) or a voltage level/pulse.
9. Why doesn't my dialer activate when I apply a +12VDC on the input(s)?
The 1K-ohm resistor (provided) needs to be installed across the alarm output terminals of the alarm panel or across the input terminals of the dialer (such as 1 and C). Program the specified input for Normally Closed (N.C.) activation. Dialer will activate once the input senses a voltage of 5-28VDC.
10. Why doesn't my dialer activate when I remove the applied +12VDC on the input(s)?
The 1K-ohm resistor (provided) needs to be installed across the alarm output terminals of the alarm panel or across the input terminals of the dialer (such as 1 and C). Program the specified input for Normally Open (N.O.) activation. Dialer will activate once the input senses that the voltage has been removed.
11. How can I install my dialer to work with a relay?
Attach the input leads of the dialer to the relay as follows: For Normally Closed activation; Input from dialer (such as; 1) to the Normally Closed (N.C.) terminal of the relay and common (C) from the dialer to common (C) on the relay. For Normally Open activation; Input from dialer (such as; 1) to the Normally Open (N.O.) terminal of the relay and common (C) from the dialer to common (C) on the relay. The coil of the relay needs to be connected to the alarm output.
12. Can I stop the dialer from continuing the dialing sequence once a dialing attempt is successful?
Yes. While the OGM is playing, press 1 1 1 on the touch-tone phone, then press 1 #1 twice within 2 seconds to initiate the Remote Turn Off (RTO) feature. Once the alarm input has been restored to the non-alarm state, the input will then be re-armed.

FCC PART 68
INFORMATION SUPPLIED TO THE USER

This equipment complies with Part 68 of the FCC Rules. The FCC Part 68 Label is located on the bottom of the enclosure. It contains the FCC Registration Number for this equipment. If requested, this information must be provided to your telephone company.

The REN is useful to determine the quantity of devices you may connect to your telephone line and still have all of those devices ring when your telephone number is called. In most, but not all areas, the sum of the RENs of all devices connected to one line should not exceed five (5.0). To be certain of the number of devices you may connect to your line, as determined by the REN, you should contact your local telephone company to determine the maximum REN for your calling area.

Connection to the telephone network should be made by using standard modular telephone jacks, type RJ11C. The RJ11C plug and/or jacks used must comply with FCC Part 68 rules.

If this telephone equipment causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes in it's facilities, equipment, operations or procedures that could affect the proper functioning of your equipment. If they do, you will be notified in advance in order for you to make necessary modifications to maintain uninterrupted service.

This equipment may not be used on coin service provided by the telephone company. Connection to party lines is subject to state tariffs.

If trouble is experienced with this unit, please contact customer service at the address and phone listed below. **DO NOT DISASSEMBLE THIS EQUIPMENT.** It does not contain any user serviceable components.

Attn: CUSTOMER SERVICE DEPT.
United Security Products, Inc.
11025 Sorrento Valley Court.
San Diego, CA 92121

Phone: (858) 597-6677

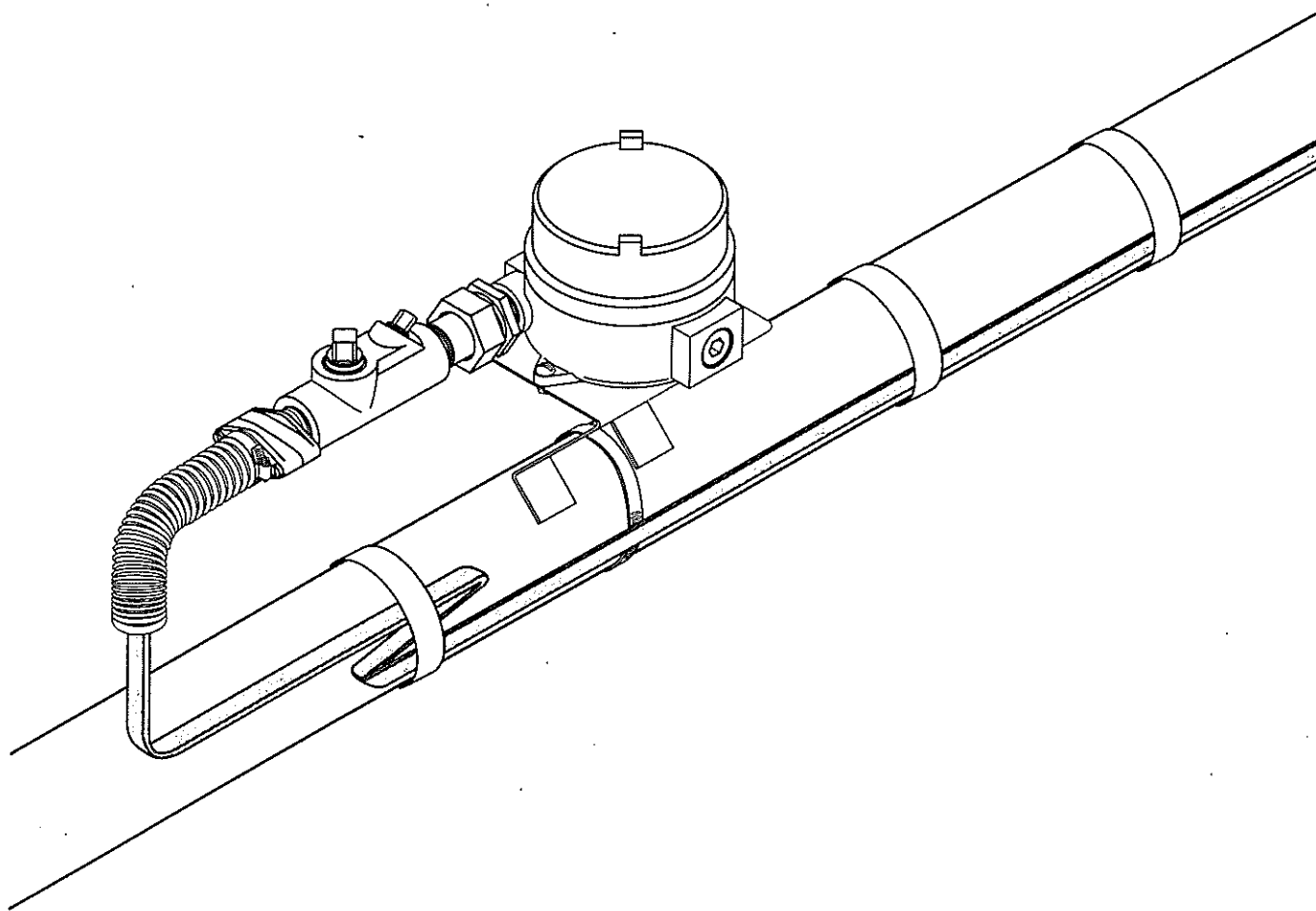
APPENDIX B-8

HEAT TRACE (RAYCHEM)

Raychem

Heat-Tracing Systems for Hazardous Division 1 Locations

Design and Installation Guide





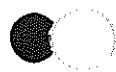
WARNING: Fire and shock hazard.

This heat-tracing system must be installed correctly to ensure proper operation and to prevent shock and fire. Read these important warnings and carefully follow all the installation instructions.

- There is a danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed. To comply with Raychem requirements, agency certifications, and the National Electrical Code, and to protect against the risk of fire, ground-fault equipment protection must be used on each heating-cable circuit. Arcing may not be stopped by conventional circuit breakers.
- Approvals and performance are based on the use of Raychem-specified parts only. Do not substitute parts or use vinyl electrical tape.
- Bus wires will short if they contact each other. Keep bus wires separated.
- Components and cable ends must be kept dry before and during installation.
- The black heating-cable core and fibers are conductive and can short. They must be properly insulated and kept dry.
- Damaged bus wires can overheat or short. Do not break bus wire strands when scoring the jacket or core.
- Damaged heating cable can cause electrical arcing or fire. Do not use metal attachments such as pipe straps or tie wire. Use only Raychem-approved tapes and cable ties to secure the cable to the pipe.
- Do not attempt to repair or energize damaged cable. Remove damaged sections at once and replace them with a new length, using the appropriate Raychem splice kit. Replace damaged components.
- Reusing the grommet, or using the wrong grommet, can cause leaks, cracked components, shock, or fire. Be sure the new type of grommet is correct for the heating cable being installed. Use a new grommet whenever the cable has been pulled out of the termination.
- Use only fire-resistant insulation materials, such as fiberglass wrap or flame-retardant foam.

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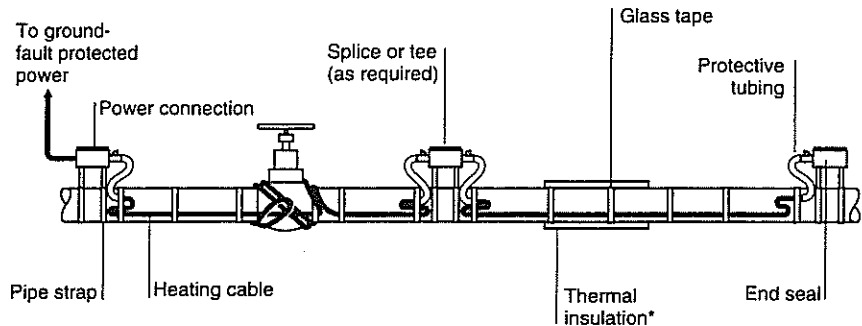


1. Introduction

1.1 Scope

This guide applies to Raychem heat-tracing systems covered by Factory Mutual (FM) Approval or Canadian Standards Association (CSA) Certification for Division 1 hazardous locations. These applications are defined by the National Fire Protection Association (NFPA) 70, National Electrical Code (NEC) Article 500, and the Canadian Electrical Code (CEC) Part I, Section 18.

1.2 Typical System with Components

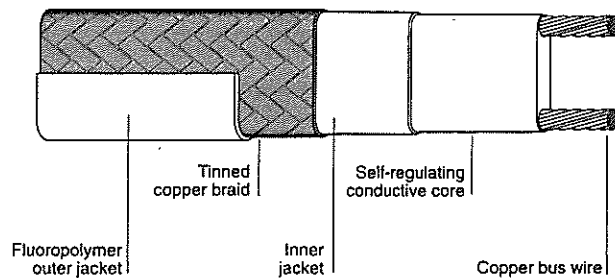


*Thermal insulation is required on all heat-traced pipe.

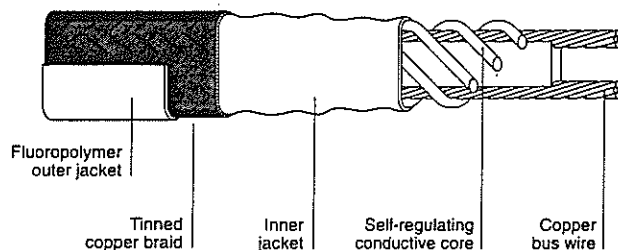
1.3 Division 1 Heat-Tracing Cables

Raychem Corporation offers solid-core and fiber-wrapped heating cables for Division 1 areas as shown below.

The design sections of this guide will help determine the heating cable best suited for your application. Table 1 in Section 2.0, Thermal Design, gives the performance data for these heating cables. All system components are specifically designed and approved for Division 1 applications. No parts can be substituted or omitted.



FM Approved HBTV-CT and HQTV-CT Heating Cables
CSA Certified BTV-CT and QTVR-CT Heating Cables

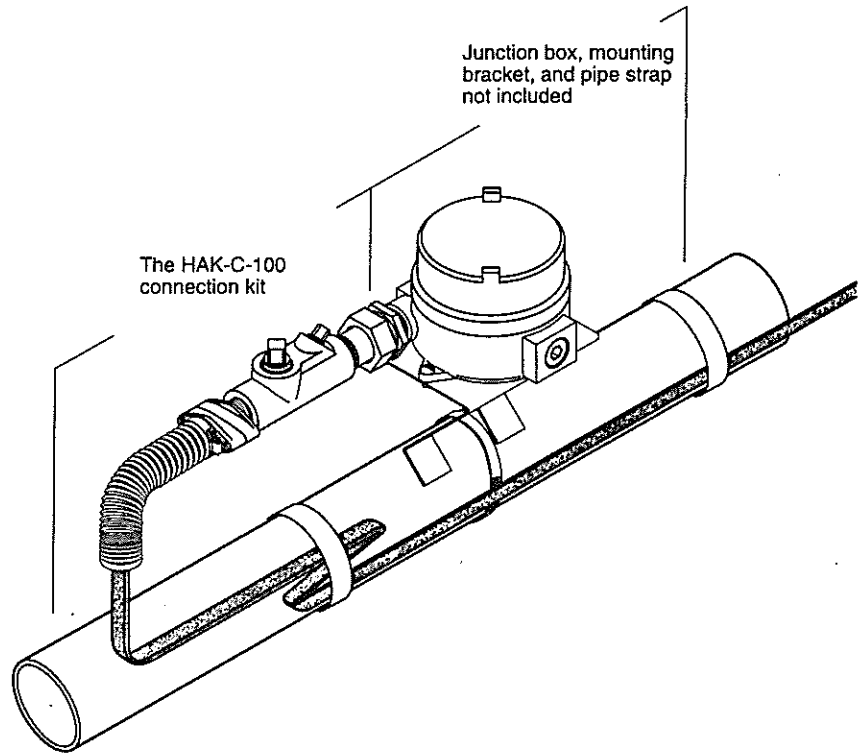


FM Approved HXTV-CT Heating Cables
CSA Certified XTV-CT Heating Cables

1.4 Electrical Connections and Components

The HAK-C-100 connection kit is FM Approved and CSA Certified. The kit must be used for all power connections, splices, tees, and end seals in Division 1 locations.

If components are installed in a Division 2 or ordinary area, other Raychem industrial connection systems can be used with the approved Division 1 heating cable.



Note: In addition to the HAK-C-100 connection kit, junction boxes, pipe straps, and mounting brackets must be ordered. Additional HAK-C-100 kits are needed for splices and tees. (Splices require one junction box and two HAK-C-100 kits; tees require one junction box and three HAK-C-100 kits.) See Section 4.0 for a complete component assembly matrix and catalog numbers.



WARNING: Fire hazard.

There is a danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed. To comply with Raychem requirements, certifications, and national electrical codes, and to protect against the risk of fire, ground-fault equipment protection must be used on each heating cable circuit. Arcing may not be stopped by conventional circuit breakers.

1.5 Electrical Protection

Raychem, the NEC, the CEC, FM, and CSA require ground-fault protection of equipment for all Division 1 locations to reduce the risk of fire caused by damage or improper installation.

These devices are commonly available with 30-mA trip levels and are rated up to 30 A for 120, 208, and single-phase 240 Vac grounded systems. Raychem also offers the TraceGuard 277 Vac ground-fault-protected circuit breaker with ratings up to 50 A.

For recommended ground-fault equipment protection, see Appendix C.

2. Thermal Design



WARNING: Fire and shock hazard.
This electrical system must be designed and installed properly. To prevent fire or electrical hazard, follow all warnings and instructions in this guide and all literature included in product packages.

2.1 Introduction

This design section covers the selection process for both FM Approved and CSA Certified systems. There are different steps required, depending on which approval agency is desired.

2.2 Special Requirements

Due to the potentially hazardous nature of Division 1 locations, these requirements must be followed at all times.

For FM Approved systems

- Use only Raychem HBTV-CT, HQTV-CT, and HXTV-CT heating cables and Raychem-HAK-C-100 components specifically approved by FM. Do not substitute any parts.
- Use ground-fault equipment protection devices (see Appendix C).
- Send field information from Appendix E to the Raychem Customer Service Center (fax 650-361-6711) for design verification.
- Complete the Division 1 Installation Record in Appendix F. Installers are required to complete and submit a Division 1 Installation Record to the Raychem Customer Service Center.

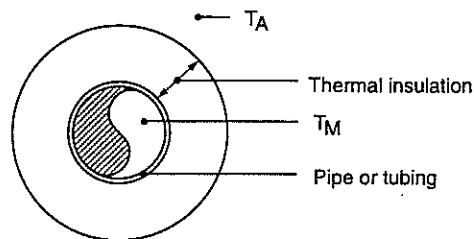
For CSA Certified systems

- Use only Raychem BTV-CT, QTVR-CT, and XTV-CT heating cables and HAK-C-100 components specifically certified by CSA. Do not substitute any parts.
- Use ground-fault equipment protection devices (see Appendix C).

2.3 Heating Cable Selection

To determine the heating cable catalog number, you must know:

- T_M : desired maintenance temperature (°F)
- T_A : minimum expected ambient temperature (°F)
- Continuous exposure temperature (°F)
- Pipe or tubing size
- Thermal insulation type and thickness
- Service voltage
- Approval required (FM or CSA)
- T-rating of the area or the lowest auto-ignition temperature (AIT), expressed in °C, in the area of use.



The following steps in this section describe how to determine this information.

Note: All thermal and electrical design information provided is based upon a standard installation: heating cable fastened with glass tape to an insulated metal pipe. The appendices in this guide are provided to assist you in calculating alternative installation methods. Consult your Raychem representative for design assistance, if needed.

Note: Publication NFPA 325 gives ignition temperatures for many hazardous materials.

Note: Keep all records of T-rating determination. The Raychem Customer Service Center will ask for this information to fill orders. This information must be recorded in Appendix E and sent to Raychem.

The purpose of the T-rating is to ensure that electrical equipment does not exceed the auto-ignition temperatures of flammables handled in a hazardous (Classified) area.

Step 1: Collect the thermal design application information:

Example:

- T_M : 40°F (4.44°C) [water freeze protection]
- T_A : -20°F (28.89°C)
- Maximum continuous exposure temperature: 100°F (37.78°C)
- Pipe or tubing size: 6" steel
- Thermal insulation type and thickness: 2" calcium silicate
- Service voltage: 240 V
- Approval required (FM or CSA): FM
- Material with the lowest AIT, expressed in °C, in the hazardous area: Benzene, AIT = 498°C

Step 2. Determine the T-rating requirement:

If the T-rating of the area has been defined, then select a heating cable from Table 1 (page 6) having a T-rating equivalent to or less than the T-rating of this area (for example, T6 is a lower T-rating than T3).

Example 1: The T-rating for the area is defined as T3.

If the T-rating for the area has not been defined, use one of the following methods.

For FM Approval:

- Select material with the lowest AIT in °C.
- Multiply ignition temperature by 0.8.
- This temperature is the maximum allowable heating cable sheath temperature.

For CSA Certification:

- Select material with the lowest AIT.
- This temperature is the maximum allowable heating cable sheath temperature.

Example 2: The material in the area with the lowest AIT is the fluid benzene, with an AIT of 498°C.

$$\begin{aligned}\text{For FM approval: T-rating} &= 80\% \times \text{AIT (°C)} \\ &= .8 \times 498^\circ\text{C} \\ &= 399^\circ\text{C}\end{aligned}$$

$$\text{For CSA: T-rating} = 498^\circ\text{C}$$

The heating cable selected cannot have a maximum sheath temperature greater than the lowest AIT for the area.

Step 3. Calculate the temperature differential (ΔT):

$$\Delta T = T_M - T_A$$

Example:

$$\text{Calculate } \Delta T = T_M - T_A$$

$$\text{Calculate } \Delta T = 40^\circ\text{F} - (-20^\circ\text{F}) [4.44^\circ\text{C} - (-28.89^\circ\text{C})]$$

$$\text{Calculate } \Delta T = 60^\circ\text{F} (15.56^\circ\text{C})$$

Step 4. Determine the pipe heat loss:

From Table 3 (page 8), match the pipe size and insulation thickness with the temperature differential (ΔT) to find the base heat loss of the pipe (Q_B).

Example:

From Table 3, 6" pipe, 2" insulation, and $\Delta T = 60^\circ\text{F}$ (15.56°C), Q_B must be calculated through interpolation:

$$Q_B = 4.2 \text{ W/ft} + 10/50 \times (8.8 - 4.2) = 4.2 + 0.9$$

$$Q_B = 5.1 \text{ W/ft @ } T_M = 40^\circ\text{F} (4.44^\circ\text{C})$$

Note: Heat-loss calculations are based on IEEE Standard 515-1996, Equation 1.

Step 5. Compensate for insulation type:

Multiply the base heat loss of the pipe (Q_B) from Step 4 by the appropriate insulation compensation factor (f) from Table 4 (page 8), to get the actual heat loss (Q_T).

$$Q_T = Q_B \times f$$

Example:

From Table 4, insulation factor (f) = 1.48 for calcium silicate:

$$Q_T = Q_B \times f$$

$$Q_B = 5.1 \text{ W/ft} \times 1.48$$

$$Q_T = 7.5 \text{ W/ft at } 40^\circ\text{F (4.44}^\circ\text{C)}$$

Step 6. Select the thermal output rating:

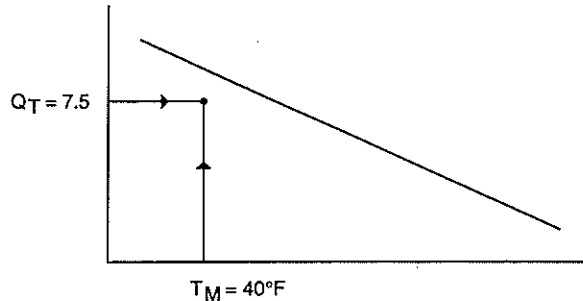
From Graphs 1 and 2 on pages 10 and 11, match the actual heat loss per foot of pipe (Q_T) with the desired maintenance temperature (T_M), and select from the power output ratings so that the power output rating at T_M equals or exceeds Q_T .

Example:

$$Q_T = 7.5 \text{ W/ft}$$

$$T_M = 40^\circ\text{F (4.44}^\circ\text{C)}$$

From Graphs 1 and 2, 8HBTV-CT exceeds 7.5 W/ft at $40^\circ\text{F (4.44}^\circ\text{C)}$.



Should the heat loss Q_T be between the two heating-cable power output curves, select the higher-rated heating cable. If the heat loss Q_T is greater than the power output of the highest-rated heating cable, you can compensate with one of the following methods:

- Use thicker insulation.
- Use insulation material with a lower K factor.
- Use two or more heating cables run in parallel.
- Spiral the heating cable.

Spiraling: If this method is selected, determine the spiral factor according to the following formula:

$$\text{Spiral factor (length of heating cable/foot of pipe)} = \frac{Q_T}{\text{Heater thermal output at } T_M}$$

When the spiral factor exceeds 1.4 or the pipe size is less than 3" IPS, Raychem recommends using two or more heating cables run in parallel.

Only HBTV-CT and BTV-CT can be used on plastic pipes. See Appendix H for thermal output adjustment factors on plastic pipes.

Step 7. Determine the heating cable family:

Select the heating cable catalog number based on the following information and Table 1 below:

- Maintenance temperature
- Heat loss calculated (Q_T)
- Service voltage
- Approval requirement
- T-rating as calculated by your required approval agency
- Continuous exposure temperature

Note: Make sure that the maximum sheath temperature of the heating cable is not higher than the T-rating (refer to Step 2). Contact the Raychem Customer Service Center if the maximum sheath temperature of the heating cable selected exceeds the temperature calculated in Step 2.

Table 1. Heating Cable Product Performance Data

FM Approved heating cable	CSA Certified heating cable	Maximum continuous exposure temperature*	Maximum intermittent exposure temperature**	T-rating/Maximum sheath temperature
HBTB-CT	BTB-CT	150°F (65°C)	185°F (85°C)	T6 (185°F, 85°C)
HQTV-CT	QTVR-CT	225°F (110°C)	225°F (110°C)	T4 (275°F, 135°C)
5HXTV1, 2-CT	5XTV1, 2-CT-T3	250°F (121°C)	420°F (215°C)	T3 (392°F, 200°C)
10HXTV1, 2-CT	10XTV1, 2-CT-T3	250°F (121°C)	420°F (215°C)	T3 (392°F, 200°C)
15HXTV2-CT	15XTV2-CT-T3	250°F (121°C)	420°F (215°C)	T3 (392°F, 200°C)
15HXTV1-CT	15XTV1-CT-T2	250°F (121°C)	420°F (215°C)	T2D (419°F, 215°C)
20HXTV1-CT	20XTV1-CT-T2	250°F (121°C)	420°F (215°C)	T2D (419°F, 215°C)
20HXTV2-CT	20XTV2-CT-T2	250°F (121°C)	420°F (215°C)	T2C (446°F, 230°C)

* With the heating cable power on.

** 1000 hours (power on/power off).

Example:

$$T_M = 40^\circ\text{F} (4.44^\circ\text{C})$$

Actual heat loss calculated (Q_T) = 7.5 W/ft. Based on $T_M = 40^\circ\text{F} (4.44^\circ\text{C})$ and $Q_T = 7.5$ W/ft, an 8-W/ft product is sufficient for the application (refer to Step 6).

Service voltage = 240 V

Approval requirement = FM

T-rating as calculated by your required approval agency = 399°C

Continuous exposure temperature = 100°F (37.78°C)

Therefore, choose 8HBTB2-CT.

Step 8. Calculate the total length of heating cable required by combining lengths from each component of the piping system:

Example:

80-ft pipe length

2 gate valves

5 0.25-in steel-welded shoe supports

1 power connection

1 end seal

(A) For the piping:

Determine the amount of heating cable required for the pipeline length.

Heating cable required for pipe length = 80 ft

(B) For each valve:

Use Table 2 on the next page to calculate the amount of heating cable required.

Table 2. Amount of Heating Cable to Use per Valve

Pipe diameter (IPS) (inches)	Minimum amount of heating cable (feet)	
1/4	0.3	For pipe diameters less than 2 inches, the numbers represent the maximum amount of heating cable that will fit on the valve.
1/2	0.8	
3/4	1.3	
1	2	
1 1/4	3.3	
1 1/2	4.3	
2	4.3	For pipe diameters between 2 and 6 inches, the numbers represent the maximum heating cable required to compensate for heat loss and a service loop.
3	4.3	
4	4.3	
6	5.0	
8	5.0	For pipe diameters greater than 6 inches, the numbers represent the minimum amount required for a service loop and do not necessarily compensate for total heat loss.
10	5.6	
14	7.3	
18	9.4	
24	12.6	

Note: Use TraceCalc 5 software to calculate the exact quantity required for the valve, based on Finite Element Analysis.

Heating cable required for valves = Two 6" valves x 4.3 ft = 8.6 ft

(C) For each pipe support shoe:

Calculate the additional heat required as follows:

$$Q_{\text{SUPPORT}} = 0.7L \times (T_M - T_A), \text{ where } L = \text{Support length (ft)}$$

Total heat loss from supports: 5 pipe supports x (0.7 x 1) x 60 = 210 W x 10% safety factor = 231 W

Calculate the additional heating cable required by dividing the total support heat loss, Q_{SUPPORT} , by the heating cable power output per foot at T_M from the thermal output curves in Table 2.

$$\text{Heating cable required for supports} = \frac{231 \text{ W}}{8.8 \text{ W/ft}} = 26.3 \text{ ft}$$

(D) For components:

Allow an additional 3 feet for each component. For this example, assume one power connection kit and one end seal, so total cable required for components is 6 feet.

Total Heating Cable Required = (A) + (B) + (C) + (D)

$$80 + 8.6 + 26.3 + 6 = 121 \text{ feet}$$

Table 3. Pipe Heat Loss*

Insulation thickness	Temperature differential		Pipe diameter (IPS) (inches)							
	ΔT		1/4	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2
	(°F)	(°C)	Tubing size (inches)							
			3/4	1	1 1/4	1 1/2	2			
0.5"	50	28	1.9	2.5	2.9	3.5	4.1	4.6	5.5	6.5
	100	56	3.9	5.2	6.1	7.2	8.6	9.6	11.5	13.5
	150	83	6.1	8.1	9.5	11.2	13.4	14.9	17.9	21.1
	200	111	8.5	11.3	13.2	15.6	18.6	20.7	24.9	29.2
1.0"	50	28	1.3	1.6	1.9	2.2	2.5	2.8	3.2	3.8
	100	56	2.7	3.4	3.9	4.5	5.2	5.8	6.8	7.8
	150	83	4.2	5.3	6.1	7.0	8.2	9.0	10.6	12.2
	200	111	5.8	7.4	8.4	9.7	11.3	12.4	14.6	16.9
	250	139	7.6	9.7	11.0	12.7	14.8	16.3	19.1	22.1
1.5"	50	28	1.1	1.3	1.5	1.7	1.9	2.1	2.4	2.8
	100	56	2.2	2.8	3.1	3.5	4.0	4.4	5.1	5.8
	150	83	3.5	4.3	4.8	5.5	6.3	6.9	8.0	9.1
	200	111	4.8	5.9	6.7	7.6	8.7	9.5	11.0	12.6
	250	139	6.3	7.8	8.7	9.9	11.4	12.4	14.4	16.5
	300	167	7.9	9.7	11.0	12.4	14.3	15.6	18.1	20.6
	350	194	9.6	11.9	13.3	15.1	17.4	19.0	22.0	25.1
2.0"	50	28	0.9	1.1	1.3	1.4	1.6	1.8	2.0	2.3
	100	56	2.0	2.4	2.7	3.0	3.4	3.7	4.2	4.8
	150	83	3.1	3.7	4.2	4.7	5.3	5.8	6.6	7.5
	200	111	4.3	5.2	5.8	6.5	7.4	8.0	9.2	10.4
	250	139	5.6	6.8	7.5	8.5	9.6	10.4	12.0	13.5
	300	167	7.0	8.5	9.4	10.6	12.1	13.1	15.0	17.0
	350	194	8.5	10.3	11.5	12.9	14.7	15.9	18.2	20.6
2.5"	50	28	0.9	1.0	1.2	1.3	1.4	1.6	1.8	2.0
	100	56	1.8	2.2	2.4	2.7	3.0	3.3	3.7	4.2
	150	83	2.8	3.4	3.7	4.2	4.7	5.1	5.8	6.5
	200	111	3.9	4.7	5.2	5.8	6.5	7.0	8.0	9.0
	250	139	5.1	6.1	6.8	7.6	8.5	9.2	10.5	11.7
	300	167	6.4	7.7	8.5	9.5	10.7	11.5	13.1	14.7
	350	194	7.8	9.3	10.3	11.5	13.0	14.0	15.9	17.9
3.0"	50	28	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.8
	100	56	1.7	2.0	2.2	2.4	2.7	2.9	3.3	3.7
	150	83	2.6	3.1	3.4	3.8	4.3	4.6	5.2	5.8
	200	111	3.6	4.3	4.8	5.3	5.9	6.4	7.2	8.0
	250	139	4.8	5.7	6.2	6.9	7.8	8.3	9.4	10.5
	300	167	6.0	7.1	7.8	8.7	9.7	10.4	11.8	13.2
	350	194	7.3	8.6	9.5	10.5	11.8	12.7	14.3	16.0
4.0"	50	28	0.7	0.9	0.9	1.0	1.1	1.2	1.4	1.5
	100	56	1.5	1.8	2.0	2.1	2.4	2.5	2.9	3.2
	150	83	2.4	2.8	3.0	3.4	3.7	4.0	4.4	4.9
	200	111	3.3	3.9	4.2	4.6	5.2	5.5	6.2	6.8
	250	139	4.3	5.1	5.5	6.1	6.7	7.2	8.1	8.9
	300	167	5.4	6.3	6.9	7.6	8.5	9.0	10.1	11.2
	350	194	6.6	7.7	8.4	9.3	10.3	11.0	12.3	13.6

Table 4. Insulation factors

Preformed pipe insulation	Insulation factor (f)	K factor at 50°F mean temp. (BTU/hr - °F - ft ² /in)*
Glass fiber (ASTM C547)	1.00	.25
Calcium silicate (ASTM C533)	1.48	.37
Cellular glass (ASTM C552)	1.48	.33
Rigid cellular urethane (ASTM C591)	0.64	.16
Foamed elastomer (ASTM C534)	1.16	.29
Mineral fiber blanket (ASTM C553)	1.16	.30
Expanded perlite (ASTM C610)	1.90	.48

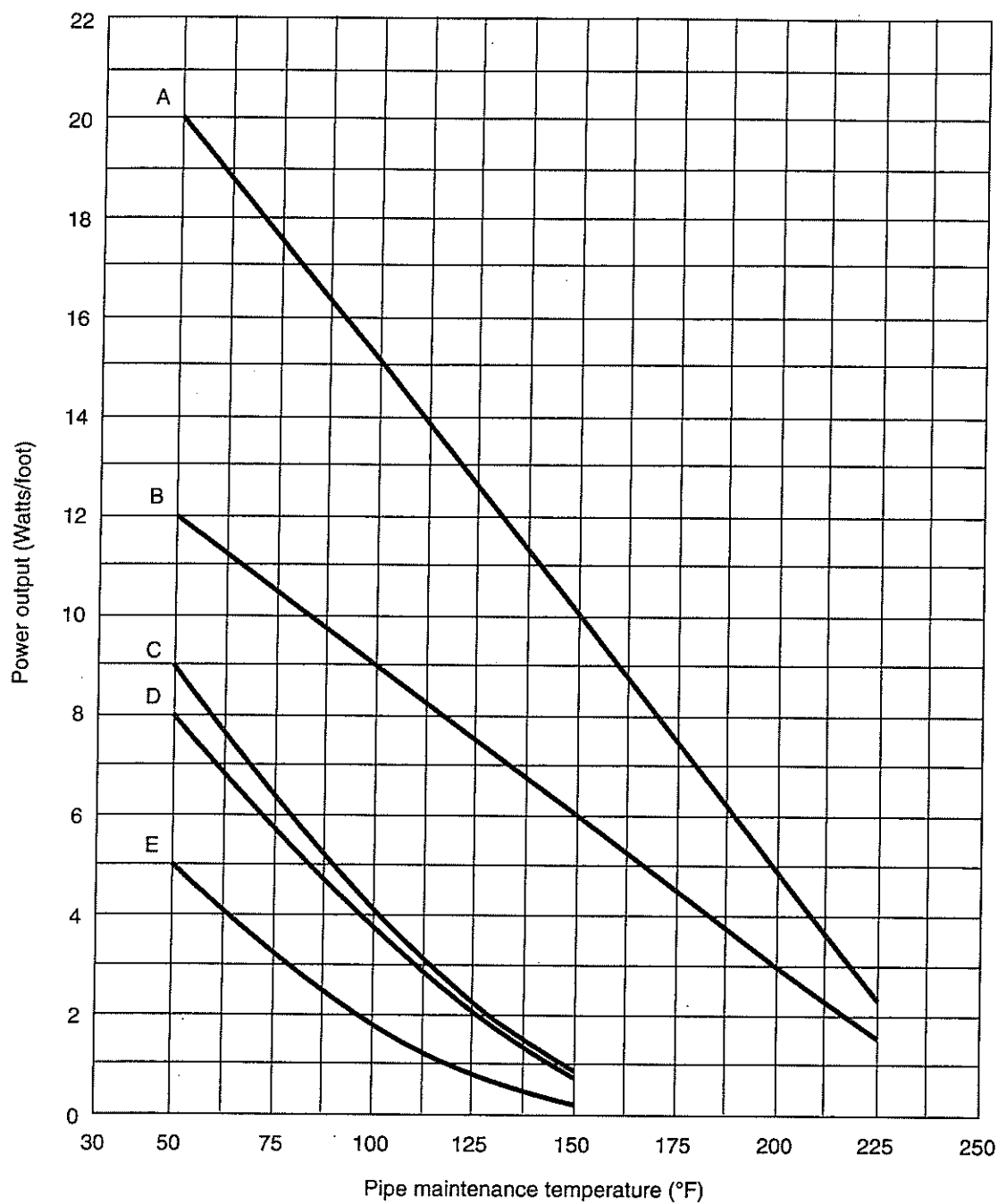
*Insulation manufacturers may publish different K-factors.

3	3 1/2	4	6	8	10	12	14	16	18	20	24
7.7	8.6	9.6	13.6	17.4	21.4	25.2	27.5	31.3	35.0	38.8	46.2
16.0	18.0	20.0	28.4	36.3	44.6	52.5	57.4	65.2	73.0	80.8	96.3
25.0	28.1	31.2	44.3	56.6	69.6	81.9	89.5	101.7	113.8	126.0	150.2
34.6	39.0	43.3	61.5	78.6	96.6	113.6	124.2	141.1	158.0	174.8	208.5
4.4	4.9	5.4	7.5	9.4	11.5	13.5	14.7	16.6	18.6	20.5	24.4
9.1	10.2	11.2	15.6	19.7	24.0	28.1	30.6	34.7	38.7	42.8	50.9
14.2	15.9	17.5	24.3	30.7	37.4	43.8	47.8	54.1	60.4	66.7	79.4
19.7	22.0	24.2	33.7	42.5	51.9	60.7	66.2	75.0	83.8	92.5	110.0
25.8	28.7	31.7	44.0	55.6	67.9	79.4	86.6	98.1	109.6	121.0	143.9
3.2	3.6	3.9	5.3	6.7	8.1	9.4	10.2	11.5	12.9	14.2	16.8
6.7	7.4	8.1	11.1	13.9	16.8	19.6	21.3	24.0	26.8	29.5	35.0
10.5	11.6	12.7	17.3	21.6	26.2	30.5	33.2	37.5	41.8	46.1	54.6
14.5	16.1	17.6	24.0	30.0	36.3	42.3	46.0	52.0	57.9	63.8	75.7
19.0	21.0	23.0	31.4	39.2	47.5	55.3	60.2	68.0	75.7	83.5	99.0
23.8	26.3	28.8	39.3	49.2	59.6	69.3	75.4	85.1	94.9	104.6	124.0
28.9	32.0	35.0	47.8	59.8	72.4	84.3	91.7	103.5	115.4	127.2	150.8
2.6	2.9	3.1	4.2	5.2	6.3	7.3	7.9	8.9	9.9	10.9	12.9
5.5	6.0	6.6	8.8	10.9	13.1	15.2	16.5	18.6	20.7	22.8	26.9
8.5	9.4	10.2	13.8	17.0	20.5	23.8	25.8	29.0	32.3	35.5	42.0
11.8	13.0	14.2	19.1	23.6	28.4	32.9	35.7	40.2	44.7	49.2	58.2
15.5	17.0	18.5	24.9	30.9	37.2	43.1	46.7	52.6	58.5	64.3	76.1
19.4	21.3	23.2	31.2	38.7	46.6	54.0	58.6	65.9	73.3	80.6	95.3
23.6	25.9	28.3	38.0	47.1	56.6	65.6	71.2	80.2	89.1	98.1	115.9
2.3	2.5	2.7	3.6	4.4	5.2	6.1	6.6	7.4	8.2	9.0	10.6
4.7	5.2	5.6	7.4	9.1	10.9	12.6	13.7	15.3	17.0	18.7	22.0
7.4	8.1	8.7	11.6	14.2	17.0	19.7	21.3	23.9	26.5	29.1	34.3
10.2	11.2	12.1	16.1	19.7	23.6	27.2	29.5	33.1	36.7	40.3	47.5
13.3	14.6	15.8	21.0	25.8	30.9	35.6	38.6	43.3	48.0	52.8	62.2
16.7	18.3	19.8	26.3	32.3	38.7	44.6	48.4	54.3	60.2	66.1	77.9
20.3	22.2	24.1	32.0	39.3	47.1	54.3	58.8	66.0	73.2	80.4	94.7
2.0	2.2	2.4	3.1	3.8	4.5	5.2	5.6	6.3	7.0	7.6	9.0
4.2	4.6	4.9	6.5	7.9	9.4	10.8	11.7	13.1	14.5	15.9	18.7
6.6	7.1	7.7	10.1	12.4	14.7	16.9	18.3	20.5	22.6	24.8	29.2
9.1	9.9	10.7	14.0	17.1	20.4	23.4	25.3	28.3	31.4	34.4	40.4
11.9	12.9	14.0	18.3	22.4	26.6	30.6	33.1	37.1	41.0	45.0	52.8
14.9	16.2	17.5	23.0	28.1	33.4	38.4	41.5	46.5	51.4	56.3	66.2
18.1	19.7	21.3	28.0	34.1	40.6	46.7	50.5	56.5	62.5	68.5	80.5
1.7	1.8	2.0	2.5	3.1	3.6	4.1	4.4	5.0	5.5	6.0	7.0
3.5	3.8	4.1	5.3	6.4	7.5	8.6	9.3	10.3	11.4	12.4	14.5
5.5	6.0	6.4	8.3	10.0	11.8	13.4	14.5	16.1	17.8	19.4	22.7
7.6	8.3	8.9	11.4	13.8	16.3	18.6	20.0	22.3	24.6	26.9	31.4
10.0	10.8	11.6	15.0	18.1	21.3	24.3	26.2	29.2	32.2	35.2	41.1
12.5	13.5	14.6	18.8	22.6	26.7	30.5	32.8	36.6	40.3	44.1	51.5
15.2	16.5	17.7	22.8	27.5	32.4	37.1	39.9	44.5	49.0	53.6	62.6

*Pipe heat loss (QB) is shown in watts per foot.
Heat-loss calculations are based on IEEE Std. 515,
with the following provisions:

- Pipes insulated with glass fiber in accordance with ASTM C547.
- Pipes located outdoors in a 20-mph wind.
- No insulating air-space assumed between pipe and insulation.
- No insulating air-space assumed between the insulation and outer cladding.
- Inclusion of a 10% safety factor.

Graph 1. Thermal Output Ratings for HBTV/BTV and HQT/QT/VR Solid-Core Heating Cables on Insulated Metal Pipes (Nominal)

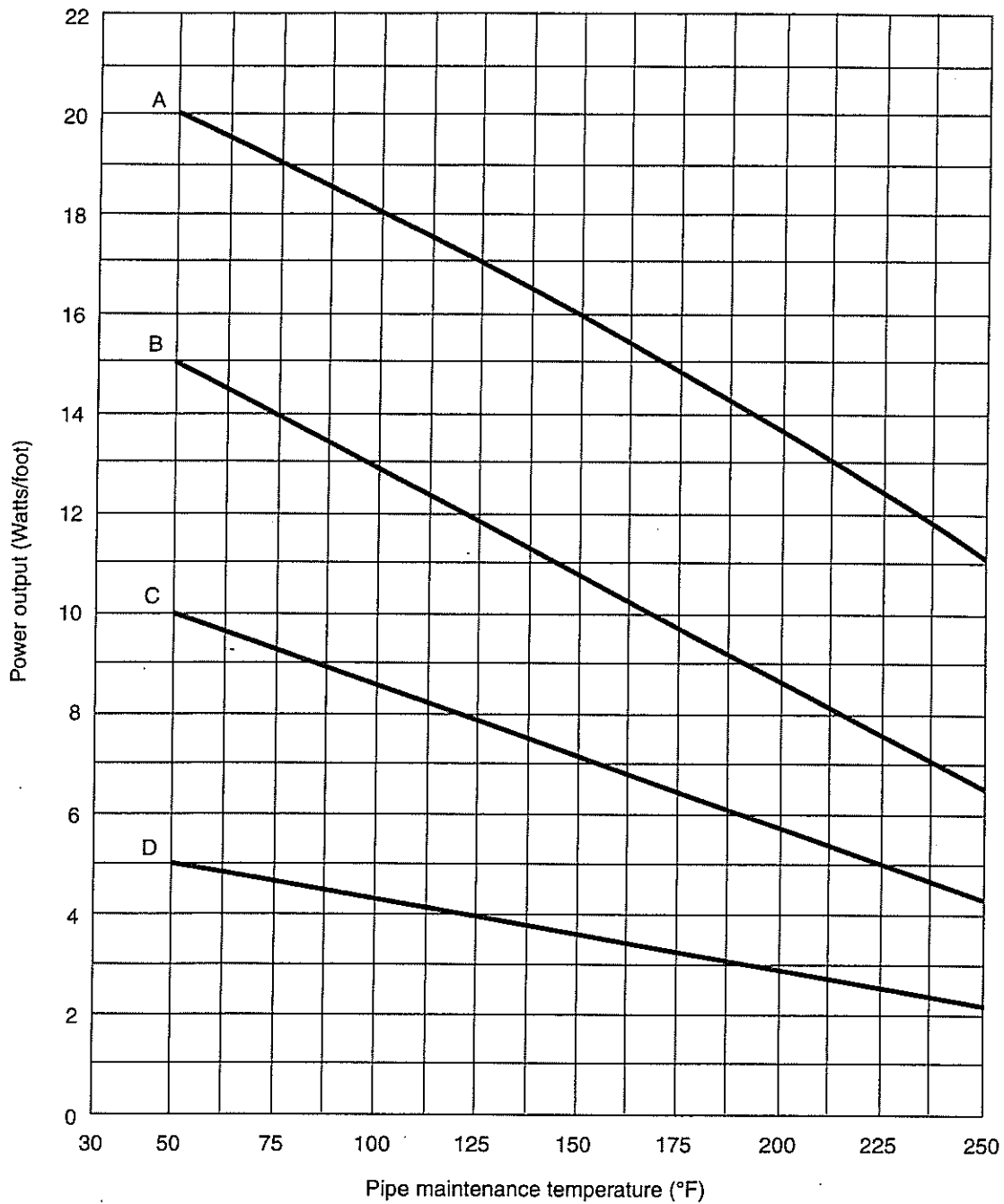


	FM Approved heating cables	CSA Certified heating cables*
A	20HQT/VR1, 2-CT	20QTVR1, 2-CT
B	12HQT/VR1, 2-CT	10QTVR1, 2-CT
C	10HBT/VR1, 2-CT	10BTV1, 2-CT
D	8HBT/VR1, 2-CT	8BTV1, 2-CT
E	5HBT/VR1, 2-CT	5BTV1, 2-CT

*Some other standard heating cables have approvals. Contact your Raychem representative or the Raychem Customer Service Center for further information.

Note: Watts/foot x 3.28 = Watts/meter
(°F-32) x 5/9 = °C

Graph 2. Thermal Output Ratings for HXTV/XTV Fiber-Wrapped Heating Cables on Insulated Metal Pipes (Nominal)



	FM Approved heating cables	CSA Certified heating cables*
A	20HXTV1, 2-CT	20XTV1, 2-CT-T2
B	15HXTV1-CT 15HXTV2-CT	15XTV1-CT-T2 15XTV2-CT-T3
C	10HXTV1, 2-CT	10XTV1, 2-CT-T3
D	5HXTV1, 2-CT	5XTV1, 2-CT-T3

*Some other standard heating cables have approvals. Contact your Raychem representative or the Raychem Customer Service Center for further information.

3. Electrical Design

Note: Ground-fault circuit interrupters (GFCIs) provide leakage current to ground trip level of 4 to 6 mA for personnel protection. Use of these devices in the place of GFEPDs may cause nuisance tripping in some circumstances and will invalidate the system approval for FM or CSA.



WARNING: Fire hazard.

There is a danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed. To comply with Raychem requirements, certifications, and national electrical codes, and to protect against the risk of fire, ground-fault equipment protection must be used on each heating cable circuit. Arcing may not be stopped by conventional circuit breakers.

3.1 Introduction

In order to comply with requirements of Raychem and the NEC, FM, and CSA, ground-fault equipment protection devices (GFEPDs) providing a minimum leakage current to ground trip level of 30 mA must be used. GFEPDs are commonly available with current over-trip ratings up to 30 A for 120, 208, and single-phase 240-Vac grounded systems. See Appendix C for Raychem recommended GFEPDs.

3.2 Special Considerations

In temperature-sensitive applications, thermostatic control may be necessary. If maximum temperature is a concern, consult the Raychem Customer Service Center for design assistance.

3.3 Circuit Breaker Selection

To determine the circuit breaker sizing, you must know the following:

- Heater type
- Total heater length

Using Table 5 on the next page, match your heating cable catalog number at the minimum startup temperature with your total heating cable length to select a circuit breaker trip rating.

Example:

In the example in Section 2.0, Step 8, the total heating cable circuit length is 121 feet. As shown in Table 5, the maximum heating cable length allowed for 8HBTV-CT powered at 240 volts with a 0°F startup temperature on a 15-A circuit breaker is 200 feet. Select the 15-A circuit breaker.

Circuit breaker trip rating: 15 A

Table 5. Circuit Breaker Selection

Circuit breaker trip ratings are based on Section 427-4 of the 1996 NEC. It says, in part, "...the rating or setting of overcurrent devices supplying fixed electric heating equipment for pipelines and vessels shall not be less than 125 percent of the total load of the heaters." Refer to Appendix B for alternative voltage adjustment factors for 240-V heaters.

Maximum Heating Cable Length (feet) vs. Circuit Breaker Trip Rating (amps)

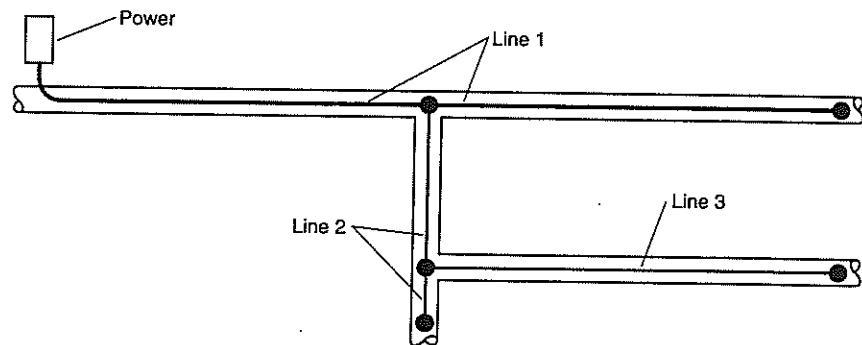
Startup temperature	120 volt					240 volt				
	15A	20A	30A	40A	50A	15A	20A	30A	40A	50A
5HBTV-CT, 5BTV-CT										
50°F (10°C)	230	270	270	270	*	460	540	540	540	*
0°F (-17.78°C)	140	185	270	270	*	280	375	540	540	*
-20°F (-28.89°C)	120	160	245	270	*	245	325	490	540	*
-40°F (-40°C)	105	145	215	270	*	215	290	435	540	*
8HBTV-CT, 8BTV-CT										
50°F (10°C)	150	200	210	210	*	300	400	420	420	*
0°F (-17.78°C)	100	130	200	210	*	200	265	400	420	*
-20°F (-28.89°C)	85	115	175	210	*	175	235	350	420	*
-40°F (-40°C)	75	105	155	210	*	155	210	315	420	*
10HBTV-CT, 10BTV-CT										
50°F (10°C)	120	160	180	180	*	240	320	360	360	*
0°F (-17.78°C)	75	105	155	180	*	155	210	315	360	*
-20°F (-28.89°C)	65	90	135	180	*	135	185	275	360	*
-40°F (-40°C)	60	80	120	165	*	120	165	245	330	*
12HQTIV-CT, 10QTIVR-CT										
50°F (10°C)	100	130	195	195	*	200	265	390	390	*
0°F (-17.78°C)	80	105	160	195	*	160	210	320	390	*
-20°F (-28.89°C)	70	95	145	195	*	145	195	295	390	*
-40°F (-40°C)	65	90	135	180	*	135	180	275	365	*
20HQTIV-CT, 20QTIVR-CT										
50°F (10°C)	60	80	120	160	195	120	160	240	320	390
0°F (-17.78°C)	45	60	95	125	160	95	125	190	255	320
-20°F (-28.89°C)	40	55	85	115	145	85	115	175	235	295
-40°F (-40°C)	40	55	80	110	135	80	110	165	220	275

* These products cannot be used with a 50 A circuit breaker, due to possible bus wire overheating, which can damage the product.

Table 5. Circuit Breaker Selection (continued)

Maximum Heating Cable Length (feet) vs. Circuit Breaker Trip Rating (amps)

Startup temperature	120 volt					240 volt				
	15A	20A	30A	40A	50A	15A	20A	30A	40A	50A
5HXTV-CT, 5XTV-CT										
50°F (10°C)	180	240	260	380	380	360	480	720	765	765
0°F (-17.78°C)	155	210	315	380	380	315	420	630	765	765
-20°F (-28.89°C)	150	200	300	380	380	300	400	600	765	765
-40°F (-40°C)	145	190	285	380	380	285	380	570	765	765
10HXTV-CT, 10XTV-CT										
50°F (10°C)	110	145	220	270	270	220	295	440	540	540
0°F (-17.78°C)	95	130	195	260	270	195	260	385	515	540
-20°F (-28.89°C)	90	120	185	245	270	185	245	370	490	540
-40°F (-40°C)	85	110	175	230	270	175	230	355	465	540
15HXTV-CT, 15XTV-CT										
50°F (10°C)	75	100	150	200	220	150	200	300	400	440
0°F (-17.78°C)	65	85	130	175	220	130	175	265	350	440
-20°F (-28.89°C)	60	80	125	165	210	125	165	250	335	420
-40°F (-40°C)	55	75	120	155	200	120	155	235	320	400
20HXTV-CT, 20XTV-CT										
50°F (10°C)	60	120	120	160	190	115	155	230	305	380
0°F (-17.78°C)	55	70	110	145	185	105	140	210	275	345
-20°F (-28.89°C)	50	70	105	140	170	100	130	200	260	330
-40°F (-40°C)	45	70	100	135	165	95	120	190	245	325



Line 1 + Line 2 + Line 3 ≤ Maximum circuit length

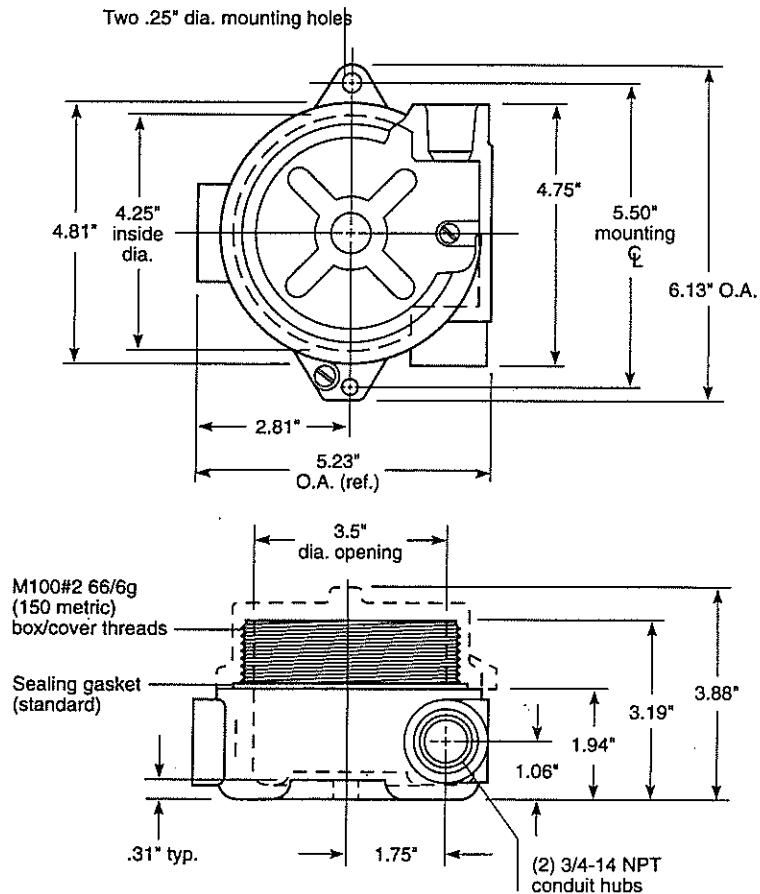
4. Components and Electrical Connections

4.1 Power Connections, Splices, Tees, and End Seals

All power connections, splices, tees, and end seals in a Division 1 location must use the HAK-C-100 connection kit, along with a Division 1 Nationally Recognized Testing Lab (NRTL) approved junction box, which must be ordered separately.

Component matrix				Additional materials required	
Connection type	Number of HAK-C-100 kits required	Number of holes required on the junction box	Junction box catalog number	Mounting brackets	Pipe straps
Power	1	2	HAK-JB2	1	1
Splice	2	2	HAK-JB2	1	1
Tee	3	3	HAK-JB3	1	1
End seal	1	1	HAK-JB2	1	1

HAK-JB2 (shown) and HAK-JB3 Junction Boxes



Note:

- HAK-JB2 and HAK-JB3 junction boxes include an approved hole plug. Kit connections are 3/4" NPT.
- Any NRTL listed junction box suitable for a hazardous area may be used. However, some junction boxes may not be compatible with the Raychem universal mounting bracket.

4.2 Core Sealing

There are two approved methods for core sealing: cold core sealing and heat-shrink core sealing. The HAK-C-100 kit includes components for each core sealing method. Raychem recommends *the cold core sealing method* for easiest installation. Sections 5.5 and 5.6 describe the kit contents and installation for this method. For those customers that want to use the heat-shrink method, the kit contents and installation method are described in Appendix D.

4.3 Attachment Tapes

GT-66 Glass Installation Tape

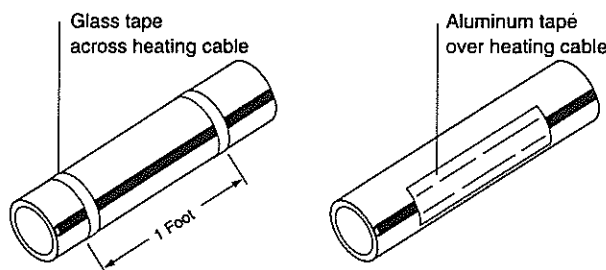
- For general use on pipes other than stainless steel
- 1/2" x 66' roll
- Temperature class: 266°F (130°C)
- Strap at 1-foot intervals
- Minimum application temperature: 40°F (4°C)

GS-54 Glass Installation Tape

- For use on stainless steel pipes
- 1/2" x 54' roll
- Temperature class: 356°F (180°C)
- Strap at 1-foot intervals
- Minimum application temperature: -40°F (-40°C)

AT-180 Aluminum Tape

- For use on pipes other than stainless steel
- 2 1/2" x 180' roll
- Temperature class: 300°F (150°C)
- Minimum application temperature: 32°F (0°C)



Tape Requirements

Tape type	Rolls needed per 100 feet of cable						
	Pipe diameter (IPS)						
	1/2"	1"	2"	3"	4"	6"	8"
GT-66	0.6	1.2	4	4	6	8	10
GS-54	0.6	1.4	4	6	6	10	12
AT-180	Use 1 foot of tape per foot of pipe.						

4.4 ETL Electric Traced Labels

For use on the outside of thermal insulation weather barrier to indicate presence of electric heat-tracing circuit.

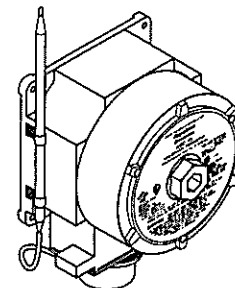
**ELECTRIC
TRACED**

Raychem

4.5 Thermostats

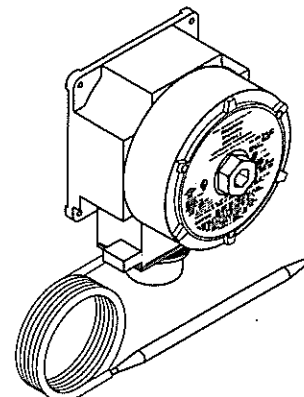
AMC-1H Ambient sensing thermostat for hazardous locations

Approvals	Hazardous locations
	Class I, Divisions 1 and 2, Groups B, C, D
	Class II, Divisions 1 and 2, Groups E, F, G
	Class III
Enclosure	NEMA 4, 7, 9 Lacquer-coated cast aluminum housing Stainless steel hardware
Sensor type	Fluid-filled (silicone) bulb and capillary
Sensor material	300 series stainless steel
Connection	Screw terminals accept #10-#14 AWG wire through 3/4" NPT conduit hub.
Range	15°F to 140°F (-9°C to 60°C)
Sensor exposure limits	-40°F to 160°F (-40°C to 71°C)
Housing exposure limits	-40°F to 160°F (-40°C to 71°C)
Switch	SPDT
Electrical rating	22 A at 125/250/480 Vac
Accuracy	±6°F (±3.3°C)
Deadband	3°F to 9°F (1.7°C to 5°C) above actuation temp.
Set point repeatability	±3°F (±1.7°C)



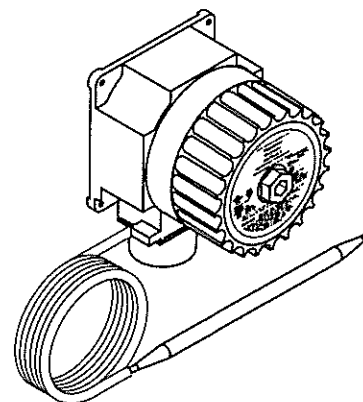
E507S-LS Line-sensing thermostat for hazardous locations

Approvals	Hazardous locations
	Class I, Divisions 1 and 2, Groups B, C, D
	Class II, Divisions 1 and 2, Groups E, F, G
	Class III
Enclosure	NEMA 4, 7, 9 Lacquer-coated cast aluminum housing Stainless steel hardware
Sensor type	Fluid-filled (silicone) bulb and 9-foot capillary
Sensor material	300 series stainless steel
Connection	Screw terminals accept #10-#14 AWG wire through 3/4" NPT conduit hub.
Range	25°F to 325°F (-4°C to 163°C)
Sensor exposure limits	-40°F to 420°F (-40°C to 215°C)
Housing exposure limits	-40°F to 160°F (-40°C to 71°C)
Switch	SPDT
Electrical rating	22 A at 125/250/480 Vac
Accuracy	±6°F (±3.3°C)
Deadband	3°F to 9°F (1.7°C to 5°C) above actuation temp.
Set point repeatability	±3°F (±1.7°C)



E507S-2LS Line-sensing thermostat for hazardous locations

Approvals	Hazardous locations
	Class I, Divisions 1 and 2, Groups B, C, D
	Class II, Divisions 1 and 2, Groups E, F, G
	Class III
Enclosure	NEMA 4, 7, 9 Lacquer-coated cast aluminum housing Stainless steel hardware
Sensor type	Fluid-filled (silicone) bulb and 9-foot capillary
Sensor material	300 series stainless steel
Connection	Screw terminals accept #10–#14 AWG wire through 3/4" NPT conduit hub.
Range	25°F to 325°F (–4°C to 163°C)
Sensor exposure limits	–40°F to 420°F (–40°C to 215°C)
Housing exposure limits	–40°F to 160°F (–40°C to 71°C)
Switch	DPST
Electrical rating	22 A at 120/240/277 Vac
Relay coil	120 Vac, 4 VA
Accuracy	±6°F (±3.3°C)
Deadband	3°F to 9°F (1.7°C to 5°C) above actuation temp.
Set point repeatability	±3°F (±1.7°C)



5. Installation



WARNING: Fire and shock hazard.

- Do not install damaged cable.
- The black heating cable core and fibers are conductive and can short. They must be properly insulated and kept dry.
- Components and cable ends must be kept dry before and during installation.

5.1 Approvals and Warranty

For the FM Approval or CSA Certification and the Raychem warranty to apply, installers must follow the instructions included in this guide. Installers must comply with all governing code requirements.

5.2 Heating Cable Installation Requirements

5.2.1 Heating Cable Storage

- Store the heating cable in a clean, dry place.
- Temperature range: -40 (40°C) to 140°F (60°C).
- Protect the heating cable from mechanical damage.

5.2.2 Preinstallation Checks

Check materials received:

- Review the heating cable design and compare the list of materials with the catalog numbers of heating cables and electrical components received to confirm that proper materials are on-site. The heating cable type is printed on its jacket.
- Inspect heating cable and components for in-transit damage. Continuity and insulation resistance (megohmmeter) testing of each reel is recommended. See Section 5.10 for a test method.

Check piping to be traced:

- Make sure all mechanical pipe testing (for example, pipe pressure test) is complete.
- Walk the system and plan the routing of the cable on the pipe.

5.3 Heating Cable Installation

5.3.1 Heating Cable Handling

Heating cable handling tips:

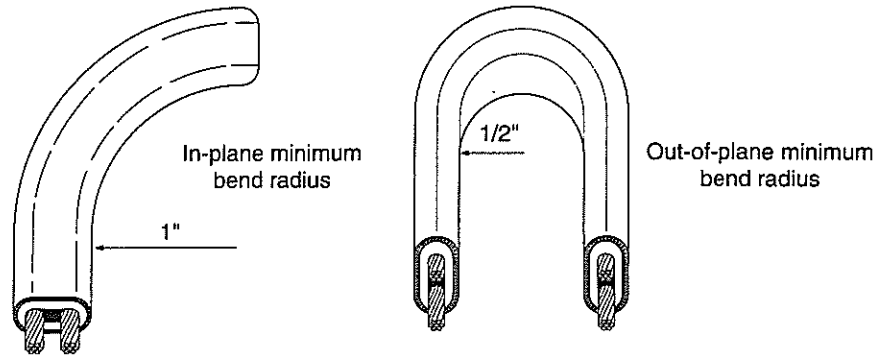
- Paint and pipe coating must be dry to the touch before heating cable installation.
- When pulling the heating cable, avoid:
 - sharp edges
 - excessive pulling force
 - kinking and crushing
 - walking on the cable or running over it with equipment

Heating cable pulling tips:

- Use a reel holder that pays out smoothly with little tension.
- Keep heating cable strung loosely but close to the pipe being traced, to avoid interference with supports and equipment.
- Leave a three-foot heating cable service loop at all power connection, splice, tee, and end seal locations.
- Add additional heating cable to trace the fittings and supports, or for spiraling as required by the design specifications. Consult Section 2.0, Thermal Design, for recommended allowances.
- Protect heating cable from moisture, contamination, and mechanical damage.

Heating cable minimum bend radius:

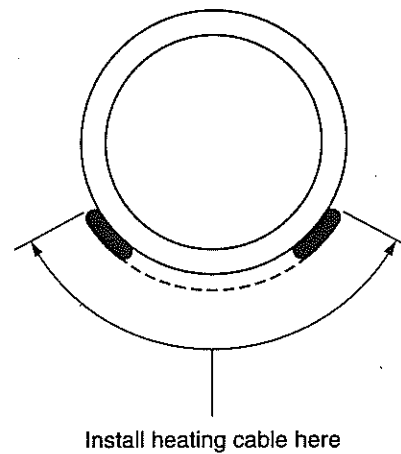
To prevent conductor damage and possible shorting, heating cable should not be bent to a radius of less than 1 inch in the in-plane direction or less than 1/2 inch in the out-of-plane direction.



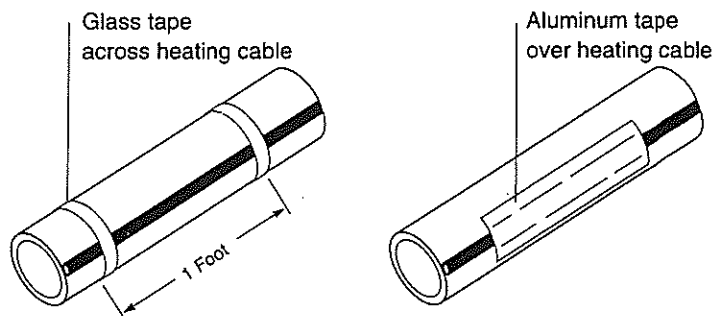
5.3.2 Heating Cable Positioning

The heating cable may be installed straight, spiraled, or in multiple runs as required by the design specification or Raychem product literature.

Install the heating cable on the lower section of the pipe (as shown) to protect it from damage, unless using the spiraling method described in Section 5.3.6.



5.3.3 Heating Cable Attachment Recommendations



5.3.4 Cutting the Heating Cable

Cut the heating cable after it is attached to the pipe. Before cutting it, confirm the tracing allowance per Section 2.3, Step 8.

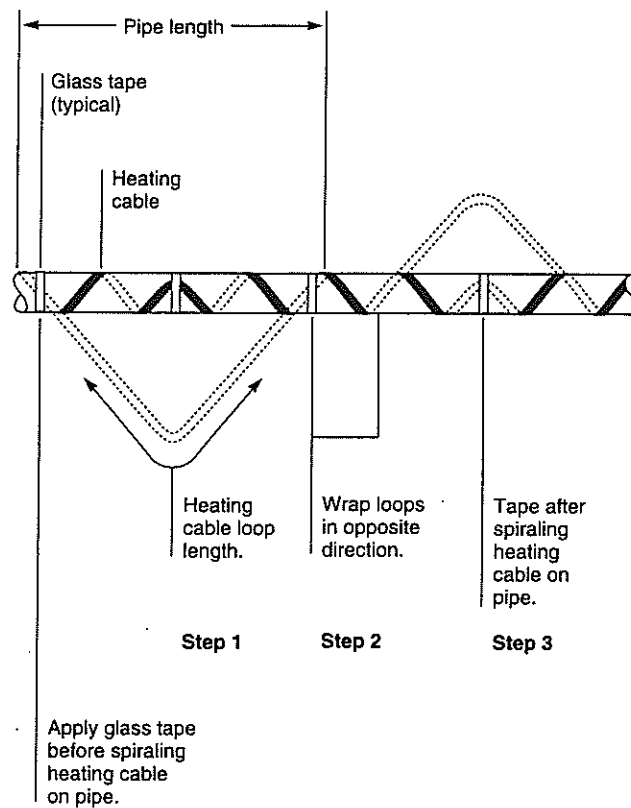
Heating cables can be cut to length without affecting the heat output per foot.

5.3.5 Typical Installation Details

Wrap pipe fittings and pipe supports as shown in the following installation details to properly compensate for higher heat-loss rates at heat sinks and to allow easy mechanical maintenance.

Consult the design specification or Raychem product literature for the tracing requirements for fittings and supports.

5.3.6 Spiraling Method



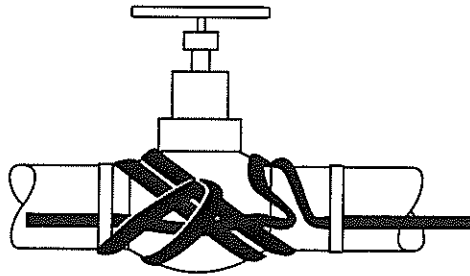
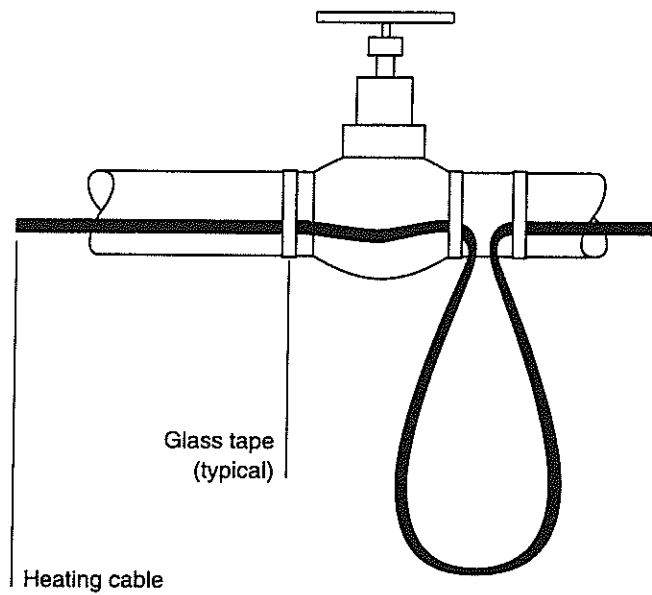
Heating cable loop length = Pipe length x Spiral factor
(see Section 2, Thermal Design)

Step 1. Make the starting heating cable loop as shown.

Step 2. Grasp heating cable loop and wind around pipe.

Step 3. Space evenly and attach to pipe.

5.3.7 Valve (typical)

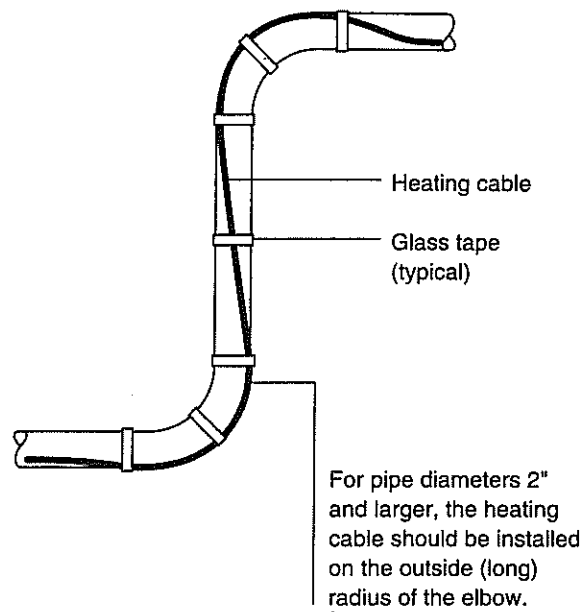


The drawing shows the general installation method. The heating cable configuration will vary for different valve shapes and pipe sizes.

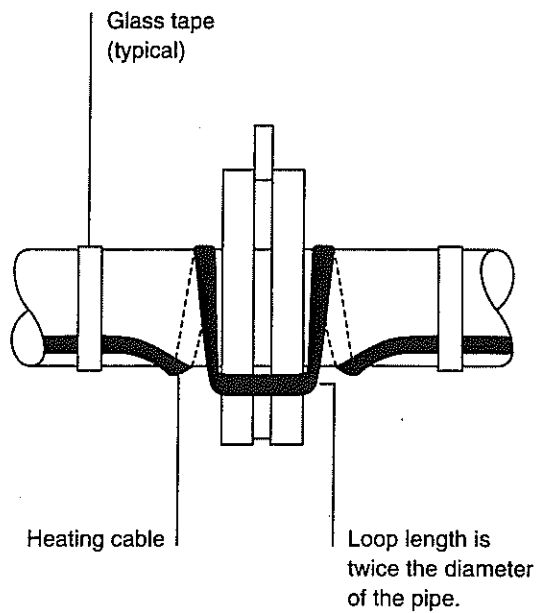
Refer to Section 5.3.1, Heating Cable Handling, for heating cable minimum bend radius.

Refer to Table 2 in Section 2, Thermal Design, for amount of heating cable to use per valve.

5.3.8 Elbow

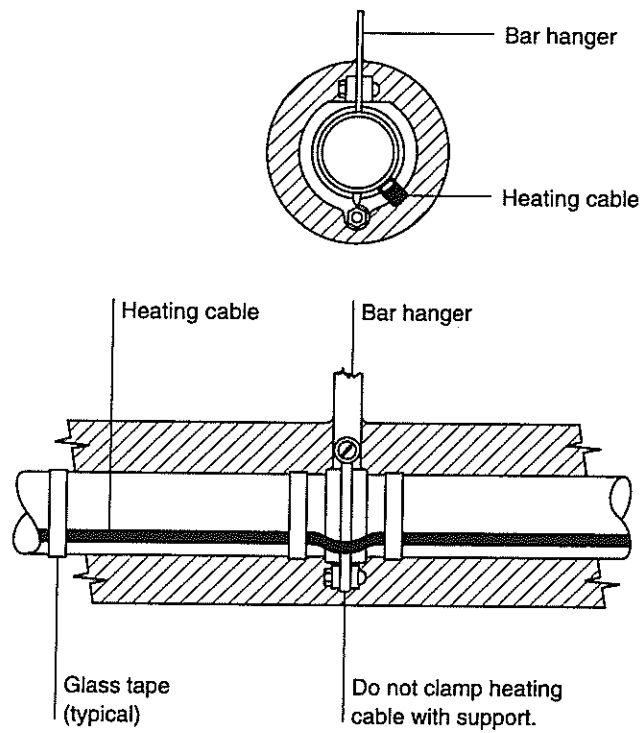


5.3.9 Flange

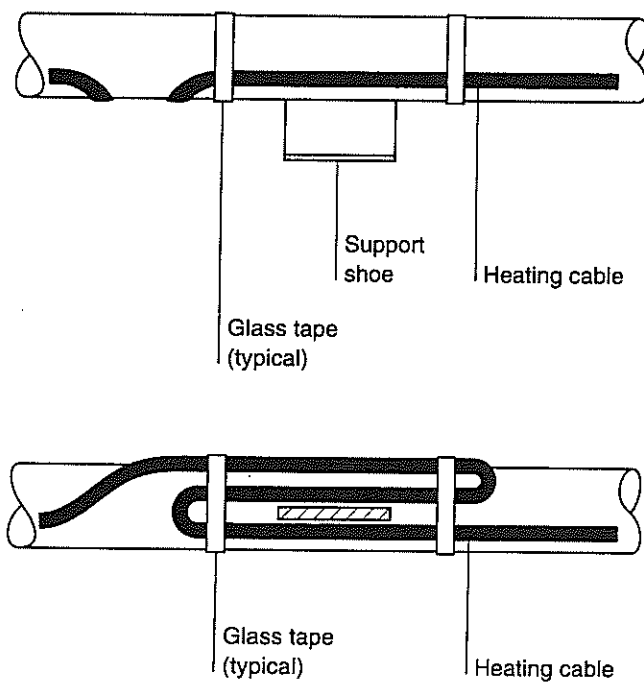


Note: Refer to page 20 for heating-cable minimum bend radius.

5.3.10 Pipe Bar Hanger



5.3.11 Pipe Support Shoe



Note: Refer to page 20 for heating-cable minimum bend radius.



WARNING: Approvals and performance are based on the use of Raychem-specified parts only. Do not substitute parts or use vinyl electrical tape.

5.4 Component Installation Requirements

The HAK-C-100 connection kit must be used in order to meet code, approval agency, and warranty requirements for Division 1 locations. Carefully follow all instructions and observe the following:

- Use only Raychem Division 1 heating cables and the correct Raychem components, as specified in this manual.
- Use a ground-fault equipment protection device for the circuit (see Section 5.9.4, GFEPD Wiring Schematics).
- Use the Installation Record, Appendix F, to ensure that the installation and checkout have been completed correctly.
- To ensure explosionproof connections, all fittings must be tight. Use recommended tools.
- Ketones and amines can dissolve the corrugated protective tubing. Protect the tubing from exposure to these chemicals wherever they may be present.
- Verify that the ambient temperature is above 32°F (0°C) before pouring seals.

5.5 HAK-C-100 Connection Kit Description

This kit includes approved components required for cold core sealing, to seal the entry of the Raychem heating cables into an approved junction box for power connections, splices, tees, and end seals. Junction box, mounting bracket, and pipe strap are ordered separately.

An optional heat-shrink core sealer kit is provided for those customers wanting this option (see Appendix D).

HAK-C-100 Kit contents:

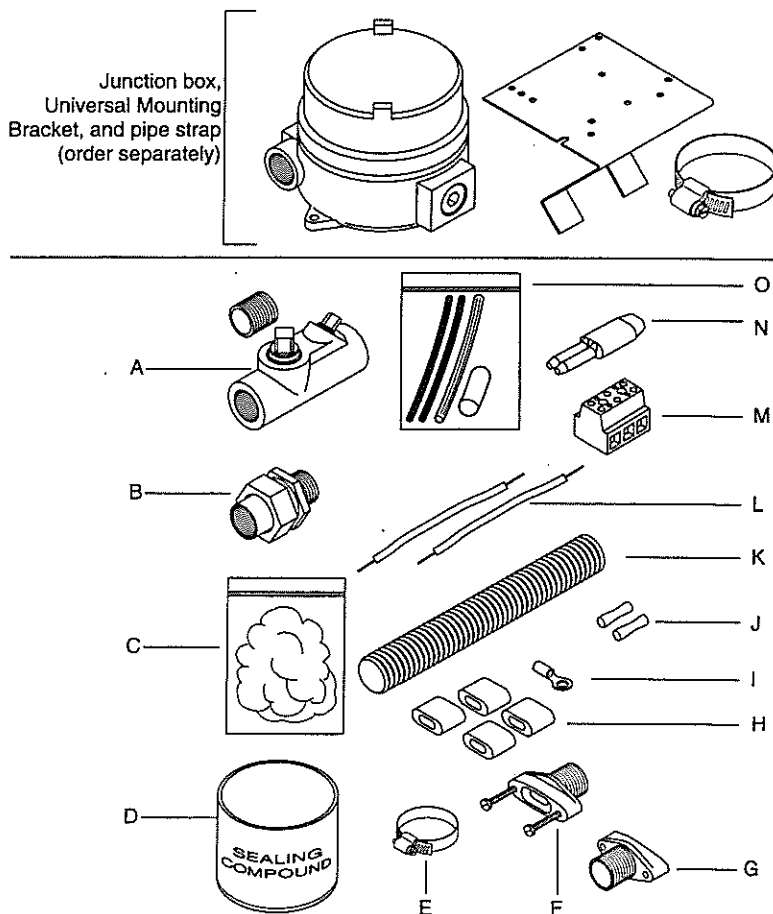
- A 1 Sealing fitting and nipple
- B 1 Union
- C 1 Packing fiber
- D 1 Sealing compound
- E 1 Tubing clamp
- F 1 Compression gland with threaded inserts
- G 1 Compression gland
- H 4 grommets (one each B, C, E, R)
- I 1 Ring terminal
- J 2 Butt connectors
- K 1 Corrugated tubing
- L 2 Cold leads
- M 1 Terminal block
- N 1 Core sealer
- O 1 Yellow/green heat-shrink tubing
- 1 Heat-shrink core sealing kit

Additional materials that may be required and are available from Raychem:

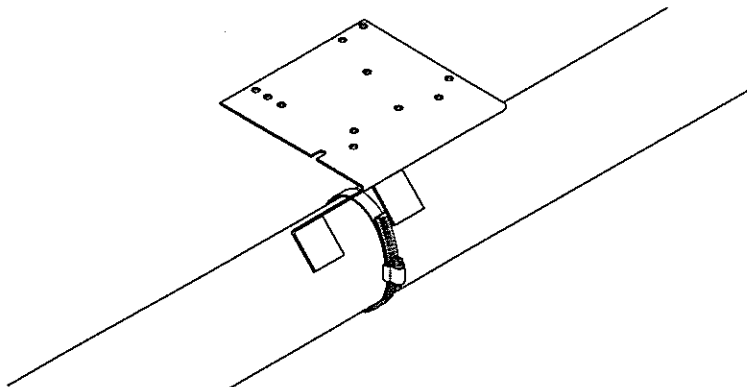
- Pipe strap, per pipe size
- Junction box
- Universal mounting bracket (UMB)
- Tape: GT-66, GS-54

Tools required:

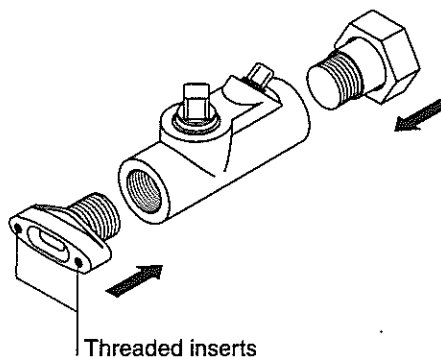
- Flatblade screwdriver
- Utility knife
- Needle nose pliers
- Wire cutters/strippers
- Pipe wrench
- Ruler
- Small volume of water
- Crimp tool - Burndy MR8-9Q
- Crimp tool - Panduit CT-100



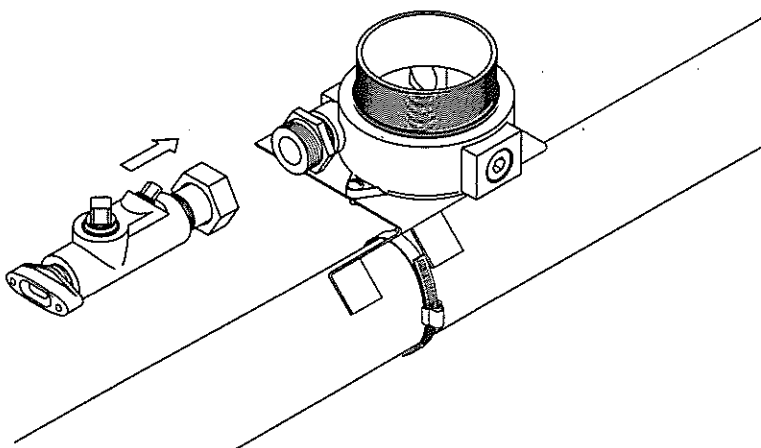
5.6 HAK-C-100 Connection Kit Installation



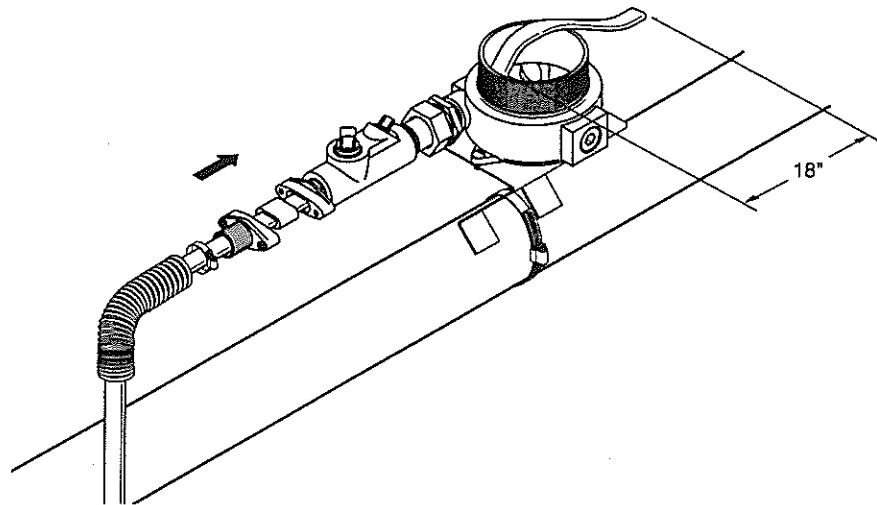
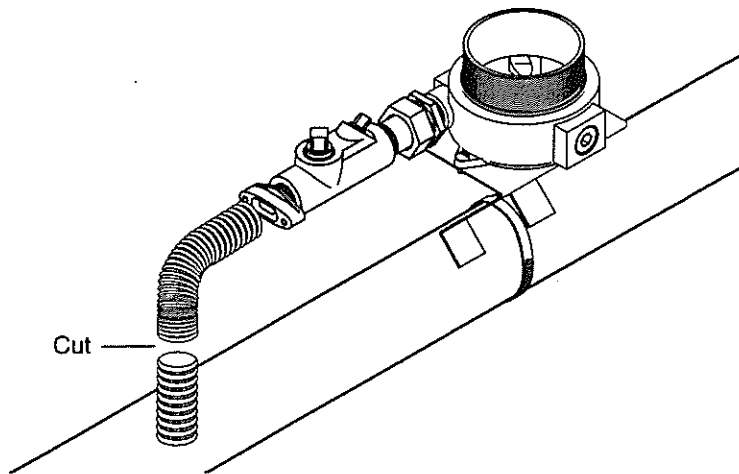
1. Fasten universal mounting bracket (UMB) on pipe, using appropriate size stainless steel pipe strap, or fabricate and locate suitable mounting plate for junction box within 24 inches of desired connection on pipe.



2. Thread compression gland half **with threaded inserts** into end of sealing fitting nearest vertical plug. Disassemble union. Thread female half of union onto nipple. Thread nipple into other end of sealing fitting nearest angled plug.



3. Thread male half of union into box entry. Assemble union halves together. Mount box on bracket.

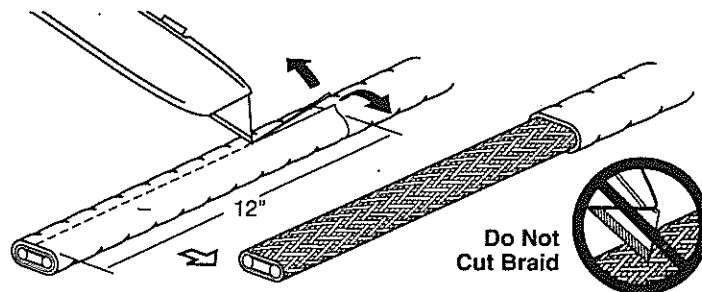


WARNING: Correct grommet must be used for heating cable being installed or electrical hazard could result.

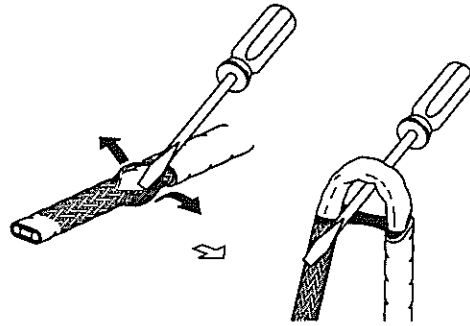
4. Corrugated tubing is provided. Measure length required to transition from compression gland to pipe surface, and cut to length.



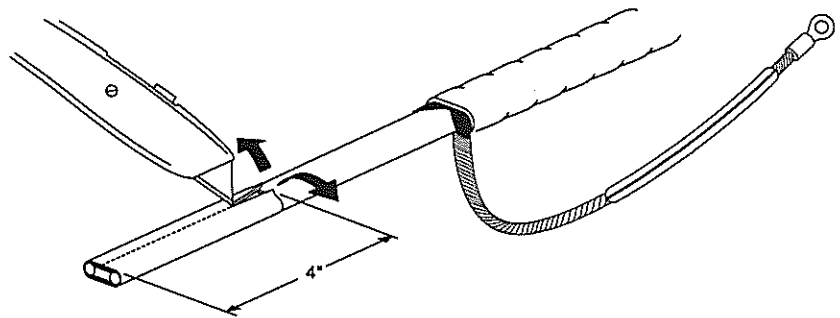
WARNING: Fire hazard.
Do not cut braid or bus wires. Damaged heating cable must be replaced.



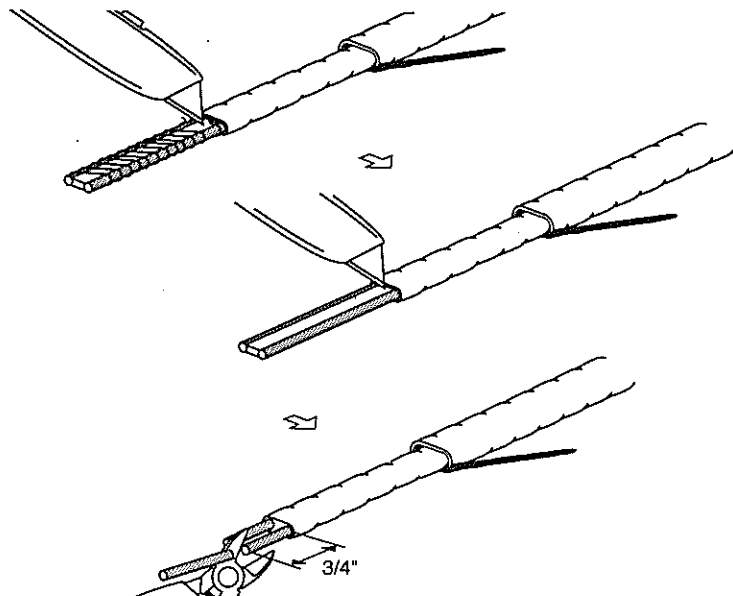
5. Being careful not to damage braid, score around outer heating cable jacket 12 inches from the end that extends out of the junction box. Score from this point to end of heating cable. Remove outer jacket.



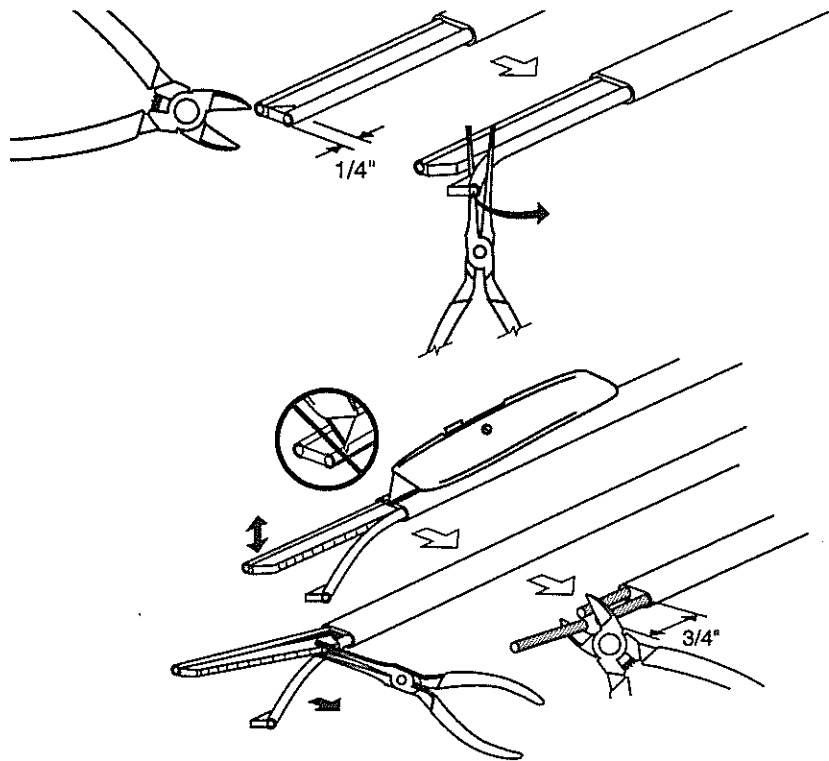
6. Using a small screwdriver as an aid, spread braid at base to expose inner jacket of heating cable. Bend heating cable at base of braid while pushing it through and working insulated heating cable out. Pull heating cable completely out of braid. Twist braid to form a tight pigtail. Slip yellow/green heat-shrink tube over braid to prevent stray braid wires from touching bus wires. Make sure yellow/green heat-shrink tube is located next to ring terminal to prevent interference with the sealing compound. Crimp ring terminal to braid pigtail using a Panduit CT-100 crimp tool. Trim braid if needed.



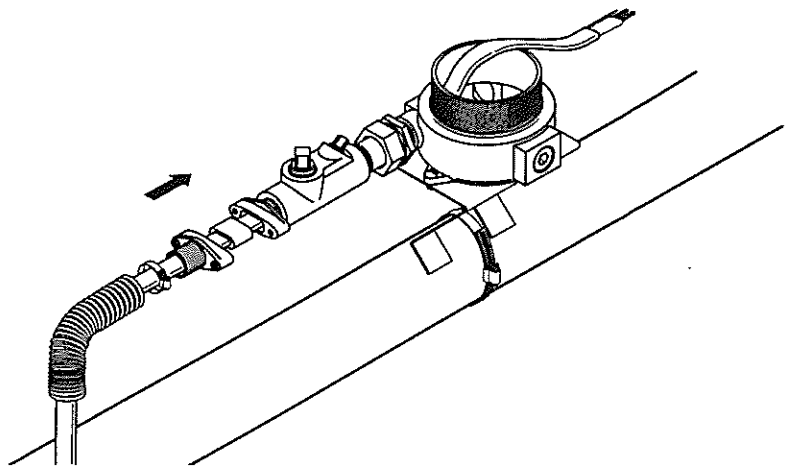
7. Score around inner jacket 4 inches from end. Score from this point to end of heating cable. Flex along score lines and remove inner jacket to expose polymer core material or fibers.



8. For fiber heating cables, cut and remove all fiber strands. Score and remove center spacer. Cut heating cable conductors to 3/4 inch. Clean bus wires.



9. For solid-core heating cables, notch core with diagonal cutters. Twist back and peel bus wire from core. Score core between bus wires at base jacket. Bend and snap core. Peel core free from bus wire. Cut heating cable conductors to 3/4 inch. Clean bus wires.



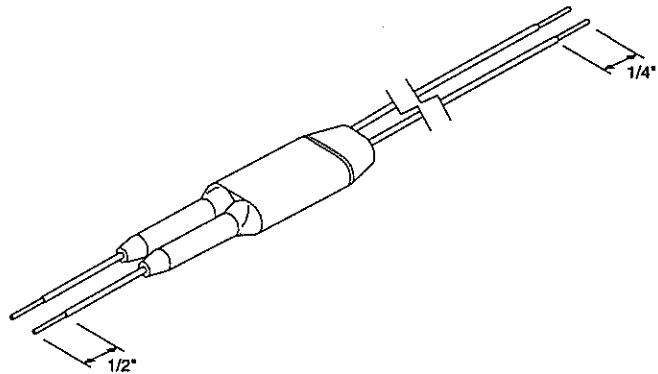
10. Slide corrugated protective tubing, tubing clamp, and other half of compression gland (without inserts) onto heating cable. Select correct grommet (see tables on the next page) and slide onto heating cable. Slide heating cable through all components and out top of junction box (see illustration). Allow 18 inches of heating cable to extend beyond box.

Heating Cable for FM Only	Grommet
5HBTV1, 2-CT	B
8HBTV1, 2-CT	C
10HBTV1, 2-CT	E
12HQT1, 2-CT	C
20HQT1, 2-CT	E
5HXTV1, 2-CT, 10HXTV1, 2-CT, 15HXTV1, 2-CT, 20HXTV1, 2-CT*	R

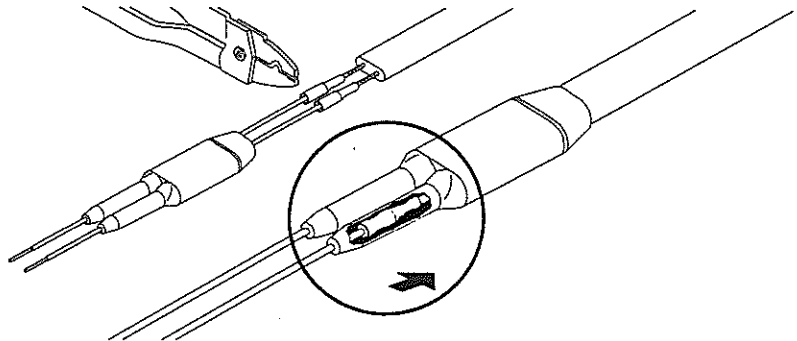
Heating Cable for CSA Only	
LBTV-CT	K
5BT1, 2-CT	B
8BT1, 2-CT	C
10BT1, 2-CT	E
10QTVR1, 2-CT	C
20QTVR1, 2-CT	E
All XTV	R

*8HXTV-CT and 18HXTV-CT are obsolete products. Call Raychem to determine "N" grommet availability for these products.

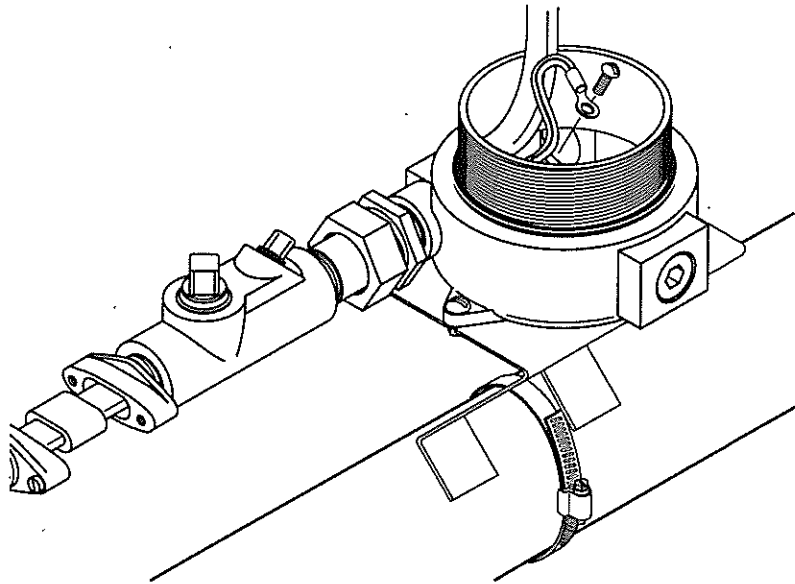
11. Following the test method outlined in Section 5.10.2 (and illustrated in Figure 1 of that section), perform an insulation resistance test on the heating cable. Record these readings in the "Insulation Resistance Testing" section of the FM Required Division 1 Installation Record, which is Appendix F of this manual.



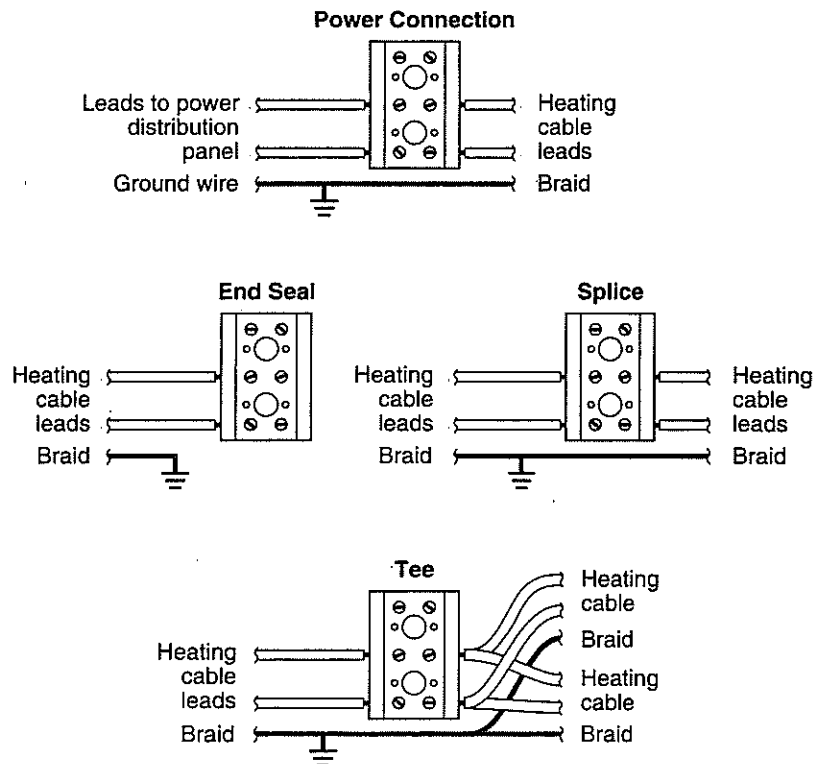
12. Slide a cold lead into each leg of the core sealer and out the other end. Strip cold lead ends to dimension shown.



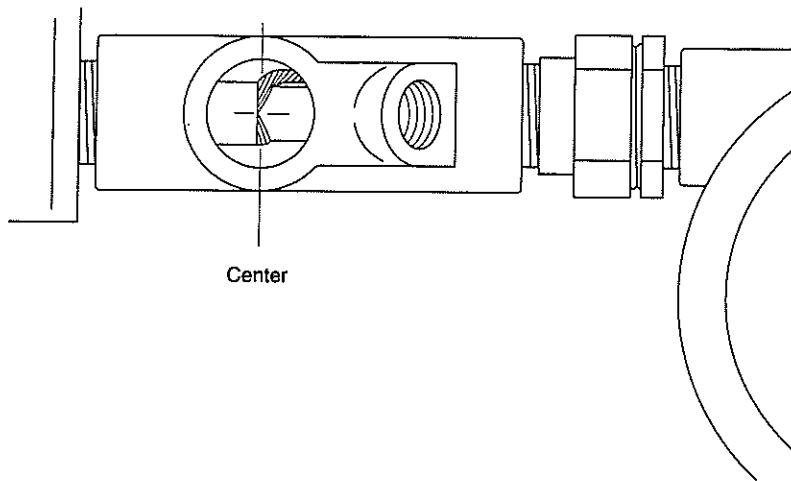
13. Crimp cold leads to heating cable bus wires, using a Burndy MR8-9Q crimp tool. Use large crimp opening for the cold lead and smaller opening for the bus wire. Slide the core sealer over crimped connectors until it bottoms out on heating cable.



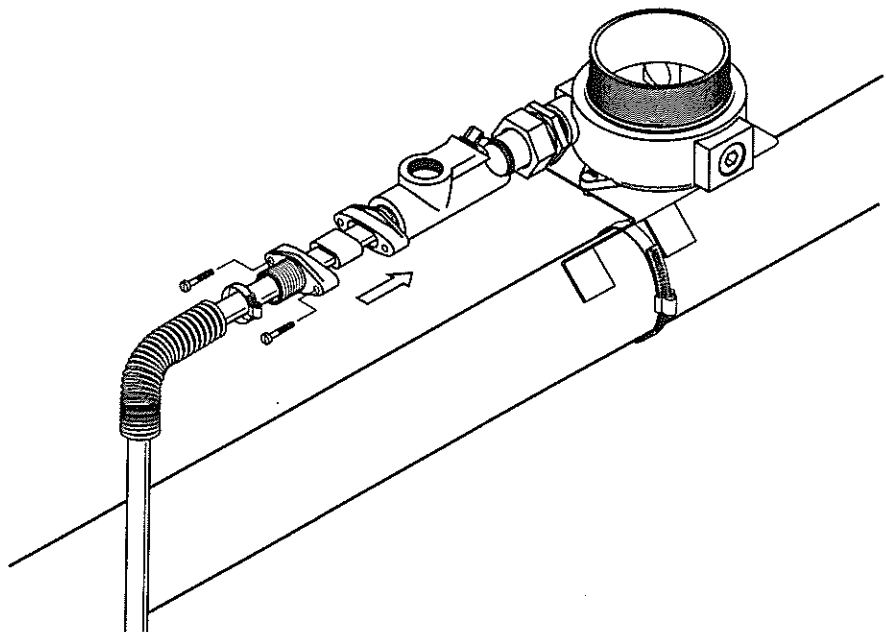
14. Fasten terminal to ground lug in junction box. Ground wire for heating cable braid must be connected to junction box ground lug.



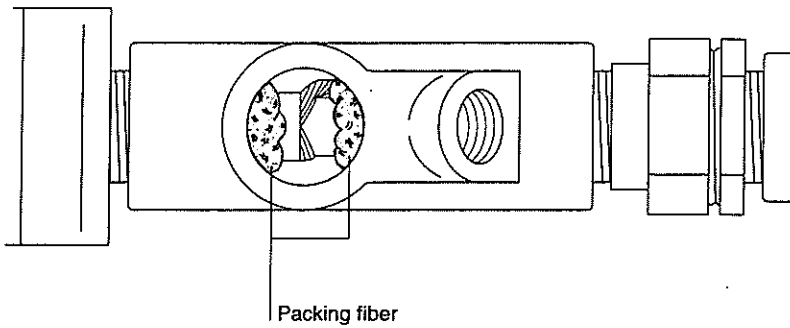
15. Make connections to terminal block. Do not connect ground wire or braid to terminal block. (Terminal block is installed "floating" in the junction box.)



16. Remove large plug from sealing fitting. Pull heating cable back through component hardware, centering end of outer jacket in sealing fitting opening. Be sure no yellow/green tubing extends into seal fitting.

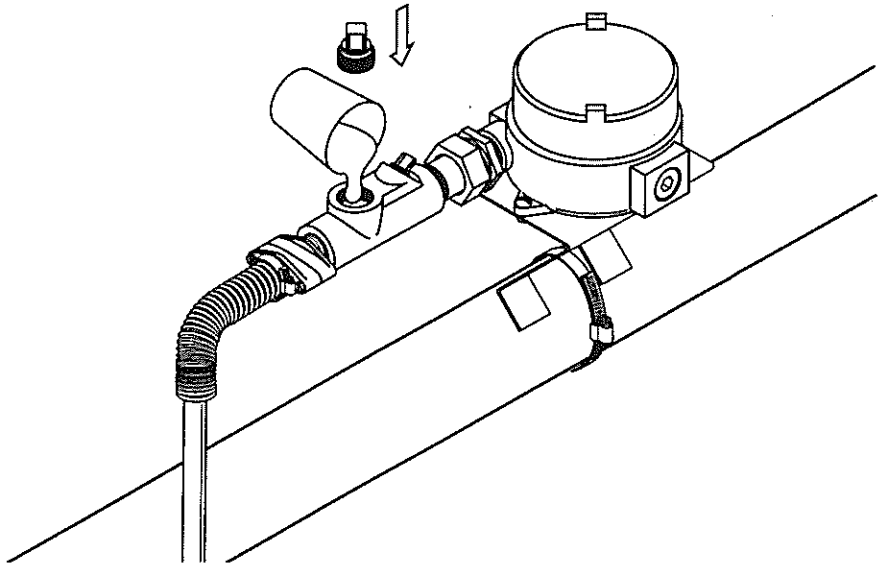


17. Position grommet in cavity. Install screws in compression gland and tighten firmly. **Be careful not to change position of heating cable in sealing fitting.** Screw corrugated tubing onto end of compression gland. Install tubing clamp.



18. Using packing fiber, pack around heating cable, forming a dam to prevent sealing compound from leaking.

Note: Make sure the insulation resistance testing is completed prior to pouring seals. Refer to Step 11 and Section 5.10.2, Figure 1.



19. Mix sealing compound according to manufacturer's recommendation on container. Sealing mixture should be a pourable paste. Pour into sealing fitting. Install fitting plug. Stow wires and terminal block in junction box and install cover.

5.7 Thermal Insulation Requirements

5.7.1 Preinsulation Checks

Visually inspect the heating cable and components for correct installation and damage. Refer to Section 6.2, Troubleshooting, for a summary of symptoms, possible causes, and recommended corrections.

5.7.2 Insulation Installation Hints

Correct temperature maintenance requires dry thermal insulation, properly installed.

Check insulation type and thickness against the design specification, or consult Raychem product literature for insulation data.

Check that all pipework—including fittings, wall penetrations, and other areas—has been completely insulated.

Insulate as soon as possible after tracing to prevent heating cable damage.

5.7.3 Marking

Mark the location of heating cable components on outside of insulation.

Install "Electric Traced" labels along piping at 10-foot (3-meter) intervals on alternate sides.

5.8 Thermostat Controls

Follow the installation instructions supplied with the thermostat. Use the proper wiring diagram for the heating cable layout and control method desired. Wire the thermostat using the normally closed (NC) terminals so that the contacts close with falling temperature.

5.9 Power Supply and Electrical Protection Requirements

5.9.1 Voltage Rating

Make sure that the heating cable voltage rating is suitable for the available service voltage.

5.9.2 Electrical Loading

Size overcurrent protective devices according to the design specification or applicable Raychem product literature. If devices other than those specifically identified are used, consult the factory for the appropriate sizing information.

5.9.3 Ground-Fault Protection

Use ground-fault equipment protection devices with a 30-mA trip level.

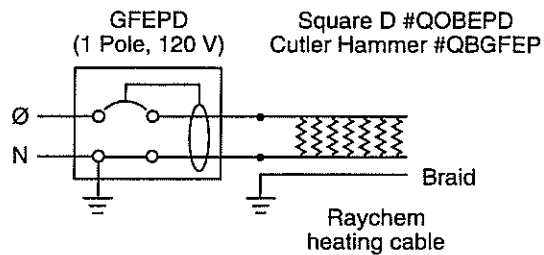
5.9.4 GFEPD Wiring Schematics



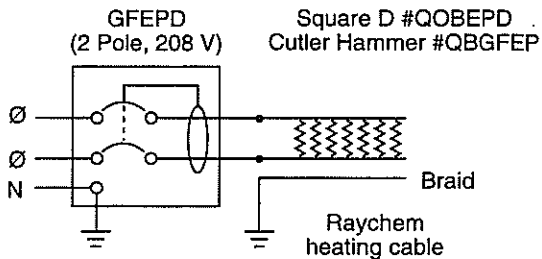
WARNING: Fire hazard.

There is a danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed. To comply with Raychem requirements, certifications, and national electrical codes, and to protect against the risk of fire, ground-fault equipment protection must be used on each heating cable circuit. Arcing may not be stopped by conventional circuit breakers.

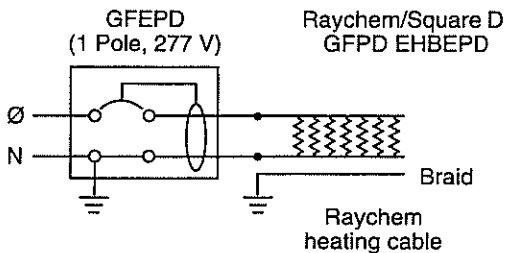
120 Vac
Schematic



208/240 Vac
Schematic



277 Vac
Schematic



5.10 Heating Cable Testing

5.10.1 Insulation Resistance Testing

Insulation resistance testing with a megohmmeter should be conducted before installation, before thermal insulation, after insulation, before powering the circuits, and as part of the periodic system inspection routine. A 2500 Vdc tester should be used.

First measure the resistance between the heating cable bus wires and the braid (Test A), then measure the resistance between the braid and the metal pipe (Test B).

Insulation resistance testing is a reliable indicator of the electrical integrity of the system when all the installation instructions are properly followed.

5.10.2 Test Method

Connect the test as shown below:



WARNING: Fire hazard.
Megohmmeter test can produce sparks. Be sure there are no flammable vapors in the area before performing this test.

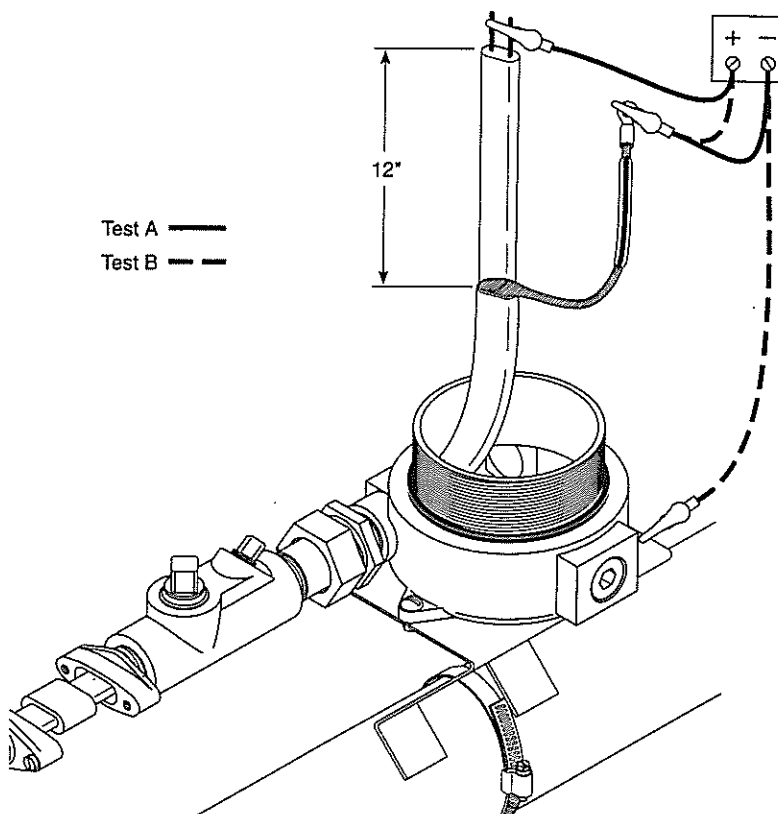


Figure 1. Insulation Resistance Test

Important: Be sure to isolate the braid from ground before performing Test B. To perform Test B after sealing compound is poured into sealing fitting (as braid may contact sealing fitting or junction box), see Figure 2, Postinsulation Resistance Test, on the next page.

Tests A and B should each be performed at three voltages—500, 1000, and 2500 Vdc. If there is variation between these readings, refer to Section 6.2, Troubleshooting. Record the A and B insulation resistance values at 2500 Vdc in Appendix F.

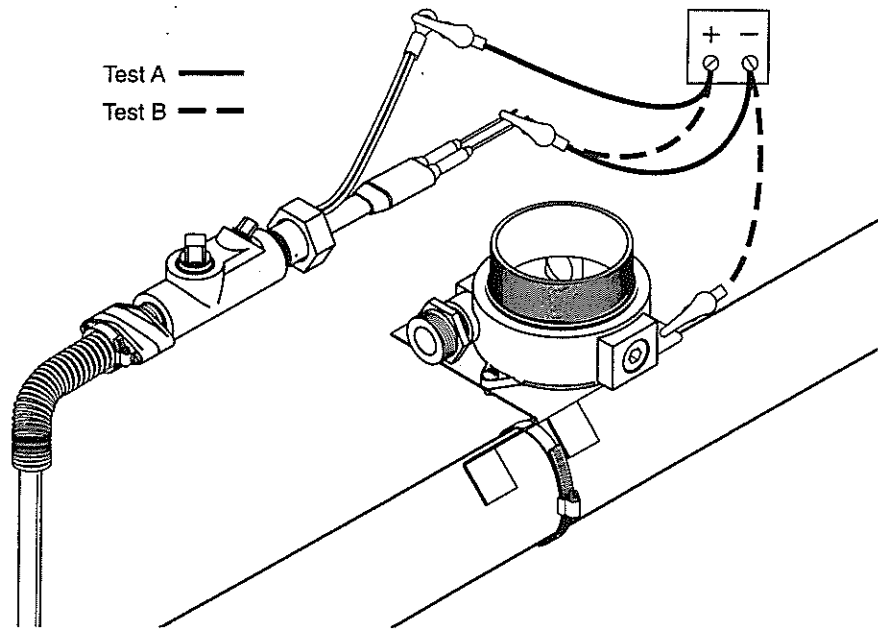


Figure 2 . Postinsulation Resistance Test

Disconnect braid and bus wires from terminals, disconnect union and pull cable out of the junction box, isolate the assembly from ground and conduit, and test as shown.

When reinstalling assembly in the junction box, be sure core sealer is fully installed over the heating cable.

5.10.3 Insulation Resistance Criteria

A clean, dry, properly installed circuit should measure thousands of megohms, regardless of heating cable length or measuring voltage (0–2500 Vdc). The following criteria are provided to assist in determining acceptability of an installation where optimum conditions may not apply.

- All insulation resistance values should be greater than or equal to 1000 megohms.
- Insulation resistance values from Test A, for any particular circuit, should not vary more than 25% as a function of measuring voltage.
- Insulation resistance values from Test B, for any particular circuit, should not vary more than 25% as a function of measuring voltage.

If any of the above conditions is not met, consult Section 6.2, Troubleshooting, for further details.

6. Operation, Maintenance, and Repair



WARNING: Damaged heating cable or components can cause electrical shock, arcing, and fire. Do not attempt to repair or energize damaged cable. Remove damaged sections at once and replace them with a new length using the appropriate Raychem splice kit.

6.1 Operation and Inspection

6.1.1 Heating Cable Operation

Temperature exposure must not exceed that specified in Raychem product literature. Exceeding those limitations will shorten product service life.

Pipe insulation must be complete and dry to maintain the correct temperature.

6.1.2 Periodic Inspection

Visual inspection: Heating cable and pipe insulation should be checked periodically to make sure that no physical damage has occurred.

Insulation resistance testing: The system should be tested once a year in accordance with the instructions for the Postinsulation Resistance Test in Section 5.10.2, Figure 2.

Functional testing of electrical protection and temperature control systems should be done as necessary.

The Inspection Record (Appendix G) should be filled out during maintenance of each circuit in the system.

6.1.3 Piping System Repair and Maintenance

During pipe repair work, disconnect heating cable circuits and protect heating cables from mechanical or thermal damage.

Check heating cable installation after pipe repairs and restore thermal insulation following the recommendations in Section 5.7. Ensure that electrical protection devices are working properly.

6.1.4 Heating Cable Damage

Do not repair damaged heating cable. Remove entire damaged section and splice in a new length, using Raychem HAK-C-100 kits.

Refer to Section 6.2, Troubleshooting, for a summary of symptoms, possible causes, and recommended corrections.

6.2 Troubleshooting

Symptoms	Probable Causes	Correction
Insulation resistance is less than expected or varies with voltage (500, 1000, 2500 Vdc).	Nicks or cuts in heating cable, with or without moisture present. Short between braid and heating cable core or braid and pipe.	Check all connections in power, splice, tee, and end seal kits for cuts in heating cable jackets, or for improper stripping distances. Restrip heating cable to remove damaged areas or establish proper distances. If heating cable is not yet insulated, visually inspect for damage, especially at elbows and flanges and around valves. If system is insulated, disconnect heating cable section between power kits, splices, etc., and test again to isolate damaged section of cable. Use Raychem DET2200 fault locator or other appropriate device to locate fault. Replace damaged heating cable sections.
Meter needle oscillates rapidly or indicates charging and discharging.	Arcing created by damage to insulation or exposed electrical parts.	Same as above.
Insulation resistance increases slowly with time.	Moisture present between energized parts.	Check all connections in power, splice, tee, and end seal kits for signs of moisture. Dry out connections and retest. Be sure all conduit entries are sealed, and that condensate in conduit cannot enter power connection boxes. If no water is present in connections, isolate sections as described in correction outlined above. If heating cable core or bus wires are exposed to large quantities of water, replace heating cable. (Drying the heating cable is not sufficient, as the power output of the heating cable can be significantly reduced.)
Insulation resistance decreases rapidly during or after the charging period.	Heavily wetted surfaces between energized parts.	Same as above.
Circuit breaker trips.	Nick or cut in heating cable or power feed wire with moisture present.	Replace damaged cable.
	Circuit breaker undersized.	Reestablish what the current loads are going to be, and resize the breaker. Do not exceed maximum circuit length for heating cable used. Check to see if existing power wire sizing is compatible with larger-size breaker.
	Circuit oversized.	Same as above.
	Start-up at too low a temperature.	Same as above.
	Defective circuit breaker.	Replace circuit breaker.
	Connections and/or splices shorting out.	To locate shorting problems, follow these steps: • Visually inspect the power connections, splices, and end seals for proper installation; correct as necessary. • Check for visual indications of damage around the valves, pump, and any area where there may have been maintenance work. • Look for crushed or damaged insulation lagging along the pipe. Replace damaged sections of heating cable. Using a megohmmeter, test per installation instructions.
	Physical damage to heating cable is causing a direct short.	Same as above.
	Bus wires connected at the end.	Check and seal junction box to ensure bus wires are secured properly in terminal block. The heating cable may have been permanently damaged by excessive current and may need to be replaced.
	Excessive moisture in connection boxes or splices.	Dry out and reseal connections and splices. Using a megohmmeter, test per installation instructions.

Symptoms	Probable Causes	Correction
Power output appears correct but pipe temperatures are below design value.	Insulation is wet.	Remove and replace with dry insulation, and secure proper weatherproofing.
	Insufficient heating cable was used on valves, supports, and other heat sinks.	Splice in additional heating cable but do not go over maximum circuit length.
	Thermostat was set incorrectly.	Reset thermostat.
	Improper thermal design.	Check with the local or factory representative for design conditions; modify as recommended.
Power output is zero or appears low.	Low or no input voltage.	Repair electrical supply lines and equipment.
	Circuit is shorter than the design shows, due to splices or tees not being connected, or the heating cable having been severed.	Check routing and length of heating cable (use "as built's"). Connect splices or tees, locate and replace the damaged heating cables, then recheck the power.
	Improper connection causing a high-resistance connection.	Recrimp with the correct procedure.
	Control thermostat is wired in normally open position.	Rewire in the normally closed position.
	Pipe is at an elevated temperature.	Reduce pipe temperature. Check the pipe temperature. Verify the power output of heating cable (see note below for method).
	Heating cable has been exposed to excessive moisture or chemicals.	Replace damaged heating cable. Check the pipe temperature. Verify the power output of heating cable (see note below for method).
	Heating cable has been exposed to excessive temperatures.	Same as above.

Note: The power output is temperature-sensitive and requires the following special procedure to determine its value:

1. Check the pipe temperature under the thermal insulation at several locations.
2. Power the heating cable and allow it to stabilize for 10 minutes, then measure current and voltage at the junction box.
3. Calculate the power (watts/ft) of the heating cable by multiplying the current by the input voltage and dividing by the actual circuit length.

$$\frac{\text{Current (amps)} \times \text{Volts (Vac)}}{\text{Length (feet)}} = \text{Power (W/ft)}$$

4. See the Thermal Output Ratings Graphs on pages 10 and 11 for expected power output at measured temperature.

7. Answers to Frequently Asked Questions

A. Product

What is “new” about Raychem’s hazardous area product offering?

- HBTv-CT products are new; we did not offer these lower-power products in the past.
- HXTv-CT products are modified and are now identical to our standard XTV-CT product offering with the exception of print logo. (**Note:** The HQTv-CT products are unchanged.)
- The connection kit has been renamed, HAK-C-100, a heat-shrink connection kit has been added, and grommets have been changed (no more “N” grommet).
- The CID1 design and installation guide has been updated.

What is “new” about the HAK-C-100 kit? How is it different from the old HAK-G-FM and HAK-G-CSA kits?

The new HAK-C-100 is exactly the same as the old HAK-G-FM kit, with two exceptions:

1. We added a heat-shrink connection kit from the HAK-G-CSA kit to the HAK-G-FM kit and basically consolidated the two connection kits into one.
2. We changed the grommets to reflect our standard grommet selection, since the new hazardous area products are identical to our standard heating cable products, with the exception of print logo.

Why does Raychem have different product names for the FM Approved hazardous area versus the CSA Certified hazardous area product line?

The FM requirements are based on IEEE 515 standards; the CSA requirements are based on CSA Standard C22.2-138. IEEE requires manufacturer review and approval of each application because IEEE wants to ensure the cables are properly installed in these areas.

When will TraceCalc software be updated to include the new hazardous area products?

TraceCalc 5-Plus and TraceCalc 5-Quick software now include the new HBTv, HQTv, HXTv products.

B. Application

What is required to get FM approval?

- Field information required for FM must be filled out (see Appendix E) and the information approved by Raychem.
- The approved FM CID1 heating cable must not exceed the T-rating for the area, or the heating cable's maximum sheath temperature must not exceed 80% (as expressed in °C) of the auto-ignition temperature (AIT) for the hazardous materials in the area.
- Postinstallation, the FM-required CID1 Installation Record (Appendix F) must be completed and sent to Raychem's Customer Service Center, where it will be kept on file.

Why is the Field Information form required?

This form is required by FM as part of their approval. It has two purposes:

1. It identifies the company and the contact person responsible for the hazardous area heat-tracing design.
2. It identifies either the T-rating for the area or the lowest AIT of the hazardous substances in the area. This information is used by Raychem to verify that the Raychem heating cable meets the area requirements.

Note: The customer must identify the T-rating for the area. If this information is not available, then the lowest AIT for the area must be identified. This section must be filled out by the person designing the system and/or the person most familiar with the hazardous location. Raychem cannot fill this section in because we cannot make any assumptions about the area being designed.

What if I don't know the AIT?

If the T-rating is not known, then identifying the lowest AIT in the area should be done by contacting the safety manager or project expert. Identifying the correct AIT is critical to ensure the safest design, and this information is required before Raychem can process the order. Raychem cannot make any assumptions about the area; therefore, this information must be obtained from the area expert.

What is the difference between the flash point and the AIT?

The flash point of a liquid is the minimum temperature at which the liquid gives off sufficient vapor to form an ignitable mixture with air near the surface of the liquid or within the test vessel used. "Ignitable mixture" means a mixture that is within the flammable range (between the upper and lower limits), and thus is capable of propagation of flame away from the source of ignition. The AIT of a substance is the minimum temperature required to cause self-sustained combustion, independently of a flame or heated element.

As an example of the difference between the flash point temperature and the AIT, gasoline is listed in the *NFPA Guide to Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids 1994 Edition* as having a flash point of -50°F (45.5°C) and an AIT of 880°F (471.1°C). This means that gasoline will form vapors at temperatures above -50°F (45.5°C). These vapors could burn if exposed to a flame. However, only if the temperature exceeds 880°F (471.1°C) will those vapors self-ignite (without being exposed to a flame).

If the heat tracing goes through a CID1 area but is terminated in an ordinary area, do you need to use hazardous area components?

If both ends of the heating cable are terminated in a CID2 area, then Raychem ordinary area industrial components can be used with the approved CID1 heating cable, subject to acceptance by the authority having approval jurisdiction. This statement is documented in the new CID1 design and installation guide in Section 1.4, page 2.

Why would customers want to use the heat-shrink core sealing method (described in Appendix D)?

In some climates, such as Alaska's, customers prefer to use heat-shrink components because they are easier to install in very cold temperatures when wearing gloves is necessary.

Why does Raychem *not* use the new cold core seal in the new HAK-C-100 connection kit?

The new cold core seal is more flexible and therefore not as robust as the sealing method designed for the hazardous area products.

What happens if the end user does not fill out the FM-required CID1 Installation Record (Appendix F) after installing the product?

The customer will not have an approved FM system. This form must be filled out and returned to the Raychem Customer Service Center to complete the approval process.

In North America, we are starting to hear about “Zone” approvals. How do these approvals relate to CID1 applications?

The NEC declares that cables certified for use in CID1 areas may be used in Zone 1 areas, and cables certified for use in CID2 areas may be used in Zone 2 areas. However, cables with Zone 1 or Zone 2 approvals are not approved for CID1 or CID2 areas, respectively.

The reason for this difference is that CID1 approvals cover hazardous areas not included in Zone 1 areas, so Zone 1-approved products may not necessarily be tested for all CID1 areas.

What indicator light solution is available for CID1 areas?

The E-100-L is not approved for CID1 areas, and currently Raychem does not offer an end-of-line indicator light for these areas. However, as we upgrade our CID1 components in the coming months, we will add this capability to those kits.

C. Installation

In the CID1 design guide, there is a new section describing the minimum bend radius. Why is the minimum bend radius important?

It is important not to bend the heating cables less than one inch in the in-plane direction or less than half an inch in the out-of-plane direction, to prevent bus wire damage.

Which products can be used on plastic pipes?

HBTV is the product that should be used on all types of standard plastic pipes. Typically, the maximum exposure temperature for PVC pipe (schedule 40) is 150°F. In some cases, plastic pipes can withstand higher temperatures, which would sometimes allow HQTV to be used. TraceCalc can be used to see if a heating cable is appropriate to be used on a particular pipe.

D. Operation and Maintenance

What is the warranty?

The standard Raychem Industrial Heat Tracing warranty. An extended warranty is offered on these products as well. A warranty package can be ordered, free of charge, through the Raychem Customer Service Center.

How can I get more information?

For answers to questions not listed here, please contact the Raychem Customer Service Center at (800) 361-4525 in the U.S. and (800) 988-5171 in Canada.

E. Logistics

Our policy on stocking these products has changed. These products can be stocked by our channel partners; however, they then must accept responsibility for getting the Field Information and the Inspection Records completed and returned to the Raychem Customer Service Center. The rep stocking the product must verify the design requirements.

Appendix A: System Approvals

FM Approval

Raychem HBTV-CT, HQTV-CT and HXTV-CT heating cables have the following approvals when used with an HAK-C-100 connection kit, and an approved junction box.

Factory Mutual
Class I, Division 1, Groups B, C, and D
Class II, Division 1, Groups E, F, and G
Class III, Division 1



Note:

HXTV-CT heating cables are FM-approved for use in Class II and Class III areas only if the individual system is specially engineered by Raychem.

CSA Certification

Raychem BTV-CT, QTVR-CT and XTV-CT heating cables are CSA Certified when used with an HAK-C-100 connection kit and an approved junction box.

Class I, Division 1, Groups B, C, and D
Class II, Division 1, Groups E, F, and G
Class III, Division 1



Appendix B: Alternate Voltage Adjustment Factors

Raychem heating cables can be used with nominal variations ($\pm 5\%$) in service voltages without causing significant changes in power output.

The table below shows the effect of alternate voltages on 240 V Raychem heating cables as compared to the nominal power output rating at 240 V. **Note:** When using circuit length adjustment factors that are greater than 1.00, do not exceed the maximum circuit lengths shown below.

Heating cable	Thermal output adjust factor	Circuit length adjustment factor	Maximum heating cable circuit length
Operating voltage: 208 Volts			
5HBT2-CT, 5BT2-CT	0.85	0.99	500 feet
8HBT2-CT, 8BT2-CT	0.89	0.93	385 feet
10HBT2-CT, 10BT2-CT	0.89	0.93	330 feet
12HQT2-CT, 10QTVR2-CT	0.85	0.98	365 feet
20HQT2-CT, 20QTVR2-CT	0.90	0.92	350 feet
5HXT2-CT, 5XT2-CT-T3	0.84	1.00	720 feet
10HXT2-CT, 10XT2-CT-T3	0.83	0.98	510 feet
15HXT2-CT, 15XT2-CT-T3	0.85	0.97	415 feet
20HXT2-CT, 20XT2-CT-T2	0.88	0.97	350 feet
Operating voltage: 277 Volts			
5HBT2-CT, 5BT2-CT	1.12	1.07	585 feet
8HBT2-CT, 8BT2-CT	1.08	1.08	465 feet
10HBT2-CT, 10BT2-CT	1.08	1.05	395 feet
12HQT2-CT, 10QTVR2-CT	1.18	1.06	410 feet
20HQT2-CT, 20QTVR2-CT	1.07	1.06	430 feet
5HXT2-CT, 5XT2-CT-T3	1.18	1.03	750 feet
10HXT2-CT, 10XT2-CT-T3	1.17	1.06	575 feet
15HXT2-CT, 15XT2-CT-T3	1.13	1.08	475 feet
20HXT2-CT, 20XT2-CT-T2	1.10	1.11	440 feet

Example:

Adjust the power output of 8HBT2-CT for a service voltage of 208 volts:

The power output of 8HBT2-CT at 40°F is 8.8 watts/ft. From the table above, the power output of 8HBT2-CT, if powered at 208 volts, is 89% of its 240-volt rating.

Adjusted power output:

$$8.8 \text{ W/ft} \times 89\% = 7.8 \text{ w/ft at 208 volts}$$

To find the maximum heating cable circuit length for 8HBT2-CT if started at 50°F and powered at 208 volts:

From the circuit breaker selection table, (Table 3), 8HBT2-CT, if started at 50°F on a 15-amp circuit breaker with a service voltage of 240 volts, has a maximum circuit length of 200 feet. From the table above, the circuit length adjustment factor for 8HBT2-CT powered at 208 volts is 0.93.

Adjusted maximum circuit length:

$$200 \times 0.93 = 186 \text{ ft at 208 volts}$$

A 15-amp breaker is acceptable.

Appendix C: Ground-Fault Equipment Protection Devices

Ground-Fault Circuit Breaker Selection Table

The following breakers are available from your local Raychem distributor.

Bolt-on style					
Manufacturer	Square D		Cutler Hammer (Westinghouse)		Raychem TraceGuard*
Voltage	120	208/240**	120	208/240**	277
15 amps	QOB115EPD	QOB215EPD	QBGFEP1015	QBGFEP2015	EHB14015EPD
20 amps	QOB120EPD	QOB220EPD	QBGFEP1020	QBGFEP2020	EHB14020EPD
30 amps	QOB130EPD	QOB230EPD	QBGFEP1030	QBGFEP2030	EHB14030EPD
40 amps	—	—	N/A	QBGFEP2040	EHB14040EPD
50 amps	—	—	N/A	QBGFEP2050	EHB14050EPD
Panelboard	NQOD	NQOD	POW-R-LINE 1	POW-R-LINE 1	NEHB
Plug-on style					
Manufacturer	Square D		Cutler Hammer (Westinghouse)		Raychem TraceGuard*
Voltage	120	208/240**	120	208/240**	277
15 amps	QQ115EPD	QQ215EPD	QPGFEP1015	QPGFEP2015	N/A
20 amps	QQ120EPD	QQ220EPD	QPGFEP1020	QPGFEP2020	N/A
30 amps	QQ130EPD	QQ230EPD	QPGFEP1030	QPGFEP2030	N/A
40 amps	—	—	N/A	QPGFEP2040	N/A
50 amps	—	—	N/A	QPGFEP2050	N/A
Panelboard	QQ Load Center	QQ Load Center	POW-R-LINE 1	POW-R-LINE 1	
Padlocks***	QQ1PA	GF12PA	QLPB123PL	QLPB123PL	GFPOHPA-EH

*Raychem's TraceGuard 277 circuit breaker is manufactured by Square D.

**Two-pole ground-fault breakers require 120 volts to power the internal electronics. 240-volt delta systems without a 120-volt neutral reference will require an additional transformer to provide the reference.

*** Padlocks are required to comply with NEC section 427-55(a) if the circuit breaker is utilized for disconnecting.

N/A = Not Available.

Note: Bell alarm contacts may be ordered through your local electrical distributor by adding a "2100" suffix to the Square D part number or a "W1" suffix to the Westinghouse part number (example: QOB120EPD2100 is a 20-amp, 120-V breaker with bell alarm contacts).

Neilsen-Kuljian Ground-Fault Sensors

A Neilsen-Kuljian ground-fault sensor may be used for:

- Ground-fault monitoring and alarm, per the exception to NEC Section 427-22
- Applications where current or voltage exceeds the ratings of available ground-fault circuit breakers
- Applications that require ground-fault trip levels other than 30 mA, such as 70 mA for VL heating cables

The Neilsen-Kuljian ground-fault sensor has a ground-fault trip level adjustable from 1 to 100 mA. As long as a detected fault persists, the normally open switch will stay closed. It can be connected to an alarm light or to the shunt-trip of a breaker. There is also an associated red light on the ground-fault sensor to indicate a fault. A green light is provided to indicate the presence of 120-Vac power. The sensor also has a built-in TEST function, which simulates the fault and confirms that the unit is operational.

Notes:

1. When using 240-volt Raychem heating cables at operating voltages of 208 or 277 volts, use the circuit length adjustment factors in Appendix B.
2. Circuit breaker trip rating should not exceed the maximum trip rating shown for heating cables of that product family.
3. All Raychem heating cables must be installed in accordance with local codes and practices.

Appendix D: Heat-Shrink Core Sealer Installation

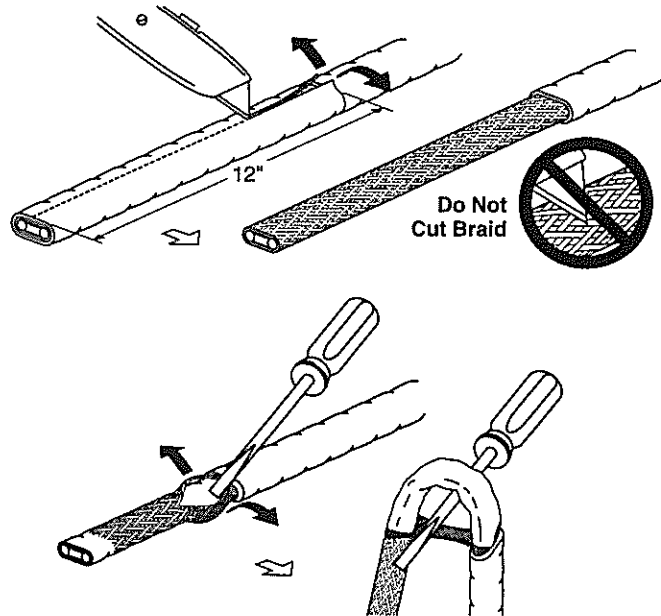
A. Heat-Shrink Kit Description

As part of the HAK-C-100 kit, an optional heat-shrink core sealer kit is provided for those customers wanting this option. The heat-shrink core sealer kit contains:

- Two 6-inch black heat-shrinkable tubes
- One 1-inch yellow heat-shrinkable tube

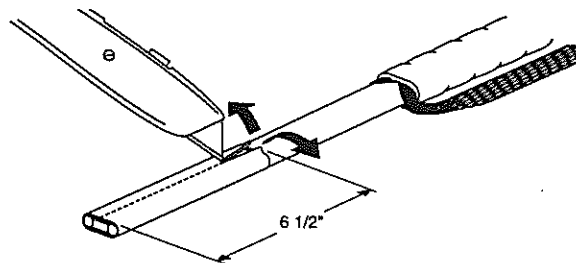
B. Installation Instructions

Follow the Section 5.6 instructions, but replace steps 5 through 9 with the following heat-shrink core sealer instructions.

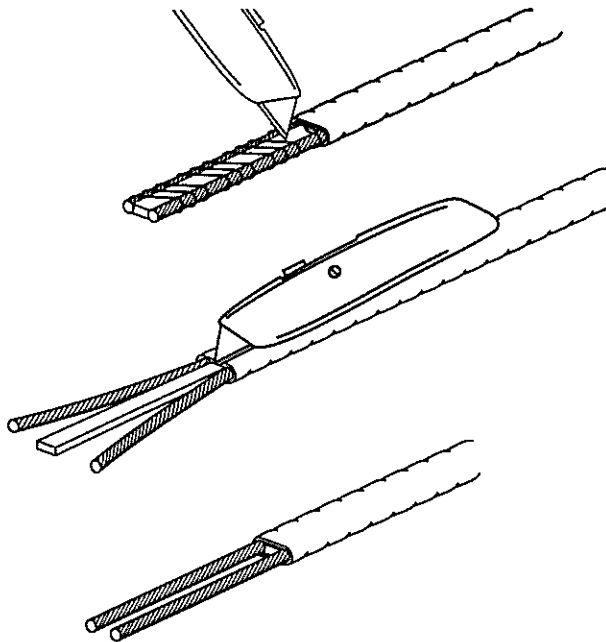


5. Score around outer heating cable jacket 12 inches from end. Score from this point to end of heating cable. Remove outer jacket, being careful not to damage braid.

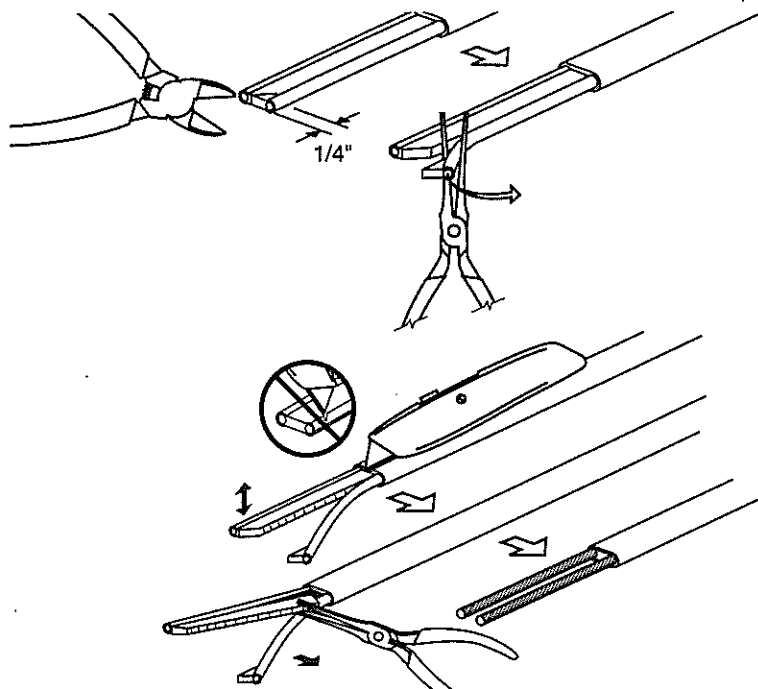
Using a small screwdriver as an aid, spread braid at base to expose inner jacket of heating cable. Bend heating cable at base of braid while pushing it through and working insulated heating cable out. Pull heating cable completely out of braid. Twist braid to form a tight pigtail.



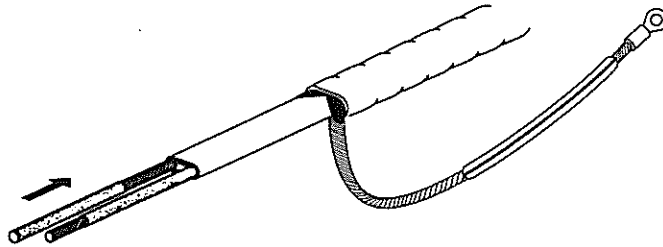
6. Score around inner heating cable jacket 6 1/2 inches from end. Score from this point to end of heating cable. Flex along score lines and remove the inner jacket to expose polymer core or fibers. Slip yellow/green heat-shrink tube over braid to prevent stray braid wires from touching bus wires.



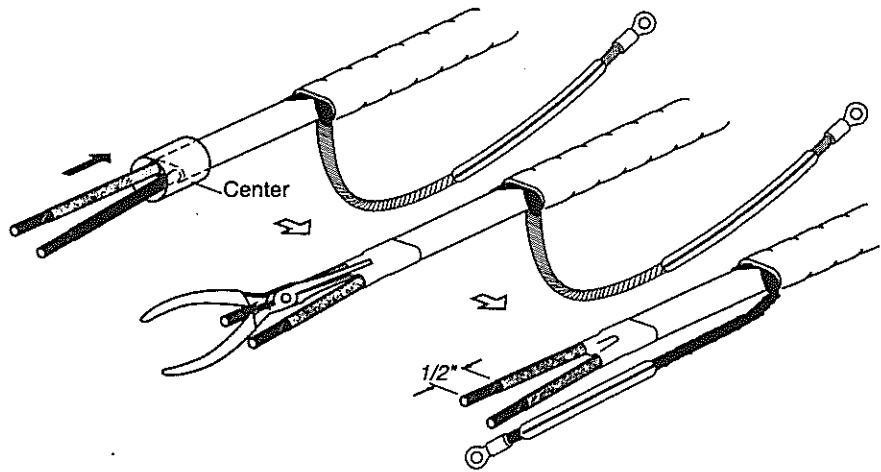
7a. For the fiber heating cables, cut and remove all fiber strands. Score and remove center spacer. Clean bus wires.



7b. For the solid core heating cables, notch core. Twist back and peel bus wire from core. Score core between bus wires at inner jacket. Bend and snap core. Peel core free from bus wire. Clean bus wires.



8. Slide on black heat-shrinkable tubes. Use heat gun or mini-torch with soft yellow flame to gently heat tubes until they shrink. Because heat guns or mini-torches can cause fire or explosion in hazardous areas, be sure there are no flammable materials or vapors in the area. Twist braid to form a tight pigtail. Slip yellow/green heat-shrink tube over braid to prevent stray braid wires from touching bus wires. Crimp ring terminal to braid pigtail using a Panduit CT-100 crimp tool. Trim braid if needed.



9. Center clear yellow tube over end of inner jacket. Heat tube until it shrinks and adhesive flows out ends. While still hot, pinch between bus wires and hold for 5 seconds. Trim wire ends to 1/2 inch.

Appendix E: Field Information Required for FM Approval

The purpose of this form is to ensure that the heat-tracing system used in the Division 1 location is appropriate for that area classification. Send this form to the Raychem Customer Service Center (fax number 650-361-6711). In the United States, the center's toll-free fax number is 1-800-527-5703. In Canada, the toll-free fax number is 1-800-988-5172.

This form must be completely filled out before the Division 1 heating cable and components can be shipped to the customer.

1) Purchase order number: _____

2) Name of person filling out this form: _____

3) Company: _____ Address: _____ Phone: (____) _____

4) How many HAK-C-100 component kits will you require? _____

5) Name and location of company where the Division 1 heating cable and components will be installed.

Company Name: _____

Address: _____

City: _____ State: _____ Zip Code: _____

Contact Person: _____ Phone: _____

6) What is the T-classification of the area? (If none, fill out questions 7 and 8.)

7) What substance in the area is influencing the decision to use Division 1 equipment? _____

8) What is the auto ignition temperature (AIT) expressed in °C, of the substance? _____

The maximum sheath temperature is 80% x AIT (expressed in °C).

Note: This section must be filled out if no T-rating is available. See Section 7.0, Answers to Frequently Asked Questions, for the definition of AIT. Appendix J references AIT temperatures for selected flammable gases and vapors.

9) Design data

Heating catalog number _____

Heating trace ratio _____

Application: pipe, vessel _____

Size: _____ Material: steel _____ plastic _____

Min. ambient _____

Max. ambient _____

Installed: indoors _____ outdoors _____

Design safety factor _____

Maintain temp. _____

Normal operating temp. _____

Max. intermittent temp. _____

Insulation type _____

Thickness _____ Oversized yes no

Voltage _____

10) The user has been notified that ground-fault equipment protection devices are required for all Division 1 applications.

All of the above information is believed to be correct.

Signature: _____ Date: _____

For Raychem use only

Attach this form to the Raychem purchase order. Order number: _____

APPROVED BY: _____ DATE: _____

(Customer Service Center)

Appendix F: FM Required Division 1 Installation Record

To complete the FM approval process, this form must be returned to the Raychem Customer Service Center (fax number 650-361-6711) upon completion.

Company Name Purchase Order No. Reference Drawing(s)

Circuit ID No.	Test Value/Remarks	Date	Initials
Area:			
Auto-ignition temperature (AIT)			
Group classification			
Heater Circuit:			
Heater type			
Supply voltage			
Circuit length			
Maximum pipe temperature			
Heat temp. identification number (T-rating)			
Components:			
Power connection			
End seal			
Tee connection			
Splice			
Ground-Fault Equipment Protection:			
Make and model			
Ground-fault equipment protection device trip level (mA)			
Installation Instructions:			
Correct components per manufacturer's specification			
Seal fittings opened and inspected (properly poured)			
Ground-leakage device tested			
Insulation Resistance Testing:			
Refer to Section 5.10.2, tests A and B.			
Use 2500 Vdc for self-regulating cables; use 1000 Vdc for MI cables.			
Instrument used			
Calibration date			
As measured on the pipe before insulation is installed:*			
Insulation resistance between core and braid (Test A)			
Insulation resistance between braid and pipe (Test B)			
As measured after insulation is installed:*			
Insulation resistance between core and braid (Test A)			
Insulation resistance between braid and pipe (Test B)			

*Minimum insulation resistance must be 1000 mΩ. If less than 1000 mΩ, see Section 6.2, Troubleshooting.

Circuit Ready to Commission

Prepared by Company Date

Approved by Company Date

Appendix G: Inspection Record

For freeze protection circuits, perform these checks before winter arrives.
For temperature maintenance circuits, perform these checks at least twice a year.

Panel ID number

Circuit ID number

Heating cable type

Circuit length

Date _____

[illegible]

Appendix H: BTV Heating Cable Selection for Insulated Plastic Pipes

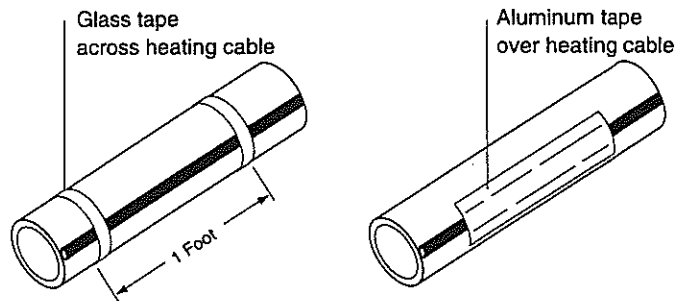
HBTV-CT and BTV-CT heating cables are ideal for heat-tracing plastic pipes. However, increased resistance to heat transfer from the heating cable to the plastic pipe necessitates compensation of its thermal output. Aluminum tape may be used to increase the thermal output of HBTV and BTV heating cables on plastic pipes.

The thermal output adjustment factors for typical applications are shown below.

Thermal Output Adjustment Factors (pipe wall thickness 0.250" or less*)

Heating cable	Glass tape across heating cable	Aluminum tape over heating cable
5HBTV1-CT, 5BTV1-CT	0.55	0.75
5HXTV2-CT, 5BTV2-CT	0.50	0.75
8HBTV1-CT, 8BTV1-CT	0.50	0.70
8HBTV2-CT, 8BTV2-CT	0.45	0.65
10HBTV1-CT, 10BTV1-CT	0.40	0.60
10HBTV2-CT, 10BTV2-CT	0.45	0.70

*Equivalent to 3 1/2" schedule 40 PVC pipe. For greater pipe wall thickness, consult the factory or your Raychem representative.



Appendix I: Effect of Aluminum Tape on Raychem Heating Cable

Aluminum tape (AT-180) can be used with Raychem heating cable with nominal variations in power output. The chart below shows the multiplier for power output and circuit length for both 120-volt and 240-volt Raychem heating cable as compared to the nominal ratings, when installed on carbon steel pipe.

Note: When using circuit length adjustment factors, do not exceed the maximum circuit lengths shown below.

Auto-Trace heating cables powered at	120 Volts			240 Volts		
	Power output factor	Circuit length multiplier	Maximum heating cable circuit length	Power output factor	Circuit length multiplier	Maximum heating cable circuit length
5HBTV-CT, 5BTV-CT	1.2	0.83	225 feet	1.2	0.83	450 feet
8HBTV-CT, 8BTV-CT	1.2	0.77	160 feet	1.3	0.77	320 feet
10HBTV-CT, 10BTV-CT	1.3	0.77	135 feet	1.2	0.83	300 feet
12HQT-CT, 10QTV-CT	1.15	0.83	130 feet	1.15	0.83	325 feet
20HQT-CT, 20QTV-CT	1.25	0.77	150 feet	1.25	0.77	300 feet
5HXTV-CT, 5XTV-CT	1.15	0.83	320 feet	1.15	0.83	635 feet
10HXTV-CT, 10XTV-CT	1.15	0.83	225 feet	1.15	0.83	450 feet
15HXTV-CT, 15XTV-CT	1.15	0.83	180 feet	1.15	0.83	370 feet
20HXTV-CT, 20XTV-CT	1.15	0.83	155 feet	1.15	0.83	320 feet

Appendix J: Hazardous Gases and Vapors

The following pages contain excerpts from the National Fire Protection Association publication NFPA 497M "Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations 1994 Edition." The list includes the ignition temperatures and group classifications for Class I gases. Class II dusts and Class III fibers and filings are not listed.

Note that considerable skill and judgment must be applied when deciding to what degree an area contains hazardous concentrations of vapors, combustible dust, or easily ignitable fibers and filings. Many factors—such as temperature, barometric pressure, quantity of release, humidity, ventilation, and distance from the vapor source—must be considered. When information on every factor concerned is properly evaluated, a consistent classification of the selection and location of electrical equipment can be developed.

For a complete list of properties of flammable liquids, gases, and solids, see NFPA 497M, "Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations 1994 Edition."

Group Classification and Auto-ignition Temperature (AIT) of Selected Flammable Gases and Vapors

Material	Group	°F	°C
Acetaldehyde	C*	347	175
Acetic Acid	D*	867	464
Acetic Anhydride	D	600	316
Acetone	D*	869	465
Acetone Cyanohydrin	D	1270	688
Acetonitrile	D	975	524
Acetylene	A*	581	305
Acrolein (inhibited)	B*	455	235
Acrylic Acid	D	820	438
Acrylonitrile	D*	898	481
Allyl Alcohol	C*	713	378
Allyl Chloride	D	905	485
Ammonia	D*	928	498
n-Amyl Acetate	D	680	360
Aniline	D	1139	615
Benzene	D*	928	498
Benzyl Chloride	D	1085	585
1,3-Butadiene	B*	788	420
Butane	D*	550	288
1-Butanol	D*	650	343
2-Butanol	D*	761	405
n-Butyl Acetate	D*	790	421
iso-Butyl Acetate	D*	790	421
n-Butyl Acrylate (inhibited)	D	559	293
Butylamine	D	594	312
Butylene	D	725	385
n-Butyraldehyde	C*	425	218
n-Butyric Acid	D	830	443
Carbon Monoxide	C*	1128	609
Chlorobenzene	D	1099	593
Cresol	D	1038–1110	559–599
Crotonaldehyde	C*	450	232
Cumene	D	795	424
Cyclohexane	D	473	245
Cyclohexene	D	471	244

Material	Group	°F	°C
Cyclohexanol	D	572	300
Cyclohexanone	D	473	245
Cyclopropane	D*	938	503
p-Cymene	D	817	436
n-Decanol	D	550	288
Decene	D	455	235
Diacetone Alcohol	D	1118	603
o-Dichlorobenzene	D	1198	647
1,1-Dichloroethane	D	820	438
1,2-Dichloroethylene	D	860	460
Dicyclopentadiene	C	937	503
Diethyl Benzene	D	743-842	395-450
Diethylene Glycol Monobutyl Ether	C	442	228
Diethylene Glycol Monomethyl Ether	C	465	241
Diethylamine	C*	594	312
Diethyl Ether	C*	320	160
N-N-Dimethyl Aniline	C	700	371
Di-isobutylene	D*	736	391
Di-isobutyl Ketone	D	745	396
Di-isopropylamine	C	600	316
Dimethylamine	C	752	400
Dimethyl Formamide	D	833	455
Dimethyl Sulfate	D	370	188
1,4-Dioxane	C	356	180
Dipentene	D	458	237
Di-N-propylamine	C	570	299
Dodecene	D	491	255
Epichlorohydrin	C*	772	411
Ethane	D*	882	472
Ethanol	D*	685	363
Ethyl Acetate	D*	800	427
Ethyl Acrylate (inhibited)	D*	702	372
Ethylamine	D*	725	385
Ethyl Benzene	D	810	432
Ethyl Chloride	D	966	519
Ethylene	C*	842	450
Ethylene Chlorohydrin	D	797	425
Ethylene Glycol Monobutyl Ether	C	460	238
Ethylene Glycol Monobutyl Ether Acetate	C	645	340
Ethylenediamine	D*	725	385
Ethylene Dichloride	D*	775	413
Ethylene Glycol Monoethyl Ether	C	455	235
Ethylene Glycol Monoethyl Ether Acetate	C	715	379
Ethylene Glycol Monomethyl Ether	D	545	285
Ethylenimine	C*	608	320
Ethylene Oxide	B*	804	429
Ethyl Formate	D	851	455
2-Ethylhexaldehyde	C	375	191
2-Ethyl Hexanol	D	448	231
2-Ethyl Hexyl Acrylate	D	485	252
Ethyl Mercaptan	C*	572	300
Formaldehyde (Gas)	B	795	429

Material	Group	°F	°C
Formic Acid (90%)	D	813	434
Fuel Oils	D	410–765	210–407
Furfural	C	600	316
Furfuryl Alcohol	C	915	490
Gasoline	D*	536–880	280–471
Heptane	D*	399	204
Heptene	D	500	260
Hexane	D*	437	225
2-Hexanone	D	795	424
Hexene	D	473	245
Hydrazine	C	74–518	23–270
Hydrogen	B*	968	520
Hydrogen Cyanide	C*	1000	538
Hydrogen Sulfide	C*	500	260
Isoamyl Acetate	D	680	360
Isobutyl Acrylate	D	800	427
Isobutyraldehyde	C	385	196
Isophorone	D	860	460
Isoprene	D*	428	220
Isopropyl Acetate	D	860	460
Isoamyl Alcohol	D	662	350
Isopropylamine	D	756	402
Isopropyl Ether	D*	830	443
Iso-octyl Aldehyde	C	387	197
Kerosene	D	410	210
Liquefied Petroleum Gas	D	761–842	405–450
Mesityl Oxide	D*	652	344
Methane	D*	999	630
Methanol	D*	725	385
Methyl Acetate	D	850	454
Methyl Acrylate	D	875	468
Methylamine	D	806	430
Methyl n-Amyl Ketone	D	740	393
Methylcyclohexane	D	482	250
Methylcyclohexanol	D	565	296
Methyl Ether	C*	662	350
Methyl Ethyl Ketone	D*	759	404
Methyl Formal	C*	460	238
Methyl Formate	D	840	449
Methyl Isobutyl Ketone	D*	840	449
Methyl Isocyanate	D	994	534
Methyl Methacrylate	D	792	422
2-Methyl-1-Propanol	D*	780	416
2-Methyl-2-Propanol	D*	892	478
alpha-Methyl Styrene	D	1066	574
Monoethanolamine	D	770	410
Monoisopropanolamine	D	705	374
Monomethyl Aniline	C	900	482
Monomethyl Hydrazine	C	382	194
Morpholine	C*	590	310
Naphtha (CoalTar)	D	531	277
Nitrobenzene	D	900	482

Material	Group	°F	°C
Nitroethane	C	778	414
Nitromethane	C	785	418
1-Nitropropane	C	789	421
2-Nitropropane	C*	802	428
Nonane	D	401	205
Octane	D*	403	206
Octene	D	446	230
Pentane	D*	470	243
1-Pentanol	D*	572	300
2-Pentanone	D	846	452
1-Pentene	D	527	275
Propane	D*	842	450
1-Propanol	D*	775	413
2-Propanol	D*	750	399
Propionaldehyde	C	405	207
Propionic Acid	D	870	466
Propionic Anhydride	D	545	285
n-Propyl Acetate	D	842	450
Propylene	D*	851	455
Propylene Dichloride	D	1035	557
Propylene Oxide	B*	840	449
n-Propyl Ether	C	419	215
Propyl Nitrate	B*	347	175
Pyridine	D*	900	482
Styrene	D*	914	490
Tetrahydrofuran	C*	610	321
Tetrahydronaphthalene	D	725	385
Toluene	D*	896	480
Turpentine	D	488	253
Unsymmetrical Dimethyl Hydrazine (UDMH)	C*	480	249
Valeraldehyde	C	432	222
Vinyl Acetate	D*	756	402
Vinyl Chloride	D*	882	472
Vinylidene Chloride	D	1058	570
Vinyl Toluene	I'	921	494
Xylenes	D*	867-984	464-529

* Material has been classified by test.

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All information, including illustrations, is believed to be reliable. Users, however, should independently evaluate the suitability of each product for their application. Raychem makes no warranties as to the accuracy or completeness of the information, and disclaims any liability regarding its use. Raychem's only obligations are those in the Raychem Standard Terms and Conditions of Sale for this product, and in no case will Raychem be liable for any incidental, indirect, or consequential damages arising from the sale, resale, use, or misuse of the product. Specifications are subject to change without notice. In addition, Raychem reserves the right to make changes—without notification to Buyer—to materials or processing that do not affect compliance with any applicable specification.

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Class I, Division 1, self-regulating heating cables for hazardous locations

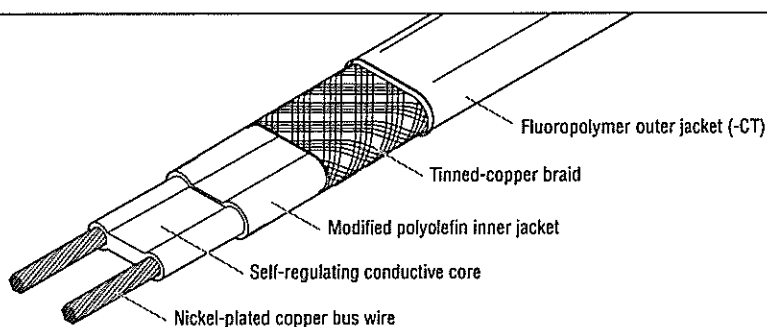
Electrical freeze protection for hazardous (CID1) locations

The HBTV family of self-regulating heating cables provides the solution to freeze-protection and process-temperature maintenance applications for CID1 areas. HBTV

heating cables maintain process temperatures up to 150°F (65°C) and can withstand intermittent exposure to temperatures up to 185°F (85°C). The cables are configured for use in hazardous (CID1) areas, including areas where corrosives may be present.

Raychem® HBTV cables meet the requirements of the U.S. National Electrical Code. For additional information, contact your Tyco Thermal Controls representative or call Tyco Thermal Controls at (800) 545-6258.

Heating cable construction



Application

Area classification	Hazardous (classified) locations
Traced surface type	Metal and plastic
Chemical resistance	Organic and aqueous inorganic chemicals and corrosives

Supply voltage

HBTV1	100–130 Vac
HBTV2	200–277 Vac

Temperature rating

Maximum maintain or continuous exposure temperature (power on)	150°F (65°C)
Maximum intermittent exposure temperature, 1000 hours (power on or off)	185°F (85°C)

Temperature ID number (T-rating)

T6: 185°F (85°C)
Temperature ID numbers are consistent with North America national electrical codes.

Approvals

(1) All Class I, Div. 1 designs must be reviewed by the manufacturer

Hazardous Locations



Class I, Div. 1, (1) Groups B, C, D
Class II, Div. 1, Groups E, F, G

Design and installation

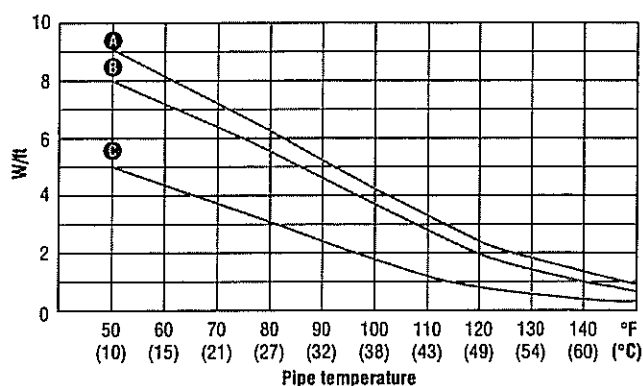
For proper design and installation, use TraceCalc® Pro software or the Design section of the *Industrial Product Selection and Design Guide*. Also, refer to the *Installation Guide for Hazardous Division 1 Locations* (H56075). Literature is available through the Tyco Thermal Controls Fax-on-Demand system and via the Tyco Thermal Controls Web site, www.tycothermal.com.

Nominal power output rating on metal pipes at 120 V/240 V

Adjustment factors		
	Power output	Circuit length
208 V		
5HBT2V2-CT	0.85	0.94
8HBT2V2-CT	0.89	0.92
10HBT2V2-CT	0.89	0.92
277 V		
5HBT2V2-CT	1.12	0.94
8HBT2V2-CT	1.08	1.11
10HBT2V2-CT	1.08	1.11

To choose the correct heating cable for your application, use the Design section of the *Industrial Product Selection and Design Guide*. For more detailed information, use TraceCalc Pro design software.

- A 10HBTV-CT
 B 8HBTV-CT
 C 5HBTV-CT



Maximum circuit lengths based on circuit-breaker sizes

		Maximum continuous circuit length (in feet) per circuit breaker							
		120 V				240 V			
		15 A	20 A	30 A	40 A	15 A	20 A	30 A	40 A
5HBTV-CT	50°F	230	270	270	270	460	540	540	540
	0°F	140	190	270	270	285	380	540	540
	−20°F	125	165	250	270	250	330	500	540
	−40°F	110	145	220	270	220	295	440	540
8HBTV-CT	50°F	150	200	210	210	300	400	420	420
	0°F	100	130	200	210	200	265	400	420
	−20°F	85	115	175	210	175	235	350	420
	−40°F	80	105	155	210	155	210	315	420
10HBTV-CT	50°F	120	160	180	180	240	315	360	360
	0°F	80	110	160	180	160	215	325	360
	−20°F	70	95	140	180	145	190	285	360
	−40°F	65	85	125	170	125	170	255	340

Note: Tyco Thermal Controls and national electrical codes require both ground-fault protection of equipment and a grounded metallic covering on all heating cables. Following are some of the ground-fault breakers that satisfy this equipment protection requirement: Square D Type QOB-EPD or QO-EPD; Raychem/Square D Type GPPD EHB-EPD (277 Vac); Cutler Hammer (Westinghouse) Type QBGFEP.

Product characteristics

	5HBTV-CT	8HBTV-CT 10HBTV-CT
Minimum bend radius	@68°F (20°C): 1/2 in (12.7 mm)	@68°F (20°C): 1/2 in (12.7 mm)
Weight (lb per 10 ft, nominal)	0.7	1.0
Bus wire size	16 AWG	16 AWG
Outer jacket color	Black	Black
Heating cable dimensions	0.46 x 0.25 in	0.65 x 0.25 in

Components

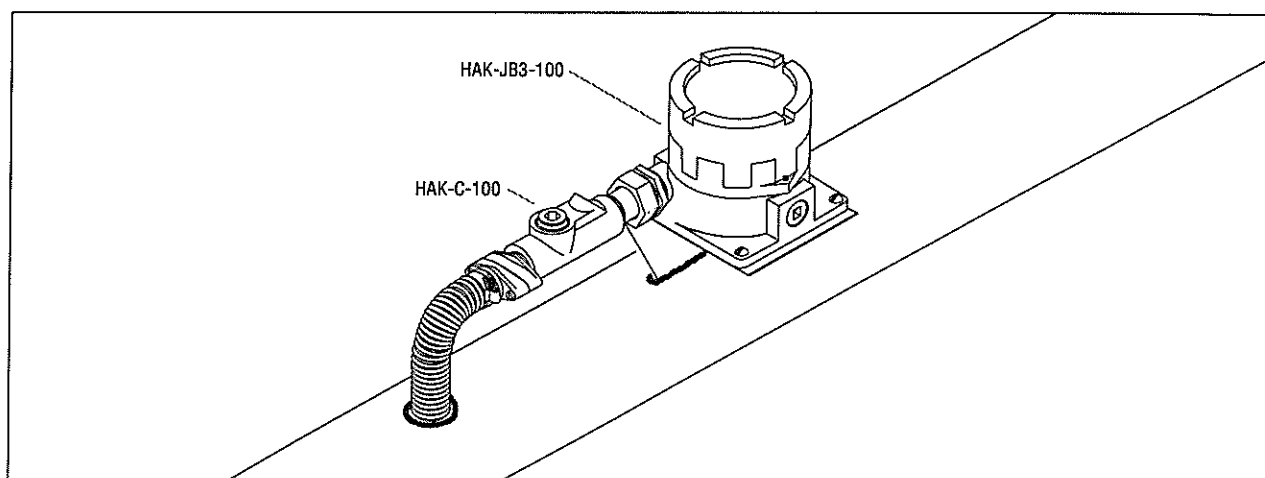
Tyco Thermal Controls offers a full range of components for power connections, splices, and end seals. These components must be used to ensure proper functioning of the product and compliance with warranty, code, and approvals requirements.

Connection kit and junction box for CID1 hazardous locations

The HAK-C-100 connection system is FM approved for use with Raychem® brand HBTV, HQTV, and HXTV heating cables in Class I, Division 1 hazardous locations. It is also CSA certified for use with Raychem brand BTV, QTVR, XTV, and VPL heating cables in Class I, Division 1 locations.

The HAK-C-100 is a cold-applied connection kit that contains all of the materials required for sealing one heating cable entry into a junction box. The HAK-JB3-100 is an explosion-proof, corrosion-resistant junction box that serves as a power connection, splice, tee, or end termination.

Each kit contains all the necessary materials for a complete installation except for the pipe straps and a UMB mounting bracket, which must be ordered separately.



Kit description

HAK-C-100	HAK-JB3-100
Materials for one connection. One kit required for each heating cable entry into a junction box.	1 stainless-steel housing 3 3/4-in NPT entries 2 plugs 1 grounding bar kit

Approvals

Hazardous Locations



Class I, Div. 1, Groups B, C, D
Class II, Div. 1, Groups E, F, G
Class III

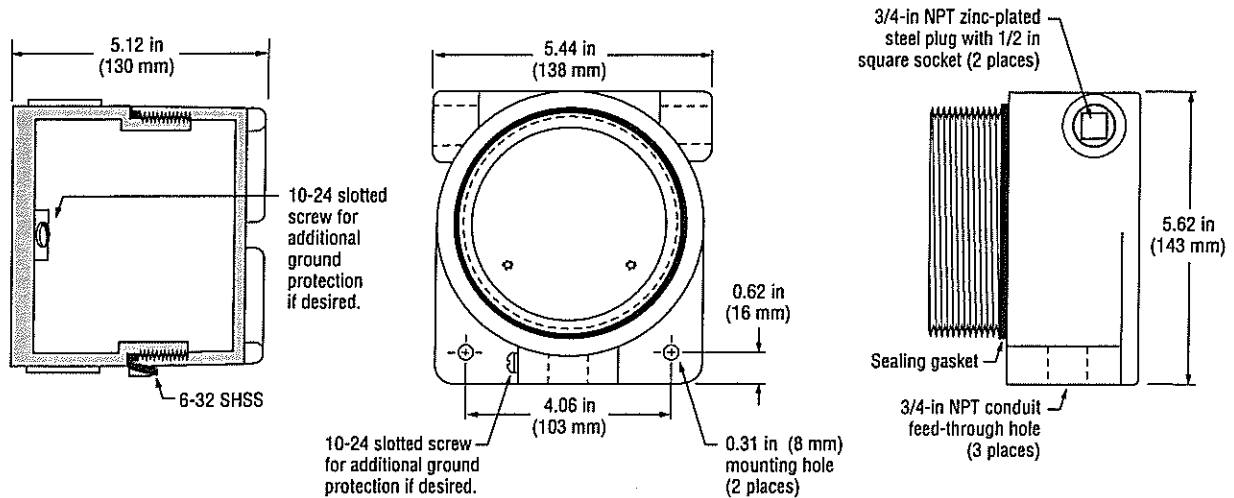


Class I, Div. 1, Groups B, C, D
Class II, Div. 1, Groups E, F, G
Class III

Ordering details

	HAK-C-100	HAK-JB3-100
Catalog number	HAK-C-100	HAK-JB3-100
Part number	014385-000	325925-000
Weight	3.0 lb	3.1 lb

HAK-JB3-100 junction box dimensions



Materials required per connection type

	Number of HAK-C-100 kits required	Number of holes used on the junction box	Universal mounting bracket (UMB)	Pipe strap
Power	1	2	1	1
Splice	2	2	1	1
Tee	3	3	1	1
End seal	1	1	1	1

Materials of construction

Junction box

Copper-free aluminum with corrosion-resistant polyester powder coating

HEAT TRACE Controller

Pyrotenax - 910 * E1 FWL * SSR2

Ser # 01100137

EnACL. Type 4X / IP65

~~240V~~ 220V / Single ph. - 30amps max.



Burns Cascade
Fred Pitcher
716-651-0050

3332 WALDEN Ave

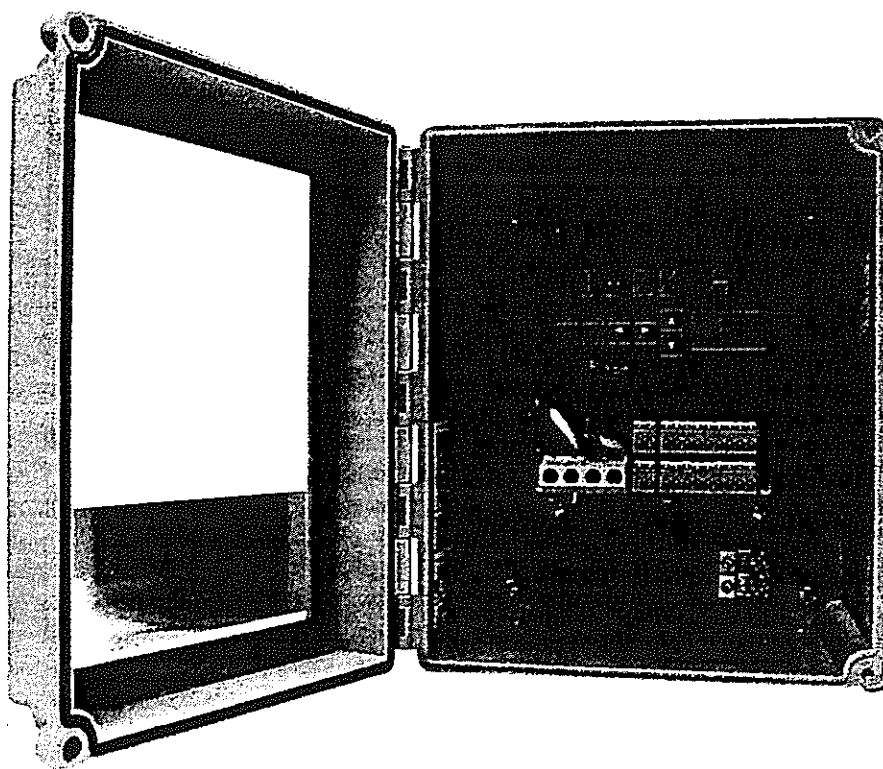
General Cable Pyrotenax

910 Series HTC Digitrace™ Heat Trace Controller

**Installation, Operating and
Maintenance Instructions**

Firmware versions up to V3.1X
Document # 910MANUAL

Please read all instructional literature carefully and thoroughly before starting. Refer to the inside front cover for the listing of Liabilities and Warranties.



DigiTrace™ 910 Series Heat Trace Controller

Installation and Maintenance Instructions for
Firmware Versions up to and including V3.1X

NOTICE: The information contained in this document is subject to change without notice.

CERTIFICATION

General Cable Pyrotenax certifies that this product met its published specifications at the time of shipment from the Factory.

WARRANTY

This General Cable Pyrotenax product is warranted against defects in material and workmanship for a period of 12 months from the date of installation or 30 months maximum from the date of shipment, whichever occurs first. During the warranty period, General Cable Pyrotenax will, at its option, either repair or replace products that prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by General Cable Pyrotenax. The Buyer shall prepay shipping charges to General Cable Pyrotenax and General Cable Pyrotenax shall pay shipping charges to return the product to the Buyer. However, the Buyer shall pay all shipping charges, duties, and taxes for products returned to General Cable Pyrotenax from another country.

General Cable Pyrotenax warrants that the software and firmware designated by General Cable Pyrotenax for use with a product will execute its programming instructions properly when installed on that product. General Cable Pyrotenax does not warrant that the operation of the hardware, or software, or firmware will be uninterrupted or error-free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Buyer, Buyer-supplied software or interfacing, unauthorized modification

or misuse, operation outside of the specifications for the product, or improper installation.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. GENERAL CABLE PYROTENAX DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE THE BUYER'S SOLE AND EXCLUSIVE REMEDIES. GENERALCABLE PYROTENAX SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

CONDUCTED AND RADIATED EMISSIONS - FCC/DOC STATEMENT OF COMPLIANCE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

This equipment does not exceed Class A limits for radio emissions as set out in Schedule V to VIII of the Radio Interference Regulations of Communication Canada.

Cet appareil respecte les limites de bruits radioélectriques applicables aux appareils numériques de Classe A prescrites dans la norme sur le matériel brouilleur: "Appareils Numériques", NMB-003 édictée par le Ministère des Communications.

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SECTION I - OVERVIEW

1-1 INTRODUCTION

This manual provides information pertaining to the installation, operation, testing, adjustment, and maintenance of the General Cable Pyrotenax DigiTrace™ Model 910 Series Heat Tracing Controller.

Additional copies of this user manual may be ordered separately through your nearest sales office using the order number listed on the front cover.

1-2 CONTROLLERS COVERED BY THIS MANUAL

This document covers the 910 Series Heat Trace Controllers and its available options. The information coincides with the specific releases of firmware for the 910 product which are listed on the front page. As General Cable Pyrotenax releases new firmware to modify or enhance the product significantly, new documentation will accompany these releases. To ensure that you are using the correct documentation for your particular version of controller, please check the firmware version number of the 910 against the version number listed on the front of this manual. This may be displayed using the Operator Console or a communicating device such as a 780/GCC-9000 group communicator. As subsequent changes are made, supplements to this document will be issued to registered users and included in manuals shipped after the firmware is released. Supplements will make specific reference to the operational or functional changes.

1-3 PRODUCT OVERVIEW

1-3-1 Description

The 910 Series electronic Heat Tracing Controller controls, monitors, and communicates alarms and data for one heating circuit. It offers a complete range of control and monitoring features as well as superior reliability compared to multi-point systems. The ability to install the units in Class 1, Division 2 and Zone 2 areas, supports direct field installation if desired. Available with a solid-state relay (SSR) output for use in hazardous areas or with electro-mechanical relay (EMR) output for use in ordinary (non-hazardous) areas.

1-3-2 Features

A detailed description of available features may be found in Section V of this manual. Highlights of specific features are included in the following text.

Keypad and Alpha-numeric Display

A six character alpha-numeric LED display provides the operator with large easy to read messages and prompts, eliminating complex and cryptic programming. Six individual keys are provided to quickly access alarming and operational information.

-40 to 60°C (-40 to 140°F) Operation

Extended temperature operation permits installation in all but the harshest environments.

Single or Dual Temperature Sensor Inputs

The ability to utilize one or two temperature sensor (TS) inputs, allows the selection of one of eight control modes and programming of all temperature parameters.

High and Low Temperature Alarms

High and low temperature alarms are offered for both temperature sensor inputs.

High and Low Current Alarms

The 910 offers full adjustment of both the high and low alarm points over the entire current measurement range.

Solid State or Electro-mechanical Relay (EMR) Output

The 910 is available with either a solid-state relay (SSR), or an electro-mechanical relay (EMR) output switch. With the SSR option, the user may select a time-proportional control algorithm, a simple deadband control mode, or one of two ambient control algorithms. The EMR version always uses either the deadband mode or the proportional ambient contactor mode. Switching device failure alarms are supported for both types of output devices.

Ground Fault Alarm and Trip

Ground Fault (GF) current levels are monitored and may be displayed in milliamps. The availability of the actual ground fault level gives the user the choice of both alarm and trip levels suitable for the particular installation.

Overcurrent Protection

A unique overcurrent protection algorithm greatly reduces the possibility of damage to the circuit or the controller in the event of a temporary overload while allowing for initially high in-rush currents (SSR options only).

Soft Starting

Given the circuit breaker size, the 910 will limit the energy let-through to help prevent nuisance breaker trips due to cable in-rush. This feature makes the controller particularly attractive for use with self-regulating cables (SSR options only).

Minimum/Maximum Temperature Tracking

The controller maintains the minimum and maximum temperature values it has measured since the last reset of these values. This is helpful in determining causes of temperature alarms.

Latching/Non-latching Temperature Alarms

User selectable non-latching temperature alarms allow the controller to automatically clear the alarm when the condition no longer exists.

High and Low Voltage Alarms

Operating at voltages less than design can cause serious loss of heater output. The alarming of preset voltage deviations ensures availability of sufficient wattage output.

Power-Limiting

The 910 will control the maximum output wattage if the full load power exceeds the specified Maximum Power Setpoint. This feature eliminates the need for low voltage transformers in many applications and can assist in standardization of heating cable types (SSR options only).

Auto-cycling

The controller will momentarily energize the circuit (for 10 seconds) at a programmable interval. Circuit alarms will be generated at the time of auto-cycle instead of when the heat is required. This feature eliminates the need for a preventative maintenance program as these tests are performed at regular intervals by the controller.

Temperature Sensor Failure Alarm

Both open and shorted sensors are detected and alarmed by the controller.

Random Start

A startup delay between 0 and 9 seconds ensures that all units do not come on line at the same time.

Full Digital Communications

An optional internal communications interface allows the communication of alarms and analog data to a monitoring system. The standard modem version maintains compatibility with General Cable Pyrotenax's Group Communications Controller (Model 780/GCC-9000). Other versions provide industry-standard RS-232 or RS-485 serial communications for applications requiring direct

interfacing to other devices. With the availability of the heat trace data at the user's fingertips, historical trending of temperatures, power consumption, or other parameters are available for analysis and system optimization.

CSA NRTL/C & Factory Mutual Approvals (Pending)

The 910 Series of controllers are approved for Class I, Division II, Groups A,B,C,D and Zone 2 areas making them ideal for direct installation in the field. This may save the significant expense of wiring back to a centrally located electrical distribution center.

1-4 COMPONENTS

The 910 Series controller is made up of two components. Each component's primary function is described below.

1-4-1 Control Module

The 910 Control Module forms the heart of a single point heat trace control solution. Each Control Module provides all of the intelligence required to control and monitor one heat trace circuit. It includes indicators for alarm and output status and an Operator Console. An internal connector is provided to plug in an optional communications interface.

The Control Module packaging provides a rugged, vibration-proof design.

Temperature sensor, communications, and alarm control wiring are connected to the lever-operated spring terminals, providing gas-tight, vibration-resistant connections.

A large, easy to read alpha-numeric display and menu-driven interface eases controller configuration and eliminates the need for an external programmer. Access is available for all monitored parameters, programmed values, and alarm information. Enhanced security is provided by password protection.

Single phase current monitoring, ground fault detection, and voltage monitoring are provided. The 910 Control Module also incorporates a universal power supply, allowing operation directly from 100 to 277 Vac.

1-4-2 Communications Interface

In applications where the user wishes remote configuration capability, or wants to communicate trace information and/or alarms to another device such as a Group Communications Controller (780

Series/GCC-9000), an optional communications interface may be installed in the Control Module.

A modem version that maintains compatibility with existing Pyrotech controls is available, or other industry-standard interfaces such as RS-232 and RS-485 may be specified.

1-5 CONTROLLER ASSEMBLIES

Two standard assemblies are stocked at the Factory:

1. An SSR version for use in ordinary or Class I, Division 2 and Zone 2 areas, and
2. An EMR version for use in ordinary locations only.

1-6 ORDERING AND CONFIGURATION GUIDE

Controller Assemblies

<i>Stock Enclosure Assemblies</i>	
Description	Model Code
- Controller in a 10"x8" Nema 4X Fiberglass enclosure with window and door latches. 2 pole, 30A 120-277V EMR output. - Controls a single circuit with a 2-pole electro-mechanical relay.	910*E1FWL*EMR2
- Controller in a 10"x8" Nema 4X Fiberglass enclosure with window and door latches. 2 pole, 30A 120-277V SSR output. - Controls a single circuit with a 2-pole Solid-state relay.	910*E1FWL*SSR2

Options

Append the following option code(s) to the end of the standard Model Code to have the option included at the Factory:

*RTD10CS	10ft. SS corrugated sheath 3-wire 100Ω Pt RTD
*E1SW	Stainless Steel Enclosure (replace *E1FWL with *E1SW)
*MDM	Modem communications option
*485	2-wire isolated RS-485 communications option
*232	RS-232 communications option
*ALR	Red LED Pilot Light
*ALG	Green LED Pilot Light

Contact your local representative for other available configurations that are not listed above.

SECTION II - INSTALLATION AND WIRING

CAUTION: BE SURE ALL PERSONNEL INVOLVED IN INSTALLATION, SERVICING, AND PROGRAMMING ARE QUALIFIED AND FAMILIAR WITH ELECTRICAL EQUIPMENT, THEIR RATINGS AND PROPER PRACTICES AND CODES. MULTIPLE VOLTAGES AND SIGNAL LEVELS MAY BE PRESENT DURING THE INSTALLATION, OPERATION, AND SERVICING OF THIS PRODUCT. DO NOT POWER THE PRODUCT UNTIL THE SAFETY PROVISIONS OUTLINED IN SECTION II HAVE BEEN OBSERVED.

2-1 INTRODUCTION

This Section includes information regarding the initial inspection, preparation for use, and storage instructions for the 910 Series Heat Trace Controller.

2-2 INITIAL INSPECTION

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been verified for completeness and the equipment has been checked mechanically and electrically. Procedures for configuring and operating the heat trace controller are given in Sections III, IV, and V. If the shipment is incomplete, there is mechanical damage, a defect, or the controller does not pass the electrical performance tests, notify the nearest General Cable Pyrotenax representative. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as your General Cable Pyrotenax representative. Keep the shipping materials for the carrier's inspection.

2-3 OPERATOR SAFETY CONSIDERATIONS

The standard 910 controller using solid-state relays is suitable for Class 1, Division 2, Groups A, B, C, D and Zone 2 hazardous areas. Hazardous areas are defined by Article 500 of the National Electrical Code and Section 18 of the Canadian Electrical Code. Electro-mechanical relay (EMR) based assemblies are suitable for use in ordinary (non-hazardous) areas only.

CAUTION: SOME WIRING CONFIGURATIONS WILL USE MORE THAN ONE POWER SOURCE AND ALL MUST BE DE-ENERGIZED PRIOR TO PERFORMING ANY MAINTENANCE ON A CONTROLLER CIRCUIT.

2-4 OPERATING ENVIRONMENT

The operating environment should be within the limitations specified in the 910 Heat Trace Controller Specifications outlined in Appendix A.

2-5 INSTALLATION LOCATION

The wide ambient operating temperature range of the controller permits installation in most any convenient location. Considerations should include expected atmospheric conditions, accessibility for maintenance and testing, the location of existing conduits and hazardous area rating. Ambient temperature conditions may affect load current ratings.

CAUTION: ALWAYS BE SURE THAT THE INTENDED LOCATION IS CLASSIFIED AS AN AREA THAT THE PRODUCT IS APPROVED FOR AS DEFINED BY ARTICLE 500 OF THE NATIONAL ELECTRICAL CODE AND/OR PART I, SECTION 18 OF THE CANADIAN ELECTRICAL CODE.

2-6 MOUNTING PROCEDURES

Mounting hole dimensions for the standard enclosures are shown in Appendix B. Conduit entries should be made in the bottom of the enclosure if possible to reduce the possibility of water entry or leakage. Conduit entries must be drilled/punched following the enclosure manufacturers' recommendations. Use bushings suitable for the enclosure type and install such that the completed installation remains waterproof. For non-metallic enclosures, grounding hubs and conductors must be installed in accordance with

Article 501-4(b) of the National Electrical Code and Part I of the Canadian Electrical Code.

The user may want to consider enclosure drain holes in applications where moisture is a problem — drill 0.125" holes in the bottom of the enclosure on both the left and right sides. Two holes reduce the possibility that one will plug and ensures drainage if the enclosure is not perfectly level. Note that drilling holes in the enclosure compromises the NEMA 4 rating.

2-6-1 Controller Installation and Removal

CAUTION: ALWAYS ENSURE THAT THE POWER TO THE UNIT IS TURNED OFF DURING INSTALLATION OR REMOVAL TO AVOID THE RISK OF INJURY AND DAMAGE TO THE CONTROLLERS.

WARNING - EXPLOSION HAZARD! DO NOT INSTALL OR REMOVE THE CONTROL MODULE WHILE THE UNIT IS POWERED.

2-7 WIRING

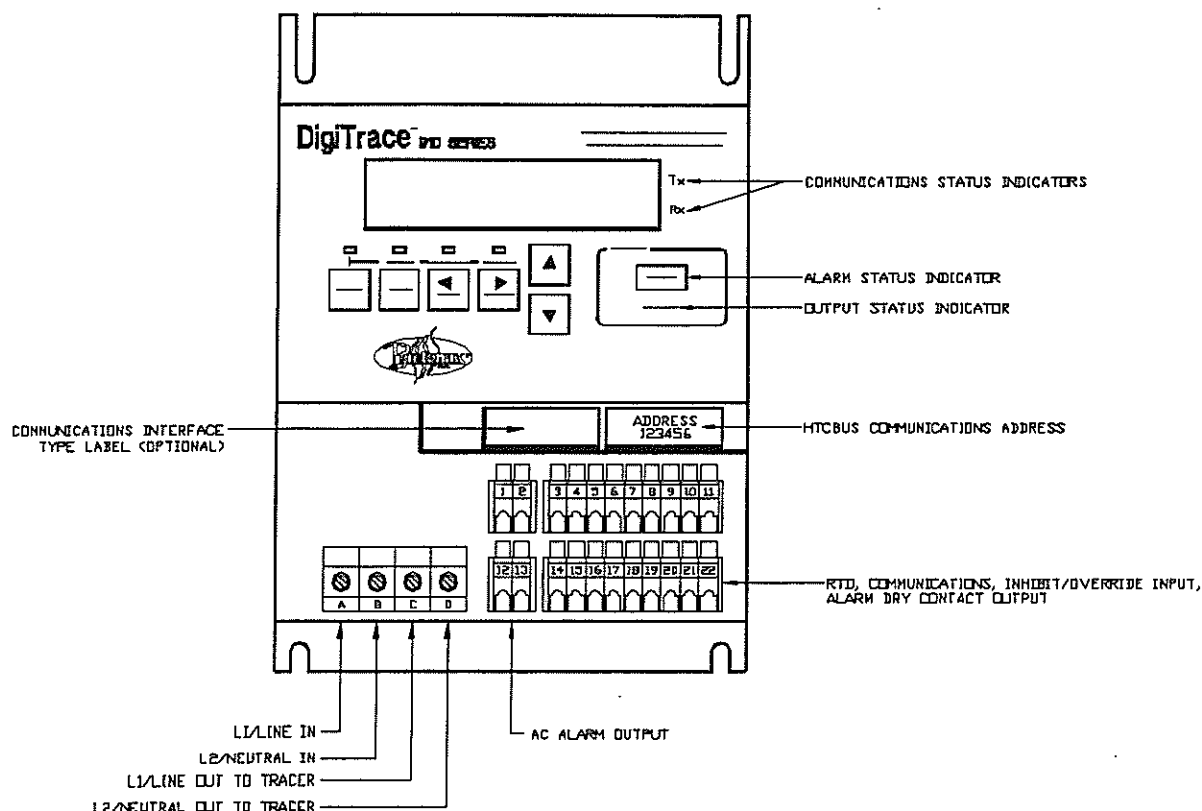
Wiring diagrams for typical configurations are included in Appendix C of this manual.

CAUTION: ALWAYS VERIFY WIRING CONNECTIONS BEFORE APPLYING POWER TO THE CONTROLLER OR CONNECTED CIRCUITS. TO AVOID INJURY OR EQUIPMENT DAMAGE, DO NOT INSTALL OR REMOVE WIRING WHILE CONTROLLER POWER IS ON.

To minimize the chance of loose connections, the 910 uses lever-operated, spring-loaded terminals for signal wiring. See Appendix A for allowable wire sizes and recommended insulation strip lengths.

2-7-1 Temperature Sensor Connections

Use shielded, twisted, three-conductor wire for the extension of RTD leads. The wire size should ensure that the maximum allowable lead



D910-010

Figure 2-1 Control Module

resistance is not exceeded. Shields on RTD wiring should be grounded at the controller end only, using the terminals provided.

<u>Temperature Sensors</u>	<u>Terminal #</u>
Shield	19
TS 1 Source (WHT)	20
TS 1 Sense (WHT)	21
TS 1 Common (RED)	22
Shield	8
TS 2 Source (WHT)	9
TS 2 Sense (WHT)	10
TS 2 Common (RED)	11

2-7-2 Alarm Relay Connections

Two types of alarm relays are provided: one is a programmable dry contact output relay and the other is a line voltage AC relay (Triac). Both may be programmed for N.O., N.C., steady or flashing operation, and are typically used to annunciate an alarm to an external device such as a DCS, PLC, etc.

Note: Both alarm relays are controlled by the 910 using the same signal. The N.O., N.C., and flashing parameter settings affect both the dry contact and the AC alarm relays.

Note: The dry contact alarm relay is intended to be used for switching low-voltage, low-current signals. DO NOT USE THIS RELAY TO DIRECTLY SWITCH LINE VOLTAGES. Ensure that your application stays within the ratings of the relay contacts as defined in Appendix A.

The AC alarm relay is typically used to drive a local, external, line-voltage pilot light, etc. Refer to the wiring diagrams in Appendix C for example connection details.

<u>Dry Contact Alarm & Control Signals</u>	<u>Terminal #</u>
Alarm Relay Dry Contact Output	14
Alarm Relay Dry Contact Output	15
Ground	4
+12Vdc nom. Out	3

<u>AC Alarm & Control Signals</u>	<u>Terminal #</u>
L1/Line Out	1
L2/Neutral Out	2
AC alarm relay	12
AC alarm relay	13

2-7-3 External Input

These input terminals are used to implement the inhibit and override features. Refer to Section V of this manual for programming details, and Appendix C for example wiring diagrams.

<u>Misc. Signals</u>	<u>Terminal #</u>
External Input (+)	6
External Input (-)	7

2-7-4 Communication Signal Connections

The communications terminal assignments change based on the type of option installed. If present in a 910 Control Module, the type of communications interface will be identified by a label located on the Operator Console.

Communications wiring should use twisted pair, shielded cable. Shields on communications wiring should be grounded at one end only, using the terminals provided.

The following table defines the appropriate signal connections for the various types of interfaces:

Modem Interface Connections

(Note that these particular signals are not polarity sensitive):

<u>Communication Signal</u>	<u>Terminal #</u>
Modem	16
Modem	17
Shield	18

RS-485 (2-wire) Connections

<u>Communication Signal</u>	<u>Terminal #</u>
Receive/Transmit Data (+)	16
Receive/Transmit Data (-)	17
Shield	18

RS-232 (3-wire) Connections

<u>Communication Signal</u>	<u>Terminal #</u>
Receive Data/ (RXD/)	16
Transmit Data/ (TXD/)	17
Common	18

2-7-5 Power Connections

All of the power terminals are labeled for easy identification. Do not attempt to use wire sizes that exceed the marked terminal ratings and avoid terminating two wires on the same terminal whenever possible.

Always be sure that all terminals are adequately tightened according to the terminal manufacturer's specification. See Appendix A for allowable wire sizes, recommended insulation strip lengths and tightening torque. A loose terminal can cause arcing and damage to the terminal or incorrect operation of the controller.

Note: Make sure that power terminals are re-tightened several days after installation. Stranded wire will tend to compress when initially installed, therefore these terminals should be checked for tightness several times after the system is installed to ensure that a good connection is maintained. Be certain to use the proper size screwdriver for the terminal blocks to minimize the chance of damage to the terminals.

If the controllers are installed in either a metallic or non-metallic enclosure, follow the enclosure manufacturers' recommendations for proper grounding. Do not rely on conduit connections to provide a suitable ground.

Grounding terminals/screws are provided for connection of system ground leads. Proper system grounding is required for safe and correct operation of the controller's protection features.

2-7-6 Input Power

The 910 controller may be powered directly from a 120 to 277 Vac circuit. The wiring terminal assignments are defined below:

<u>Power Connections</u>	<u>Terminal #</u>
Line / L1 Power Input	A
Neutral / L2 Power Input	B
Line / L1 Output to Trace	C
Neutral / L2 Output to Trace	D

Wiring diagrams for typical configurations are included in Appendix C.

CAUTION: MANY WIRING CONFIGURATIONS WILL USE MORE THAN ONE POWER SOURCE AND ALL MUST BE DE-ENERGIZED PRIOR TO PERFORMING ANY MAINTENANCE ON A CONTROLLER CIRCUIT.

2-8 INITIAL POWER-UP

CAUTION: BEFORE APPLYING POWER TO THE CONTROLLER, ENSURE THAT POWERING THE CIRCUIT WILL NOT DAMAGE IT IF POWER LIMITING OR THE SETPOINT TEMPERATURE HAVE NOT BEEN SET CORRECTLY. IF THERE IS ANY DOUBT, THE LOAD SHOULD BE DISCONNECTED UNTIL THE 910 HAS BEEN SUITABLY PROGRAMMED FOR CORRECT AND SAFE OPERATION.

2-8-1 Initial Cable Test

To minimize the risk of damage to the controller due to a cable fault, the integrity of the heating cable should be verified by:

- (1) performing a high voltage insulation test using a "Megger" and,
- (2) using an ohmmeter to ensure that the heating cable is not shorted.

THESE TESTS MUST BE PERFORMED WITH THE CONTROLLER OUTPUT DISCONNECTED.

Once the cable has been checked, it may be reconnected to the controller and power applied.

2-8-2 Random Start Delay

All 910 Series Control Modules incorporate a RANDOM START-UP DELAY feature, ensuring that all units do not power on at the same time. When power is first applied to a controller, it will hold its output off for a random time (0 to 9 seconds), equal to the last digit of the HTCBUS™ communications address (see Section 5-6-2). Once the start-up delay has timed out, the controller will begin normal operation.

2-9 SETUP FOR THE 910

The 910 may be programmed using the Operator Console, or if the modem communications option is installed, with a Group Communications Controller (Model 780/GCC-9000). For instructions on the operation of these devices, refer to the corresponding operating manuals. For complete instructions on programming the 910, see the Programming and Configuration Section of this manual.

SECTION III – OPERATOR **CONSOLE &** **OPERATION**

3-1 ALPHA-NUMERIC DISPLAY

The Console incorporates a 6 character 14 segment plus decimal LED display. Messages and prompts that are greater than 6 characters long are scrolled, allowing more meaningful, non-cryptic messages to be used.

3-2 KEYPAD

The local keypad consists of 6 keys that allow you to select the console mode function that you are interested in. For certain keys, the **SHIFT** key selects an alternate function, as shown by the text above that key.

Key	Function
SHIFT	- press to activate a SHIFTed function -- the next key pressed uses the alternate (shifted) function - the SHIFT LED illuminates, indicating the next key uses the alternate (shifted) function - pressing SHIFT again cancels the alternate (shifted) function
TEST [shift ALARM]	- turns on tracing for 30 seconds - when prefixed by the SHIFT key, this key switches the console to the Alarm mode
← BACK [shift MONITOR]	- exits the current menu (or cancels the new setting when editing a parameter) - moves the cursor to the left when editing an alpha-numeric parameter - when prefixed by the SHIFT key, this key switches the console to the Monitor mode

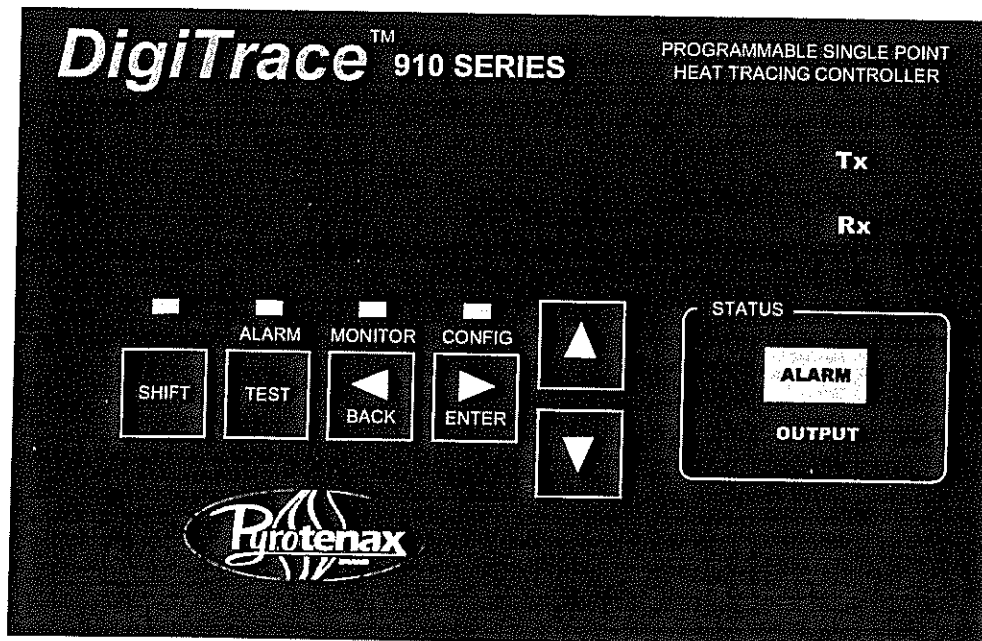


Figure 3-1 Operator Console

Key	Function
→ ENTER [shift CONFIG]	- selects the item in the display (or accepts the setting when editing a parameter) - moves the cursor to the right when editing an alpha-numeric parameter - when prefixed by the SHIFT key, this key switches the console to the Configure mode
↑	- moves to the previous item in a menu - increments the value when editing
↓	- moves to the next item in a menu - decrements the value when editing

3-3 LED INDICATORS

The console includes eight LED indicators:

Four LEDs indicate the Console operating mode. (**SHIFT**ed function, **ALARM**, **MONITOR**, or **CONFIG**ure modes).

There are two status LEDs which indicate the alarm and control output status of the controller:

1. The output LED, when illuminated, indicates that the output of the controller is turned on and is allowing current to flow into the load. For SSR versions, a flashing LED indicates that the controller is pulsing its output on and off to maintain the setpoint temperature and/or control the average amount of current/power the tracer uses.
2. The alarm LED will flash (approximately once per second) when the controller has detected an alarm condition.

The two additional LEDs are used to indicate external communications activity and are only used when an optional communications interface is installed. The "Rx" LED flashes to show that the Controller is receiving information via its communications port. The "Tx" LED flashes when the Controller is transmitting information via its communications port.

3-4 OPERATIONAL BASICS

3-4-1 Operating Modes

The console operates in one of four modes and is related to the basic function the operator selects. These modes are:

Mode	Function
Scan	This is the default mode. In this mode, the console sequentially displays load current, temperature and setpoint readings.
Alarm	Invoked when you press the SHIFT key followed by ALARM key. This mode allows you to examine or reset any alarms that may exist. The LED above the ALARM key is illuminated while in this mode.
Monitor	Invoked when you press the SHIFT key followed by MONITOR key. In this mode, you may examine any of the controller readings such as temperature, load current, ground fault current, etc. The LED above the MONITOR key is illuminated while in this mode.
Configure	Invoked when you press the SHIFT key followed by CONFIG key. In this mode, you may examine or alter the controller configuration. The LED above the CONFIG key is illuminated while in this mode.

3-4-2 Menus

Each of the operating modes has a list of data items associated with it. For example, in the **Monitor** mode you may view temperatures, load current, resistance, ground fault current, voltage, or power information. This collection of data items is referred to as a menu.

Only one menu item may be viewed at a time. The ↓ (↑) keys move to the next (previous) item in the menu. When you reach the end of the menu (indicated by ---- END ----), ↓ wraps you to

the first item in the menu; conversely, **↑** wraps you to the last item in the menu.

Some of the items within a menu are actually entry points to sub-menus -- these entries are indicated with "..." at the end of the message. To enter a sub-menu, press the **→** key. To move around in the menu, use the **↓** and **↑** keys move to the next and previous items respectively. The **←** key exits the current menu and returns to the previous menu.

After approximately five minutes of keypad inactivity, the current menu and mode will be exited and the console will revert back to the **Scan** mode.

Note: Some menus are dynamic, that is, some items appear or disappear depending on the configuration. For example, if you disable the Low Voltage Alarm, then the corresponding Low Voltage Setpoint is not available and will not be displayed.

3-4-3 Changing the Configuration

To change the Controller configuration:

- Position the desired parameter (menu item) in the display.
- Press the **→** key to initiate an edit session.
- If the console is "locked" you are prompted to enter the passcode.
- The present setting will flash on the display to indicate that you are editing the parameter.
- Use the **↑** and **↓** keys to change the value.
- The operation of the **→** and **←** varies depends on the type of data being editing. See the following sections for details.

Note: Once you have initiated an edit session, you must end it before switching to another mode or invoking another function. An edit session ends when you enter a new value (using the **→** key) or you back out of it (using the **←** key).

3-4-4 Changing a Non-numeric Parameter

To change a non-numeric parameter (e.g.: an alarm mask setting):

- Position the appropriate parameter in the display.
- Press the **←** key to initiate the edit session.
- If the console is "locked" you are prompted to enter the passcode.

- The present setting will flash on the display to indicate that you are editing the parameter.
- Use **↑** or **↓** until the desired value appears in the display.
- Pressing **→** saves the new value.
- Pressing **←** ends the edit session without altering the parameter.

3-4-5 Changing a Numeric Parameter

To change a numeric parameter (e.g. the control setpoint):

- Position the appropriate parameter in the display.
- Press the **→** key to initiate the edit session.
- If the console is "locked" you are prompted to enter the passcode.
- The present value is displayed and the last (rightmost) digit blinks.
- The blinking digit identifies the digit that you are editing.
- Use **↑** or **↓** to set the desired value.
- Use **←** or **→** to move to a different digit.
- To enter a negative value, scroll to the first (leftmost) digit until a "-" appears in the display.
- Pressing **→** while on the last (rightmost) digit saves the new value.
- Pressing **←** while on the first (leftmost) digit ends the edit session without altering the parameter.

3-4-6 Passcode Protection

The 910 Series Controller provides a passcode for protection of its configuration. You may view any portion of the configuration with the console "locked", however, when you attempt to initiate an edit session by pressing **→**, you are prompted to enter the passcode. Entering the passcode is just like entering any other numeric value; see Section 3-4-5 "Changing a Numeric Parameter".

Once the console is "unlocked", you may edit any configuration parameter. The console will automatically re-lock after approximately five minutes of keypad inactivity, or until the user explicitly locks it.

Note: Setting the programmed passcode to "0" disables passcode protection.

Note: The console does not have to be unlocked to reset alarms.

3-4-7 Feature Modes

There are two types Configuration Menus in the 910 Series Controller:

1. a "Basic" Configuration Menu which only contains seven parameters, and
2. an "Advanced" Configuration Menu which contains all of the parameters.

Both types of Configuration Menus contain a "Feature Mode" parameter which allows the user to select which type of Configuration Menu is most desirable.

3-4-8 Quick Notes on Operation

Remember the following basic rules for efficient Console use:

- use the **SHIFT** key followed by the appropriate function key -- **ALARM**, **MONITOR**, or **CONFIG** -- to select the operating mode
- use **↓** and **↑** to move around in the menu
- use **→** to enter a new menu, enter a new value, or select a menu item
- use **←** to exit the current menu or cancel an edit

SECTION IV – OPERATOR CONSOLE MODES

4-1 ALARM MODE

The **Alarm** mode is invoked when you press the **SHIFT** key followed by the **ALARM** key. This mode allows you to examine and reset any alarms that may exist. Use ↓ (↑) to examine the next (previous) active alarm.

4-1-1 Resetting One Alarm

To reset an alarm, press →. You are prompted for confirmation -- answering "YES" resets the alarm and advances you to the next alarm.

4-1-2 Resetting All Alarms

To reset all active alarms, press →. You are prompted for confirmation -- press ↑ to select "ALL" and press → to accept.

4-1-3 Monitor Mode Tracking

The **Monitor** mode "tracks" the **Alarm** mode. If the **Monitor** mode is selected while viewing an alarm, the controller will enter the **MONITOR** menu and display an appropriate reading.

For example, if you are examining a High Load Current Alarm and then select the **Monitor** mode, the starting point within the **MONITOR** menu will be the load current reading. Once the **Monitor** mode has been selected, you may move around in the menu using ↓ and ↑.

4-1-4 Alarm Messages

Table 4-1 lists sample alarms and the corresponding starting point in the **Monitor** mode menu, if it is invoked from the **Alarm** mode.

Sample Alarm	Message	Monitor Mode Starting Point
LO TS 1	= -2 °C	TS 1 Temperature
HI TS 1	= 102 °C	"
TS 1 FAIL	= ALARM	"
LO TS 2	= -4 °C	TS 2 Temperature
HI TS 2	= 105 °C	"
TS 2 FAIL	= ALARM	"
CTL TS FAIL	= ALARM	Control Temperature
LO LOAD	= 0.5 A	Load Current
HI LOAD	= 21.0 A	"
HI GFI	= 52 mA	Ground Fault Current
GFI TRIP	= 77 mA	"
LO VOLT	= 85 V	Voltage
HI VOLT	= 140 V	"
LO RESIST	= 3.38 Ω	Resistance
HI RESIST	= 9.24 Ω	"
OVERCURRENT TRIP	= ALARM	Load Current
SWITCH FAIL	= ALARM	"
HTC RESET	= ALARM	Time Since Last Reset
SWITCH LIMITING	= ALARM	Load Current
C.B. LIMITING	= ALARM	"
POWER LIMITING	= ALARM	Power
EEROM DATA FAIL	= ALARM	N/A
CONTACTOR COUNT	= 200000	Contactor Cycle Count

Table 4-1

4-2 MONITOR MODE

The **Monitor** mode is invoked when you press the **SHIFT** key followed by the **MONITOR** key.

This mode allows you to test the heat tracing and examine any of the analog readings. The data is updated in real-time, providing the user with a method of viewing tracer information as it occurs.

4-2-1 Main Menu

Monitor Mode Main Menu	
CONTROL TEMP = 4'C	
TS 1 TEMP = 4'C	
TS 2 TEMP = 7'C	(only if TS2 is being used)
LOAD = 8.9 A	
RESIST = 13.26 Ω	
GFI = 0 mA	
VOLT = 118 V	
POWER = 1050 W	(or POWER = 10.4 kW
TEST TRACING	(turn on tracing for 30 seconds)
DISPLAY TEST	(to abort DISPLAY TEST, press any key)
MAINTENANCE DATA...	Note the "... " indicating a sub-menu.
----- END -----	

Table 4-2

CONTROL TEMP = 4'C
TS 1 TEMP = 4'C
TS 2 TEMP = 7'C
LOAD = 8.9 A
RESIST = 13.26 Ω
GFI = 0 mA
VOLT = 118 V
POWER = 1050 W
TEST TRACING
DISPLAY TEST
MAINTENANCE DATA...
----- END -----

4-2-2 "MAINTENANCE DATA..." Sub-Menu

This sub-menu is used to view minimum and maximum temperatures, total accumulated power, hours in use, and the number of hours since the last time the Controller was reset. These parameters may be reset by the user.

Maintenance Data Sub-Menu	
MIN CTL TEMP = -2'C	
MAX CTL TEMP = 65'C	
TS 1 MIN TEMP = -2'C	
TS 1 MAX TEMP = 65'C	
TS 2 MIN TEMP = -1'C	
TS 2 MAX TEMP = 61'C	
POWER ACCUM = 145.9 kW-h	
CONTACTOR CYCLE COUNT = 1234	(only if Deadband or Prop. Amb. Contactor modes are being used)
IN USE = 2896 h	
TIME SINCE LAST RESET = 675 h	
----- END -----	

Table 4-3

4-3 CONFIGURE MODE

The **Configure** mode is selected when the operator presses the **SHIFT** key followed by the **CONFIG** key. This mode allows you to examine or alter the Controller's configuration. There are two types of configuration modes each presenting different features: Basic and Advanced.

The Basic Configuration Mode will limit the display to seven of the most commonly modified parameters, while the Advanced Configuration Mode presents all of the available parameters.

4-3-1 Basic Configure Mode Menu

Basic Configure Mode Menu	
CONTROL SETPOINT =	{-60 to 570}°C 40
LO TS 1 =	{-60 to 570}°C 40
LO LOAD =	{0.3 to 100.0} A 0.3
SWITCH CONTROL MODE =	{PROPORTIONAL, PROP AMB. SSR, DEADBAND, or PROP AMB. CONTACTOR}
CIRCUIT BREAKER =	{0.3 to 100.0} A (only if SSR is being used)
TEMP UNITS =	{°C or F }
FEATURE MODE =	{ BASIC or ADVANCED}
LOCK DATABASE	(only if passcode is not 0 and database is unlocked)
UNLOCK DATABASE	(only if passcode is not 0 and database is locked)
---- END ----	

Table 4-4

4-3-2 Advanced Configure Mode Main Menu

Menu items with a trailing "..." indicate an entry point to a sub-menu. To enter a sub-menu, use ↓ and ↑ to position the menu item in the display and then press →. Note that the controller "remembers" where you are in the **Configure** mode if you temporarily switch to a different mode (such as the **Monitor** mode). Switching back to

the **Configure** mode will return you to the same menu item.

Note: A few of the controller parameters that are often used have been duplicated in the Advanced **Configure** mode main menu for quick access. These parameters (Lo TS 1, Lo Load, Hi GFI, GFI Trip) may also be accessed using their respective sub-menus.

Advanced Configure Mode Main Menu	
CONTROL SETPOINT =	{-60 to 570}°C
LO TS 1 =	{-60 to 570}°C
LO LOAD =	{0.3 to 100.0} A
HI GFI =	{20 to 250} mA
GFI TRIP =	{20 to 250} mA
FEATURE MODE =	{BASIC or ADVANCED}
TS ALARMS CONFIG...	Note that the menu items with a trailing "..." indicate the entry point to a sub-menu.
OTHER ALARMS CONFIG...	
POINT SETUP...	
MISC. SETUP...	
COMMUNICATIONS SETUP...	
LOCK DATABASE	(only if passcode is not 0 and database is unlocked)
UNLOCK DATABASE	(only if passcode is not 0 and database is locked)
---- END ----	

Table 4-5

CONTROL SETPOINT = 20'C
LO TS 1 = -10'C
LO LOAD = 1.0 A
HI GFI = 50 mA
GFI TRIP = 75 mA
TS ALARMS CONFIG...
OTHER ALARMS CONFIG...
POINT SETUP...
MISC. SETUP...
COMMUNICATIONS SETUP...
---- END ----

4-3-3 "TS ALARMS CONFIG..." Sub-Menu

This sub-menu is used to set up alarms that relate to any of the temperature sensors. Each alarm may be ENabled or DISabled, and if the alarm is ENabled, an alarm setting may be entered.

TS Alarms Configuration Sub-Menu	
TS 1 FAIL =	{ENA or DIS}
LO TS 1 =	{ENA or DIS}
LO TS 1 =	{-60 to 570}'C
HI TS 1 =	{ENA or DIS}
HI TS 1 =	{-60 to 570}'C
TS 2 FAIL =	{ENA or DIS}
LO TS 2 =	{ENA or DIS}
LO TS 2 =	{-60 to 570}'C
HI TS 2 =	{ENA or DIS}
HI TS 2 =	{-60 to 570}'C
LO TS FILTER =	{0 to 999} MIN (only if LO TS 1 or 2 are enabled)
HI TS FILTER =	{0 to 999} MIN (only if HI TS 1 or 2 are enabled)
LATCH TS ALARMS =	{YES or NO}
CTL TS FAIL =	{ENA or DIS}
---- END ----	

Table 4-6

```

CONTROL SETPOINT = 20'C
LO TS 1 = -10'C
LO LOAD = 1.0 A
HI GFI = 50 mA
GFI TRIP = 75 mA
TS ALARMS CONFIG...

```

OTHER ALARMS CONFIG...

```

POINT SETUP...
MISC. SETUP...
COMMUNICATIONS SETUP...
---- END ----

```

4-3-4 "OTHER ALARMS CONFIG..." Sub-Menu

This sub-menu allows the user to set up all alarms that do not directly relate to the temperature sensors. These include all AC alarms (voltage, current, ground fault, etc.) as well as protection settings such as power limiting, etc.

Each alarm may be ENABLED or DISabled. If the alarm is ENABLED, an alarm setting and filter setting may be entered.

Other Alarms Configuration Sub-Menu

```

LO LOAD = {ENA or DIS}
LO LOAD = {0.3 to 100.0} A
LO LOAD FILTER = {0 to 12} S
HI LOAD = {ENA or DIS}
HI LOAD = {0.3 to 100.0} A
HI LOAD FILTER = {0 to 12} S
HI GFI = {ENA or DIS}
HI GFI = {20 to 250} mA
HI GFI FILTER = {0 to 12} S
GFI TRIP = {ENA or DIS}
GFI TRIP = {20 to 250} mA
LO VOLT = {ENA or DIS}
LO VOLT = {10 to 330} V
LO VOLT FILTER = {0 to 12} S
HI VOLT = {ENA or DIS}
HI VOLT = {10 to 330} V
HI VOLT FILTER = {0 to 12} S
LO RESIST = {ENA or DIS}
LO RESIST = {1 to 100} %
LO RESIST FILTER = {0 to 12} S
HI RESIST = {ENA or DIS}
HI RESIST = {1 to 250} %
HI RESIST FILTER = {0 to 12} S
NOMINAL RESIST = {2.00 to 2000.00}Ω (only if LO or HI is enabled)
OVERCURRENT TRIP = {ENA or DIS} (only if SSR is being used)
SWITCH FAIL = {ENA or DIS}
HTC RESET = {ENA or DIS}
C.B. LIMITING = {ENA or DIS} (only if SSR is being used)
POWER LIMITING = {ENA or DIS} (only if SSR is being used)
SWITCH LIMITING = {ENA or DIS} (only if SSR is being used)
CONTACTOR COUNT = {ENA or DIS} (only if Deadband or Prop. Amb.
Contactor are being used)
CONTACTOR COUNT = {0 to 999999} (only if Deadband or Prop. Amb.
Contactor are being used)
EEROM DATA FAIL = {ENA or DIS}
---- END ----

```

Table 4-7

```

CONTROL SETPOINT = 20'C
LO TS 1 = -10'C
LO LOAD = 1.0 A
HI GFI = 50 mA
GFI TRIP = 75 mA
TS ALARMS CONFIG...
OTHER ALARMS CONFIG...
POINT SETUP...
MISC. SETUP...
COMMUNICATIONS SETUP...
----- END -----

```

4-3-5 "POINT SETUP..." Sub-Menu

The "Point Setup" sub-menu is used to configure parameters that relate directly to the specific control point.

Included in this menu are control mode settings, circuit breaker and switch ratings, auto-cycle set up parameters, etc.

Point Setup Sub-Menu	
TAG = {19 ALPHA-NUMERIC CHARACTERS}	
SWITCH CONTROL MODE = {PROPORTIONAL, PROP AMB. SSR, DEADBAND, or PROP AMB. CONTACTOR}	
DEADBAND = {1 to 50}'C	(only if SWITCH CONTROL MODE is DEADBAND)
PROP BAND = {1 to 50}'C	(only if SWITCH CONTROL MODE is not DEADBAND)
CYCLE TIME = {10 to 255} MIN	(only if SWITCH CONTROL MODE is PROP AMB. CONTACTOR)
SWITCH RATING = {0.3 to 100.0} A	(only if SSR is being used)
CIRCUIT BREAKER = {0.3 to 100.0} A	(only if SSR is being used)
MAX POWER = {3 W to 33,000} W	(only if SSR is being used)
TS FAIL MODE = {OFF or ON}	
TS CTL MODE = {TS 1-FAIL OFF(ON) or TS 1-FAIL TO TS 2 or TS 2-FAIL OFF(ON) or TS 2-FAIL TO TS 1 or AVERAGE-FAIL OFF(ON) or AVERAGE-FAIL TO GOOD or LOWEST-FAIL OFF(ON) or LOWEST-FAIL TO GOOD }	
TS 1 TYPE = {100 Ω PLAT or NI-FE}	
TS 1 LEAD RESIST = {0 to 20.00} Ω	(only if TS 1 TYPE = NI-FE)
TS 1 HI LIMIT = {ENA or DIS}	
TS 2 TYPE = {100 Ω PLAT or NI-FE}	
TS 2 LEAD RESIST = {0 to 20.00} Ω	(only if TS 2 TYPE = NI-FE)
TS 2 HI LIMIT = {ENA or DIS}	
AUTO-CYCLE = {ENA or DIS}	
AUTO-CYCLE INTERVAL = {1 to 240}	(only if AUTO-CYCLE = ENA)
AUTO-CYCLE UNITS = {HOURS or MINUTES}	(only if AUTO-CYCLE = ENA)
OVERRIDE SOURCE = {REMOTE or EXT. INPUT}	
LOAD SHEDDING = {ENA or DIS}	
----- END -----	

Table 4-8

CONTROL SETPOINT = 20'C
LO TS 1 = -10'C
LO LOAD = 1.0 A
HI GFI = 50 mA
GFI TRIP = 75 mA
TS ALARMS CONFIG...
OTHER ALARMS CONFIG...
POINT SETUP...
MISC. SETUP...
COMMUNICATIONS SETUP...
---- END ----

4-3-6 "MISC. SETUP..." Sub-Menu

The "Misc. Setup" sub-menu is used to configure miscellaneous parameters.

Misc. Setup Sub-Menu	
TEMP UNITS =	{ 'C or 'F }
VERSION =	V3.16.3
EXT. INPUT =	{ NOT USED, INHIBIT or FORCE ON }
FLASH ALARM OUTPUT =	{ YES or NO }
ALARM OUTPUT =	{ N.C. or N.O. }
LANGUAGE =	{ ENGLISH or FRANCAIS }
PASSCODE =	{ 0000 to 9999 } (only if 0 or database is unlocked)
SCROLL DELAY =	{ 0.07 to 0.25 } S
LOAD DEFAULTS	
---- END ----	

Table 4-9

```

CONTROL SETPOINT = 20'C
LO TS 1 = -10'C
LO LOAD = 1.0 A
HI GFI = 50 mA
GFI TRIP = 75 mA
TS ALARMS CONFIG...
OTHER ALARMS CONFIG...
POINT SETUP...
MISC. SETUP...
COMMUNICATIONS SETUP...
----- END -----

```

4-3-7 "COMMUNICATIONS SETUP..." Sub-Menu

The settings found in this sub-menu must be configured whenever an optional communications board is installed in the Control Module.

Communications Setup Sub-Menu		
PROTOCOL =	{HTCBUS or MODBUS ASCII or MODBUS RTU}	
HTCBUS ADDR =	{1 to 16777215}	(only if PROTOCOL= HTCBUS)
MODBUS ADDR =	{1 to 247}	(only if PROTOCOL is not HTCBUS)
MODBUS SUB ADDR =	{0 to 31}	(only if PROTOCOL is not HTCBUS)
BAUD RATE =	{AUTO or 9600 or 4800 or 2400 or 1200 or 600 or 300}	
PARITY =	{NONE or ODD or EVEN}	(only if PROTOCOL is not HTCBUS)
HARDWARE =	{NONE or MODEM or RS-232 or RS-485}	
DRIVER =	{AUTO or RS-485 or RS-232 or MODEM}	
PROFILE =	{AUTO or 3-WIRE RS-232 or RS-485 or 1200 BAUD MODEM or 300 BAUD MODEM}	
Tx DELAY =	{0.00 to 2.50} S	
----- END -----		

Table 4-10

SECTION V - CONFIGURATION

PARAMETER

DETAILS

5-1 INTRODUCTION

The Sections that follow explain the various functions of the 910 controller and how they may be accessed. The first line of each Section identifies the function to be described. Each Section goes on to explain the **Purpose** of the function, the **Range** over which it may be set, the **Procedure** for setting or enabling the feature, and finally any **Notes** or **Cautions** that pertain to the particular function.

Setting and using the alarming functions of the 910 controller is a two step procedure:

1. The alarm must be enabled or disabled as desired. When using the Operator Console, access to all alarming functions is available using the ADVANCED CONFIGURE mode sub-menus. When using either the Model 780/GCC-9000 Group Communications Controller, the alarm masks may be found in the HTC SET-UP Section. Please see the appropriate operating manual for instructions on accessing controller parameters using these devices.

2. The corresponding alarm point value may be modified appropriately for the application. When using the Operator Console, access to the alarm points is also available using the ADVANCED CONFIGURE mode sub-menus. Modification of the alarm setpoint values is found in the HTC SETPOINTS Section of the Model 780/GCC-9000 Group Communications Controller. Please see the appropriate operating manual for instructions on accessing controller parameters using these devices.

Note: The Operator Console and the Model 780/GCC-9000 WILL NOT allow modification of an alarm point value if the alarm has been disabled (DIS) with the exception of the HIGH TS ALARM temperature settings. These may still be modified if the corresponding HIGH LIMIT CUTOFF has been enabled (ENA).

5-2 POINT SETUP PARAMETERS

This Section describes the setup parameters that relate to the 910.

5-2-1 Control Setpoint Temperature

Purpose: The CONTROL SETPOINT temperature is the value at which the heat trace controller maintains the circuit temperature through either proportional, proportional ambient SSR, proportional ambient contactor or deadband control, depending on the controllers' configuration. The CONTROL SETPOINT temperature is compared to the temperature measured by the control temperature sensor (TS). A decision is then made to turn on or turn off the output to control power to the tracer.

Range: -60 to 570°C (-76 to 1058°F)

Procedure: Adjust the CONTROL SETPOINT temperature value to the desired maintain temperature. The HTC will switch the output ON and OFF in an attempt to maintain this temperature.

Note: See Section 7-2 of this manual for an explanation of Proportional, Proportional Ambient SSR, Proportional Ambient Contactor and Deadband Control algorithms.

Note: When using the Operator Console, the CONTROL SETPOINT temperature range may be limited by the CONSOLE SETPOINT MAXIMUM and MINIMUM values (see Sections 5-2-23 and 5-2-24). This is a safety feature to prevent users in the field from modifying the CONTROL SETPOINT temperature setting to a dangerous level.

5-2-2 Alpha-numeric TAG Assignment

Purpose: A 19 character alpha-numeric TAG may be assigned to a control point to allow it to be easily associated with a pipe, vessel, process, circuit, drawing name or number.

Setting: Any combination of 19 characters from A-Z, 0-9, "/", "-", ".", "(", ")", or "#".

Procedure: Using the Operator Console, enter the desired text.

5-2-3 Switch Control Mode

Purpose: This allows selection of the type of algorithm to be used by the HTC to maintain the CONTROL SETPOINT temperature. There are four different control algorithms available in the HTC – proportional, proportional ambient SSR, proportional ambient contactor and deadband.

See Section 7-2 for a complete explanation of these controlling techniques as implemented in the HTC.

Setting:

PROPORTIONAL, PROPORTIONAL AMBIENT SSR, PROPORTIONAL AMBIENT CONTACTOR or DEADBAND

Procedure: Select the desired control technique. Note that deadband control and proportional ambient contactor should be selected when using contactors or when precise control and advanced current handling functions are not required.

Note: If deadband is selected, a DEADBAND setting will be available in the HTC configuration menu, otherwise, a PROPORTIONAL BAND setting will be available. No MAXIMUM POWER, SWITCH CURRENT RATING or CIRCUIT BREAKER CURRENT RATING settings are available when the controller is set to operate in either contactor mode. If proportional ambient contactor is selected, the CYCLE TIME setting will also be available.

5-2-4 Proportional Band Setting

(For use with the three proportional control modes only).

Purpose: When an HTC equipped with SSRs is used to control a heating circuit, proportional or proportional ambient SSR modes are normally used, allowing for more precise temperature control. When using contactors, the proportional ambient contactor mode should be selected.

This programmable proportional band acts to vary the on to off time of the output based on the difference between the measured control temperature and the desired CONTROL SETPOINT temperature.

Range: 1 to 50°C (2 to 90°F)

Procedure: Adjust the PROPORTIONAL BAND setting to the desired differential from the CONTROL SETPOINT temperature.

Note: See Section 7-2 of this manual for an explanation of how the three proportional modes use the PROPORTIONAL BAND setting.

Note: When using Series-type, Constant wattage, or Self-regulating tracers in an ambient temperature control application, significant energy savings may be realized by setting the PROPORTIONAL BAND to match the expected range of operating ambient temperatures. Tracer design is normally done assuming worst-case

conditions, where 100% of the design output power is required to maintain the desired minimum temperature. When the ambient temperature is above the design minimum, but some heat is still required, adjusting the PROPORTIONAL BAND width accordingly will allow only the amount of power required by the application to be consumed, while maintaining the minimum required temperature.

Example: A water line must be protected from freezing when the ambient temperature falls below +10°C. Either the proportional ambient SSR or proportional ambient contactor mode is selected as the control method (depending on the type of switch being used). The heater and insulation combination are chosen to impart enough heat to the line to keep it from freezing at a worst-case ambient temperature of -40°C. At +10°C, the heater should be completely off, since no heat is required at this temperature to guarantee that the product will not freeze. It follows that the amount of heat required by the water line decreases as the ambient temperature increases from -40°C to +10°C (theoretically, at -15°C the heater output should be approximately 50%). Setting the CONTROL SETPOINT temperature to 10°C, and the PROPORTIONAL BAND to 50°C, will force the controller's output to be 100% on at -40°C, 50% on at -15°C, and off at +10°C.

5-2-5 Deadband Setting

(Deadband control mode only).

Purpose: When an HTC equipped with a contactor is used to control a heating circuit, it is necessary to use deadband rather than proportional control. This is done to prevent the contactor from switching on and off rapidly and being worn out prematurely. This deadband acts as an on/off control where the decision to turn the output off or on is based upon a window of difference between the measured control temperature and the desired CONTROL SETPOINT temperature.

Range: 1 to 50°C (2 to 90°F)

Procedure: Adjust the DEADBAND setting to the desired differential from the desired CONTROL SETPOINT temperature. When the control temperature is above the setpoint + deadband value, the controller will turn off the output to the tracer. If the control temperature drops down below the setpoint, the output will be turned back on. Note that the smaller the DEADBAND setting, the more often the contactor will cycle on and off, decreasing its operational life.

Note: See Section 7-2 of this manual for an explanation of Deadband Control. Note that the MAXIMUM POWER, SWITCH CURRENT RATING, and CIRCUIT BREAKER CURRENT RATING settings are not available when the HTC is set to Deadband mode (typically when switching a contactor).

5-2-6 Cycle Time Setting

(For proportional ambient contactor control mode only).

Purpose: This parameter determines the minimum amount of time it will take for a complete contactor ON-OFF-ON cycle.

Range: 10 to 255 Minutes

Procedure: Adjust the CYCLE TIME setting to yield the desired contactor ON+OFF time for a particular duty cycle. For instance, if the contactor should remain on for 5 minutes with a 50% duty cycle, then the CYCLE TIME should be 10 minutes. A new duty cycle (based on measured control temperature, PROPORTIONAL BAND and CONTROL SETPOINT) is calculated every time the contactor is required to change state.

Note: If the calculated duty cycle is 0% or 100%, then the contactor will not change state and the duty cycle will not be calculated again for a time period = CYCLE TIME/30.

Note: The minimum cycle time setting is 10 minutes, and the minimum controller output duty cycle is 3%. This results in a minimum contactor ON time of 18 seconds.

5-2-7 Switch Current Rating Setting (SSR Only)

Purpose: The SWITCH CURRENT RATING setting defines the current rating of the output switch. It is used by the controller to limit the maximum average current that will be allowed to flow to the load before it begins to adjust the output duty cycle, limiting the amount of current to an acceptable level.

Range: 0.3 to 100.0 Amps

Procedure: Adjust the SWITCH CURRENT RATING setting to match the current rating of the output device (i.e. 30.0 Amps).

5-2-8 Circuit Breaker Current Rating Setting (SSR Only)

Purpose: The CIRCUIT BREAKER CURRENT RATING setting helps prevent in-rush induced nuisance tripping of the circuit breaker

immediately upstream of the controller. The HTC evaluates the square of the current related to time (I^2t) and adjusts the output duty cycle accordingly, limiting the amount of current to an acceptable level.

Range: 0.3 to 100.0 Amps

Procedure: Adjust the CIRCUIT BREAKER CURRENT RATING setting to the heating circuit breaker size (i.e. 30.0 Amps).

Note: This feature SHOULD NOT be used to reduce the size of a circuit breaker or increase the maximum heating cable length. It can be quite effective in preventing nuisance trips due to incorrect design or factors outside those considered by the design.

5-2-9 Maximum Power Setting (SSR Only)

Purpose: This user selectable level limits the maximum amount of power applied to a heat trace circuit. This is an average power calculated by the controller using the average current and applied voltage. The HTC switches the output on and off rapidly to limit the average current to an appropriate level. The MAXIMUM POWER level may be adjusted to eliminate step-down transformers, lower the effective output wattage of a cable, or implement energy management of the heat trace circuit.

Range: 3 to 33,000 Watts

Procedure: Adjust the MAXIMUM POWER level to the desired value (watts). Use the TEST TRACING function to observe the power limiting operation.

Note: This function may be set within reasonable limits for the particular tracer being powered. The effective resolution of the setting is limited to 1/30th of the calculated full on power.

Note: Do not set the MAXIMUM POWER below full output for applications that do not require power limiting.

5-2-10 TS Fail Mode

Purpose: This parameter determines whether the HTC turns the output switch ON or OFF if all selected temperature sensors fail to provide a valid control temperature.

Setting:
OFF or ON

Procedure: If the HTC should turn the output switch off when it cannot read a valid control

temperature, then select OFF, otherwise if the output switch should turn on then select ON.

Note: This parameter is part of the TS CONTROL MODE.

5-2-11 Temperature Sensor Control Mode

Purpose: The TS CONTROL MODE allows the selection of one of eight possible temperature control modes for the controller. The different modes allow redundant fail-safe temperature sensing, averaging, or minimum maintain temperature control.

Setting: Select one of the following eight possible modes:

CONTROL TS & DESCRIPTION

CONTROL USING TS 1, FAIL OFF/ON
CONTROL USING TS 1, FAIL TO TS 2
CONTROL USING TS 2, FAIL OFF/ON
CONTROL USING TS 2, FAIL TO TS 1
CONTROL ON AVERAGE, FAIL OFF/ON
CONTROL ON AVERAGE, FAIL TO GOOD
CONTROL ON LOWEST, FAIL OFF/ON
CONTROL ON LOWEST, FAIL TO GOOD

Where OFF/ON = Controllers' output switch turned OFF or ON as determined by the TS FAIL MODE.

Example: With a TS CONTROL MODE of CONTROL ON AVERAGE, FAIL TO GOOD, the controller will measure both sensors (TS 1 and TS 2), averaging the two temperature values, display the results and cycle the heater ON or OFF to maintain the CONTROL SETPOINT temperature. This is the primary control mode. If either sensor should fail, the controller will transfer control to the remaining "good" sensor and generate the appropriate TS 1 or TS 2 FAILURE ALARM (assuming that the alarm is enabled). The temperature will now be maintained based on this measured value. If the remaining "good" sensor fails, the controller will turn the heater OFF or ON as determined by the TS FAIL MODE setting. The appropriate TS 1 or TS 2 FAILURE ALARM will be also be generated.

Procedure: Select the control mode that best suits the application.

Note: Ensure that TS FAILURE ALARMS are enabled. See Sections 5-4-1, 5-4-4, and 5-4-10 for a complete explanation of RTD failure detection in the HTC.

5-2-12 TS 1 Type

Purpose: This parameter specifies the type of RTD that is connected to the HTC's TS 1 input.

Setting:

3 wire 100 Ω Platinum or 2(or 3) wire 100 Ω Nickel Iron (NI-FE).

Procedure: Select the type of RTD that is connected to the TS 1 input.

Note: If a 2 wire 100 Ω Nickel Iron (NI-FE) RTD is selected then the TS 1 LEAD RESISTANCE must be entered manually (see Section 5-2-13).

5-2-13 TS 1 Lead Resistance

(For NI-FE RTDs only).

Purpose: This parameter specifies the lead resistance of a 2 wire Nickel Iron RTD connected to the HTC's TS 1 input.

Range: 0 to 20.00 Ω

Procedure: Measure the resistance of one of the Nickel Iron RTD leads (from the RTD to the HTC's TS 1 input) and use this value as the TS 1 LEAD RESISTANCE.

5-2-14 TS 1 High Limit Cutout

Purpose: When enabled, the TS 1 HIGH LIMIT CUTOUT feature will override the CONTROL SETPOINT temperature and force the controller output off if the TS 1 reading exceeds the HIGH TS 1 ALARM temperature setting. This is a non-latching condition, so once the TS 1 reading drops below the HIGH TS 1 ALARM temperature setting, the controller will resume normal operation.

Setting:

ENABLE or DISABLE

Procedure: Enable or disable the cutout feature as desired.

Note: The TS 1 HIGH LIMIT CUTOUT feature overrides an auto-cycle test. A pending auto-cycle will be initiated immediately after the TS 1 temperature drops below the HIGH TS 1 ALARM temperature setting.

Note: If a TS 1 failure occurs and the TS 1 HIGH LIMIT CUTOUT feature is enabled, the switch output will latch **off** regardless of the TS CONTROL MODE setting or the TS FAIL MODE setting.

Note: If the TS 1 HIGH LIMIT CUTOUT feature is enabled, then the HIGH TS 1 ALARM temperature

setting can be set, regardless of whether the HIGH TS 1 ALARM is enabled.

5-2-15 TS 2 Type

Purpose: This parameter specifies the type of RTD that is connected to the HTC's TS 2 input.

Setting:

3 wire 100 Ω Platinum or 2(or 3) wire 100 Ω Nickel Iron (NI-FE).

Procedure: Select the type of RTD that is connected to the TS 2 input.

Note: If a 2 wire 100 Ω Nickel Iron (NI-FE) RTD is selected then the TS 2 LEAD RESISTANCE must be entered (see Section 5-2-16).

5-2-16 TS 2 Lead Resistance

(For NI-FE RTDs only)

Purpose: This parameter specifies the lead resistance of a 2 wire Nickel Iron RTD connected to the HTC's TS 2 input.

Range: 0 to 20.00 Ω

Procedure: Measure the resistance of one of the Nickel Iron RTD leads (from the RTD to the HTC's TS 2 input) and use this value as the TS 2 LEAD RESISTANCE.

5-2-17 TS 2 High Limit Cutout

Purpose: When enabled, the TS 2 HIGH LIMIT CUTOUT feature will override the CONTROL SETPOINT temperature and force the controller output off if the TS 2 reading exceeds the HIGH TS 2 ALARM temperature setting. This is a non-latching condition, so once the TS 2 reading drops below the HIGH TS 2 ALARM temperature setting, the controller will resume normal operation.

Setting:

ENABLE or DISABLE

Procedure: Enable or disable the cutout feature as desired.

Note: The TS 2 HIGH LIMIT CUTOUT feature overrides an auto-cycle test. A pending auto-cycle will be initiated immediately after the TS 2 temperature drops below the HIGH TS 2 ALARM temperature setting.

Note: If a TS 2 failure occurs and the TS 2 HIGH LIMIT CUTOUT feature is enabled, the switch output will latch **off** regardless of the TS CONTROL MODE setting or the TS FAIL MODE setting.

Note: If the TS 2 HIGH LIMIT CUTOUT feature is enabled, then the HIGH TS 2 ALARM temperature setting can be set, regardless of whether the HIGH TS 2 ALARM is enabled.

5-2-18 Auto-Cycle Enabling

Purpose: The auto-cycle function momentarily (approximately 10 seconds) applies power to the heating circuit at the selected interval. It is used to test the integrity of the heating circuit. Alarms present at the time of auto-cycle then become latched and remain active after the completion of the auto-cycle function. Auto-cycling effectively eliminates the need for preventive maintenance by automatically verifying the heating circuit integrity.

Setting:

ENABLE or DISABLE

Procedure: Enable or disable the auto-cycling feature as desired. If the feature is disabled, you will not be prompted to enter the AUTO-CYCLE INTERVAL or AUTO-CYCLE UNITS.

Note: Auto-cycling should always be enabled for normal operation. Disabling this feature should only be required where the HTC system is monitoring a circuit exercised by some other device or means. Although this function defeats temperature control and forces output on, the controller will continue to adjust the output for protection purposes or power limiting (SSR option only).

Note: Auto-cycling is inhibited if the controller is in the load shedding mode. See Section 7-3.

Note: If auto-cycling is enabled, the HTC will always auto-cycle for 10 seconds when power is initially applied.

Note: If auto-cycling is enabled, and TS FAIL MODE = OFF and all the control temperature sensors have failed, the HTC will still perform an auto-cycle.

Note: If an alarm condition, with an alarm filter time greater than 0, appears during the auto-cycling, then the auto-cycle will be extended (past the 10 seconds) until the alarm filter time has expired.

5-2-19 Auto-Cycle Time Interval

Purpose: AUTO-CYCLE INTERVAL is the number of hours/minutes between successive heating circuit integrity tests depending on the AUTO-CYCLE UNITS specified.

Range: 1 to 240

Procedure: Set the AUTO-CYCLE INTERVAL to the desired time period.

Note: When using proportional ambient contactor mode, the CYCLE TIME setting should be less than the AUTO-CYCLE INTERVAL otherwise auto-cycling could affect the duty-cycle.

Note: If an AC ALARM becomes active during an auto-cycle, but the AUTO-CYCLE INTERVAL expires prior to the corresponding ALARM FILTER time, then auto-cycling will continue until the ALARM FILTER time has elapsed.

Note: For the earliest possible alarming of heating circuit problems the AUTO-CYCLE INTERVAL should be set to a small value.

5-2-20 Auto-Cycle Time Units

Purpose: The Auto-cycle time units parameter allows selection of minutes or hours for the AUTO-CYCLE INTERVAL setting.

Setting:
HOURS or MINUTES

Procedure: Set the AUTO-CYCLE UNITS to the desired time units.

5-2-21 Override Source

Purpose: An override signal can be sent to the HTC from one of two sources. This override signal can be used to override the controller's temperature control and force the output switch off or on. This is especially useful when the user wishes to turn a controller or a group of controllers off over the summer months, during maintenance, or when a line is flowing and does not require heating.

Setting:
REMOTE or EXT. INPUT

Procedure: If the override signal will be generated remotely and received by the HTC via the optional communications interface, select REMOTE as the OVERRIDE SOURCE. If the override signal will be received by the HTC via the external input, select EXTERNAL INPUT as the OVERRIDE SOURCE.

Note: If the EXTERNAL INPUT is not configured as either INHIBIT or FORCE ON then OVERRIDE SOURCE will always automatically be set to REMOTE. See Section 5-3-3 for further details.

Note: If the auto-cycle feature is enabled, it will continue to function even when an INHIBIT override signal is being received as long as load shedding is not active.

Note: Fail safe mode is inactive if an INHIBIT override signal is being received.

Note: Load shedding and fail safe modes are inactive if a FORCE ON override signal is being received.

Note: Only the LOW TS ALARMS for temperature sensors used by the TS CONTROL MODE are inactive if an INHIBIT override signal is being received.

5-2-22 Load Shedding Enabling

Purpose: The load shedding function allows the controller output to be forced OFF by way of a remote contact input on the 780 Group Communications Controller. It may be used to turn OFF the output of one or more controllers in order to reduce energy consumption to avoid peak demand surcharges, remove power from unused circuits, or remove power from circuits which may be subjected to steam cleaning.

Setting: ENABLE or DISABLE

Procedure: Enable or disable the load shedding control mode as desired.

Note: To completely configure the HTC for load shedding operation, the following additional parameters must be set up using the Model 780/GCC-9000:

Fail Safe Mode
Load Shedding GCC Contact Association

These additional parameters may only be accessed using the Group Communications Controller. See the appropriate Section of the GCC manual for further details.

Note: Fail safe mode is not supported when using proportional ambient SSR or proportional ambient contactor modes.

Note: For fail safe mode to function, at least one LOW TS ALARM of the controlling temperature sensor(s) must be enabled and the corresponding LOW TS ALARM temperature setting must be less than the CONTROL SETPOINT temperature.

5-2-23 Console Setpoint Maximum

Purpose: When using the Operator Console the maximum setting of the CONTROL SETPOINT

temperature may be limited to the CONSOLE SETPOINT MAXIMUM value. This is a safety feature to prevent users in the field from modifying the CONTROL SETPOINT temperature setting to a dangerous level.

Range: -60 to 570°C (-76 to 1058°F)

Procedure: Adjust the CONSOLE SETPOINT MAXIMUM temperature value to limit the maximum allowable CONTROL SETPOINT TEMPERATURE that may be set using the Operator Console. The CONSOLE SETPOINT MAXIMUM may only be set using a communicating device such as the Model 780/GCC-9000. See the 780/GCC-9000 user manual for the proper procedure.

Note: The CONSOLE SETPOINT MAXIMUM is not displayed on the Operator Console.

5-2-24 Console Setpoint Minimum

Purpose: When using the Operator Console the minimum setting of the CONTROL SETPOINT temperature may be limited to the CONSOLE SETPOINT MINIMUM value. This is a safety feature to prevent users in the field from modifying the CONTROL SETPOINT temperature setting to a dangerous level.

Range: -60 to 570°C (-76 to 1058°F)

Procedure: Adjust the CONSOLE SETPOINT MINIMUM temperature value to limit the minimum allowable CONTROL SETPOINT TEMPERATURE that may be set using the Operator Console. The CONSOLE SETPOINT MINIMUM may only be set using a communicating device such as the Model 780/GCC-9000. See the 780/GCC-9000 manual for the proper procedure.

Note: The CONSOLE SETPOINT MINIMUM is not displayed on the Operator Console.

5-3 MISCELLANEOUS SETUP PARAMETERS

The following Section describes miscellaneous setup parameters.

5-3-1 Temperature Display Units

Purpose: This allows selection of the type of temperature units to display on the Operator Console. All temperature related values will be displayed in the selected units.

Note: This setting will not affect the temperature units displayed at a 780/GCC-9000 Group Communications Controller. The GCC may be set independently.

Setting:
DEGREES C or DEGREES F

Procedure: Adjust the setting to the desired temperature units (°C or °F).

Note: To minimize possible confusion, it is recommended that the temperature units be set the same on the HTC and any other communicating devices.

5-3-2 Version of Firmware And Hardware

Purpose: The first 3 digits indicate the revision level of the firmware programmed into the controller. As new features are added to the HTC, the firmware revision level is incremented to allow the user to determine which features are available for the particular unit being used. The fourth digit indicates the type of 910 hardware.

5-3-3 External Input Port

Purpose: This input port may be used as an OVERRIDE SOURCE to sense a remote dry contact closure. This will override the controller's temperature control and force its output switch off or on.

Setting: NOT USED, INHIBIT or FORCE ON

Procedure: If the EXTERNAL INPUT is not being used select NOT USED. If a remote dry contact closure should force the output switch off then select INHIBIT. If a remote dry contact closure should force the output switch on, then select FORCE ON.

If the EXTERNAL INPUT is set to INHIBIT or FORCE ON, then OVERRIDE SOURCE must be set to EXT. INPUT.

Note: When used with the INHIBIT/FORCE ON feature, a contact closure sensed by the EXTERNAL INPUT will initiate the INHIBIT/FORCE ON mode. An open input will cause the controller to revert back to normal temperature control operation.

One possible use of the INHIBIT feature is to use an external device (such as a flow meter) to provide a contact closure if there is flow in a line. As long as the line has adequate flow, the heating will be off (INHIBITED from operating). See Appendix C for typical connection diagrams when using this input.

Note: EXTERNAL INPUT must be set to INHIBIT or FORCE ON before OVERRIDE SOURCE can be set to EXT. INPUT. Setting EXTERNAL INPUT to NOT USED will automatically set OVERRIDE SOURCE to REMOTE.

5-3-4 Flash Alarm Output Setting

Purpose: Programs both the alarm output relays (dry contact and AC alarm) for flashing or steady output in case of an alarm condition.

Setting: YES (Flash) or NO (Steady)

Procedure: Set the alarm output relays to flash or not to flash on an alarm condition, whichever suits the application.

Note: If the alarm output is used to drive a pilot light, it is recommended that YES be selected to enable flashing operation. When the output is also configured for normally closed operation, the pilot light will be on steady for normal operation, flash in case of alarm and be extinguished due to a bulb failure or loss of power.

Note: If multiple alarm outputs from different controllers are wired in series (i.e.: multi-point panels), set this parameter to NO (steady).

5-3-5 Alarm Output Normal State

Purpose: Configures both the alarm output relays (dry contact and AC alarm) for normally open or normally closed operation. The normal condition is assumed to be when the HTC is powered and no alarms exist.

Setting: N.O. (Normally Open) or N.C. (Normally Closed)

Procedure: Set the alarm output relays to normally open or normally closed to suit the application.

Note: If a pilot light is used for indication of alarms, normally closed operation provides a steady illumination of the lamp when the circuit is operating correctly. A light that is flashing or out indicates a fault condition. A burned out lamp is readily identified if the HTC is set to flash the dry contact alarm output relay and the AC Alarm Relay output in case of alarm. See the Section 5-3-4.

5-3-6 Language

Purpose: Defines which language the Operator Console is to use when prompting the user for input and/or displaying messages and status.

Setting: ENGLISH or FRANCAIS

Procedure: Select the language of choice -- ENGLISH for English prompts and messages, or FRANCAIS for French prompts and messages.

5-3-7 Passcode

See Section 5-7-1.

5-3-8 Scroll Delay Setting

Purpose: Allows the user to modify the speed at which information is scrolled on the Operator Console for ease of viewing.

Range: 0.07 to 0.25 Seconds

Procedure: Decreasing the scroll delay value will cause the information on the display to scroll by faster. Increasing the scroll delay value will cause the information on the display to scroll by slower.

5-4 TEMPERATURE SENSOR ALARMS CONFIGURATION

This Section defines the temperature related alarming functions of the 910 controller.

5-4-1 Temperature Sensor 1 Failure Alarm

Purpose: Enabling TS 1 FAILURE will provide indication of an open or shorted failure of TS 1.

Alarm Mask:
ENABLE or DISABLE

Procedure: Enable or disable alarming of a failed temperature sensor connected to the TS 1 input as required.

Note: This failure alarm should be enabled if a temperature sensor is connected to the TS 1 input.

Note: This alarm is always latched and must be reset by the user.

5-4-2 Low Temperature Sensor 1 Alarm

Purpose: If enabled, the LOW TS 1 ALARM allows for alarming of low temperature conditions as sensed by the first temperature sensor (TS 1).

Alarm Mask:
ENABLE or DISABLE

Range: -60 to 570°C (-76 to 1058°F)

Procedure: Adjust the LOW TS 1 ALARM temperature setpoint to the desired value. Note

that the LOW TS 1 ALARM must be enabled in order to adjust the LOW TS 1 ALARM temperature setpoint.

Note: This alarm should normally be enabled and the setpoint should be appropriate for the heating application. Maintaining a minimum 5 °C differential between low temperature alarming and the CONTROL SETPOINT temperature will minimize nuisance alarming due to momentary dips in temperature. Another alternative to this is to configure the controller for non-latching temperature alarms.

Note: This alarm must be enabled and its setpoint must be below the CONTROL SETPOINT temperature if fail safe mode uses the temperature reading from TS 1.

5-4-3 High Temperature Sensor 1 Alarm

Purpose: If enabled, the HIGH TS 1 ALARM allows for alarming of high temperature conditions as sensed by the first temperature sensor (TS 1).

Alarm Mask:
ENABLE or DISABLE

Range: -60 to 570°C (-76 to 1058°F)

Procedure: Adjust the HIGH TS 1 ALARM temperature setpoint to the desired value. Note that the HIGH TS 1 ALARM must be enabled in order to adjust the HIGH TS 1 ALARM temperature setpoint unless the TS 1 HIGH LIMIT CUTOFF feature is enabled.

Note: This alarm should only be used for applications where a product that is sensitive to over temperature is involved. General usage may result in nuisance alarms due to the flow of hot product or steam out. This may be a case where the alarm should be enabled and non-latching temperature alarming should be used. A high temperature condition resulting from a forced on failure of the heating circuit should first be alarmed by the SWITCH FAILURE ALARM. See Section 5-5-18 for more information.

5-4-4 Temperature Sensor 2 Failure Alarm

Purpose: Enabling TS 2 FAILURE will provide indication of an open or shorted failure of TS 2.

Alarm Mask:
ENABLE or DISABLE

Procedure: Enable or disable alarming of a failed temperature sensor connected to the TS 2 input as required.

Note: If no second sensor is installed, this alarm should be disabled. This failure alarm should be enabled if a second temperature sensor is connected to the TS 2 input.

Note: This alarm is always latched and must be reset by the user.

5-4-5 Low Temperature Sensor 2 Alarm

Purpose: If enabled, the LOW TS 2 ALARM allows for alarming of low temperature conditions as sensed by the second temperature sensor (TS 2).

Alarm Mask:
ENABLE or DISABLE

Range: -60 to 570°C (-76 to 1058°F)

Procedure: Adjust LOW TS 2 ALARM temperature setpoint to the desired value. Note that the LOW TS 2 ALARM must be enabled in order to adjust the LOW TS 2 ALARM temperature setpoint.

Note: If no second sensor is installed this alarm should be disabled. This alarm should be enabled and the setpoint should be appropriate for the heating application. Maintaining a minimum 5 °C differential between low temperature alarming and the CONTROL SETPOINT temperature will minimize nuisance alarming due to momentary dips in temperature. Another alternative to this is to configure the controller for non-latching temperature alarms.

Note: This alarm must be enabled and its setpoint must be below the CONTROL SETPOINT temperature if fail safe mode uses the temperature from TS 2.

5-4-6 High Temperature Sensor 2 Alarm

Purpose: If enabled, the HIGH TS 2 ALARM allows for alarming of high temperature conditions as sensed by the second temperature sensor (TS 2).

Alarm Mask:
ENABLE or DISABLE

Range: -60 to 570°C (-76 to 1058°F)

Procedure: Adjust the HIGH TS 2 ALARM temperature setpoint to the desired value. Note that the HIGH TS 2 ALARM must be enabled in order to adjust the HIGH TS 2 ALARM temperature setpoint unless the TS 2 HIGH LIMIT CUTOFF feature is enabled.

Note: If no second sensor is installed this alarm should be disabled. This alarm may be used for applications where a product that is sensitive to over temperature is involved. General usage could result in nuisance alarms due to the flow of hot product or steam out. This may be a case where the alarm could be enabled and non-latching temperature alarming used. A high temperature condition resulting from a forced on failure of the heating circuit should first be alarmed by the SWITCH FAILURE ALARM. See Section 5-5-18 for more information.

5-4-7 Low Temperature Sensor Alarm Filter Time Setting

Purpose: The LOW TS ALARM FILTER will prevent LOW TS 1 and/or LOW TS 2 ALARMS from being indicated until their corresponding alarm condition has existed for the duration of the LOW TS ALARM FILTER time.

Range: 0 to 999 Minutes

Procedure: Adjust the LOW TS ALARM FILTER time to the desired value. Note that either the LOW TS 1 ALARM and/or the LOW TS 2 ALARM must be enabled in order to adjust the LOW TS ALARM FILTER time.

Note: If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.

Note: If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5-4-8 High Temperature Sensor Alarm Filter Time Setting

Purpose: The HIGH TS ALARM FILTER will prevent HIGH TS 1 and/or HIGH TS 2 ALARMS from being indicated until their corresponding alarm condition has existed for the duration of the HIGH TS ALARM FILTER time.

Range: 0 to 999 Minutes

Procedure: Adjust the HIGH TS ALARM FILTER time to the desired value. Note that either the HIGH TS 1 ALARM and/or the HIGH TS 2 ALARM must be enabled in order to adjust the HIGH TS ALARM FILTER time.

Note: If an alarm condition appears and then disappears before the alarm filter time has

expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.

Note: If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

Note: The HIGH TS ALARM FILTER time setting will not affect the cutout time when the HIGH LIMIT CUTOFF feature is enabled.

5-4-9 Latch Temperature Sensor Alarms Setting

Purpose: This allows for the selection of automatic clearing of all HIGH and LOW TS ALARMS (non-latching) when a temperature alarm condition no longer exists or permanent alarming of such a condition (latching) until the alarm is manually reset.

Setting:
YES (LATCHING) or NO (NON-LATCHING)

Procedure: Adjust the LATCH TS ALARMS setting to the desired mode (latching or non-latching).

Note: If your application is subject to periodic situations where cold or hot product is part of the process, it may be appropriate to configure the HTC for non-latching temperature alarms to avoid nuisance alarms. If it is important to be aware of any temperature alarm conditions that may have existed in a pipe, then the HTC should be configured for latching temperature alarms.

Note: This setting does not affect the TS FAILURE ALARMS -- these are always latching.

5-4-10 Control Temperature Sensor Failure Alarm

Purpose: CONTROL TS FAILURE ALARM indicates a failure of the temperature sensor designated as the control sensor.

One of eight TS CONTROL MODES may be selected. These modes determine which TS input(s) is(are) designated to provide the control temperature. See Section 5-2-11 for a full description of the temperature sensor control designations.

Alarm Mask:
ENABLE or DISABLE

Procedure: Enable or disable the alarming of a failure of the designated control temperature sensor as required.

Note: This alarm should always be enabled. If the controller experiences a CONTROL TS FAILURE it will turn the output off or on (as specified by TS FAIL MODE) until this alarm is cleared.

5-5 OTHER ALARMS CONFIGURATION

This Section defines the non-temperature related alarming functions of the 910 controller (current, ground fault, voltage and resistance).

5-5-1 Low Load Current Alarm

Purpose: Alarms current levels which are lower than a preset limit for the application. Monitoring for lower than expected current levels may be an effective means of continuity monitoring. See also HIGH RESISTANCE ALARM in Section 5-5-14.

Alarm Mask:
ENABLE or DISABLE

Range: 0.3 to 100.0 Amps

Procedure: Adjust the LOW CURRENT ALARM level to the desired value. Note that the LOW CURRENT ALARM must be enabled in order to adjust the LOW CURRENT ALARM level.

Note: For series type heating cables, adjusting the LOW CURRENT ALARM to 50% of full load current will properly alarm a problem and reduce nuisance alarms due to voltage dips. Parallel heaters should be adjusted to a level as close as possible to full load current but lower than the current at worst case voltage. The low current setting as a percentage of full load current will vary depending on the facility and its power system.

Note: A LOW CURRENT ALARM may also result from a switch failed open. The controller cannot detect a switch failure due to no current. A no current condition would be identified by a LOW CURRENT ALARM (if enabled) and the analog value reported with the alarm will be 0.0 A.

Note: It may be advantageous to consider using the HIGH RESISTANCE ALARM to indicate a cable fault when using certain types of heaters. See Sections 5-5-12 and 5-5-14 for an explanation of the resistance alarming feature.

5-5-2 Low Load Current Alarm Filter Time Setting

Purpose: The LOW CURRENT ALARM FILTER will prevent LOW LOAD CURRENT ALARMS from being indicated until a low current condition has existed for the duration of the LOW CURRENT ALARM FILTER time.

Range: 0 to 12 Seconds

Procedure: Adjust the LOW CURRENT ALARM FILTER time to the desired value. Note that the LOW CURRENT ALARM must be enabled in order to adjust the LOW CURRENT ALARM FILTER time.

Note: If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.

Note: If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5-5-3 High Load Current Alarm

Purpose: Alarms current levels which are higher than a preset limit for the application.

Alarm Mask:
ENABLE or DISABLE

Range: 0.3 to 100.0 Amps

Procedure: Adjust the HIGH CURRENT ALARM level to the desired value. Note that the HIGH CURRENT ALARM must be enabled in order to adjust the HIGH CURRENT ALARM level.

Note: As the HTC automatically protects itself from overload, it would not normally be necessary to enable this alarm. It can be used effectively to guard against accidental paralleling of heating circuits. In-rush, or cold start currents typically associated with self-regulating cables may cause nuisance HIGH CURRENT ALARMS. If this is undesirable this alarm should be disabled.

5-5-4 High Load Current Alarm Filter Time Setting

Purpose: The HIGH CURRENT ALARM FILTER will prevent HIGH LOAD CURRENT ALARMS from being indicated until a high current condition has existed for the duration of the HIGH CURRENT ALARM FILTER time.

Range: 0 to 12 Seconds

Procedure: Adjust the HIGH CURRENT ALARM FILTER time to the desired value. Note that the HIGH CURRENT ALARM must be enabled in order to adjust the HIGH CURRENT ALARM FILTER time.

Note: If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.

Note: If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5-5-5 High Ground Fault Current Alarm

Purpose: Alarms ground fault current levels which are higher than a preset limit for the application.

Alarm Mask:
ENABLE or DISABLE

Range: 20 to 250 mAmps

Procedure: Adjust the HIGH GFI ALARM level to the desired value. Note that the HIGH GFI ALARM must be enabled in order to adjust the HIGH GFI level.

5-5-6 High Ground Fault Current Alarm Filter Time Setting

Purpose: The HIGH GFI ALARM FILTER will prevent HIGH GFI ALARMS from being indicated until a high GFI condition has existed for the duration of the HIGH GFI ALARM FILTER time.

Range: 0 to 12 Seconds

Procedure: Adjust the HIGH GFI ALARM FILTER time to the desired value. Note that the HIGH GFI ALARM must be enabled in order to adjust the HIGH GFI ALARM FILTER time.

Note: If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.

Note: If the user resets an alarm while the alarm condition is still exists, then the alarm will not be

indicated again until the entire alarm filter time has expired.

5-5-7 Ground Fault Trip Alarm

Purpose: This value sets the upper limit of allowable ground fault leakage current. Exceeding this limit will result in the output switch being latched off and the GFI TRIP ALARM activated to indicate a ground fault condition.

Alarm Mask:
ENABLE or DISABLE

Range: 20 to 250 mAmps

Procedure: If ground fault tripping is desired, enable the GFI TRIP ALARM and adjust the G.F. TRIP CURRENT to the desired value. To disable ground fault tripping, disable the alarm. Note that the GFI TRIP ALARM must be enabled in order to adjust the G.F. TRIP CURRENT level.

CAUTION: IN ORDER TO IMPLEMENT A GROUND FAULT TRIP FUNCTION, ALL NON-GROUNDED POWER CONDUCTORS MUST BE OPENED UPON DETECTION OF A GROUND FAULT CONDITION.

Note: National Electrical Codes may require that all legs of non-neutral based power sources be opened upon detection of a Ground Fault. Multi-pole switch configurations should be used on non-neutral based power systems. Check the requirements with your local Electrical Authority.

5-5-8 Low Voltage Alarm

Purpose: Alarms voltage levels which are lower than a preset limit for the application.

Alarm Mask:
ENABLE or DISABLE

Range: 10 to 330 Volts

Procedure: Adjust the LOW VOLTAGE ALARM level to the desired value. Note that the LOW VOLTAGE ALARM must be enabled in order to adjust the LOW VOLTAGE ALARM level.

Note: It is recommended that the LOW VOLTAGE ALARM always be enabled.

5-5-9 Low Voltage Alarm Filter Time Setting

Purpose: The LOW VOLTAGE ALARM FILTER will prevent LOW VOLTAGE ALARMS from being indicated until a low voltage condition has existed for the duration of the LOW VOLTAGE ALARM FILTER time.

Range: 0 to 12 Seconds

Procedure: Adjust the LOW VOLTAGE ALARM FILTER time to the desired value. Note that the LOW VOLTAGE ALARM must be enabled in order to adjust the LOW VOLTAGE ALARM FILTER time.

Note: If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.

Note: If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5-5-10 High Voltage Alarm

Purpose: Alarms voltage levels which are higher than a preset limit for the application. Serves as a monitor of the voltage used to power the tracing circuit.

Alarm Mask:
ENABLE or DISABLE

Range: 10 to 330 Volts

Procedure: Adjust the HIGH VOLTAGE ALARM level to the desired value. Note that the HIGH VOLTAGE ALARM must be enabled in order to adjust the HIGH VOLTAGE ALARM level.

5-5-11 High Voltage Alarm Filter Time Setting

Purpose: The HIGH VOLTAGE ALARM FILTER will prevent HIGH VOLTAGE ALARMS from being indicated until a high voltage condition has existed for the duration of the HIGH VOLTAGE ALARM FILTER time.

Range: 0 to 12 Seconds

Procedure: Adjust the HIGH VOLTAGE ALARM FILTER time to the desired value. Note that the HIGH VOLTAGE ALARM must be enabled in order to adjust the HIGH VOLTAGE ALARM FILTER time

Note: If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.

Note: If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5-5-12 Low Resistance Alarm

Purpose: Alarms heater resistance levels which have decreased from the NOMINAL RESISTANCE setting by more than the selected amount.

Alarm Mask:
ENABLE or DISABLE

Range: 1 to 100% (deviation from NOMINAL RESISTANCE)

Procedure: Adjust the LOW RESISTANCE ALARM deviation to the desired value. Note that the LOW RESISTANCE ALARM must be enabled in order to adjust the LOW RESISTANCE deviation.

Note: This feature would not normally be enabled. It can be used effectively to guard against accidental paralleling of heating circuits. Care must be taken when using this alarm feature with heating cables that exhibit a variable resistance with temperature. Low resistance alarming may not be practical when the load has an increasing resistance with temperature (such as self-regulating cables).

Note: Use of the LOW RESISTANCE ALARM assumes that the controller power is derived from the same circuit as the tracing power.

Note: No LOW RESISTANCE ALARMS will be generated if the measured voltage is below the LOW VOLTAGE ALARM setpoint, regardless if the LOW VOLTAGE ALARM is enabled. This stops an alarm from being generated when the circuit power is turned off. If the LOW VOLTAGE ALARM is disabled, ensure that the LOW VOLTAGE setpoint is set to a relevant level otherwise no LOW RESISTANCE ALARMS will occur.

Note: LOW RESISTANCE ALARMS will only be generated if the output switch is on.

5-5-13 Low Resistance Alarm Filter Time Setting

Purpose: The LOW RESISTANCE ALARM FILTER will prevent LOW RESISTANCE ALARMS from being indicated until a low resistance condition has existed for the duration of the LOW RESISTANCE ALARM FILTER time.

Range: 0 to 12 Seconds

Procedure: Adjust the LOW RESISTANCE ALARM FILTER time to the desired value. Note that the LOW RESISTANCE ALARM must be enabled in order to adjust the LOW RESISTANCE ALARM FILTER time.

Note: If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.

Note: If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5-5-14 High Resistance Alarm

Purpose: Alarms heater resistance levels which have increased from the NOMINAL RESISTANCE setting by more than the selected amount. The HIGH RESISTANCE ALARM may be used to indicate an open or a high resistance connection or, when using constant wattage parallel cables, may indicate the failure of one or more heating zones. It may also be used to monitor a failed series-type cable while minimizing nuisance alarms created by voltage fluctuations.

Alarm Mask:
ENABLE or DISABLE

Range: 1 to 250% (deviation from NOMINAL RESISTANCE)

Procedure: Adjust the HIGH RESISTANCE ALARM level to the desired value. Note that the HIGH RESISTANCE ALARM must be enabled in order to adjust the HIGH RESISTANCE deviation.

Note: Using the LOW CURRENT ALARM feature to ensure that unexpected decreases in current consumption by the heating cable are alarmed, is a reliable method of monitoring the integrity of series-type heating cables. When using parallel-type heaters (zoned constant-wattage or self-regulating), the LOW CURRENT ALARM setting must be chosen as close to the lowest expected current as possible to detect failed zones, or cable degradation. The problem with such a close setting is that it inevitably leads to nuisance alarms, particularly when voltage fluctuations are present. By using the HIGH RESISTANCE ALARM, nuisance alarms due to voltage dips may be minimized.

Note: Use of the HIGH RESISTANCE ALARM assumes that the controller power is derived from the same circuit as the tracing power.

Note: Care must be taken when using this alarm feature with heating cables that exhibit a variable resistance with temperature. High resistance alarming may not be as effective if the load has a decreasing resistance with temperature.

Note: No HIGH RESISTANCE ALARMS will be generated if the measured voltage is below the LOW VOLTAGE ALARM setpoint, regardless if the LOW VOLTAGE ALARM is enabled. This stops an alarm from being generated when the circuit power is turned off. If the LOW VOLTAGE ALARM is disabled ensure that the LOW VOLTAGE setpoint is set to a relevant level otherwise no HIGH RESISTANCE ALARMS will occur.

Note: HIGH RESISTANCE ALARMS will only be generated if the output switch is on.

5-5-15 High Resistance Alarm Filter Time Setting

Purpose: The HIGH RESISTANCE ALARM FILTER will prevent HIGH RESISTANCE ALARMS from being indicated until a high resistance condition has existed for the duration of the HIGH RESISTANCE ALARM FILTER time.

Range: 0 to 12 Seconds

Procedure: Adjust the HIGH RESISTANCE ALARM FILTER time to the desired value. Note that the HIGH RESISTANCE ALARM must be enabled in order to adjust the HIGH RESISTANCE ALARM FILTER time.

Note: If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.

Note: If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5-5-16 Nominal Resistance Setting

Purpose: This parameter defines the nominal expected heater resistance. A value must be entered by the user to allow the HIGH and LOW RESISTANCE ALARMS to be used. In installations where the power source may

experience periodic fluctuations (surges and/or brown-out conditions), alarming on resistance deviation offers an improved method of monitoring tracer integrity than simple LOW and HIGH CURRENT ALARMS. Since the ratio of voltage to current is monitored, the HIGH and LOW RESISTANCE ALARMS offer cable monitoring that is relatively immune to voltage fluctuations.

Range: 2.00 to 2000.00 Ω

Procedure: The NOMINAL RESISTANCE value can only be set if either the LOW RESISTANCE and/or the HIGH RESISTANCE ALARMS are enabled. Once the controller and the heating cable have been installed, the following procedure should be used to determine the NOMINAL RESISTANCE setting:

- Adjust the CONTROL SETPOINT temperature to turn on the output switch.
- Allow the load to come up to design temperature and its power consumption to stabilize.
- Using the Operator Console, access the RESISTANCE reading and record its value. Return the CONTROL SETPOINT temperature to its proper setting.
- Enter the recorded resistance value as the NOMINAL RESISTANCE setting.

Note: The setup procedure outlined above may have to be repeated a number of times to arrive at a correct nominal resistance setting. This value will be affected by the heating cable temperature, which in turn is affected by ambient temperature, insulation level, a full or empty pipe or vessel, etc.

5-5-17 Overcurrent Trip Alarm (SSR only)

Purpose: The overcurrent trip feature is always enabled when using an SSR output switch and is used to provide protection for the output switch. Enabling this alarm will only inform the user of an excessively high current condition and that the output switch has been latched off. During a high current condition, the controller attempts to soft start a heating cable using a technique involving measured in-rush current and the SWITCH CURRENT RATING. If the controller is unable to start the cable, it will eventually trip its output switch off and will not retry or pulse its output switch again. At this point the OVERCURRENT TRIP ALARM is latched on.

Note: The controller is NOT a safety cutout or an overcurrent protective device as defined by the National and Canadian Electrical Codes (NEC & CEC). A protective device such as a circuit breaker or fuse must be included as part of a proper design and be selected in accordance with

the requirements defined in the National Electrical Code (NEC) and/or the Canadian Electrical Code (CEC).

Note: The controller cannot protect the SSR from short circuits or excessive overcurrent conditions. Always ensure that the power is off prior to performing any maintenance or troubleshooting of the heating circuit. Verify that no damage has occurred to the cable or the controller prior to re-energizing the circuit.

Alarm Mask:
ENABLE or DISABLE

Procedure: Adjust the SWITCH CURRENT RATING setting to the actual current rating of the SSR. Enable or disable the alarm as required. Note that the OVERCURRENT TRIP ALARM does **not** have to be enabled in order to adjust the SWITCH CURRENT RATING setting.

Note: It is highly recommended that this alarm be left enabled since an overcurrent trip condition would normally represent a serious problem. NOTE that this is a factory set alarm value and disabling the alarm does not disable the overcurrent trip function. In some applications the use of self-regulating cable will produce very high in-rush currents during cold startup. These currents may exceed the overcurrent trip limit and the controller will not be able to soft start the trace circuit. If this condition persists please contact your nearest sales office for recommendations and solutions to this problem.

5-5-18 Switch Failure Alarm

Purpose: The purpose of the SWITCH FAILURE ALARM is to indicate that an output switch failure has occurred. The controller determines that if the output switch is turned off and there is load current present, then the output switch has failed closed and the alarm is latched on.

Alarm Mask:
ENABLE or DISABLE

Procedure: Enable or disable the alarming of an output switch that has failed in the closed position.

Note: The SWITCH FAILURE ALARM SHOULD ALWAYS BE ENABLED. A high temperature condition as a result of a failed circuit can only be caused if the output switch fails closed. When an output switch fails closed, the controller cannot turn the tracer power off, therefore no protection features are available (ground fault trip, power limiting, etc.). If a SWITCH FAILURE ALARM is detected, the unit should be serviced immediately.

5-5-19 HTC Reset Alarm

Purpose: The HTC RESET ALARM is used to indicate:

- 1) Power to the HTC has been interrupted and subsequently restored.
- 2) A transient has caused the HTC's micro-processor to restart.
- 3) An internal condition has caused the HTC's micro-processor to restart its program.

Alarm Mask:

ENABLE or DISABLE

Procedure: Enable or disable alarming on reset as desired.

Note: Normally the HTC RESET ALARM is left disabled since powering the controller off and on for maintenance or trouble-shooting would require the user to reset this alarm every time. If the particular installation includes a Model 780/GCC-9000, this alarm may be left enabled since resets are not considered normal occurrences and the Model 780/GCC-9000 provides the capability to easily log and reset alarms such as these. The difference in time between when a COMMUNICATIONS FAIL ALARM and an HTC RESET ALARM are logged provide an indication of how long the circuit has been "OFF".

5-5-20 Circuit Breaker Limiting Status (SSR Only)

Purpose: The circuit breaker limiting feature is always enabled when using an SSR output switch and is intended to prevent the circuit breaker immediately upstream of the controller from tripping during a temporary overcurrent condition. Enabling this alarm will only inform the user that circuit breaker limiting is currently active.

Alarm Mask:

ENABLE or DISABLE

Procedure: Adjust the CIRCUIT BREAKER CURRENT RATING setting to the heating circuit breaker size (i.e. 15.0 or 20.0 Amps). Enable or disable the alarm as required. Note that the CIRCUIT BREAKER LIMITING ALARM does **not** have to be enabled in order to adjust the CIRCUIT BREAKER CURRENT RATING setting.

Note: This is a non-latching alarm.

Note: This alarm may be considered an advisory alarm. If the measured current exceeds the level that would cause the upstream circuit breaker to release, the HTC will begin to switch the SSR ON

and OFF rapidly to limit the average current to an acceptable level.

5-5-21 Power Limiting Status (SSR Only)

Purpose: The power limiting feature is always enabled when using an SSR output switch and is intended to limit the average amount of power that is applied to the trace circuit. The controller measures the voltage and current of the tracing circuit and will vary its output switch to limit the amount of power applied to the trace to the value set by the MAXIMUM POWER setting. Enabling this alarm will only inform the user that power limiting is currently active.

Alarm Mask:

ENABLE or DISABLE

Procedure: Adjust the MAXIMUM POWER setting to the desired value. Enable or disable the alarm as required. Note that the POWER LIMITING ALARM does **not** have to be enabled in order to adjust the MAXIMUM POWER setting.

Note: This is a non-latching alarm.

Note: This alarm may be considered more appropriately an advisory alarm and is normally disabled. It will be active if the MAXIMUM POWER setting is set below the power output level required for temperature maintenance. In other words, if the circuit demands the maximum power allowed and the alarm is enabled, then this alarm will be indicated and the output switch will pulse ON and OFF to limit the average power output to a value approximately equal to the MAXIMUM POWER setting.

5-5-22 Switch Limiting Status (SSR Only)

Purpose: The switch limiting feature is always enabled when using an SSR output switch and is intended to provide protection for the output switch. Enabling this alarm will only inform the user that switch limiting is currently active and an excessively high current condition is present. The controller pulses its output switch for a small number of cycles and reads the resulting current. If the measured current exceeds the SWITCH RATING setting, then the duty-cycle of its output switch will be varied so that an average current not exceeding the SWITCH RATING setting is maintained.

Alarm Mask:

ENABLE or DISABLE

Procedure: Adjust the SWITCH CURRENT RATING setting to the actual current rating of the SSR. Enable or disable the alarm as required.

Note that the SWITCH LIMITING ALARM does **not** have to be enabled in order to adjust the SWITCH CURRENT RATNG setting.

Note: This is a non-latching alarm.

Note: This alarm should normally be left enabled. Currents in this range cannot be considered normal and should be investigated.

5-5-23 Contactor Count Alarm

Purpose: Generates an alarm if the number of off-to-on transitions of a contactor reaches or exceeds the CONTACTOR COUNT ALARM setting. This serves as a method to perform preventative maintenance on the contactor before a failure is likely to occur.

Alarm Mask:
ENABLE or DISABLE

Range: 0 to 999999 off-to-on transitions

Procedure: Adjust the CONTACTOR ALARM setting to the desired value. Note that the CONTACTOR ALARM must be enabled in order to adjust the CONTACTOR ALARM setting.

Note: The CONTACTOR ALARM is only available if the SWITCH CONTROL MODE is set to either DEADBAND or PROPORTIONAL AMBIENT CONTACTOR.

5-5-24 EEROM Data Failure Alarm

Purpose: The EEROM DATA FAILURE ALARM indicates that the controller has detected a failure in its non-volatile memory.

Alarm Mask:
ENABLE or DISABLE

Procedure: Enable or disable alarming of a non-volatile memory failure as desired.

Note: The EEROM DATA FAILURE ALARM should always be enabled. This memory stores all of the controller's configuration and calibration settings and the alarm will only be generated if the microprocessor cannot bypass the failed area of its memory. This indicates an internal problem and the 910 should be replaced and returned to the factory for repair.

5-6 COMMUNICATIONS SETUP

The following Section describes the setup parameters that relate to the way in which the controller is to communicate with another device. If the optional communications interface is not installed in the 910 Control Module, these parameters need not be configured.

5-6-1 Protocol

Purpose: Defines the communications language used by the controller to communicate with other devices.

Setting: HTCBUS™ or MODBUS ASCII or MODBUS RTU

Procedure: Select the HTCBUS™ protocol when communicating with existing Pyrotenax Heat Trace Control products, including the Model 780/GCC-9000 Group Communications Controller.

If you are communicating directly with the controller using a different device, select the MODBUS protocol. For a detailed description of the controller's MODBUS mapping please refer to "910 Series Heat Trace Controller - Modbus Protocol Interface" document.

5-6-2 HTCBUS™ Address

Purpose: Defines the communications address to be used by the controller when using the HTCBUS™ protocol to communicate with a Model 780/GCC-9000.

Range: 1 to 16,777,215

Procedure: Set the communications address as desired. This must be an address unique to the entire communications network to avoid messaging conflicts. The HTCBUS™ protocol must be selected in order to set the HTCBUS™ ADDRESS.

Note: A unique HTCBus™ communications address is always assigned by the Factory and identified by the label under the Operator Console (see Figure 2-1). It is recommended that the pre-assigned address be used whenever possible to minimize the chances of an address being duplicated in the user's system.

5-6-3 MODBUS Address

Purpose: The MODBUS ADDRESS along with the MODBUS SUB ADDRESS define the communications address to be used by the

controller when using either MODBUS protocol to communicate with a MODBUS compatible device.

Range: 1 to 247

Procedure: Set the communications address as desired. Together with the MODBUS SUB ADDRESS, this combination must be unique to the entire communications network to avoid messaging conflicts. Either MODBUS protocol must be selected in order to set the MODBUS ADDRESS.

5-6-4 MODBUS Sub Address

Purpose: The MODBUS SUB ADDRESS along with the MODBUS ADDRESS define the communications address to be used by the controller when using either MODBUS protocol to communicate with a MODBUS compatible device.

Range: 0 to 31

Procedure: Set the communications sub address as desired. Together with the MODBUS ADDRESS, this combination must be unique to the entire communications network to avoid messaging conflicts. Either MODBUS protocol must be selected in order to set the MODBUS SUB ADDRESS.

Note: Since a 910 HTC does not use all 65,535 data registers that are available for each MODBUS ADDRESS, the data register range is sub divided to allow up to 32 HTCs to share the same MODBUS ADDRESS. This increases the number of HTCs allowed on a single Modbus port from 247 to 7,904 (= 247 x 32). This requires that any HTC sharing the same MODBUS ADDRESS as another HTC must have its own unique MODBUS SUB ADDRESS.

5-6-5 Baud Rate

Purpose: Defines the data rate at which communications occur.

Setting: AUTO or 9600 or 4800 or 2400 or 1200 or 600 or 300

Procedure: Select the data rate to be compatible with other devices that will be connected to the controller for communications purposes.

Note: Not all communications interfaces will support the various data rates -- it is recommended that the setting be set to AUTO. The controller will automatically select a BAUD RATE that is compatible with the communications interface installed. If BAUD RATE = AUTO and a MODEM communication interface is used then a

data rate of 300 will always be used. Otherwise, if BAUD RATE = AUTO and a non-MODEM communication interface is used then a data rate of 9600 is used.

5-6-6 Parity (Modbus)

Purpose: Defines the type of parity bit to be used with MODBUS communications.

Setting: NONE or ODD or EVEN

Procedure: Select the desired type of parity. Note that PARITY can only be selected when using either MODBUS protocol.

5-6-7 Hardware

Purpose: Identifies the type of communications interface installed in the 910. The controller will automatically determine and display which communications interface type is available.

Values: NONE, MODEM or RS-232 or RS-485

5-6-8 Driver

Purpose: Defines the way in which the controller's program communicates with the communications interface.

Setting: AUTO or RS-232 or RS-485 or MODEM

Procedure: It is recommended that the setting be set to AUTO -- this will allow the controller to automatically choose the setting to match the type of communications interface installed.

5-6-9 Profile

Purpose: Defines the way in which the controller's program supports communications handshaking and communication interface signals.

Setting: AUTO or
3-WIRE RS-232 or
RS-485 or
1200 BAUD MODEM or
300 BAUD MODEM

Procedure: Select the PROFILE to be compatible with other devices that will be connected to the controller for communications purposes. It is recommended that the setting be set to AUTO. The controller will automatically select a profile based on the type of communications interface installed in the 910.

Notes:

AUTO: Selects a communications profile based on the data rate and the type of communications interface installed in the 910.

3-WIRE RS-232: Continuously asserts the internal RTS signal. Internal CTS and DCD signals are ignored. The Tx Delay timer is active. This is the profile used when PROFILE = AUTO and an RS-232 communication interface is used with the 910.

RS-485: Uses the internal RTS signal and the Tx Delay timer. Internal CTS and DCD signals are ignored. This is the profile used when PROFILE = AUTO and an RS-485 communication interface is used.

1200 BAUD MODEM: Uses the internal RTS signal with a fixed 10 msec Tx Delay time, ignores the internal CTS signal. Uses the internal DCD signal to qualify each receive data character. This is the profile used when PROFILE = AUTO, BAUD RATE = 1200 and a MODEM communication interface is used.

300 BAUD MODEM: Uses the internal RTS signal with a fixed 30 msec Tx Delay time, ignores the internal CTS signal, uses the internal DCD signal to qualify each receive data character. This is the profile used when PROFILE = AUTO, BAUD RATE is not 1200 and a MODEM communication interface is used.

5-6-10 Tx Delay

Purpose: Allows a programmable delay between the receipt of a communications message and the controller's reply. In some applications, it may be necessary to delay the controller's response to an inquiry for a short period of time to allow external devices to start up, stabilize and/or synchronize.

Range: 0.00 to 2.50 seconds

Procedure: Set the amount of delay between the receipt of a message and the controller's response as required.

Note: This selectable TX DELAY is only used if the PROFILE is set to either RS-485 or RS-232.

5-7 OPERATOR CONSOLE FUNCTIONS

The following features are part of the controller's programming, but are only used in conjunction with the Operator Console.

5-7-1 Passcode

Purpose: The four digit, numeric PASSCODE feature stops unauthorized users from modifying the controller's configuration parameters using the Operator Console.

Range: 0000 to 9999

Procedure: Enter the desired PASSCODE (in the "Miscellaneous Setup" sub-menu) using the Operator Console keypad. A PASSCODE of 0000 disables the lockout feature and allows all configuration parameters to be modified using the Operator Console without requiring a PASSCODE. Setting the PASSCODE to any other value will require the database to be unlocked, by entering the correct PASSCODE, prior to modifying any of the controller's configuration parameters using the Operator Console.

Note: The PASSCODE can only be edited if it is set to 0 or the database has been unlocked by entering the proper PASSCODE.

5-7-2 Lock Database

Purpose: If the PASSCODE has been enabled (PASSCODE is not set to 0) and the user has unlocked console modification access to the controller's configuration parameters, the LOCK DATABASE feature allows the user to re-lock this modification access once programming has been completed.

Procedure: Select the LOCK DATABASE function (at the end of the "Configuration Mode Main Menu") to lock out Operator Console configuration modification access. The display will confirm the operation by displaying a "DATABASE LOCKED" message.

Note: Operator Console configuration modification access will automatically re-lock after approximately 5 minutes of keypad inactivity.

5-7-3 Unlock Database

Purpose: If a PASSCODE has been enabled (PASSCODE is not set to 0) and the user wants to modify any of the controller's configuration parameters using the Operator Console, then the database must first be unlocked.

Procedure: Try modifying any configuration parameter, or select the UNLOCK DATABASE function (at the end of the "Configuration Mode Main Menu"), and a prompt for the PASSCODE will appear. If the correct PASSCODE is entered then the display will confirm the operation by displaying a "DATABASE UNLOCKED" message.

5-7-4 Test Tracing

Purpose: The TEST TRACING feature provides an easy method of temporarily overriding the temperature control, without having to modify the CONTROL SETPOINT temperature or any other configuration parameter.

Procedure: Press the "TEST" key on the Operator Console or select the "TEST TRACING" function to force the output switch on for approximately 30 seconds. After the test time has expired, the unit will automatically revert back to normal operation.

Note: This feature only overrides temperature control, it does not override other control parameters such as power limiting.

Note: If loadshedding is active then TEST TRACING is inhibited.

5-7-5 Display Test

Purpose: The DISPLAY TEST feature provides an easy method of illuminating each display segment and all the LEDs of the Operator Console to ensure that they are functioning properly.

Procedure: Select "DISPLAY TEST" and watch the Operator Console to verify that each display segment and each LED is illuminated during the test sequence.

Note: Pressing any key on the Operator Console keypad during the DISPLAY TEST will cause the DISPLAY TEST to abort.

5-7-6 Load Defaults

Purpose: To provide a quick method of setting all of the controller's configuration parameters to the factory default configuration parameters, as defined in Appendix G. As well, all of the maintenance data parameters are reset. Note that all load shedding parameters (including fail safe) are configured with default values. The CONSOLE SETPOINT MAXIMUM and MINIMUM are also configured with default values.

Procedure: Select the LOAD DEFAULTS function (in the "Miscellaneous Setup" sub-menu) using the Operator Console keypad.

Note: This function will also overwrite the communication configuration parameters, which could affect existing communications to the controller.

5-7-7 Feature Mode

Purpose: Provides two types of menus on the Operator Console for configuring the 910.

Setting: BASIC or ADVANCED

Procedure: Select BASIC if access to only the seven most common parameters is required. Select ADVANCED if access to all of the 910 parameters is required.

SECTION VI - MONITORED PARAMETER DETAILS

6-1 INTRODUCTION

The following text provides a brief summary of each of the measured and calculated parameters that the 910 Series Control Module provides to the user. Detailed information regarding settings, alarms limits, etc. may be found in Section V of this manual.

Detailed information regarding the display of these variables using the Operator Console may be found in Section 4-2 of this manual.

For detailed information regarding the display of these variables using the Model 780/GCC-9000, refer to the GCC user manual.

6-2 ANALOG READINGS

6-2-1 Control Temperature

Purpose: This is the temperature that the controller uses to determine whether its output switch should be on or off. Depending on the TS CONTROL MODE setting and whether one or two RTDs are installed, the CONTROL TEMPERATURE may be derived from TS 1 or TS 2 or a combination of the two temperatures. See Section 5-2-11 of this manual for further details regarding the TS CONTROL MODE settings.

6-2-2 TS 1 Temperature

Purpose: This temperature is the value that the controller is reading from the RTD connected to its TS 1 input. Depending on the TS CONTROL MODE, it may be used to determine the CONTROL TEMPERATURE (see Section 6-2-1 above).

Note: If the TS 1 input is not being used by the controller, the TS 1 TEMPERATURE is not displayed.

6-2-3 TS 2 Temperature.

Purpose: This temperature is the value that the controller is reading from the RTD connected to its TS 2 input. Depending on the TS CONTROL MODE, it may be used to determine the CONTROL TEMPERATURE (see Section 6-2-1 above).

Note: If the TS 2 input is not being used then by the controller then the TS 2 TEMPERATURE is not displayed.

6-2-4 Load Current

Purpose: The LOAD CURRENT reading indicates the average current being drawn by the heating cable.

6-2-5 Resistance

Purpose: Resistance is calculated using the average voltage reading divided by the average current reading to yield a load resistance in ohms. If the controller's output switch is on, but no current is present, the RESISTANCE will read "open circuit".

Note: If the controller's output switch is off, the RESISTANCE will always display the last resistance which was calculated while the output switch was last on.

6-2-6 Ground Fault Current

Purpose: If the controller detects any leakage current in the output circuit, it will indicate the level in milliamps.

Note: To minimize nuisance alarms, the controller will not report a leakage current of less than 20 mAmps.

6-2-7 Voltage

Purpose: The voltage reading indicates the average circuit voltage being measured by the 910.

6-2-8 Power

Purpose: Load power provides an indication of the average power being consumed by the heat trace cable.

Note: The controller calculates load power by multiplying the average voltage reading by the average current reading.

6-3 MAINTENANCE DATA

6-3-1 Max / Min Temperature Values

MAX CONTROL TEMP
MIN CONTROL TEMP
TS 1 MAX TEMP
TS 1 MIN TEMP
TS 2 MAX TEMP
TS 2 MIN TEMP

Purpose: This feature indicates the maximum and minimum temperatures recorded by the HTC since the last time the values were reset. It may be useful to log the maximum/minimum temperatures experienced on a particular tracing circuit for the purposes of trouble shooting or gathering data for future design criteria. The temperature values are written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user. Max/min temperatures are recorded for TS 1, TS 2 and the CONTROL TS.

Range: Can only be reset (cleared) by the operator.

Procedure: The max/min temperatures may be reset using the Operator Console or a communicating device such as the Model 780/GCC-9000. See the appropriate manual for the proper procedure. Resetting any one of the temperatures will reset all of them.

6-3-2 Power Accumulator

Purpose: This feature indicates the total power consumption of the trace circuit since the last time the POWER ACCUMULATOR was reset. It may be useful to log the amount of power consumed on a particular trace circuit for the purposes of energy management or gathering of data for future design criteria. The value of this accumulator is written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user.

Procedure: The POWER ACCUMULATOR may be reset to zero using the Operator Console or a communicating device such as the Model 780/GCC-9000. See the appropriate manual for the proper procedure.

Note: The POWER ACCUMULATOR value will roll over to zero when the upper limit of the POWER ACCUMULATOR has been exceeded. This upper limit is 214,748,364.7 kW-hours.

6-3-3 Contactor Cycle Counter

Purpose: This feature indicates the total number of off-to-on transitions a contactor has made since

the last time the CONTACTOR CYCLE COUNTER was reset. This serves as a method to perform preventative maintenance on the contactor according to the manufacturer's specifications. This count value is written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user.

Procedure: The CONTACTOR CYCLE COUNTER may be reset to zero using the Operator Console or a communicating device such as the Model 780/GCC-9000. See the appropriate manual for the proper procedure.

Note: Once the CONTACTOR CYCLE COUNTER reaches 999,999,999 it will stop counting.

Note: The CONTACTOR CYCLE COUNTER is only indicated if the SWITCH CONTROL MODE is set to either DEADBAND or PROPORTIONAL AMBIENT CONTACTOR.

6-3-4 Time In Use

Purpose: The purpose of this feature is to indicate the total hours in use of the controller since its initial operation. It may be useful to log the amount of time a particular controller has been in operation for the purposes of maintenance planning or reliability testing. The value of this accumulator is written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user.

Procedure: The IN USE hours accumulator can be reset to zero using the Operator Console or a Model 780/GCC-9000. See the appropriate operating manual for detailed instructions.

Note: The IN USE hours accumulator value will roll over to zero when the upper limit of the accumulator has been exceeded. This limit is 999,999,999 hours.

6-3-5 Time Since Last Reset

Purpose: This feature indicates the total hours in use of the controller since the last reset. It may be useful to log the amount of time a particular controller has been in operation since the last time the controller's power was cycled for troubleshooting purposes.

Procedure: The TIME SINCE LAST RESET hours accumulator can only be reset by cycling the controller's power.

Note: The TIME SINCE LAST RESET will roll over to zero when the upper limit of 65,535 hours has been exceeded.

6-3-6 Peak Load Current

Note: The PEAK LOAD CURRENT is not displayed on the Operator Console.

Purpose: This feature indicates the highest instantaneous load current measured since the last time the PEAK LOAD CURRENT was reset. This value is written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user.

Procedure: The PEAK LOAD CURRENT may only be reset to zero using a communicating device such as the Model 780/GCC-9000. See its manual for the proper procedure.

6-3-7 Peak Ground Fault Current

Note: The PEAK GROUND FAULT CURRENT is not displayed on Operator Console.

Purpose: This feature indicates the highest instantaneous ground fault current measured since the last time the PEAK GROUND FAULT CURRENT was reset. This current value is written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user.

Procedure: The PEAK LOAD CURRENT may only be reset to zero using a communicating device such as the Model 780/GCC-9000. See its manual for the proper procedure.

6-3-8 External Input Status

Note: The EXTERNAL INPUT STATUS is not displayed on the Operator Console.

Purpose: This feature indicates the actual status of the external input regardless of the controller's configuration. This may be useful if the user wishes to use the controller's external input to monitor the status of an external dry contact and pass this on to another device.

Procedure: The EXTERNAL INPUT STATUS may only be viewed using communications software such as PyroMaster™. See its manual for the proper procedure.

SECTION VII - CONTROL MODES

7-1 INTRODUCTION

There are several different types of control modes in the controller. Some of these modes require further explanation in order to fully understand and implement their operation.

This Section describes the functionality of the control modes available in the HTC and how to set their associated parameters.

7-2 SWITCH CONTROL MODES

There are four different SWITCH CONTROL modes associated with the HTC. The following is an explanation of their implementation in the controller and the differences between them.

7-2-1 Proportional Control (for use with SSRs ONLY)

Proportional control on the HTC is implemented as follows:

- When using SSRs to directly control the power applied to a trace circuit, the output may be switched on/off very rapidly. The controller implements proportional temperature control on a cycle by cycle basis (50 or 60 Hz power line cycle).
- This algorithm monitors the temperature of the heating circuit and compares it to the CONTROL SETPOINT temperature. If the temperature of the control sensor is at or below the CONTROL SETPOINT temperature, then power is applied to the trace with a duty cycle of 100% -- the controller output is full on.
- If the temperature sensed by the control sensor is equal to or greater than the CONTROL SETPOINT temperature + the PROPORTIONAL BAND setting, then the controller output will have a duty cycle of 0% -- the output will be off.
- The temperature of the control sensor is constantly monitored and the output duty cycle is adjusted proportionally according to where the temperature falls within the 0% - 100% band.

Proportional Control Temperature Band

<u>Control Sensor Temperature</u>	<u>Duty Cycle</u>
Setpoint+proportional band	0%
Setpoint+proportional band/2	50%
Setpoint	100%

7-2-2 Deadband Control (for use with contactors)

Deadband control on the HTC is implemented as follows:

- When using the HTC in an application where the controller is used to open and close a contactor, proportional control cannot be used since this would cycle the contactor too quickly. In these situations, a deadband control algorithm is used. The output duty cycle is not controlled, instead the output is either fully on or completely off. The user may set the DEADBAND value.
- The controller monitors the temperature of the trace circuit and compares it to the CONTROL SETPOINT temperature as in the proportional control mode. If the control sensor temperature is above the CONTROL SETPOINT temperature by more than the DEADBAND value, the output is turned off.
- If the control sensor temperature falls below the CONTROL SETPOINT temperature the output is turned on.

This is a very simple control algorithm but it works very effectively in heat trace applications where the temperature of a traced system changes relatively slowly.

Deadband Control Temperature Band

<u>Control Sensor Temperature</u>	<u>Output State</u>
Setpoint+deadband	Off
Setpoint	On

When the control sensor temperature is within the deadband, the output does not change its state. Also, when using deadband control, a contactor is not allowed to toggle faster than every 2 seconds. If an AC alarm with an alarm filter time greater than 0 is detected, the contactor will not toggle until the alarm filter time has expired.

7-2-3 Proportional Ambient SSR Control (for use with SSRs ONLY)

When an HTC using an SSR is used to control the output using the ambient temperature, this control mode should be used.

Proportional ambient SSR control on the HTC is implemented as follows:

- When using SSRs to directly control the power applied to a heating circuit, the output may be switched on/off very rapidly. The controller implements proportional temperature control on a cycle by cycle basis (50 or 60 Hz power line cycle).
- This algorithm monitors ambient temperature and compares it to the CONTROL SETPOINT temperature. If the temperature of the control sensor is at or below the CONTROL SETPOINT temperature minus the PROPORTIONAL BAND setting, then power is applied to the trace with a duty cycle of 100% -- the controller output is fully on.
- If the temperature sensed by the control sensor is equal to or greater than the CONTROL SETPOINT temperature, then the output will have a duty cycle of 0% -- the controller output will be off.
- The temperature of the control sensor is constantly monitored and the output duty cycle is adjusted proportionally according to where the temperature falls within the 0% - 100% band.

Proportional Ambient SSR Control Temperature Band

<u>Control Sensor Temperature</u>	<u>Duty Cycle</u>
Setpoint	0%
Setpoint-proportional band/2	50%
Setpoint-proportional band	100%

Note: The load shedding "fail safe mode" is not supported when using proportional ambient SSR control, since ambient temperature is being monitored rather than pipe temperature.

7-2-4 Proportional Ambient Contactor Control (for use with contactors)

When an HTC using a contactor is used to control the output based on the ambient temperature, this control mode should be used.

Proportional ambient contactor control on the HTC is implemented as follows:

- The output may not be switched on/off rapidly when using a contactor, so proportional temperature control is implemented by applying the required duty cycle over the selected CYCLE TIME.
- The output is fully on for a portion of the CYCLE TIME as determined by the calculated duty cycle, and it will be completely off for the remainder of the CYCLE TIME.
- The duty cycle is calculated each time the output toggles, based on the ambient

temperature, PROPORTIONAL BAND setting and the CONTROL SETPOINT temperature setting.

- The controller monitors the ambient temperature and compares it to the CONTROL SETPOINT temperature as in proportional ambient SSR control. If the temperature of the control sensor is at or below the CONTROL SETPOINT temperature minus the PROPORTIONAL BAND setting, then power is applied to the trace with a duty cycle of 100%. The controller output will be fully on for 1/30th of the CYCLE TIME setting before the duty cycle is calculated again.
- If the temperature sensed by the control sensor is equal or greater than the CONTROL SETPOINT temperature, then the output will have a duty cycle of 0%. The controller output will be off for 1/30th of the CYCLE TIME setting before the duty cycle is calculated again.

Proportional Ambient Contactor Control Temperature Band

<u>Control Sensor Temperature</u>	<u>Duty Cycle</u>
Setpoint	0%
Setpoint-proportional band/2	50%
Setpoint-proportional band	100%

Note: The load shedding "fail safe mode" is not supported when using proportional ambient contactor control, since ambient temperature is being monitored rather than pipe temperature.

Also note that if an AC alarm, with an alarm filter time greater than 0, is detected the contactor will not toggle until the alarm filter time has expired.

7-3 LOAD SHEDDING CONTROL MODE

Load shedding is a control mode that may be programmed and initiated only by the Model 780/GCC-9000 Group Communications Controller, which overrides temperature control and forces the output of the controller OFF until reset by the 780/GCC-9000. Load shedding is initiated by a contact closure (or opening) on one of the four contact inputs on the GCC. Each contact input initiates a load shedding command for the group of controllers associated with that contact input. Each controller may be associated with one or more groups. Refer to the Load Shedding Section in the GCC manual for details on setting up the load shedding features of the HTC.

When power is applied to the controller, it determines if load shedding mode has been enabled. If enabled, the controller immediately enters load shedding operation (holding its output off) and waits to see if the GCC has initiated a load shedding command. If no command is present, the controller resumes normal operation. If a load shedding command is present, the controller will continue to hold its output OFF, until one of three conditions occurs:

1. The contact input which initiated load shedding clears and the GCC issues the command to terminate load shedding mode.
2. Communications are interrupted between the controller and the GCC (as in the case of a damaged communications wire or loss of power to the GCC). Approximately 30 seconds after communications ceases, the controller will return to normal operation.
3. Communications between the controllers and the GCC goes "Off-line" for approximately two minutes (as occurs when the 760 Hand Held Programmer is used to communicate with the controller).

Note: The controller will return to normal operation if communications between the GCC and the controller is disrupted in any way. This will return temperature control to the HTC. Also, the HTC does not perform a periodic auto-cycle test while operating in load shed mode. The Group Communications Controller must be configured for load shedding operation before the controller may be set up for load shedding control.

There are three parameters that must be set up in the controller to completely configure it for load shedding operation:

1. The load shedding feature must be enabled.
2. The FAIL SAFE MODE parameter must be enabled or disabled depending on the application requirements. If FAIL SAFE MODE is enabled, then at least one LOW TS ALARM (of a TS used in the TS CONTROL MODE) must be enabled and its alarm temperature must be less than the CONTROL SETPOINT temperature, otherwise fail safe mode will be disabled.
3. The contact input(s) that are to be associated with the load shedding action for the controller must be defined.

These parameters may only be configured using the Model 780/GCC-9000 Group Communications Controller. Refer to the Model 780/GCC-9000 user

manual for details on how to set up these options. Note that the Operator Console may be used to enable or disable the load shedding feature but not set any of the other load shedding parameters.

Note: Fail safe mode is always disabled if the SWITCH CONTROL MODE is set to either of the two proportional ambient control modes.

Note: If the TS CONTROL MODE uses both TS 1 and TS 2 to calculate the control temperature, the HTC will turn on its output if the following conditions are met:

- load shedding is active
- fail safe mode is enabled
- the control temperature falls below either of the LOW TS ALARM settings
- both TS 1 and TS 2 have their LOW TS ALARMS enabled

Note: A FORCE ON override signal has higher priority than a load shedding signal. A INHIBIT signal has higher priority than fail safe mode.

SECTION VIII- **TROUBLESHOOTING**

8-1 OPERATOR CHECKS

Note: If the controller does not operate properly and is being returned to General Cable Pyrotenax for service, information must be provided as to why the unit was removed from service. Contact the General Cable Pyrotenax customer service department for a Return Authorization form and number prior to returning any units for repair.

Upon receipt of the controller, or to check the controller for an indication of normal operation, follow the operational procedures shown below. These procedures are designed to familiarize the operator with the controller and to provide an understanding of its operation.

In order to determine if a fault is associated with the heat tracing, wiring or the controller, it will be necessary to trouble-shoot the wiring and tracer circuit. If the fault remains, remove power from the controller and exchange it with another controller. This may require some reprogramming of the new HTC. Refer to the following Sections for the appropriate topic.

If the fault clears, exchange the controller on another circuit to determine if the fault moves with the controller. If the fault moves with the controller, verify that the HTC has been configured correctly for the application. If the configuration is correct it may be necessary to return the controller to General Cable Pyrotenax for evaluation.

8-1-1 Getting Started

In order to access the functions of the 910 Series HTC, use the Operator Console. If the modem communications option is installed in the 910, the Model 780/GCC-9000 Group Communications Controller may also be used to access controller parameters. Refer to the GCC User Manual for operational details.

8-2 COMMON PROBLEM AREAS

The HTC may be used as an effective troubleshooting tool to pinpoint problem areas of heat trace circuits. Described below are a few of the more common problem areas, their symptoms, and parameters to check to determine the actual faulty portion of the heat trace circuit.

8-2-1 RTDs

RTD failures after installation can generally be attributed to incorrect wiring or improper installation of the sensor. Troubleshooting of these failures is a very simple procedure if the proper steps are undertaken in the correct order. Some specific RTD problems and the correct methods for troubleshooting are outlined as follows.

1. TS Failure Alarm(s)

If the HTC controller indicates a failure of an RTD:

- Ensure that the TS TYPE setting matches the RTD being used.

TURN THE POWER TO THE CONTROLLER OFF BEFORE PROCEEDING!!

- Disconnect the RTD wiring from the input terminals.
- Measure the RTD's resistance between the source (WHT) and sense (WHT) leads at the controller (it should not exceed 40 Ω). Excessive lead resistance will cause a TS FAILURE ALARM and must be corrected. Look for loose terminals, excessive lead length, or insufficient wire gauge and correct as necessary.

- Measure the RTD's resistance between the source (WHT) or sense (WHT) lead and the common (RED) lead of the RTD at the controller (should be between 60 & 330 Ω depending on the temperature and the lead resistance. See Appendix E or Appendix F).
- Verify that the RTD is wired correctly - the heat tracing controllers will always be terminated in the order: source (WHT), sense (WHT), common (RED). When wiring to the 910, the terminals are marked as follows:

Terminal #	Description
19	Shield
20	TS 1 Source (WHT)
21	TS 1 Sense (WHT)
22	TS 1 Common (RED)
8	Shield
9	TS 2 Source (WHT)
10	TS 2 Sense (WHT)
11	TS 2 Common (RED)

The RTD manufacturer will typically color code the leads with the source and sense being the same color, and the common a different color. Ensure that the RTD extension wire shield is terminated at one end only, normally using the terminal block provided at the terminal board.

Note: Some manufacturers use the common Black-White-Red triad color code for the RTD connections. Usually, the RED lead is the common connection (same as the White-White-Red color scheme) and the White and Black connections may be used interchangeably.

2. Seemingly Incorrect Temperature

If you feel that the indicated or displayed temperature is not correct, the controller and the RTD can be quickly checked for correct operation.

To verify the RTD:

TURN THE POWER TO THE CONTROLLER OFF BEFORE PROCEEDING!!

- Disconnect the RTD wiring from the input terminals.
- To calculate the temperature indicated by the RTD, measure the resistance from source (white wire) or sense (white wire) to common (red wire) and subtract the resistance measured between source and sense. This will give a compensated resistance value that can be cross referenced to one of the RTD tables found in Appendix E or Appendix F. Compare the measured resistance and cross-referenced temperature value

obtained from the RTD table to the indicated or displayed value. These should agree to within the accuracy standards of the HTC and the RTD.

Note: Ensure you refer to the correct RTD table for the type of RTD you are using.

Note: Ensure that the TS TYPE setting matches the type of RTD that you are using.

To verify the Controller:

TURN THE POWER TO THE CONTROLLER OFF BEFORE PROCEEDING!!

- Disconnect the RTD wiring from the input terminals.
- Connect a 100 Ω resistor across the source or sense terminal and common. Insert a jumper between the source and sense terminals.
- Apply power to the controller. The indicated or displayed temperature should be about 0°C (32°F) depending on the actual resistance of the test resistor if TS TYPE is set to 100 Ω Platinum.

3. Unstable or Bouncing Temperature

An erratic indication of temperature can be caused by several factors external to the controller, however a bouncing temperature of a few degrees should not be confused with incorrect operation. The controller's accuracy and resolution will result in an indicated temperature change of a couple of degrees if the measured resistance temperature falls between two discrete values (this is sometimes referred to as quantization error). If the bounce or instability is excessive, check:

- Wire used for extension of the RTD should be three-wire, twisted and shielded with the shield grounded at the controller only. Each of the three lead wires must be of the same gauge.
- The ideal installation has a separate conduit for the RTD leads (if they have been extended). It is not usually a problem to run low signal levels in the same conduit as the power leads even in high power applications, as long as the RTD wire is a twisted, shielded type with an insulation rating equal to or greater than the highest voltage in the conduit. Follow the proper Electrical Code requirements for your particular installation.
- Terminal connections that are not tight can add resistance to an RTD circuit. Check the tightness of all screw terminal connections at

time of installation and during subsequent maintenance checks.

- Check the specifications for the particular cable being used to ensure that it does not have excessive capacitance when used in long lengths. This can cause a temperature offset between what the controller reads and what the RTD actually measures. This again is normally not a problem since the controller compensates for all but the worst cases of this.
- Lastly, it is possible for the RTD itself to fail on an intermittent basis but this failure mode should be considered unusual. This kind of failure is probably the most difficult to find but fortunately it is also the least likely as a failure mechanism.

8-2-2 Ground Fault

Ground fault alarms can be due to incorrect installation as well as leakage resulting from wet system components or faulted cables.

The 910 Series Controller detects ground faults by summing the outgoing and return trace currents through an internal current transformer. Under normal operating conditions (no ground fault condition) this current will be zero. When there is a flow of current from one of the trace supply wires to ground, a ground fault condition occurs.

If a ground fault alarm is present on start-up of a new installation it is likely due to a wiring error or damaged cable. To verify this condition:

- Check that the heating circuit neutrals return to the controller and are not connected directly to the distribution panel. This can be a common problem if the installation is a retrofit situation.
- On paralleled circuits, be certain that ALL neutrals return. The late addition of a circuit may not be obvious.

Use the monitoring feature available at the 910 Operator Console or the Model 780/GCC-9000 Group Communications Controller to view the measured ground fault current at the heat trace controller. If this value is at the maximum that the controller can measure, it is usually an indication that the wiring is incorrect. If the value is less than 250 mAmps then an actual ground fault condition may exist in the cable.

Note: The controller monitors the integrity of the ground fault (GF) detection transformer and associated wiring. If a fault is detected, the controller will report a GF value of 300 mAmps.

8-3 COMMON ALARMS - WHAT TO LOOK FOR

The 910 has a wide range of alarming features that may be selectively enabled or disabled to allow the monitoring and indication of trouble conditions. Described below are the different alarm conditions available on the 910, their meanings, and possible causes.

8-3-1 High TS 1/ TS 2 Temperature

This alarm will appear when the temperature exceeds the HIGH TS ALARM temperature setting.

Cause of Alarm:

- Alarm temperature setting too close to maintain temperature
- Flow of hot product
- Steaming out lines
- Incorrect tracer wiring

8-3-2 Low TS 1/TS 2 Temperature

This alarm will appear when the temperature decreases below the LOW TS ALARM temperature setting.

Cause of Alarm:

- Alarm temperature setting too close to maintain temperature
- Flow of cold product
- Empty Pipe
- Damaged, wet, or missing insulation
- Heating cable not sized properly for the application or damaged

8-3-3 TS 1/ TS 2 Failure

This alarm will indicate if a sensor is not operating properly. The temperature sensor may fail due to an "open" or "shorted" condition.

Cause of Alarm:

- Incorrect or damaged field wiring - open leads or excess resistance, (either intermittent or continuous) may be due to broken or damaged wires or loose terminals.
- Damaged or inoperative temperature sensors

8-3-4 Control TS Failure

This alarms a failure of the temperature sensing element designated as the control element by the TS CONTROL MODE setting. Depending on the chosen TS FAIL MODE and TS CONTROL MODE, the output switch may be latched off or on until this failure is corrected.

Cause of Alarm:

- Incorrect or damaged field wiring - open leads or excess resistance (either intermittent or continuous) may be due to broken or damaged wires or loose terminals.
- Damaged or inoperative temperature sensors

8-3-5 High Current

This alarms current levels which are greater than the HIGH CURRENT ALARM setting for the application.

Cause of Alarm:

- Alarm setting too close to normal operating current
- High in-rush current from "cold start" of self regulating cable
- Damaged or partially shorted heating cable
- "As built" cable length is greater than design value

8-3-6 Low Current

This alarms current levels which are less than the LOW CURRENT ALARM setting.

Cause of Alarm:

- Alarm setting too close to normal operating current
- Low source voltage
- Damaged or inoperative heating cable
- Open connection - wiring problem

8-3-7 High GFI

This alarms ground fault current levels which are greater than the HIGH GFI ALARM setting.

Cause of Alarm:

- Alarm setting too close to normal leakage current
- Damaged cable insulation and/or moisture present
- Moisture in junction box
- Poor splice or termination
- Moisture provides conductive ground path which allows ground fault current

8-3-8 GFI Trip

This value sets the upper limit of allowable ground fault leakage. Exceeding this limit will result in the output switch being latched off and the alarm activated to indicate a ground fault condition.

Cause of Alarm:

- Trip setting too close to normal leakage current
- Damaged cable insulation and/or moisture present

- Moisture in junction box
- Poor splice or termination
- Moisture provides conductive ground path which allows ground fault current

8-3-9 High Voltage

This alarms voltage levels which are greater than the HIGH VOLTAGE ALARM setting.

Cause of Alarm:

- Alarm setting too close to normal operating voltage
- Incorrect wiring
- Power Surge

8-3-10 Low Voltage

This alarms voltage levels which are less than the LOW VOLTAGE ALARM setting.

Cause of Alarm:

- Alarm setting too close to normal operating voltage
- Damaged power cable
- "Brown-out" conditions
- Loss of power to the circuit

8-3-11 Overcurrent Trip

If the controller is unable to start the cable due to high current or after attempting to soft start it, the controller will trip its output switch off.

Cause of Alarm:

- Excessive in rush current
- Incorrect wiring
- Damaged cable

8-3-12 Switch Failure

This alarm will indicate that the controller senses current flow when the output switch should be off.

Cause of Alarm:

- Some other device energized heat trace
- Output switch has failed "closed"

8-3-13 HTC Reset

This alarm is latched when power is restored after an interruption. Used to identify intermittent power losses.

Cause of Alarm:

- Circuit breaker tripped
- Power line transient

8-3-14 Power Limiting

This alarm indicates that the solid state relay is limiting the average amount of power that is applied to the trace circuit as defined by the MAXIMUM POWER setting.

Cause of Alarm:

- Power applied to trace circuit is being limited to the MAXIMUM POWER setting

8-3-15 C.B. Limiting

This alarm indicates that the solid state relay is limiting the average current that is applied to the trace circuit to the C.B. CURRENT RATING setting to protect the upstream heater circuit breaker from tripping.

Cause of Alarm:

- Excessive current caused by in-rush current
- C.B. CURRENT RATING setting too low for normal heater current draw or not matched to actual circuit breaker size

8-3-16 Switch Limiting

This alarm indicates that the controller is limiting the average current that is applied to the trace circuit based on the SWITCH RATING setting to protect the solid state relay from excess current.

Cause of Alarm:

- Excessive current caused by in-rush current
- Excessive ambient temperature

8-3-17 High Resistance

This alarm indicates that the heating cable resistance has deviated from the NOMINAL RESISTANCE setting by more than the HIGH RESISTANCE ALARM setting.

Cause of Alarm:

- Alarm setting too close to actual operating resistance
- NOMINAL RESISTANCE not set properly
- Open connection - wiring problem
- Damaged cable

8-3-18 Low Resistance

This alarm indicates that the heating cable resistance has deviated from the NOMINAL RESISTANCE setting by more than the LOW RESISTANCE ALARM setting.

Cause of Alarm:

- Alarm setting too close to actual operating resistance
- NOMINAL RESISTANCE not set properly
- Partial short - wiring problem
- Damaged cable

8-3-19 EEROM Data Failure

This alarm indicates that the controller has detected a failure in its non-volatile memory (this is where all of the controller's configuration and calibration settings are stored). This indicates an internal problem and the HTC should be replaced and returned to the factory for repair.

Cause of Alarm:

- The HTC cannot bypass the failed area of its memory and has loaded factory defaults into this failed area.

8-3-20 Contactor Count

This alarm indicates that the number of off-to-on transitions of a contactor has exceeded the CONTACTOR COUNT ALARM setting and the contactor should be replaced.

Cause of Alarm:

- Contactor is has been controlling the trace circuit for a long time
- Some configuration parameter (i.e. DEADBAND, AUTO CYCLE INTERVAL, load shedding etc.) is causing the contactor to toggle more than usual.

SECTION IX - MAINTENANCE

9-1 OPERATOR MAINTENANCE

The 910 series controller is designed to be a maintenance free product. Once installed properly the only maintenance required is re-tightening of the terminal connections approximately one week after installation and inspection periodically thereafter. Also, alarm pilot lamps (if installed) may need periodic replacement.

CAUTION: MAKE SURE THAT THE POWER TO THE CONTROLLER IS OFF WHEN REPLACING THE PILOT LAMPS! ALSO, BE CERTAIN POWER IS OFF TO THE CONTROLLER BEFORE ATTEMPTING TO TEST OR SERVICE THE HEAT TRACING.

DO NOT RELY ON THE CONTROLLER AS A DISCONNECT DEVICE!

9-2 REPLACEABLE PARTS

There are no user-serviceable parts in the 910 series controller or accessories (except lamps in optional alarm pilot lights). The unit is designed to be easily changed out in the field in a matter of minutes. A 910 appearing inoperative should be returned to the nearest General Cable Pyrotenax Service Center for service.

WARNING: TAMPERING WITH THE 910 COMPONENTS WITHOUT APPROVAL FROM GENERALCABLE PYROTENAX COULD RESULT IN THE PRODUCTS' WARRANTY BEING VOID.

Appendix A – Specifications

Specifications are @ 25°C unless otherwise noted and are subject to change without notice.

System Ratings

Storage Ambient	-40 to +85°C (-40 to +185°F)
Approvals	CSA NRTL/C, Factory Mutual (Pending)
Classification	• CI I, Div 2, Grps A,B,C,D and Ex nA IIA, IIB, IIC (Zone 2) • SSR Version T-code: T4 • Ordinary locations (SSR and EMR versions)

Wiring Terminal Ratings

Signal Terminals	28-12AWG, strip length: 0.22"
Power Terminals	30A: 22-8AWG, strip length: 0.47", torque: 10.7 in-lb (1.2 N-m)
Ground Lugs	14-6AWG torque: 12 in-lb (1.35 N-m)

Assembly Ratings

Operating Temperature	-40 to +60°C (-40 to +140°F)
Enclosures	FRP: Nema 4X/IP65 SS: Type 304, Nema 4X/IP65
Solid-State Relay Rating	• 2 pole switching • 30A resistive continuous @ 40°C, derate linearly to 15A max. @ 60°C • 120-277Vac nom. max., 1PH, 50/60Hz, 80A 1 sec. in-rush, 625A 1 cycle in-rush
Electro-mechanical Relay Rating	• 2 pole switching • 30A resistive continuous @ 40°C, derate linearly to 20A max. @ 60°C • 120-277Vac nom. max.

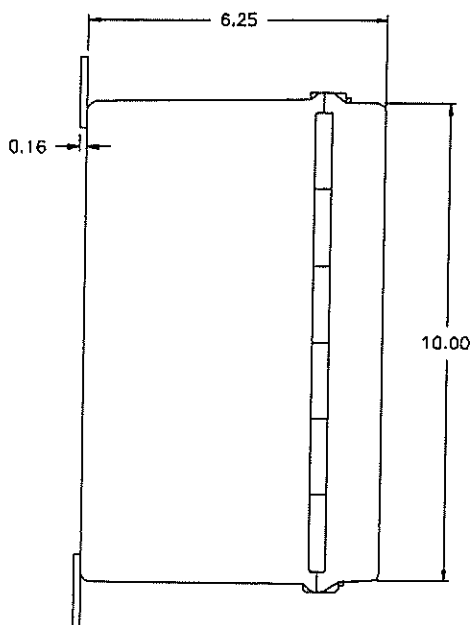
Control Module Ratings

Operating Temperature	-40 to +75°C (-40 to +167°F)
Power Requirements	100 to 277Vac nom., 1PH, 50/60Hz, 0.2A. max. + 0.75A (Aux. AC output terminals)
Output Power	+12Vdc nom., 250ma. max.
Control Modes	• Proportional, Deadband, Proportional Ambient (SSR), Proportional Ambient (Contactor) modes • Adjustable 1 to 50°C (2 to 90°F)
Temperature Inputs	(2) RTD inputs: 3-wire 100Ω Platinum (DIN 43760, $\alpha=0.00385\Omega/\Omega/^{\circ}\text{C}$) or 2/3-wire 100Ω Ni-Fe, open/shorted sensor detection/protection, lead resistance compensated 0 to 20Ω per lead.
Temperature Measurement Range	-60 to +570°C (-76 to +1058°F), accuracy: $\pm 0.5\%$ of span $\pm 1\text{LSD}$
Voltage Measurement Range	80 to 295Vac, accuracy: $\pm 1\%$ of span $\pm 2\text{LSD}$, repeatability: $\pm 1.5\%$ of span
Current Measurement Range	0.3 to 100A, resolution: 0.1A (0.3 to 11A range), 0.3A (11 to 40A range), 0.7A (40 to 100A range), accuracy: $\pm 2.5\%$ of reading resolution, repeatability: $\pm 3\%$ of reading $\pm$ resolution
GF Current Measurement Range	20 to 250ma, accuracy: $\pm 2.5\%$ of span $\pm 2\text{LSD}$ at nominal load, repeatability: $\pm 4\%$ of span
Dry Contact Alarm Relay Output	48Vac/dc, 500ma, 10VA switching max.
AC Alarm Relay Output	0.75A, 120-277Vac nom. max.

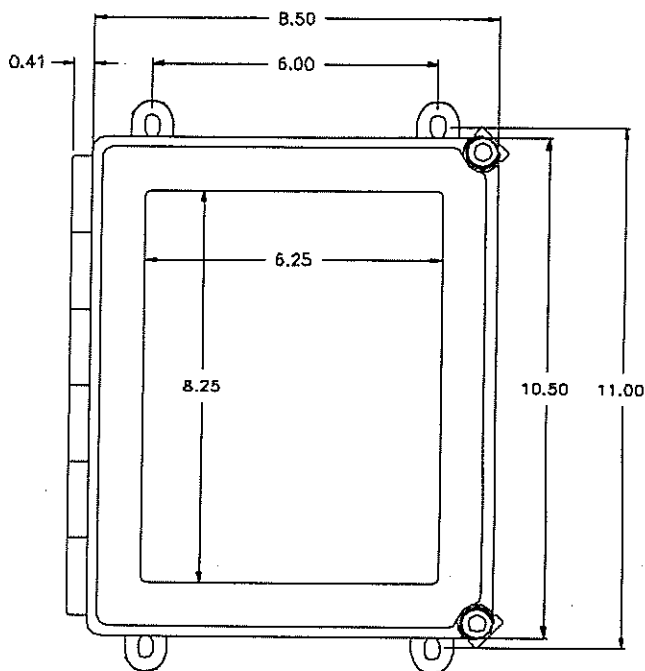
Appendix B - TYPICAL ENCLOSURE DIMENSIONS

The following drawings provide the user with enclosure size and mounting dimensions for the stock 910 enclosure assemblies. Please contact your local General Cable *Pyrotecnax* representative for information regarding other available sizes and configurations.

B-1 Standard Fiberglass EMR Assembly #10170-001



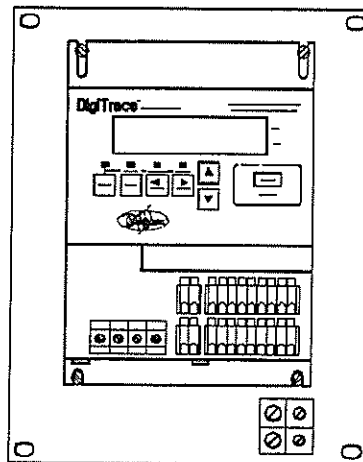
LEFT SIDE VIEW



FRONT VIEW

2-pole 30A EMR Assembly
in a Fiberglass
Enclosure with Window.

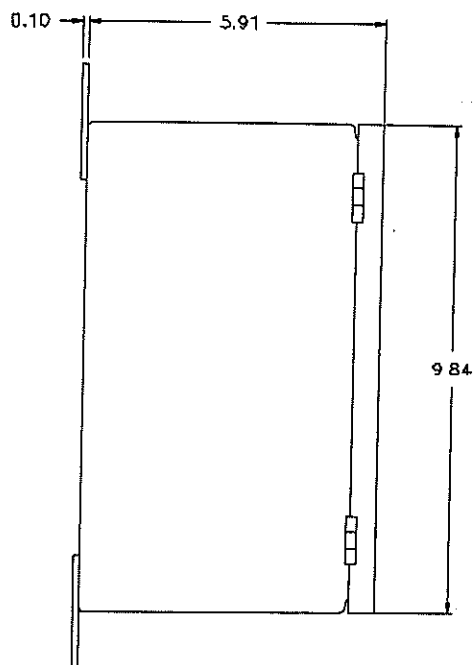
Model: 910*E1FWL*EMR2



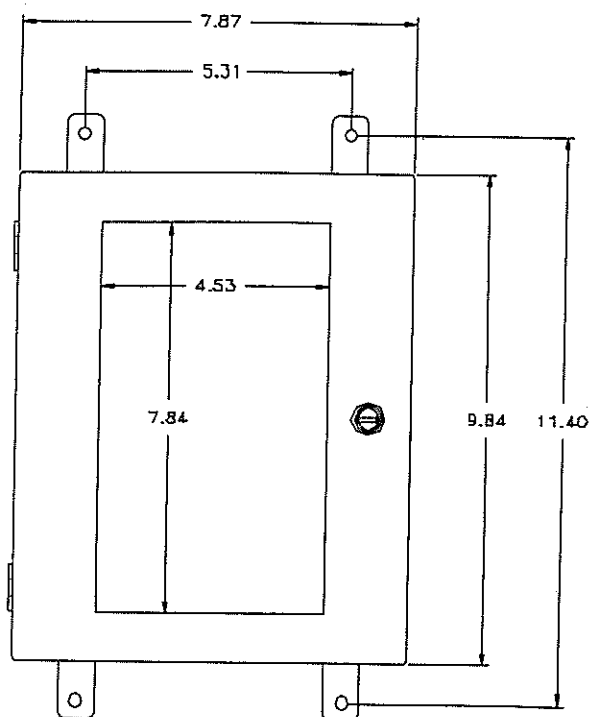
BACKPLANE

D910-001

B-2 Optional Stainless Steel EMR Assembly #10170-003



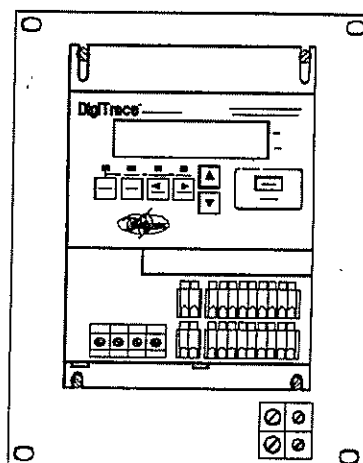
LEFT SIDE VIEW



FRONT VIEW

2-pole 30A EMR Assembly
in a Stainless Steel
Enclosure with Window.

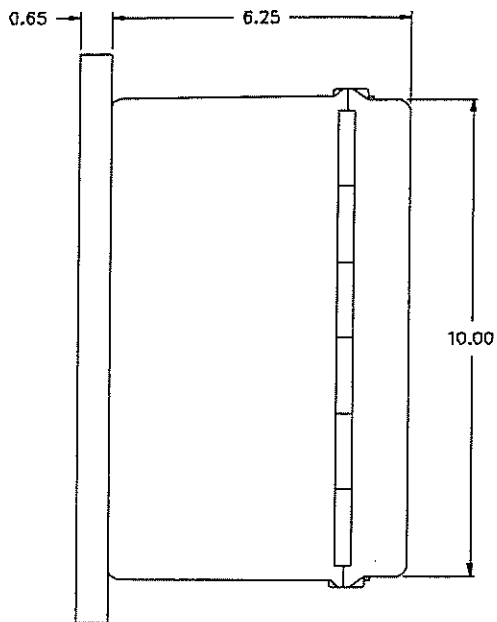
Model: 910*E1SW*EMR2



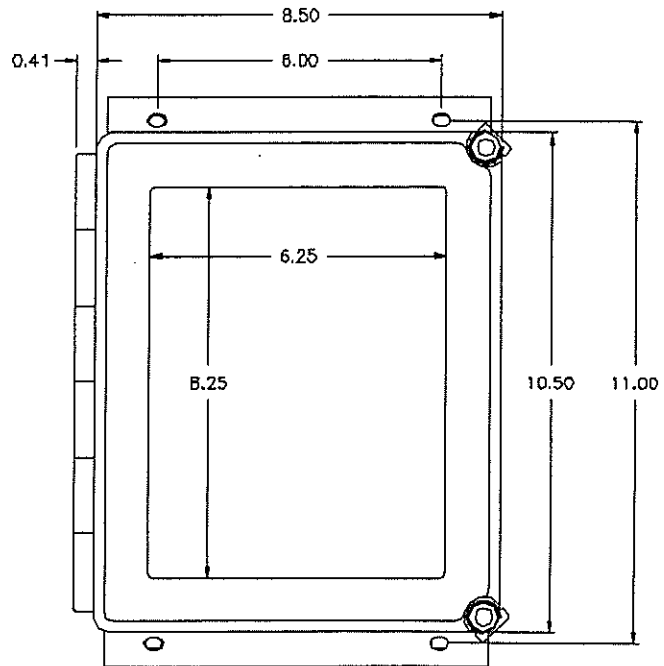
BACKPLANE

D910-003

B-3 Standard Fiberglass SSR Assembly #10170-002



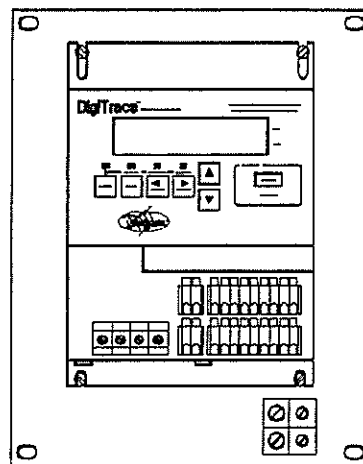
LEFT SIDE VIEW



FRONT VIEW

2-pole 30A SSR Assembly
in a Fiberglass
Enclosure with Window.

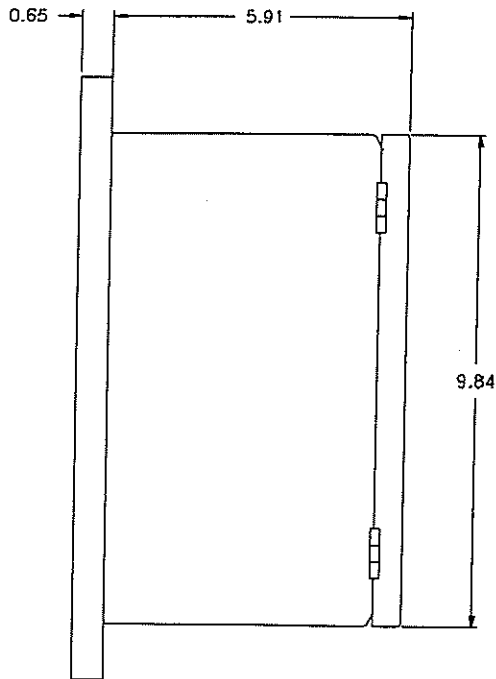
Model: 910*E1FWL*SSR2



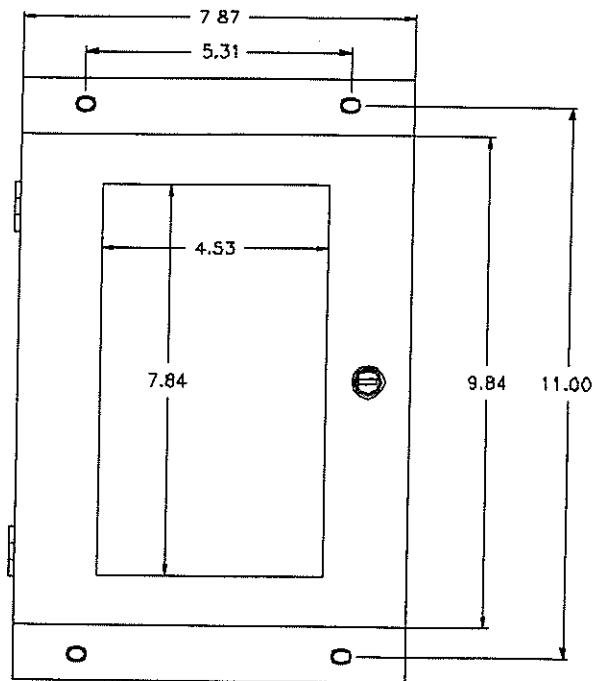
BACKPLANE

D910-002

B-4 Optional Stainless Steel SSR Assembly #10170-004



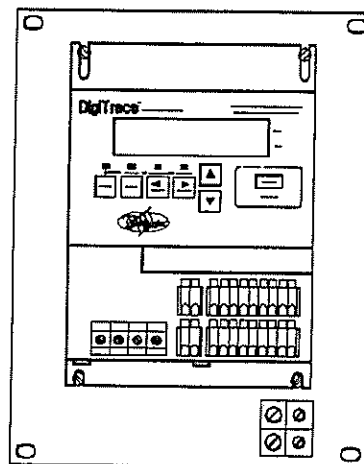
LEFT SIDE VIEW



FRONT VIEW

2-pole 30A SSR Assembly
in a Stainless Steel
Enclosure with Window.

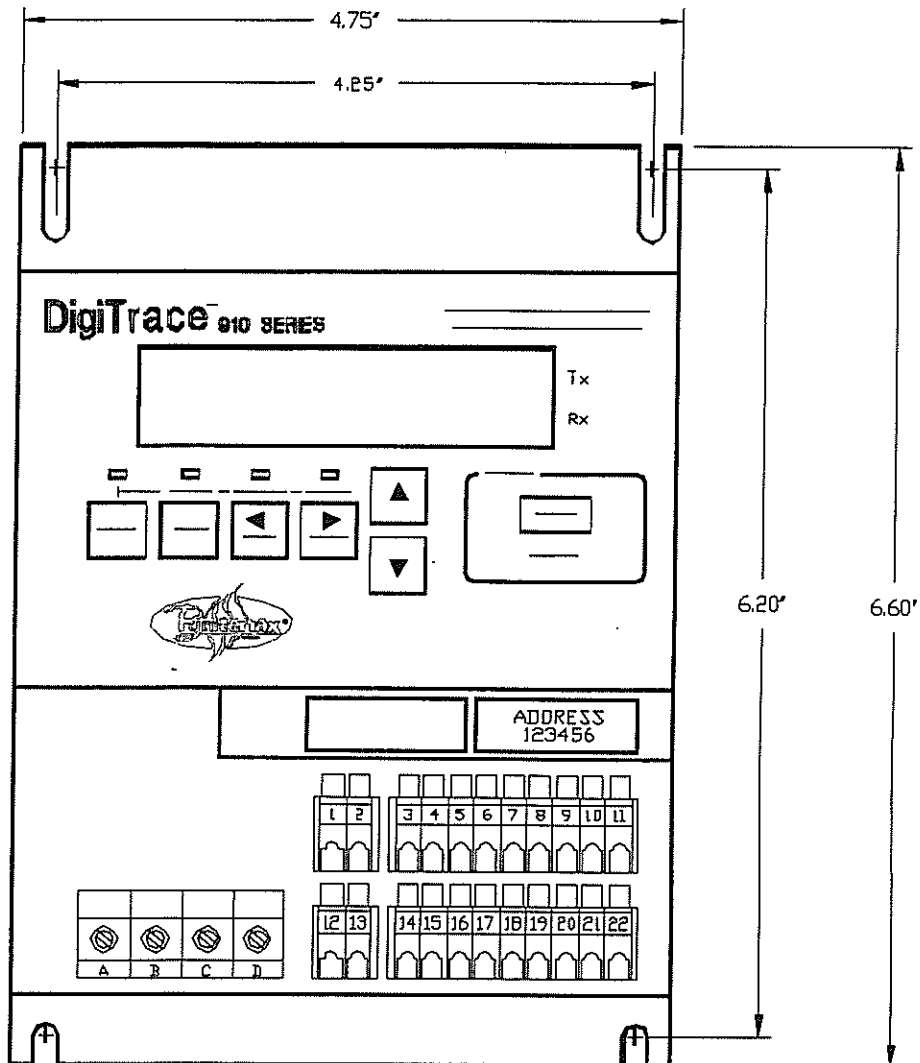
Model: 910*E1SW*SSR2



BACKPLANE

D910-004

B-5 910 Series HTC Control Module Dimensions

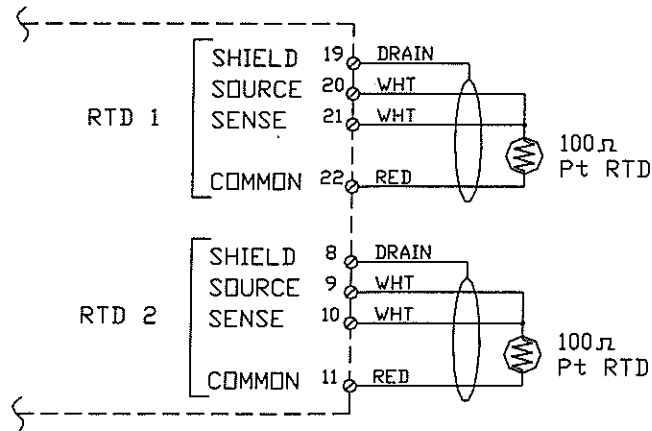


D910-010

Appendix C - Wiring Diagrams

The following drawings provide sample wiring diagrams for the 910 Series control products and optional accessories. Please contact your local General Cable *Pyrotecnax* representative for information regarding other available options.

C-1 TS Wiring



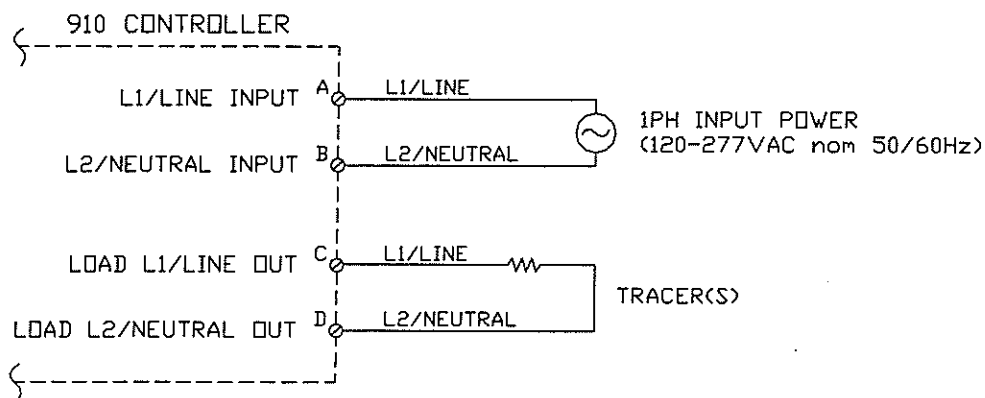
TS 1 and TS 2 Wiring Diagram

D910-005

Note: Temperature sensor manufacturers may use different lead wire colors than those shown in the diagram above. Some common color combinations are shown in the table below, but others may also be available. See Sections 2-7-1 and 8-2-1 for additional details.

Signal Description	Lead Wire Color Scheme #1	Lead Wire Color Scheme #2
Source	White	White
Sense	White	Black
Common	Red	Red

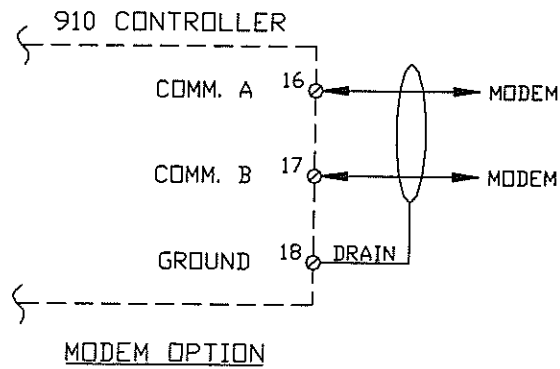
C-2 Power Wiring



D910-006

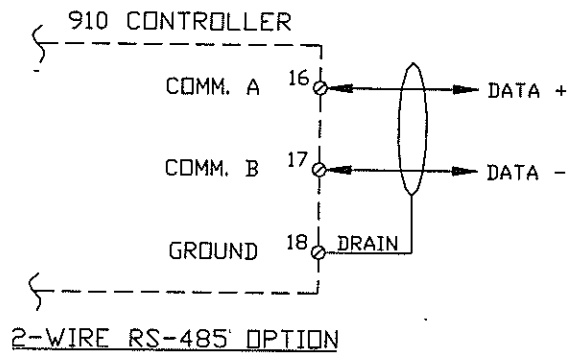
C-3 Communication Wiring

C-3-1 2-Wire Modem Option



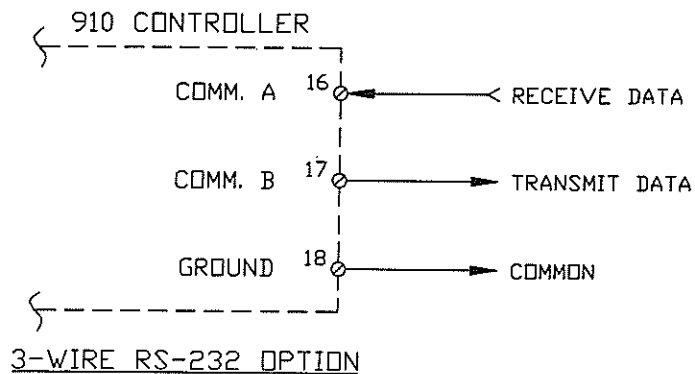
D910-008

C-3-2 2-Wire RS-485 Option



D910-008

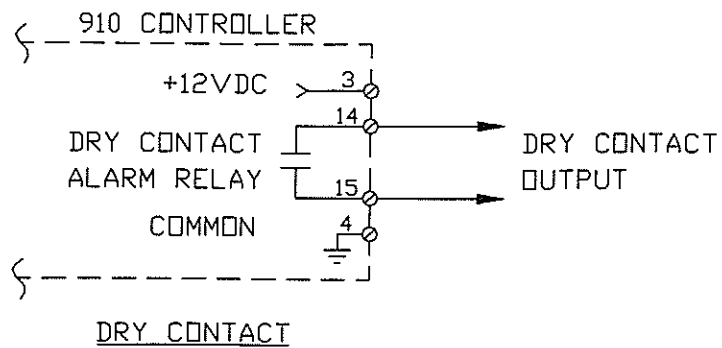
C-3-3 RS-232 Option



D910-008

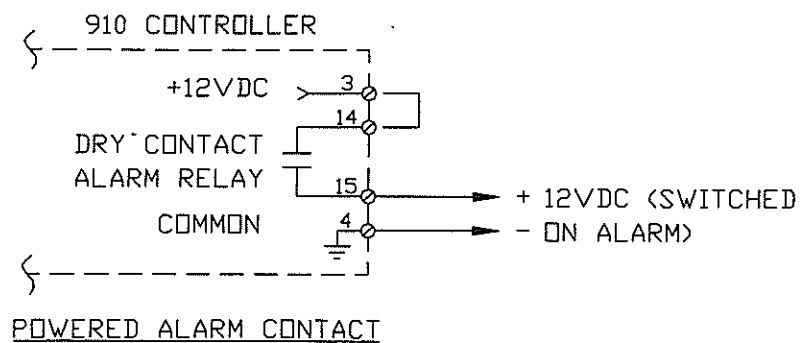
C-4 Alarm Output Wiring

C-4-1 Used as a Dry Contact



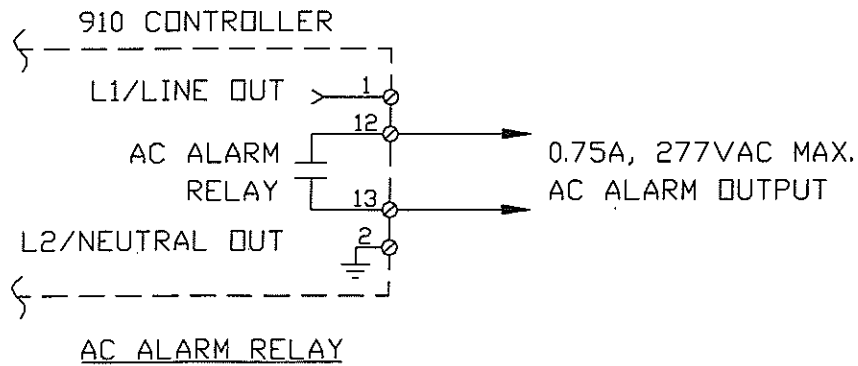
D910-007

C-4-2 Used as a Switched DC Contact



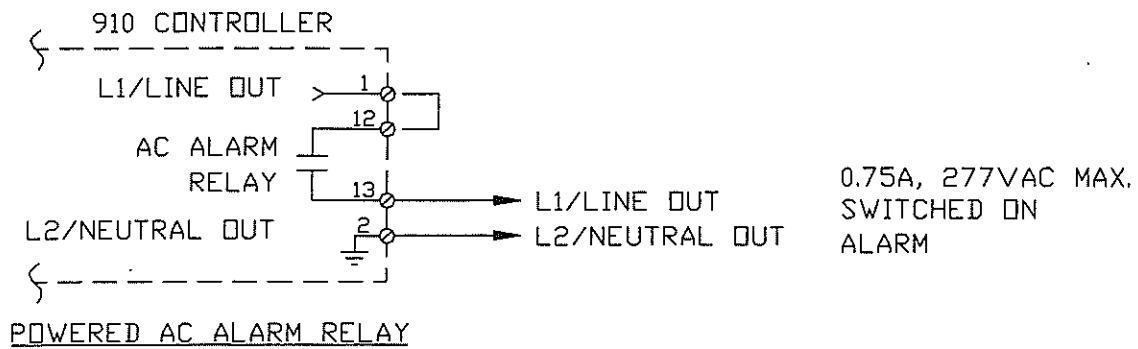
D910-007

C-4-3 Used as an AC Alarm Relay



D910-007

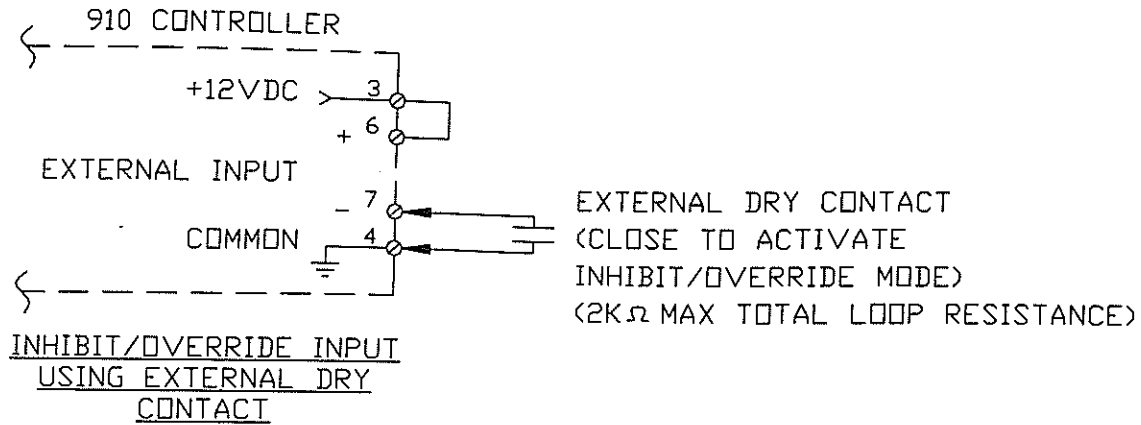
C-4-4 Used as a Powered AC Alarm Relay



D910-007

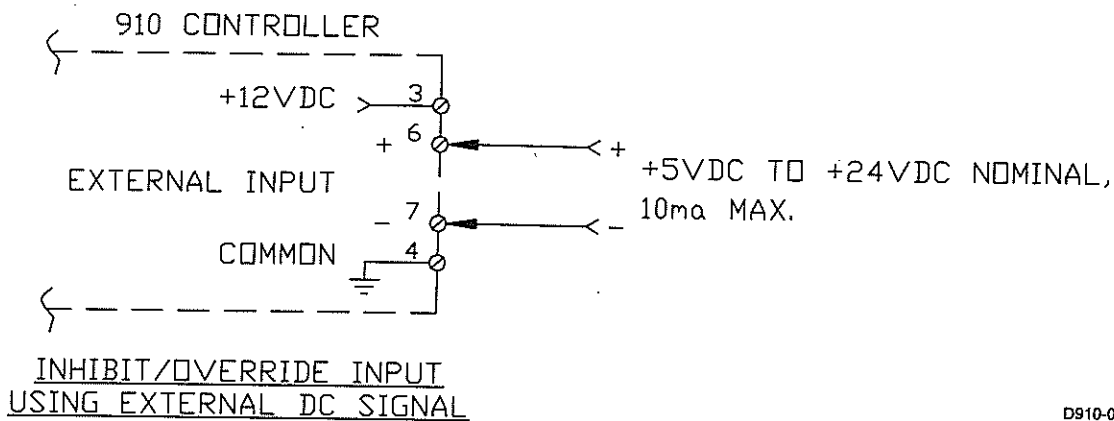
C-5 External Input Port Wiring

C-5-1 External Inhibit/Override Using a Dry Contact



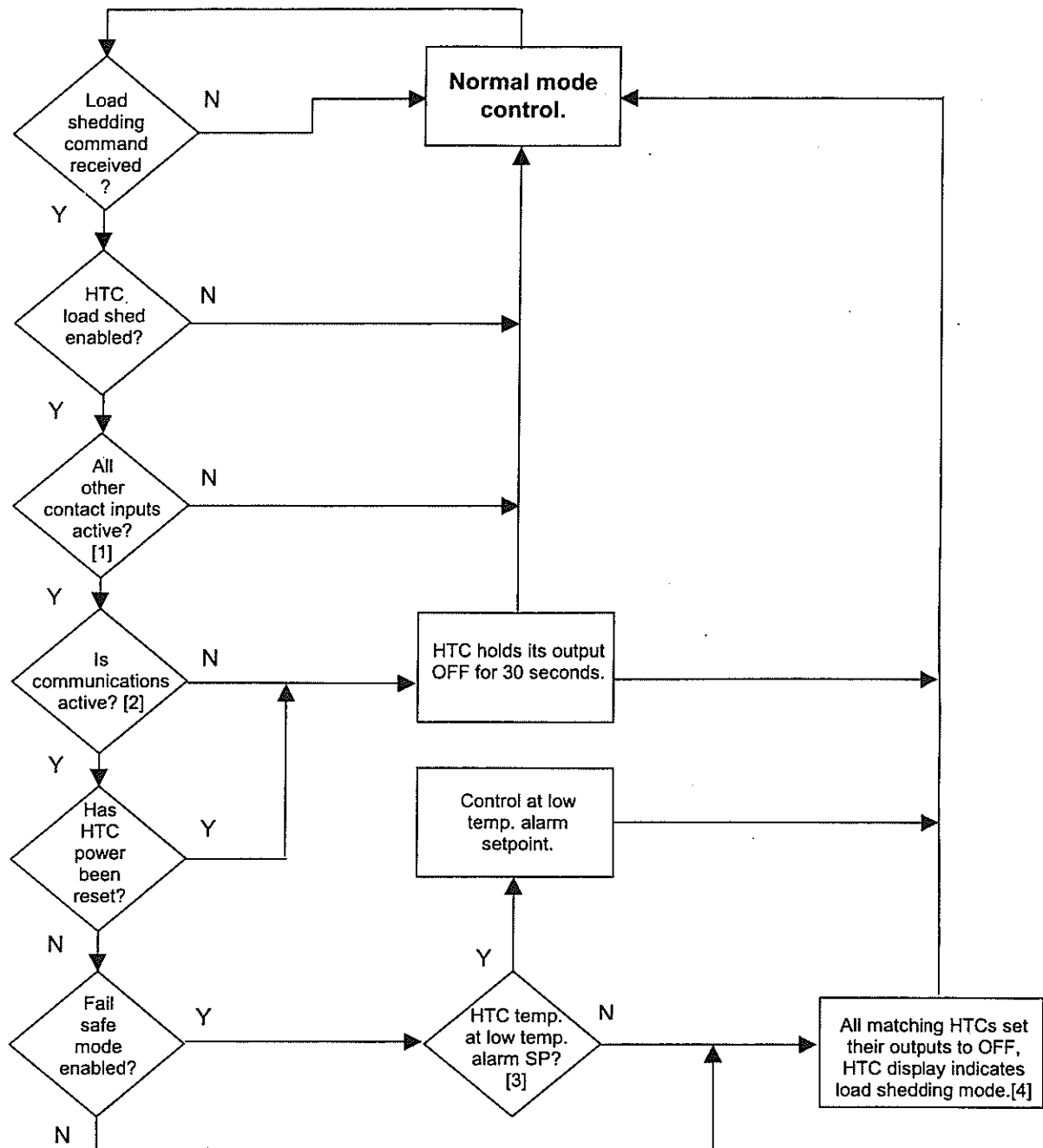
D910-009

C-5-2 External Inhibit/Override Using a DC Signal



D910-009

Appendix D - HTC LOAD SHEDDING SEQUENCE



[1] If an HTC is associated with more than one contact input, all inputs must be activated before the HTC will go into a Load Shedding mode.

[2] If communications between an HTC and an upstream device such as a GCC or the PyroMaster™ software are interrupted, or if the power has been reset to the HTC, the HTC will hold its output OFF, waiting for a Load Shedding command.

[3] Only if the Low Temperature Alarm is ENABLED.

[4] For 910/920 Series controllers, a "<Load Shedding>" message will be displayed after the load current reading.

Appendix E - 100 Ω PLATINUM RTD TABLE

(DIN 43760 - 100 Ω Platinum Resistance Temperature (RTD) - 0.00385 Ohms/Ohm/ $^{\circ}$ C)

Ohms	$^{\circ}$ C	$^{\circ}$ F	Ohms	$^{\circ}$ C	$^{\circ}$ F	Ohms	$^{\circ}$ C	$^{\circ}$ F
60.25	-100	-148	159.18	155	311	250.48	410	770
62.28	-95	-139	161.04	160	320	252.19	415	779
64.30	-90	-130	162.90	165	329	253.90	420	788
66.31	-85	-121	164.76	170	338	255.61	425	797
68.33	-80	-112	166.61	175	347	257.32	430	806
70.33	-75	-103	168.46	180	356	259.02	435	815
72.33	-70	-94	170.31	185	365	260.72	440	824
74.33	-65	-85	172.16	190	374	262.42	445	833
76.33	-60	-76	174.00	195	383	264.11	450	842
78.32	-55	-67	175.84	200	392	265.80	455	851
80.31	-50	-58	177.68	205	401	267.49	460	860
82.33	-45	-49	179.51	210	410	269.18	465	869
84.27	-40	-40	181.34	215	419	270.86	470	878
86.25	-35	-31	183.17	220	428	272.54	475	887
88.22	-30	-22	184.99	225	437	274.22	480	896
90.19	-25	-13	186.82	230	446	275.89	485	905
92.16	-20	-4	188.63	235	455	277.56	490	914
94.12	-15	5	190.45	240	464	279.23	495	923
96.09	-10	14	192.26	245	473	280.90	500	932
98.04	-5	23	194.07	250	482	282.56	505	941
100.00	0	32	195.88	255	491	284.22	510	950
101.95	5	41	197.69	260	500	285.87	515	959
103.90	10	50	199.49	265	509	287.53	520	968
105.85	15	59	201.29	270	518	289.18	525	977
107.79	20	68	203.08	275	527	290.83	530	986
109.73	25	77	204.88	280	536	292.47	535	995
111.67	30	86	206.67	285	545	294.11	540	1004
113.61	35	95	208.45	290	554	295.75	545	1013
115.54	40	104	210.24	295	563	297.39	550	1022
117.47	45	113	212.02	300	572	299.02	555	1031
119.40	50	122	213.80	305	581	300.65	560	1040
121.32	55	131	215.57	310	590	302.28	565	1049
123.24	60	140	217.35	315	599	303.91	570	1058
125.16	65	149	219.12	320	608	305.53	575	1067
127.07	70	158	220.88	325	617	307.15	580	1076
128.98	75	167	222.65	330	626	308.76	585	1085
130.89	80	176	224.41	335	635	310.38	590	1094
132.80	85	185	226.17	340	644	311.99	595	1103
134.70	90	194	227.92	345	653	313.59	600	1112
136.60	95	203	229.67	350	662	315.20	605	1121
138.50	100	212	231.42	355	671	316.80	610	1130
140.39	105	221	233.17	360	680	318.40	615	1139
142.29	110	230	234.91	365	689	319.99	620	1148
144.17	115	239	236.65	370	698	321.59	625	1157
146.06	120	248	238.39	375	707	323.18	630	1166
147.94	125	257	240.13	380	716	324.76	635	1175
149.82	130	266	241.86	385	725	326.35	640	1184
151.70	135	275	243.59	390	734	327.93	645	1193
153.58	140	284	245.31	395	743	329.51	650	1202
155.45	145	293	247.04	400	752	331.08	655	1211
157.31	150	302	248.76	405	761	332.66	660	1220

Appendix F - 100 Ω NICKEL-IRON RTD TABLE

Ohms	°C	°F	Ohms	°C	°F	Ohms	°C	°F
69.8	-73	-100	133.4	68	155	218.2	210	410
71.1	-70	-95	134.8	71	160	220.1	212	415
72.3	-67	-90	136.3	73	165	222.0	215	420
73.1	-65	-85	137.8	76	170	223.9	218	425
74.3	-62	-80	139.3	79	175	225.8	221	430
75.5	-59	-75	140.8	82	180	227.7	223	435
76.7	-56	-70	142.3	85	185	229.6	226	440
78.0	-53	-65	143.8	87	190	231.5	229	445
78.8	-51	-60	145.3	90	195	233.5	232	450
80.0	-48	-55	146.8	93	200	235.4	235	455
81.2	-45	-50	148.4	96	205	237.4	237	460
82.2	-42	-45	149.9	98	210	239.3	240	465
82.9	-40	-40	151.5	101	215	241.3	243	470
84.2	-37	-35	153.0	104	220	243.3	246	475
85.7	-34	-30	154.6	107	225	245.3	248	480
86.9	-31	-25	156.2	110	230	247.2	251	485
88.1	-28	-20	157.7	112	235	249.3	254	490
88.9	-26	-15	159.3	115	240	251.2	257	495
90.1	-23	-10	160.9	118	245	253.3	260	500
91.4	-20	-5	162.5	121	250	255.2	262	505
92.2	-17	0	164.2	123	255	257.3	265	510
93.4	-15	5	165.8	126	260	259.3	268	515
94.6	-12	10	167.4	129	265	261.4	271	520
95.8	-9	15	169.0	132	270	263.4	273	525
97.1	-6	20	170.7	135	275	265.5	276	530
98.3	-3	25	172.3	137	280	267.6	279	535
99.5	-1	30	174.0	140	285	269.6	282	540
100.8	1	35	175.7	143	290	271.7	285	545
102.0	4	40	177.4	146	295	273.8	287	550
103.3	7	45	179.1	148	300	275.9	290	555
104.6	10	50	180.8	151	305	278.0	293	560
105.9	12	55	182.5	154	310	280.1	296	565
107.2	15	60	184.2	157	315	282.3	298	570
108.5	18	65	185.9	160	320	284.4	301	575
109.8	21	70	187.6	162	325	286.5	304	580
111.1	23	75	189.4	165	330	288.6	307	585
112.5	26	80	191.1	168	335	290.8	310	590
113.8	29	85	192.9	171	340	293.1	312	595
115.2	32	90	194.6	173	345	295.2	315	600
116.5	35	95	196.4	176	350	297.5	318	605
117.9	37	100	198.2	179	355	299.8	321	610
119.2	40	105	199.9	182	360	301.4	323	615
120.6	43	110	201.7	185	365	303.7	326	620
122.0	46	115	203.5	187	370	306.0	329	625
123.4	48	120	205.3	190	375	308.3	332	630
124.8	51	125	207.2	193	380	310.6	335	635
126.2	54	130	209.0	196	385	312.2	337	640
127.6	57	135	210.8	198	390	314.5	340	645
129.0	60	140	212.7	201	395	316.8	343	650
130.5	62	145	214.5	204	400	319.1	346	655
131.9	65	150	216.4	207	405	320.6	348	660

Control Set for $\uparrow$
 1. AS/100 Nickel - Iron RTD
 2. ADVANCES $\downarrow$

Appendix G – Factory Default Configuration V3.1X 910 Series HTC

BASIC MODE MENU

(All other parameters are set as shown in the Advanced Mode Sub-Menus)

Configuration Mode Menu			
Parameter	Factory	User	
Control Set point	68°F (20°C)		
Lo TS 1	14°F (-10°C)		
Lo Load	1.0A		
Switch Control Mode	Deadband		
Circuit Breaker	*n/a (30.0A)		
Temp. Units	°F		
Feature Mode	Basic		

ADVANCED MODE MENUS

Configuration Mode Main Menu			
Parameter	Factory	User	
Control Set point	68°F (20°C)		
Lo TS 1	14°F (-10°C)		
Lo Load	1.0A		
Hi GFI	20 mA		
GFI Trip	30 mA		
Feature Mode	Advanced		

TS Alarms Configuration Sub-Menu			
Parameter	Factory	User	
TS 1 Fail	Enable		
Lo TS 1	Enable (14°F (-10°C))		
Lo TS 1	14°F (-10°C)		
Hi TS 1	Disable		
Hi TS 1	*n/a		
TS 2 Fail	(212°F (100°C))		
Lo TS 2	Disable		
Lo TS 2	Disable		
Lo TS 2	*n/a		
Hi TS 2	(14°F (-10°C))		
Hi TS 2	*n/a		
Hi TS 2	(212°F (100°C))		
Lo TS Filter	0 min		
Hi TS Filter	*n/a (0 min)		
Latch TS Alarms	Yes		
CTL TS Fail	Enable		

Other Alarms Configuration Sub-Menu			
Parameter	Factory	User	
Lo Load	Enable		
Lo Load	1.0 A		
Lo Load Filter	0 sec		
Hi Load	Disable		
Hi Load	*n/a (30.0A)		
Hi Load Filter	*n/a (0 sec)		
Hi GFI	Enable		
Hi GFI	20 mA	40	
Hi GFI Filter	0 sec		
GFI Trip	Enable		
GFI Trip	30 mA	50	
Lo Volt	Enable		
Lo Volt	90 V		
Lo Volt Filter	0 sec		
Hi Volt	Disable		
Hi Volt	*n/a (270 V)		
Hi Volt Filter	*n/a (0 sec)		
Lo Resist	Disable		
Lo Resist	*n/a (50%)		
Lo Resist Filter	*n/a (0 sec)		
Hi Resist	Disable		
Hi Resist	*n/a (50%)		
Hi Resist Filter	*n/a (0 sec)		
Nominal Resist	*n/a (6.00 Ω)		
Overcurrent Trip	*n/a (Enable)		
Switch Fail	Enable		
HTC Reset	Disable		
C.B. Limiting	*n/a (Disable)		
Power Limiting	*n/a (Disable)		
Switch Limiting	*n/a (Disable)		
Contact Count	Enable		
Contact Count	200,000		
EEROM Data Fail	Enable		

Point Setup Sub-Menu			
Parameter	Factory	User	
Tag	TAG (factory ID)		
Switch Control Mode	Deadband		
Prop Band	*n/a (4°F (2°C))		
Deadband	5°F (3°C)		
Cycle Time	*n/a (10 min)		
Switch Rating	*n/a (30.0 A)		
Circuit Breaker	*n/a (30.0 A)		
Max Power	*n/a (7200 W)		
TS Fail Mode	Off		
TS CTL Mode	TS1-Fail Off		
TS 1 Type	100Ω Plat		

TS 1 Lead Resist	*n/a (0Ω)
TS 1 Hi Limit	Disable
TS 2 Type	100Ω Plat
TS 2 Lead Resist	*n/a (0Ω)
TS 2 Hi Limit	Disable
Auto-cycle	Enable
Auto-cycle Interval	8
Auto-cycle Units	Hours
Override Source	Remote
Load Shedding	Disable

Misc. Setup Sub-Menu			
Parameter	Factory	User	
Temp. Units	°F		
Version	V3.1x.xx		n/a
Ext. Input	Not Used		
Flash Alarm Output	Yes		
Alarm Output	N.C.		
Language	English		
Passcode	0		
Scroll Delay	0.15 secs		
Load Defaults	(See user manual)		

Communication Setup Sub-Menu			
Parameter	Factory	User	
Protocol	HTC BUS		
HTC BUS Addr	(factory ID)		
Modbus Addr	*n/a (1)		
Modbus Sub Addr	*n/a (0)		
Baud Rate	Auto		
Parity	*n/a (None)		
Hardware	None, Modem, RS-232, RS-485		n/a
Driver	Auto		
Profile	Auto		
Tx Delay	0.06 secs		

*n/a: Parameter may only appear if certain features are enabled. Values shown in brackets are the Factory defaults if the settings are enabled.

This information defines the default 910 Series Control Module configuration as set by the Factory for firmware V3.1X. These settings are subject to change without notice.

It is the user's responsibility to verify that all configuration parameters are chosen appropriately for the intended application.

APPENDIX B-9

AIR CONDITIONER (FRIEDRICH)



INSTALLATION & OPERATING INSTRUCTIONS

FOR "WS," "WE" AND "WY" MODELS

WELCOME to years of economical comfort with your new Friedrich Room Air Conditioner.

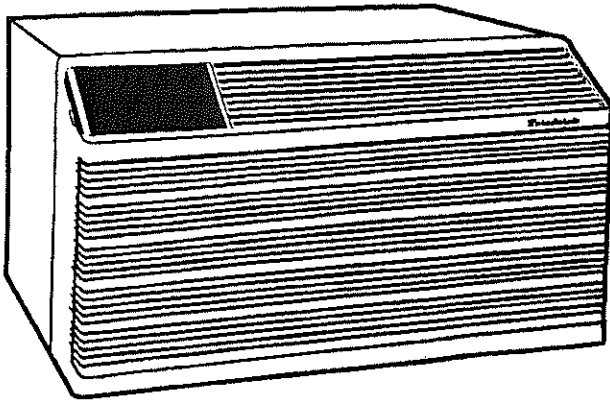
Your new Friedrich Room Air Conditioner has been carefully engineered and manufactured to give you many years of dependable, efficient operation, keeping your room at a comfortable temperature and humidity level. Many extra features have been built into your Friedrich Room Air Conditioner to assure quiet running, greatest circulation of cool, dry air, most flexible selection of function controls, and high economy of operation.

There are many things you can do in and around your home to save more money - and even increase the efficiency and long life of your Friedrich unit. Here are a few examples:

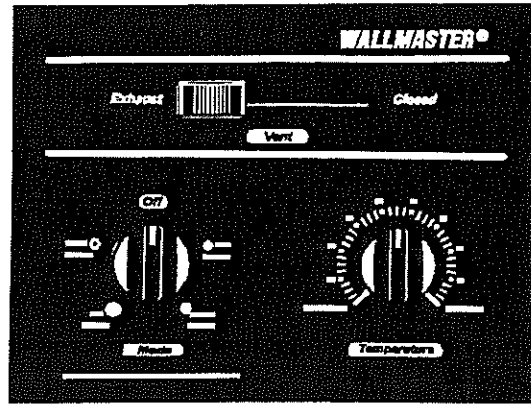
1. **How to Set Thermostat:** When you first turn on your air conditioner, select the highest fan speed and set the thermostat to its coldest position to cool the room. When the desired temperature is reached, turn the thermostat control toward "warmer" until the compressor goes off. The thermostat will then cause the compressor to go on and off to maintain this selected temperature. You can adjust the fan speed for optimum air circulation.
2. Do not block the flow of air to and from the unit - make sure the louvers are directed to give even distribution of air throughout the room. *Caution:* If air is obstructed and/or deflected back into the air conditioner, this may cause the unit to cycle on and off rapidly, which could damage your unit.
3. Move the exhaust control to CLOSED when maximum cooling or maximum recirculation of room air is desired.
4. Adequate insulation - walls, ceilings, and below floors - can save up to 50% of the cost of cooling in most areas of the country.
5. Caulking: in well insulated homes, air leaks around doors, windows, lighting and plumbing fixtures can account for as much as 30% of the load on heating and cooling systems. See that all these areas are well caulked.
6. Install weather stripping (metal is preferable to felt) around exterior doors and windows.
7. Have a fireplace? Be sure the damper is closed during air conditioner operation.
8. When it's time to reroof or repaint the outside of your home, choose light colors. They reflect heat instead of absorbing it.
9. Shade your outside walls (especially on the west) from the direct sun; most importantly, shade the unit itself. Trees and shrubs provide natural shading, but make sure they don't block the air flow around the unit. If natural shade isn't present, awnings are the best solution for shading the unit and the windows. Also, avoid areas where too much dust or pollen would be drawn into the air conditioner.
10. Inside the house, use blinds, screens or drapes on windows exposed to the sun. They will reduce your cooling needs. (Lined or insulated draperies will also help cut heating costs in winter.)
11. Make sure your attic area is properly vented. In addition, consider installing turbine or power ventilators to help remove hot air from your attic.
12. Keep your Friedrich unit clean. Use a vacuum cleaner attachment for accessible parts, but take care not to damage them. Clean the permanent filter at least twice a month.
13. Set the thermostat at a higher temperature - save 5% in energy usage for each degree of temperature over 72° F.

These are the most important suggestions for saving money on cooling costs. Some, however, may not be applicable to your house or area. Check with your local utility company for more specialized information.

PRODUCT CHARACTERISTICS ("WS" MODELS)



"WS" MODELS



CONTROL PANEL
"WS" MODELS

Model Number	Plug Type	Circuit Rating, Breaker or Time Delay Fuse
WS07 WS09 WS12	 NEMA No. 5-15P	125V-15 AMP
WS09 WS12 WS13	 NEMA No. 6-15P	250V-15 AMP

EXHAUST CONTROL

Place lever in "CLOSED" position to cool, filter, and recirculate room air only. Move it to "EXHAUST" to remove smoke or stale air from the room. Make sure the lever is locked in position.

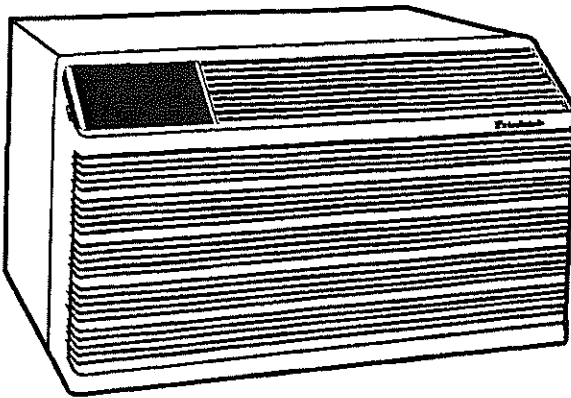
FUNCTION CONTROL

Turn the knob to "LO COOL" for cooling with lowest fan speed. Set to "MED COOL" for cooling with medium fan speed. Turn to "HI COOL" for maximum cooling with highest fan speed. Turn to "FAN ONLY" for fan only air circulation with medium speed, without cooling. Turn to "OFF" to turn the unit completely off. The fan will run continuously when operating in the cooling mode.

TEMPERATURE CONTROL

The knob labeled "WARMER/COOLER" controls the thermostat - turn it clockwise to set a cooler temperature, counterclockwise to make it warmer.

PRODUCT CHARACTERISTICS ("WE" & "WY" MODELS)



"WE" & "WY" MODELS



CONTROL PANEL
"WE" & "WY" MODELS

Model Number	Plug Type	Circuit Rating, Breaker or Time Delay Fuse
WE09 WE12 WE14 WY09 WY12	 NEMA No. 6-20P	250V-20 AMP

EXHAUST CONTROL

Place the lever in the "CLOSED" position to cool, heat, filter and recirculate room air only. Move it to the "EXHAUST" position to remove smoke or stale air from room. Make sure the lever is locked in position.

FUNCTION CONTROL

Turn the knob clockwise to "HI" for heating with highest fan speed. Set to "MED" for heating with medium fan speed. Turn to "LO" for heating with the lowest fan speed. Models designated "WE" use electric heating elements; Heat Pumps, "WY" models, use the compressor for heating, automatically switching to electric heating elements only when the outside temperature or coil temperature is 20° F (-7° C.).

Turn the knob counterclockwise to "FAN" for medium speed without cooling or heating. Turn to "HI" for cooling with the highest fan speed. Turn to "MED" for cooling with medium fan speed. Set to "LO" for cooling with the lowest fan speed. Turn the knob in either direction to "OFF" to turn the unit completely off.

NOTE: The fan will cycle with the compress or heating element and will not run constantly when in the heating mode.

TEMPERATURE CONTROL

The knob labeled "WARM/COOL" controls the thermostat - turn clockwise to set a cooler temperature, counterclockwise to make it warmer.

HOW TO CLEAN THE AIR FILTER

Your Friedrich Room Air Conditioner is equipped with a Permafoam reusable air filter with a germicidal treatment which is not affected by washing. The filter serves to remove dust, pollen, and other impurities from the air.

KEEP THE FILTER CLEAN - A clogged, dirty filter will reduce the operating efficiency of your unit and contribute to frosting of the indoor coil. Be sure to check the filter every 7 to 10 days. The filter check procedure is easy, due to the unique design of the Friedrich DECORATIVE FRONT.

FILTER ACCESS - Remove the INTAKE GRILLE from the DECORATIVE FRONT frame by grasping it at the upper right and left side corners. Pull out until the GRILLE is released from the upper retaining snaps. Tilt down toward you, lift up and out of the bottom retaining snaps. This will expose the filter. Remove the filter by pulling it toward you. Wash the filter in hot, soapy water, rinse, squeeze lightly to remove excess water, shake dry - do not twist - and replace in the unit on the two support hangers. Replace the INTAKE GRILLE by positioning the bottom of the GRILLE into the bottom retaining snaps. Tilt the front up and away from you. Press in lightly on top and the GRILLE will position itself into the upper retaining snaps.

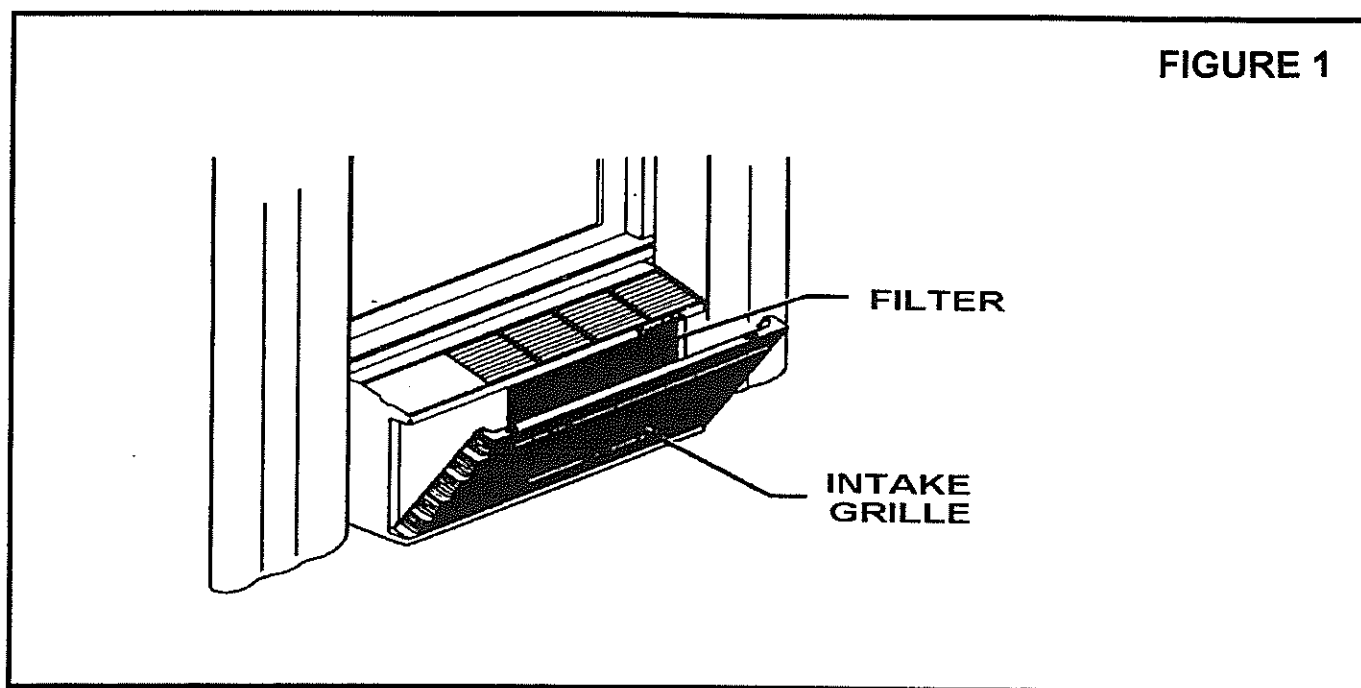


FIGURE 1

HOW TO CHANGE AIRFLOW DIRECTION...

The **DISCHARGE GRILLE** is installed at the factory to provide **horizontal** airflow into the room. (Direction 1 in Figure 2). If a **vertical** airflow is desired (Direction 2), the direction can be changed by rotating the **DISCHARGE GRILLE**.

Turn the FUNCTION CONTROL to "OFF". Do not operate the FAN MOTOR while changing the airflow.

Remove the **DISCHARGE GRILLE RETAINER** attached with one screw in the right side of the grille.

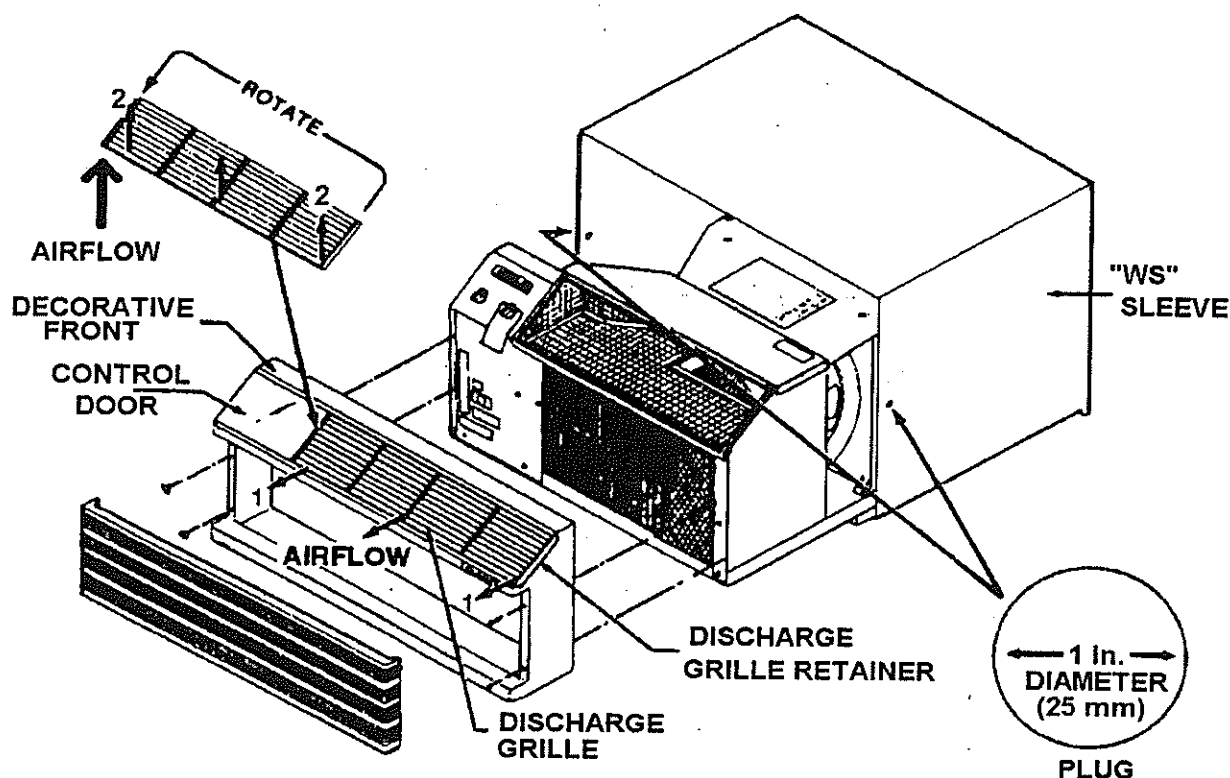
Remove the **DISCHARGE GRILLE** from the retaining slots near the **CONTROL DOOR**, and rotate the grille as shown in Figure 2.

Reinstall the **DISCHARGE GRILLE** by placing it in its retaining slots. Reattach the **DISCHARGE GRILLE RETAINER** with the retaining screw. The unit is now ready to operate.

HOW TO COVER INNER WEATHER PANEL HOLES...

Two beige plugs are included in the plastic bag taped to the WallMaster chassis. These plugs may be used to cover the two holes left after removing the inner weather panel (see Figure 2). The plugs **must** be attached before the decorative front frame is installed.

FIGURE 2



ELECTRICAL REQUIREMENTS

IMPORTANT: Before you begin the actual installation of your air conditioner, check local electrical codes and the information below.

Your air conditioner must be connected to a power supply with the same AC voltage and hertz rating as marked on the nameplate located on the chassis. Only alternating current (AC) can be used. Consult the Operating Instructions for the correct type of receptacle for your model.

An overloaded circuit will invariably cause malfunction or failure of an air conditioner, therefore, it is extremely important that the electrical power and the wiring is adequate. Consult your dealer or power company if in doubt.

CIRCUIT PROTECTION - Before installing or relocating your Friedrich Room Air Conditioner, check the **amp rating** of the circuit breaker or "TIME-DELAY" fuse. Refer to the nameplate located on the air conditioner chassis to determine the correct fuse or circuit breaker amperage for your model. The rating **MUST NOT** exceed the value stated on the nameplate. If the air conditioner is connected to a circuit protected by a fuse, a "TIME-DELAY" fuse must be used due to momentary high current demands when your air conditioner is started.

NEVER USE EXTENSION CORDS TO OPERATE AN AIR CONDITIONER.

Your Friedrich Room Air Conditioner is equipped with a three-prong (grounded) plug for your protection against shock hazards and should be plugged directly into a properly grounded three prong receptacle. Where a two prong wall receptacle is encountered, it must be replaced with a properly grounded three prong receptacle in accordance with the National Electrical Code and local codes and ordinances. The work must be done by a qualified electrician.

NEVER CUT OR REMOVE THE GROUNDING PRONG FROM THE PLUG.

HOME MAINTENANCE CHECK LIST:

DON'T COOL

If the unit operates, but won't cool, determine if the controls are properly set. Wait three minutes before setting the thermostat to a cooler position in order to check control settings. Check the filter and clean it thoroughly, if needed.

DON'T HEAT (For Heat/Cool Models Only)

If the unit operates, but won't heat, determine if the control settings are correct. Adjust the thermostat to a warmer position and determine if it operates. Also, check the filter and clean it thoroughly, if needed.

ODORS IN HEATING (For Heat/Cool Models Only)

You may notice a smoke odor the first time the heater element comes on. This is common in any type of heat system when first turned on for the winter. The odor comes from dust and other particles that accumulate during the warm months. The odor will dissipate quickly.

DON'T RUN

If the unit fails to operate, check to see if the power cord is firmly plugged in. Check for blown fuses or tripped circuit breakers. Restore the circuit breaker or replace the blown fuse with a proper size "TIME-DELAY" fuse. The proper fuse size is shown elsewhere in these instructions. After restoring the current supply to the unit, wait three minutes before restarting.

FROSTING OF THE INDOOR COIL

Certain operating conditions may produce indoor coil frost. During the cooling operation, a dirty filter or restricted air distribution in combination with cool, damp weather could cause such an occurrence. Should the indoor coil frost over while cooling, set the control to FAN and keep it running until the frost on the coil is gone. Setting the thermostat to a slightly warmer position will probably keep the coil from frosting over again.

CLEANING THE DECORATIVE FRONT

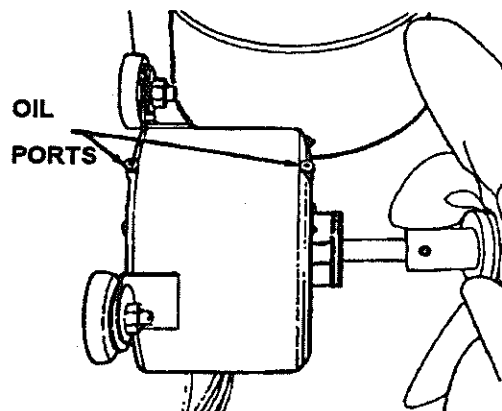
The DECORATIVE FRONT of your Friedrich Room Air Conditioner, as well as the complete cabinet, may be cleaned with warm water and mild detergent. Under adverse operating conditions, the indoor and outdoor coils and base pan may require periodic cleaning to maintain efficient operation. Your Friedrich dealer should be called when this service is required.

LUBRICATION

Although fan motors are factory lubricated and sealed, oil ports are provided so you can lubricate the motor annually. To lubricate, proceed as follows:

1. Shut off electrical power to unit and remove unit cord from wall outlet.
2. Remove the four hex slotted screws which hold the DECORATIVE FRONT to the unit.
3. Pull chassis approximately halfway out of the sleeve or until the oil ports on the fan motor can be reached.
4. Remove the oil port plugs from each end of motor. If equipped with metal plugs, it may be necessary to use pliers and twist the plugs slightly to loosen. Add oil according to the motor manufacturers instructions printed on the motor. (See Figure 3) If no instructions are on the motor, add up to 30 drops of SAE 10W30 motor oil to each port. Replace the oil plugs.

FIGURE 3



THINGS TO KNOW ABOUT A WALLMASTER HEAT PUMP:

During the heat pump operation, you may notice some functions that did not occur when the unit was used for cooling:

1. It is common for ice to form on the outdoor coil of your WallMaster Heat Pump. The ice forms due to moisture in the outdoor air passing over cold (below freezing) coil surfaces.
2. When the outdoor coil forms ice, your heat pump will automatically initiate a defrost. The compressor will stop and the fan will continue to run. The electric heat will be turned on to continue warming the room while the outdoor air defrosts the outdoor coil. After the defrost is completed, the unit will automatically return to the heat pump mode.
3. It is normal for vapor (steam) to rise from the outdoor coil during the defrost. This is similar to expelling warm breath on a cold morning.
4. If the outdoor temperature or the coil temperature drops below 20° F (-7° C.) during heat pump operation, your WallMaster Heat Pump will automatically switch to electric resistance heat and will continue to operate in this mode as long as the outdoor temperature remains at 40° F (4° C.) or below.

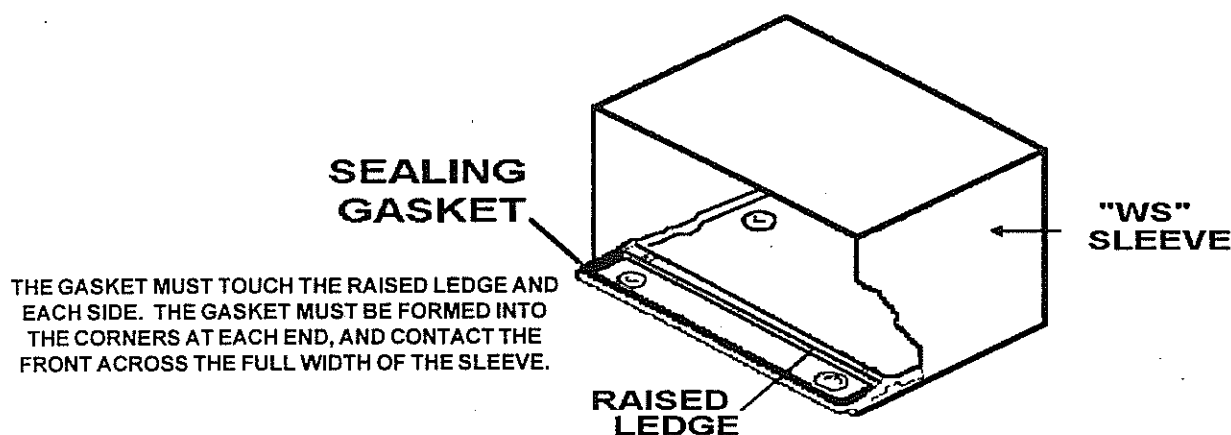
WALLMASTER CHASSIS INSTALLATION INSTRUCTIONS

FOR "WS", "WE" AND "WY" MODELS

These instructions are provided for installation of **WallMaster** air conditioner chassis models into thru-the-wall **sleeves**. This chassis has been U.L. approved with the sleeve listed on the serial nameplate of this chassis. Important Warranty Information is provided in the Operating Instructions. Keep these instructions in a convenient location for any warranty service that may be required.

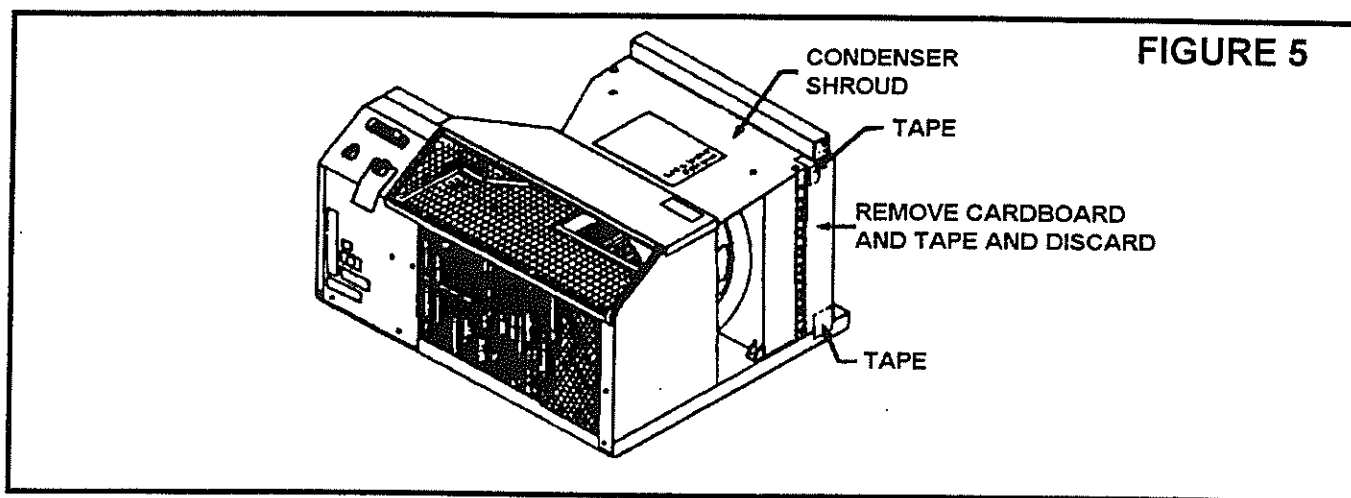
- STEP 1.** Check the sleeve to be certain it has been correctly installed in the wall. Remove the unpainted front panel on the "WS" sleeve. **Remove the rear cardboard WEATHER PANEL.** Leave the rear grille in place. Discard the other items taken out.
- A. Check the anchor screws. There should be five (5) in the "WS" SLEEVE (two in each side and one in the top center).
 - B. Determine if the sleeve has a downward slope, to the outside, of 1/2 bubble on a level. See the sleeve installation instructions for further details.
 - C. Check to be sure the sleeve has been sealed around all edges with an industrial type caulking on both the outside and inside to prevent rain entry.
 - D. A sleeve sealing gasket has been provided in the chassis shipping carton. Remove it from the carton, peel the protective coating from the adhesive, and install it in the sleeve (adhesive down) as shown in Figure 4.

FIGURE 4



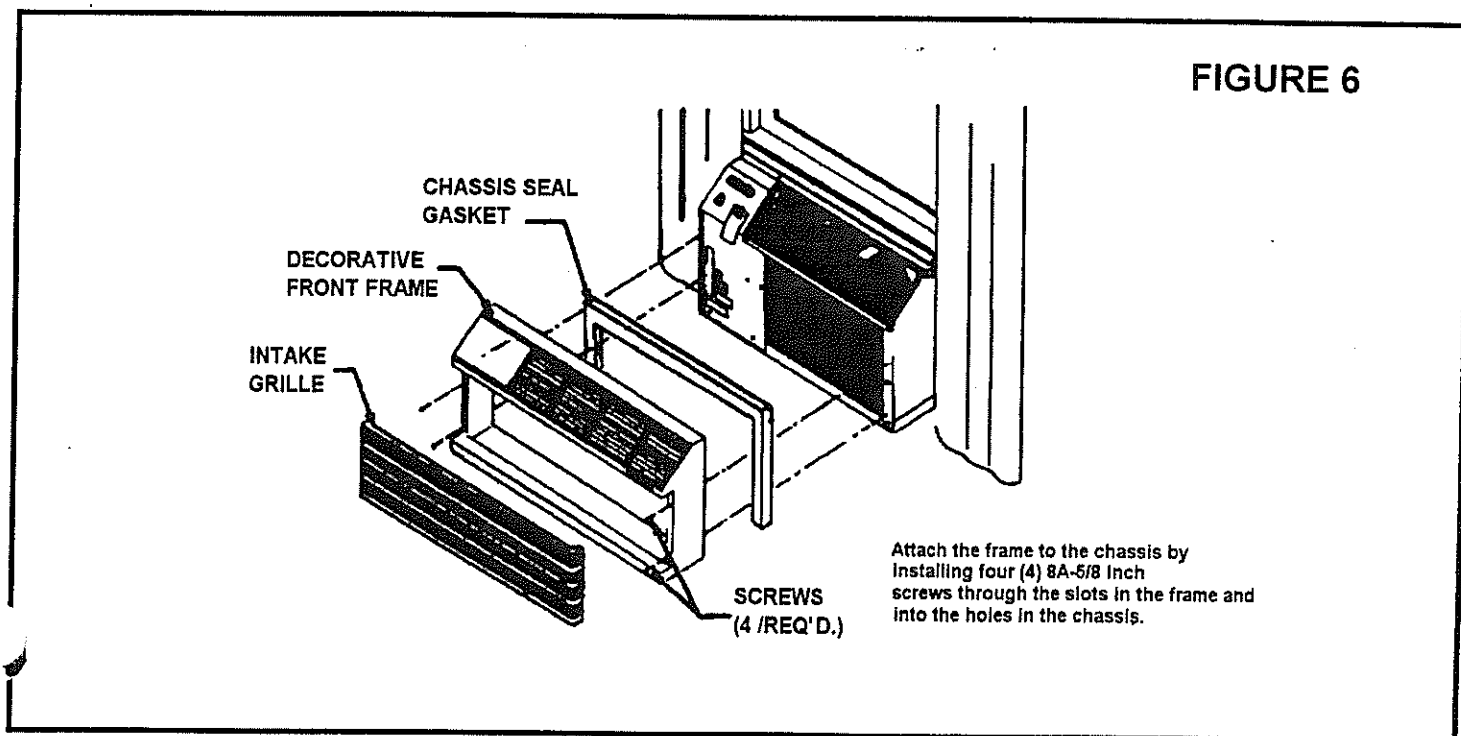
- STEP 2.** Check the electrical receptacle to see that it conforms to the requirements for the chassis model to be installed. See the Operating Instructions for the receptacle requirements.
- STEP 3.** The **decorative front** is packaged in a separate box inside the chassis shipping carton, between the chassis and the carton. Remove this box and set the box aside until later.

- STEP 4.** Remove the chassis from the shipping carton. Remove the cardboard which is placed against the hairpins and is taped to the condenser shroud (see Figure 5). Be careful not to allow anything to impact against the hairpins as this may result in damage to them. Lift the chassis by the basepan and slide it into the sleeve until it contacts the rear grille. With the chassis in proper position, the front edge of basepan must extend out 4 3/4 inches from the front (side) edge of sleeve.



- STEP 5.** Install the Chassis Seal Gasket (Gray Foam Gasket), carefully "stuff" the gasket between chassis and cabinet starting at either bottom corner and go up the side, across top and down the opposite side. **It is important that this gasket be properly installed as it prevents air leakage around chassis.**

- STEP 6.** Remove the intake grille from the decorative front frame by grasping it at the upper right and left side corners. Pull out until the grille is released from the upper retaining snaps. Tilt it down toward you, lift up and out of the bottom retaining snaps. Install the decorative front frame in place over the sleeve opening and attach it to the chassis with four sheet metal screws as shown in Figure 6. Replace the intake grille by positioning the bottom of the grille into the bottom retaining snaps. Tilt the front up and away from you. Press in lightly on top, and the grille will position itself into upper retaining snaps.

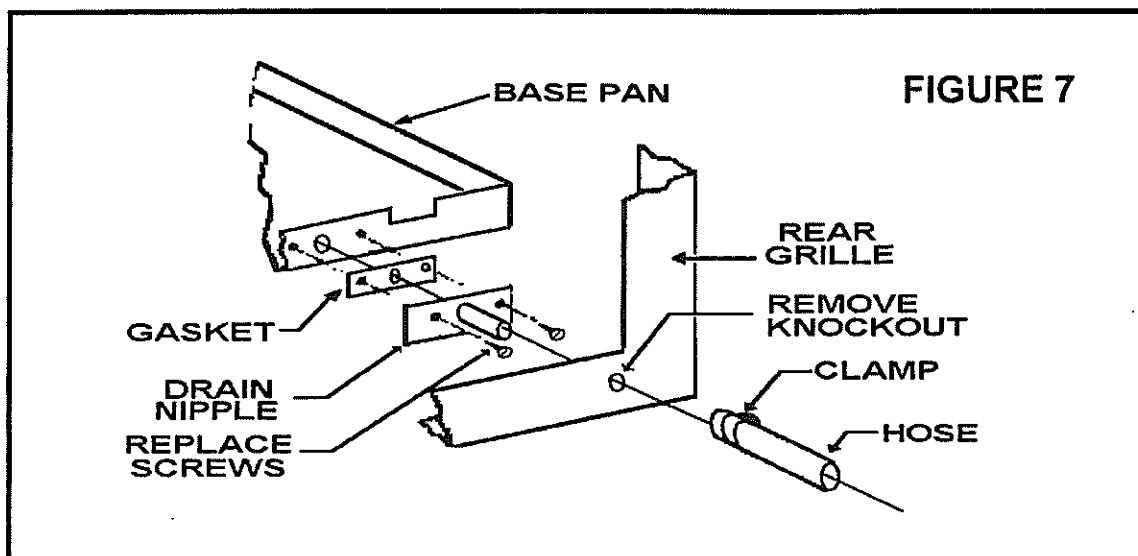


CONDENSATE REMOVAL ("WS", "WE" & "WY" MODELS)

If you desire to drain condensate from the basepan during unit operation, this unit is provided with a drain nipple that can be attached to the basepan. **You must provide a 5/8" diameter hose and clamp which will attach to the drain nipple.** Follow the instructions below:

- STEP 1.** Find the drain plate on the rear of the basepan and remove it. (See Figure 7). Using the plate screws, install the gasket and the drain nipple to the basepan.
- STEP 2.** Remove the knockout in the lower right side of the rear grille. Slide the chassis into the "WS" Sleeve so that the drain nipple extends through the knockout.
- STEP 3.** Slip the clamp around the hose and slide the hose over the drain nipple. Tighten the clamp around the hose and drain nipple.

If the chassis must be removed from the sleeve for service, remove the drain hose before sliding the chassis out of the sleeve.



ALTERNATE DRAIN KITS

"DK" (Drain Kit)

In the event that the outdoor temperature drops below 37° F, any water that remains in the chassis basepan is drained into the sleeve pan on "WE" and "WY" models to prevent freezing. (NOTE: In the cooling mode of the "WS", "WE" AND "WY" models, condensate overflow is possible in very humid climates.) For these particular instances, an **optional drain kit (Accessory #DK)** is available for water removal. See Part No. 920-038-00 for complete installation instructions.

"IDK" (Interior Drain Kit)

New construction allowing for condensate drain systems built within the walls can use the **Friedrich Interior Drain Kit (Accessory #IDK)** designed for installation in the bottom of the sleeve below the bellows aperture (heat/cool models only). See Part No. 920-041-00 for complete installation instructions.

Friedrich®

TERMS OF LIMITED WARRANTY - FRIEDRICH ROOM AIR CONDITIONERS

LIMITED WARRANTY - FIRST YEAR

ANY PART: If any part supplied by Friedrich fails because of a defect in workmanship or material within 12 months from date of original purchase, FRIEDRICH will repair the product at no charge, provided the room air conditioner is reasonably accessible for service. Any additional labor cost for removing inaccessible units and/or charges for mileage related to travel by a service agency that exceeds 30 miles one way will be the responsibility of the owner. This remedy is expressly agreed to be the exclusive remedy within 12 months from the date of the original purchase.

LIMITED WARRANTY - SECOND THROUGH FIFTH YEAR

SEALED REFRIGERANT SYSTEM: If the sealed refrigeration system (defined for this purpose as the compressor, condenser coil, evaporator coil, reversing valve, check valve, capillary, filter drier, and all interconnecting tubing) supplied by FRIEDRICH in your Room Air Conditioner fails because of a defect in workmanship or material within 60 months from date of original purchase, FRIEDRICH will pay the cost of labor and parts necessary to repair the Sealed Refrigeration System: PROVIDED FRIEDRICH will not pay the cost of diagnosis of the problem, removal and transportation of the air conditioner to and from the service agency, and reinstallation charges associated with repair of the Sealed Refrigeration System. All such costs will be the sole responsibility of the owner. This remedy is expressly agreed to be the exclusive remedy within 60 months from the date of the original purchase.

SMART CENTER WARRANTY (for those models so equipped): If the electronic control panel fails because of a defect in workmanship or material within 60 months from the date of original purchase, FRIEDRICH will replace this part; provided Friedrich will not pay the cost of diagnosis, or the cost of labor to remove and replace the part. This part replacement does not require the unit to be moved. Any removal, transportation and reinstallation will be the sole responsibility of the owner.

APPLICABILITY AND LIMITATIONS: This warranty is applicable only to units retained within the 50 states of the U.S.A., the District of Columbia and Canada. This warranty is not applicable to:

1. Air filters or fuses.
2. Products on which the model and serial numbers have been removed.
3. Products which have defects or damage which results from improper installation, wiring, electrical current characteristics, or maintenance; or caused by accident, misuse or abuse, fire, flood, alterations and/or misapplication of the product and/or units installed in a corrosive atmosphere, default or delay in performance caused by war, government restrictions or restraints, strikes, material shortages beyond the control of FRIEDRICH, or acts of God.

OBTAINING WARRANTY PERFORMANCE: Service will be provided by the FRIEDRICH Authorized Dealer or service organization in your area. He is listed in the Yellow Pages. If assistance is required in obtaining warranty performance write to: Room Air Conditioner Service Manager, Friedrich Air Conditioning Co., P.O. Box 1540, San Antonio, Texas 78295-1540.

LIMITATIONS: THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES. Anything in the warranty notwithstanding, ANY IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND/OR MERCHANTABILITY SHALL BE LIMITED TO THE DURATION OF THIS EXPRESS WARRANTY. THE MANUFACTURER EXPRESSLY DISCLAIMS AND EXCLUDES ANY LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGE FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY.

NOTE: Some states do not allow limitation on how long implied warranty lasts, or do not allow the limitation or exclusion of consequential or incidental damages, so the foregoing exclusions and limitations may not apply to you.

OTHER: This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

PROOF OF PURCHASE: Owner must provide proof of purchase in order to receive any warranty related services.

All service calls for explaining the operation of this product will be the sole responsibility of the consumer.

All warranty service must be provided by an authorized FRIEDRICH service agency, unless authorized by FRIEDRICH prior to repairs being made.

In case of questions regarding the provisions of this warranty, the English version will govern.

Friedrich wants you to remain pleased with your Room Air Conditioner.
Should further assistance be needed concerning this warranty, contact:

R.A.C. Customer Assurance
Friedrich Air Conditioning Co.
P.O. Box 1540
San Antonio, TX 78295-1540

Your personal warranty registration record

WARRANTY REGISTRATION: Please complete and return your **Warranty Registration Card** (not this form) immediately and mail to FRIEDRICH. While it is not required that you do so in order to obtain warranty performance, it registers your warranty, making it easier and faster to verify the period of your warranty coverage and to contact you, should field service and/or product recall ever become necessary.

FOR YOUR RECORDS: FILL IN THE FOLLOWING INFORMATION WHEN UNIT IS INSTALLED, SO IT WILL BE READILY AVAILABLE IF NEEDED LATER.

Model No. Serial No. _____ Date Installed _____

Bought from: _____
(Dealer name)

(Dealer Address) (Person to contact)

(Phone)

**ALWAYS USE FRIEDRICH FACTORY AUTHORIZED PARTS.
USE OF NON-FRIEDRICH PARTS COULD VOID YOUR WARRANTY**

Friedrich®

FRIEDRICH AIR CONDITIONING CO.

ROOM AIR CONDITIONING DIVISION P.O. BOX 1540

SAN ANTONIO, TX 78295-1540

Friedrich®

INSTRUCCIONES DE INSTALACION Y FUNCIONAMIENTO PARA LOS MODELOS "WS", "WE" Y "WY"

BIENVENIDO: A muchos años de comodidad y economía con su nueva unidad de aire acondicionado para habitación de Friedrich.

Su nueva unidad de aire acondicionado para habitación Friedrich ha sido diseñada y fabricada cuidadosamente para darle muchos años de operación eficiente, confiable y económica, manteniendo su habitación en niveles cómodos de temperatura y humedad. Se han puesto muchas características adicionales en su aire unidad de acondicionado para habitación Friedrich con el fin de garantizarle un funcionamiento silencioso, una mayor circulación de aire frío y seco, una selección más flexible de controles de funciones y una mayor economía en toda la operación.

Hay muchas cosas que usted puede hacer en su casa y alrededor de ella para contribuir a economizarle dinero y aún a incrementar la eficiencia y durabilidad de su unidad Friedrich. A continuación detallamos algunos ejemplos:

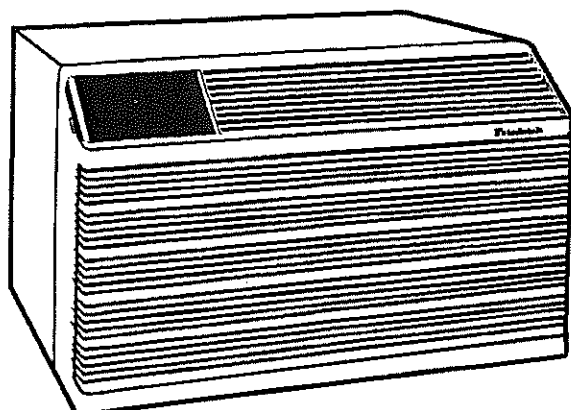
1. **Cómo graduar el termostato:** Cuando usted enciende inicialmente su aire acondicionado, seleccione la máxima velocidad del ventilador y gradúe el termostato en la posición máxima para enfriar la habitación. Cuando se ha obtenido la temperatura deseada, cambie el termostato a "warmer" (más caliente) hasta que el compresor se apague. El termostato hará que el compresor se prenda y apague, según sea necesario para mantener esa temperatura. Usted puede graduar la velocidad del ventilador para la mejor circulación de aire.
2. No obstaculice el flujo de aire hacia y desde la unidad -asegúrese de que las rejillas de ventilación están dirigidas para dar una distribución adecuada de aire a toda la habitación. *Advertencia:* Si se obstruye el aire hacia la unidad y este regresa a ella, puede ocasionar que la unidad se prenda y apague con excesiva rapidez, lo cual puede causarle daño.
3. Mueva el control del conducto de ventilación a CLOSED (cerrado) cuando desee máximo enfriamiento o máxima recirculación del aire.
4. En la mayoría de las áreas del país, un aislamiento adecuado, en las paredes, cielo rasos y debajo de los pisos, puede economizarle hasta un 50% del costo de enfriamiento.
5. Unos buenos rellenos y el no tener corrientes de aire alrededor de puertas, ventanas, conexiones eléctricas y de tuberías, pueden significar un 30% de economía en el costo de sus sistemas de enfriamiento y calefacción. Asegúrese de que todos los rellenos alrededor de ellos estén bien hechos.
6. Instale cinta aislante para el clima (preferiblemente metálica) alrededor de sus puertas y ventanas exteriores.
7. ¿Tiene una chimenea? Asegúrese de que la compuerta esté cerrada mientras el aire acondicionado esté funcionando.
8. Elija colores claros cuando tenga que cambiarle el techo o pintar su casa. Ellos refractan el calor en vez de absorberlo.
9. Procure crear sombra para sus paredes exteriores (especialmente las del occidente) para evitar el sol directo; aún más importante, mantenga su unidad a la sombra.

Los árboles y los arbustos proporcionan sombra natural, pero asegúrese de que ellos no bloquean el aire alrededor de la unidad. También evite áreas en donde haya mucho polvo o polen, los cuales filtrarán a la unidad.

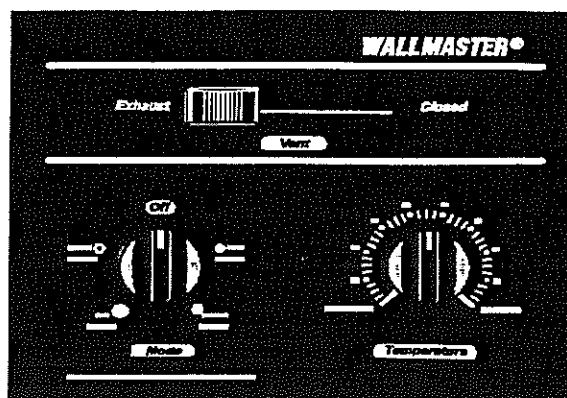
Si no tiene sombra natural, un toldo de lona o una marquesina son la mejor solución para dar sombra a la unidad y las ventanas.
10. Dentro de la casa, use persianas, biombos o cortinas en las ventanas que están expuestas al sol. Esto disminuirá sus necesidades de enfriamiento. (Las cortinas forradas o con aislamiento también ayudan a disminuir el costo de calentamiento de la vivienda en invierno).
11. Asegúrese de que su ático esté ventilado adecuadamente. Además, considere instalar una turbina o un ventilador para ayudar a sacar el aire caliente.
12. Mantenga su unidad de aire acondicionado Friedrich limpia. Use una aspiradora para las partes accesibles pero tenga cuidado de no dañarlas. Limpie el filtro permanente al menos dos veces al mes.
13. Gradúe el termostato en temperaturas más altas (menos frías). Puede economizar un 5% de uso de energía por cada grado en que usted lo tenga por encima de 72 grados Fahrenheit (22°C).

Estas son nuestras sugerencias más importantes para economizar sus gastos de aire acondicionado. Algunos de ellos quizás no sean aplicables en su casa o en su área. Chequee con su compañía de servicios para información más especializada para su caso.

ARACTERISTICAS DEL PRODUCTO (EN LOS MODELOS "WS")



MODELOS "WS"



PANEL DE CONTROL
DE LOS MODELOS "WS"

Número de modelo	Tipo de enchufe	Circuitos Interruptor o Fusible de acción retardada
WS07 WS09 WS12	 NEMA No. 5-15P	125V-15AMP
WS09 WS12 WS13	 NEMA No. 6-15P	250V-15AMP

ONTROL DEL CONDUCTO DE VENTILACION

coloque la palanca en la posición **"CLOSED"** (cerrada) para enfriar, filtrar y recircular únicamente el aire de la habitación. Colóquela en **"EXHAUST"** (conducto de ventilación) para sacar el humo o el aire viejo de la habitación, asegurándose de que la palanca esté bien asegurada en la posición.

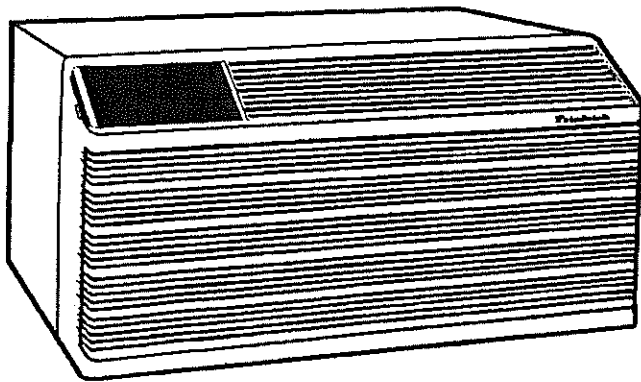
ONTROL DE FUNCIONES

gire el botón a **"LO COOL"** (enfriamiento bajo) con el ventilador en su velocidad mínima. Gírelo a **"MED COOL"** (enfriamiento intermedio) con el ventilador en su velocidad intermedia. Gírelo a **"HI COOL"** (enfriamiento máximo) con el ventilador en su velocidad máxima. Gírelo a **"FAN ONLY"** (solamente ventilador) únicamente para circulación de aire, con el ventilador en su velocidad intermedia, sin enfriamiento. Gírelo a **"OFF"** (apagada) para apagar totalmente la unidad. El ventilador funcionará continuamente mientras la unidad esté en la posición de enfriamiento.

ONTROL DE TEMPERATURA

el botón llamado **"WARMER/COOLER"** (más caliente/más fría) es el termostato. Gírelo en el sentido de las manecillas del reloj para graduarlo en más frío y en el sentido opuesto para graduarlo en menos frío.

CARACTERISTICAS DEL PRODUCTO (EN LOS MODELOS "WE" y "WY")



MODELOS "WE" Y "WY"



PANEL DE CONTROL
DE LOS MODELOS "WE" Y "WY"

Número del modelo	Tipo de enchufe	Circuitos, Interruptor o Fusible de acción retardada
WE09 WE12 WE13 WY09 WY12	 NEMA No. 6-20P	250V-20AMP

CONTROL DEL CONDUCTO DE VENTILACION

Coloque la palanca en la posición **"CLOSED"** (cerrada) para enfriar, calentar, filtrar y recircular únicamente el aire de la habitación. Muévela a la posición **"EXHAUST"** (conducto de ventilación) para remover el humo o el aire viejo de la habitación, asegurándose de que la palanca esté bien asegurada en la posición.

CONTROL DE FUNCIONES

Gire el botón en el sentido de las manecillas del reloj hasta la posición **"HI"** (máxima) para calentar, con el ventilador en su máxima velocidad. Gírelo hacia **"MED"** (mediana) para calentar, con el ventilador en su velocidad intermedia. Gírelo hacia **"LO"** (mínima) para calentar, con el ventilador en su velocidad mínima. (Elementos para calefacción eléctrica en los modelos "WE"; Heat Pumps (unidades de bombeo de calor) y los modelos "WY" usan el compresor para calentar, cambiando automáticamente a calor eléctrico cuando la temperatura exterior o de los serpentines es de 20 grados Fahrenheit o menos (-7 grados C.).

Gire el botón en el sentido opuesto a las manecillas del reloj hacia **"FAN"** (ventilador) para velocidad intermedia de ventilación, sin frío ni calor. Gírelo a **"HIGH"** (máxima) para enfriamiento, con el ventilador a su máxima velocidad. Gírelo a **"MED"** (intermedia) para enfriamiento, con el ventilador en su velocidad intermedia. Gírelo a **"LO"** (mínima) para enfriar, con el ventilador en su velocidad mínima. Gire el botón en cualquiera de las dos direcciones hasta **"OFF"** (apagada) para apagar completamente la unidad.

ADVERTENCIA: El ventilador funcionará con el compresor o el elemento de calefacción y no funcionará constantemente cuando está en la modalidad de calefacción.

CONTROL DE TEMPERATURA

El botón llamado **"WARM/COOL"** (caliente/fría) es el termostato. Gírelo en el sentido de las manecillas del reloj para obtener menos calor, en el sentido contrario para obtener más calor.

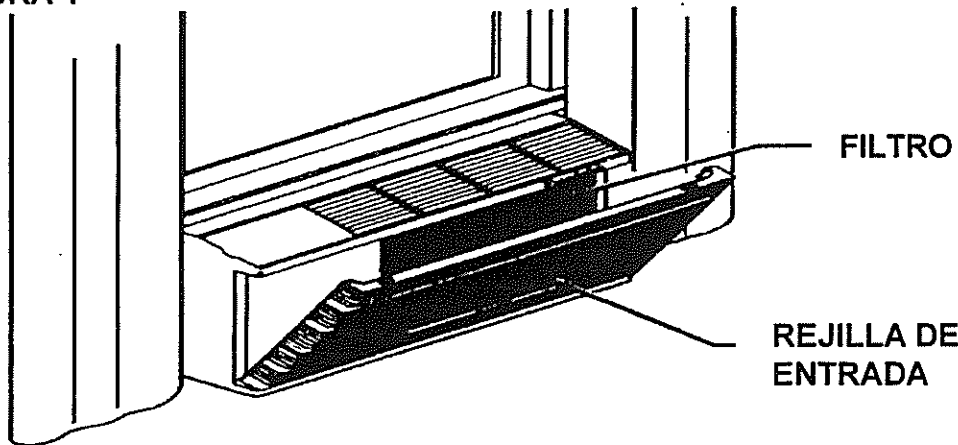
COMO LIMPIAR EL FILTRO

La unidad de aire acondicionado para habitación de Friedrich está equipada con un filtro de múltiple uso Permafoam (espuma), con un tratamiento germicida (contra bacterias), el cual no cambia cuando se lava. El filtro sirve para remover polvo, polen y cualquiera otra impureza del aire.

MANTENGA LIMPIO EL FILTRO - Un filtro atascado o sucio reducirá la eficiencia de operación de su unidad y contribuirá a que se forme escarcha en el serpentín interior. Asegúrese de revisar el filtro cada 7 a 10 días. El procedimiento es muy sencillo, debido al diseño único de la CUBIERTA DECORATIVA de su unidad Friedrich.

ACCESO AL FILTRO - Remueva la REJILLA DE ABSORCION del marco de la CUBIERTA DECORATIVA, incliniéndola de las esquinas superiores izquierda y derecha. Tire de la rejilla hasta que se safe de los broches de presión. Inclínela hacia usted, levántela y sáquela de los broches de presión inferiores. Esto dejará el filtro a la vista. Remuévalo tirando de él llevándolo hacia usted. Lávelo con agua caliente jabonosa, enjuáguelo, ajústelo un poco para sacarle el agua, sacúdalo pero no lo doble y póngalo de nuevo en la unidad, en los dos ganchos de soporte. Vuelva a colocar la REJILLA DE ABSORCION colocando la base inferior de la misma sobre los broches de presión que la sostienen. Inclínela frente hacia arriba, en el sentido opuesto a usted mismo. Presione un poco la parte superior y la rejilla quedará colocada en los broches de presión superiores.

FIGURA 1



PARA CAMBIAR LA DIRECCION DEL FLUJO DEL AIRE...

La REJILLA DE SALIDA es instalada en la fábrica para proporcionar un flujo de aire **horizontal** hacia la habitación. Dirección 1 en la Figura 2). Si se desea un flujo **vertical** (Dirección 2), la dirección puede ser cambiada haciendo rotar la REJILLA DE SALIDA.

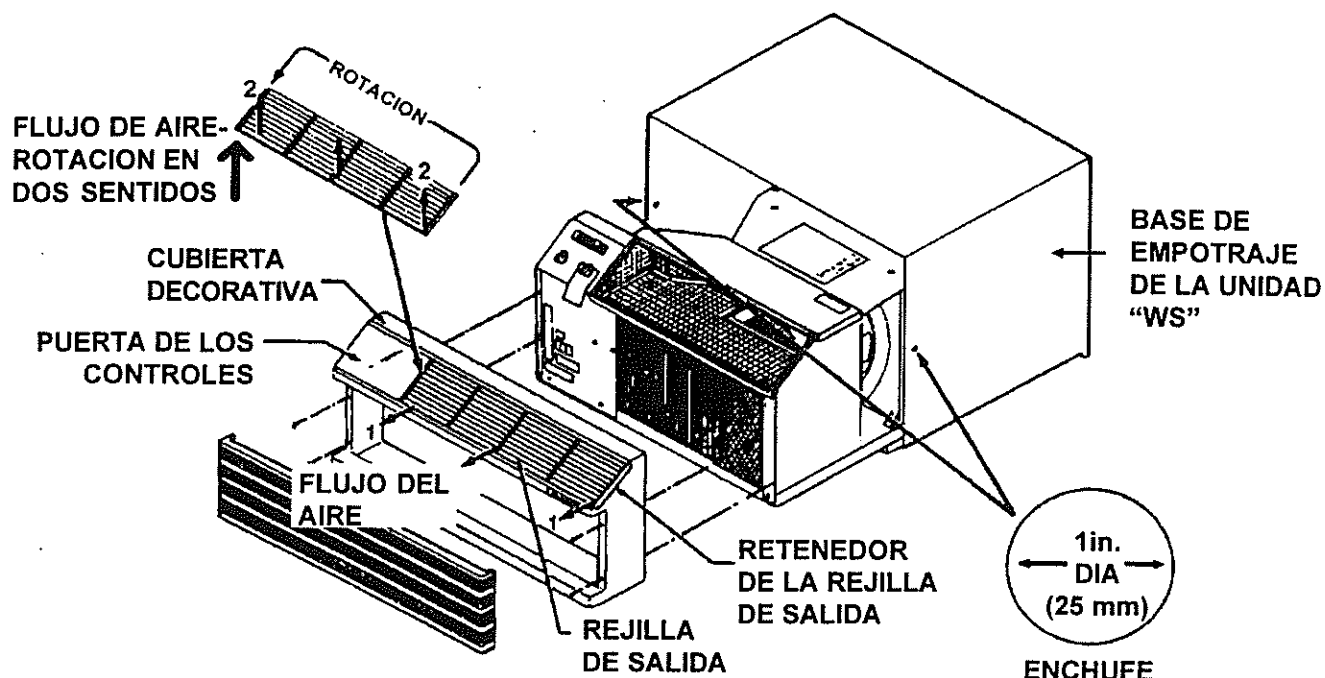
Gradúe el CONTROL DE FUNCIONES en "OFF" (apagada). No haga funcionar el MOTOR DEL VENTILADOR mientras cambia el flujo del aire. Quite el RETENEDOR DE LA REJILLA DE SALIDA que está asegurado con un tornillo, en el lado derecho de la REJILLA. Retire la REJILLA DE SALIDA de las ranuras que la retienen, cerca de la PUERTA DE CONTROL y rote la REJILLA como se muestra en la Figura 2.

Vuelva a instalar la REJILLA DE SALIDA poniéndola nuevamente en las ranuras retenedoras. Vuelva a asegurar el RETENEDOR DE LA REJILLA DE SALIDA con el tornillo que la sostiene. La unidad está ya lista para funcionar.

PARA CUBRIR LOS ORIFICIOS DEL PANEL INTERIOR DE CLIMA... (INNER WEATHER PANEL)

En la bolsa plástica pegada al chasis Wallmaster, se están incluyendo dos enchufes habanos. Si se desea, estos enchufes pueden ser usados para cubrir los dos orificios que quedan a la vista al remover el panel interior de clima. (Ver Figura 2). Los enchufes **deben** colocarse antes de que se instale el march de la cubierta decorativa.

FIGURA 2



REQUERIMIENTOS ELECTRICOS

IMPORTANTE: Antes de que comience la instalación de su unidad de aire acondicionado, revise los códigos de electricidad locales y toda la información que sigue a continuación.

Su unidad debe estar conectada a una fuente de energía con el mismo voltaje AV y frecuencia (hertz rating) que están marcados en la placa de identificación localizada en el chasis. Se puede usar únicamente corriente alterna (AC). Consulte las Instrucciones de Funcionamiento para determinar el receptáculo adecuado para el modelo de su unidad.

Un circuito recargado con seguridad ocasionará mal funcionamiento o problemas a su unidad. Por lo tanto, es esencial que la corriente y los cables utilizados sean los correctos. En caso de cualquier duda, consulte con su distribuidor Friedrich o con la empresa de energía local.

PROTECCION DE LOS CIRCUITOS -Antes de instalar o de reubicar su unidad de aire acondicionado Friedrich, revise el amperaje del interruptor de circuitos o fusible DE ACCION RETARDADA. Refiérase a la placa de identificación en el chasis, para que determine el tipo correcto de fusible o de interruptor que debe usar con su modelo. La clasificación **NO DEBE EXCEDER** a la que está especificada en la placa de identificación. Si la unidad está conectada a un circuito protegido por un fusible, debe utilizarse un FUSIBLE DE ACCION RETARDADA, para proteger a su unidad de las altas y bajas repentinas de corriente.

NUNCA USE CABLES DE EXTENSION PARA HACER FUNCIONAR SU UNIDAD DE AIRE ACONDICIONADO

Su unidad de aire acondicionado Friedrich está equipada con un enchufe de tres patas (atierrado) para protegerle a usted contra los peligros de electrocutarse y debe ser conectado en un receptáculo de tres patas con un atterramiento correcto. Cuando se encuentre un receptáculo de dos patas, este debe reemplazarse por uno de tres patas, con un atterramiento correcto, que cumpla con los requerimientos de los códigos nacionales de electricidad y los códigos y las ordenanzas locales. Este trabajo debe ser hecho por un electricista especializado.

NUNCA CORTE O RETIRE DEL ENCHUFE LA PATA DE ATIERRAMIENTO.

LISTA DE CONTROL PARA MANTENIMIENTO EN EL HOGAR:

NO ENFRIA

Si la unidad funciona pero no enfría, determine si los controles están graduados correctamente. Espere tres minutos antes de cambiar el termostato a una posición de mayor enfriamiento. Revise el filtro y límpielo bien, de ser necesario.

NO CALIENTA (Únicamente para los modelos de calefacción/enfriamiento)

Si la unidad funciona pero no calienta, determine si los controles están graduados correctamente. Cambie el termostato a una posición de más calefacción para darse cuenta de si funciona. Además, revise el filtro y límpielo bien, de ser necesario.

OLORES PROCEDENTES DE LA UNIDAD CUANDO ESTA CALENTANDO (Únicamente para los modelos de calefacción/enfriamiento)

Usted puede notar un olor a humo la primera vez que se enciende el elemento del calentador. Esta situación es común en cualquier tipo de sistema de calefacción cuando se prende en el invierno. El olor proviene del polvo y otras partículas que se acumulan durante los meses de calor. Este olor desaparecerá rápidamente.

NO FUNCIONA

Si la unidad no funciona, revise el cordón de la energía para darse cuenta de que esté bien conectado. Revise también los fusibles y el interruptor de circuitos; arréglole si es necesario o reemplace el fusible fundido (si lo hay) por otro de ACCION RETARDADA del tamaño adecuado. El tamaño adecuado de fusible se muestra en otra parte de estas instrucciones. Después de reestablecer la corriente a la unidad, espere tres minutos antes de volverla poner a funcionar.

FORMACION DE ESCARCHA EN EL SERPENTIN INTERIOR

Ciertas condiciones operativas pueden producir la formación de escarcha en el serpentín interior. Durante la operación de enfriamiento, un filtro sucio o una distribución restringida del aire, combinados con un clima húmedo y frío, pueden hacer que esto ocurra. Si se produce la escarcha en el serpentín interior mientras enfría, ponga el control en **FAN (ventilador)** y manténgalo así hasta que la escarcha en el serpentín desaparezca. El graduar el termostato en una temperatura ligeramente más caliente ayudará a evitar que la escarcha se forme de nuevo.

PARA LIMPIAR LA CUBIERTA DECORATIVA

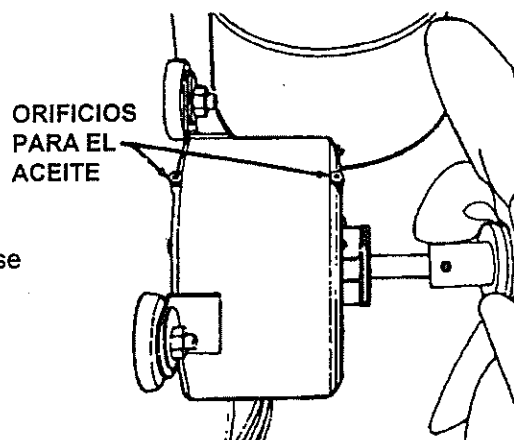
La CUBIERTA DECORATIVA de su unidad de aire acondicionado para habitación Friedrich, lo mismo que la totalidad del gabinete, pueden limpiarse con agua tibia y un detergente suave. Bajo condiciones de funcionamiento adversas, el serpentín interior y exterior y la bandeja base pueden requerir limpiezas periódicas, con el fin de mantener una operación eficiente. Cuando se requiera este servicio usted deberá llamar a su distribuidor Friedrich.

LUBRICACION

A pesar de que los motores del ventilador se lubrican y sellan en la fábrica, se suministran conductos para el aceite para que usted pueda lubricar su motor anualmente. Para lubricar, proceda como se detalla a continuación:

1. Apague la energía de la unidad y desconéctela de la pared.
2. Remueva los cuatro tornillos hex de ranura que fijan la CUBIERTA DECORATIVA a la unidad.
3. Saque el CHASIS hasta más o menos la mitad de la base de empotraje o hasta que los conductos del aceite del motor queden accesibles.
4. Remueva los tapones de los conductos del aceite de cada lado del MOTOR. Si tienen tapas metálicas puede ser necesario usar unas pinzas y darles una ligera vuelta para aflojarlos. Ponga el aceite al MOTOR siguiendo las instrucciones del fabricante. (Figura 3). Si no encuentra instrucciones en el MOTOR, ponga hasta 30 gotas de aceite SAE10W30 para motor en cada uno de los conductos. Vuelva a colocarles los tapones.

FIGURA 3



COSAS QUE USTED DEBE SABER SOBRE SU UNIDAD DE BOMBEO DE CALOR (HEAT PUMP) WALLMASTER

Cuando la unidad de bombeo de calor (Heat Pump) esté en funcionamiento, usted puede notar algunas funciones que no tuvieron uso cuando la unidad estaba enfriando:

1. Es común que se forme hielo en el serpentín exterior de su unidad de bombeo de calor (Heat Pump) Wallmaster. El hielo se forma debido a la humedad que tiene el aire exterior cuando pasa sobre la superficie fría (por debajo de cero grados C, (32 grados F.) del serpentín.
2. Cuando el serpentín exterior forma hielo, su unidad de bombeo de calor (Heat Pump) iniciará automáticamente el proceso de descongelación. El compresor parará y el ventilador seguirá funcionando. El calor se iniciará para continuar calentando la habitación mientras el aire exterior descongela el serpentín al aire libre. Una vez que la descongelación es total, la unidad volverá automáticamente a la modalidad de bombeo de calor.
3. Es normal que salga vapor del serpentín al aire libre durante el proceso de descongelación. Esto se parece al vapor que se forma cuando uno exhala aire caliente por boca y nariz, en una mañana muy fría.
4. Si la temperatura exterior o la temperatura del serpentín baja de 20 grados Fahrenheit (-7 grados C.) durante la operación de calefacción, su unidad de bombeo de calor (Heat Pump) Wallmaster cambiará automáticamente al calor de resistencia eléctrica y continuará operando en esa modalidad, hasta que la temperatura exterior se mantenga por debajo de 40 grados Fahrenheit (4 grados C.).

INSTRUCCIONES PARA LA INSTALACION DEL CHASIS WALLMASTER PARA LOS MODELOS "WS", "WE" Y "WY"

Se proporcionan estas instrucciones para la instalación del chasis de la unidad de aire acondicionado **Wallmaster** en las bases de empotraje en la pared. Este chasis ha sido aprobado (U.L.) con la base de empotraje listada en la placa de serie del chasis. Información muy importante de la garantía se suministra en las Instrucciones de funcionamiento anterior a estas instrucciones. Guarde estas instrucciones en un lugar seguro por si se llega a requerir algún servicio relacionado con la garantía.

PASO 1. Revise la base de empotraje para asegurarse de que está instalada correctamente en la pared. Retire el panel anterior sin pintar de la base de empotraje de la unidad "WS". **Retire el cartón detrás del PANEL DEL CLIMA.** Deje la rejilla posterior en su sitio. Descarte los otros elementos que se sacan.

- A. Revise los tornillos de anclaje. Deben haber cinco (5) en la BASE DE EMPOTRAJE de la unidad "WS", (dos en cada lado y uno en el centro de la parte superior).
- B. Determine si la base de empotraje tiene un declive hacia el exterior (de 1/2 burbuja en el nivel). Lea las instrucciones de la base de empotraje para mayores detalles.
- C. Asegúrese de que la base de empotraje se ha sellado en sus bordes con un compuesto de relleno tipo industrial (tanto en el interior como en el exterior), para prevenir que la lluvia pueda entrar.
- D. Una arandela para sellar la base de empotraje se incluye en la caja de transporte del chasis. Sáquela de la caja, quítele la cubierta protectora al adhesivo e instálela en la base de empotraje (con el adhesivo hacia abajo), como se muestra en la Figura 4.

FIGURA 4

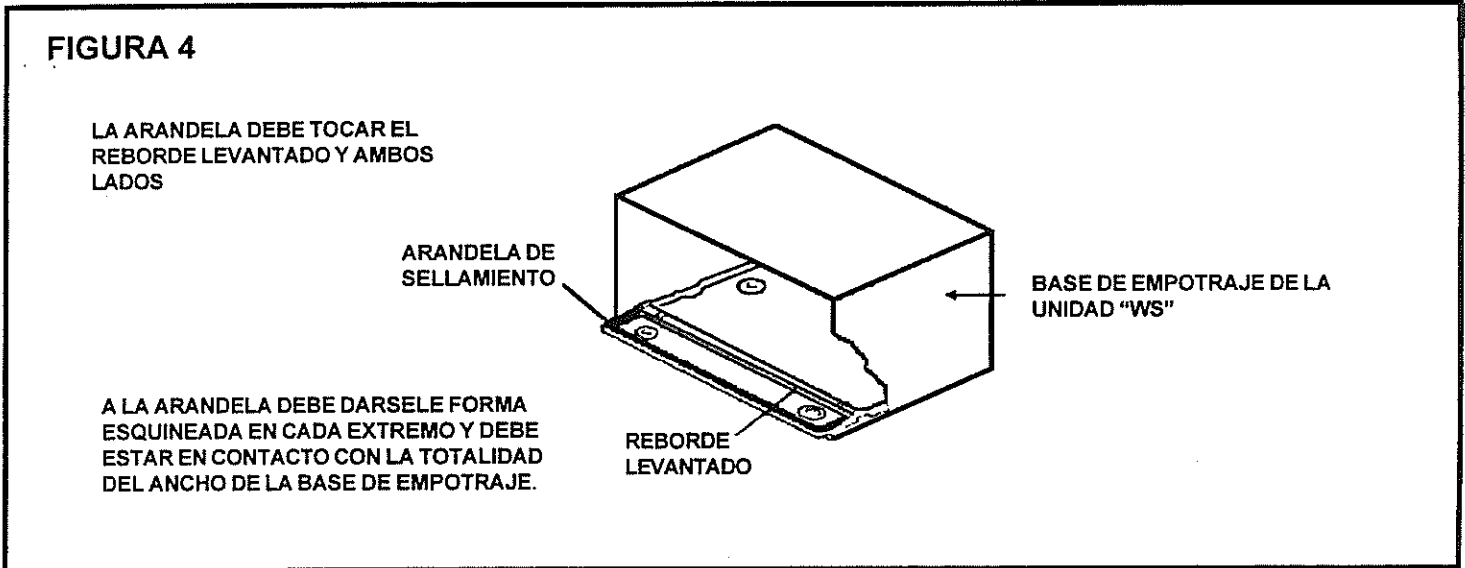
LA ARANDELA DEBE TOCAR EL
REBORDE LEVANTADO Y AMBOS
LADOS

ARANDELA DE
SELLAMIENTO

BASE DE EMPOTRAJE DE LA
UNIDAD "WS"

A LA ARANDELA DEBE DARSELE FORMA
ESQUINEADA EN CADA EXTREMO Y DEBE
ESTAR EN CONTACTO CON LA TOTALIDAD
DEL ANCHO DE LA BASE DE EMPOTRAJE.

REBORDE
LEVANTADO

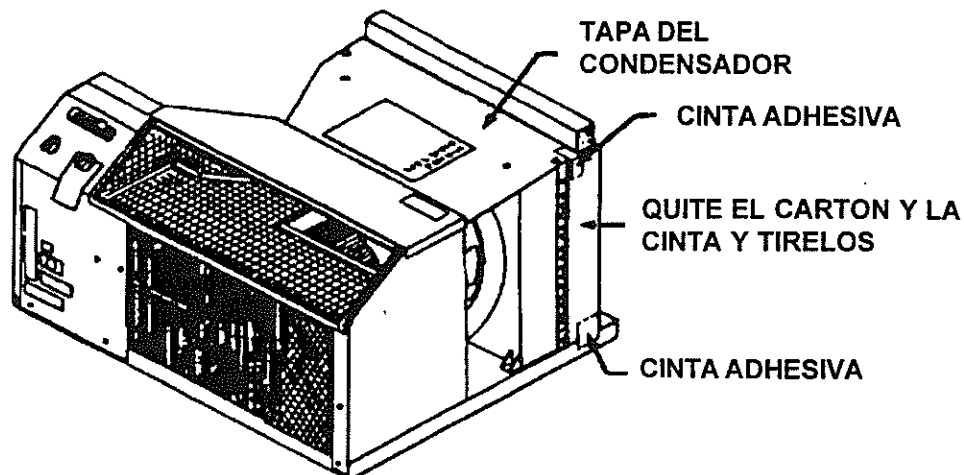


PASO 2. Revise el receptáculo eléctrico para ver si coincide con los requerimientos necesarios para ser instalado con el modelo de chasis. Lea las Instrucciones de funcionamiento para obtener los requerimientos del receptáculo.

PASO 3. La cubierta decorativa está empacada en una caja separada dentro de la caja de transporte del chasis, entre este y la caja. Saque esta caja y póngala a un lado hasta después.

PASO 4. Saque el chasis de la caja para transportarlo. Retire el cartón que está colocado contra los ganchos y que está asegurado a la tapa del condensador (Ver figura 5). Tenga cuidado de no permitir que ningún elemento entre en contacto con los ganchos, pues esto puede causarles daño. Levante el chasis de la bandeja base y deslícelo en la base de empotraje hasta que esté en contacto con la rejilla posterior. Con el chasis en la posición correcta, el borde anterior de la bandeja base debe sobresalir del frente de la base de empotraje 4 pulgadas y 3/4 (Frente).

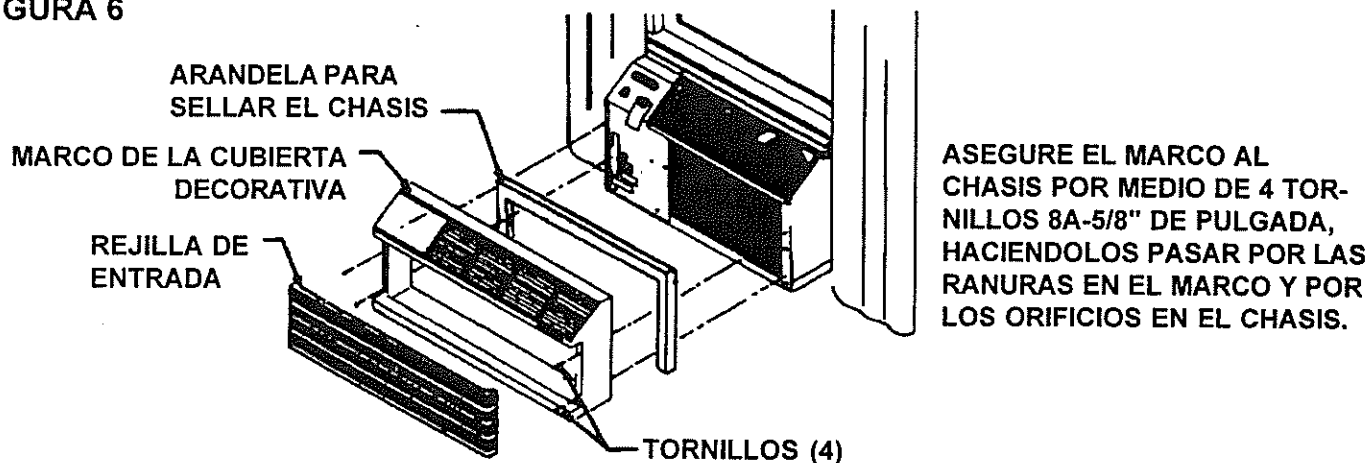
FIGURA 5



PASO 5. Instale la **arandela de sellar el chasis (arandela de espuma gris)**. Con cuidado, "META" la arandela entre el chasis y el gabinete, empezando por uno de los lados y yendo hasta el otro por encima y por debajo. Es esencial que esta arandela quede instalada correctamente pues ella previene que se produzca filtración de aire alrededor del chasis.

PASO 6. Cogiéndola de las esquinas superiores izquierda y derecha quite la **rejilla de entrada** del marco de la cubierta decorativa. Tirela hacia afuera hasta que la rejilla se desprenda de los broches que la sujetan en la parte de arriba. Inclínela hacia usted, levántela y sáquela de los broches que la sujetan en la parte de abajo. Instale el marco de la cubierta decorativa en su sitio, sobre la abertura de la base de empotraje y sujétela al CHASIS con cuatro tornillos metálicos, como se muestra en la Figura 6. Coloque la rejilla de entrada poniendo la base inferior de la rejilla en los broches que la sujetan en la parte de abajo. Incline el frente hacia arriba, alejándolo de usted. Presione suavemente en la parte de arriba y la rejilla se colocará ella misma en los broches que la sujetan en la parte de arriba.

FIGURA 6

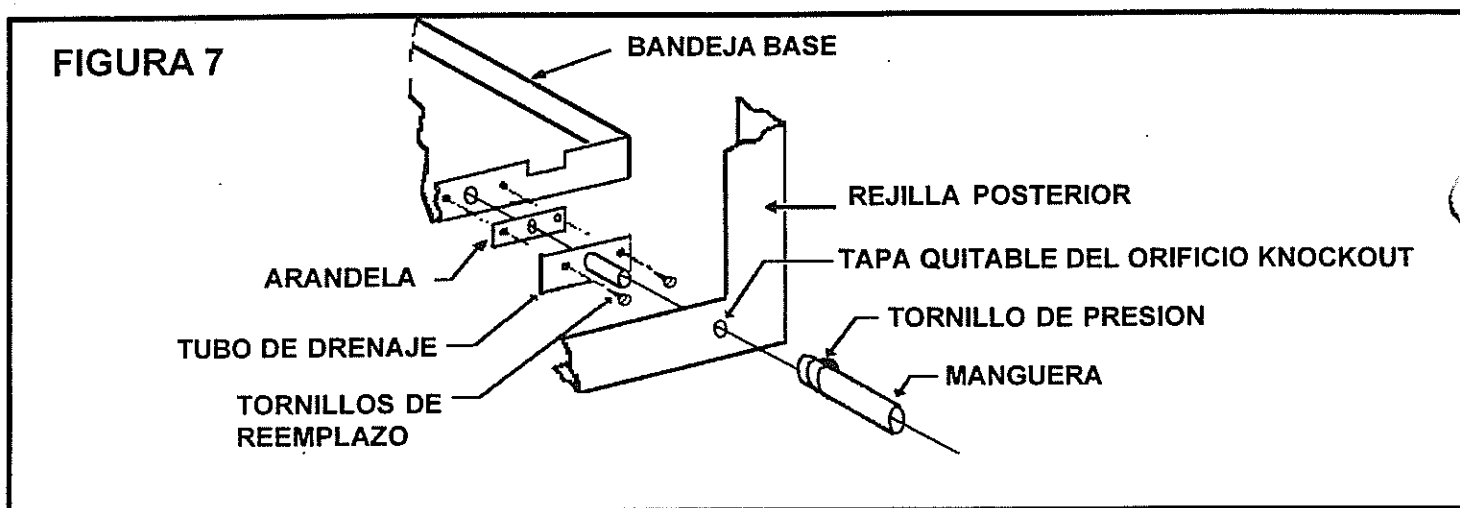


DRENAJE DE LA CONDENSACION EN LOS MODELOS "WS", "WE" Y "WY"

Si usted quiere drenar la condensación formada en la bandeja base mientras la unidad está en funcionamiento, utilice el tubo de drenaje que trae la unidad, el cual puede asegurarse a la bandeja base. **Usted deberá conseguir una manguera de 5/8 de pulgada de diámetro y un tornillo de presion para que la asegure al tubo de drenaje.** Siga las instrucciones a continuación:

- PASO 1.** Busque la **placa para drenaje** en la parte posterior de la bandeja base y quítela. (Ver Figura 7). Usando los tornillos de la placa, instale la arandela y el tubo de drenaje en la bandeja base.
- PASO 2.** Quite la tapa removible del **orificio knockout** en la parte inferior derecha de la rejilla posterior. Deslice el chasis en la base de empotraje para la unidad "WS", de tal forma que el tubo de drenaje pase por el orificio knockout.
- PASO 3.** Coloque el **tornillo de presion** alrededor de la manguera y deslice la manguera sobre el tubo de drenaje. Cierre el tornillo de presion alrededor de la manguera y del tubo de drenaje.

Si el chasis tiene que ser removido de la base de empotraje para alguna reparación, retire la manguera antes de deslizar el chasis fuera de la base de empotraje.



EQUIPOS OPCIONALES PARA DRENAJE

"DK" (Equipo de drenaje)

En los modelos "WE" y "WY", en caso de que la temperatura exterior baje de 37 grados Fahrenheit, cualquier cantidad de agua que se encuentre todavía en la bandeja base del chasis es drenada a la bandeja de la base de empotraje, para prevenir que se congele. **(ADVERTENCIA:** En climas excesivamente húmedos, en la modalidad de enfriamiento de los modelos "WS", "WE" y "WY" es posible que se produzca un derrame de exceso de condensación). Para estos casos especiales, hay disponible un **equipo para drenaje opcional ("DK")**. Refiérase a la Parte No. 920-038-00 para las instrucciones completas para instalación.

"IDK" (Equipo para drenaje interior)

La construcción nueva para permitir a los sistemas de drenaje contruidos dentro de las paredes puede utilizar el **equipo de drenaje interior Friedrich ("IDK")**, diseñado para instalación en la parte inferior de la base de empotramiento, debajo de la abertura de los fuelles (en los modelos de calefacción y enfriamiento únicamente). Refiérase a la Parte No. 920-041-00 para las instrucciones completas para instalación.



Términos de la garantía limitada - Unidades de aire acondicionado Friedrich

GARANTIA LIMITADA - PRIMER AÑO

TODAS LAS PARTES: Si cualquiera de las partes suministradas por FRIEDRICH no funciona debido a un defecto de manufactura o del material dentro de los 12 meses siguientes a la fecha original de compra, FRIEDRICH reparará el producto sin costo alguno, siempre y cuando que la unidad esté razonablemente accesible para el servicio. Todo costo adicional ocasionado por remover unidades inaccesibles y/o costos por millaje relacionados con el viaje de servicio, los cuales excedan una distancia de 30 millas (una vía), correrán por cuenta del propietario. Esta solución es la solución única convenida dentro de los 12 meses siguientes a la fecha original de compra.

GARANTIA LIMITADA - DEL SEGUNDO AL QUINTO AÑO

SISTEMA REFRIGERANTE SELLADO: Si el sistema refrigerante sellado (definido para este propósito como el compresor, condensador, serpentín, serpentín de evaporación, válvula de reversa, válvula de control, capilar, secador de filtro y tubería de interconexión) suministrado por FRIEDRICH con su unidad de aire acondicionado falla, debido a un defecto de manufactura o del material, dentro de los 60 meses siguientes a la fecha original de compra, FRIEDRICH pagará el costo de la reparación y de las partes necesarias para arreglar el sistema refrigerante sellado. Sin embargo, FRIEDRICH no pagará el costo del diagnóstico del problema, el retiro y transporte de la unidad hacia/de la agencia de servicio, ni los gastos de reinstalación asociados con la reparación del sistema refrigerante sellado. Todos esos costos correrán por cuenta del propietario. Esta solución es la solución única convenida dentro de los 60 meses siguientes a la fecha original de compra.

GARANTIA SMART CENTER (para aquellos modelos que vienen equipados así): Si el panel de control electrónico falla debido a un defecto de manufactura o del material, dentro de los 60 meses siguientes a la fecha original de compra, FRIEDRICH reemplazará esa parte. Sin embargo, FRIEDRICH no pagará el costo del diagnóstico del problema, o los costos de la labor involucrada en remover y reemplazar la parte. El reemplazo de esta parte no requiere el retiro de la unidad. Cualquier costo de retiro, transporte y reinstalación correrá por cuenta del propietario.

APLICABILIDAD Y LIMITACIONES: Esta garantía es aplicable únicamente a unidades que permanezcan dentro del territorio de los 50 Estados Unidos de América, el Distrito de Columbia y Canadá. Esta garantía no es aplicable a:

1. Filtros de aire o fusibles
2. Productos en los cuales se hayan retirado las especificaciones de los modelos y los números de serie.
3. Productos que sufran defectos o daños resultantes de instalación o tendido eléctrico incorrectos, características de la corriente eléctrica o mal mantenimiento. Daños causados por accidentes, mal uso o abuso, incendio, inundación, alteraciones y mala aplicación del producto y/o unidades que se hayan instalado en una atmósfera corrosiva, problemas causados por guerra, restricciones gubernamentales, paros, carencia de materiales que vaya más allá del control de FRIEDRICH, o actos de la naturaleza.

PARA OBTENER CUMPLIMIENTO DE LA GARANTIA: El servicio será prestado por el concesionario/representante autorizado de FRIEDRICH o la organización de servicio afiliada en su área. Estos están listados en las Páginas Amarillas. Si requiere ayuda para obtener el cumplimiento de la garantía, por favor escriba a:

Room Air Conditioner Service Manager, Friedrich Air Conditioning Co., Box 1540, San Antonio, TX 78295-1540.

LIMITACIONES: ESTA GARANTIA SE CONCEDE EN LUGAR DE OTRAS GARANTIAS. Además de lo que se detalla en la garantía, CUALQUIER GARANTIA DE IDONEIDAD EXPRESA PARA CUALQUIER PROPOSITO PARTICULAR Y/O PARA MERCADEO SE LIMITARÁ A LA DURACION CONCEDIDA POR ESTA GARANTIA EXPRESA. EL FABRICANTE RENUNCIA EXPRESAMENTE Y EXCLUYE CUALQUIER RESPONSABILIDAD POR DAÑOS INCIDENTALES O CONSECUENCIALES DETERMINADOS POR EL ROMPIMIENTO DE CUALQUIER GARANTIA EXPRESA O IMPLICITA.

NOTA: Algunos estados no permiten limitaciones sobre el tiempo de duración de una garantía implícita, o no permiten la limitación o exclusión de daños incidentales o consecuenciales, así que puede ser que esas exclusiones no apliquen en su caso.

OTRA: Esta garantía le da derechos legales específicos. Es posible que usted tenga otros derechos que son variables en cada estado.

PRUEBA DE COMPRA: El propietario debe tener la prueba/recibo de compra correctos para recibir servicios relacionados con la garantía.

Todas las llamadas telefónicas relacionadas con la operación/reparación de este producto correrán por cuenta del consumidor.

Todo servicio de garantía debe ser prestado por una agencia de servicio autorizada por FRIEDRICH, a menos que FRIEDRICH autorice expresamente otro arreglo antes de que se haga la reparación.

En caso de preguntas relacionadas con los términos de esta garantía, la versión en inglés es la que tiene prioridad.

Friedrich desea que usted se mantenga siempre satisfecho con su unidad de aire acondicionado. Si necesita cualquier tipo de ayuda adicional referente a la garantía, por favor, póngase en contacto con:

R.A.C. Customer Assurance
Friedrich Air Conditioning Co.
P.O. Box 1540
San Antonio, TX 78295

Su tarjeta personal de registro de la garantía

REGISTRO DE LA GARANTIA: Por favor llene y envíe a FRIEDRICH su Tarjeta de Registro de la Garantía (no esta tarjeta). Aunque para obtener su garantía no es obligatorio que usted lo haga, esto registra su garantía y nos facilita y acelera el proceso de verificar el período de cobertura de su garantía y el de ponernos en contacto con usted, si llega a ser necesario el que deba dársele servicio a nuestro producto.

PARA SU ARCHIVO: LLENE LA INFORMACION SIGUIENTE CUANDO SE INSTALA LA UNIDAD, PARA QUE ESTE DISPONIBLE SI ES NECESARIA POSTERIORMENTE.

Modelo No. _____ Serie No. _____ Fecha de instalación _____

Fué comprada en: _____

(Nombre del distribuidor)

(Dirección del distribuidor)

(Persona de contactar)

(Teléfono:)

UTILICE SIEMPRE LOS REPUESTOS (PARTES) DE
FABRICA AUTORIZADOS POR FRIEDRICH. EL USO DE
PARTES NO AUTORIZADAS PUEDE ANULAR SU
GARANTIA.

Friedrich®

FRIEDRICH AIR CONDITIONING CO.

ROOM AIR CONDITIONING DIVISION P.O. BOX 1540

SAN ANTONIO, TX 78295-1540

Friedrich®

INSTRUCTIONS D'INSTALLATION ET D'UTILISATION POUR LES MODÈLES "WS," "WE" ET "WY"

BIENVENUE à des années de confort économique avec le climatiseur Friedrich.

Le climatiseur Friedrich neuf a été soigneusement développé et fabriqué pour donner des années de fonctionnement fiable et efficace, et pour maintenir une pièce à une température et à un niveau d'humidité confortables. Beaucoup de caractéristiques spéciales ont été incorporées dans le climatiseur Friedrich pour assurer un fonctionnement silencieux, une plus grande circulation d'air frais et sec, une sélection très flexible des commandes de fonction et un fonctionnement économique.

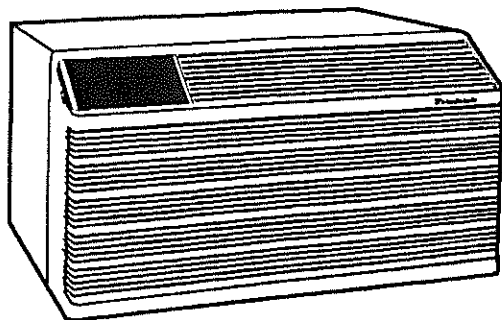
Il est possible de faire de nombreux changements dans la maison et autour pour économiser de l'argent et même pour augmenter le rendement et la longévité de l'appareil Friedrich. Voici quelques exemples.

1. **Réglage du thermostat** - À la mise en marche du climatiseur, choisir la vitesse la plus élevée du ventilateur et régler le thermostat à la température la plus froide pour refroidir la pièce. Quand la température désirée est obtenue, tourner le thermostat vers « warmer » (plus chaud) jusqu'à ce que le compresseur s'arrête. Le thermostat met alors le compresseur en marche et l'arrête pour maintenir la température désirée. Il est possible de régler la vitesse du ventilateur afin d'obtenir la circulation optimale de l'air.
2. Il ne faut pas bloquer le passage de l'air entrant ou sortant de l'appareil. Vérifier que les bouches sont dirigées pour donner une distribution uniforme de l'air dans toute la pièce. *Prudence* - Si le passage d'air est bouché ou si l'air frais est renvoyé dans l'admission du climatiseur, l'appareil peut se mettre en marche et s'arrêter fréquemment, ce qui peut l'endommager.
3. Fermer la commande d'évacuation (CLOSED) pour obtenir le refroidissement maximal ou la circulation maximale de l'air.
4. L'isolation adéquate des murs, des plafonds et sous les planchers peut économiser jusqu'à 50 % des frais de climatisation dans la plupart des régions du pays.
5. Dans les maisons avec des murs bien isolés, l'application de mastic sur des fuites autour des portes, des fenêtres et les appareils d'éclairage et de plomberie peut faire une différence de 30 % sur la charge des systèmes de climatisation et de chauffage. Vérifier que tous ces endroits sont bien enduits de mastic.
6. Installer du calfeutrage (le métal est préférable au feutre) autour des portes extérieures et des fenêtres.
7. Cheminée ? Vérifier que le registre est fermé pendant la saison de climatisation.
8. Quand le moment est arrivé d'installer une nouvelle toiture ou de repeindre l'extérieur de la maison, choisir des couleurs claires. Elles reflètent la chaleur plutôt que de l'absorber.
9. Protéger les murs extérieurs de la maison (spécialement vers l'ouest) contre l'exposition directe au soleil. Plus important, mettre de l'ombre sur le climatiseur. Des arbres et des buissons fournissent de l'ombre naturelle, mais il faut s'assurer qu'ils ne bloquent pas le passage de l'air autour de l'appareil. Il faut également éviter les endroits où une quantité excessive de poussière ou de pollen peut être aspirée dans le climatiseur.

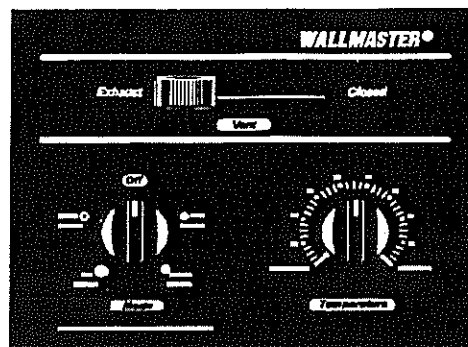
S'il n'y a pas d'ombre naturelle, des auvents sont la meilleure solution pour créer de l'ombre pour l'appareil et les fenêtres.
10. À l'intérieur de la maison, utiliser des stores, des écrans ou des rideaux sur les fenêtres exposées au soleil. Ils réduisent les besoins de climatisation (des rideaux doublés ou isolés aident aussi à diminuer le chauffage en hiver).
11. Vérifier que les combles sont aérés correctement. En plus, il faut considérer l'installation d'une turbine ou de ventilateurs à moteur pour aider à éliminer l'air très chaud des combles.
12. Maintenir l'appareil Friedrich propre. Nettoyer avec un aspirateur les parties accessibles, mais il faut faire attention de ne pas les endommager. Nettoyer le filtre permanent au moins deux fois par mois.
13. Régler le thermostat à une température plus élevée, chaque degré Fahrenheit au-dessus de 72 °F (22 °C) économise 5 % d'énergie.

Ces suggestions sont les plus importantes pour économiser de l'argent sur la climatisation. Certaines peuvent ne pas s'appliquer à une maison ou une région spécifique. Obtenir des renseignements supplémentaires auprès des compagnies de distribution de gaz et d'électricité.

CARACTÉRISTIQUES DU PRODUIT (MODÈLE "WS")



MODÈLES WS



PANNEAU DE COMMANDE
DES MODÈLES WS

N° de modèle	Type de fiche	temporisateur	Capacité du circuit, du disjoncteur ou du fusible
WS07 WS09 WS12	 NEMA No.	5-15P	125V-15 AMP
WS09 WS12 WS13	 NEMA No.	6-15P	250V-15 AMP

COMMANDE D'ÉVACUATION D'AIR

Mettre le levier sur la position **CLOSED (fermée)** uniquement pour refroidir, filtrer et recirculer l'air de la pièce. Mettre sur **EXHAUST (évacuation)** pour éliminer la fumée ou l'air vicié de la pièce. Prendre soin de verrouiller la commande en position.

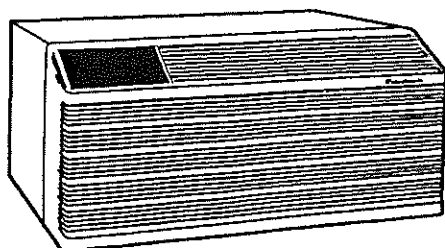
COMMANDE DE FONCTION

Mettre le bouton sur **LO COOL (refroidissement faible)** pour refroidir avec la vitesse la plus faible du ventilateur. Mettre le bouton sur **MED COOL (refroidissement moyen)** pour refroidir avec la vitesse moyenne du ventilateur. Mettre le bouton sur **HI COOL (refroidissement puissant)** avec la vitesse la plus élevée du ventilateur. Mettre le bouton sur **FAN ONLY (ventilateur seulement)** pour faire circuler l'air avec la vitesse moyenne du ventilateur, sans refroidissement. Mettre le bouton sur **OFF (arrêt)** pour arrêter l'appareil complètement. Le ventilateur fonctionne continuellement quand en mode de refroidissement.

COMMANDE DE TEMPÉRATURE

Le bouton identifié **WARMER/COOLER (plus chaud / plus froid)** est le thermostat. Le tourner dans le sens des aiguilles d'une montre pour obtenir une température plus basse, et dans le sens inverse des aiguilles d'une montre pour obtenir une température plus élevée.

CARACTÉRISTIQUES DU PRODUIT (MODÈLES "WE" ET "WY")



MODÈLES WE ET WY



PANNEAU DE COMMANDE DES
MODÈLES WE ET WY

N° de modèle	Type de fiche	Capacité du circuit du disjoncteur ou du fusible temporisateur
WE09 WE12 WE13 WY09 WY12	 NEMA No. 6-20P	250V-20 AMP

COMMANDE D'ÉVACUATION D'AIR

Mettre le levier sur la position **CLOSED (fermée)** uniquement pour refroidir, filtrer et recirculer l'air de la pièce. Mettre sur **EXHAUST (évacuation)** pour éliminer la fumée ou l'air vicié de la pièce. Prendre soin de verrouiller la commande en position.

COMMANDE DE FONCTION

Tourner le bouton dans le sens des aiguilles d'une montre jusqu'à **HIGH (haut)** pour chauffer avec la vitesse la plus élevée du ventilateur. Mettre le bouton sur **MED (moyen)** pour chauffer avec la vitesse moyenne du ventilateur. Mettre le bouton sur **LO (bas)** pour chauffer avec la vitesse basse du ventilateur. Les modèles WE utilisent des résistances électriques pour le chauffage ; les modèles WY de pompe de chaleur utilisent le compresseur pour chauffer et passent automatiquement au chauffage électrique quand la température extérieure ou la température du serpentin est inférieure à 20 °F (-7° C).

Tourner le bouton dans le sens inverse des aiguilles d'une montre jusqu'à **FAN (ventilateur)** pour faire fonctionner le ventilateur à la vitesse moyenne, sans refroidir ni chauffer. Mettre le bouton sur **HI (haut)** pour refroidir avec le ventilateur à la vitesse élevée. Mettre le bouton sur **MED (moyen)** pour refroidir avec le ventilateur à vitesse moyenne. Mettre le bouton sur **LO (bas)** pour refroidir avec le ventilateur à vitesse basse. Tourner le bouton dans n'importe quelle direction jusqu'à **OFF (arrêt)** pour arrêter complètement l'appareil.

REMARQUE - Le ventilateur se met en marche et s'arrête en même temps que le compresseur ou la résistance de chauffage et ne fonctionne pas continuellement quand en mode de chauffage.

COMMANDE DE TEMPÉRATURE

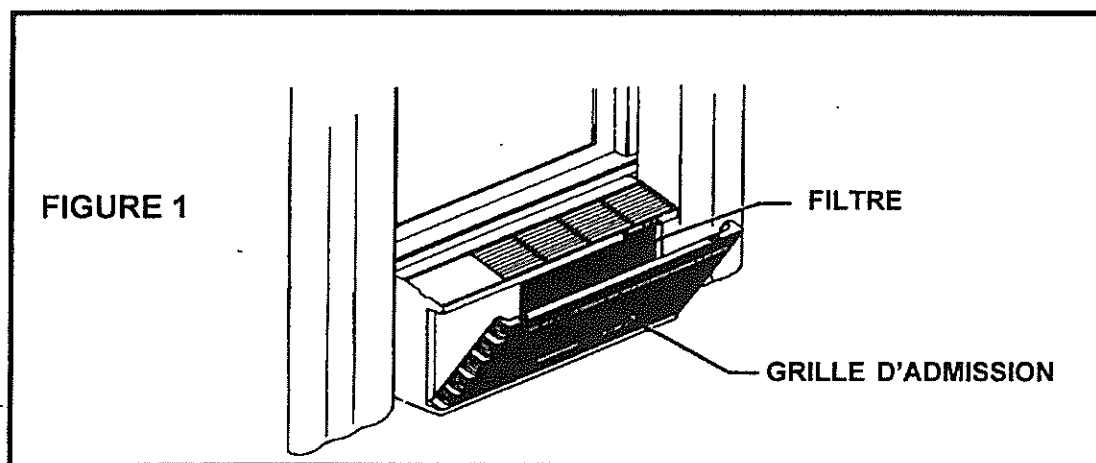
Le bouton identifié **WARM/COOL (chaud/froid)** est le thermostat. Le tourner dans le sens des aiguilles d'une montre pour obtenir une température plus basse et dans le sens inverse des aiguilles d'une montre pour obtenir une température plus élevée.

NETTOYAGE DU FILTRE

Le climatiseur Friedrich est équipé d'un filtre de type Permafoam réutilisable, avec un traitement germicide qui n'est pas affecté par le lavage. Le filtre est utilisé pour enlever la poussière, le pollen et les autres impuretés de l'air.

MAINTENANCE DE LA PROPRETÉ DU FILTRE - Un filtre colmaté et sale réduit le rendement de l'appareil et contribue à la formation de givre sur le serpentin interne. Il faut prendre soin d'inspecter le filtre tous les 7 ou 10 jours. La procédure d'inspection du filtre est simple, grâce à la construction unique du panneau avant décoratif Friedrich.

ACCÈS AU FILTRE - Pour enlever la grille d'admission du panneau avant décoratif, prendre la grille fermement aux coins supérieurs droit et gauche. Tirer jusqu'à ce que la grille soit libérée des agrafes de retenue. L'incliner vers soi, la soulever et la sortir des agrafes de retenue. Ceci expose le filtre à air. Tirer sur le filtre pour le sortir. Laver le filtre dans de l'eau très chaude savonneuse, rincer, serrer légèrement pour enlever l'excès d'eau, secouer et sécher, ne pas tordre, et remettre en place dans les deux supports de l'appareil. Pour remettre la grille d'admission en place, mettre le bas de la grille dans les agrafes inférieures. Faire basculer le panneau avant vers le haut, vers l'appareil. Appuyer légèrement sur le haut et la grille se met automatiquement en position dans les agrafes supérieures.



CHANGEMENT DE LA DIRECTION DE PASSAGE DE L'AIR ...

La grille de décharge est installée à l'usine pour fournir un débit d'air **horizontal** dans la pièce (direction 1, figure 2). Il est possible de tourner la grille de décharge pour obtenir un débit d'air **vertical** (direction 2), si désiré.

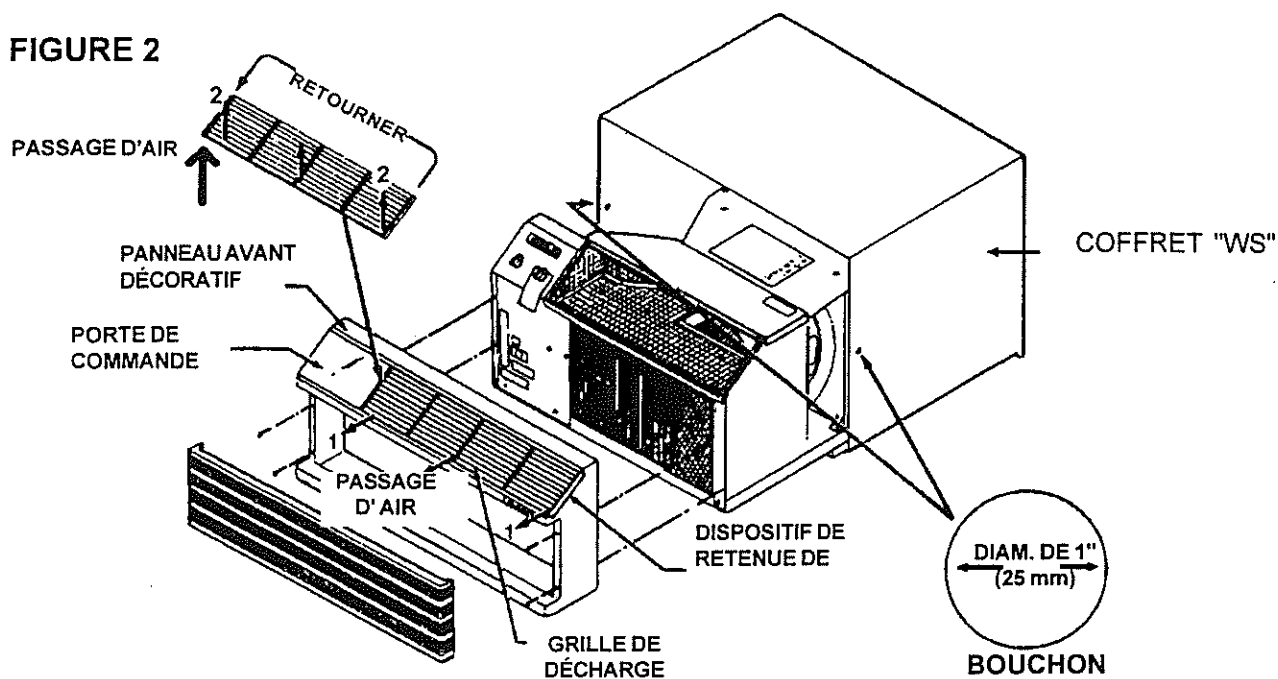
Mettre la commande de fonction sur OFF (ARRÊT). Il ne faut pas faire fonctionner le moteur du ventilateur pendant le changement de direction de débit d'air. Enlever la vis du dispositif de retenue de la grille de décharge sur le côté droit de la grille. Enlever la grille de décharge des rainures de retenue, près de la porte de commande et retourner la grille, comme montré sur la figure 2.

Mettre la grille dans les rainures de retenue pour remettre en place la grille de décharge. Revisser le dispositif de retenue de la grille de décharge. L'appareil est prêt à être mis en service.

COUVERTURE DES TROUS DU PANNEAU INTERNE DE PROTECTION CONTRE LES INTEMPÉRIES ...

Deux bouchons beiges sont inclus dans le sac en plastique collé sur le châssis du WallMaster. Il est possible d'utiliser ces bouchons pour couvrir les deux trous exposés après la dépose du panneau interne de protection contre les intempéries (consulter la Figure 2). Il **faut** installer les bouchons avant d'installer le bâti décoratif avant.

FIGURE 2



ALIMENTATION ÉLECTRIQUE

IMPORTANT - Avant de commencer l'installation du climatiseur, il faut vérifier les codes électriques locaux et les renseignements qui suivent.

L'alimentation électrique du climatiseur doit avoir les mêmes caractéristiques (tension et fréquence) que celles indiquées sur la plaque d'identification sur le châssis. Il ne faut utiliser que du courant alternatif. Consulter les instructions d'utilisation pour déterminer le type de prise correct pour le modèle à installer.

Un circuit surchargé crée un mauvais fonctionnement ou des pannes du climatiseur. Il est donc extrêmement important d'avoir une alimentation électrique et des fils appropriés. En cas de doute, consulter le distributeur ou la compagnie d'électricité.

PROTECTION DU CIRCUIT - Avant d'installer ou de déplacer un climatiseur Friedrich, vérifier la capacité du disjoncteur ou du fusible temporisateur. Consulter la plaque d'identification sur le châssis du climatiseur pour déterminer la capacité nécessaire pour ce modèle. Il **NE FAUT PAS** dépasser la capacité indiquée sur la plaque d'identification. Si le climatiseur est branché sur un circuit protégé par un fusible, il faut utiliser un fusible temporisateur, car le climatiseur a une demande élevée au moment de la mise en marche du compresseur.

IL NE FAUT JAMAIS UTILISER DE RALLONGE AVEC LE CLIMATISEUR

Le climatiseur Friedrich est équipé d'un cordon avec une fiche à 3 broches (à la terre) pour protéger contre les électrocutions et il faut le brancher dans une prise à trois broches correctement mise à la terre. Quand il y a une prise à deux broches, il faut la remplacer avec une prise à trois broches avec mise à la terre selon les codes et règlements électriques locaux et nationaux. Ce travail doit être fait par un électricien qualifié.

NE FAUT JAMAIS COUPER OU ENLEVER LA BROCHE DE MISE À LA TERRE.

GUIDE DE DÉPANNAGE

PAS DE REFROIDISSEMENT

Si l'appareil fonctionne, mais ne refroidit pas, déterminer si les commandes sont réglées correctement. Attendre trois minutes avant de régler le thermostat à une température plus basse afin de vérifier le réglage. Inspecter le filtre et le nettoyer soigneusement, si nécessaire.

PAS DE CHAUFFAGE (seulement pour les modèles avec chauffage et refroidissement)

Si l'appareil fonctionne, mais ne chauffe pas, déterminer si les commandes sont réglées correctement. Régler le thermostat à la température la plus élevée pour déterminer s'il fonctionne. Inspecter aussi le filtre et le nettoyer soigneusement, si nécessaire.

ODEURS DANS LE CHAUFFAGE (seulement pour les modèles avec chauffage et refroidissement)

Il est possible de sentir une odeur de fumée la première fois que le chauffage se met en marche. Ceci est normal pour n'importe quel système de chauffage la première qu'il est mis en marche au début de l'hiver. L'odeur est causée par la combustion de la poussière et autres particules qui se sont accumulées pendant les mois chauds. L'odeur se dissipe rapidement.

L'APPAREIL NE FONCTIONNE PAS

Si l'appareil ne fonctionne pas, vérifier que le cordon d'alimentation est branché correctement. Vérifier si le fusible est grillé ou le disjoncteur déclenché. Remettre le disjoncteur à l'état initial ou remplacer le fusible grillé par un fusible temporisé de la bonne capacité. La capacité du fusible est indiquée ailleurs dans ces instructions. Après avoir remis l'appareil sous tension, attendre trois minutes avant de le mettre en marche.

GIVRE SUR LE SERPENTIN INTERNE

Certaines conditions de fonctionnement peuvent produire du givre sur le serpentin interne. Pendant le refroidissement, un filtre sale ou un débit d'air limité en combinaison avec un temps frais et humide peut causer un tel problème. Si le serpentin interne se recouvre de givre pendant le refroidissement, mettre la commande sur **FAN (ventilateur)** et laisser le ventilateur fonctionner jusqu'à ce que le givre soit complètement éliminé. Le réglage du thermostat à une température légèrement plus élevée évite généralement le retour du givre.

NETTOYAGE DU PANNEAU AVANT DÉCORATIF

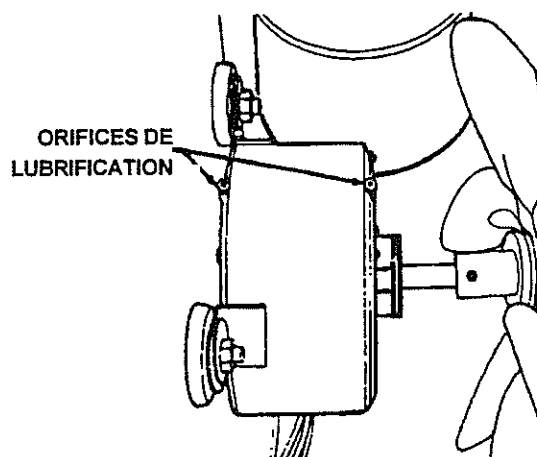
Il est possible de nettoyer LE PANNEAU AVANT DÉCORATIF panneau avant décoratif du climatiseur Friedrich, ainsi que le coffret tout entier, avec de l'eau chaude et un détergent doux. En cas de conditions de fonctionnement difficiles, il peut être nécessaire de nettoyer régulièrement le serpentin interne, le serpentin externe et le plateau pour maintenir le bon rendement de l'appareil. Ce nettoyage doit être fait par un distributeur Friedrich.

LUBRIFICATION

Bien que le moteur du ventilateur soit lubrifié et scellé à l'usine, il existe des orifices de lubrification pour lubrifier le moteur une fois par an. Pour lubrifier, suivre la procédure suivante.

1. Arrêter le climatiseur et le débrancher.
2. Enlever les quatre vis à tête fendu hexagonale retenant le PANNEAU AVANT DÉCORATIF sur l'appareil.
3. Sortir le châssis à moitié du coffret ou jusqu'à ce qu'il soit possible d'atteindre les orifices de lubrification du moteur du ventilateur.
4. Enlever les bouchons des orifices de lubrification de chaque extrémité du moteur. Si équipé de bouchons métalliques, il peut être nécessaire de les tourner légèrement avec des pinces pour les desserrer. Ajouter de l'huile selon les recommandations du fabricant qui se trouvent sur une étiquette sur le moteur (consulter la Figure 3). S'il n'y a pas d'instruction sur le moteur, ajouter un maximum de 30 gouttes d'huile moteur SAE 10W30 dans chaque orifice. Remettre les bouchons en place.

FIGURE 3



POMPES DE CHALEUR WALLMASTER

Pendant le fonctionnement de la pompe de chaleur, il est possible de remarquer des conditions qui n'avaient pas lieu pendant le refroidissement.

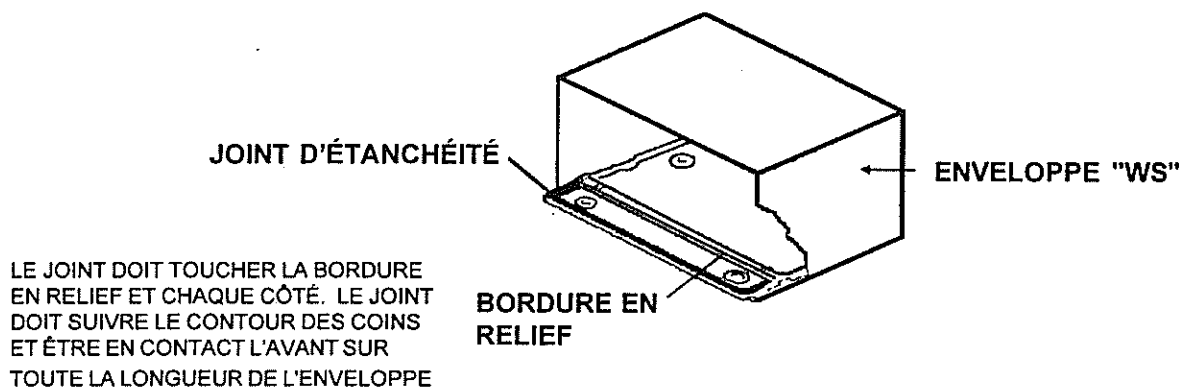
1. Il est normal d'avoir une accumulation de givre sur le serpentin extérieur de la pompe de chaleur WallMaster. Le givre est formé par le passage de l'air extérieur humide sur les surfaces froides (température inférieure à 0 °C, 32 °F).
2. La pompe de chaleur lance automatiquement un cycle de dégivrage quand il y a formation de givre sur le serpentin extérieur. Le compresseur s'arrête et le ventilateur continue à fonctionner. La résistance électrique est mise en marche pour continuer à chauffer la pièce pendant que l'air extérieur dégivre le serpentin extérieur. Après le dégivrage, l'appareil se remet automatiquement en mode de pompe de chaleur.
3. Il est normal d'avoir de la vapeur qui s'élève du serpentin extérieur pendant le dégivrage. Ceci est similaire à une haleine visible par temps froid.
4. Si la température extérieure ou la température du serpentin est inférieure à 20 °F (-7 °C) pendant le cycle de chauffage, la pompe de chaleur WallMaster passe automatiquement au chauffage par résistance électrique et continue sur ce mode tant que la température extérieure reste inférieure à 40 °F (4 °C).

INSTRUCTIONS D'INSTALLATION DU CHÂSSIS WALLMASTER POUR LES MODÈLES "WS," "WE" ET "WY"

Ces instructions sont fournies pour l'installation d'un climatiseur à châssis WallMaster dans une enveloppe traversant le mur. Ce châssis a été approuvé par U.L. avec l'enveloppe indiquée sur la plaque d'identification du châssis. Les instructions d'utilisation précédant ces instructions donnent des renseignements importants sur la garantie. Il faut garder ces instructions dans un endroit pratique au cas où il faudrait faire des réparations sous garantie.

- ÉTAPE 1.** Vérifier que l'enveloppe est installée correctement dans le mur. Enlever le panneau avant sans peinture d'enveloppe WS. **Enlever le panneau de protection contre les intempéries en carton à l'arrière.** Laisser la grille arrière en place. Jeter les autres articles enlevés.
- A. Inspecter les vis d'ancrage. Il doit y en avoir cinq pour le l'enveloppe WS (deux de chaque côté et une au centre supérieur).
 - B. Déterminer si l'enveloppe est inclinée vers l'extérieur. L'inclinaison doit être d'une demi-bulle sur un niveau à bulle. Obtenir des détails supplémentaires dans les instructions d'installation de l'enveloppe.
 - C. Vérifier que du mastic de type industriel a été installé tout autour de l'enveloppe, à l'extérieur et à l'intérieur, pour éviter l'entrée de la pluie.
 - D. Un joint d'étanchéité de l'enveloppe est fourni dans le carton d'expédition du châssis. Le sortir du carton, enlever la feuille de protection de la surface adhésive et l'installer dans l'enveloppe (adhésif vers le bas), comme montré sur la Figure 4.

FIGURE 4



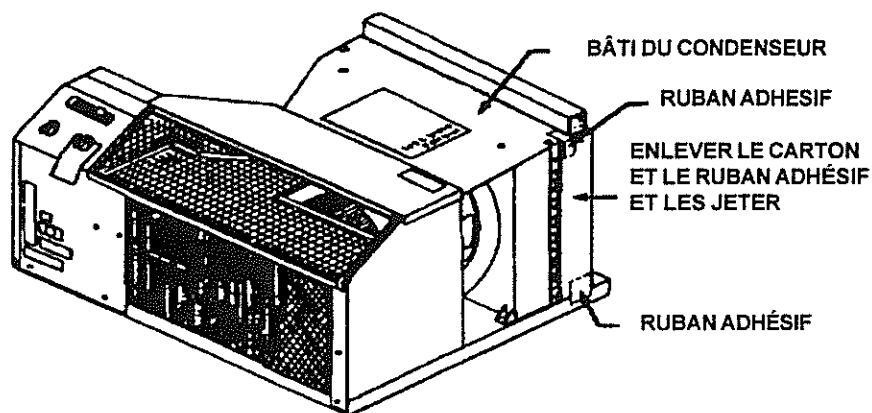
- ÉTAPE 2.** Vérifier que la prise électrique correspond au modèle du châssis à installer. Consulter les paramètres dans les instructions d'utilisation.

- ÉTAPE 3.** Le panneau avant décoratif est emballé dans une boîte séparée à l'intérieur du carton d'expédition du châssis, entre le châssis et le carton. Sortir cette boîte et la mettre de côté pour utilisation ultérieure.

ÉTAPE 4.

Sortir le châssis du carton d'expédition. Elever le carton placé contre les agrafes en épingle à cheveux et collé avec du ruban adhésif sur le bâti du condenseur (consulter la Figure 5). Il faut faire attention de ne pas toucher les agrafes en épingle à cheveux sous peine de les endommager. Soulever le châssis du plateau et le glisser dans l'enveloppe jusqu'à ce qu'il touche la grille arrière. Avec le châssis en position, le bord avant du plateau doit dépasser de 4-3/4" (12 cm) du bord avant de l'enveloppe

FIGURE 5



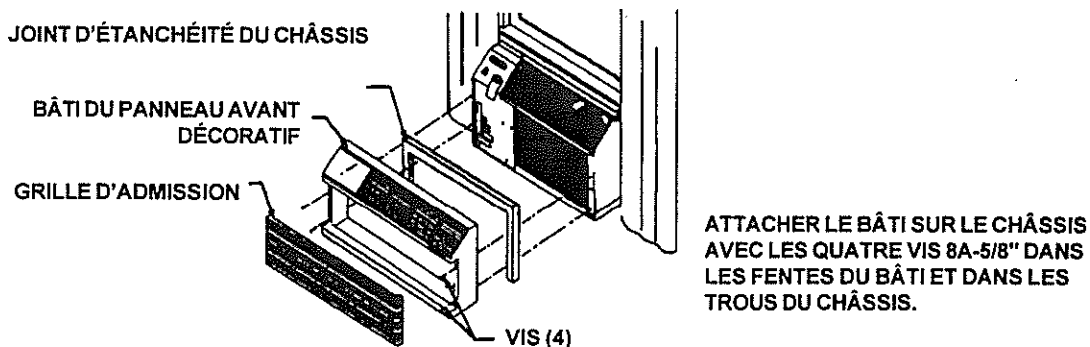
ÉTAPE 5.

Installer le joint d'étanchéité du châssis (joint en mousse grise). Enfoncer le joint avec précaution entre le châssis et l'enveloppe en commençant à un coin inférieur, monter sur un des côtés, le long du haut et descendre de l'autre côté. Il est IMPORTANT d'installer correctement ce joint pour éviter les fuites d'air autour du châssis.

ÉTAPE 6.

Prendre fermement la grille d'admission du panneau avant décoratif aux coins supérieurs gauche et droit et tirer pour la sortir du bâti du panneau avant décoratif. Tirer jusqu'à ce que la grille sorte des agrafes de retenue supérieures. Faire basculer vers soi, la soulever et la sortir des agrafes de retenue inférieures. Mettre le bâti du panneau avant décoratif en place sur l'ouverture de l'enveloppe et l'installer sur le châssis avec quatre vis à tête, comme montré sur la Figure 6. Pour remettre la grille d'admission en place, mettre le bas de la grille dans les agrafes de retenue inférieures. Faire basculer le panneau avant vers le haut et vers l'appareil. Appuyer doucement en haut et la grille se met en position automatiquement dans les agrafes de retenue supérieures.

FIGURE 6

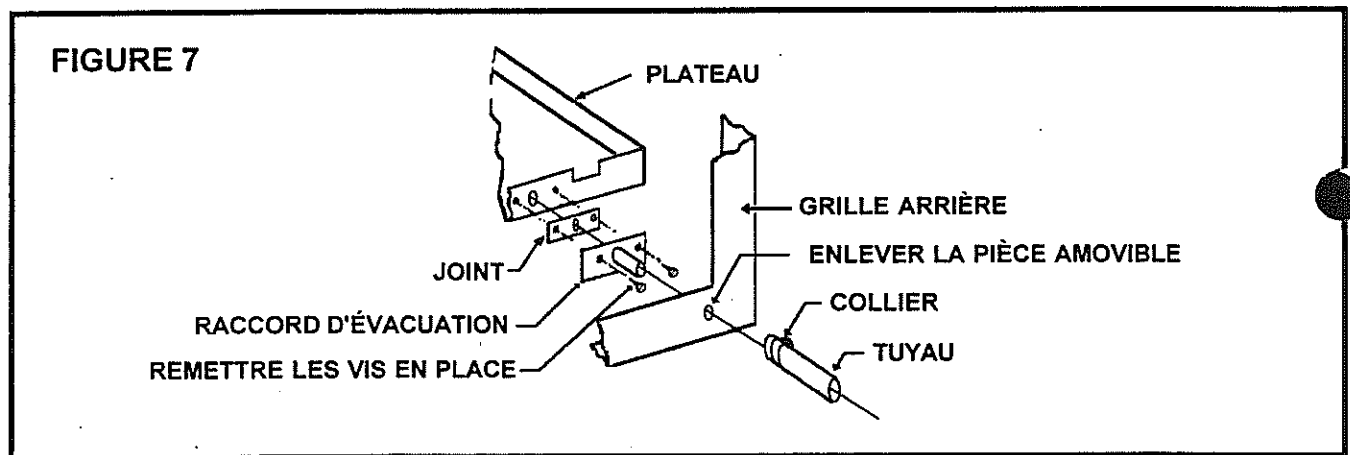


ÉLIMINATION DE LA CONDENSATION (MODÈLES "WS," "WE" ET "WY")

Cet appareil est fourni avec un raccord d'évacuation qu'il est possible d'installer sur le plateau pour permettre l'élimination de la condensation du plateau. **L'utilisateur doit fournir un tuyau de 5/8" de diamètre et un collier, pour le branchement sur le raccord.** Suivre les instructions suivantes.

- ÉTAPE 1.** Enlever la plaque de vidange à l'arrière du plateau (consulter la Figure 7). Avec les vis de la plaque, installer le joint et le raccord d'évacuation sur le plateau.
- ÉTAPE 2.** Enlever la pièce amovible sur le côté droit inférieur de la grille arrière. Glisser le châssis dans l'enveloppe WS pour que le raccord d'évacuation passe dans le trou de la pièce amovible.
- ÉTAPE 3.** Glisser le collier autour du tuyau et glisser le tuyau sur le raccord d'évacuation. Serrer le collier autour du tuyau et du raccord de vidange.

Il faut enlever le tuyau avant de sortir le châssis de l'enveloppe pour faire des réparations.



AUTRES KITS DE D'ÉVACUATION

DK (kit de d'évacuation)

Quand la température ambiante tombe au-dessous de 37 °F (3 °C), l'eau restant dans le bassin du plateau est vidée dans le plateau du coffret des modèles WE et WY pour éviter le gel. **(REMARQUE** - Il est possible d'avoir un débordement quand les modèles WS, WE et WY sont utilisés en mode de refroidissement dans des climats très humides). Pour ces cas particuliers, un **kit de d'évacuation en option (accessoire n° DK)** est offert pour éliminer l'eau. Consulter les instructions d'installation complètes dans n° de pièce 920-038-00.

IDK (kit d' évacuation intérieur)

Les nouvelles constructions permettant l'installation de systèmes de purge de condensation dans les murs peuvent utiliser le kit d'évacuation intérieur de **Friedrich (accessoire n° IDK)** développé pour installation au bas d'enveloppe, sous l'ouverture du soufflet (modèles avec chauffage et refroidissement seulement). Consulter les instructions d'installation complètes dans n° de pièce 920-041-00.

Friedrich®

Garantie limitée - Climatiseurs Friedrich

GARANTIE LIMITÉE - PREMIÈRE ANNÉE

TOUTES LES PIÈCES - Si, dans les 12 mois suivant la date d'achat initial, une pièce fournie par FRIEDRICH est défectueuse à cause d'un défaut de main d'oeuvre ou de matériel, FRIEDRICH réparera le produit gratuitement, pourvu qu'il soit raisonnablement facile d'obtenir accès au climatiseur pour le réparer. Toute main d'oeuvre nécessaire pour déposer des appareils d'accès difficile et/ou les frais de déplacement (kilométrage) par le centre de réparation, au delà de 30 miles (45 km) dans une seule direction, sont la responsabilité du propriétaire. Ce remède est expressément accepté comme le seul remède dans les 12 mois suivant la date d'achat initial.

GARANTIE LIMITÉE - DEUXIÈME À CINQUIÈME ANNÉE

SYSTEME DE RÉFRIGÉRATION ÉTANCHE - Si le système de réfrigération étanche (dans le cadre de cette garantie, défini comme le compresseur, le serpentín de condenseur, le serpentín d'évaporateur, la vanne d'inversion, le clapet de non-retour, le tube capillaire, le filtre-déshydrateur et tous leurs tubes de raccordement) faisant partie du climatiseur FRIEDRICH est défectueux à cause d'un défaut de main d'oeuvre ou de matériel dans les 60 mois à compter de la date d'achat initial, FRIEDRICH remboursera les frais de main d'oeuvre et de pièces nécessaires pour réparer le système de réfrigération étanche. FRIEDRICH ne paiera pas pour les frais de diagnostic du problème, de dépose, de transport du climatiseur jusqu'au centre de réparation et de retour ni les frais de repose associés à la réparation du système de réfrigération étanche. Tous ces frais sont à la charge du propriétaire. Ce remède est expressément accepté comme le seul remède dans les 60 mois suivant la date d'achat initial.

GARANTIE DU SMART CENTER (pour les modèles qui en sont équipé) - Si le panneau de commande électronique est défectueux à cause d'un défaut de main d'oeuvre ou de matériel dans les 60 mois suivant de la date d'achat initial, FRIEDRICH remplacera cette pièce. FRIEDRICH ne paiera pas pour les frais de diagnostic du problème, de dépose ni de remplacement de la pièce. Il n'est pas nécessaire de déposer l'appareil pour remplacer cette pièce. Tous les frais de dépose, de transport et de repose sont à la charge exclusive du propriétaire.

CONDITIONS D'APPLICATION ET LIMITATIONS - Cette garantie s'applique à tous les appareils vendus au détail aux États-Unis, dans le District de Colombia et au Canada. Cette garantie ne s'applique pas :

- aux filtres à air ni aux fusibles ;
- aux produits dont le numéro de modèle et le numéro de série ont été enlevés ;

3. aux produits dont les défauts ou dégâts ont été causés par une mauvaise installation, un mauvais câblage, l'alimentation avec une mauvaise tension ou par un mauvais entretien ; ni causés par un accident, une mauvaise utilisation ou des abus, un incendie, des inondations, des modifications et/ou une mauvaise application du produit et/ou des appareils installés dans une atmosphère corrosive, problèmes ou délais de réparation causés par actes de guerre, des restrictions ou limitation par le gouvernement, des grèves, des manquements de matériel en dehors du contrôle de FRIEDRICH ou par des cas de force majeure.

OBTENTION DE RÉPARATION SOUS GARANTIE - Le service sera fourni par un distributeur agréé par FRIEDRICH ou un centre de réparation dans la région. Ils sont indiqués dans les Pages Jaunes. S'il faut de l'assistance pour obtenir des réparations sous garantie, écrire à Room Air Conditioner Service Manager, Friedrich Air Conditioning Co., P.O. Box 1540, San Antonio, Texas 78295-1540.

LIMITATIONS - CETTE GARANTIE A ÉTÉ DONNÉE EN REMPLACEMENT DE TOUTE AUTRE GARANTIE. Indépendamment de cette garantie, TOUTE GARANTIE SOUS-ENTENDUE D'APPLICATION POUR UN BUT PARTICULIER ET/OU DE VENDABILITÉ EST LIMITÉE À LA DURÉE DE LA GARANTIE EXPRESSE, LE FABRICANT SPÉCIFIQUEMENT DÉCLINE ET REFUSE TOUTE RESPONSABILITÉ POUR LES DOMMAGES INDIRECTS OU SECONDAIRES POUR INEXÉCUTION DE TOUTE GARANTIE EXPRESSE OU SOUS-ENTENDUE.

REMARQUE - Certaines provinces ne permettent pas les limitations sur la longueur de la garantie sous-entendue ou ne permettent pas la limitation ni l'exclusion des dommages indirects ou secondaires, il est donc possible que ces exclusions et limitations ne s'appliquent pas à un cas spécifique.

AUTRE - Cette garantie donne des droits spécifiques et il est possible que le propriétaire ait d'autres droits qui varient d'une province à l'autre.

PREUVE D'ACHAT - Le propriétaire doit fournir la preuve d'achat pour pouvoir recevoir des services sous garantie. Tous les appels pour expliquer le fonctionnement de ce produit sont à la charge du consommateur.

Toute réparation sous garantie doit être faite par un agent de réparation agréé par FRIEDRICH, sauf en cas d'autorisation préalable par FRIEDRICH.

En cas de question concernant les clauses de cette garantie, la version en anglais a priorité.

Friedrich désire que le climatiseur continue à vous satisfaire. Pour obtenir de l'assistance supplémentaire concernant cette garantie, contacter :

R.A.C. Customer Assurance
Friedrich Air Conditioning Co.
P.O. Box 1540
San Antonio, TX 78295-1540

Enregistrement de la garantie

ENREGISTREMENT DE LA GARANTIE - Remplissez et envoyez immédiatement cette carte d'enregistrement de garantie (pas ce formulaire) à Friedrich. Bien que ce ne soit pas obligatoire pour obtenir satisfaction sous garantie, elle enregistre la garantie, facilitant et accélérant la vérification de la période de garantie et pour nous permet de vous contacter pour vous informer en cas de réparation ou de rappel de produit.

POUR VOTRE DOSSIER - REMPLISSEZ LES RENSEIGNEMENTS SUIVANTS AU MOMENT DE L'INSTALLATION DE L'APPAREIL, POUR CONSULTATION ULTÉRIEURE.

N° de modèle _____ N° de série _____ Date d'installation _____

Acheté chez : _____
(nom du distributeur)

_____ (adresse du distributeur) _____ (personne à contacter)

_____ (n° de téléphone)

**IL FAUT TOUJOURS UTILISER DES PIÈCES D'ORIGINE
FRIEDRICH. L'UTILISATION DE PIÈCES D'UNE AUTRE SOURCE
PEUT ANNULER LA GARANTIE.**

Friedrich®

FRIEDRICH AIR CONDITIONING CO.
ROOM AIR CONDITIONING DIVISION P.O. BOX 1540 SAN ANTONIO, TX 78295-1540

APPENDIX B-10

MOTOR CONTROL CENTER (CUTLER HAMMER)

MCC General Information

MCC General Information

MCC Quantity 1
Standards UL845, NEMA, NEC
Special Codes UL
Service Voltage (3 Phase) 480V
Frequency 60 Hz
System 3PH4W

Incoming Line Termination

Device: HFD Main Bkr (150A trip), Lugs: 1-#4-4/0
Cable Entry Top
Splice Kit / Transition None
MCC Type Match Up
MCC Type Match Up GO# ** None **

Enclosure Specifications

Total Structures 2
Type NEMA 1 Gasketed
Depth 21" Front Mt Only
Height 90"
Horizontal Wireways 9" High, Top & Bottom
Vertical Wireways 4"
Channel Sills, No
Bottom Plates No
150 Watt Space Heaters None
Space Heater Thermostat No
Master Terminal Block Location None
Seismic Zone 3/4 Braces No

MCC Starter Specifications

Wiring Class 1B
Control Voltage 120V
Control Voltage Src Ind CPT
Nameplate Size 1" X 2.5"
Nameplate Color Black / White Letters
Overload Heater Packs Supplied
Pilot Dev. Model 10250T
Ind. Light Type 6v Xfmr
PL Color (On) Red

Bus System Specifications

Main Bus Amps 600A
Main Bus Material Copper
Main Bus Bar Plating Tin
Insulated Horiz. Bus No
1000A/sq in. Cu Bus No
Vertical Bus Amps See Structure Schedule
Vertical Bus Material Tin Plated Copper
Vertical Bus Barrier Isolated, Red
Bus Bracing 65,000
Ground Bus 300
Ground Bus Location Top
Ground Bus Lug Size 1-#6-350Kcmil
Ground Bus Lug Type Screw
Plug-in 300A Vert. Gnd. Bus No
Neutral Lug landing only
Neutral Bus Lug Location Incoming Line
Neutral Bus Lug Size 1-#6-350Kcmil
Neutral Bus Lug Type Screw
Horizontal Bus Temperature Rise 65 deg C
Bottom Vert. Bus Barrier No
Vertical Ground Bus No

Structure Schedule

There are 2 structure(s).
Structure(s) 2 have a 300 A Vertical Bus.
Structure(s) 1 have a 600 A Vertical Bus.

Total width of all sections is 40.0"
Height of all sections is 90.00"

Unit Modifications

Heater Packs Supplied
Wiremarkers at Each End
Terminal Block - Latching Pull-Apart, Std.
#16awg, MTW Control Wire

Gen. order # HBU 34768-001

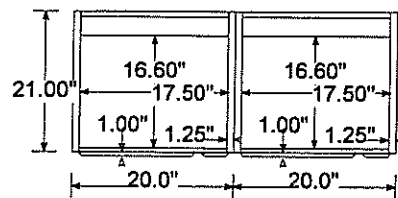
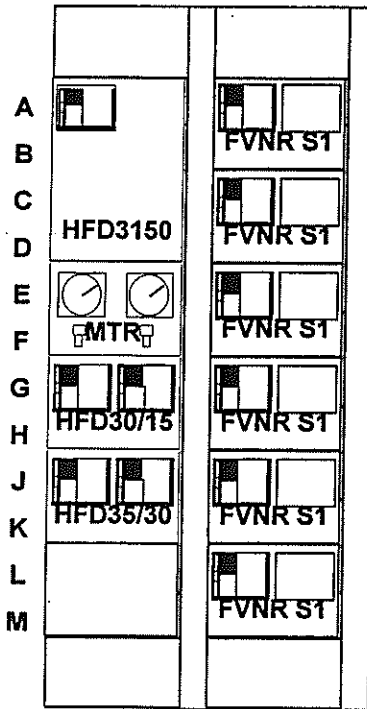
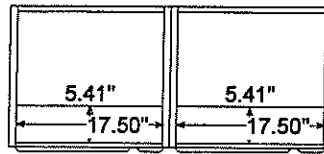
THE INFORMATION ON THIS DOCUMENT IS CREATED BY CUTLER HAMMER. IT IS DISCLOSED IN CONFIDENCE AND IT IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED.	PREPARED BY Weeg, Gregory A	DATE 07/10/01	Cutler Hammer		
	APPROVED BY	DATE	JOB NAME Pfohl Bros. Landfill MCC		
	VERSION 4.1		TYPE MCC 2100	DRAWING TYPE Final As Built	
	REVISION	DWG SIZE A	G.O. HBU34768	ITEM 001	SHEET 1 OF 6
NEG-ALT NUMBER BUIB05152101-0001					

Notes/Special Instructions

CT's to be 150:5 at metering
480/120 PT

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	Weeg, Gregory A		07/10/01			
	APPROVED BY		DATE		JOB NAME	
				Pfohl Bros. Landfill MCC		
		DESIGNATION				
VERSION		TYPE		DRAWING TYPE		
4.1		MCC 2100				
NEG-ALT NUMBER	REVISION	DWG SIZE	G.O.	ITEM	SHEET	
BUIB05152101-0001		A	HBU34768	001	2 OF 6	

Top View



Floor View

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	APPROVED BY		DATE			
					DESIGNATION	
	VERSION 4.1		TYPE MCC 2100		DRAWING TYPE	
NEG-ALT NUMBER BUIB05152101-0001	REVISION	DWG SIZE A	G.O. HBU34768	ITEM 001	SHEET 3 OF 6	

Unit	Nameplate	Description	Class	Starter Size HP/FLA Wire Diag.	Bkr/Sw Poles Trip/Clip	Unit Features
1FD	150A MAIN CIRCUIT BREAKER SERVICE ENTRANCE	HFD Main Bkr (150A trip), Lugs: 1-#4-4/ -#4-4/0		WD-1	HFD 3P 150	1 Service Entrance Label
1FF	METERING	Amm, Vm, and Switche s		WD-2		
1FHL	SPD	HFD Twin Bkr (30A/15 A trip)		5599A85	HFD 3P 30	
1FHR	UNIT HEATER 7.5 KW	HFD Twin Bkr (30A/15 A trip)		5599A85	HFD 3P 15	
1FKL	LIGHTING TRANSFORMER 10 KVA	HFD Twin Bkr (35A/30 A trip)		5599A85	HFD 3P 35	
1FKR	SPARE	HFD Twin Bkr (35A/30 A trip)		5599A85	HFD 3P 30	
1FM		12" Door				

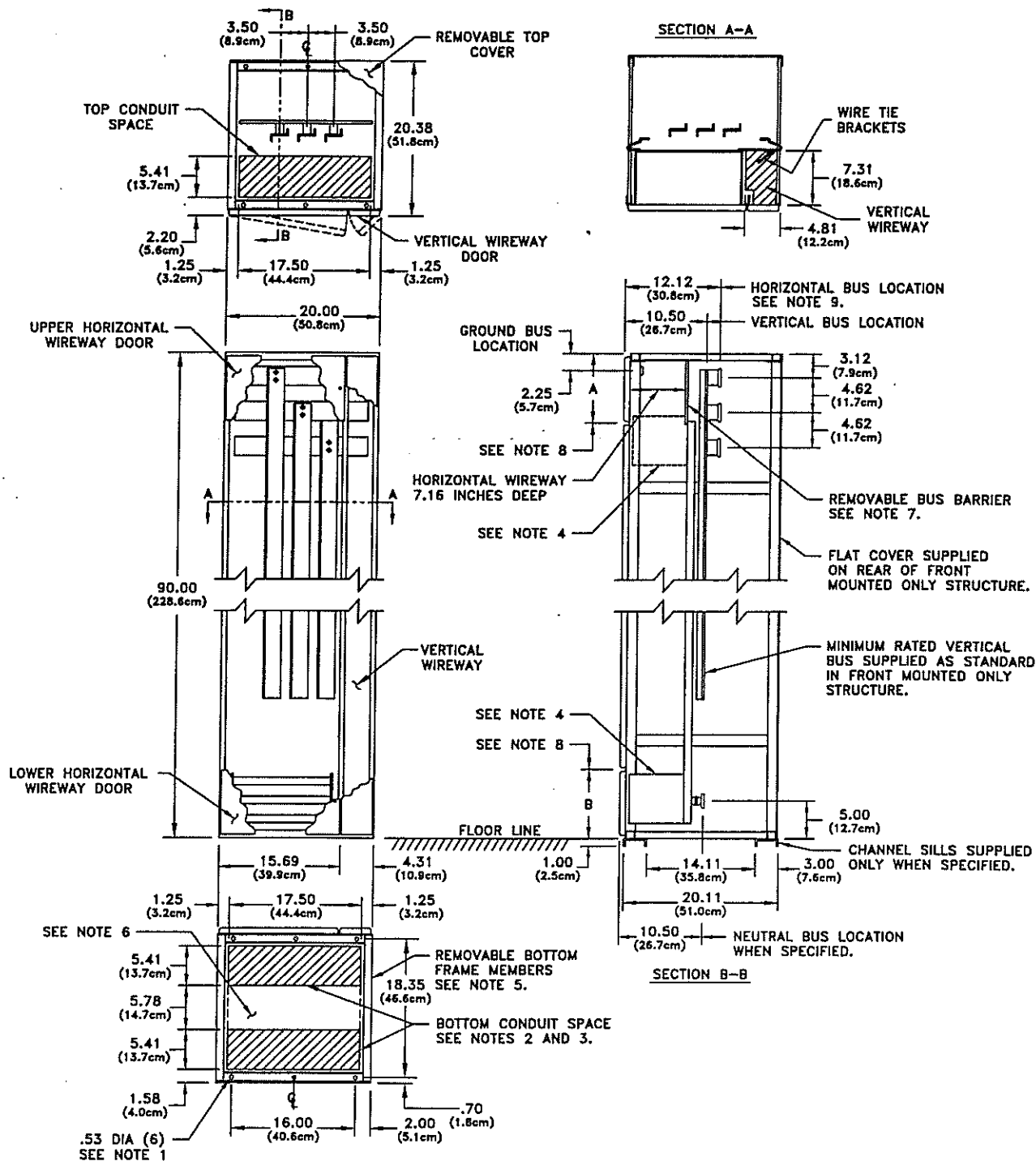
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	APPROVED BY	DATE	JOB NAME Pfohl Bros. Landfill MCC DESIGNATION		
	VERSION 4.1		TYPE MCC 2100		DRAWING TYPE
NEG-ALT NUMBER BUIB05152101-0001	REVISION	DWG SIZE A	G.O. HBU34768	ITEM 001	SHEET 4 OF 6

Unit	Nameplate	Description	Class	Starter Size HP/FLA Wire Diag.	Bkr/Sw Poles Trip/Clip	Unit Features
2FB	WET WELL "WW1" PUMP	FVNR Starter Size 1 HMCP	F206	1 0.75 WD-3	HMCP 3P 3	1 100VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 1-4 2 N.O. Starter Aux Contacts, Size 1-4 1 Pilot Light-10250T (Run) 1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)
2FD	WET WELL "WW2" PUMP	FVNR Starter Size 1 HMCP	F206	1 0.75 WD-3	HMCP 3P 3	1 100VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 1-4 2 N.O. Starter Aux Contacts, Size 1-4 1 Pilot Light-10250T (Run) 1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)
2FF	WET WELL "WW3" PUMP	FVNR Starter Size 1 HMCP	F206	1 1.5 WD-3	HMCP 3P 7	1 100VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 1-4 2 N.O. Starter Aux Contacts, Size 1-4 1 Pilot Light-10250T (Run) 1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)
2FH	WET WELL "WW4" PUMP	FVNR Starter Size 1 HMCP	F206	1 1.5 WD-3	HMCP 3P 7	1 100VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 1-4 2 N.O. Starter Aux Contacts, Size 1-4 1 Pilot Light-10250T (Run) 1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)
2FK	WET WELL "WW5" PUMP	FVNR Starter Size 1 HMCP	F206	1 0.75 WD-3	HMCP 3P 3	1 100VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 1-4 2 N.O. Starter Aux Contacts, Size 1-4 1 Pilot Light-10250T (Run) 1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)

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	APPROVED BY		DATE		JOB NAME Pfohl Bros. Landfill MCC	
	VERSION 4.1		TYPE MCC 2100		DRAWING TYPE	
NEG-ALT NUMBER RUIB05152101-0001	REVISION	DWG SIZE A	G.O. HBU34768		ITEM 001	SHEET 5 OF 6

Unit	Nameplate	Description	Class	Starter Size HP/FLA Wire Diag.	Bkr/Sw Poles Trip/Clip	Unit Features
2FM	WET WELL "WW6" PUMP	FVNR Starter Size 1 HMCP	F206	1 1.5 WD-3	HMCP 3P 7	1 100VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 1-4 2 N.O. Starter Aux Contacts, Size 1-4 1 Pilot Light-10250T (Run) 1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)

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	VERSION 4.1		TYPE MCC 2100		DRAWING TYPE	
NEG-ALT NUMBER BUIB05152101-0001	REVISION	DWG SIZE A	G.O. HBU34768		ITEM 001	SHEET 6 OF 6



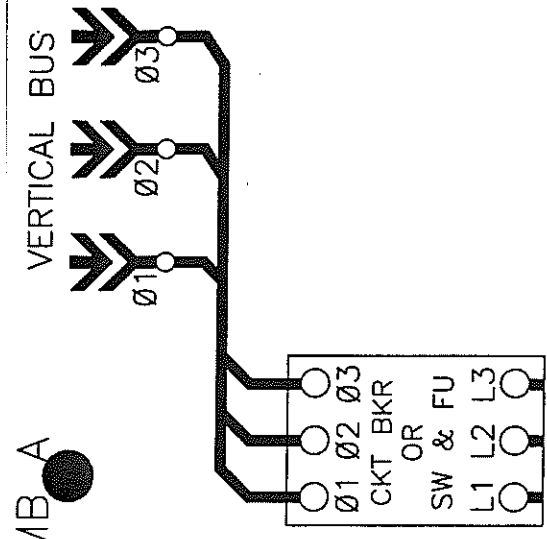
STANDARD VERTICAL SECTION
20 INCHES WIDE WITH 4 INCH WIREWAY
21 INCHES DEEP
FRONT MOUNTED ONLY

Cutler-Hammer E.T.N
FREEDOM 2100/ADVANTAGE
MOTOR CONTROL CENTER

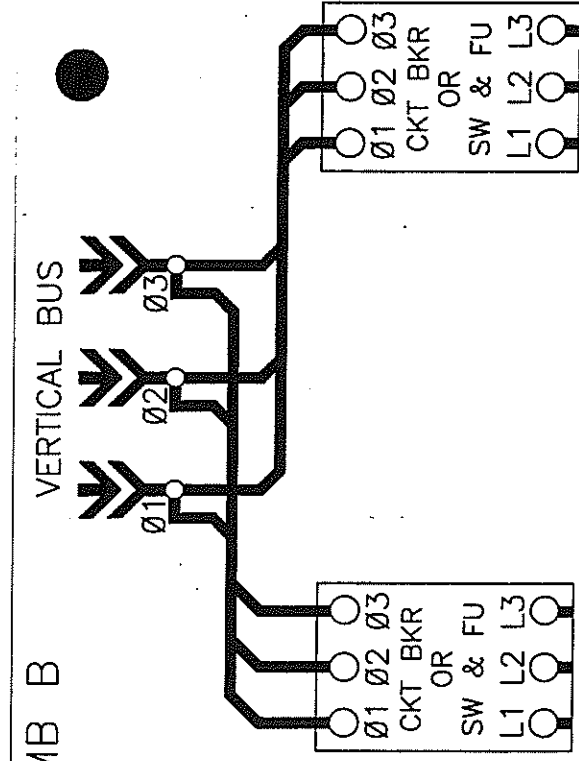
REV
C

4710A31

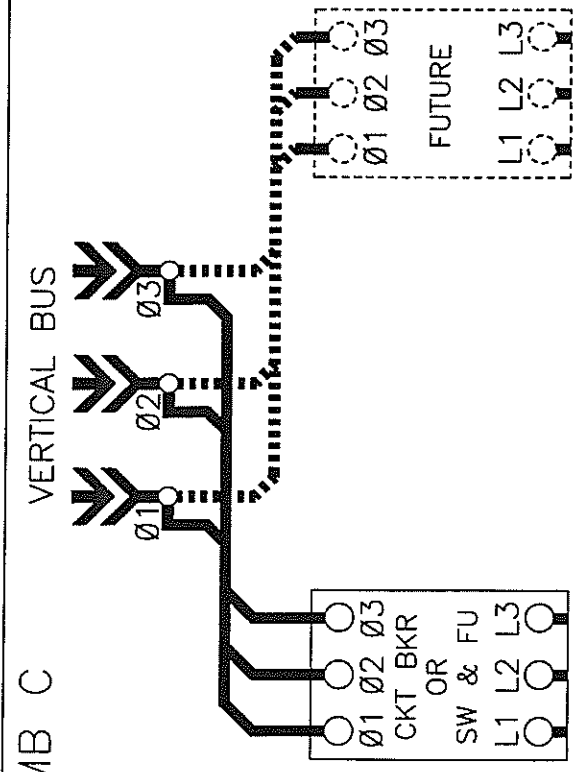
COMB A



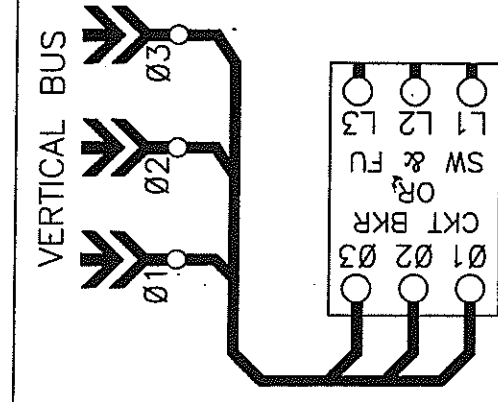
COMB B



COMB C



COMB D

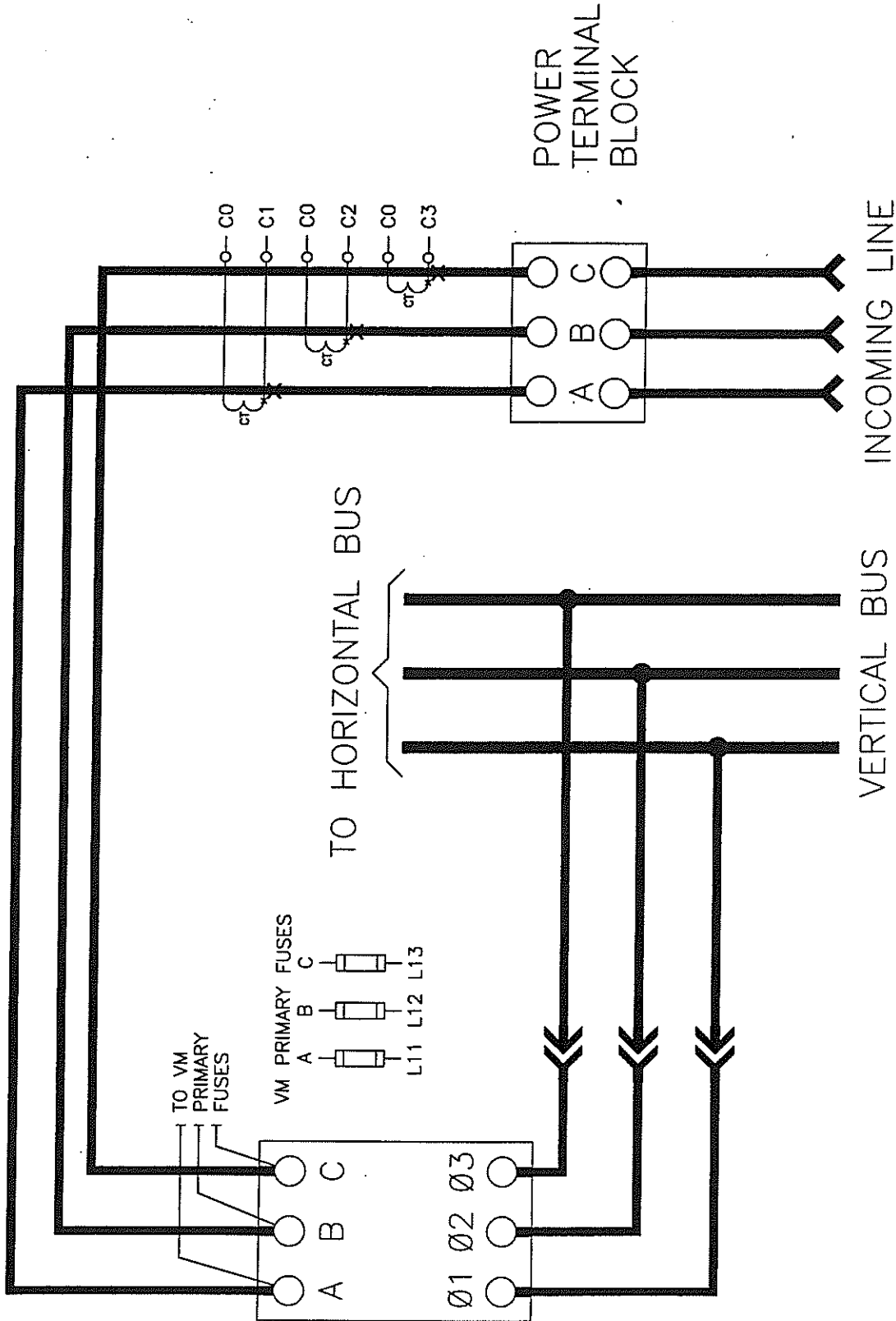


MOTOR CONTROL CENTER STANDARD UNIT WIRING DIAGRAM

- COMBINATION A: SINGLE BREAKER OR SWITCH & FUSE 3 POLE
- COMBINATION B: DUAL BREAKERS OR SWITCH & FUSE 3 POLE
- COMBINATION C: SINGLE BREAKER OR SWITCH & FUSE 3 POLE WITH FUTURE SPACE
- COMBINATION D: SINGLE BREAKER OR SWITCH & FUSE 3 POLE (UNIT).

Cutler-Hammer

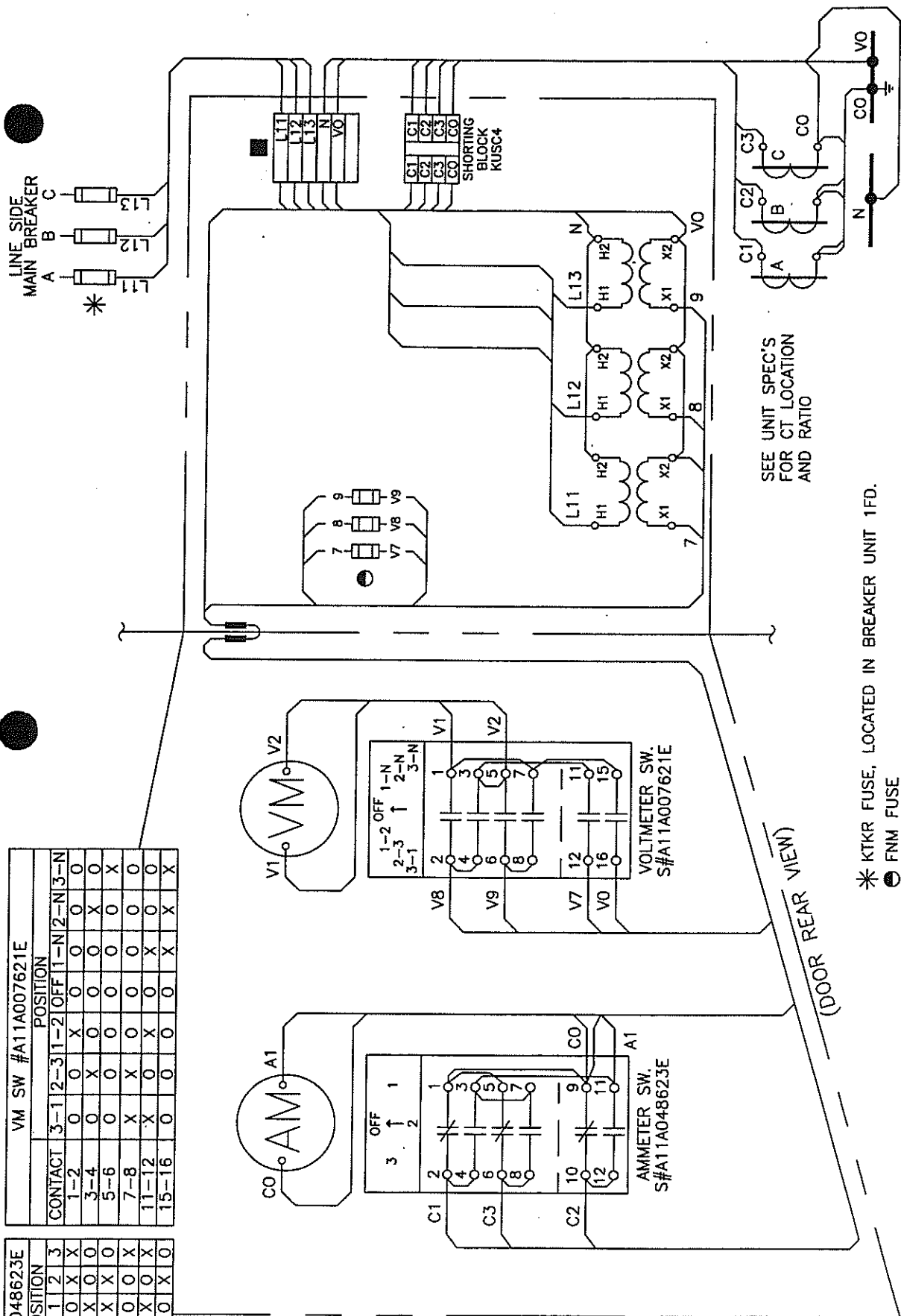
REV	F	DRAWING NUMBER	5599A85	CC
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1		REVISION													
THE INFORMATION ON THIS DOCUMENT IS CREATED BY CUTLER-HAMMER. IT IS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED				DCTR R.M. TORRES		DATE 7/09/01		Cutler-Hammer			WINDSOR, CT				
				APPO		DATE		TITLE MAIN CB WITH CT'S							
				APPO		DATE		TYPE FREEDOM 2100			CONNECTION				
				REVISION 2		DWG SIZE A		G.O. HBU34768			DWG WD-1		SHEET 1 OF 1		
				FEDERAL ID NO		PRODUCT CODE CF									
FILE: WD-1															

AM SW #A048623E		POSITION	
CONTACT	OFF	1	2
1-2	X	O	X
3-4	O	X	O
5-6	X	X	O
7-8	O	O	X
9-10	X	X	O
11-12	O	O	X

VM SW #A11A007621E		POSITION	
CONTACT	3-1	2-3	1-2
1-2	O	O	X
3-4	O	X	O
5-6	O	O	O
7-8	X	X	O
9-10	X	O	X
11-12	O	O	X
13-14	O	O	X
15-16	O	O	X



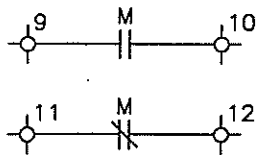
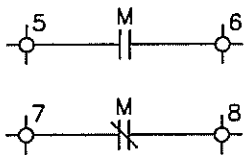
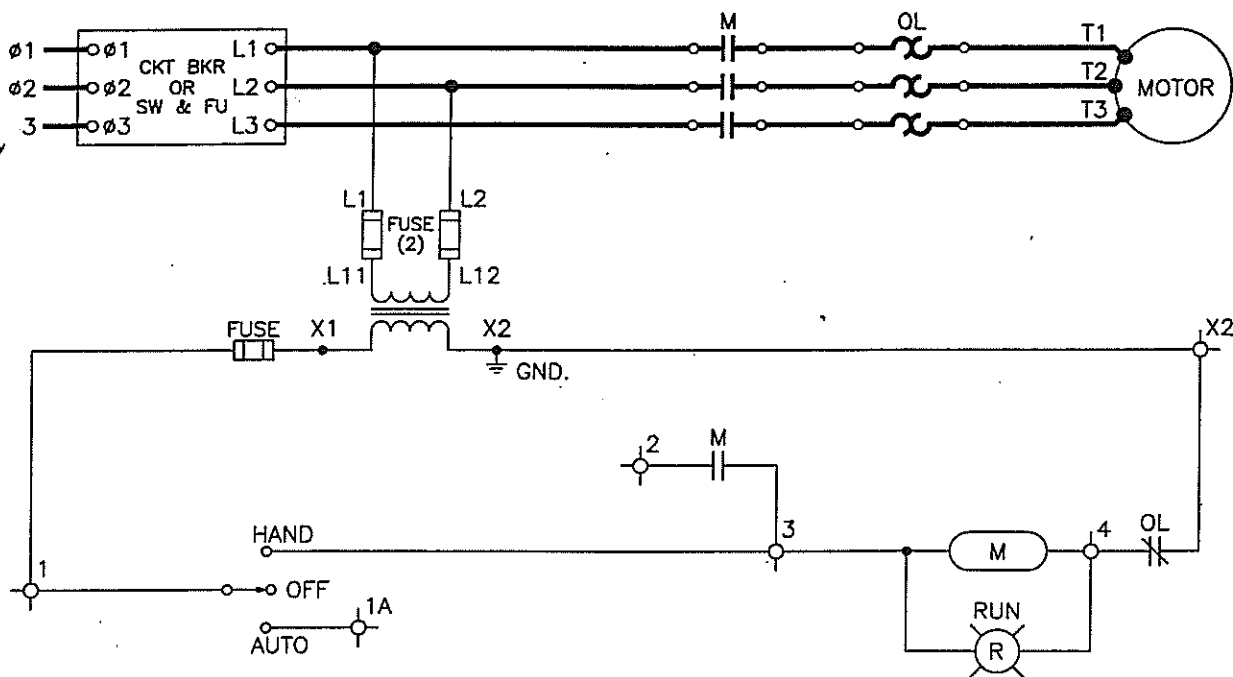
* KTRR FUSE, LOCATED IN BREAKER UNIT 1FD.

● FNM FUSE

■ ONLY USE FIXED MOUNTED TERMINAL BLOCKS (NOT PULL APART)

SEE UNIT SPEC'S
FOR CT LOCATION
AND RATIO

REVISION		8/8/01	Revised PT	use wiring.
1	2			
THE INFORMATION ON THIS DOCUMENT IS CREATED BY CUTLER-HAMMER. IT IS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED.				
FEDERAL ID NO	PRODUCT CODE	CF	REVISION	2
DWG	DWG SIZE	A	G.O.	HBU34768
CONNECTION	TYPE	FREEDOM 2100	TITLE	AM VM & SWITCH
WINDSOR, CT	CUTLER-HAMMER	DATE	7/09/01	DTR
1 OF 1	WD-1	DATE		R.M. TORRES



X2
1
2
3
4
5
6
7
8
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10
11
12

1	REVISION	7/17/01	Nbrs. Revised Term.		THE INFORMATION ON THIS DOCUMENT IS CREATED BY CUTLER-HAMMER. IT IS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED	FEDERAL ID NO	PRODUCT CODE CF	REVISION	2	DWG SIZE	A	G.O.	HBU34768	DWG	WD-3	SHEET	1 OF 1
								APPD		DATE		TYPE	FREEDOM 2100		SCHEMATIC		
								APPD		DATE		TITLE	FVNR STARTER				
								DFTF	R.M.TORRES	DATE	7/10/01	Cutler-Hammer		WINDSOR, CT			

WINDSOR, CT

Cutler-Hammer

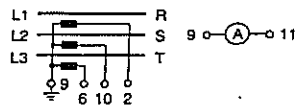
DATE 7/10/01

DTR R.M. TORRES

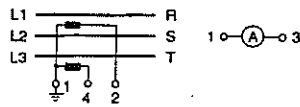
REVISION 1

Ammeter Switches:

A048 1pole



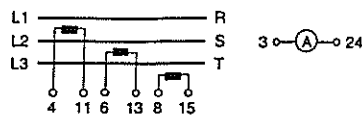
A021 1pole



A019 2pole

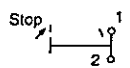


A038 2pole



Control Switches:

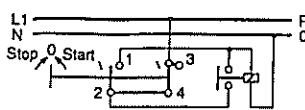
A174



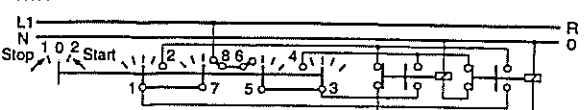
A175



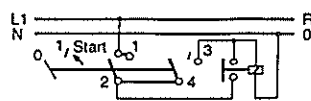
A176



A177

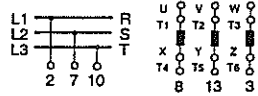


A178

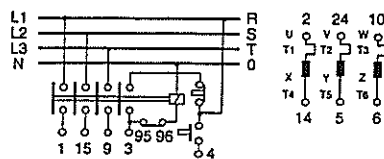


Star- Delta Switches:

A410

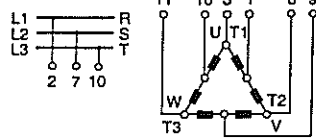


A416

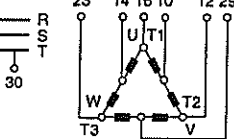


Motor Control Switches:

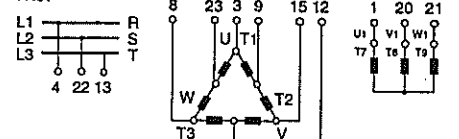
A440



A442

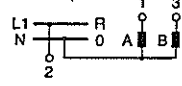


A457

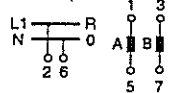


General Application Switches:

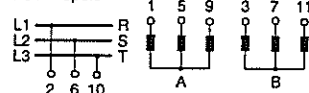
A310 1pole



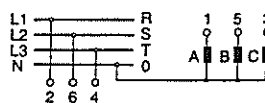
A312 2pole



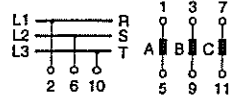
A314 3pole



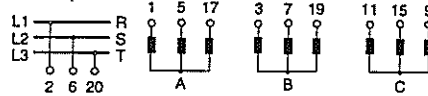
A311 1pole



A313 2pole

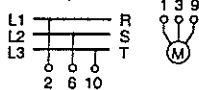


A315 3pole



Motor Reversing Switches:

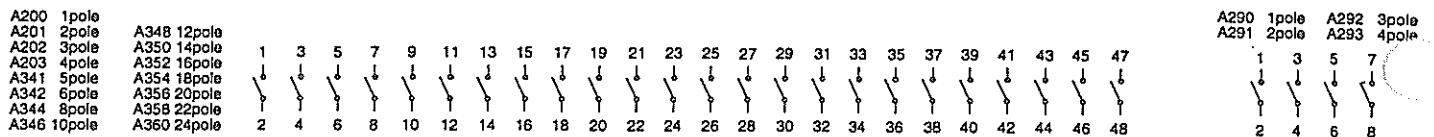
A401 3pole



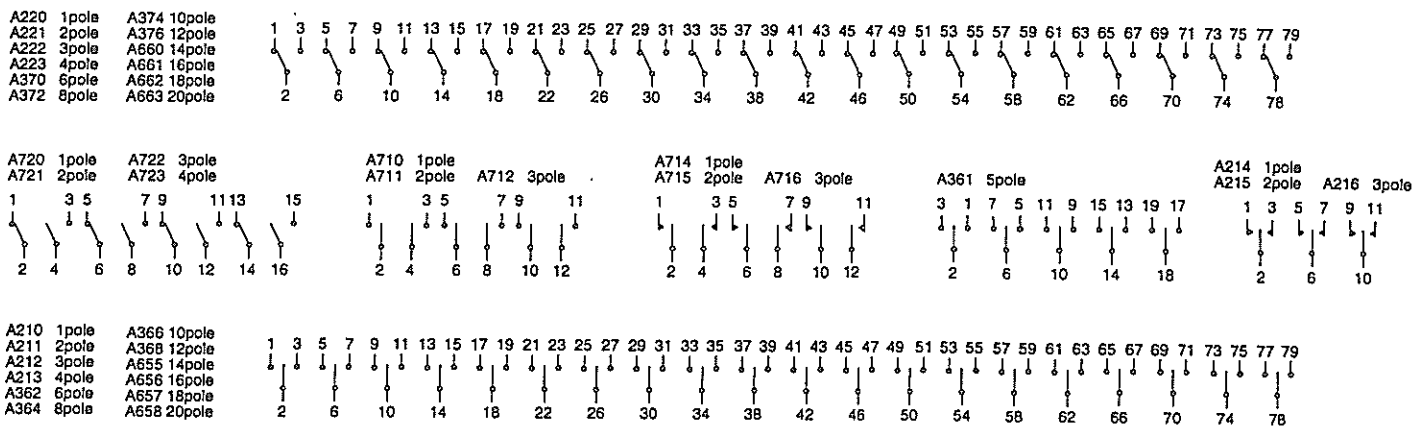
Technical Data according to UL and CSA Specifications			Ratings according to UL			Ratings according to CSA		
			A11 A11C	A14 A14C	A30	A11 A11C	A14 A14C	A30
Rated Voltage		V A.C.	600	600	600	600	600	600
Ampere Rating		A	10	16	25	10	16	32
Standard motor load - DOL-Rating: 3phase - 3pole	110V - 120V	HP	1	1,5	3	1	1,5	4,5
	220V - 240V	HP	1	3	7,5	2	3,3	7,5
	440V - 480V	HP	1	7,5	15	5	7,5	18
	550V - 600V	HP	1	10	20	5	10	25
	1phase - 2pole	HP	0,5	0,75	2	0,5	0,6	2,3
	110V - 120V	HP	1	1,5	3	1	1,5	4,5
	220V - 240V	HP	1	3	7,5	1,5	2	-
	277V	HP	1	3	7,5	3	3,4	9
	440V - 480V	HP	1	5	10	3	-	-
	550V - 600V	HP	1	-	-	-	-	-
Pilot Duty	Heavy	-	A600	A600	A600	A600	A600	-
Type of wire		-	use copper wire only / utilisez conducteurs en cuivre					
Temperature rating of wire		°C	60/75	-	-	-	-	-
Torque value for field wiring terminals		lb-in. Nm	7 0,8	-	-	-	-	-

Nominal Voltage		1V	6V	12V	24V	48V	110V	220V	380V	440V	550V	600V	Nominal Voltage		1V	6V	12V	24V	48V	110V	220V	380V	440V	550V	600V
AD11	A A.C.	6	3	2	1	0,8	0,4	0,2	0,13	0,1	0,08	0,05	AD12	A A.C.	-	6	5	3	2	1,3	1	0,8	0,5		
	A D.C.	4	2,5	1,5	0,8	0,3	0,2	0,1	0,06	0,05	0,03	0,02		A D.C.	-	4	3	2,2	1,2	0,6	0,3	0,2	0,15	0,1	0,1

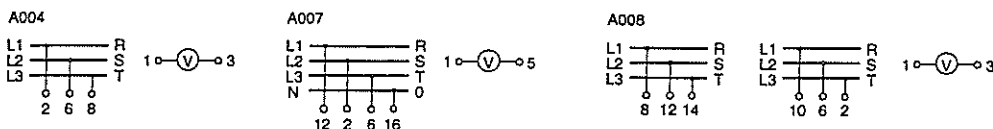
ON/OFF Switches:



Double-throw Switches:



Voltmeter Switches:



MOUNTING INSTRUCTION SWITCH SIZE S1

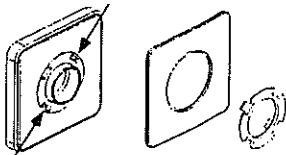
KRAUS & NAIMER Φ

MOUNTING OF ESCUTCHEON PLATE:

Mountings:
EA, EA-V, ECA, EC1A,
EDA, ED1A, EFA, EFA-V,
EGA, ERA, KD1A, KN1A,
VEA, VEA-V, VE1A

val:
means of a screw driver

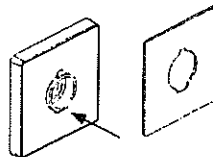
Mounting:
Insert escutcheon plate,
Snap on fixation ring



Mountings:
E, E-V, EC, EC1, ED, ED1,
EF, EF-V, EG, ER, KD1,
KN1, VE, VE-V, VE1

Removal:
By means of a screw driver

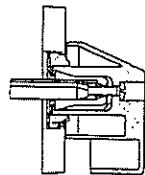
Mounting:
Snap on by pressing



MOUNTING OF HANDLE:

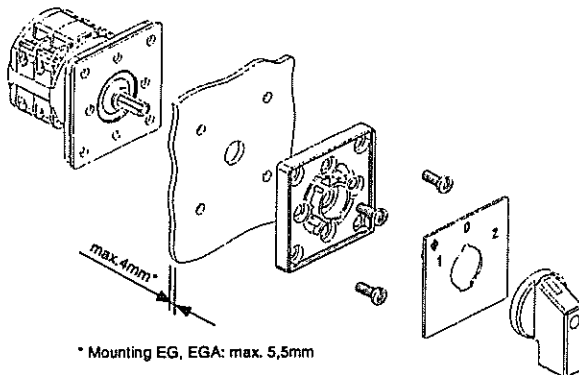
Removal:
Loosen the screw,
pull off handle

Mounting:
Loosen the screw and
push it into the handle,
slip the handle onto the
shaft, fasten the screw



MOUNTINGS:

E, EA, E-V, EA-V, EF, EFA, EF-V, EFA-V,
EG, EGA, KD1, KD1A, KN1, KN1A:



EC, ECA, EC1, EC1A, ED, EDA, ED1, ED1A:

Mounting onto control panel as shown for mounting E
(max. control panel thickness EC, ECA: A-switches: 5,5mm
ED, EDA: CA10B-switches: 2mm
A-, C32-, C42-switches: 7,5mm)

ing of protective cover:

EC, ECA, ED, EDA: Slip on the protective cover from the rear.

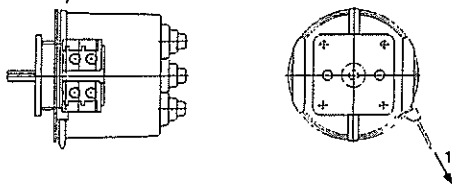
EC1, EC1A, ED1, ED1A: Slip on the protective cover from the rear and
fix it by means of a cable wrapper (1) (see picture).

Protection of the protective cover:

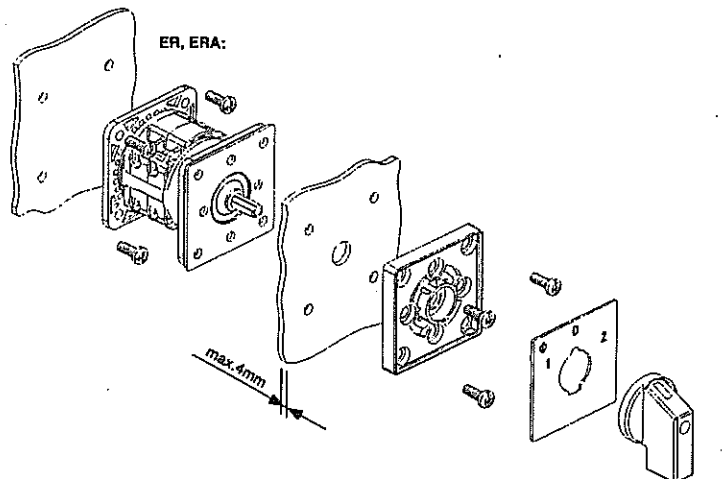
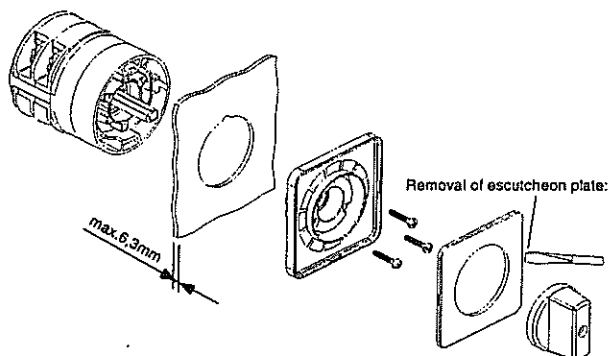
EC, ECA, ED, EDA: IP30: CA-, CG-, D-switches

IP42: C-, A-switches

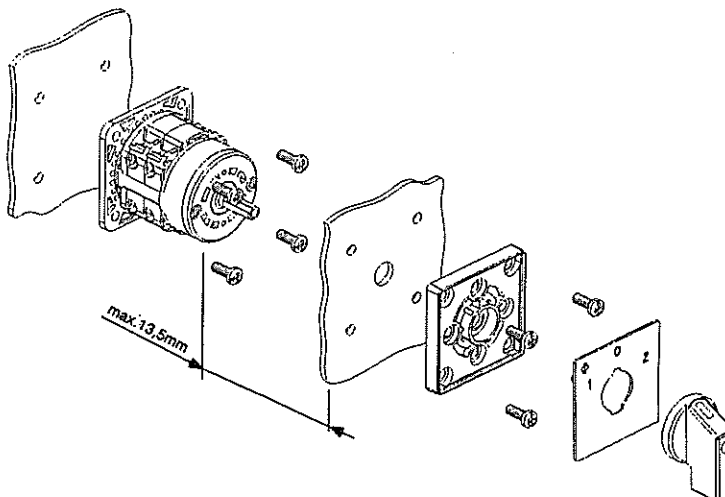
EC1, EC1A, ED1, ED1A: IP42



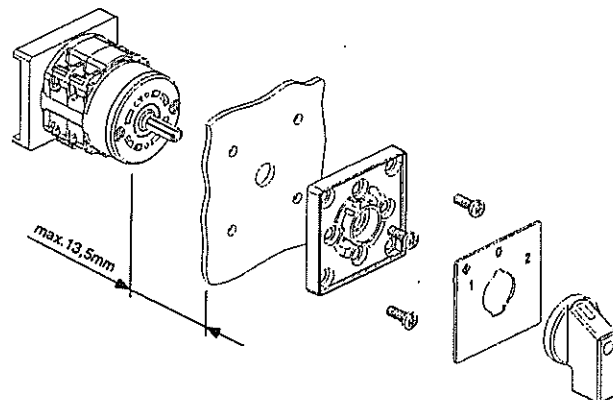
EL1, EL2, EL4:



VE, VEA, VE-V, VEA-V:



VE1, VE1A:



MOUNTING DIMENSIONS mm:

PANEL MOUNTING:

Single hole mounting:

Mounting	EL1	EL2	EL4
Protection ¹	IP40	IP40	IP40
Drilling plan	B	B	B

1. Control panel sided

Two or four hole mounting:

Mounting	E, EA	E-V EA-V	EC ECA	EC1 EC1A	ED EDA	ED1 ED1A	EF	EF-V	EFA	EFA-V	EG EGA	EGF	ER, ERA	ERF	KD1 KD1A	KN1 KN1A
Protection ¹	IP40	IP40	IP40	IP40	IP65	IP65	IP65	IP65	IP65	IP65	IP40	IP65	IP40	IP65	IP40	IP40
Drilling plan	A	A	A	A	A	A	A	A	A	A	A	A	R	A	R	A
E	10-15	10-15	10-15 ²	10-15	22 ³	19-22	19-22	19-22	22-25	22-25	13-17	26-30	10-15	19-22	10-15	10-15
F	48	48	48 ⁴	48	48 ⁴	48	48	48	48	48	68	68	48	48 ⁵	48	48

1. Control panel sided

2. For A-, C32- and C42-switches : 13-15mm

3. For A-, C32- and C42-switches : 28-33mm

4. For A-, C32- and C42-switches : 68mm

5. For C42-switches : 68mm

BASE MOUNTING:

Mounting	VE, VE-V VEA, VEA-V	VE1 VE1A
Protection ¹	IP40	IP40
Drilling plan	A	A
E	10-15	10-15
F	48	48

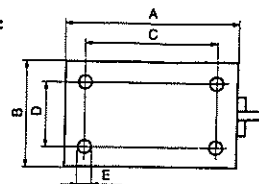
1. Control panel sided

2. For C42 switches: 68mm

GK CAST ALUMINIUM ENCLOSURE:

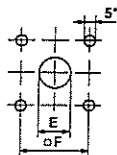
Protection: IP65

A	B	C	D	E
100	100	66	86	4,8
140	140	93	120	7,0
200	140	180	93	7,0

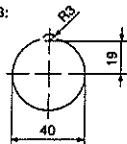


Drilling plan control panel:

A:



B:

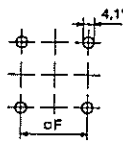


¹ - Mounting EG, EGA: ø6mm

² - A-, C32- and C42-switches mounting EC, ECA, ED, EDA: ø6mm

Hole dimensions of the base mounting plate:

R:



¹ C42-switches: ø5,4mm

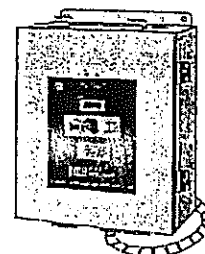
APPENDIX B-11

SURGE PROTECTOR (MAIN POWER SUPPLY)



SurgeFree 120M & 160M

Installation Instructions



1. Confirm Model with Power Service.

Measure Ø-N, Ø-Ø, with voltmeter to confirm application voltage prior to installation.

Model	Power Service	Description	Wiring Diagram
120M-120T	120/240 VAC	1 ph, 3w + gnd	1
120M-120Y	120/208 VAC	3 ph, 4w + gnd, Wye	2
120M-220Y	220/380 VAC	3 ph, 4w + gnd, Wye	2
120M-240Y	240/415 VAC	3 ph, 4w + gnd, Wye	2
120M-240DCT	240/120/120 VAC	3 ph, 4w + gnd, High-leg Delta	3
120M-277Y	277/480 VAC	3 ph, 4w + gnd, Wye	2
120M-347Y	347/600 VAC	3 ph, 4w + gnd, Wye	2
120M-240D	240 VAC	3 ph, 3w + gnd, Delta	4
120M-480D	480 VAC	3 ph, 3w + gnd, Delta	4
120M-600D	600 VAC	3 ph, 3w + gnd, Delta	4
160M-120T	120/240 VAC	1 ph, 3w + gnd	1
160M-120Y	120/208 VAC	3 ph, 4w + gnd, Wye	2
160M-220Y	220/380 VAC	3 ph, 4w + gnd, Wye	2
160M-240Y	240/415 VAC	3 ph, 4w + gnd, Wye	2
160M-240DCT	240/120/120 VAC	3 ph, 4w + gnd, High-leg Delta	3
160M-277Y	277/480 VAC	3 ph, 4w + gnd, Wye	2
160M-347Y	347/600 VAC	3 ph, 4w + gnd, Wye	2
160M-240D	240 VAC	3 ph, 3w + gnd, Delta	4
160M-480D	480 VAC	3 ph, 3w + gnd, Delta	4
160M-600D	600 VAC	3 ph, 3w + gnd, Delta	4

MCG SURGE PROTECTION

12 Burt Drive, Deer Park, New York 11729 USA

<http://www.mcgsurge.com>

Phone: 1-631-586-5125 Fax: 1-631-586-5120

Toll Free: 1-800-851-1508

Info@mcgsurge.com

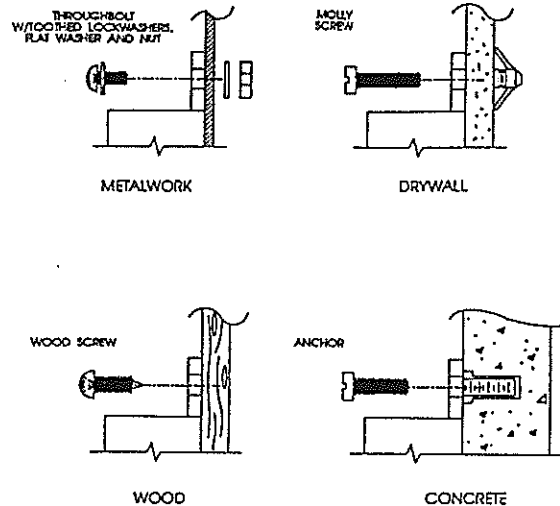
● Disconnect Power before Installation.

All wiring to be done in accordance with National Electric Code and local codes by qualified electricians.

0

3. Mounting.

For best performance, mount protector as close to service panel as possible. Secure unit to mounting surface. Use proper fasteners as indicated. (Fasteners not supplied.)



4. Wiring

The protector is factory supplied with power cable installed. Cut back power cable as short as possible for best performance. **Electrician Note:** connect cable to service panel as shown. Refer to wiring diagrams 1-4.

4A. Wiring Diagrams.

Fig.1

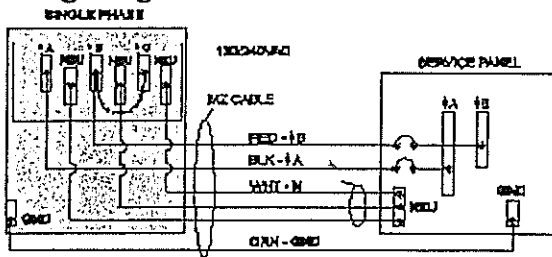


Fig.3

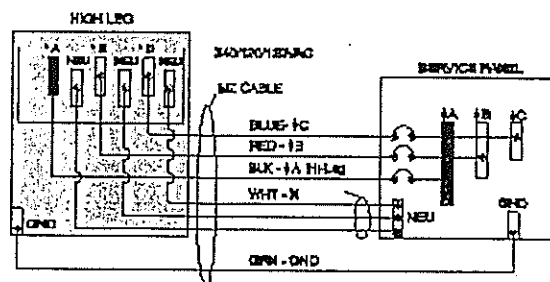


Fig.2

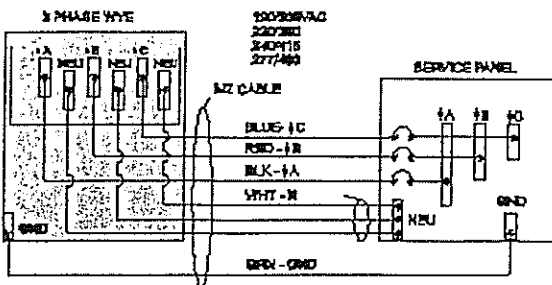
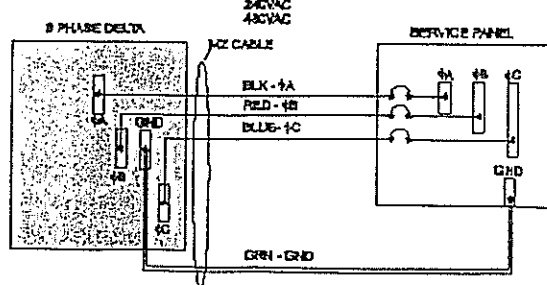


Fig.4



MCG SURGE PROTECTION

12 Burt Drive, Deer Park, New York 11729 USA

<http://www.mcgsurge.com>

Phone: 1-631-586-5125 Fax: 1-631-586-5120

Toll Free: 1-800-851-1508

Info@mcgsurge.com

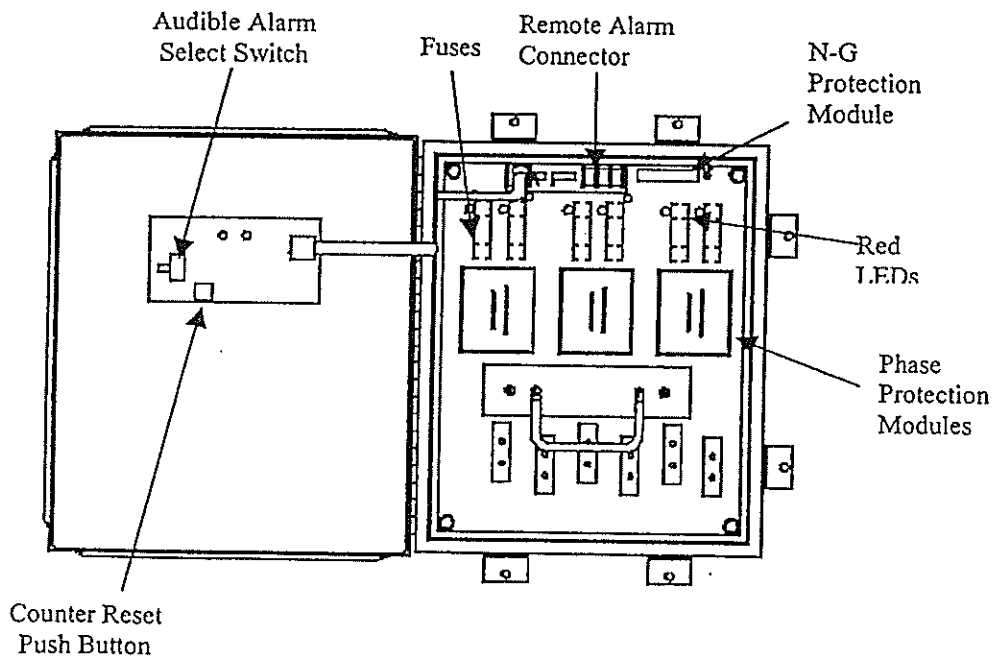
Recommended Circuit Breaker Size

#12 AWG	20 Amp
#10 AWG	30 Amp
#8 AWG	30 Amp
#6 AWG	55 Amp

5. Diagnostics & Troubleshooting

When the red "Protection Reduced" light is lit...

- o Open door.
- o Locate red lights indicating modules and fuses needing to be replaced.
- o Remove four thumbscrews from dead front.
- o Pull handle to remove switch assembly.
- * CAUTION - After switch assembly is removed, power still exists at terminals below barrier.
- o Front panel lights will extinguish.
- o Replace appropriate modules and fuses.
- o Reinstall switch assembly and thumbscrews.
- o Close and secure door.
- o Green light on, red light off, full protection restored.
- o Consult factory for assistance: 1-800-851-1508.



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Toll Free: 1-800-851-1508

Info@mcgsurge.com

Remote Alarm Wiring Option

When desired, a 3-wire remote monitoring cable can be connected to the remote alarm relay connector located within the enclosure. The relay deactivates when any section of the surge suppression modules requires replacement or when power is removed from the suppressor. This can also be used as a power failure alarm.

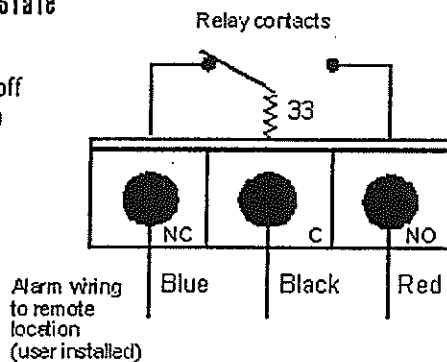
The center terminal is common. The outer two terminals provide a normally closed or normally open contact (when deactivated). The relay is activated during normal operation. SAD's provide surge protection for alarm relay.

Do not exceed alarm relay contact ratings:

Maximum load 100 mA.
Max. switching voltage 100VDC or 130VAC

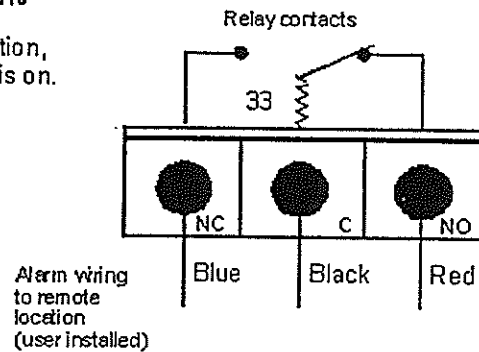
Deactivated State

Unit failure or
power to unit off
(power failure)

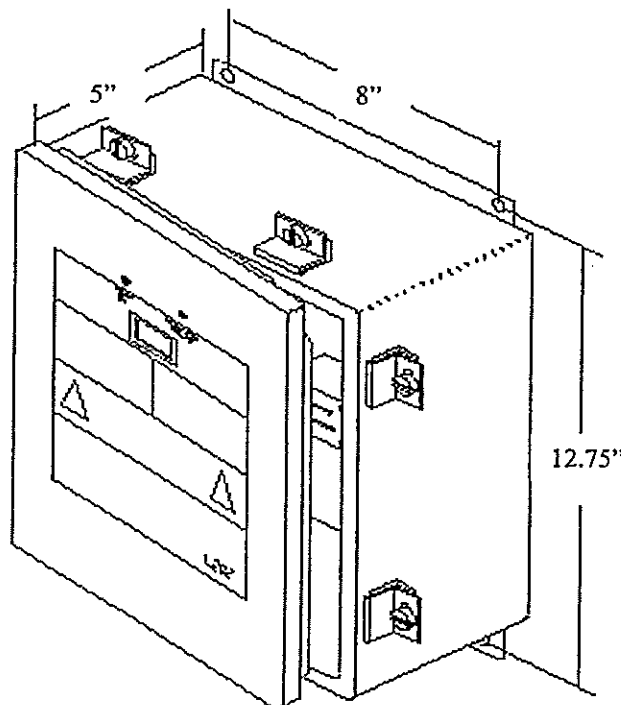


Activated State

Normal operation,
power to unit is on.



7. Mounting Specifications



MCG SURGE PROTECTION

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Toll Free: 1-800-851-1508

Info@mcgsurge.com

APPENDIX B-12

ELECTRICAL PREVENTATIVE MAINTENANCE

PFOHL BROTHERS LANDFILL
ELECTRICAL PREVENTIVE MAINTENANCE PROGRAM

Index

1. Introduction
2. General Requirements
3. Electrical System Overview
4. 480V Motor control Center
5. Transient Voltage Surge Suppressor
6. Lighting Transformer
7. Lighting Panelboards
8. Lighting
9. Electrical Heat Tracing
10. Wiring
11. Grounding

1. Introduction

This document presents the Electrical Preventive Maintenance Program for the Pfohl Brothers Landfill Site. The program is prepared in accordance with the guidelines of NFPA 70B, Recommended Practice for Electrical Equipment Maintenance. The program enhances the site's electrical operational safety and ensures reliable electrical equipment operation by reducing equipment failure to a minimum.

2. General Requirements

The program shall be performed, in a planned and safe manner, by qualified and trained personnel only.

During the program execution, all required equipment de-energizing and lock-out procedures, temporary grounding means, protective barricades and safety guards must be provided, and all required warning signs posted.

The program shall be carried out in the time allocated for the process equipment maintenance shutdown.

On completion, all inspection/test forms (filled-in, signed and dated) shall be filed in the maintenance program dossier.

3. Electrical System Overview

The site's incoming power service is a 480V, 3-phase, 60Hz solidly grounded neutral system. The service is being supplied by NYSEG via overhead line.

The site power distribution is achieved through a use of a simple radial distribution network as shown on the site's one-line diagram.

The site electrical power distribution equipment and systems consist of a 480V motor control center (MCC), transient voltage surge suppressing device, a lighting transformer supplying power to a distribution panelboard, building lighting, electrical heat tracing, interconnecting wiring and grounding.

4. 480V Motor Control Center

The 480 V MCC is a Cutler-Hammer, two section line-up assembly housing the site's power service main circuit breaker, main metering, motor control combination starters and feeder circuit breakers.

The MCC supplies 480V power to the site's six wet well pump motors, lighting transformer and building electrical unit heater.

The MCC main metering consists of a panel type voltmeter and ammeter. Both meters are indicating type metering devices provided to assist the site operator with the everyday operation and the system electrical troubleshooting. The MCC voltmeter is connected to the incoming service line on the line side of the main circuit breaker (MCB). This allows the operator to prove that the service line is energized before closing the MCB.

Each MCC starter is equipped with a motor circuit protector, 100VA control power transformer, motor contactor and overloads, "hand-off- auto" selector switch and a motor red running light. The motor overloads are Class 20 overload heater packs, selected on the motor full load amps (FLA) basis.

The MCC feeder circuit breakers are molded-case bolt -on type breakers.

Both, the motor and feeder circuit breaker operating handles have lock out provisions to ensure implementation of the site "lock and tag" safety procedures.

To properly maintain the MCC, the plant operation personnel shall follow the MCC manufacturer recommended maintenance procedures. The following tasks shall be a minimum requirement:

Annually:

- Inspect MCC's enclosure for clean appearance and hardware tightness.
- Test operation of MCC main metering to prove it is functioning properly.
- Test operation of each MCC circuit breaker manually (this will help keep the breaker contacts clean).
- With the MCC's main circuit breaker open and locked out, inspect each inside compartment of the MCC for loose hardware; tighten as required. Thoroughly clean and vacuum the MCC interior, and wipe down the MCC exterior with a dry cloth.

Every three (3) years:

- Perform all tasks specified for the annual inspection.
- With the MCC main circuit breaker open and locked out, wipe clean all MCC buswork, and check for signs of tracking or overheating at the buswork connections.
- Power factor test the MCC buswork.

5. Transient Voltage Surge Suppressor

The site transient voltage surge suppressor (TVSS) is a MCG Model SF-160M, 480V, 3-phase transient voltage surge suppression device. The TVSS is connected to the MCC main bus (via a 30A circuit breaker) protecting the site service entrance equipment against the most severe voltage surges induced by lightning and utility switching.

Inspect and test operation of the TVSS quarterly. The TVSS maintenance shall be as recommended by the equipment manufacturer.

6. Lighting Transformer

The building lighting transformer is a Square D, 10kVA, 480-240/120V dry type transformer. The transformer supplies power to the lighting panelboard.

The following are the recommended transformer maintenance tasks (to be performed with the transformer's circuit breaker open and locked out) :

Annually:

- Remove transformer case cover and inspect the transformer core and coils for signs of overheating.
- With the transformer case removed, clean the transformer core and coils with a vacuum cleaner.

Every three (3) years:

- Perform all tasks specified for the annual inspection.
- Perform windings insulation resistance test.

7. Lighting Panelboards

The building lighting panelboard is fed by the lighting transformer. It is a Square D, NQOD, 240/120V distribution panelboard equipped with QOB molded-case bolt -on circuit breakers. The panelboard supplies power to the building lighting, HVAC, electrical heat tracing and control power uninterrupted power supply (UPS).

The following are the recommended panelboard maintenance tasks. Annually, with the panel's feeding transformer primary circuit breaker open and locked out, perform the following tasks:

- Confirm availability and accuracy of the panel directory.
- Remove panel's front cover and inspect each circuit for loose connections and signs of overheating. Tighten connections as necessary. If the breaker's contacts are badly deteriorated, replace the breaker.
- Thoroughly clean and vacuum the panel's interior (a clean circuit breaker case will better dissipate internal heat, and reduce potential arcing conditions between live conductors, and between live conductors and ground).
- Manually operate each circuit breaker (it is not unusual for a molded case circuit breaker to be in service for an extended period and never be called on to perform its tripping functions. Manual operation of the breaker will help keep the breaker's contacts clean).

8. Lighting

The site lighting consists of normal and emergency building lighting.

The normal lighting comprises industrial type fluorescent fixtures controlled by the manual switches.

The emergency lighting is supplied by the self-contained battery supported unit. The frequency of the unit's battery replacement shall be as recommended by the unit manufacturer.

Replace lamps in lighting fixtures as they fail, or when lamp blinking is observed. Replacement lamps shall be of the same color, wattage and voltage as those being replaced.

The following are the recommended lighting system maintenance tasks:

Quarterly:

- Check operation of all lighting controls switches to prove functioning of all lighting circuits.
- Test operate the emergency lighting unit to prove its proper functioning.

Annually:

- Clean lamps, reflectors and lenses of every light fixture (cleaning is an essential part of maintaining lighting output at close to the original design level).

9. Electrical Heat Tracing

The site electrical heat tracing system prevents the wet well water piping from freezing. The

system consists of Raychem self-regulated heat trace cable, applied over the subject piping, and a Pyrotex Digitrace 910 controller located in the site building. The heat trace cable is ambient temperature controlled.

The following is the recommended system maintenance.

Annually, preferably during off season, perform the following tasks:

- Visual inspection to prove that no physical damage has occurred.
- Insulation resistance test as recommended by the heat trace manufacturer.
- Verify controller settings, and simulate the controller set point to prove proper operation of the system.

10. Wiring

All site wiring is either low voltage power or instrumentation cables. The site's wiring devices consist of the equipment attachment cord plugs and plugs, connectors and receptacles.

The following are the recommended wiring and wiring devices maintenance tasks:

Annually, (with the cable under task circuit breaker open and locked out):

- Check accessible cables and cords for signs of mechanical damage and/or insulation color deterioration.
- Check cable conductors for loose terminal connections (tighten if required).
- Check that equipment attachment plugs are fitting firmly when inserted into matching connector or receptacle.
- Check for presence of cable/conductor identification tags.
- The majority of the site cables are in the underground conduits. Check all exposed building conduits for signs of rust and/or mechanical damage. All rusted conduit areas shall be removed and repaired with a zinc rich paint.
- Perform visual inspection of all wiring devices to confirm that all devices are in place, sound and secure. If any device becomes loose or fails, repair it or replace.

Every three (3) years (with all power sources disconnected and locked out):

- Check insulation resistance of all power cables.

11. Grounding

The site grounding consists of a ground loop around the building and individual ground rods at the wells.

The following is the recommended grounding system maintenance tasks:

Annually:

- Perform visual inspection of all exposed grounding system components to verify that all system connections are secure, and that all system components show no signs of deterioration.

Every three (3) years:

- In addition to the annual inspection, perform the system grounding electrode resistance test to prove the system effectiveness and integrity. The testing personnel should use an approved industrial grade ground tester to perform the test, and apply the fall-of-potential testing method. The grounding electrode resistance reading shall be below 5 Ohms.

APPENDIX B-13

INSTRUMENTATION CONTROL SYSTEM

APPENDIX B-13A

OPERATING CONTROL

OPERATING CONTROLS

PFOHL BROTHERS LANDFILL

Cheektowaga, New York

A. Introduction

The Pfohl Brothers Landfill control system consists of 6 wet wells containing groundwater pumps that pump water collected in the wet wells through a header to the municipal sanitary sewer system. Each wet well contains a level transmitter and a flow transmitter. In addition there is a meter pit containing a flow transmitter to measure the total flow to the municipal sewer.

The well pumps are driven by 460 volt motors that are supplied by the Motor Control Center (MCC) located in the site control building. They are normally operated automatically based on the level of water in the wells turning a pump on at 5 ft and off at 1.5 ft.

A control panel is located in the control building and is used to operate the system and to view process data using touch screen graphics. An Autodialer is interfaced to the system so that in the event of the occurrence of an alarm the dialer will call out to inform someone of the situation. In addition, the operator can call into the dialer to get the status of alarms at the site or to collectively turn the site well pumps on or off.

The system has manual and automatic operation capability. In either mode the operator must insure all disconnects on motor starters are on for the pumps to be used. Also, the operator must insure all control equipment circuit breakers and fuses are on or installed.

B. HMI Screens

There are 10 unique screens provided by the Human Machine Interface (HMI) software for use by the operator. The following briefly describes the information and functions each screen provides.

MAIN SCREEN (Figure 1)

Provides the following information:

- Date and time.
- If Trending is on or off.
- If Alarm logging is on or off.
- Indication a well has an alarm.
- Indication of a running pump.
- Indication if a well is on/off level control.
- Indication of a Remote Site Shutdown.
- Indication a control power failure occurred.
- Indication that FT-107 has a Bad Quality signal.
- Indication that a Flow Deviation occurred.
- Indication of instantaneous and total flows

Provides the following control functions:

- Launch the Level Trends screen
- Launch the Pump Trends screen
- Launch the Well Flow Trends screen
- Launch the Utilities screen
- Launch the Alarm screen

- Launch individual Wet Well screens
- Exit the HMI program
- Reset Flow Deviation and FT-107 Bad Quality alarms

ALARM SUMMARY SCREEN (Figure 2)

Provides the following information:

- Time tagged listing of alarms that have occurred and not yet been corrected.

Possible alarms are:

- Bad Quality level or flow signal from a transmitter
- High or low level condition in a well
- Pump failure at a well
- Flow failure from a well
- Remote Site Shutdown
- Control Power Failure
- Flow Total Deviation

Provides the following control functions:

- Acknowledgement of alarm messages.
- Launch an alarm log viewer.

A typical alarm indication is as follows (note: most recent alarm occurrence is at top of list):

- When an alarm is first reported it shows a message containing the Alarm Label/Date/Time/Description.
- At the time an alarm is cleared a second line of information occurs identical to the first line except the label field is blank.

The alarm text color and highlight color changes as follows:

- New alarm – text is RED and highlighting is RED
- Alarm cleared but not acknowledged – text is Blue and highlighting is Yellow
- Alarm acknowledged but not cleared – text is Violet and highlighting is Yellow
- Alarm acknowledged and cleared – removed from screen

UTILITIES SCREEN (Figure 3)

Provides the following information:

- If trending is running or stopped.
- If alarm logging is running or stopped.

Provides the following control functions:

- Launch the window used to reset pump runtime indications to zero.
- Launch the window used to reset total flow indications to zero.
- Launch the Daily Flow Report screen.
- Start and stop trending.
- Start and stop alarm logging.

RESET PUMP RUNTIME SCREEN (Figure 4)

Provides the following information:

- Hours of operation since last reset for each pump.
- Date of last runtime reset for each pump.

Provides the following control functions:

- Individual reset of the runtime counters for each of the well pumps.

RESET FLOW TOTALIZERS SCREEN (Figure 5)

Provides the following information:

- Total gallons pumped since last reset for each well.
- Date of last totalizer reset for each well.

Provides the following control capabilities:

- Individual reset of the flow totalizers.

PUMP OPERATIONS TRENDS SCREEN (Figure 6)

Provides the following information:

- Historical trend simultaneously showing when each of the 6 well pumps was on or off.

WELL LEVEL TRENDS SCREEN (Figure 7)

Provides the following information:

- Historical trend simultaneously showing the level, in feet, in each of the 6 wells.

WELL FLOW TRENDS SCREEN (Figure 8)

Provides the following information:

- Historical trend simultaneously showing the flow, in gpm, of each of the 6 wells, the total flow to the sewer and a calculated summation of the 6 well flows.

DAILY FLOW REPORT SCREEN (Figure 9)

Provides the following information:

- Indication of data for the last 14 days.
- Indicates the total flow indication of FT-107 at the end of the day for the last 14 days.
- Indicates the total flow from the site for the day for the last 14 days.
- Indicates the total hours of runtime on each of the well pumps at the end of the day for the last 14 days.

WET WELL SCREENS (Figure 10)

Provides the following information:

- Indication of an alarm condition occurring at the well.
- Indication if the pump is on or off.
- Indication if level control is on or off.
- Level of the water in the well in feet.
- Flow rate from the well when the pump is running in gpm.
- The accumulated gallons pumped from the well since last resetting the flow totalizer.
- Total hours of runtime on the well pump since last resetting the runtime totalizer.
- Date pump runtime was last reset.
- Date flow totalizer was last reset.

Alarm conditions that will be indicated are:

- Level Invalid
 - PLC's A/D card indicates the well level signal is defective.
- Flow Invalid
 - PLC's A/D card indicates the well flow signal is defective.
- Pump Failure
 - PLC issued output to pump starter but did not receive a running indication.
- Flow Failure
 - A PLC issued output to pump starter, received a running indication, but did not detect the presence of a flow.

Provides the following control functions:

- Reset the alarm indication if cleared.
- Start and stop the automatic level control function for the well.
- Launch the Utilities screen.

Note: The screens for each wet well provide the same information and control functions.

C. Operating Procedures

The following describes how to operate the system.

1. To Manually Operate a Pump:

- To start a pump manually place the Hand-Off-Auto (HOA) switch on the front of the Motor Control Center (MCC) starter bucket for the selected pump in the **HAND** position and the pump will start running.
- To stop the pump, place the switch in the **OFF** position.

Note: In the HAND position the pump will continue to run even if the well becomes empty.

2. To Enable Automatic Operation of a Pump on Level Control:

- To enable automatic operation of a pump based on the water level in the well place the HOA switch on the front of the MCC starter bucket for the selected pump in the **AUTO** position.
- To disable automatic operation of the pump, place the HOA switch in the **OFF** position.

3. To Start/Stop Alarm Logging:

- From the Main screen (Figure 1) touch the **UTILITIES** button.
- On the Utilities screen (Figure 3) touch the **START ALARMS** button to start the alarm reporting control function.
- On the Utilities screen (Figure 3) touch the **STOP ALARMS** button to stop the alarm reporting control function.
- Close the screen by touching the **CLOSE WINDOW** button.

Note: Alarm logging is automatically started when the HMI program is first activated.

4. To Start/Stop Trending:

- From the Main screen (Figure 1) touch the **UTILITIES** button.
- On the Utilities screen (Figure 3) touch the **START TRENDS** button to start gathering and trending data.
- On the Utilities screen (Figure 3) touch the **STOP TRENDS** button to stop gathering and trending data.
- Close the screen by touching the **CLOSE WINDOW** button.

Note: Trending is automatically started when the HMI program is first activated.

5. To Start/Stop Level Controls:

- From the Main screen (Figure 1) touch the icon for the well you wish to start or stop.
- On the Wet Well screen (Figure 10) that pops up turn the level control on or off by touching the buttons in the level control box.
- Close the screen by touching the **CLOSE WINDOW** button.

6. To View Pump Trends:

- From the Main screen (Figure 1) touch the **PUMP TRENDS** button.
- On the trend screen (Figure 6) touch the **OLDEST** button to view the oldest data in the history files.
- On the trend screen touch the **NEWEST** button to view the newest data in the history files.
- On the trend screen touch the **-1DAY/-12HR** button to view data 24/12 hours prior to that being displayed.
- On the trend screen touch the **+1DAY/+12HR** button to view data 24/12 hours ahead of that being displayed.
- On the trend screen touch the **Pause/Scroll** button to pause/scroll the data being viewed (data continues to be logged even if the display is placed in pause mode).
- Close the screen by touching the **CLOSE WINDOW** button.

7. To View Level Trends:

- From the Main screen (Figure 1) touch the **LEVEL TRENDS** button.
- On the trend screen (Figure 7) touch the **OLDEST** button to view the oldest data in the history files.
- On the trend screen touch the **NEWEST** button to view the newest data in the history files.
- On the trend screen touch the **-8HR/-4HR** button to view data 8/4 hours prior to that being displayed.
- On the trend screen touch the **+8HR/+4HR** button to view data 8/4 hours ahead of that being displayed.
- On the trend screen touch the **Pause/Scroll** button to pause/scroll the data being viewed (data continues to be logged even if the display is placed in pause mode).
- Close the screen by touching the **CLOSE WINDOW** button.

8. To View Flow Trends:

- From the Main screen (Figure 1) touch the **FLOW TRENDS** button.
- On the trend screen (Figure 8) touch the **OLDEST** button to view the oldest data in the history files.
- On the trend screen touch the **NEWEST** button to view the newest data in the history files.
- On the trend screen touch the **-8HR/-4HR** button to view data 8/4 hours prior to that being displayed.
- On the trend screen touch the **+8HR/+4HR** button to view data 8/4 hours ahead of that being displayed.
- On the trend screen touch the **Pause/Scroll** button to pause/scroll the data being viewed (data continues to be logged even if the display is placed in pause mode).
- Close the screen by touching the **CLOSE WINDOW** button.

9. To View Daily Flow Report:

- From the Main screen (Figure 1) touch the **UTILITIES** button.
- On the Utilities screen (Figure 3) touch the **SELECT** button next to *Display Daily Flow Report*.
- On the Log screen (Figure 9) select proper start and end dates if other than default of the last 14 days is desired.
- On the Log screen touch the **REFRESH** button.

- Close the Log screen by touching the **CLOSE WINDOW** button.
- Close the Utilities screen by touching the **CLOSE WINDOW** button.

10. To Reset a Pump Runtime Totalizer:

- From the Main screen (Figure 1) touch the **UTILITIES** button.
- On the Utilities screen (Figure 3) touch the **SELECT** button next to *Reset Runtime Meters*.
- On the Reset Runtime Meter screen (Figure 4) touch the **RESET** button of the pump to be reset.
- Close the Reset Runtime Meters screen by touching the **CLOSE WINDOW** button.
- Close the Utilities screen by touching the **CLOSE WINDOW** button.

11. To Reset a Flow Totalizer:

- From the Main screen (Figure 1) touch the **UTILITIES** button.
- On the Utilities screen (Figure 3) touch the **SELECT** button next to *Reset Flow Totalizers*.
- On the Reset Flow Totalizers screen (Figure 5) touch the **RESET** button of the totalizer to be reset.
- Close the Reset Flow Totalizers screen by touching the **CLOSE WINDOW** button.
- Close the Utilities screen by touching the **CLOSE WINDOW** button.

APPENDIX B-13B

OPERATING SCREENS FIG. 1-FIG. 10

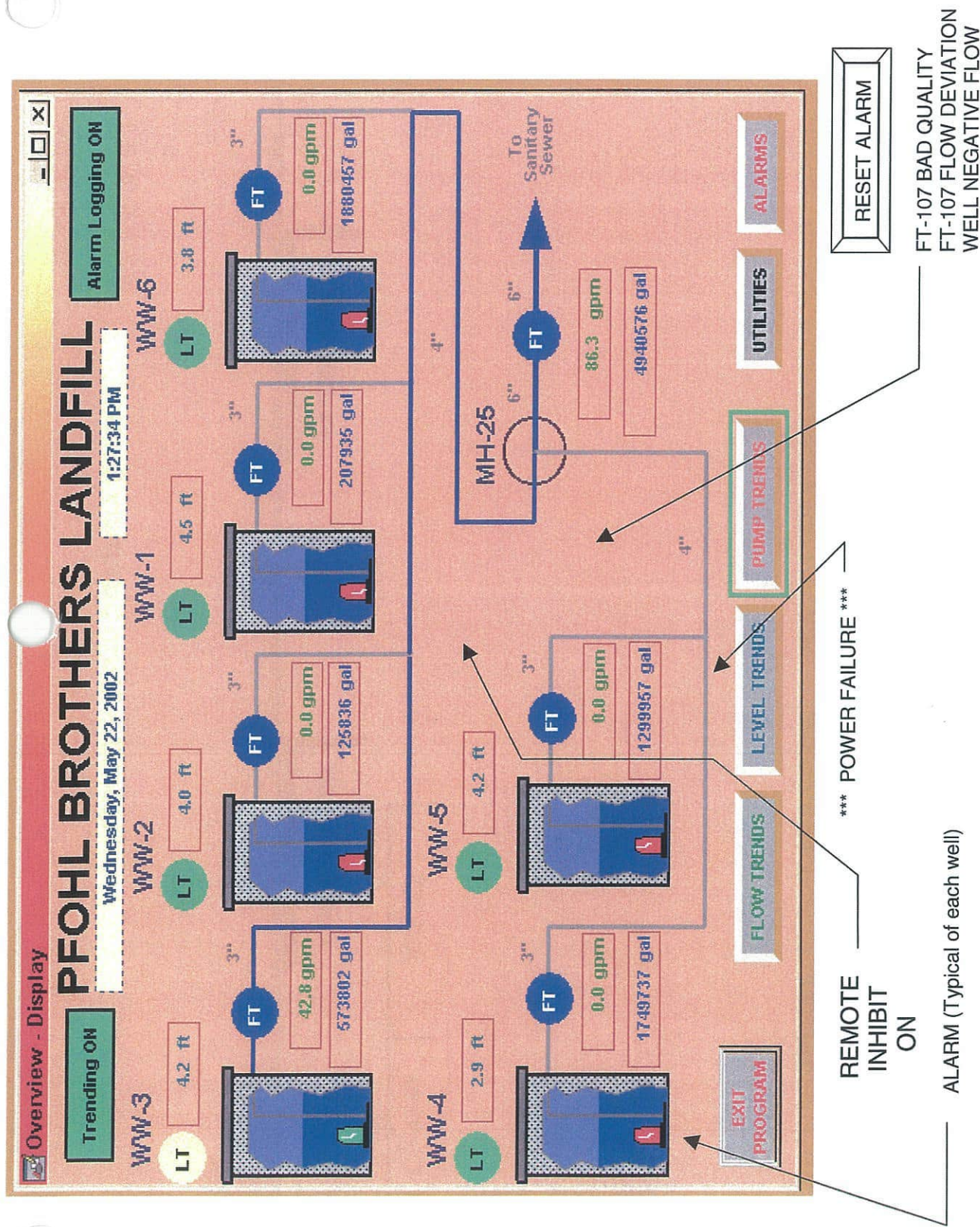


Figure 1 - Overview Screen (Showing hidden alarm text and pushbutton)

ALARM SUMMARY

Alarm Label	Alarm Date	Alarm Time	Tag Description
	5/31/02	10:53:44 AM	WW 1 Flow Failure
	5/31/02	10:53:42 AM	WW 2 Flow Failure
	5/31/02	10:53:37 AM	WW 3 Flow Failure
Site Inhibit	5/31/02	10:52:16 AM	Inhibit Pumping from Site
FFA-103	5/31/02	10:52:01 AM	WW 3 Flow Failure
FFA-102	5/31/02	10:51:36 AM	WW 2 Flow Failure
FFA-101	5/31/02	10:50:46 AM	WW 1 Flow Failure

Ack Current

Ack All

CLOSE WINDOW

ALARM VIEWER

Figure 2 – Alarm Summary Screen

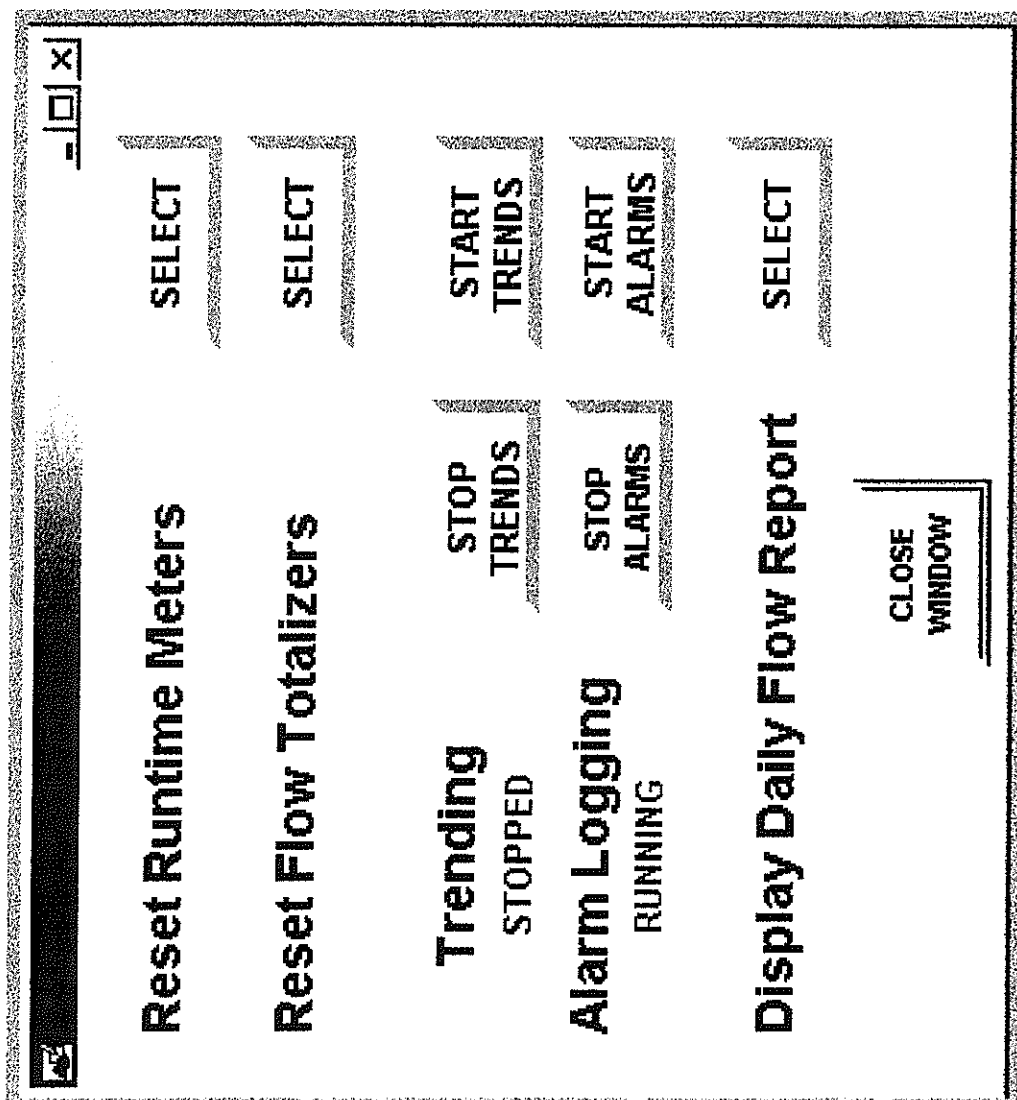


Figure 3 - Utilities Screen

		
Pump No. P-1 Runtime (hours) = 29 Last Reset 3 / 12 / 2002	Pump No. P-4 Runtime (hours) = 526 Last Reset 3 / 12 / 2002	RESET
Pump No. P-2 Runtime (hours) = 0 Last Reset 3 / 12 / 2002	Pump No. P-5 Runtime (hours) = 374 Last Reset 3 / 12 / 2002	RESET
Pump No. P-3 Runtime (hours) = 218 Last Reset 3 / 12 / 2002	Pump No. P-6 Runtime (hours) = 429 Last Reset 3 / 12 / 2002	RESET
CLOSE WINDOW		

Figure 4 – Reset Pump Runtime Screen

Wet Well No. 1, FT-101		Wet Well No. 4, FT-104	
Total = 207935	RESET	Total = 1749737	RESET
Last Reset 3 / 12 / 2002		Last Reset 3 / 12 / 2002	
Wet Well No. 2, FT-102		Wet Well No. 5, FT-105	
Total = 125836	RESET	Total = 1289957	RESET
Last Reset 3 / 12 / 2002		Last Reset 3 / 12 / 2002	
Wet Well No. 3, FT-103		Wet Well No. 6, FT-106	
Total = 573802	RESET	Total = 1880457	RESET
Last Reset 3 / 12 / 2002		Last Reset 3 / 12 / 2002	
CLOSE WINDOW		Sewer Discharge, FT-107	
		Total = 4940576	RESET
		Last Reset 3 / 14 / 2002	

Figure 5 – Reset Flow Totalizer Screen

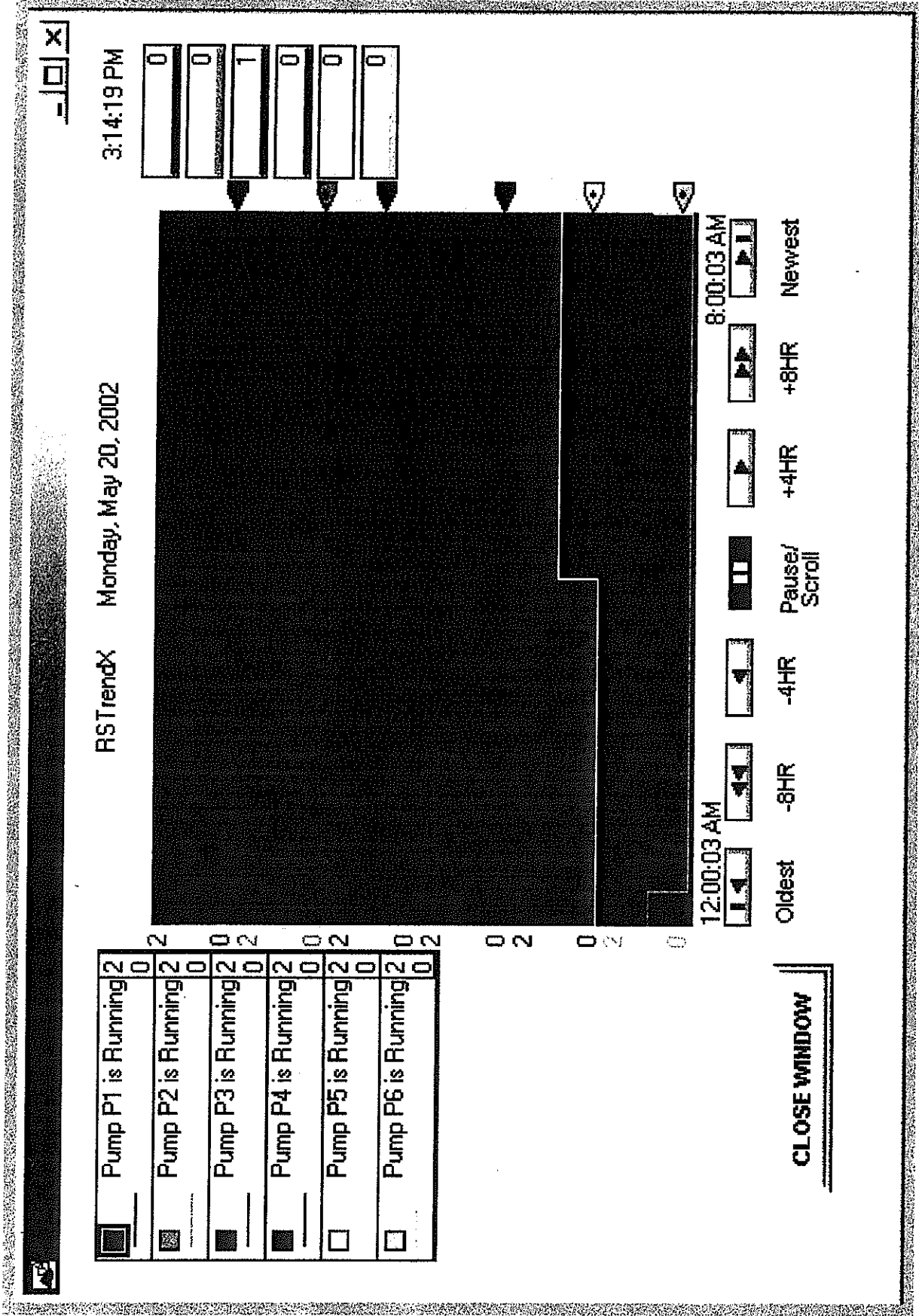


Figure 6 – Pump Operations Trends Screen

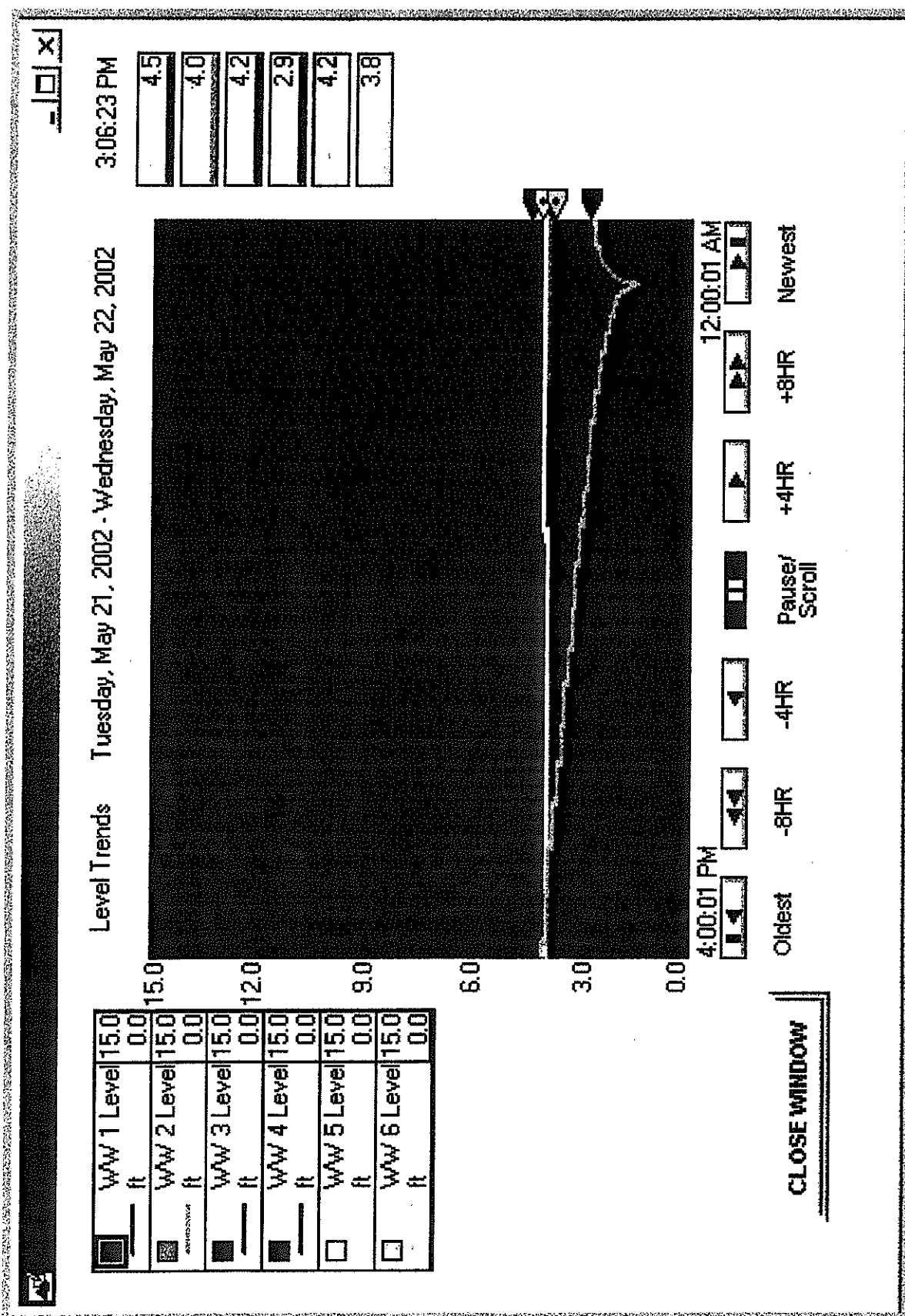


Figure 7 – Well Level Trends Screen

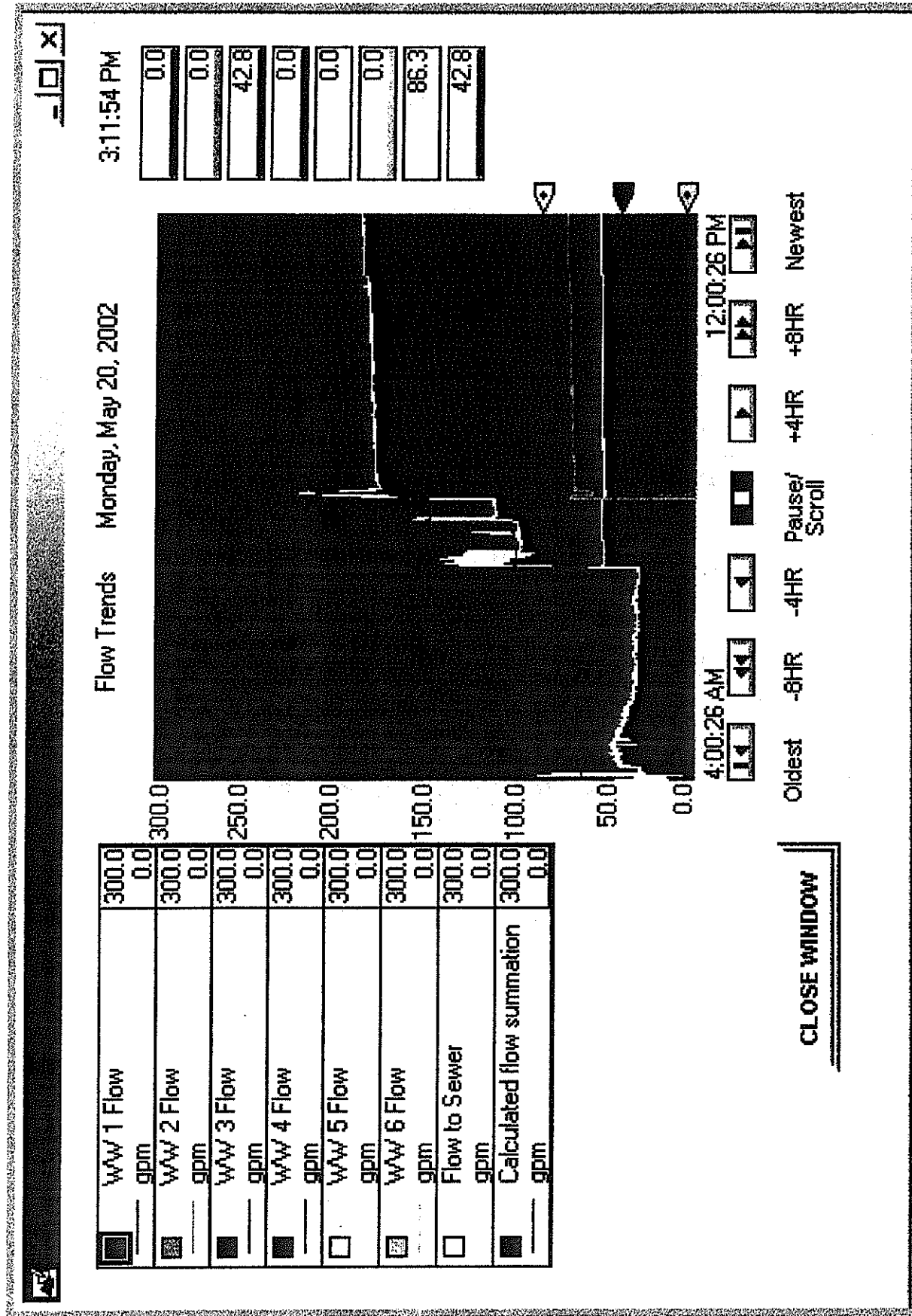


Figure 8 -- Well Flow Trends Screen

Start date: 5/23/2002 Start time: 2:05:12 PM End date: 6/6/2002 End time: 2:05:12 PM Refresh

Date	Day's Flow	Pmp 1 RT	Pmp 2 RT	Pmp 3 RT	Pmp 4 RT	Pmp 5 RT	Pmp 6 RT	Running Total
5/23/2002 11:58:16 PM	81506	29	0	231	535	374	439	5042737
5/24/2002 11:58:11 PM	43032	29	0	231	543	374	443	5085768
5/25/2002 11:58:27 PM	56106	29	0	231	550	378	449	5141874
5/26/2002 11:58:11 PM	86792	29	0	231	558	385	459	5228666
5/27/2002 11:58:25 PM	21577	29	0	231	564	385	459	5250242
5/28/2002 11:58:13 PM	87523	29	0	239	570	385	471	5337765
5/29/2002 11:58:27 PM	43261	29	0	246	577	385	471	5381026
5/30/2002 11:58:26 PM	69683	29	0	246	585	385	483	5450709
5/31/2002 11:58:26 PM	21680	29	0	246	592	385	483	5472389
6/1/2002 11:58:11 PM	172788	42	0	261	604	396	497	5645176
6/2/2002 11:58:25 PM	65055	52	0	267	612	396	500	5710231
6/3/2002 11:58:10 PM	19663	52	0	267	618	396	500	5729894
6/4/2002 11:58:02 PM	96624	52	0	274	624	396	516	5826518
6/5/2002 11:58:25 PM	61953	52	0	281	630	396	523	5888471

CLOSE WINDOW

Figure 9 – Daily Flow Report Screen

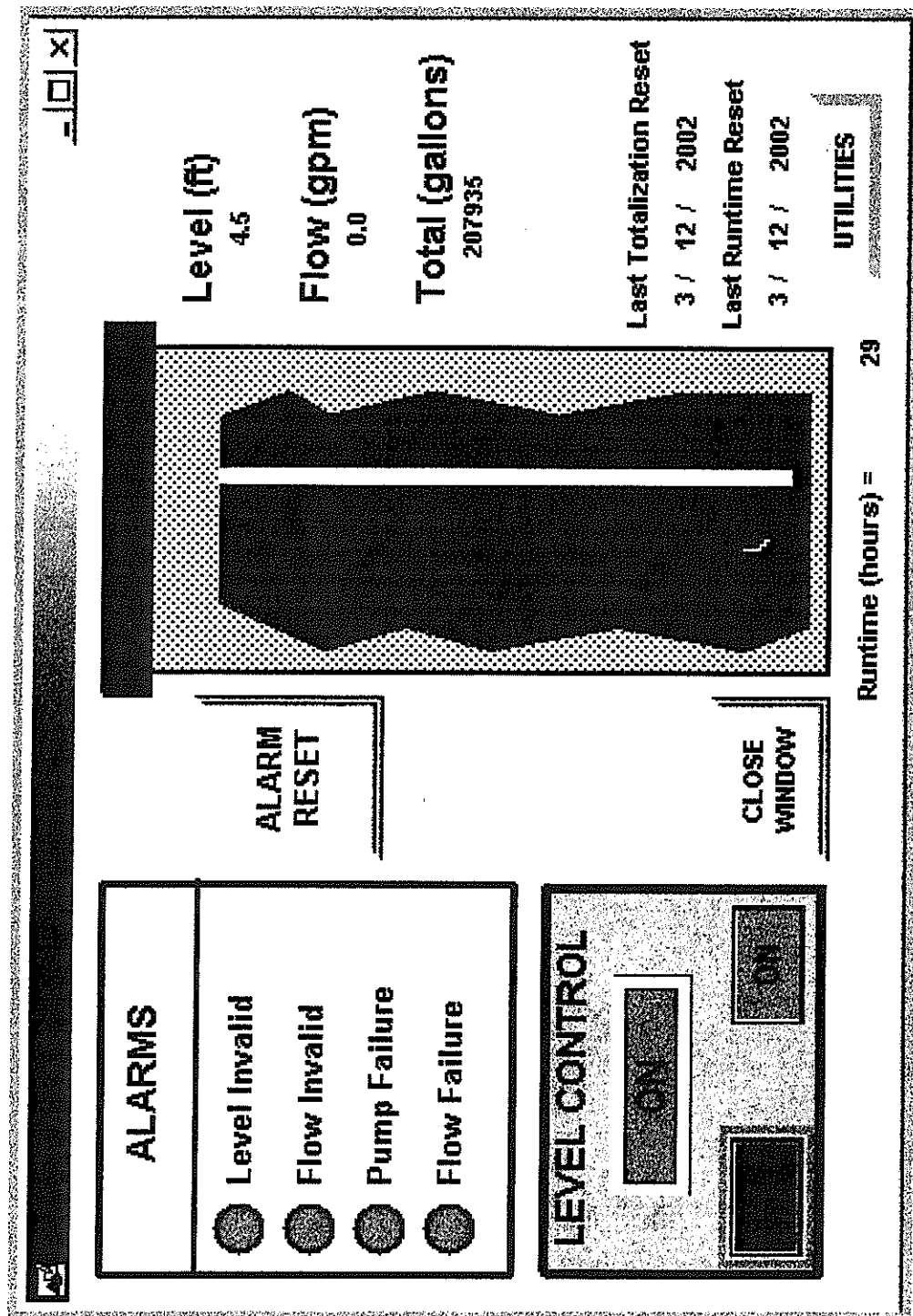


Figure 10 – Wet Well Screen

APPENDIX B-13C

CONTROL STARTUP PROCEDURES

Control Startup Procedures

A. System Startup

1. Apply power to the control panel:

- Insure circuit # 6 in panel LP is **ON**.

2. Energize the control system:

- Insure the computer maintenance keyboard and mouse are plugged into the panel mounted PC.
- Insure all DIN rail mounted fuses are closed.
- Place switch SW-1 to the **ON** position.
- Turn on the UPS by depressing the button located on the front of the unit.

The PLC based control system will start running and the panel mounted PC will begin a startup.

3. Start the HMI software:

Wait for the PC to display the Windows NT "Begin Logon" window then do the following:

- Press **Ctrl + Alt + Del** on keyboard inside of control panel.
- Enter the password **pfohl** then touch the **OK** button. NT will finish loading and automatically launch **RSView32 Runtime 150**.
- Touch the open folder icon.
- Double touch the **Pfohl HMI Program** folder.
- Double touch on **HMI_PROG** to open HMI project.
- Touch the **Run Project** bar.

The program will be loaded, historical logging will begin and the Overview screen will be displayed, the control system is now fully functional.

Note: If the **EXIT PROGRAM** button should ever be accidentally be pushed shutting of the HMI software just touch the **Run Project** bar to restart the program.

B. System Shutdown

1. Shut off automatic level control

- From the Main screen touch the icon for the well you wish to stop level control on.
- On the Wet Well screen that pops up turn the level control off by touching the **OFF** button in the level control box.
- Close the screen by touching the **CLOSE WINDOW** button.

2. Stop the HMI software:

- Touch the **EXIT PROGRAM** button on the Overview screen.
- Touch the box with an **X** in it located in the extreme upper right-hand corner of the display.
- Touch **Start** at the left side of the Task bar.
- Touch **Shutdown**.
- Touch **Shutdown the computer?** (if required).

- Touch **Yes**.

2. Deenergize the control system:

- Turn off the UPS by depressing the button located on the front of the unit.
- Place switch SW-1 to the **OFF** position.
- Open circuit # 6 in panel LP.

APPENDIX B-13D

PC REQUIREMENTS

Revised 09/06/02

PERSONAL COMPUTER REQUIREMENTS

The control PC mounted in the control panel requires that the following software be loaded on it for proper operation:

1. Windows NT 4.0 (Service Pack 6)
2. Rockwell Software RAC6181 industrial computer – Touchscreen Driver
3. Upgrade to Windows Internet Explorer 6.0 or greater
4. Rockwell Software RSLinx Professional (Version 2.30.01)
5. Rockwell Software RSView32 (Version 6.30.16)
6. Rockwell Software TrendX utility (from Rockwell Software Extensions disk)
 - Upgrade Rockwell Software TrendX utility to 3.20.
 - Upgrade per Rockwell Software TrendX application note # R9535
 - Upgrade per Rockwell Software TrendX application note # R9793
 - Upgrade per Rockwell Software LogViewer utility application note # A8346
7. Upgrade ODBC Drivers per Rockwell Software application note # A5717

The disks containing the above software, except for the Internet Explorer, ODBC Drivers and Rockwell Software application note upgrades, are stored at the site in the control building. The Internet Explorer upgrade must be obtained from Microsoft's website and the Rockwell updates are obtained from the Rockwell Knowledge Base website.

Before operating the HMI software the following must be done to the PC:

1. Add the new directory **C:\control\logdata**
2. Add the new directory **C:\Pfohl HMI Program**
 - Programmer must copy the HMI program from the backup floppy disk into this directory.
3. Set up **C:\Program Files\Rockwell Software\RSView\rsvviewrt32.exe** to automatically launch **maximized** upon booting the computer.

APPENDIX B-13E

RS VIEW HMI SOFTWARE REVISIONS

Knowledgebase

Rockwell
Automation



Release Note

R9793 - TrendX 3.20.04 Patch to improve real-time trend loading

Previously Released as #R708

General Category:s HMI (Visualization)
Product(s): TrendX
Catalog #:
Series / Revision: 3.20.04
Subject
(Keyphrases):
Summary of
Technote
Information:

Problem:

When loading a real-time trend object in an RSView32 display, it can take a 3-5 seconds for the display to complete loading.

Cause:

The TrendX Data Acquirer accesses data through the RSView32 object model, but this was not optimized. The TrendX Data Acquirer is now optimized for loading real-time data.

Solution:

The attached patch fixes the issue as described.

Installation:

This patch requires TrendX 3.20.04 to be installed on the system

The patch file should be copied to all RSView32 machines. ADS clients do not require this patch.

1. Copy the RSTXData.exe file into the \Program Files\Rockwell Software\TrendX directory (assuming a default TrendX installation) replacing the existing file.



RSTXData.exe

Filename Version Date and Time Size

RSTXData.exe 1.0.16.4 9/7/01 2:28:05 PM 90,112 bytes

Related Links:

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Knowledgebase

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Release Note

R9793 - TrendX 3.20.04 Patch to improve real-time trend loading

Previously Released as #R708

General Category:s HMI (Visualization)
Product(s): TrendX
Catalog #:
Series / Revision: 3.20.04
Subject
(Keyphrases):
Summary of
Technote
Information:

Problem:

When loading a real-time trend object in an RSView32 display, it can take a 3-5 seconds for the display to complete loading.

Cause:

The TrendX Data Acquirer accesses data through the RSView32 object model, but this was not optimized. The TrendX Data Acquirer is now optimized for loading real-time data.

Solution:

The attached patch fixes the issue as described.

Installation:

This patch requires TrendX 3.20.04 to be installed on the system

The patch file should be copied to all RSView32 machines. ADS clients do not require this patch.

1. Copy the RSTXData.exe file into the \Program Files\Rockwell Software\TrendX directory (assuming a default TrendX installation) replacing the existing file.



RSTXData.exe

Filename Version Date and Time Size

RSTXData.exe 1.0.16.4 9/7/01 2:28:05 PM 90,112 bytes

Related Links:

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Knowledgebase

**Rockwell
Automation**

Application Note

A5717 - ODBC Driver Download Link to Microsoft

Previously Released as #A508

General Category:s HMI (Visualization)
Product(s): RSView32
Catalog #:
Series / Revision: 5.01.26; 6.10.16
Subject
(Keyphrases):
Summary of
Technote
Information:

Background:

Occasionally the version of the ODBC drivers can be updated incorrectly by installing various RSI and Microsoft products. When the various ODBC dlls are not all at the same revision, problems can occur.

Solution:

Install the latest ODBC files from the Microsoft download page at the following location. These are contained in the most recent MDAC service pack. MDAC stands for Microsoft Data Access Components. Select the Typical Install for x86 platforms. When Windows 95 is the operating system, you must have the DCOM patch already installed from Microsoft, which is also available at this site.

<http://www.microsoft.com/data/download.htm>

Alternate Download Location Rockwell Software:

<http://www.software.rockwell.com/download/mmi/rsview32/misc/mdac%5Ftyp%2Eexe>

Additional Information:

If the MDAC install generates the following error message, you MUST continue with the install.

The ODBC resource DLL(win\system32\odbcint.dll) is a different version than the ODBC driver manager (win\system32\ODBC32.dll)

You need to reinstall the ODBC components to ensure proper operation.

For More Information on ODBC dlls:

[Jump to P1179 ODBC Versions](#)

Knowledgebase

Rockwell
Automation



Release Note

R9535 - TrendX 3.20.04 Patch to improve Tag Browser load time

Previously Released as #R687

General Category:s HMI (Visualization)**Product(s):** TrendX**Catalog #:****Series / Revision:** 3.20.04**Subject****(Keyphrases):****Summary of****Technote****Information:**

Problem:

When using TrendX's Tag Browser to add a pen to a trend, it may take 5-10 minutes or more for the Tag Browser to come up initially. RSView32 may appear to be hung. The tag browser in other areas of RSView32 comes up within a few seconds.

Cause:

The project contains many tag folders (in the thousands). The number of tags isn't an issue. This issue only occurs in TrendX because it doesn't use the standard RSView32 tag browser. TrendX uses a custom tag browser to allow tag browsing on an ADS client machine. TrendX's tag browser loads all folders and subfolders before showing the tag browser.

Solution:

The attached patch fixes the issue as described. With the patch, TrendX only loads the top level folders initially. Sub-folders are only loaded when needed. This allows the tag browser to load quickly, but it will take slightly longer to expand sub-folders.

Installation:

This patch requires TrendX 3.20.04 to be installed on the system.

The patch file should be copied to all RSView32 machines, including ADS clients.

1. Unzip the files in the archive to a temporary folder
2. Copy both files into the \Program Files\Rockwell Software\RSCCommon directory (assuming a default TrendX installation) replacing the existing files.



TrendXTBFix.zip

(Zip File Size: 25 KB)

Knowledgebase

Rockwell
Automation

Application Note

A8346 - RSViewLogViewer ActiveX control to view RSView Data log, Alarm log and Activity log files

Previously Released as #A1672

General Category:s HMI (Visualization)
Product(s): RSView32
Catalog #:
Series / Revision: 6.30.16
Subject
(Keyphrases):
Summary of
Technote
Information:

Revision Notes:

April 18, 2002: Version 2.2.12 - Added ability to do filtering at runtime. Also fixed a problem where the Date column would always show up.

March 19, 2002: Version 2.2.11 - Fixed a problem where printing doesn't work properly.

February 22, 2002: Version 2.2.10 - Fixed a number of issues:

- Fixed a problem where RSView could crash when adding and removing tags from the Data Source tab at runtime.
- Prevent invalid characters from being entered for the Timespan.
- Correct misspelled method DisplaySpanData -> DisplaySpanData.

Background:

The RSViewLogViewer ActiveX control displays data log, Alarm log or Activity log data in a grid format. Using the ActiveX control, you can select the log type, fields to display and time span or by a specific time. During runtime the log type, fields or time settings can be modify by right clicking on the controls and selecting properties. Data can also be printed or saved to CSV files during runtime using the right mouse button.

Known Anomalies:

- This control will not function properly if RSView is installed on a Windows 2000 Terminal Server. It will function correctly if RSView Active Display client software is installed on the Windows 2000 Terminal Server
- Data that is in error or that has a Begin or End marker will not be displayed, printed, or saved in the CSV file.
- The RSViewLogViewer ActiveX control does not display Datalog string tags.
- When multiple controls are on the same graphic, datalog data may not appear automatically. Pressing the Refresh button will populate the table.

Adjusting Column Widths:

To Adjust the Column widths select the log type and the fields desired. Test run the graphic and adjust the columns to the desired width. Return to edit mode and save the graphic. Any adjustments to the columns select or changing the log type will cause the columns to return to their default size.

Changing Column Headers:

Column header names can be changed at design time. To change a column header go to the property page and highlight a selected field. right click on the selected field and a text box will appear were a new header name can be entered, press accept when finished. To remove a header name delete all the text in the text box.

Control Configuration:

The following are a list of possible settings:

- Font
- Display Date and Time on the control
- Display Data Source property tab during runtime via right mouse button
- Display Time Settings property tab during runtime via right mouse button
- Start and End times
- Time Span: Now - x days, hours, minutes or seconds
- ColumnHeaders
- Date format
- Sort Order

Methods:

The ActiveX control contains the following methods, which can be invoked from RSView32.

Method	Description
DataRefresh	Performs a query using the current settings
DisplaySpanData(ModelName As String, TimeUnits As String, TimeSpan As Long, ComputerName As String, Tags As String)	Performs a query using the values passed where: ModelName = datalog model TimeUnits = days, hours, minutes or seconds TimeSpan = number of time units to go back in time ComputerName = name of RSView32 computer -- pass an empty string when not changing computers

	Tags = tag names separated by a semicolon -- pass an empty string to get all of the tags. Example: <pre>RSVLogViewer1.DisplaySpanData "ModelA","Minutes",30,"","Tag1;Tag2;Tag3"</pre>
DisplayData(ModelName As String, StartDate As String, EndDate As String, ComputerName As String, Tags As String)	Performs a query using the values passed where: ModelName = datalog model StartDate = date and time of first record EndTime = date and time of last record ComputerName = name of RSView32 computer -- pass an empty string when not changing computers Tags = tag names separated by a semicolon -- pass an empty string to get all of the tags. Example: <pre>RSVLogViewer1.DisplayData "ModelA","2000-5-28 1:30:33 AM","2000-5-28 1:30:33 AM","ComputerA",""</pre>
PrintData(bChoosePrinter as Boolean)	Prints the viewable data. If bChoose printer is false the default printer is used. When set to true a Printer dialogue will appear.
SaveToCSV(FileName as String)	Saves the displayed data in CSV format to the file specified. If the file name is a zero length string then a file Save As dialogue will appear.
DisplayPropertyPages()	Displays the property pages to change the data source or the time.

Properties:

This ActiveX contains the following properties:

Property	Description
LogType as integer	Determines the Log type. 0 = Data log, 1 = Alarm Log, 2 = Activity log
ColWidth as string	Column widths separated by a semicolon colon. Example: 459.0;1200;3800
StartDate as Date	Returns or sets the current starting date
EndDate as Date	Returns or sets the current ending date

Installation Requirements:

The RSViewLogViewer ActiveX control has the following software requirements:

- TrendX version 3.0 or later. The TrendX data retrieval engine extracts the data from the RSView32 log files. Install TrendX from the RSView32 Extensions CD or download it from <http://www.software.rockwell.com/support/download/>
- Microsoft Data Access Components (MDAC) version 2.1 or Greater. Windows 2000 comes with the correct MDAC installed, but Windows 9X and NT4 do not. To determine if the MDAC is required, open VBA in RSView32 and select Tools then References and look for Microsoft ActiveX Data objects 2.1 library. If it is not in the list, download the MDAC version 2.50.4403.12 or later from Microsoft at <http://www.microsoft.com/data/download.htm>
- Microsoft Internet Explorer version 5.01 or later

Attention:

Although we have tested this utility and are confident that it functions correctly, you must also test this utility thoroughly outside of a production environment before applying it in your project. It is possible that its functionality does not match your requirements. It is also possible that a defect in the utility might prevent it from being implemented successfully in your project. If you encounter a defect in this utility, please notify Rockwell Software technical support so we can take corrective action.

Installation:

Download the following file and double click to install. The RSViewLogViewer will appear in the RSView32 ActiveX toolbar in the utilities tab the next time you start RSView32.

<http://www.software.rockwell.com/download/mmi/rsview32/misc/rsviewlogviewer.exe>

Related Links:

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APPENDIX B-13F

CONTROL PANEL MAINTENANCE

Control Panel Maintenance

PLC Control Panel Maintenance

The PLC control panel provides automatic operation of the wet well pumps and provides the operator's interface to the system. It is interfaced to all the instruments installed in the wet wells as well as the start circuits located in the MCC for all the well pumps. It displays operating data such as well levels and pump flow rates to the operator.

The following shall be minimum maintenance requirements for the panel but may be updated as operation of the site indicates.

With the control panel power sources open and locked out, the Uninterruptable Power Supply (UPS) shut off, and all equipment unplugged from the UPS perform the following tasks on the panel assembly:

As required:

- Wipe the face of the panel mounted industrial personal computer (PC) with a soft cloth. The cloth may be moistened with clean water. Do not use any glass sprays or other chemicals.

Monthly:

- Clean the dust filters on the intake and exhaust louvers on the right side of the control panel. Pull the black bezels off the louver assembly from the outside to get access to the filter media.
- Clean the dust filter on the bottom of the panel mounted industrial PC. Pull the black bezel off the bottom of the PC to get access to the filter media. There is an integrally molded clip on each side of the bezel, be careful not to break any when removing.

Annually:

- Inspect control panel for loose hardware and tighten connections as necessary.
- Thoroughly clean and vacuum the panel's interior, and wipe enclosure exterior with a dry rag.
- Use compressed air to remove dust buildup in and around equipment such as the PLC chassis and panel ventilation louvers.
- Check every panel component for signs of discoloration and replace if required.
- Test the operation of all panel pushbutton and selector switch stations.
- When power to the panel is restored, test all pilot lights operation.

Every two (2) years:

- Perform all tasks specified for the annual inspection.
- Test the operation of all control components including power supplies, control relays and the like.
- Test the accuracy of all PLC analog input and output signals.
- Test the operation of all PLC digital input and output signals.

Software Maintenance:

There are two software packages used in the Pfohl Brother's Landfill control system, RSLogix 500 and RSView32. Both are products of Allen-Bradley, RSLogix operates the PLC and RSView provides the screen displays on the PC.

This software has no maintenance requirements; however, if either program should become corrupted it would be necessary to reload the software. The software is provided on CDs and/or floppy disks stored at the site.

In the event the PLC software is reloaded the accumulated flow totals and pump runtime values would be changed to what ever values happen to be on the backup disks, the data at the time of failure would be lost. Therefor, after reloading the software start the system then reset each flow and pump runtime totalizer as described in the O&M manual.

APPENDIX B-13G

PLC ALARMS

PFOHL BROTHERS PLC GENERATED ALARMS

There are several alarm conditions monitored by the control system. The following chart indicates those conditions and the actions taken when they occur.

There are four alarm contact outputs on the PLC that are wired to the Autodialer. The dialer will use them to call out and report the following; a Process Alarm has occurred, a Level Alarm has occurred, a Flow Alarm has occurred or a Pump Failure has occurred. The conditions causing these messages are indicated in the chart below.

Alarm Condition	When Tested	Latched	Reset	Pump Status During AUTO Operation	LI	FI	Autodialer Alarms		
							Proces s	Level	Flow
BQ Level Input	M, L	Yes	Manual	Associated pump inhibited	Set = 99 Shown in Red			X	
BQ Flow Input	M, L	Yes	Manual	Associated pump inhibited		Set = 0 Shown in Red			X
BQ FT-107 Input	M, L	Yes	Manual	All pumps inhibited					X
Low Level	M, L	Yes	Manual	Associated pump inhibited				X	
High Level	M, L	Yes	Manual	No effect on pump operations				X	
Flow Failure	M, L	Yes	Manual	Associated pump inhibited					X
Flow Deviation	M, L	Yes	Manual	All pumps inhibited					X
Pump Failure	L only	Yes	Manual	Associated pump inhibited					X
Negative Well Flow	M,L	Yes	Manual	No effect on pump operations		Shown in Red			X
Control Power Fail	M, L	No	Auto	All pumps inhibited for 5 min after return of power. Initiates alarm if outage is longer then 4 hours			X		
Low Battery	M, L	No	Auto	No effect			X		
CPU Fault	M, L	No	Auto	All pumps inhibited, PLC is down			X		

Notes: Note 1 Note 2 Note 3

1. M = Manual Operation; L = Level Controlled Operation
2. When alarms that inhibit all pumps are cleared the pumps are sequentially enabled to prevent a sudden load on the power system.
3. Level indication may fluctuate between 99.0 and other values if going in and out of alarm.

APPENDIX B-13H

ALLEN-BRADLEY COMPUTER VENDOR LITERATURE

RAC6181 Industrial Computers



Allen-Bradley

Product Profile

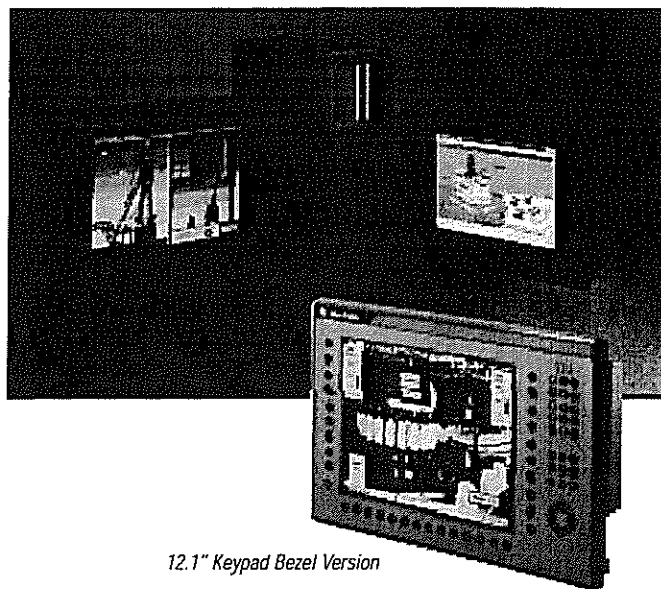
Rugged Computing Power in a Small Form Factor

The Allen-Bradley RAC6181 Industrial Computer from Rockwell Automation makes it easier than it ever to step into an industrial computer for MMI or control. Why? Because now you have access to the computing power you need in a small form factor — at a price lower than most full-sized industrial computers.

Outfitted with a 10.4" or 12.1" color thin film transistor (TFT) active matrix flat panel display, the RAC6181 Industrial Computer is considerably smaller than other workstations. The 10.4" version is only 10¼" high and 12¾" wide making it much smaller than many industrial computers. To maintain that slim profile, and to ensure it will fit into just about any panel, all expansion slots, peripherals, and the power supply connect from the side of the unit.

Small size does not mean small functionality, though. The RAC6181 is driven by powerful Intel® Pentium®, Celeron™ and Pentium III (600 and 866MHz) processors. Two-slot and four-slot chassis are available to accommodate the right degree of expansion you need for your application. For operator input you can select an optional touchscreen, or make use of a the flexible keypad bezel option (12.1" version only). And of course, the RAC6181 is designed to run on Windows® 98, Windows NT®, and Windows 2000 operating systems.

But the best thing about the RAC6181 is that all this performance, flexibility and reliability is available to you at a very competitive price. Starting at less than \$3000 list, harnessing the power of a computer in your demanding industrial control applications is no longer cost prohibitive.



12.1" Keypad Bezel Version

Additional Features

- Shock-mounted hard drives protect against damage caused by vibration.
- An internal half-height bay accommodates a 1.44" floppy drive.
- DVD-ROM and CD-RW options.
- Non-display version and stainless steel NEMA 4X bezel options.
- Class I, Division 2 certification (Groups A, B, C, D).
- AC or DC power.



**Rockwell
Automation**

Bringing Together Leading Brands in Industrial Automation

Specifications

	10.4 in.	12.1 in.	12.1 in. Keypad	Non-Display
Display Type	Color thin film transistor (TFT) active matrix. Resistive analog touchscreen optional			N/A
Display Video Resolution	640x480	800x600	800x600	N/A
External Video Support	1024x768 (16 bit or 64k color) or 1280x1024 (8 bit or 256k color)			N/A
Video On-board CPU Card	2MB PCI Video with external CRT support (HD15)			
Backlight	Snap-in cold-cathode florescent lamps, 50,000 hours to half brightness			N/A
Processor	Intel Pentium 166 MHz, 233 MHz MMX • AMD K6-2™ 366MHz Celeron 566MHz • Pentium III 600MHz, 866MHz			
System Memory	32Mb to 256Mb			
Backplane Type, slots	2-Slot Half-Length Passive Backplane, 1 PCI + 1 Shared PCI/ISA 4-Slot Half-Length Passive Backplane, 2 PCI, 1 ISA + 1 shared PCI/ISA			
Hard Drive Options	Standard (30+ Gbyte); Large (60+ Gbyte), EIDE, pre-installed in shock mount isolation kit			
Removable Media	Standard 1.44 Mb floppy, optional DVD-ROM, optional CD-RW			
Communications Options	Embedded Ethernet® (10/100 base T/TX), optional add-in network cards			
Operating Systems Options	Windows® 98, Windows NT® Workstation 4.0, Windows 2000 Professional			
Mounting	Panel mount, via mounting studs	Panel mount, via mounting studs	Panel mount, via mounting clips	Panel mount, via mounting studs
Approx. Dimensions – WxHxD (2-Slot)	12.75in. x 10.25in. x 5.49in. (323.9mm x 260.4mm x 139.7mm)	13.75in. x 11.0in. x 5.81in. (349.25mm x 279.4mm x 147.6mm)	16.36in. x 11.12in. x 5.64in. (415.7mm x 282.6mm x 143.3mm)	13.5in. x 9.125in. x 4.87in. (342.9mm x 231.7mm x 123.7mm)
Approx. Dimensions – WxHxD (4-Slot)	12.75in. x 10.25in. x 7.15in. (323.85mm x 260.35mm x 181.71mm)	13.75in. x 11.0in. x 7.47in. (349.25mm x 279.4mm x 189.6mm)	16.36in. x 11.12in. x 6.81in. (415.7mm x 282.6mm x 173.02mm)	13.5in. x 9.125in. x 6.04in. (342.9mm x 231.7mm x 153.4mm)
Cutout Dimensions – WxH	11.75in. x 9.25in. (298.45mm x 234.95mm)	12.75in. x 10.0in. (323.85mm x 254.0mm)	15.35in. x 10.11in. (389.89mm x 256.8mm)	N/A
CD-ROM Adder	CD-ROM adds 1.8in. (45.2mm) in depth			
Approximate Weight (2-Slot)	15.9 lbs. (7.2 kg)	16.2 lbs. (7.4 kg)	16.2 lbs. (7.4 kg)	13.2 lbs. (5.6 kg)
Approximate Weight (4-Slot)	21.9 lbs. (9.9 kg)	22.2 lbs. (10.1 kg)	22.2 lbs. (10.1 kg)	19.2 lbs. (8.7 kg)
Power Requirements	120/240 VAC auto-ranging (option) 18-32 VDC (option)			
Environmental	Ratings: NEMA 4 when mounted; EN 60950 (NEMA4x with stainless steel bezel option)			
Temperature	Operating: 5°C to 50°C Non-operating: -25°C to 60°C			
Relative Humidity	8% to 80% non-condensing			
Vibration	Operating: 1.0g @ 10 to 150 Hz sine sweep; 0.006in. peak to peak Non-operating: 2.0g @ 20 to 500 Hz; 0.01in. peak to peak			
Shock	Operating: 15g (1/2 sine, 11 msec) Non-operating: 30g (1/2 sine, 11 msec)			
Certifications	CE mark, UL/cUL 1950, Class 1 Div 2 Groups A,B,C,D (Series B)			

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AMD K6-2 is a trademark of Advanced Micro Devices, Inc.

Intel and Pentium are registered trademarks of Intel Corporation. Celeron is a trademark of Intel Corporation.

Ethernet is a registered trademark of Digital Equipment Corporation, Intel, and Xerox Corporation.

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Europe: Rockwell Automation, Brühlstraße 22, D-74834 Elztal-Dallau, Germany, Tel: (49) 6261 9410, Fax: (49) 6261 17741

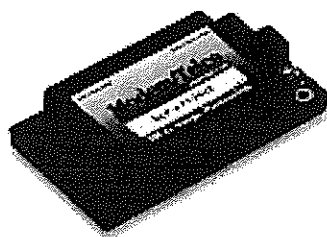
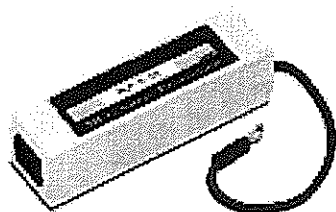
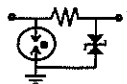
Asia Pacific: Rockwell Automation, 55 Newton Road, #11-01/02 Revenue House, Singapore 307987, Tel: (65) 351 6723, Fax: (65) 355 1733

APPENDIX B-13I

MODEM

DLP-4.68 & DLP-4.71

Protects Modems, Fax, Telco, T1, E1



Modems, facsimile machines and telephone equipment are easily damaged by transients caused by lightning and switching surges. The DLP-4 series installs in minutes between the telephone/data line and the sensitive equipment to provide quick and dependable protection for I/O ports.

The DLP-4.68 handles hit after hit without degradation. Employing fast-acting Avalanche diodes ensures ongoing protection, even under demanding conditions.

For particularly severe transient conditions, model DLP-4.71 incorporates a gas diode for substantially greater heavy-duty diversion capability. Protection circuitry on both units automatically resets after the transient has passed.

Model	DLP-4.68	DLP-4.71
Duty	General	Heavy
Connector	RJ11/45/48 (F/F)	1-RJ11 (F/F)
Protected	Pins 1-8	Pins 2, 3, 4, 5
Series Rs	-	2.4 Ohms
Attenuation	<1db at 10 MHz	<1db at 10 MHz
Mounting	3.5" x 1" x 1"	4.2" x 2.25" x .185" ID
UL	497B	497A (Fuse), 497B

Ordering Information

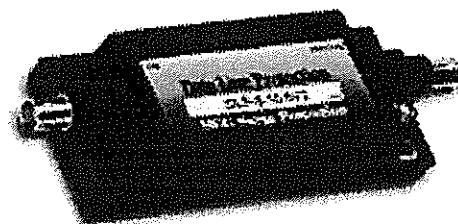
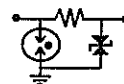
DLP-4.71	-	25V2	
Basic Model Number		Series Resistance	
		6V for RS-422, 423, 485	
		25V for RS-232	
		62V for CSU/DSU	
		200V for Dial-up Lines	

Note: Use Suffix F for Fusing.

MCG Surge Protection

DLP-5.10

Protects 10BASE-T, Token Ring, I/O Ports



The DLP-5.10 is a heavy-duty wideband protector that prevents cable transients from damaging sensitive loads. When sensing a transient on either the shield or the center conductor, the DLP-5.10 operates in nanoseconds to automatically shunt damaging transients to earth ground.

The unit offers ideal protection for 10BASE-T, HUBs, Routers, token ring and I/O ports.

Installation is quick and easy using BNC connectors. The DLP-5.10, like all MCG protectors, is backed with a 10 year, no-nonsense warranty. Please call our Tech Support staff with all you application questions.

Model	DLP-5.10
Duty	Heavy
Connector	BNC (F/F)
Clamp V	6V
Protected Lines	Center & Shield
Series Rs	2 Ohms
Attenuation	<1db at 70 MHz
Mounting	4.2" x 1.50" x .185" ID
UL	497B

Ordering Information

DLP-5.10	-	6V2	
Model Number		Series Resistance (ohms)	
		Clamp Voltage	

1-800-851-1508
<http://www.mcgsurge.com>

12 Burt Drive, Deer Park, N.Y. 11729, U.S.A. ♦ Phone (516) 586-5125 ♦ Fax (516) 586-5120 ♦ Note: New (631) Area Code begins 11/1/99 ♦ E-Mail: Mcginfo@mcgsurge.com

APPENDIX B-13J

RS VIEW 32 SOFTWARE



Japanese

Rockwell Software

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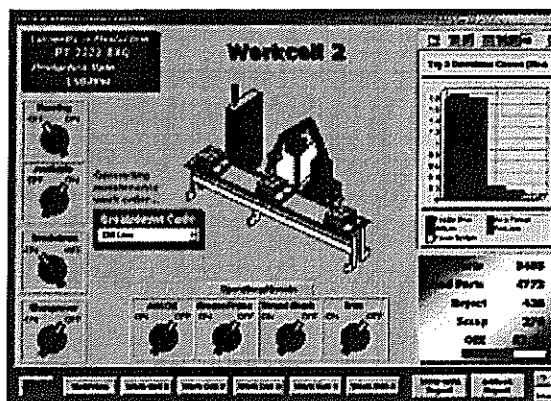


RSView32

The Clearest View of your Enterprise

Product Overview

RSView32™ is an integrated, component-based HMI for monitoring and controlling automation machines and processes. Designed for the Microsoft Windows



environments, RSView32 is Windows 2000 Ready. RSView32 is available in English, **Chinese**, French, German, Italian, Japanese, Portuguese, Korean, and Spanish. RSView32 expands your view with open technologies that provide unprecedented connectivity to other Rockwell Software products, Microsoft products, and third-party applications.

RSView32 was the first HMI software to:

- Open its graphic displays as OLE containers for ActiveX™ controls-with thousands of third-party ActiveX controls to choose from, you can drop ready-made solutions right into your projects
- Develop an object model to expose portions of its core functionality, allowing RSView32 to easily interoperate with other component-based software products
- Integrate Microsoft's popular Visual Basic® for Applications (VBA) as a built-in programming language allowing almost unlimited ways to customize your RSView32 projects
- Support OPC standards as both a server and a client for fast, reliable communications with a wide variety of

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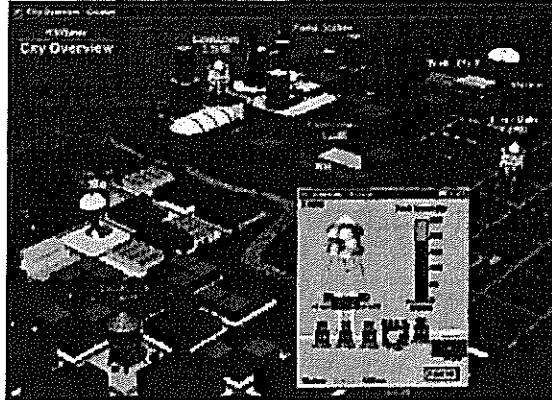


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N

hardware devices

- Implement Add-On Architecture (AOA) technology to expand RSView32's functionality and integrate new features directly into RSView32's core



Extend your view with remote access

RSView32 Active Display System™ is a true client/server application that adds on to and extends the reach of your RSView32 HMI software. With RSView32 Active Display System, you can view and control your RSView32 projects from remote locations.

RSView32 WebServer™ allows anyone with a valid RSView32 user account to access snapshot views of graphic displays, tags, and alarms through any standard web browser.

Customize RSView32's core features with Add-on Architecture

RSView32 redefined the meaning of "HMI core features" with its add-on

architecture (AOA).
AOA technology
expands
RSView32's
functionality by
integrating new
software
components directly
into RSView32.
Customize
RSView32's feature
set by installing only
those components
you need.

At no additional
charge, RSView32
Special Edition
includes the
following AOA
components that you
can install
separately:

- **RSView32**
Messenger™:
Provides
powerful
alarm
annunciation,
paging, and
messaging
tools.
- **RSView32**
TrendX™:
Monitors real-
time data and
provides
historical
trending from
RSView32
data logs.
- **RSView32**
SPC™:
Offers
integrated,
real-time
Statistical
Process
Control.
- **RSView32**

RecipePro™:

Enhances
RSView32
recipe
management
and control.

***Purchase add-ons for the
semiconductor industry*****RSView32 SECSHost:**

An ActiveX control that
lets your RSView32
projects communicate with
semiconductor
manufacturing equipment
using the SECS
communications standards.

RSView32 GEMTool:

Uses add-on architecture
technology to provide
RSView32 with the ability
to handle all SECS-II
messages required by the
Generic Equipment Model
(GEM) standard.

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APPENDIX B-13K

SLC 500 PROCESSOR

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Resources

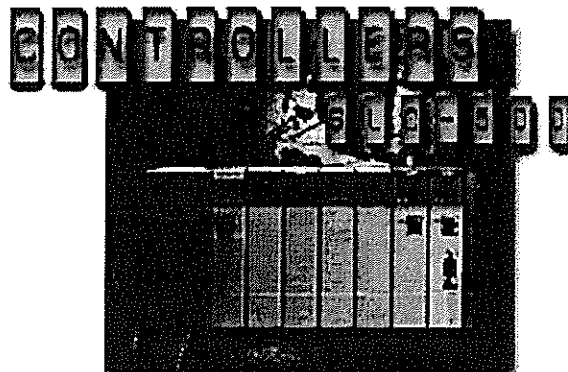
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SLC 500 Processors...

Power and Flexibility for a Complete Control Solution



The SLC 500 family is a growing family of small programmable controllers built around two hardware options: a fixed controller or a modular controller. The modular controller offers you maximum flexibility in system configuration. With its multiple processor choices, numerous power supply options and extensive I/O capacity, the modular SLC 500 controller allows you to create a system specifically designed for your application.

The fixed controller provides the power supply, inputs and outputs, and processor in one unit. It also offers a 2-slot expansion chassis for increased flexibility. The programming tools and most I/O modules are compatible between the two hardware options, so you can cost effectively solve a broad range of applications.

What's New

- **5/03, 5/04, 5/05 Instruction Set Enhancements** including Block Transfer Read/Write Time Stamping, Enhanced Diagnostics
- **1747-PSD, Portable Program Storage Device** for Program Upload/Download to SLC 5/03, 5/04, 5/05, ML 1000, 1200, and 1500 controllers
- **1747-SCNR ControlNet Scanner** allows communication to other CNET controllers and 1746 I/O.
- **1747-ACN15/ACNR15 ControlNet Adapters** allow communication via CNET to 1746 I/O.
- **1747-BSN Back-Up Scanner Module** for critical applications requiring SLC 500 Redundancy
- **1746-P7, 12/24 Vdc Power Supply** for Motor Vehicle and Battery Powered Applications
- **1746-NI16I, 16 Channel Analog Input Module** for Current High Density Analog Signals
- **1746-NI16V, 16 Channel Analog Input Module** for Voltage High Density Analog Signals
- **1746-NT8, 8 Channel Thermocouple/mV Input Module** for High Density Temperature/millivolt Measurement
- **1746-NR8, 8 Channel RTD/resistance Input Module** for High Density Temperature/resistance Measurement
- **1746-BAS-T, High Speed Basic Module** for High Speed Co-Processing and RS-232 Interface

Choice of Controllers

The SLC 500 line offers a range of choices in memory, I/O capacity, instruction set, and communication ports to allow you to tailor a control system to your exact application requirements. These products have a strong reliability history covering hundreds of thousands of installations in a broad range of applications.

SLC 500 fixed I/O processors offer 20, 30, or 40 digital I/O. By adding an expansion chassis, you can add 2 I/O modules for a maximum of 64 additional I/O.

SLC 5/01 processors let you configure modular controllers of up to 960 I/O and a 1K- or 4K-instruction memory capacity.

SLC 5/02 processors let you configure modular controllers of up to 4096 inputs plus 4096 outputs nominally and a 4K-instruction memory. By installing an optional scanner module into one of the 30 I/O module slots, you can add Remote I/O or DeviceNet I/O to the system. They offer 19 additional instructions, including a message instruction for initiating peer-to-peer communication.

SLC 5/03 processors let you configure modular controllers of up to 4096 inputs plus 4096 outputs and a memory of 8K or 16K words. In addition to the features of the SLC 5/02, they have a second built-in communication port — an RS-232-C port that can be configured for ASCII or DF1 protocol, and can be configured for connection to a 1761-NET-AIC converter to provide access to a DH-485 network. SLC 5/03 processors provide bit-instruction execution times of 0.44ms and an overall system throughput of up to 10 times faster than competitive processors. Additional capabilities include: floating-point math, online programming and run-time editing, flash memory upgrades, built-in key-switch, and a built-in real-time clock and calendar.

SLC 5/04 processors let you configure modular controllers of up to 4096 inputs plus 4096 outputs and a memory of either 16K, 32K, or 64K words. They have all the features of the SLC 5/03 processors, plus a faster communication port and shorter execution times (bit-instruction execution times of 0.37ms). Instead of a DH-485 port, the SLC 5/04 has a built-in DH+ port for communication with other SLC 5/04 and PLC processors, operator interfaces, and programming terminals. Communication via the DH+ network is three times faster than DH-485 communication.

SLC 5/05 processors provide high bandwidth networking for standards-based distributed programmable controller systems. They have all of the features of the SLC 5/04 processors, and also bring 10BASE-T 10-Mbps Ethernet connectivity to the popular SLC 500 family. Through Ethernet networks, SLC 5/05 processors can communicate plant-floor data in data acquisition, supervisory control, program management, statistical quality control, maintenance management, production scheduling, and material tracking applications.

Broad Capabilities

- Simple and affordable processors with broad capabilities to address applications such as material handling, HVAC control, assembly operations, small process control, and SCADA applications
- Advanced instruction set based on PLC-5 mid-size processors
- Broad line of digital and analog I/O modules, including intelligent I/O modules and including I/O modules available from third-party (Encompass™ program) vendors
- Each SLC 500 or SLC 5/01 processor has a DH-485 port for programming and processor-to-processor communication initiated from the other node
- SLC 5/02, SLC 5/03, SLC 5/04 and SLC 5/05 processors have communication

ports (Ethernet, DH+, DH-485, or RS-232-C) that can initiate communication

- Add Universal Remote I/O with a 1747-SN scanner module
- Add DeviceNet I/O with a 1747-SDN scanner module
- Add BASIC or C programming capability with a 1747-BAS module

Programming

Choose from three programming options for SLC 500 processors.

- RSLogix 500? Programming Software

RSLogix 500, a Microsoft® 32-bit Windows 95® and Windows NT? programming software package, supports Allen-Bradley SLC 500 and MicroLogix? families of processors. RSLogix 500 is designed to offer powerful functionality, superior diagnostics, reliable communications, and an easy to use interface.

RSLogix 500 provides everything you expect in a programming software package, from consolidated project view to drag-and-drop editing. Plus, RSLogix 500 is part of the RSLogix family of products that share:

- A common user interface and feature set
- Flexible, easy-to-use editors
- Point-and-click I/O configuration
- Powerful database editor
- Diagnostic and troubleshooting tools
- Dependable communications

- SLC 500 A.I. Series Programming Software

SLC 500 A.I. Series programming software is a DOS based, user-friendly, menu driven and function-key driven software package for programming the SLC 500 family processors using familiar ladder logic. The software package provides online and offline development, documentation and reporting capabilities.

- 1747-PT1 Hand-Held Terminal (HHT) that also requires the 1747-PTA1E memory pak

Hand-Held Terminal (HHT) v2.03 is a powerful portable programming platform used to configure the SLC 500 Fixed, SLC 5/01, and the SLC 5/02 processors, enter or modify an application program, monitor the execution of the application program in real-time, or troubleshoot an application program.

When used with the memory pak (v2.03), the HHT can be used to program the SLC 5/02 processor as well as connect to the DH-485 network. Note that the HHT does not support nested branching or conditional output branches.

Input/Output

The 1746 I/O platform is a modular hardware design that uses a cost and space effective means to add I/O modules to your control system. I/O modules are available in a variety of densities including 4, 8, 16, and 32 point and can interface to AC, DC, and TTL voltage levels.

The SLC 500 family also offers specialty I/O modules that enhance your control system. These modules range from analog, motion control, and communication to provide a unique, easy to use interface between the modules and the processor.

Connectivity

- Ethernet
- ControlNet
- DeviceNet
- DH+
- DH 485
- RS-232-C

Standards Compliance

- **ISO 9000 Registration:**
Rockwell Automation facilities are registered to ISO 9001 standards. Our quality system for design, development, manufacture, delivery, and internal customer service processes has been verified by third party audits.
- **> Marine and Off-Shore Applications**
PLC-5 controllers have been certified for use in marine and offshore applications around the world by Lloyd's Register, American Bureau of Shipping, Det Norske Veritas, Bureau Veritas, Registro Italiano Navale, Germanischer Lloyd, and the Korean Registry.
- **UL Certification:**
Generally Rockwell Automation pursues applicable certification by Underwriters Laboratories (UL) for our products. For actual UL recognition of a specific controller, always refer to the label on the product.
- **CSA Certification:**
Generally Rockwell Automation pursues applicable certification by the Canadian Standards Association (CSA) for our products. For actual CSA recognition of a specific controller, always refer to the label on the product.
- **European Union Directives:**
Rockwell Automation products covered by European Union Directives are intended for sale and use within the European market and conform with the essential requirements of these directives. For actual CE conformity of a specific controller, always refer to the label on the product.

Specifications

Total I/O capacity (absolute maximum)	SLC 500 = 104 I/O with expansion chassis SLC 5/01 = 960 I/O SLC 5/02 = 480 local I/O + remote I/O SLC 5/03, 5/04, 5/05 = 4096 I/O
I/O module types	4-I/O, 8-I/O, 12-I/O, 16-I/O, and 32-I/O modules Input-only, output-only, and combination input/output modules Analog and digital I/O circuits <u>compatible I/O modules</u>
I/O chassis	<u>I/O chassis information</u>
Power supply	<u>Power supply information</u>
Memory capacity	SLC 500 = 1K instructions SLC 5/01 = 1K or 4K instructions SLC 5/02 = 4K instructions SLC 5/03 = 8K or 16K words SLC 5/04,

	5/05 = 16K, 32K, or 64K words
Memory type	Battery-backed RAM, EPROM, or EEPROM
Battery	SLC 5/01, 5/02, 5/03, 5/04, 5/05: 1747-BA
Communication ports	SLC 500, SLC 5/01, SLC 5/02 = DH-485 SLC 5/03 = DH-485 and RS-232-C SLC 5/04 = DH+ and RS-232-C SLC 5/05 = Ethernet and RS-232-C
Programming devices	RSLogix 500 Programming Software RSLogix Emulate Software RSPocketLogix Software Windows CE Software 1747-PT1 Hand-Held Terminal 1747-RAC6000 Industrial Computer Products Memory device information
¹ Works with SLC 500, 5/01, and 5/02 processors only	

For more detailed information, see the [Allen-Bradley Automation Systems Catalog](#).

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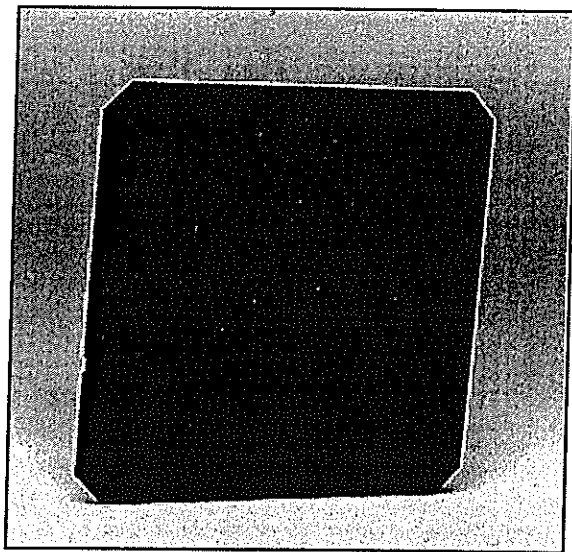
APPENDIX B-14

PANEL EQUIPMENT

APPENDIX B-14A

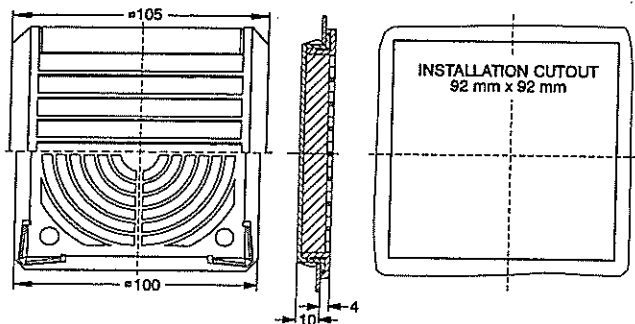
EXHAUST FILTERS

Pfannenberg Model PFA Exhaust Filters

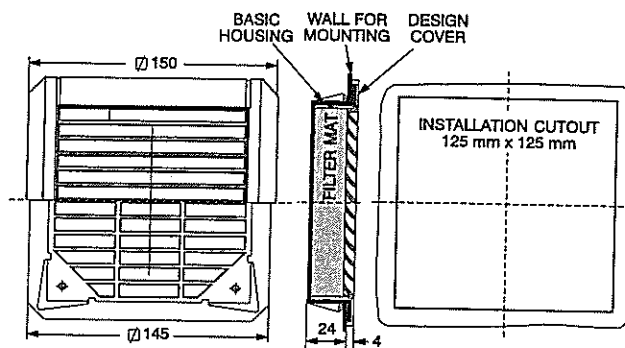


Exhaust Filters

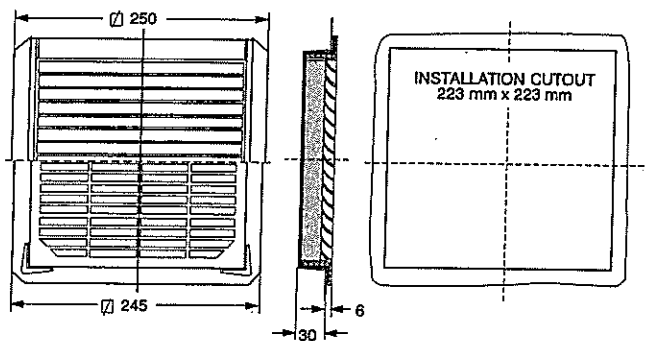
- Built to IP54 standards (except PFA1000 - IP43 standards)
- Flammability - UL94-VO
- Polycarbonate fire retardant plastic grilles, and a durable, re-usable filter mat.
- Grilles are black allowing for a complementary match to all cabinet colors.
- Gasket recommended if enclosure finished with textured paint.



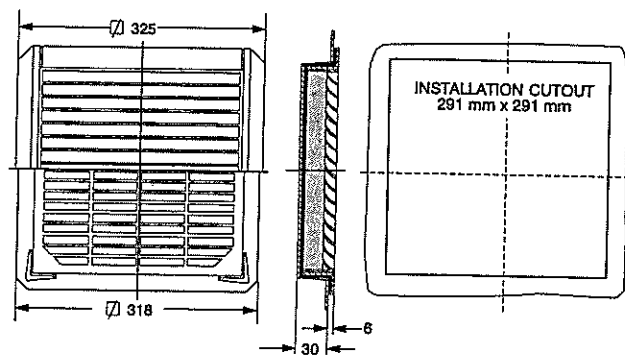
PFA1000



PFA2000



PFA3000



PFA5000

PART No.	FILTER GRADE (g/sq. ft)	FILTERING LEVEL	COMPARABLE IP STANDARD
PFA1000	1615	67%	IP43
PFA2000	5382	92%	IP54
PFA3000	5382	92%	IP54
PFA5000	5382	92%	IP54

All dimensions in inches (unless specified otherwise)

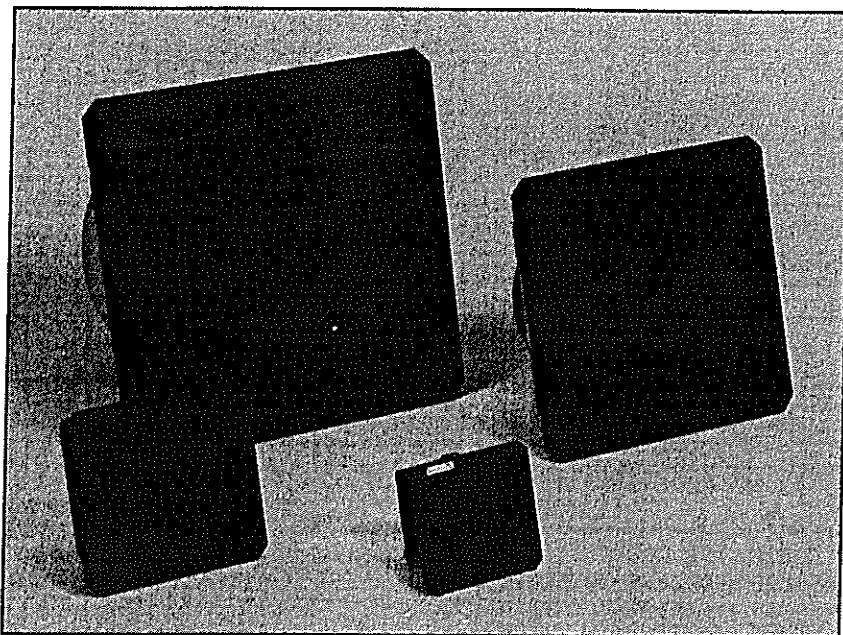
APPENDIX B-14B

FILTER FANS



FANS

Pfannenberg Model PF Filter Fans



Description

- This line of fans provides the world's most innovative technology for fan cooling and pressurizing of industrial cabinets. With electrical/electronic component costs and temperatures rising, a high quality Filter Fan provides an economical method of ensuring your enclosure does not overheat.
- Filtered passive ventilation can be provided by an Exhaust Filter for either convection cooling or in combination with a fan in forced air cooling.
- The design of this fan line is unique due to its slim-line profile - when installed, the front louvered grille protrudes less than one quarter inch. The attractive grille maintains the sleek aesthetics of an enclosure system.

Easy Installation

- The patented Pfannenberg "Click and Fit" system allows for rapid Filter Fan and Exhaust Filter installation without screws; this time saving feature will cut installation time by up to 30 minutes from traditional box fan packages.
- After using the convenient cut-out template (furnished with every unit), the fan and/or exhaust filter just snaps into the opening.

Features

- All models are 115V with an expected service life of 30,000 hours
- Built to IP54 standards (except PF1000/PFA1000 - IP43 standards)
- Flammability - UL94-VO

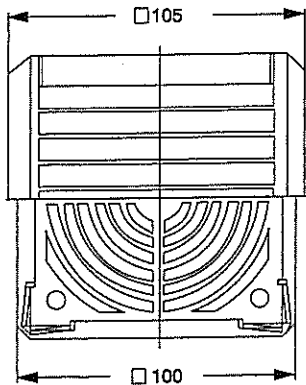
- UL fan motor
- CSA fan motor
- High performance fan motors with finger guards
- Polycarbonate fire retardant plastic grilles, and a durable, reusable filter mat.
- Grilles are black allowing for a complementary match to all cabinet colors.
- Gasket recommended if enclosure finished with textured paint

Accessories

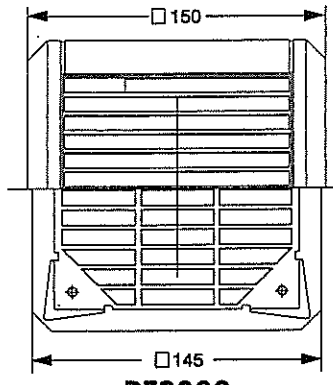
- Exhaust filters **K38**
- Replacement filters **K39**
- Gaskets **K39**

PART No.	FREE FLOW AIR DELIVERY (CFM)	AIR DELIVERY w/EXHAUST (CFM)	MAX. DYNAMIC PRESSURE (PA)	FILTER GRADE (G/SQ. FT)	FILTERING LEVEL	SOUND LEVEL (dB)	CONNECTOR TYPE	AMBIENT TEMP. °F Max/Min	COMPARABLE IP STANDARD	SHIP WT. LBS.
PF1000	14.1	8.8	29	1615	67%	39	2 - 12" wires	140/14	IP43	3
PF2000	27.7	17.7	62	5382	92%	43	2 pin plug	122/14	IP54	5
PF2500	70.8	44.2	81	5382	92%	55	terminal strip	122/14	IP54	7
PF3000	94.2	85.4	59	5382	92%	55	terminal strip	122/14	IP54	10
PF4000	132.5	88.3	172	5382	92%	65	terminal strip	122/14	IP54	10
PF5000	247.8	182.5	190	5382	92%	69	terminal strip	122/14	IP54	15
PF6000	320.8	220.8	215	5382	92%	71	terminal strip	122/14	IP54	15

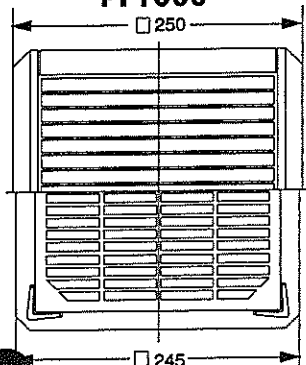
All dimensions in inches (unless specified otherwise)



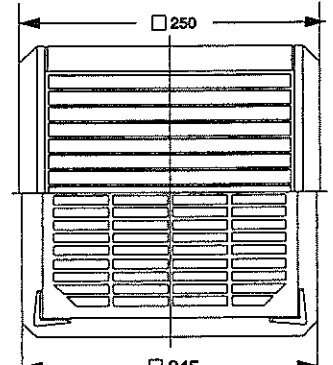
PF1000



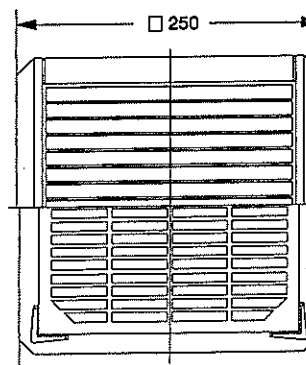
PF2000



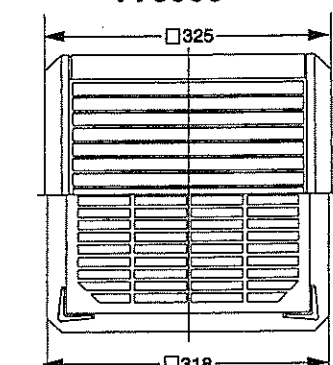
PF2500



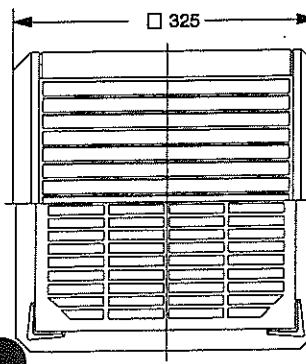
PF3000



PF4000



PF5000



PF6000

K37

All dimensions in inches (unless specified otherwise)

APPENDIX B-14C

AC SURGE PROTECTOR

SurgeFree™

MODEL

400 Series Protectors

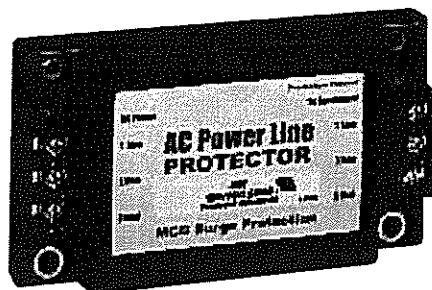
OEM Equipment Protection

The 400 series installed at or within a piece of equipment (PLCs, fire alarm monitoring systems, security system controls, etc.) provide compact, heavy-duty surge suppression. The units employ a sophisticated combination of brute force surge protection and impulse filtering to prevent damage or malfunction to sensitive equipment.

FEATURES

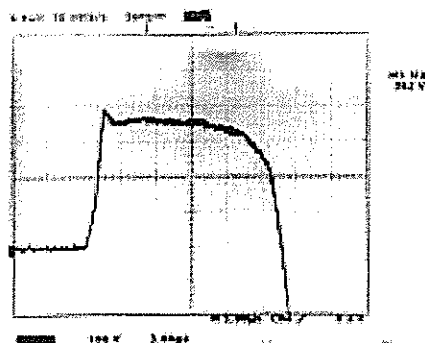
- 10,000 transient amps of surge protection.
- Compact, series installed unit.
- Screw terminals for quick installation.
- All modes of protection, L-N, L-G, N-G.
- Power present green LED.
- 5 Amp - 25 Amp rated current available.

Max. Cont. Op. VAC: 115% Rated Line Voltage
145% for 240
Response Time: <5 Nanoseconds
Modes of Protection: L-N, L-G, N-G
Surge Current/Phase (8/
20µs): 10kA
1 Event 5kA
2 2kA
100 1kA
1,000 500A
10,000 Green LED
Power Present Indicator: 13,000 ft. (4000m)
Operating Altitude: -40° to +70°C
Temperature (Operating): -40° to +85°C
Temperature (Storage): High impact plastic
Enclosure: 4.95" x 2.85" x 1.25" (126 x 73 x 32mm)
Dimensions: 4.2" x 2.25" / .185 ID - 4 holes
Mounting: 107 x 57mm/4.7mm ID 4 holes
4.95" x 4.36" x 1.10" (126 x 111 x 28mm)
Dimensions (405 Only): 4.2" x 3.76" / .185 ID - 4 holes
Mounting (405 Only): 107 x 96mm/4.7mm ID - 4 holes
Solderless screw terminals
Connection: <1 lb., (.45kg)
Shipping Weight:

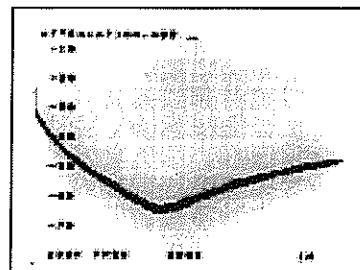


ANSI/IEEE Cat. A
20mm MOVs

10 Year Warranty



Shown here is a typical clamp waveform:
415-120V suppression voltage is 393V
peak at 3kA (8/20).



Typical filter attenuation for model 405.

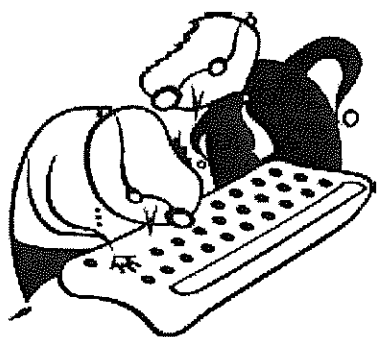
12 Burt Drive, Deer Park, New York 11729, USA • Telephone: (631) 586-5125 • Fax: (631) 586-5120

MCG Surge Protection • Toll Free: 1-800-851-1508, www.mcgsurge.com, E-Mail: info@mcgsurge.com

Specifications

**The 400 Series of surge protectors meet or exceed
ANSI/IEEE C62.41-1991 and UL 1449, 2nd Ed.**

Model	405	407	415	416	417
Rated Voltage (50/60/400Hz)	120VAC	120VAC	120VAC	120VAC	240VAC
Rated Current (rms.)@40°C	5A	7A	15A	25A	25A
Service (Phase)	1	1	1	1	1
Surge Current in kA (8/20µs)	10	10	10	10	10
Clamp Voltage (1mA) Peak	220V	220V	220V	200V	425V
Suppression Voltage: Impulse (B3) 6kV/3kA	392V	392V	392V	420V	760V
UL 1449 Surge Voltage Rating 6kV/500A	330V	330V	400V	400V	700V
Surge Energy (Joules), 10/1000µs	540	540	540	540	900
Filter Attenuation (50 ohm)	-20db	45 kHz	30 kHz	30 kHz	30 kHz
MCG Part Number:	-30db	75 kHz	95 kHz	90 kHz	90 kHz
405-439-405-00	-40db	150 kHz	300 kHz	300 kHz	300 kHz
407-439-407-00	-50db	250 kHz	750 kHz	880 kHz	800 kHz
415-439-415-00	-60db	450 kHz	1.5 MHz	1.4 MHz	1.0 MHz
416-439-416-00					700 kHz
417-439-417-00					



Did You Know...?

You can print out full boilerplate specifications for all MCG products off our website.

Come visit us at
www.MCGSURGE.com

12 Burt Drive, Deer Park, New York 11729, USA • Telephone: (631) 586-5125 • Fax: (631) 586-5120

MCG Surge Protection • Toll Free: 1-800-851-1508, www.mcgsurge.com, E-Mail: info@mcgsurge.com

APPENDIX B-14D

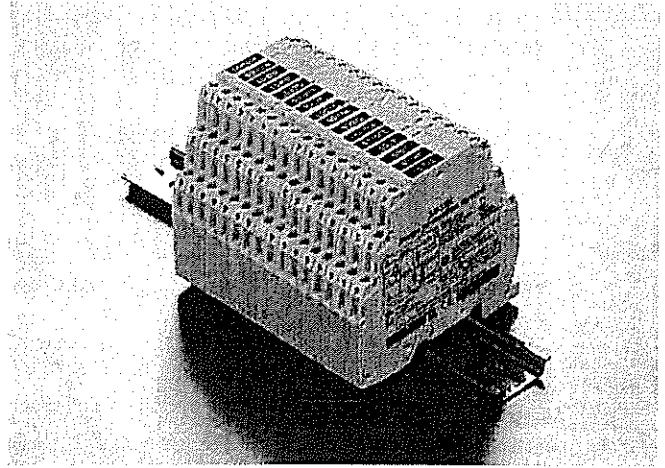
SD DATA SURGE PROTECTORS

SD Series

Ultra-slim user friendly devices for protecting electronic equipment and systems against surges on signal and I/O cabling



- Ultra-slim space saving design
- 10kA maximum surge current
- Auto-resetting - maintenance free
- Range of voltage ratings - to suit all process I/O applications
- High bandwidth, low resistance, RTD, PSTN and 3-wire transmitter versions available
- 10 year product warranty



The **SD Series** is a range of surge protection devices combining unparalleled packing densities, application versatility, proven reliable hybrid circuitry, simple installation and optional 'loop disconnect' facilities - features which make the Series the ultimate surge protection solution for process equipment, I/O systems and communications networks.

The **exceptionally high packing densities** are the consequence of an ultra slim 'footprint' for individual modules which can thus 'double-up' as feedback terminals. Each module provides full hybrid surge protection for 2 and 3-wire loop protection.

Modules with a comprehensive range of voltage ratings cover all process related signals such as RTDs, THCs, 4-20mA loops, telemetry outstations, shut-down systems and fire and gas detectors.

Optional 'loop disconnect', is a feature which allows commissioning and maintenance to be carried out without removal of the surge protection device. This facility is provided by the SD07, SD16, SD32 and SD55 units. In addition,

a third connection on the field and safe side of the protector is provided in order to terminate shields safely.

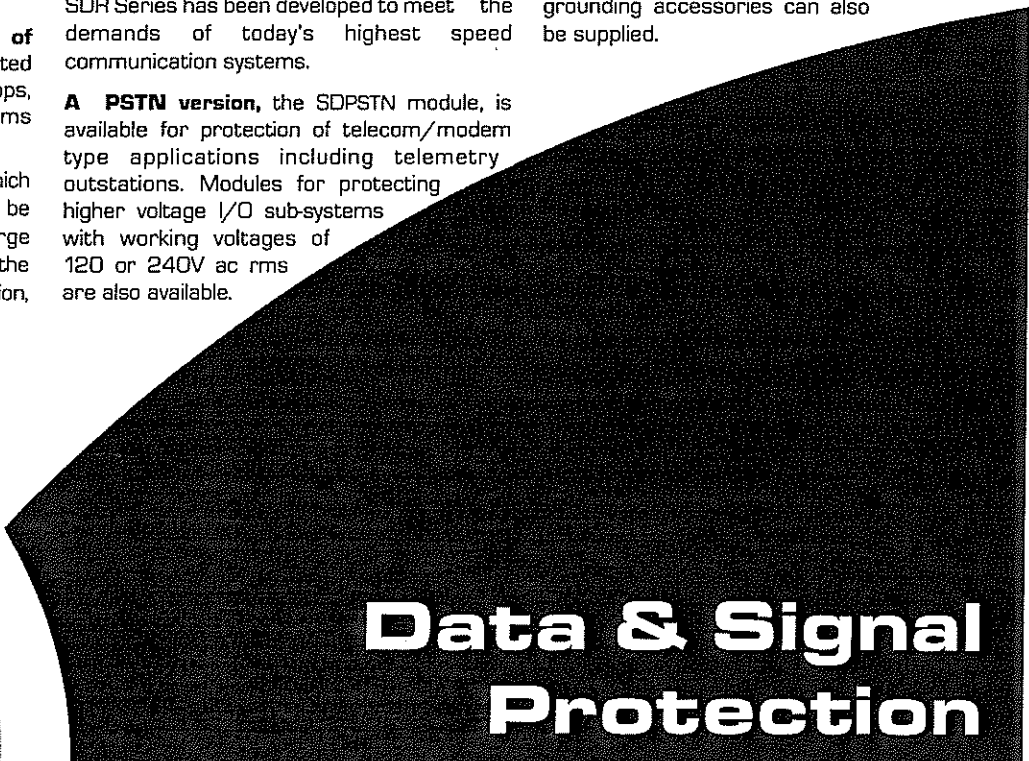
For three wire applications the specially designed SDRTD (Resistance Temperature Detector) and the SD32T3, (for separately powered 4-20mA loops) provide full 3-wire protection in a single compact unit. The recommended choice for the protection of 3-wire pressure transducers on low power circuits is the SD**R3 range.

For higher bandwidth applications, the SDR Series has been developed to meet the demands of today's highest speed communication systems.

A PSTN version, the SDPSTN module, is available for protection of telecom/modem type applications including telemetry outstations. Modules for protecting higher voltage I/O sub-systems with working voltages of 120 or 240V ac rms are also available.

One simple manual operation clamps modules securely onto DIN rail, which automatically provides the essential high-integrity ground connection. Where a number of SD modules are mounted on one rail, any that are incorrectly mounted (and therefore not securely grounded) are very obvious and can easily be remounted correctly.

'Top-hat' (T-section) DIN rail is generally suitable for mounting SD modules although for adverse environments, a specially-plated Telematic version is available from MTL. A comprehensive range of mounting and grounding accessories can also be supplied.



Data & Signal Protection

Guide to applications and selection

The SD Series of SPDs includes models for almost all possible applications operating at voltages up to 250V ac. The optional 'fuse/disconnect' package provides both fused protection against fault currents and a convenient method of isolating field circuitry from protected circuitry without requiring additional disconnect terminals. The standard fuse (which is replaceable) is rated 250mA with 50mA fuses also being available by special request. Where only the disconnect feature is required, solid links can be used.

As an example, this feature is of particular value in applications in which an SPD is used with a bulk power supply feeding multiple loops. The individual module fuse prevents a fault or follow on current on one loop disrupting the power supply to the others. Also, loops can be removed from the circuit for maintenance reasons or added without requiring additional disconnect terminals.

The following guide to selection suggests the most suitable SDs for a number of specific applications. For technical information, see the detailed specifications on the back page of this publication (some field circuit protection is shown as an example).

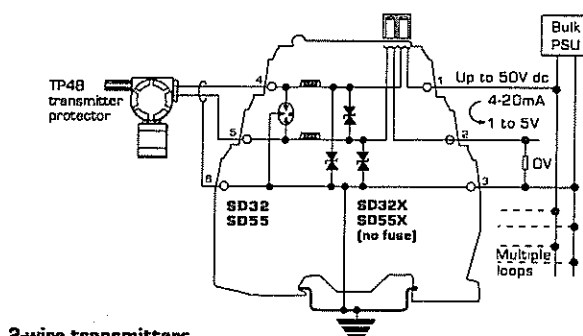
Analog inputs (high-level)

2-wire transmitters, 4-20mA, conventional and smart

The SPDs recommended for use with 'conventional' and 'smart' 4-20mA transmitters (fed by a well-regulated supply) are the SD32 and SD55, the choice depending upon the maximum working voltage of the system (32V and 55V respectively). The diagram illustrates a prime example of an application for which the fuse/disconnect facility is particularly useful; however, both models are available in 'X' versions without the optional fuse/disconnect feature.

FIELD CIRCUIT

PROTECTED CIRCUIT

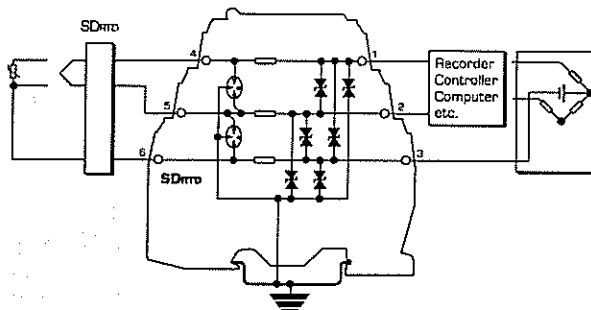


2-wire transmitters

Analog inputs (low-level)

RTDs, THCs and mV sources

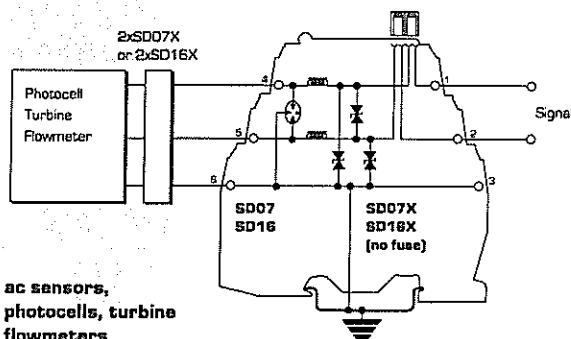
These applications are best served using the SDRTD. For optimum accuracy, the energizing current should be chosen to ensure the voltage across the RTD does not exceed 1V over the full measurement range. When using a PT100 device, we recommend an energizing current of 1mA.



3-wire RTDs

AC sensors, photocells, and turbine flowmeters

The SD07 or SD16 (depending upon the operational voltage) are the preferred choices for this application. SD07X and SD16X are also suitable.



ac sensors, photocells, turbine flowmeters

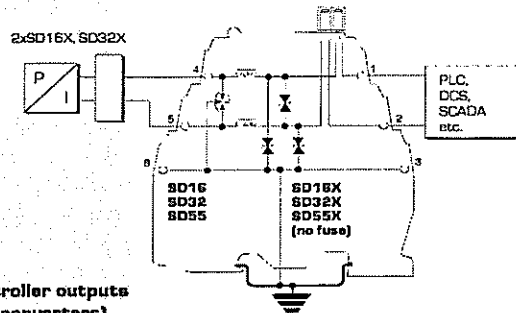
FIELD CIRCUIT

PROTECTED CIRCUIT

Analog outputs

Controller outputs (I/P converters)

For this application, the recommendations are the SD16, SD32 and SD55 (and the equivalent 'X' versions), the final choice depends upon the working voltage.

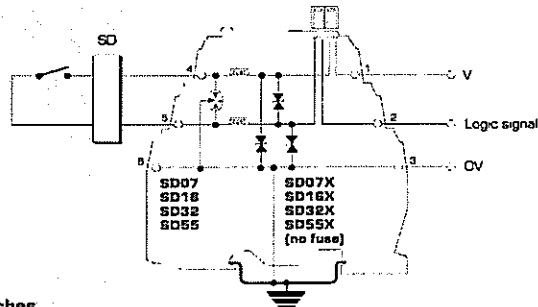


Controller outputs
(I/P converters)

Digital (on/off) inputs

Switches

Suitable SPDs for switches include the SD07, SD16, SD32 and SD55 modules - the choice depending upon the operating voltage of the system. The 'X' versions of these are also suitable.

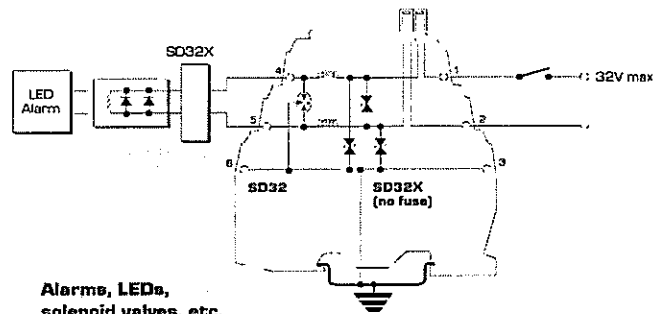


Switches

Digital (on/off) outputs

Alarms, LEDs, solenoid valves, etc.

The recommended choice for this application is the SD32 or SD32X.

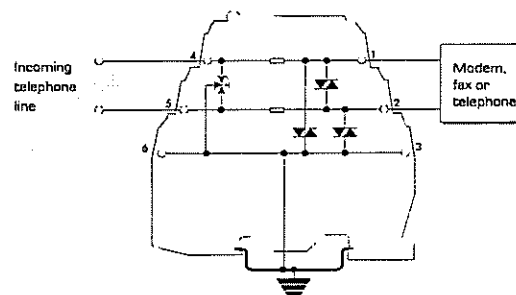


Alarms, LEDs,
solenoid valves, etc.

Telemetry (PSTN)

Telemetry outstations

The SDPSTN has been designed specifically for the protection of signals transmitted on public switched telephone networks.

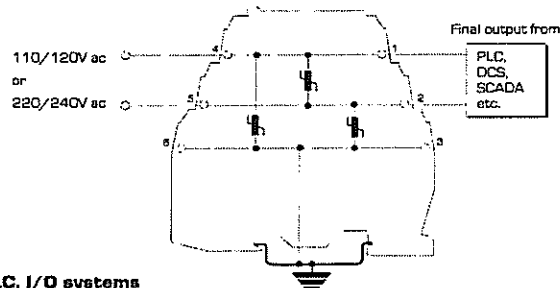


Telecom line

AC supplied equipment

PLC, I/O systems

For systems on 110-120V ac, the SD150X is the recommended choice and for 220-240V ac systems, the SD275X is recommended.



PLC, I/O systems

Transmitter and sensor protection

Transmitters and sensors are widely used in highly exposed areas and where lightning damage is common. In many cases, the ideal solution for 2-wire transmitters or sensors is the TP48 which mounts directly onto the transmitter via spare conduit entries or a tee fitting. Where these entries are not available or 3-wire devices are used, the compact design and simple installation of the SD Series makes it the obvious choice for transmitter protection.

The SDs within the junction box should be installed no further than one meter away but as close as possible to the sensor or transmitter they are protecting. A bond is required from the general mass of steelwork to the sensor or transmitter housing either using a flat short braid or a cable of at least 0.16 inch² (4mm²) cross sectional area. In most instances this bond is automatically made by fixing the metallic transmitter housing to the plant structure. This bond ensures the voltage difference between the signal conductors and the transmitter housing is below the transmitter's insulation rating. Please note that the transmitters or sensors are connected to the 'Protected Equipment' terminals of the SD and not the 'Field Cables'.

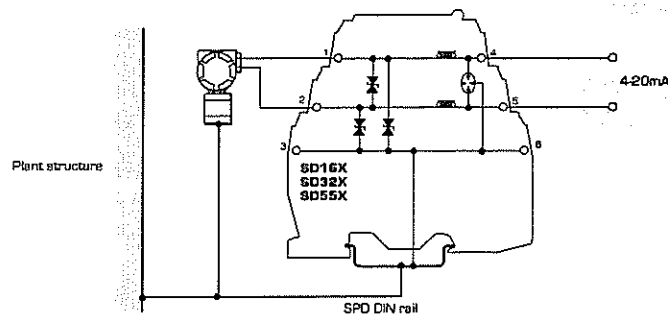
2-wire transmitters or sensors

4-20mA transmitters, conventional and smart

Where the TP48 is not an acceptable solution, either because of technical suitability or difficulties in mounting, the SD16X, SD32X and SD55X are an excellent alternative.

FIELD CIRCUIT

PROTECTED CIRCUIT



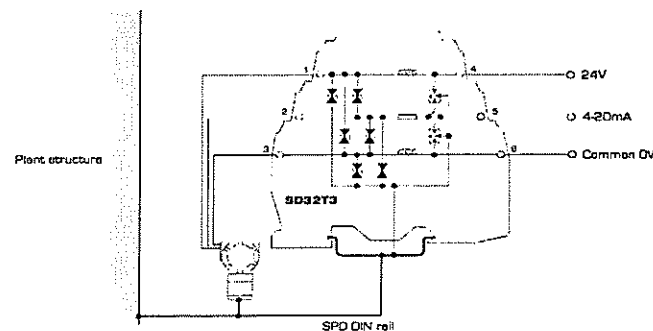
2-wire transmitter or sensor

3-wire transmitters or sensors

Vibration Sensors and 4-20mA loop process control systems invariably require three wire connections, when powered from an external source.

This may be accomplished in one unit by using the SD32T3 three terminal Surge Protection Device (SPD). Because the SD32T3 protects all three conductors within the same unit, higher protection is achieved, as the SPD hybrid circuitry is common to all three wires.

The SD07R3, SD16R3, SD32R3 and SD55R3 are also available for the protection of 3-wire pressure transducers on low power circuits.



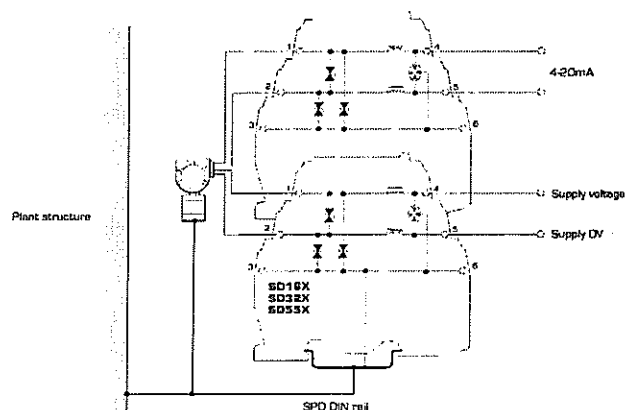
3-wire transmitter or sensor

4-wire transmitters or sensors

Flow meters, level detectors, etc.

4-wire systems such as level detectors require two SDs, one for the supply and the other for the transmitter output. Generally the voltages across the pairs are similar and so the recommended choice would be a pair of SD16X, SD32X or SD55Xs. However, AC powered transmitters should be protected with an SD150X or 275X (depending upon supply voltage) for the supply inputs.

Loadcells are catered for by Telematic's LC30 which is suitable for both 4 and 6-wire load cells.



4-wire transmitter or sensor

Communication systems protection

High speed data links between buildings or one part of a plant to another have become more common with the widespread use of smart transmitters and the increase in unmanned installations. The SD Series has an SPD suitable for all process I/O applications with a choice of low resistance units, high bandwidth and a variety of voltage variants. The SDR Series has been specially designed to meet the requirements for high speed data links with an extremely high bandwidth.

Communication systems

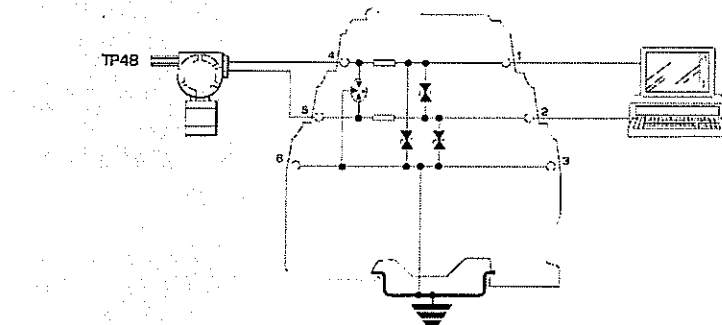
There are many types of communications protocols from the relatively slow speed RS232 to industrial systems such as Allen Bradley Data Highway protocol running at 10MHz. These communication systems work at different operating voltages and therefore must be selected with this in mind. Table 1 below shows suitable SD Series surge protection devices for various communications protocols.

Bus powered systems

There are a variety of bus powered systems specially designed for the process industry. The ideal surge protection device for these systems is the SD32R as it has a very high bandwidth and a modest in-line resistance.

FIELD CIRCUIT

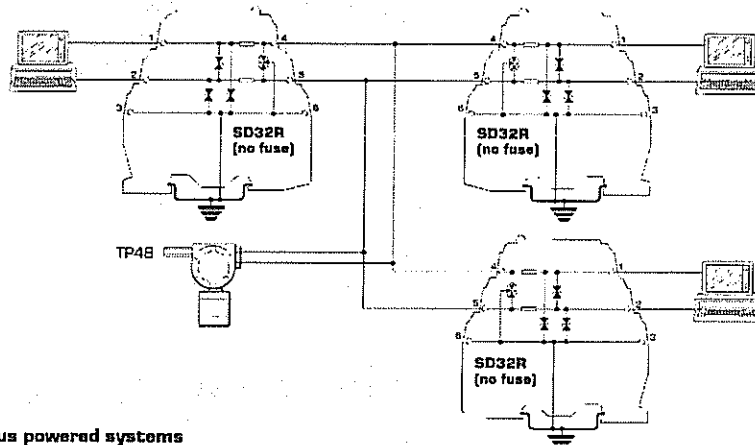
PROTECTED CIRCUIT



Communication systems

FIELD CIRCUIT

PROTECTED CIRCUIT



Bus powered systems

Typical Applications

Table 1 shows suitable SD devices for different applications. In some applications alternative devices may be used, for example, where lower in-line resistance or a higher voltage power supply is used.

Telematic have operationally tested the recommended SD Series units with the representative highways listed. However, no formal approval for their use in these systems has been sought from the respective bodies.

Table 1

Application	Preferred SPD	Alternative
Allen Bradley Data Highway Plus	SD16R	
Foundation Fieldbus		
31.25kbits/s voltage mode	SD32R	
1.0/2.5 Mbits/s	SD55R	
HART	SD32X	SD32, SD32R
Honeywell DE	SD32X	SD32, SD32R
LonWorks		
FFT-10	SD32R	
LPT-10	SD55R	
TP-78	SD07R	
IS78†	SD32R	
Modbus 'S Modbus Plus (RS485)	SD16R	
PROFIBUS		
DP	SD32R	
PA (IEC 1158, 31.25 kbits/s)	SD32R	
RS232	SD16	SD16X
RS422	SD16R	
RS423	SD16R	
RS485	SD16R	
WorldRP (IEC 1158)	SD32R	
31.25 kbits/s voltage mode		
1.0/2.5 Mbits/s	SD55R	

Hazardous area applications

The dangers from lightning induced sparking in Division 1 are considered real enough to require preventative measures. The National Electrical Code (NEC) articles 501-17 for gasses and 502-17 for dust stresses the importance of SPDs in hazardous areas. An outdoor installation where there is a high likelihood of both lightning induced transients and combustible gases requires the installation of SPDs to prevent possible ignition of the gases and damage to safety related equipment. Areas which are particularly at risk include flammable liquid storage tanks, effluent treatment plants, distillation columns in petrochemical works and gas pipelines.

Division 1

SPDs for transmitter protection should be installed in Division 1 (figure 1) but sufficiently close to the location where the gas vapor is continuously present to prevent high voltages entering that location. The distance from the SPD to the interface should be less than one meter where possible. Because there is only a very small free volume, the SD Series is suitable for mounting in an explosionproof enclosure where Division 1 mounting is required. Alternatively, dependent upon location, a TP48 transmitter protection device can be used.

Division 2

In practice, the SPD would normally be mounted on the transmitter or sensor housing which usually lies in Division 2 and is very close to a continuously hazardous area. The SD Series is suitable for protecting electrical circuits in Division 2, and can be used without affecting the safety aspects of the circuit. Non-incendive (low-current) circuits can be protected using any SD Series unit mounted in either the safe or Division 2 area including those with the fuse disconnect facility. Non-arcing (high current) circuits can also be protected except that SPDs with the fuse disconnect facility may only be mounted in the safe area. When mounted in Division 2, the SD units must be mounted in a suitable enclosure, normally the minimum requirements are NEMA 13 (IP54) and 7Nm resistance to impact.

Certification

Introducing surge protection into Intrinsically Safe (IS) circuits is trouble free provided that input safety parameters are not exceeded (for more information refer to Telematic application notes TAN1004 and TAN1005). SD Series devices have certification for use in IS circuits located in Division 1 or 2 (excludes SD150X, SD275X and SDPSTN). Their certification parameters are:

SD**s, SD**Xs, SD32T3:

$I_{max} = 186mA$
 $P_{max} = 1W (-30^{\circ}C < T_{amb} < +75^{\circ}C)$
 or $P_{max} = 1.2W (-30^{\circ}C < T_{amb} < +60^{\circ}C)$
 or $P_{max} = 1.3W (-30^{\circ}C < T_{amb} < +40^{\circ}C)$
 $C_i = 0\mu F, L_i = 220\mu H$

SD**Rs, SD**R3s, SDRTD:

$P_{max} = 1W (-30^{\circ}C < T_{amb} < +75^{\circ}C)$
 or $P_{max} = 1.2W (-30^{\circ}C < T_{amb} < +60^{\circ}C)$
 or $P_{max} = 1.3W (-30^{\circ}C < T_{amb} < +40^{\circ}C)$
 $C_i = 0\mu F, L_i = 0\mu H$

Use with Division 2 circuits is covered by Part B of the CSA Certificate.

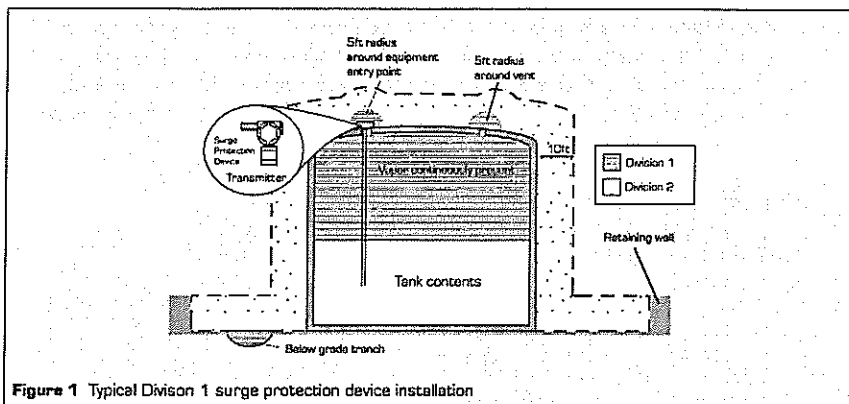


Figure 1 Typical Division 1 surge protection device installation

Installation

Positioning: The SDs should be mounted on the field wiring side to ensure that any surges entering from the field do not damage any intrinsically safe barriers or galvanic isolators in the system. The SDs and intrinsically safe interface should be mounted close to each other but on separate DIN rails in order to maintain the required 1.97" (50mm) clearance between safe area and hazardous area terminals of the IS interface.

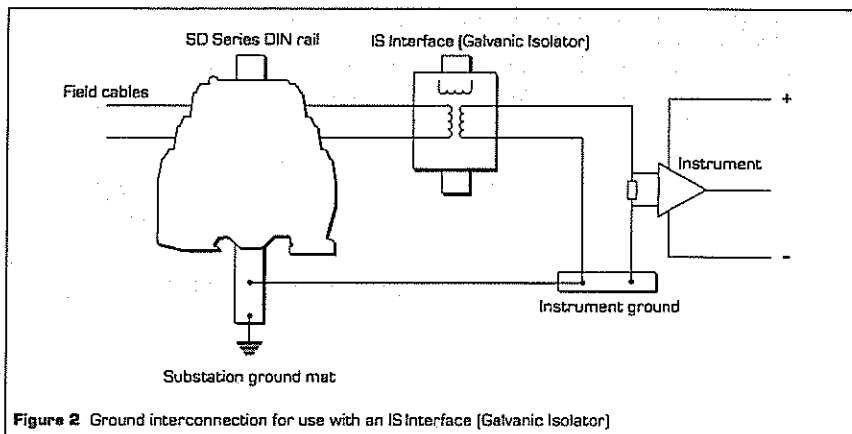


Figure 2 Ground interconnection for use with an IS interface (Galvanic Isolator)

Grounding

The recommended grounding for field mounted devices has been illustrated previously but it is the grounding at the control panel that is more critical as there are usually a number of grounding systems, each with their own requirements. The grounding system illustrated here replaces the instrument OV bond, the control system PSU bond and the IS ground with one single ground connection to meet all the design requirements and give the most effective protection against the effects of lightning induced surges.

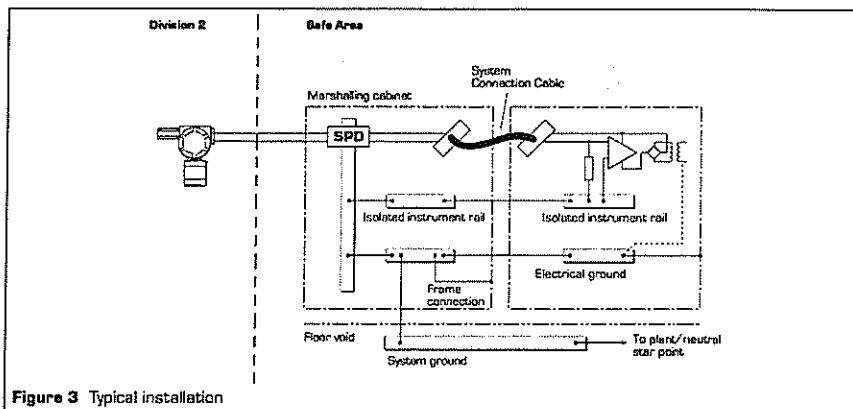


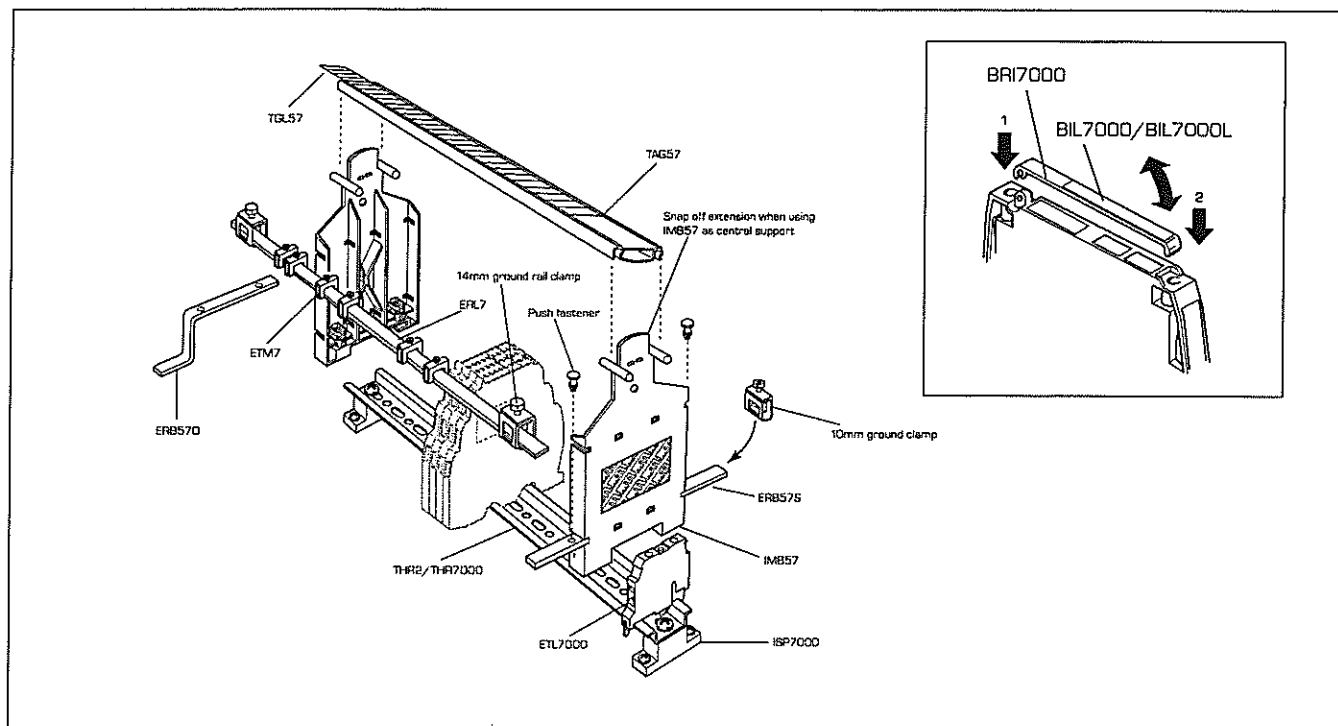
Figure 3 Typical installation

In all installations utilizing safety related apparatus consideration should be given to protecting the system supply and any long communication cable.

SD Series mounting kits and accessories

The SD Series has a full range of mounting kits and accessories to simplify installation and tagging of individual loops. Insulating spacers (ISP7000) are available to allow mounting of the units onto backplanes without compromising correct grounding practice. These are placed at regular intervals along the rail or at each end as required. Ground connections can be made to the DIN rail via the ground terminal (ETL7000). Weatherproof enclosures are also available with all the necessary mounting accessories to install the SD Series surge protection devices.

Two tagging systems are available. One consists of tagging strips (TAG57) with labels (TGL57) mounted on posts (IMB57) at each end of a row of surge protection devices (SPDs). The other consists of separate tagging identifiers (BRI7000) mounted on the tops of individual SPDs. Both methods can be used conjointly. Replaceable fuses or solid links are available in packs of 5 (SD-F25, SD-F05 and SD-LNK).



Mounting accessories

ISP7000	Insulating spacer
THR2	Standard DIN rail, 35mm x 7.5mm
THR7000	T-section DIN rail, specially nickel plated, 35mm x 7.5mm, 1m length

Grounding/earth rail accessories

ETL7000	Ground terminal, DIN rail mounted
IMB57	Insulated mounting block (two needed)
ERB57S	Ground rail bracket, straight
ERB570	Ground rail bracket, offset
ERL7	Ground rail, 1m length
ETM7	Ground terminal, pack of 50

Tagging accessories

TAG57	Tagging strip, 1m length
TGL57	Tagging strip labels, set of 10 x 0.5m
BRI7000	Barrier identifier
BIL7000	Barrier identification labels, sheet of 120
BIL7000L	Barrier identification labels, A4 sheet of 128

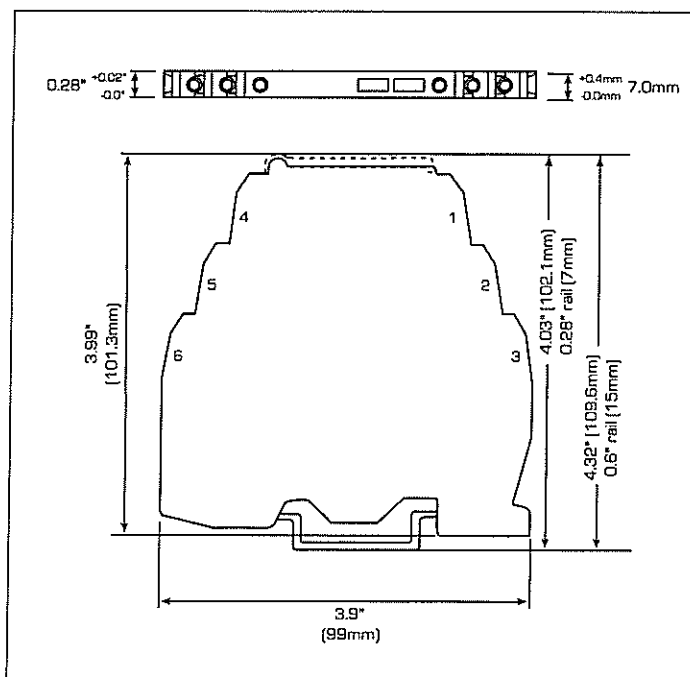
Enclosures

DX070	Enclosure for up to 9 x SD Series SPDs
DX170	Enclosure for up to 22 x SD Series SPDs
DX430	Enclosure for up to 58 x SD Series SPDs

Accessories (replacement)

SD-F25	Replaceable fuse pack - 250mA standard (available in packs of 5)
SD-F05	Replaceable fuse pack - 50mA special (available in packs of 5)
SD-LNK	Solid Link (available in packs of 5)

DIMENSIONS



Specification

All figures typical at 77°F (25°C) unless otherwise stated)

Protection

- Full hybrid line to line
- Each line to shield/ground

GDT rating

- 10kA (8/20µs),
- (not applicable to SD150X and SD275X)

MOV rating

- 6.5kA (8/20µs),
- (SD150X and SD275X only)

Reaction time

- Within nanoseconds (10⁻⁹s)

RTD resistance range (SDRTD)

- 10 to 1500Ω

Degradation accuracy (SDRTD at 1mA)

- 0.1% (RTD resistance ≥ 100Ω)
- 0.1Ω (RTD resistance < 100Ω)

Ambient temperature

- 22°F to +167°F (-30°C to +75°C) - working
- 40°F to +176°F (-40°C to +80°C) - storage
- See page 6 for certification parameters

Humidity

- 5 to 95% RH (non-condensing)

Case flammability

- UL94 V-2

Terminals

- 0.1 inch² (2.5mm²)
- 12 AWG

Mounting

- T-section ('Top-hat') DIN rail
- (35mm x 7.5mm or 35mm x 15mm rail)

Weight

- 2.47oz (70g) approximately

EMC compliance

- To Generic Immunity Standards,
- EN 50082, part 2 for industrial environments

R&TTE compliance

- EN 50082-2 : 1995
- EN 41003 : 1999
- EN 60950 : 1992
- (not applicable to SD150X and SD275X)

LVD compliance

- SD150X & SD275X
- EN 60950 : 1992
- EN 61010 : 1995
- SDPSTN
- EN 41003 : 1999

Model	Working voltage*		Rated load current	Nominal resistance	Max. leakage current	Max. continuous operating voltage	Let-through voltage	Bandwidth (Frequency)	Special feature
	(Vdc)	(Vac)	(mA)	(Ω/line)	(µA)	(V)	(V)		
SD07	7	5	50 or 250*	4.2†	500	7.7	30	25kHz	Fuse Disconnect
SD16	16	11	50 or 250*	4.2†	5	17	40	25kHz	Fuse Disconnect
SD32	32	22	50 or 250*	4.2†	5	36	60	25kHz	Fuse Disconnect
SD55	55	38	50 or 250*	4.2†	5	62	100	25kHz	Fuse Disconnect
SD07R	7	5	400	2.7	500	7.7	30	50MHz	High Bandwidth
SD16R	16	11	400	4.7	5	17	40	50MHz	High Bandwidth
SD32R	32	22	400	10	5	36	60	50MHz	High Bandwidth
SD55R	55	38	400	10	5	62	100	50MHz	High Bandwidth
SD07X	7	5	400	2.2	500	7.7	30	25kHz	Low Resistance
SD16X	16	11	400	2.2	5	17	40	25kHz	Low Resistance
SD32X	32	22	400	2.2	5	36	60	25kHz	Low Resistance
SD55X	55	38	400	2.2	5	62	100	25kHz	Low Resistance
SD32T3	32	22	400	2.2*	5	36	60	720kHz	3 Terminal
SD07R3	7	5	400	2.7	500	7.7	30	50MHz	3 Terminal
SD16R3	16	11	400	4.7	5	17	40	50MHz	3 Terminal
SD32R3	32	22	400	10	5	36	60	50MHz	3 Terminal
SD55R3	55	38	400	10	5	62	100	50MHz	3 Terminal
SDRTD	1	0.75	1-10‡	2.7	0.3	7.7	30	50MHz	3-wire RTD
SDPSTN	162	114	550	4.7	5	175	234	4MHz	PSTN
					ac rms	dc	ac rms		
SD150X	170	120	3A‡	0.1	250	150	132	450	High current
SD275X	339	240	3A‡	0.1	250	150	275	850	High current

Note: all figures are typical at +25°C unless otherwise stated; *standard fuse; +over full working temperature range; †at 20mA with a 250mA standard fuse; ‡these units need external 3A fuses; ^Signal; *Power & Common; ‡maximum energizing current depends upon RTD resistance. See page 2 for details.

Definitions of terminology used in table

- Working voltage**
Maximum voltage between lines or lines/ground for the specified leakage current
- Maximum leakage current**
Maximum current drawn by the SPD at the working voltage
- Maximum continuous operating voltage**
Maximum voltage that can be applied to the protected terminals without damage
- Let-through voltage**
Peak output voltage after injection of test impulse from 6kV/3kA combination waveform generator (often known as 'limiting' voltage)
- Bandwidth (frequency)**
Frequency range up to which ac signals can be transmitted without undue attenuation; 3dB into 50Ω (500Ω for the SDPSTN)

To order specify -

Order by module, as listed in the specification table and/or accessory part numbers as defined on page 7.

Note: In accordance with our policy of continuous improvement, we reserve the right to change the product's specification without notice.

Approvals

Authority (Country)	Standard	Certificate/ File No.	Approved for	Product
Austel (Australia)	AS/NZ3548:1995 AS/NZS4117:1996 TSD01: 1997	—	Private wire	SD07R
BASEEFA (UK)	EN 50014 & EN 50020	Ex96D2219X	EEx ia IIC T4	SD07X, SD16X SD32X, SD55X, SD32T3
CSA, CSA/C/US (Canada, USA)	CSA C22.2 No. 0-M1991 CSA C22.2 No. 157-M1992 UL 913, 5th edition CSA C22.2 No. 142-M1987 CSA C22.2 No. 213-M1987 UL 508, 17th edition UL 1604, 3rd edition	LR 103652-3	EEx ia Class 1, Groups A, B, C and D, T4 Class 1, Div 2 Groups A,B,C, D T4*	SD07, SD16, SD32, SD55 SD07X, SD16X, SD32X, SD55X SD07R, SD16R, SD32R, SD55R SDRTD, SD32T3 SD07R3, SD16R3, SD32R3, SD55R3
UL (USA)	UL 497B Listed	E220693	Isolated loop communication circuits	SD07, SD16, SD32, SD55 SD07X, SD16X, SD32X, SD55X SD07R, SD16R, SD32R, SD55R SD07R3, SD16R3, SD32R3, SD55R3 SD32T3, SDRTD
UL (USA, Canada)	UL 1449 2nd Edition Listed	E217523	AC power protection	SD150X, SD275X

* See page 6 for further details

MTL Incorporated
9 Merrill Industrial Drive, Hampton, NH 03842 USA
Tel: +1 800 835 7075, +1 603 926 0090 Fax: +1 603 926 1899
E-mail: info@mtlinc.com, WWW: www.mtlinc.com

A member of the MTL Instruments Group plc



SD4-240 01

APPENDIX B-14E

ACOPIAN 24 VDC POWER SUPPLY



Power Supply - 24vdc.

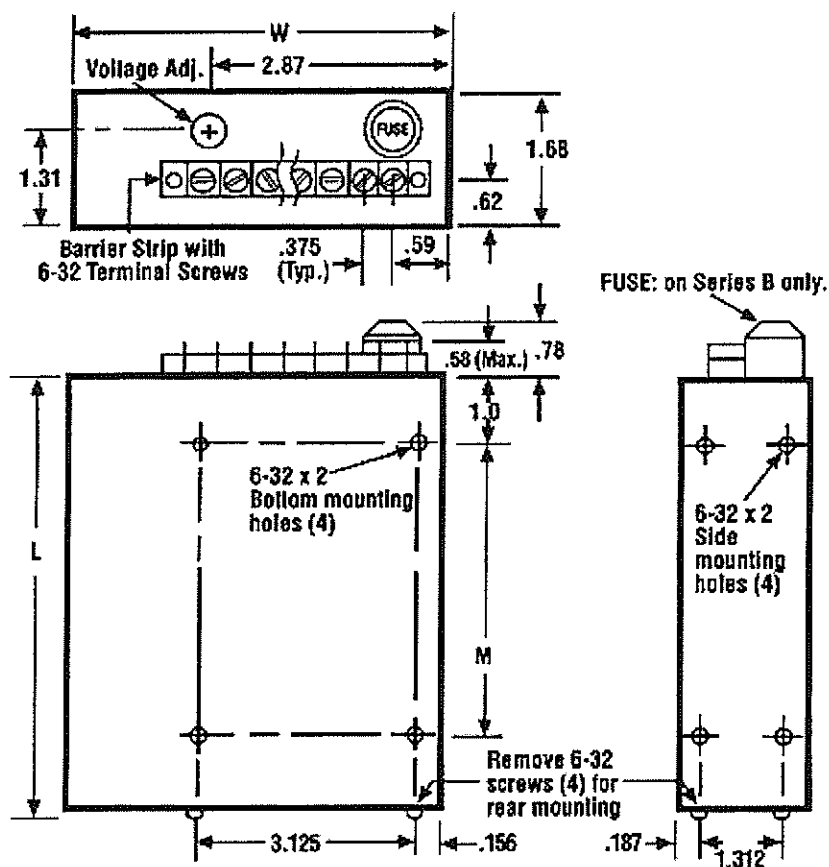
Narrow Profile
LINEAR REGULATED
AC-DC single output

- Shipped Within 3 Days
- All Models U.L. Recognized
- Five Year Warranty

B24TN75

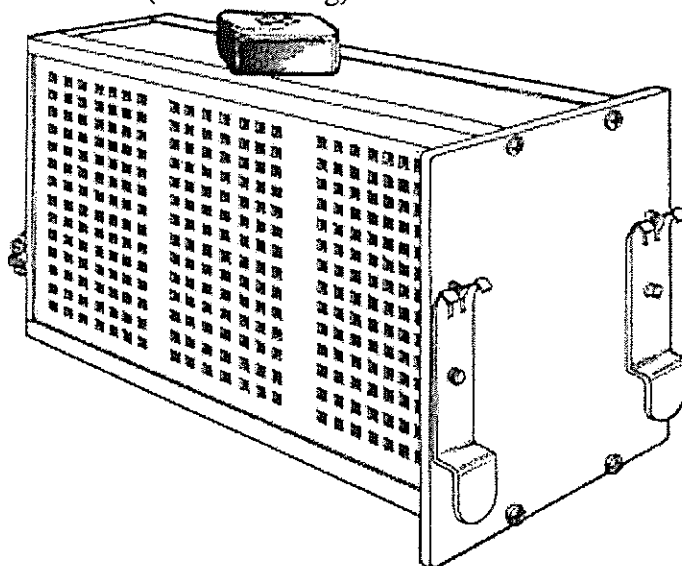
DRAWING

(All dimensions in inches.)



Case Size	L	W	M	Approx. Weight
F6T	6.59	3.84	4.0	2 lb. 4 oz.

NPR35DIN (rear mounting)



[\[HOME\]](#) [\[NARROW PROFILE Linear- MAIN SCREEN\]](#)



P.O. Box 638, Easton, PA 18044
Phone: (610) 258-5441 · Fax: (610) 258-2842

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Narrow Profile
LINEAR REGULATED
AC-DC single output

- Shipped Within 3 Days
- All Models U.L. Recognized
- Five Year Warranty

Threaded mounting holes permit mounting the power supplies to a chassis, cabinet wall or bracket, or they may be used on a test bench or table top.

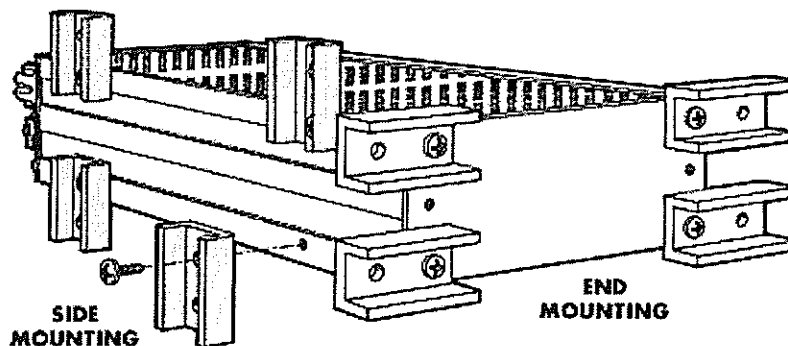
ACCESSORY MOUNTING KITS for Wall Mounting or DIN Rail Mounting

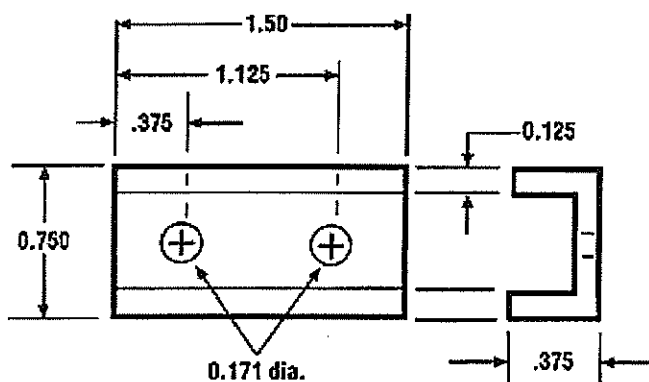
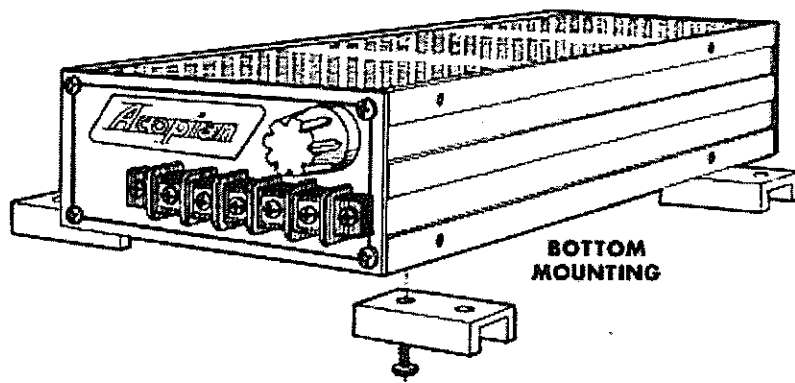
For Wall Mounting:

- NP6 Mounting Kit \$8.00
for case sizes F6T, F8T, N8T
- NP6L Mounting Kit \$8.00
for case size N8H

Model NP6L consists of two brackets 1.5" long as shown below, and two 2.5" long brackets (to extend beyond heat sink).

To mount from the power supply side of the mounting surface, necessary when the other side of the mounting surface is inaccessible, use accessory Mounting Kit NP6 or NP6L. These kits consist of four aluminum brackets and four machine screws for fastening them to the power supply, effectively adding mounting flanges to the power supply.



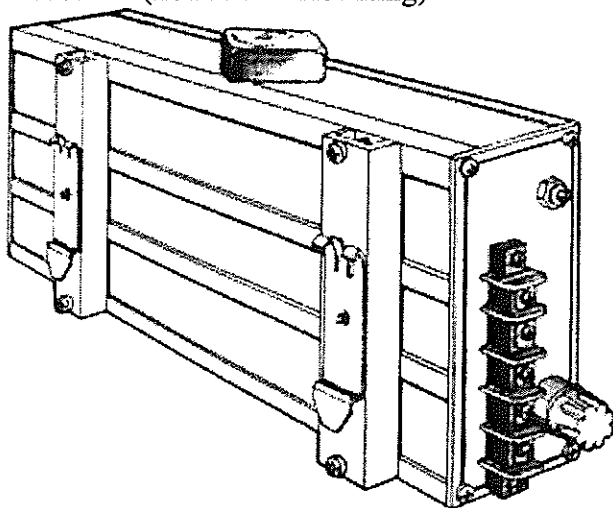


(All dimensions in inches.)

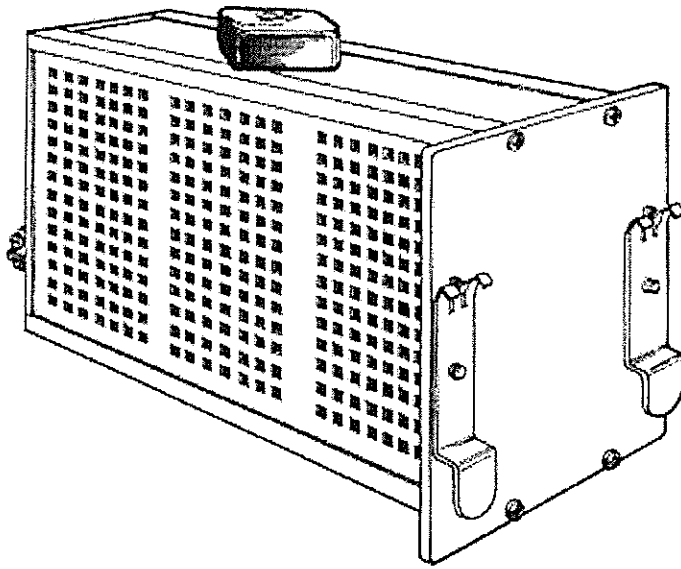
For DIN Rail Mounting:

- NPH35DIN Mounting Kit \$15.00
- NPR35DIN Mounting Kit \$15.00

NPH35DIN (horizontal mounting)



NPR35DIN (rear mounting)



[HOME] [NARROW PROFILE Linear- MAIN SCREEN]



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Phone: (610) 258-5441 · Fax: (610) 258-2842

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APPENDIX B-14F

APC UNINTERRUPTIBLE POWER SOURCE

● APC Back-UPS Pro®

Uninterruptible Power Source
Onduleur
Sistema de Alimentación Ininterumpible

● **User's Manual**

**Manuel
d'utilisateur**

**Manual de
Usario**

120 VAC

280, 420, 650,
1000, 1400



APC®
AMERICAN POWER CONVERSION



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1. Introduction

1.1 Thank you!

Thank you for selecting this uninterruptible power source (UPS). It is designed for many years of reliable, maintenance-free service.

Important safety instructions!!

Please read this manual. It provides safety, installation, and operating instructions that should be followed during installation and maintenance of the UPS and batteries. It will help you get the fullest performance and service life from your UPS. This manual describes the inner workings of the UPS and how they relate to providing superior protection from utility power problems such as blackouts, brownouts, sags, swells, EMI/RFI noise, and surges. Also included are instructions for obtaining factory service, if necessary.

If you have a problem with the UPS, please refer to this manual before calling customer service. The troubleshooting section (section 8) can help with most situations typically encountered when using the UPS.

Please save the packaging materials!

The UPS's shipping materials are designed with great care to provide protection during shipping. These materials are invaluable if you ever have to return the UPS for service. Damage sustained during transit is not covered under the warranty.

1.2 Radio Frequency Interference

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules and the Class B limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

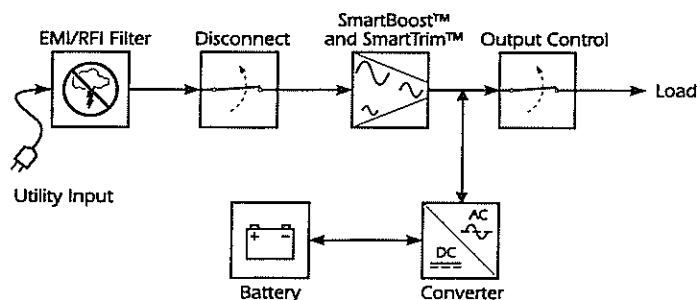
However, there is no guarantee that interference will not occur in a particular installation. If this equipment causes interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- reorient the receiving antenna
- increase the separation between the equipment and the receiver
- connect the equipment to an outlet on a circuit different from that to which the receiver is connected
- consult the dealer or an experienced radio/TV technician for help.

Shielded communications interface cables must be used with this product.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

1.3 Theory of Operation



This high-performance, line-interactive, uninterruptible power source (UPS) provides clean, reliable, AC power to computer systems — protecting them from power blackouts, brownouts, swells, sags, surges, and interference.

Normally, the UPS operates “on-line,” supplying power from the **utility input** to the **load** (workstation, server, or other device). The **converter** circuitry is used to maintain an optimal float charge level on the **battery**.

When the utility fails, the **disconnect** switch opens and the **converter** supplies AC power to the **load**. The loads operate normally until shut down or until the battery is exhausted. The UPS automatically transfers the load back to utility power and recharges the batteries when the line voltage returns to normal.

The UPS also provides surge protection and **EMI/RFI filtering**, as well as **SmartBoost™** and **SmartTrim™** automatic voltage regulation, which corrects high and low input voltage without drawing power from the battery.

Output control uses the UPS's remote interface to turn the load on or off, without disabling other UPS functions.

1.4 Features

CellGuard™ Intelligent Battery Management

The UPS provides visual and audible indications of the battery's status including low battery and replace battery conditions.

The UPS exercises the battery during its self-test, and will detect a weak battery before it is put into service. The UPS normally performs a self-test at power up and every 14 days thereafter. Self-tests can also be conducted manually with the on/off button at any time. See section 5.2.

The UPS features user-replaceable hot-swappable batteries. Batteries can be replaced without having to remove power from the loads or send the UPS in for service.

Power Management Software

This UPS offers advanced features when connected via the computer interface to a device using power management software.

Telephone Line and Network Surge Protection

This UPS provides advanced single telephone line or 10Base-T network surge suppression through the modular connectors on the back panel. See section 4.

2. Safety

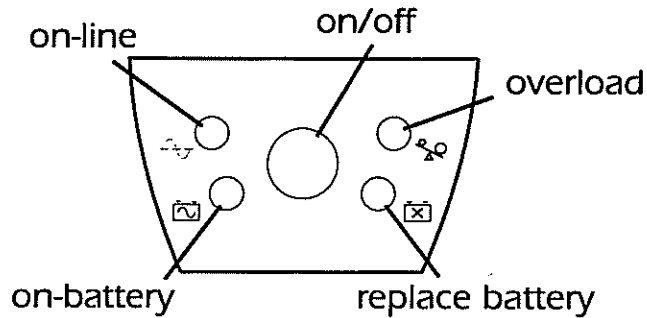


CAUTION!

- To reduce the risk of electric shock in conditions where load equipment grounding cannot be verified, disconnect the UPS from the AC power outlet before installing a computer interface or accessory slot signal cable. Reconnect the power cord only after all signaling connections are made.
- Connect the UPS to a two-pole, three-wire grounding AC power outlet. The receptacle must be connected to appropriate branch protection (fuse or circuit breaker). Connection to any other type of receptacle may result in a shock hazard and violate local electrical codes.
- The UPS has an internal energy source (the battery). **The output may be energized when the unit is not connected to an AC power outlet.**
- To deenergize the outputs of the UPS:
 1. If the UPS is on press the on/off button to switch the UPS off.
 2. Disconnect the UPS from the AC power outlet.
 3. To deenergize the UPS completely, disconnect the battery. See section 10.
- Never install telephone wiring during a lightning storm.
- Use of this equipment in life support applications where failure of this equipment can reasonably be expected to cause the failure of the life support equipment or to significantly effect its safety or effectiveness is not recommended.

3. Presentation

3.1 Front panel



Press the **on/off** button with the UPS plugged in to turn the UPS on or off. See Sec. 5.1.

On/off also activates the UPS's self-test. See section 5.2.

The **overload** LED illuminates when the loads connected to the UPS exceed the UPS's power capacity. See section 6.2.

The **replace battery** LED illuminates when the UPS's battery is no longer useful and must be replaced. See section 10.

The **on-battery** LED illuminates when the UPS is supplying battery power to the loads.

The **on-line** LED means that filtered utility line is passing through the UPS to your equipment.

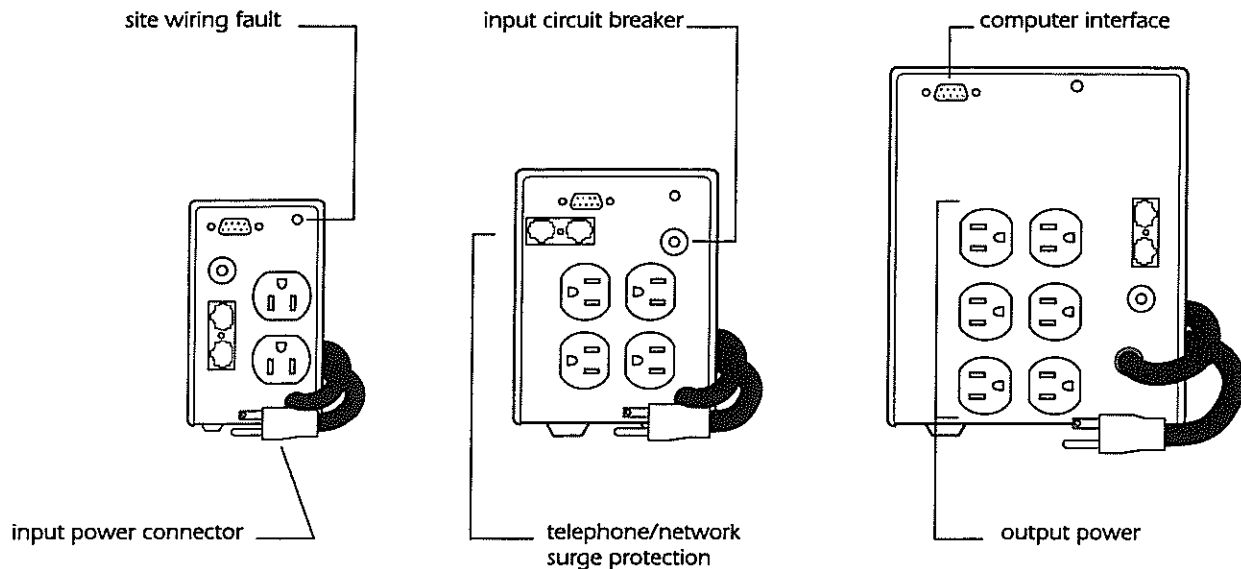
The **input power connector** is a power cord with a NEMA 5-15P connector.

The **output power** receptacles are NEMA 5-15R type.

The RJ-45/RJ-11 modular combination is used for **telephone/network surge protection** with single telephone lines and 10Base-T networks. See section 4.5.

The **computer interface port** is for UPS monitoring and control. See section 4.4.

3.2 Rear Panel



The **site wiring fault** indicator illuminates when the UPS is connected to an improperly wired AC power outlet. See section 4.9.

The **input circuit breaker** trips when loads exceed the UPS's capacity. The resettable center plunger of the circuit breaker extends when tripped.

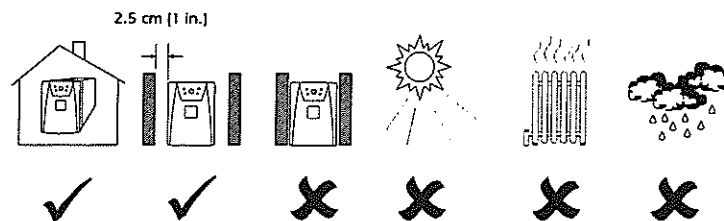
4. Installation

Please fill out and return the warranty registration card now.

4.1 Inspection

Inspect the UPS upon receipt. Notify the carrier and dealer if there is damage. The packaging is recyclable; save it for reuse or dispose of it properly.

4.2 Placement



Install the UPS in a protected area with adequate air flow that is free of excessive dust. Do not operate the UPS where the temperature and humidity is outside the specified limits. See section 12. Allow the UPS to come to room temperature before continuing.

4.3 Protection Strategies

This UPS provides high performance power line protection to the loads. There are, however, other potential entry points for damaging surges in information systems. These include serial ports (RS-232, RS-422, RS-485, etc.), parallel ports, telephone lines, and LAN connections. These other entry points must be considered in developing a comprehensive protection strategy for your system. Contact your dealer or call the number in the front of this manual for information on related products designed to accomplish total system protection.

Sensitive information systems can be further safeguarded by following these guidelines:

- Verify that all electrical outlets are properly grounded. See section 4.9.
- Connect computer leads to a different electrical service branch than heavy motor loads like air conditioners, copiers, refrigerators, and heavy industrial machinery.
- Plug all power protection and computer equipment into outlets connected to the same service branch (controlled by the same fuse or circuit breaker) where possible.

4.4 Connect Computer Interface (Optional)

Power management software and interface kits can be used with this UPS. Use only kits supplied or approved by the manufacturer. If used, connect the interface cable to the 9-pin computer interface port on the back panel of the UPS. Secure the connector's screws to complete the connection.

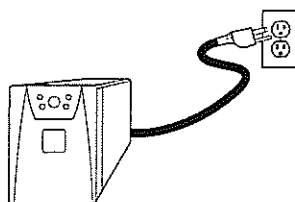
Note: Computer interface connection is optional. The UPS works properly without a computer interface connection.

4.5 Connect Telephone/Network Surge Suppression (Optional)

Connect a single line telephone or a 10Base-T network cable into the telephone/network surge protection sockets on the back of the UPS. The RJ-45/RJ-11 modular combination sockets accept all standard single line telephone and 10Base-T connections. This connection will require another length of telephone cable (supplied) or network cabling (not supplied) to complete the connection.

Note: This connection is optional. It is not needed to use the UPS.

4.6 Connect to Utility



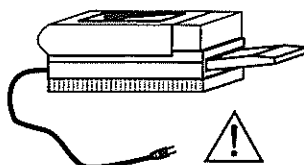
Plug the UPS into a two-pole, three-wire, grounded receptacle only. Avoid using extension cords and adapter plugs.

4.7 Charge the battery

The UPS charges its battery whenever it is connected to utility power. For best results, charge the battery for 4 hours before use. It is acceptable to use the UPS without first charging the battery, but on-battery run time may be reduced until the battery charges.

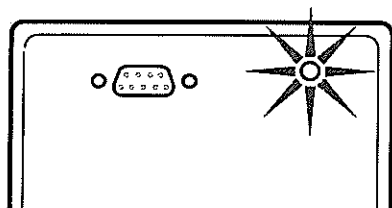
4.8 Connect the Loads

Plug the loads into the output connectors on the rear of the UPS. To use the UPS as a master on/off switch, make sure that all of the loads are switched on.



Caution: Do not connect a laser printer to the UPS along with other computer equipment unless the UPS is rated 1400 VA. A laser printer periodically draws significantly more power than when idle, and may overload the UPS. Verify that the UPS can support the loads when the printer is in full operation (printing). Test the system with all loads operating to make sure that the UPS is not overloaded. See section 6.2.

4.9 Check the Site Wiring Fault Indicator



After plugging in the loads and the UPS, check the site wiring fault indicator on the rear panel. See section 3.2 for the location of the indicator on the back panel. It lights if the UPS is plugged into an improperly wired AC power outlet. Wiring faults detected include missing ground, hot-neutral polarity reversal, and overloaded neutral circuit.

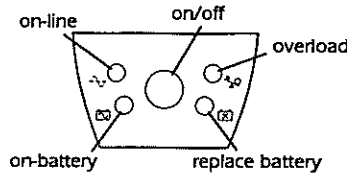
Caution: If the UPS indicates a site wiring fault, get a qualified electrician to correct the building wiring.

4.10 Plug and Play

This UPS provides optional Plug and Play installation with those computers and operating systems that support it. If you have purchased a Plug and Play UPS, a software and cable package will be included with the unit. See the documentation included in the package for more information.

5. Operation

5.1 Switch On — Switch Off



With the UPS plugged in, press and release the on/off button to supply power to the loads. The loads are immediately powered while the UPS performs a self-test. See section 5.2. Press and release the button again to turn off power to the loads. It may be convenient to use the UPS as a master on/off switch for the protected equipment.

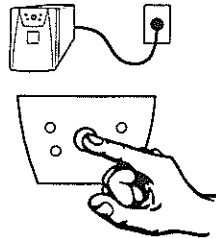
Note: The UPS is on (the internal processor is operating) whenever it is plugged in and utility voltage is present. Even when switched off the UPS maintains the battery charge.

5.2 Self-test

The UPS performs a self-test automatically when turned on and every two weeks. Automatic self-test eases maintenance requirements by eliminating the need for periodic manual self-tests.

During the self-test, the UPS briefly operates the loads on-battery. If the UPS passes the self-test, it returns to on-line operation.

If the UPS fails the self-test it immediately returns to on-line operation and lights the replace battery LED. The loads are not affected. Recharge the battery overnight and perform the self-test again. If the replace battery LED is still on, see section 10 for information on replacing the battery.



It is possible to perform a manual self-test at any time. To start a self-test:

- **Press** and hold the on/off button until the UPS beeps twice (about 2 seconds).
- **Release** the on/off button to start the self-test.

5.3 Shutdown Mode

If there is no utility power present, external devices (e. g., servers) connected to the computer interface can command the UPS to shut down. This is normally done to preserve battery capacity after the graceful shutdown of protected PC devices. In shutdown mode the UPS stops supplying power to the load, waiting for the return of utility power. The UPS alternately illuminates the upper front panel LED indicators in shutdown mode.

5.4 Cold Start

When the UPS is off and there is no utility power, it is possible to cold start the UPS to apply power to the loads from the UPS's battery.

- **Press and hold** the on/off button until the UPS beeps twice (about two seconds).
- **Release** the on/off button to start the UPS.

Note: Cold start is not a normal operating condition. On-battery and low battery alarms work as described in section 6.

6. Alarms

6.1 On Battery

In on-battery operation, the on-battery LED illuminates and the UPS sounds an audible alarm consisting of four beeps every 30 seconds. The alarm stops when the UPS returns to on-line operation.

6.2 Overload

When the UPS is overloaded (i. e., when the connected loads exceed maximum listed in section 12) the overload LED illuminates and the UPS emits a sustained tone. The alarm remains on until the overload is removed. Disconnect nonessential load equipment from the UPS to eliminate the overload. The UPS tests for overloads when operating on-battery and when performing self-tests.

6.3 Replace Battery

If the battery fails a self test, the UPS emits short beeps for one minute and the Replace Battery LED illuminates. The UPS repeats the alarm every five hours. After one week, the alarm becomes continuous. Perform the self-test procedure in Section 5.2 to confirm replace battery conditions. The alarm stops when the battery passes the self-test.

6.4 Low Battery

On-battery, when the energy reserve of the battery runs low, the UPS beeps continuously until the UPS shuts down from battery exhaustion or returns to on-line operation.

7. Options

7.1 Interface kits

For computer systems that have built-in UPS monitoring features, a series of interface kits are available to connect the UPS to your system. Each kit includes the appropriate interface cable to convert the UPS status signals into signals your system recognizes (use only factory supplied or authorized UPS monitoring cables). See your dealer or call the number at the front of this manual for more information.

7.2 Wall Mount Bracket

A special wall mount bracket is available for this UPS. See your dealer or call the number at the front of this manual for more information.

8. Troubleshooting

Problem	Possible Cause	Solution
UPS will not turn on.	On/Off button not pushed.	Press the On/Off button to power the UPS and the load.
	UPS input circuit breaker tripped.	Reduce the load on the UPS by unplugging equipment and reset the circuit breaker by pressing the plunger back in.
	Very low or no utility voltage.	Check the AC power supply to the UPS with a table lamp. If very dim or off, have the utility voltage checked.
UPS will not turn on or off.	Computer interface or accessory problem.	Disconnect the computer interface or accessory. If the UPS now works normally, check the interface cable, the attached computer, and the accessory.
UPS operates on-battery even though normal line voltage is thought to exist.	UPS's input circuit breaker tripped.	Reduce the load on the UPS by unplugging equipment and reset the circuit breaker by pushing the plunger back in.
UPS beeps occasionally.	Normal UPS operation.	None. The UPS is protecting the load.
UPS does not provide expected back up time.	The UPS's battery is weak due to recent outage or is near the end of its service life.	Charge the battery. The UPS's batteries require recharging after an extended outage. Batteries age faster when put into service often and when operated at elevated temperatures. If the battery is near the end of its service life, consider replacing the battery even if the replace battery indicator is not yet lit.
Top front panel indicators flash alternately.	The UPS has been shut down by the UPS interface kit.	None. The UPS will restart automatically when utility power returns.
All indicators are flashing (except On-Battery indicator).	Internal UPS fault.	Do not attempt to use the UPS. Turn the UPS off and have it serviced immediately.
The UPS operates normally, but the Site Wiring Fault indicator is lit.	Building wiring error such as missing ground or hot to neutral wire reversal.	Have a qualified electrician correct the building wiring.

Problem	Possible Cause	Solution
All indicators are off and the UPS is not operating.	The UPS is shut down and the battery is discharged from an extended power outage.	None. The UPS will return to normal operation when the power is restored and the battery has a sufficient charge.
The replace battery light is illuminated.	Weak batteries.	Allow the batteries to recharge for at least four hours. If the problem persists after recharging, replace the batteries. See section 10.
	Replacement batteries not connected properly.	Confirm the battery connections. See section 10.

9. Service

If the UPS requires service:

1. Use the troubleshooting section (section 8) to eliminate common problems.
2. Verify that no circuit breakers are tripped. A tripped circuit breaker is the most common UPS problem!
3. Go to section 5.2 and perform a manual self-test to check the battery.
4. If the problem persists, see the front of this manual for the correct telephone number and call customer service. If customer service is not available in your area, call the dealer that sold the UPS. Note the model number of the UPS, the serial number, and the date purchased. A technician will ask you to describe the problem and try to solve it over the phone, if possible. If this is not possible the technician will issue an RMA#. If the UPS is under warranty, repairs are free. If not, there will be a charge for repair.
5. Pack the UPS in its original packaging. If the original packing is not available, ask customer service about obtaining a new set. It is important to pack the UPS properly to avoid damage in transit. Never use styrofoam beads for packaging. Damage sustained in transit is not covered under warranty. Include a letter with your name, RMA#, address, copy of the sales receipt, description of the trouble, your day-time phone number, and a check (if necessary).
6. Mark the RMA# on the outside of the package. The factory cannot accept any package without this marking.
7. Return the UPS by insured, prepaid carrier to the address at the front of this manual.

10. Battery Replacement

This UPS has an easy to replace hot-swappable battery. Please read section 10.1 before performing the procedure in sections 10.3 or 10.4.

10.1 Warning

- This Uninterruptible Power Source (UPS) contains potentially hazardous voltages. Do not attempt to disassemble the unit beyond the battery replacement procedures below. Except for the battery, the unit contains no user serviceable parts. Repairs are performed only by factory trained service personnel.



- The batteries in this UPS are recyclable. Dispose of the batteries properly. The batteries contain lead and pose a hazard to the environment and human health if not disposed of properly. Refer to local codes for proper disposal requirements or return the battery to a factory authorized service center. See the instructions with the new battery for more information.



CAUTION—Do not dispose of batteries in a fire. The batteries may explode.

CAUTION—Do not open or mutilate batteries. They contain an electrolyte which is toxic and harmful to the skin and eyes.



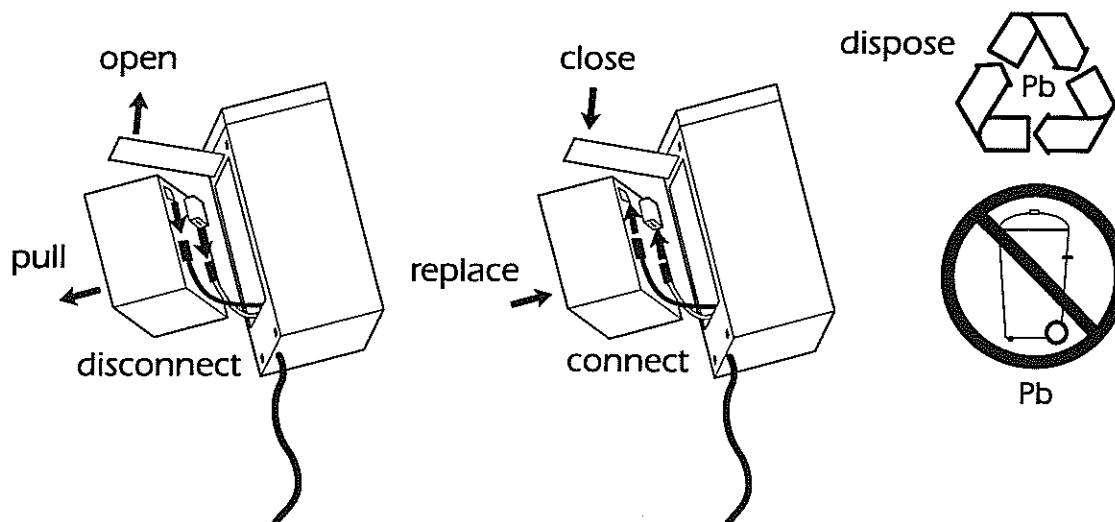
CAUTION—To avoid personal injury due to energy hazard, remove wrist watches and jewelry such as rings when replacing the batteries. Use tools with insulated handles.

CAUTION—Replace batteries with the same number and type of batteries as originally installed in the UPS.

10.2 Replacement Batteries

See your dealer or call the number at the front of this manual for information on battery recycling and replacement battery kits.

10.3 Battery Replacement Procedure (280, 420 and 650 VA models)

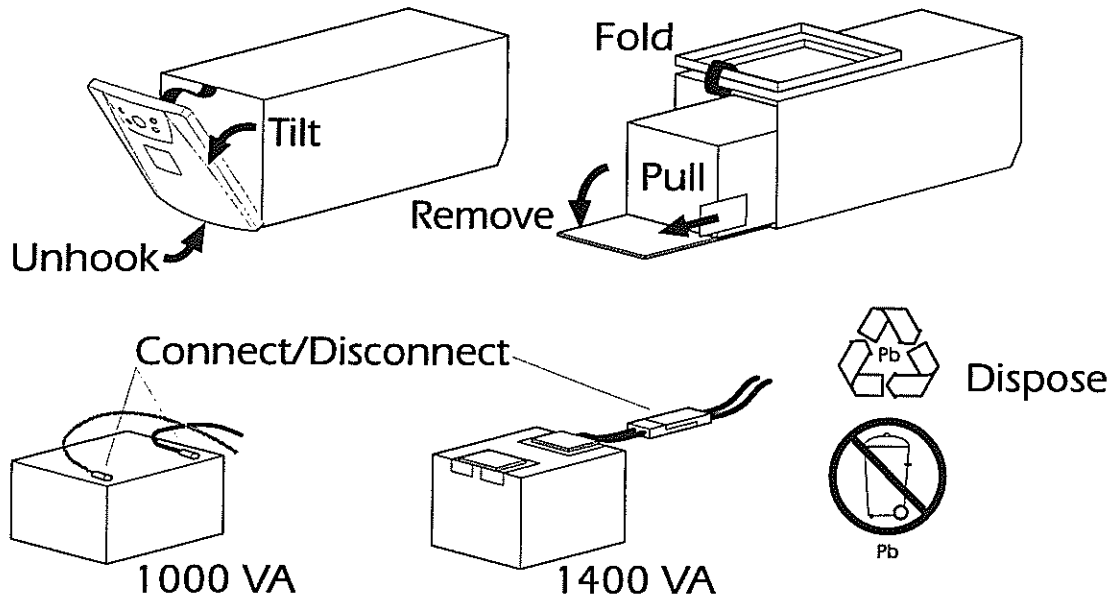


Note: Please read the cautions in section 10.1.

Battery replacement is a safe procedure, isolated from electrical hazards. You may leave the UPS and loads on for the following procedure.

1. Lay the UPS on its left side. Remove the two screws holding on the battery door and **open** the door.
Note: The battery door may need to be pulled away from the hinges somewhat to allow it to become fully swung open.
2. Gently **pull** out the battery by grasping the white tab.
3. **Disconnect** the two wires connecting the battery to the UPS. Loosen the wires by gently wiggling them while pulling straight back from the battery connector.
4. **Connect** the new battery in place of the old. **Note:** Small sparks at the battery connections are normal during connection.
5. **Replace** the new battery in the UPS. Use care to avoid pinching the wires.
6. **Close** the battery compartment door and replace the screws.
7. **Dispose** of the old battery properly at an appropriate recycling facility or return it to the supplier in the packing material for the new battery. See the new battery instructions for more information.

10.4 Battery Replacement Procedure (1000 and 1400 VA models)



Note: Please read the cautions in section 10.1.

Battery replacement is a safe procedure, isolated from electrical hazards. You may leave the UPS and loads on for the following procedure.

1. Grasp the top of the front cover and **tilt** it out and down.
2. **Unhook** the bottom of the cover from the chassis and lift it upward to expose the battery door. Be careful not to strain the ribbon cable. Do not touch the exposed printed circuit board.
3. **Fold** the front cover on top of the UPS as shown.
4. Use a screwdriver or a coin to **remove** the two battery door screws and open the door.
5. Grasp the tab and gently **pull** the battery out of the UPS.
6. **Disconnect** the battery leads.
7. **Connect** the battery leads to the new battery. **Note:** Small sparks at the battery connectors are normal during battery connection.
8. Slide the battery into the UPS, close the battery door, replace the battery compartment screws, and replace the front cover.
9. **Dispose** of the old battery properly at an appropriate recycling facility or return it to the supplier in the packing material for the new battery. See the new battery instructions for more information.

11. Storage

11.1 Storage conditions

Store the UPS covered and upright in a cool, dry location, with its battery fully charged. Before storing, charge the UPS for at least 4 hours. Disconnect any cables connected to the computer interface port to avoid unnecessarily draining the battery.

11.2 Extended storage

During extended storage in environments where the ambient temperature is -15 to $+30$ °C ($+5$ to $+86$ °F), charge the UPS's battery every 6 months.

During extended storage in environments where the ambient temperature is $+30$ to $+45$ °C ($+86$ to $+113$ °F), charge the UPS's battery every 3 months.

12. Specifications

	280 VA	420 VA	650 VA	1000 VA	1400 VA
Acceptable input voltage	0 - 160 VAC				
Input voltage (on-line operation)	92-150 VAC				
Output voltage	103-132 VAC				
Nominal input frequency	50 or 60 Hz, autosensing				
Input Protection	Resettable circuit breaker				
Frequency limits (on-line operation)	50 or 60 Hz, $\pm 5\%$				
Transfer time	2 ms typical, 4 ms maximum				
Maximum load	280 VA 180 W	420 VA 260 W	650 VA 410 W	1000 VA 670 W	1400 VA 950 W
On-battery output voltage	115 VAC				
On-battery frequency	50 or 60 Hz, ± 0.1 Hz				
On-battery waveshape	Stepped sine-wave			Trapezoid	
Protection	Overcurrent and short-circuit protected, latching shutdown on overload.				
Surge energy rating (one time, 10/1000 μ s waveform)	320 J				
Surge current capability (one time, 8/20 μ s waveform)	13kAmps maximum				
Surge response time	0 ns (instantaneous) normal mode; <5 ns common mode				
Surge voltage let-through (percentage of applied ANSI C62.41 Cat. A ± 6 kV test waveform)	<5%			<0.5%	
Noise Filter	Normal and common mode EMI/RFI suppression, 100 kHz to 10 MHz				
Battery type	Spill proof, maintenance free, user replaceable, sealed lead-acid				
Typical battery life	3 to 6 years, depending on number of discharge cycles and ambient temperature				
Typical recharge time	2 to 5 hours from total discharge				
Telephone line surge protection, 1.2 μ s/50 waveform.	± 6 kV peak				

12. Specifications (Continued)

	280 VA	420 VA	650 VA	1000 VA	1400VA
10Base-T surge protection let-through (as a percentage of an applied ±6 kV 1.2/50 μs, 125 A 8/20 μs test)	<5%				
Telephone line surge protection let-through (as a percentage of an applied ±6 kV 1.2/50 μs, 500 A 8/20 μs test)	<1%				
Operating temperature	0 to +40 °C (+32 to +104 °F)				
Storage temperature (see section 11)	-15 to +45 °C (+5 to +113 °F)				
Operating and storage relative humidity	0 to 95%, non-condensing				
Operating elevation	0 to +3,000 m (0 to +10,000 ft)				
Storage elevation	0 to +15,000 m (0 to +50,000 ft)				
Electromagnetic immunity	IEC 801-2 level IV, 801-4 level IV, 801-5 level III				
Audible noise at 1 m (3 ft)	<45 dBA			<50 dBA	
Size (H x W x D)	Model 280, 420 16.8 x 11.9 x 36.8 cm (6.6 x 4.7 14.5 in.)		16.8 x 11.9 x 36.8 cm (6.6 x 4.7 x 14.5 in.)	21.6 x 17 x 43.9 cm (8.5 x 6.7 x 17.3 in.)	
	Model 280B, 420B 15 x 8.6 x 33.8 cm (5.9 x 3.4 x 13.3 in.)				
Weight - net (shipping)	Model 280 7.2 (8.5) kg; 15.9 (18.7) lb.	Model 420 7.8 (9.1) kg 17.2 (20.0) lb.	10.9 (12.2) kg; 24.0 (26.8) lb.	19.3 (21.3) kg; 42.5 (47) lb.	24.1 (26.1) kg; 53 (57.5) lb.
	Model 280B 6.6 (7.5) kg; 14.5 (16.6) lb.	Model 420B 7.2 (8.1) kg; 15.9 (18) lb.			
Safety and approvals	UL 1778, UL 497A, CSA 22.2				
EMC verification	FCC/DOC Class B certified				

13. How to Determine On-battery Run Time

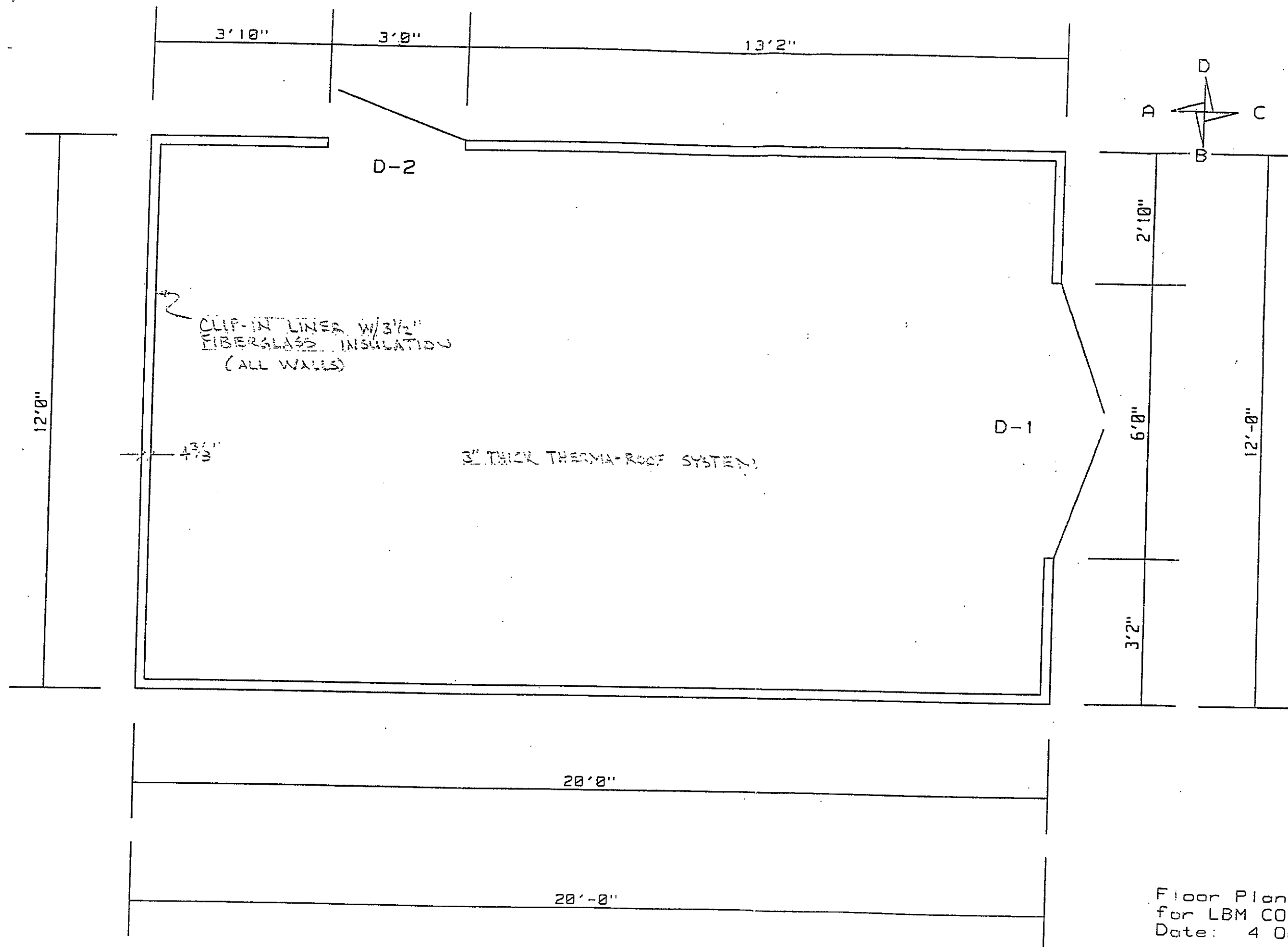
Knowing the on-battery run time of the UPS is an important part of UPS use, especially in situations where the protected device uses an operating system that requires some time to gracefully shut down.

1. To calculate the on-battery run time first determine the total load protected by the UPS in Volt-Amps. Obtain load figures from either the labelling on the protected equipment or the accompanying literature. For loads specified in watts, multiply the specified figure by 1.4. For loads specified in Amps, multiply the specified figure by 120.
2. Add the individual loads to determine the total load.
3. Compare the total load of your system to the run time table below.

Typical On-Battery Run Time Versus Load, in Minutes									
Load	280 VA	420 VA	650 VA	1000 VA	1400 VA	Load	650 VA	1000 VA	1400 VA
50 VA	35	41	90	167	306	500 VA	7.2	14	29
75 VA	25	27	64	125	236	550 VA	6.5	13	26
100 VA	18	21	49	98	190	600 VA	5.8	11	23
150 VA	12	14	29	64	133	700 VA	-	9	19
200 VA	8	10	22	47	99	800 VA	-	7.7	16
250 VA	6	7.5	17	35	74	900 VA	-	6.6	13
300 VA	-	6.2	14	27	60	1000 VA	-	5.8	11
350 VA	-	5.1	11	22	50	1200 VA	-	-	8.8
400 VA	-	4.3	9.3	19	42	1400 VA	-	-	7.2
450 VA	-	-	8.2	17	35				

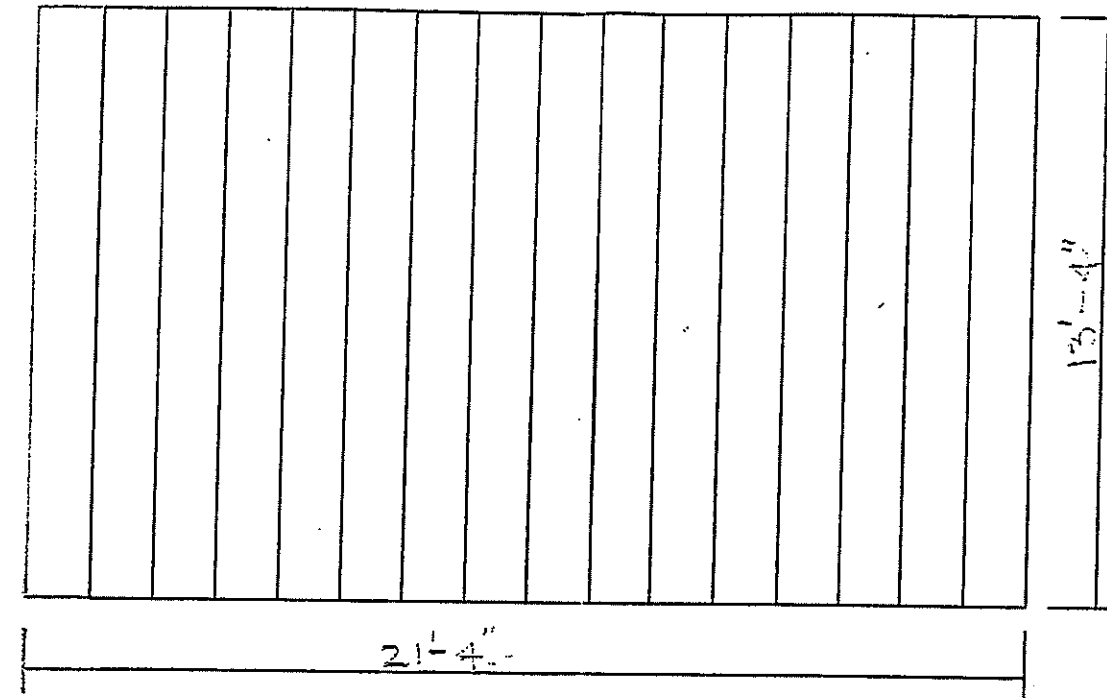
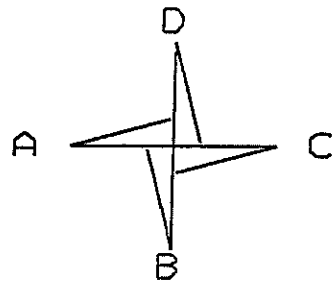
APPENDIX B-15

CONTROL BUILDING



Floor Plan
for LBM CONSTRUCTION INC
Date: 4 Oct 2001

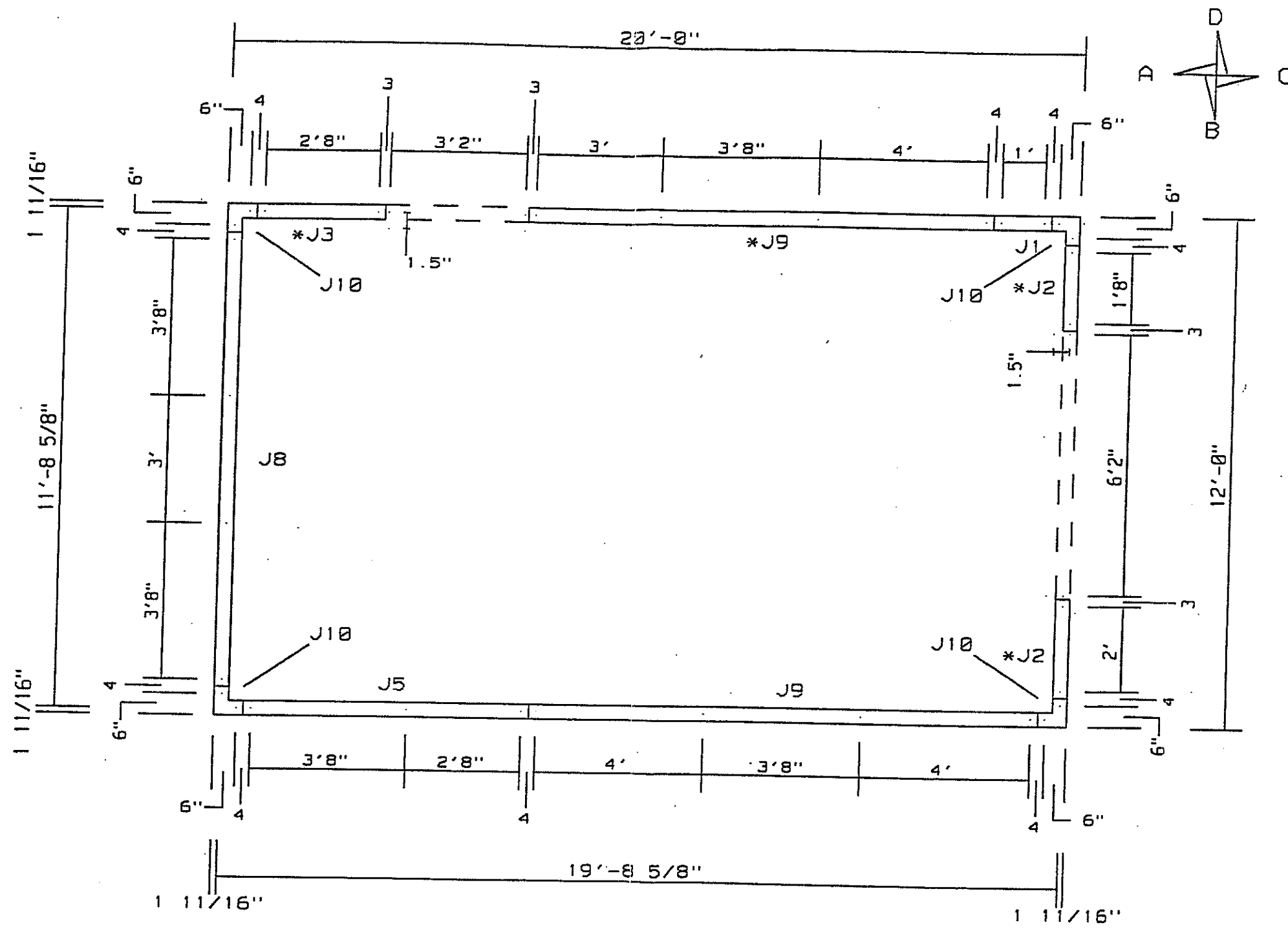
DRAWING NO. 010900-1



16 GA. 3" RIB ROOF PANELS - GALVALUME

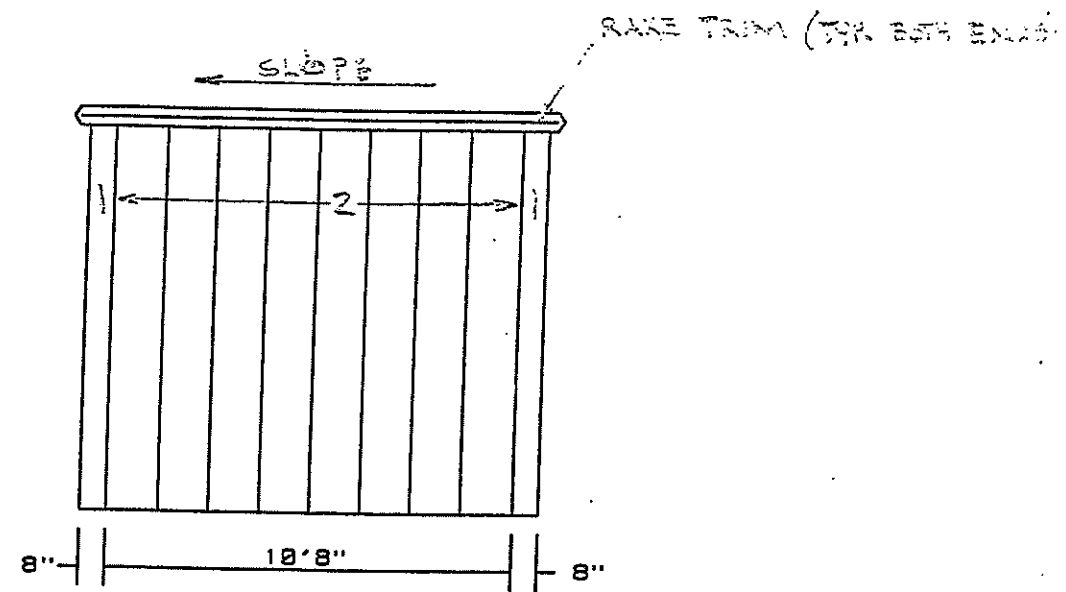
Roof Plan
for LBM CONSTRUCTION INC
Date: 4 Oct 2001

DRAWING NO. 010900-2



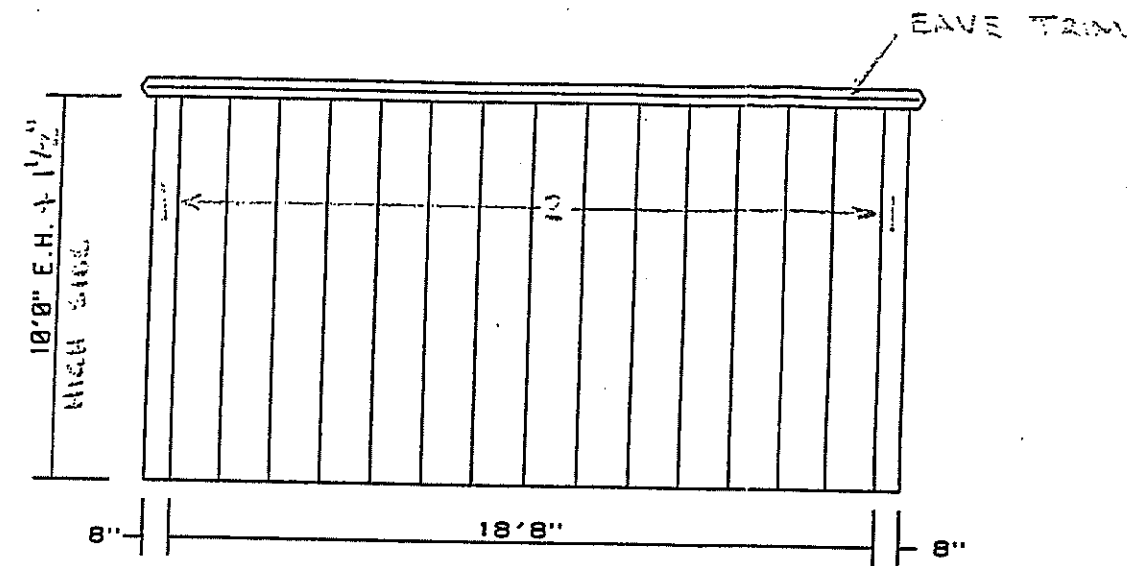
Base channel & Anchor Layout
 for LBM CONSTRUCTION INC
 Date: 4 Oct 2001
 DRAWING NO. 010900-3

* - INDICATES FIELD CUTTING.

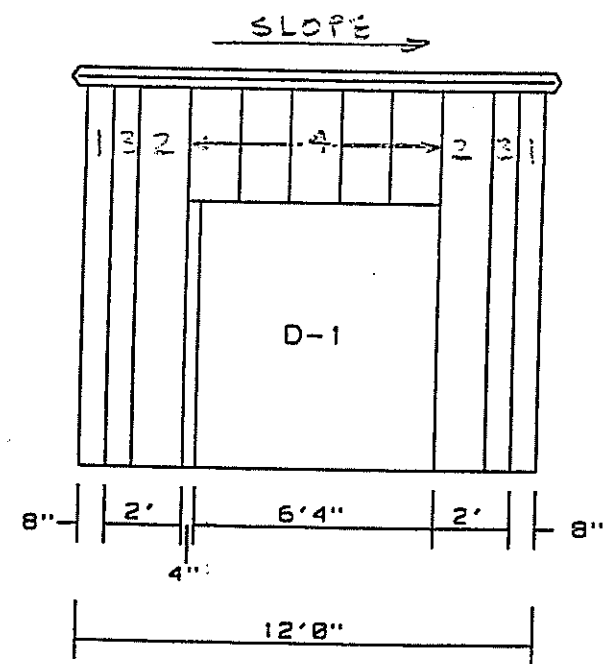


ELEVATION 'A'

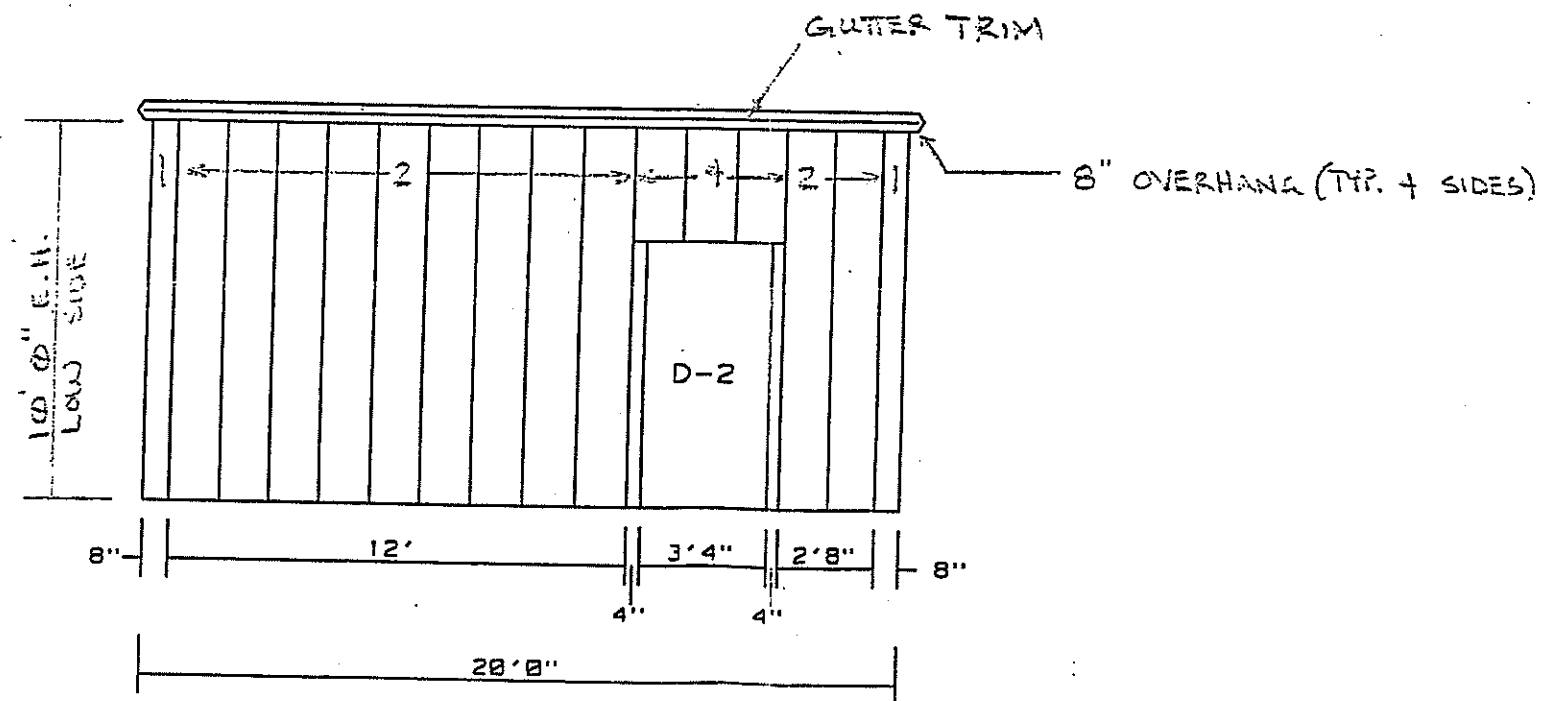
D-1 - 6' X 7' DOOR
D-2 - 3' X 7' DOOR



ELEVATION 'B'



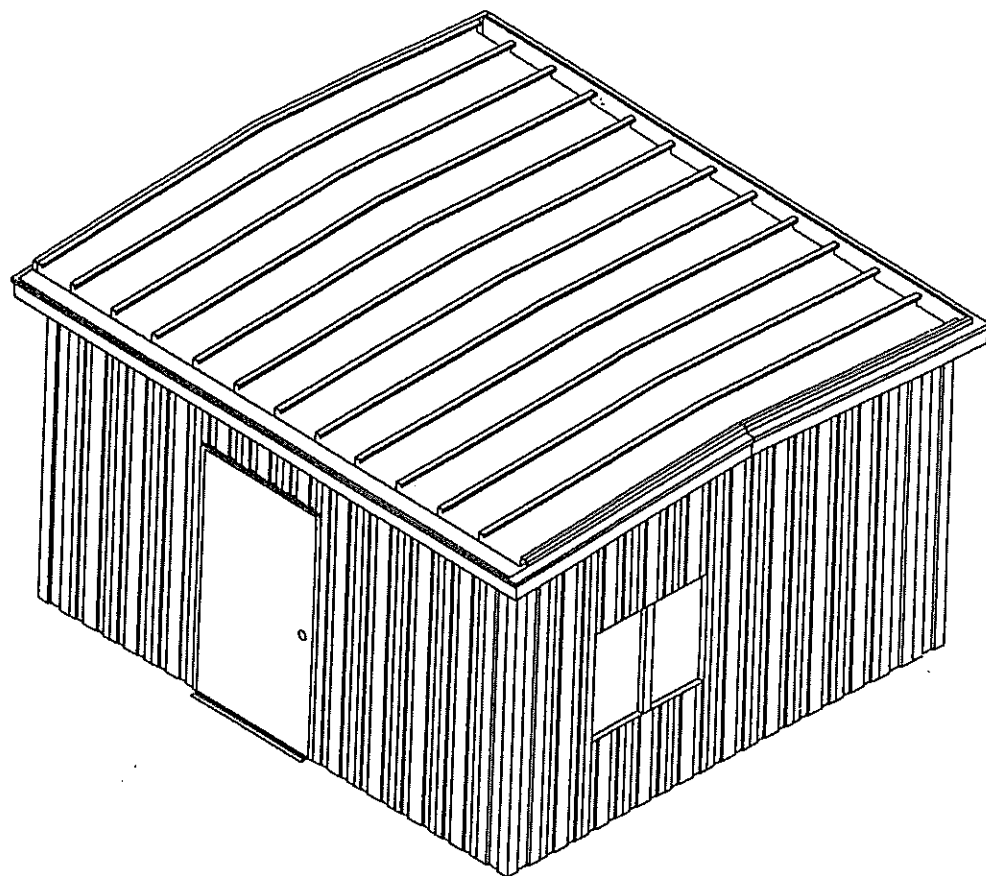
ELEVATION 'C'



ELEVATION 'D'

Wall Elevations
for LBM CONSTRUCTION INC
Date: 4 Oct 2001

DRAWING NO. 010900-4

**DELIVERY**

YOUR BUILDING WILL BE DELIVERED BY TRUCK. THE TRUCKING COMPANY SHOULD ADVISE YOU 24 HOURS IN ADVANCE OF DELIVERY SO YOU CAN ARRANGE TO RECEIVE THE MATERIALS.

UNLOADING

SMALL SELF-FRAMING BUILDINGS CAN USUALLY BE UNLOADED BY HAND. LARGER BUILDINGS, AND ALL BUILDINGS WITH STRUCTURAL FRAMES, WILL REQUIRE AN 'A' FRAME OR LIGHT HYDRAULIC CRANE FOR UNLOADING AND ERECTION.

DO NOT ROLL OR SLIDE THE MATERIAL BUNDLES OFF OF THE TRUCK SINCE DAMAGE CAN EASILY OCCUR. IF A BUNDLE IS TOO HEAVY TO HANDLE, BREAK IT APART BEFORE UNLOADING.

ALL BUNDLES SHOULD BE PLACED ON WOOD SUPPORTS AT LEAST 4" OFF OF THE GROUND. BUNDLES SHOULD HAVE ONE END ELEVATED AND BE COVERED WITH PLASTIC OR TARPULINS OPEN AT THE ENDS TO ALLOW AIR PASSAGE AND PREVENT MOISTURE FROM BEING TRAPPED.

MATERIAL INSPECTION

CARRIERS ARE RESPONSIBLE FOR BREAKAGE AND LOSS IN TRANSIT.
BEFORE ACCEPTING THE SHIPMENT, COUNT THE MATERIAL ITEMS TO BE
SURE YOU ARE RECEIVING THE QUANTITY LISTED ON THE BILL OF LADING.

IF YOU ARE SHORT, REQUEST THE DELIVERING CARRIER TO NOTE THE SHORTAGE BY THE BUNDLE NUMBER ON THE FREIGHT BILL ALONG WITH HIS SIGNATURE.

IF ANY ITEMS DELIVERED ARE IN A DAMAGED CONDITION, A NOTATION TO THIS EFFECT SHOULD BE MADE ON THE FREIGHT BILL. DAMAGED ITEMS WHICH ARE NOT USABLE OR REPAIRABLE MUST BE REJECTED TO THE CARRIER FOR SALVAGE; OTHERWISE THEY SHOULD BE REPLACED AND A CLAIM FILED FOR ACTUAL REPAIR COSTS.

IF CONCEALED DAMAGE IS DISCOVERED AFTER SHIPMENT HAS BEEN ACCEPTED
IN APPARENT GOOD CONDITION:

NOTIFY THE DELIVERING CARRIER IMMEDIATELY. HAVE THE CARRIER MAKE AN INSPECTION AND FURNISH YOU A COPY OF THE INSPECTION REPORT. THIS MUST BE DONE WITHIN 15 DAYS OF RECEIPT OF THE SHIPMENT OR THE CARRIER WILL NOT HONOR ANY CLAIM.

IMMEDIATELY REPORT ANY SHORTAGES OR DAMAGED MATERIAL TO BUTLER
BUILDER SERVICES SO REPLACEMENT MATERIALS CAN BE PROMPTLY SENT TO YOU.

BEFORE STARTING ERECTION.....

CHECK THE SQUARENESS AND LEVELNESS OF THE BUILDING FOUNDATIONS. UNLESS ANY FOUNDATION ERROR IS CORRECTED BEFORE YOU START ERECTING THE BUILDING, IT IS GOING TO COST YOU TIME AND MONEY. CHECKING PROCEDURES AND MAXIMUM TOLERANCES ARE SHOWN ON BUTLER DRAWINGS B-002 AND B-200..

SHAKE OUT THE MATERIAL AND PLACE AROUND THE BUILDING SITE FOR MINIMUM HANDLING DURING ERECTION.

THE BILL OF MATERIAL INCLUDED WITH THE BUILDING SHIPMENT WILL BE MARKED TO SHOW WHICH BUNDLE CONTAINS EACH PART.

BE SURE YOU HAVE THE PROPER EQUIPMENT TO ERECT THE BUILDING.
MINIMUM EQUIPMENT NEEDS WILL INCLUDE:

- HEAVY DUTY DRILL WITH 3/8" MASONRY BIT AND 1/8" TO 7/16" STEEL BITS
- HAMMER AND RUBBER Mallet
- 8" CRESCENT WRENCHES
- ASSORTED SCREW DRIVERS
- HACKSAW AND TIN SNIPS
- SOCKET WRENCH WITH 1/4", 5/16", 3/8", 9/16" AND 3/4" SIZE SOCKETS
- ASSORTED DRIFT PINS
- CAULKING GUN
- SCREW GUN WITH 1/4" AND 5/16" NUT RUNNERS
- BLIND RIVET GUN FOR 1/8" AND 5/32" RIVETS
- 4' CARPENTER LEVEL
- 50' TAPE MEASURE
- VISE GRIP CLAMPS
- CHALK LINE
- POWER LIFTING EQUIPMENT FOR SETTING STRUCTURAL FRAMES. (2000# MIN. CAPACITY)

[illegible]

Butler Manufacturing Company
 Kansas City, MO. USA
 Burlington, ONT. Canada

GENERAL INSTRUCTIONS

10

DATE 4-20-93

DRAWN BY

SCALE N.T.S.

ORDER NO.

REVISION	3
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DVG. NO.

B-000



K2026A (SHOWN)

3/8" X 2-1/4" WEDGE ANCHOR

K2026B

1/2" X 4" WEDGE ANCHOR WITH NUT

K2026C

1/2" X 7" WEDGE ANCHOR WITH NUT

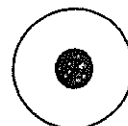
K2026D

3/8" X 5" WEDGE ANCHOR



K185-3

3/8" HEX NUT



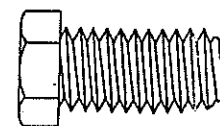
K1163

1/4" ALUMINUM AND NEOPRENE WASHER



K1164

1/2" ALUMINUM AND NEOPRENE WASHER



K1161H1

1/2" X 1" HEX BOLT
W/ NUT

K1161H3

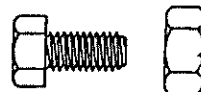
1/2" X 1 1/2" HEX BOLT W/NUT

K1161H8

1/2" X 4" HEX BOLT W/NUT

K1158H3

5/8" X 1 1/2" HEX BOLT, W/NUT



K783CS42

1/4" X 1/2" MACHINE SCREW
WITH NUT



K1324

#8 X 5/8" SELF-DRILLING FASTENER, PAINTED
BW = BIRCH WHITE
BC = CHARCOAL

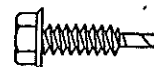


K190-4

3/8" WASHER

K190-50

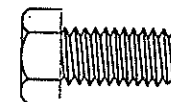
1/2" WASHER



K1237

#12 SELF-DRILLING FASTENER
WITHOUT WASHER

NO.	LENGTH	FINISH
K1237-5	3/4"	ZINC
K1238	3/4"	PAINTED

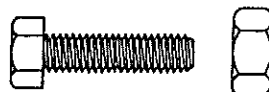


K1100B (SHOWN)

3/8" X 3/4" RIB BOLT

K1100C

3/8" X 1 1/2" HEX BOLT



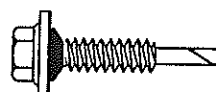
K2029A

1/4" X 1" MACHINE SCREW
WITH NUT



K1324WP

#8 X 1" PHILLIPS WAFER HEAD
SELF DRILLING FASTENER, PAINTED WHITE



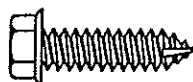
K1237-1

#12 X 1" FASTENER
WITH WASHER



K1237-6

#12 X 1 1/4" HWH
SELF-DRILLING FASTENER 'TEK-5'

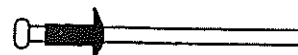


K1236 (SHOWN)

#14 X 1" DOOR FASTENER

K1235

#12 X 3/4" STITCH FASTENER



K54

5/32" BLIND RIVET, PAINTED
BW = BIRCH WHITE
BC = CHARCOAL



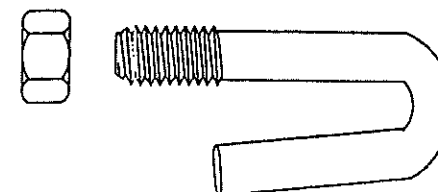
K1434

#14 X 3/4" ROOF SCREW
WITH WASHER



K1100A

3/8" RECTANGULAR NUT



K2027

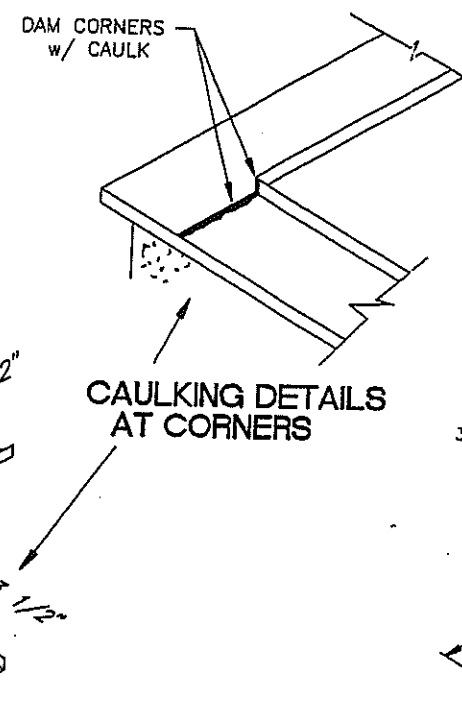
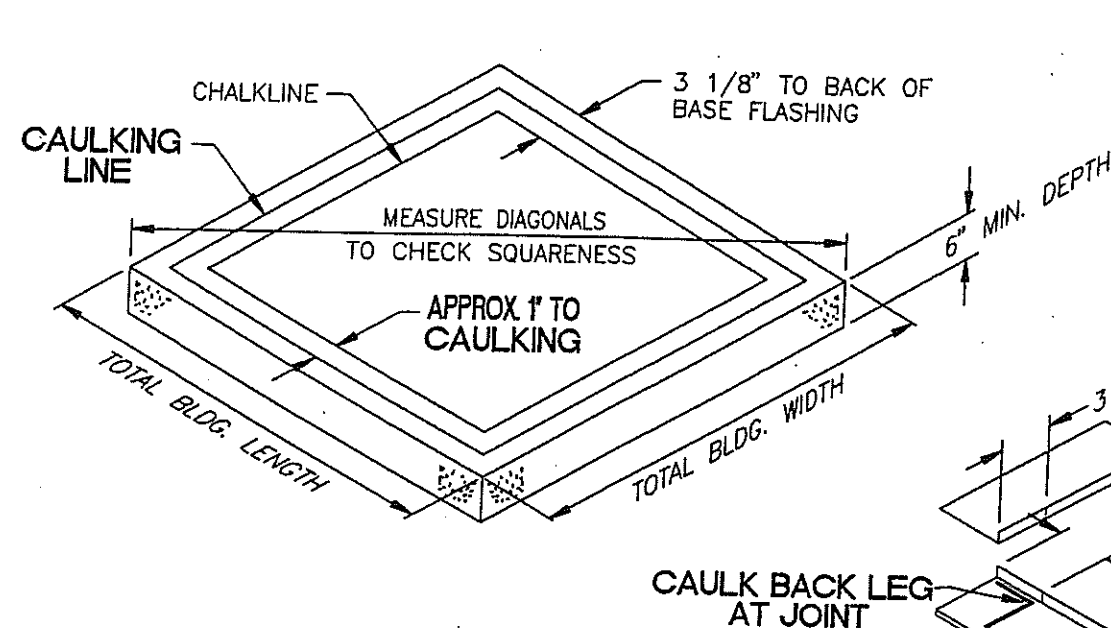
3/8" HOOK BOLT WITH NUT

REVISIONS	BY
10-7-93	VS
10-30-96	KAG
11-26-96	KAG
2-25-99	DLR
12-22-00	DLR

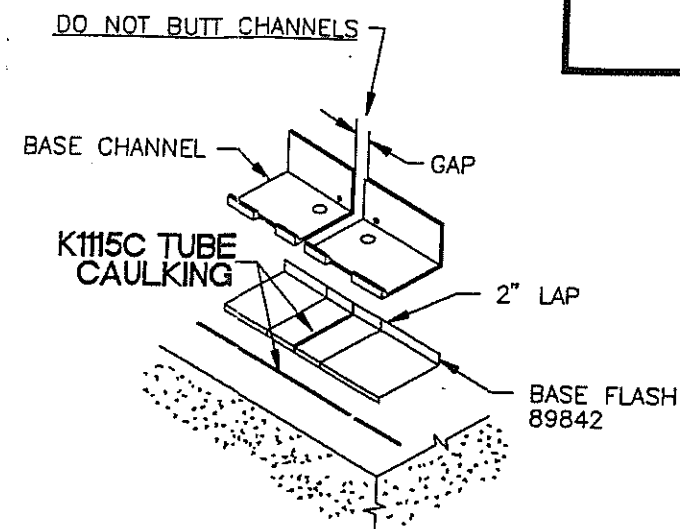
BUTLER
Butler Manufacturing Company
Kansas City, MO. USA
Burlington, ONT. Canada

BUILDING HARDWARE IDENTIFICATION	
JOB DESCRIPTION	FASTENERS
SHEET TITLE	
DATE	8-22-92
DRAWN BY	DLC
SCALE	NTS
ORDER NO.	
REVISION	5
DWG. NO.	
B-001	

NOTE:
CONCRETE MUST BE CLEAN AND DRY BEFORE
APPLYING K1115C TUBE CAULKING.



NOTE: MEASURE 32" C/C OF PANEL
NOTCH IN BASE CHANNEL
THROUGH BASE CHANNEL JOINT.
GAP SHOULD OCCUR AT JOINT.



ERECTION PROCEDURE

- STEP 1 CHECK FOUNDATION SQUARENESS.
(SEE ALLOWABLE TOLERANCES BELOW RIGHT)
- STEP 2 SNAP CHALKLINE AS SHOWN. CAULK WITH K1115C
TUBE CAULKING AS SHOWN ABOVE, OMITTING CAULK
AT ANY OVERHEAD DOOR OPENINGS.

- STEP 3 NOTCH FLASHING CORNER AS SHOWN ABOVE.
- STEP 4 POSITION BASE FLASH WITH BACK EDGE AT CHALKLINE.
OMIT FLASHING AT ANY OVERHEAD DOOR OPENINGS.
CAULK LAPS AS SHOWN. CAULK FLASHING CORNERS
AS SHOWN ABOVE.
- STEP 5 ANCHOR CORNER BASE USING HOLE AS TEMPLATE AND
DRILLING THROUGH FLASHING. SEE ABOVE DETAIL FOR
POSITIONING.
- STEP 6 CONTINUE AROUND PERIMETER OF SLAB. BASE
CHANNEL REQUIRES AN ANCHOR AT EACH END. SEE
CHART "A" FOR MAXIMUM SPACE BETWEEN ANCHORS.
- STEP 7 PLACE SHIMS UNDER BASE FLASHING WHERE NECESSARY
TO KEEP BASE CHANNEL LEVEL.

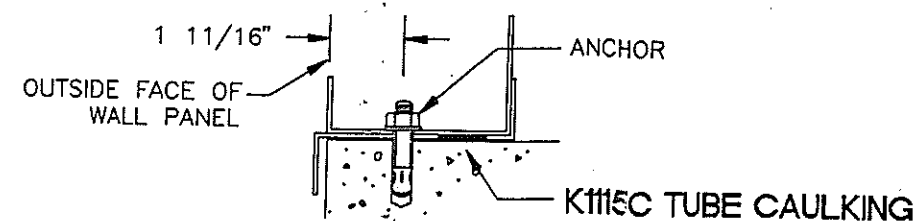
BASE CHANNELS	
PART NO.	LENGTH
J1	1'-3 7/8"
J2	2'-7 7/8"
J3	3'-11 7/8"
J4	5'-3 7/8"
J5	6'-7 7/8"
J6	7'-11 7/8"
J7	9'-3 7/8"
J8	10'-7 7/8"
J9	11'-11 7/8"

CHART A'	
4'-0" MAX. ANCHOR SPACING	
2'-8" MAX. ANCHOR SPACING	
1'-4" MAX. ANCHOR SPACING	

ALLOWABLE FOUNDATION TOLERANCES:

WIDTH AND LENGTH	± 1/8" IN 12'
	± 1/4" OVERALL
OUT OF SQUARE DIAGONALLY	± 1/2"
OUT OF LEVEL	± 1/8" IN 20'
	± 1/4" OVERALL

NOTE: USE HAMMER DRILL FOR DRILLING OF ANCHOR HOLES.
DRILL HOLE SUFFICIENT DEPTH WITH SAME DRILL BIT DIAMETER
AS ANCHOR DIAMETER.



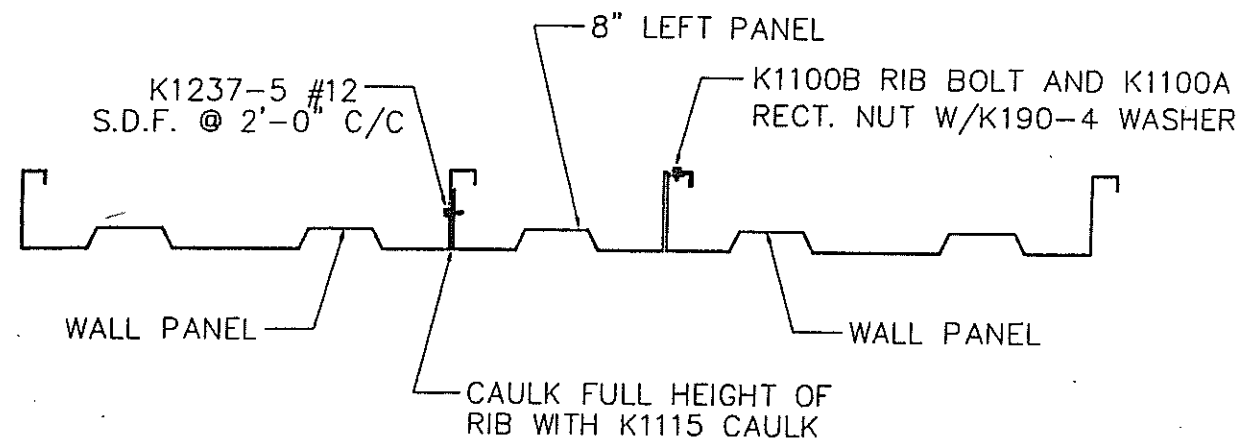
REVISIONS	BY
5-7-93	RLJ
6-6-95	DKH
10-30-96	KAG

BUTLER
Butler Manufacturing Company
Kansas City, MO. USA
Burlington, ONT. Canada

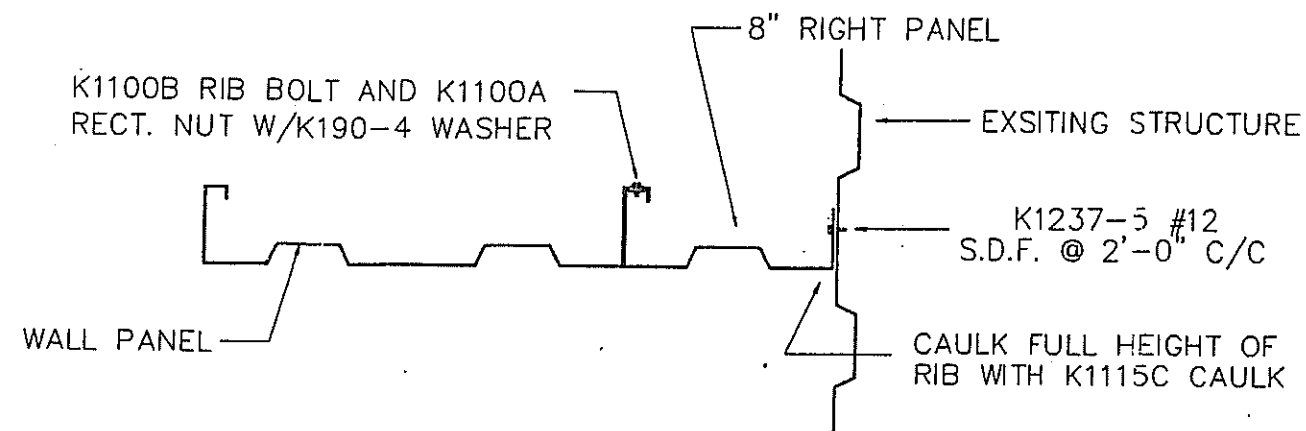
JOB DESCRIPTION
BASE CHANNEL
INSTALLATION DETAILS

SHEET TITLE

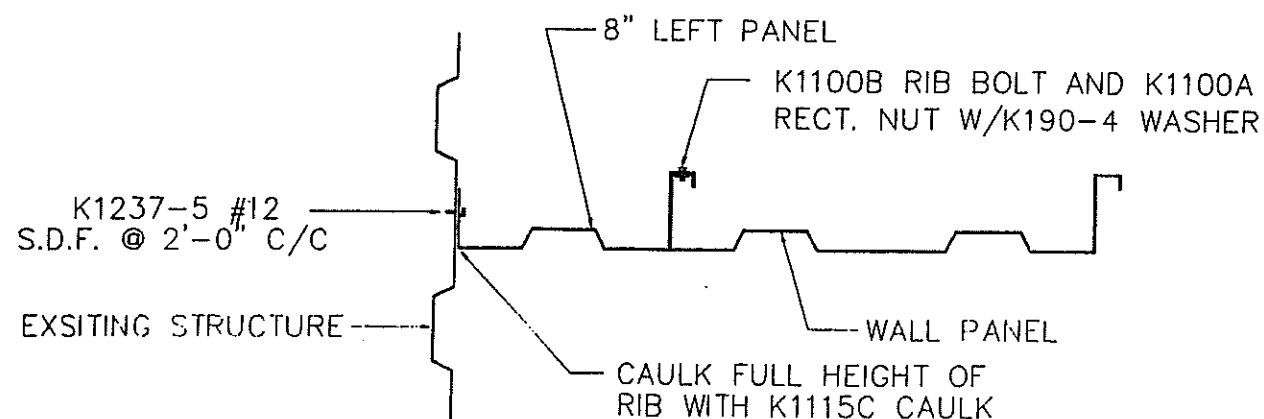
DATE	7-18-92
DRAWN BY	
SCALE	N.T.S.
ORDER NO.	
REVISION	5
DWG. NO.	B-002



DETAIL 1'



DETAIL 2'



DETAIL 3'

INSTALLATION OF 8" WALL PANEL KIT

- STEP 1. CAULK FULL HEIGHT OF PANEL LEG AND INSTALL PER WALL ERECTION DETAILS B-100 OR B-201. (USE K1115C TUBE CAULK)
- STEP 2. INSTALL RIB BOLTS (2 PER PANEL).
- STEP 3. INSTALL K1237-5 SELF DRILLING FASTENERS. 2 AT TOP, 2 AT BOTTOM, AND AT 2'-0" CENTERS.

NOTES

- IF 8" PANEL IS CONNECTED TO A NON-METAL EXISTING STRUCTURE, CUSTOMER MUST SUPPLY REQUIRED FASTENERS.
- FIELD CUT BASE CHANNEL FOR 8" PANELS. SEE BASE CHANNEL PLAN

REVISIONS	BY
10-30-96	KAG

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Butler Manufacturing Company
Kansas City, MO, USA
Burlington, ONT, Canada

JOB DESCRIPTION
**INSTALLATION OF
8" WALL PANEL KIT**
SHEET TITLE

DATE	7-17-92
DRAWN BY	
SCALE	N.T.S.
ORDER NO.	
REVISION	1
DWG. NO.	B-003

PL-1 FOUNDATION LOAD REQUIREMENTS (P.L.F.)

</

NOTE: Reference drawing #B - 002 for PL-1

PL-2 FOUNDATION LOAD REQUIREMENTS (P.L.F.)

PL-2 BAY LENGTH	LIVE LOADS VERTICAL COMPRESSION			WIND LOADS HORIZONTAL SHEAR				
	20 psf	30 psf	40 psf	BLD'G. HT.	70 mph	80 mph	90 mph	100 mph
12'-0"	195	255	315	8'-0"	32	42	53	66
16'-0"	260	340	420	10'-0"	40	53	67	82
20'-0"	325	425	525	12'-0"	48	63	80	98
24'-0"	390	510	630	14'-0"	56	74	93	115

NOTE: Reference drawing #B - 200 for
Maximum Column Reactions
and Tolerances for PL-2 Buildings

NOTE: ABOVE CHARTS HAVE BEEN CALCULATED
IN ACCORDANCE WITH 1986 MBMA

[illegible]

Butler Manufacturing Company
Kansas City, MO. USA
Burlington, ONT. Canada

DESCRIPTION	FOUNDATION LOAD REQUIREMENTS - PL-1 and PL-2 BUILDINGS
-------------	--

DATE 9-23-93

DRAWN BY RAP

SCALE

ORDER NO.

REVISION	4
----------	---

DWG. NO.

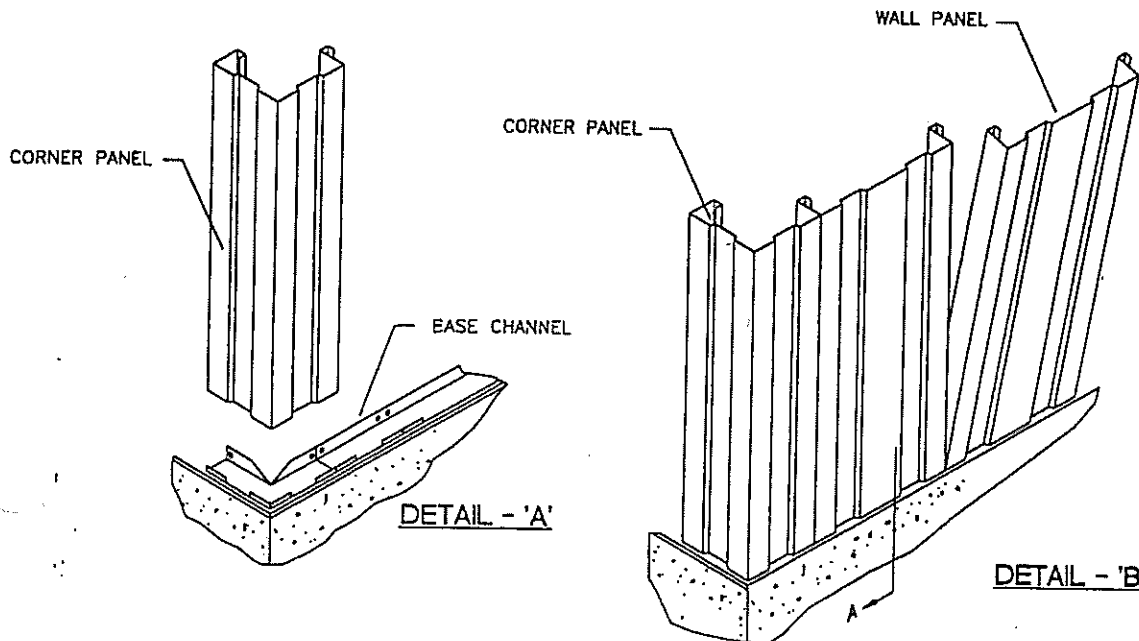
B 007

B-007

WALL ERECTION PROCEDURE

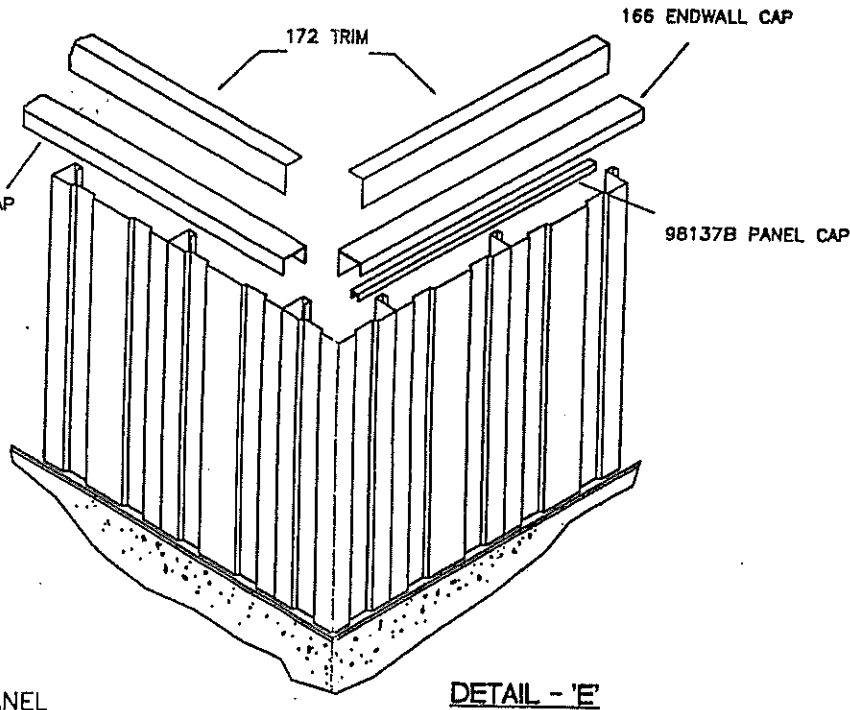
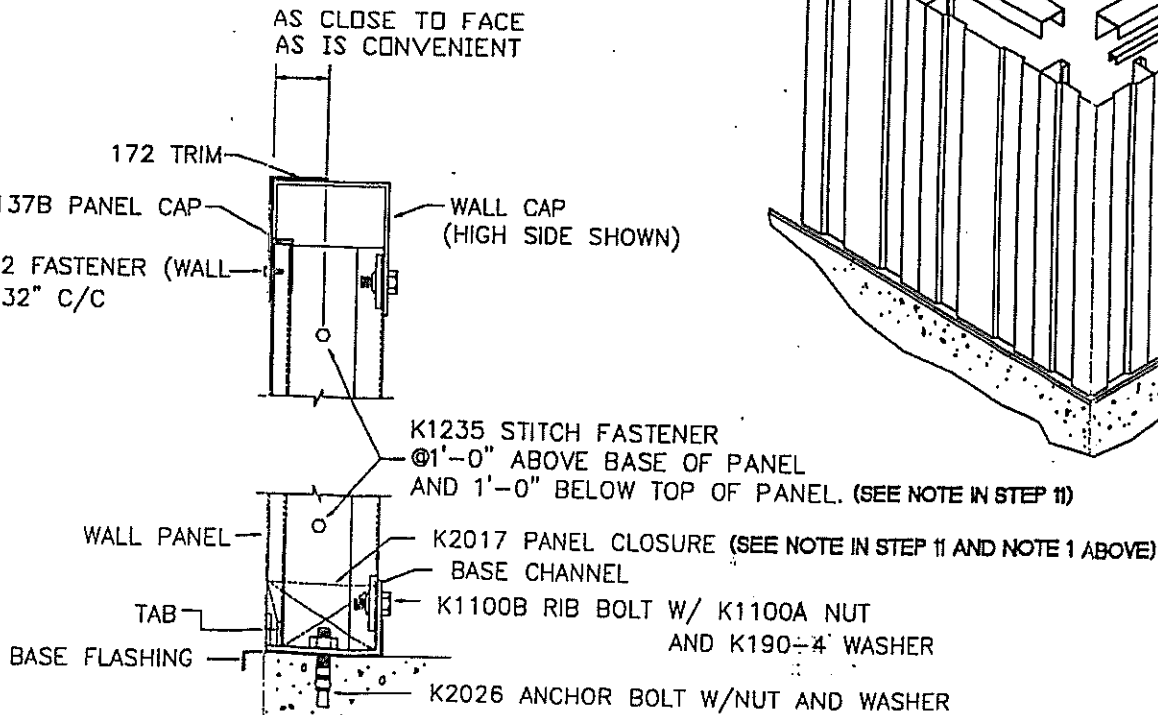
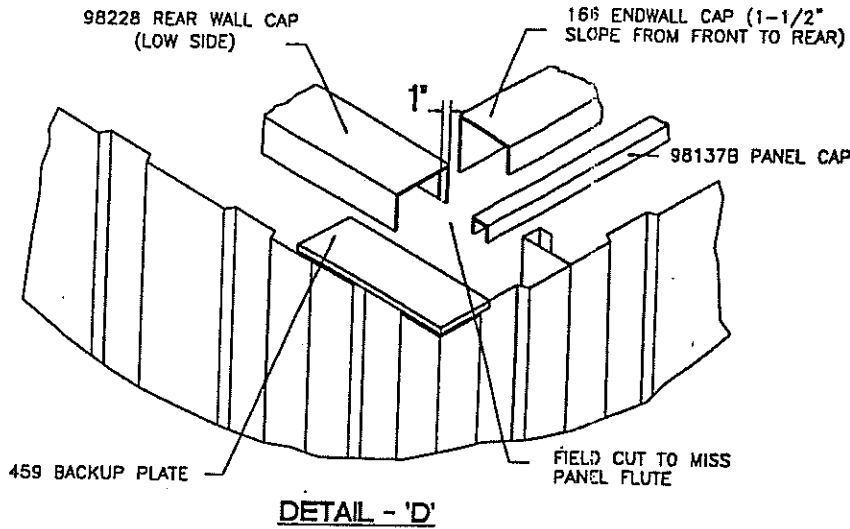
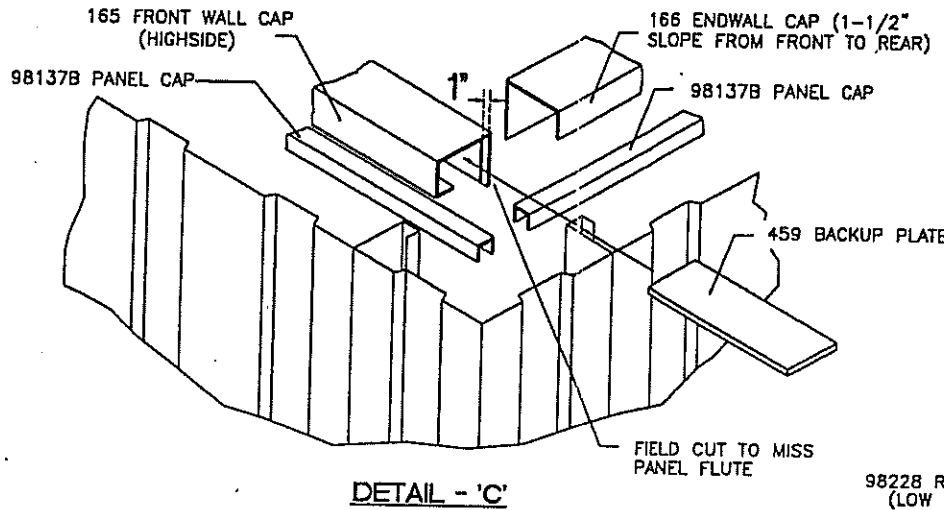
- STEP 1** INSTALL BASE CHANNEL PER DWG. #B-002
- STEP 2** SET CORNER PANEL WITH FEMALE RIB TO THE RIGHT. ERECTION OF WALL PANELS IS ALWAYS FROM LEFT TO RIGHT WHEN FACING THE OUT SIDE WALL (SEE DETAIL - 'A' AND 'B')
- STEP 3** TILT THE TOP OF THE WALL PANEL OUT FROM THE BUILDING AND SEAT IN THE BASE CHANNEL WITH THE PANEL RIBS IN THE BASE CHANNEL SLOTS. BE SURE THE PANEL FLUTES ARE BEHIND THE FLUTE RETAINER TABS. FASTEN RIBS TO CHANNEL WITH RIB BOLTS FINGER TIGHT. (SEE DETAIL - 'B', AND SECTION - 'A')
- STEP 4** CHECK VERTICAL PLUMBNESS OF WALL PANELS WITH A LEVEL. WALL PANELS MUST BE PERFECTLY PLUMB TO PREVENT GAPS FROM OCCURRING AT THE PANEL SIDE JOINTS. PLUMBNESS OF THE WALL SHOULD BE CHECKED A MAXIMUM OF EVERY 8 FEET OF WALL LENGTH.
- STEP 5** CONTINUE ERECTION OF WALL PANELS AS DESCRIBED IN STEP 2 AND 3 TEMPORARILY BRACING WALL AS REQUIRED. AT ACCESSORY OPENINGS REVIEW ACCESSORY DRAWINGS. ACCESSORIES SHOULD BE INSTALLED AS A PART OF THE WALL ERECTION.
- STEP 6** AFTER A SUFFICIENT RUN OF WALL PANELS ARE SET, INSTALL PANEL CAPS AND WALL CAPS OVER PANELS AND FINGER TIGHTEN BOLTS. PANEL CAPS ARE FURNISHED IN 8' LENGTHS WITH BUTT END CONNECTIONS AND REQUIRE NO FASTENERS. NO PANEL CAP IS REQUIRED ON THE REAR (LOW) SIDEWALL.
- FRONT AND REAR WALL CAPS ARE FURNISHED IN 8' AND 12' SECTIONS AND MUST BE FIELD CUT TO LENGTH REQUIRED AND NOTCHED TO CLEAR ENDWALL CORNER PANEL FLUTE. (SEE DETAIL - 'C' AND 'D') TOP OF FRONT WALL CAP WILL BE 1 1/2" ABOVE WALL PANELS AND REAR WALL CAP WILL REST ON WALL PANELS. FASTEN RIBS TO WALL CAP WITH RIB BOLTS FINGER TIGHT.
- NOTE** CONNECTING HOLES ARE SLOTTED TO ALLOW ADJUSTMENT OF ENDWALL CAPS TO BE LEVEL WITH FRONT AND REAR WALL CAPS.
- STEP 7** INSTALL 459 BACK UP PLATES UNDER WALL CAPS AT EACH CORNER AND TEMPORARILY HOLD IN PLACE WITH CLAMPS UNTIL ROOF IS INSTALLED (SEE DETAIL - 'C' AND 'D')
- STEP 8** CHECK BUILDING WALLS FOR PLUMBNESS AND SQUARE AND TIGHTEN ALL RIB BOLTS.
- STEP 9** PLACE 172 TRIM OVER WALL CAPS AROUND THE PERIMETER OF THE BUILDING. ATTACH TO WALL PANELS WITH K1238 #12 FASTENER @ 32" C/C (SEE SECTION - 'A' AND DETAIL - 'E')
- STEP 10** INSTALL ROOF. SEE DWG. #B-101
- STEP 11** INSTALL K2017 PANEL CLOSURE IN BOTTOM OF EACH PANEL. (SEE NOTE 1 ABOVE) INSTALL K1235 STITCH FASTENERS IN EACH WALL PANEL RIB AS SHOWN. (SEE SECTION 'A')

NOTE: PANEL CLOSURES AND STITCH FASTENERS ARE INSTALLED AFTER BUILDING HAS BEEN SQUARED AND PLUMBED ONLY.



NOTE:

1 K2017 PANEL CLOSURES ARE INSTALLED AT THE BOTTOM OF ALL FLUTED EXTERIOR WALL PANELS AND TOP AND BOTTOM OF ALL FLUSH EXTERIOR WALL PANELS AND FLUSH INTERIOR PARTITION PANELS. PANEL CLOSURES ARE TO BE INSTALLED AFTER BUILDING HAS BEEN SQUARED AND PLUMBED. PANEL CLOSURES ARE ALSO INSTALLED AT TOP AND BOTTOM OF ALL WALL OPENINGS.

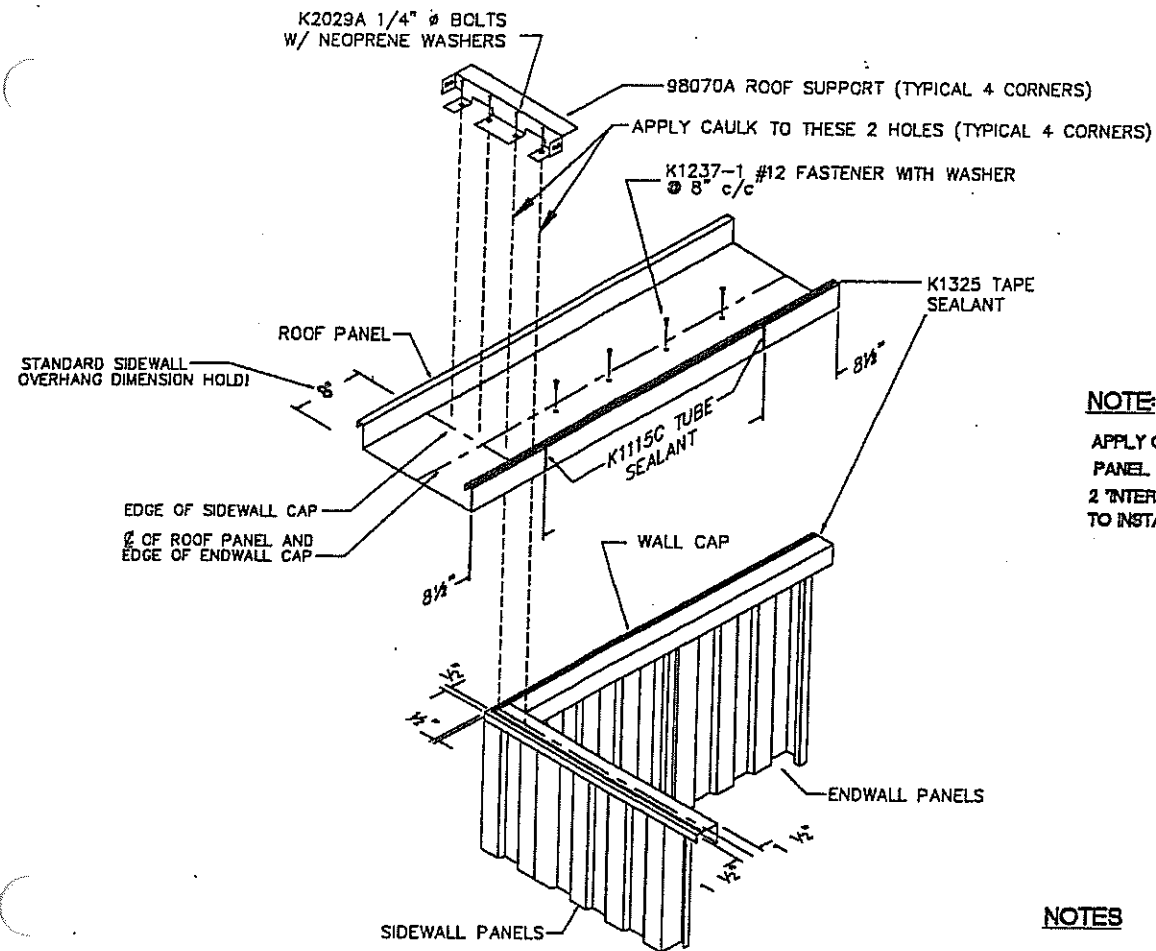


REVISIONS
3-1-83
4-21-84
10-30-88
12-1-88
3-8-88
3-08-01

BUTLER
Butler Manufacturing Company
VANARAH CITY, MO. USA

WALL ERECTION DETAILS
FOR 'PL-1' BUILDINGS

DATE	7-8
DRAWN BY	
SCALE	
ORDER NO.	
REVISION	
DWG. NO.	



NOTE:

APPLY CAULKING TO THE 2 "INTERIOR" ROOF PANEL HOLES AND TO BOTH SIDES OF THE 2 "INTERIOR" HOLES IN ROOF PANEL LEG PRIOR TO INSTALLING THE 98070A ROOF SUPPORT.

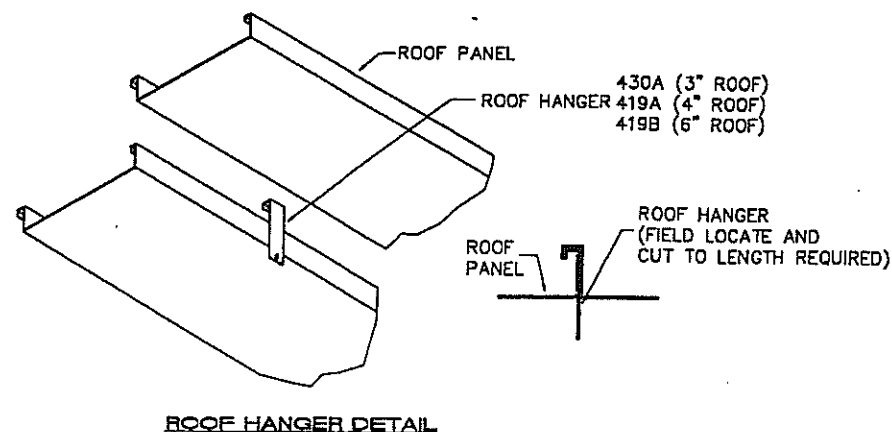


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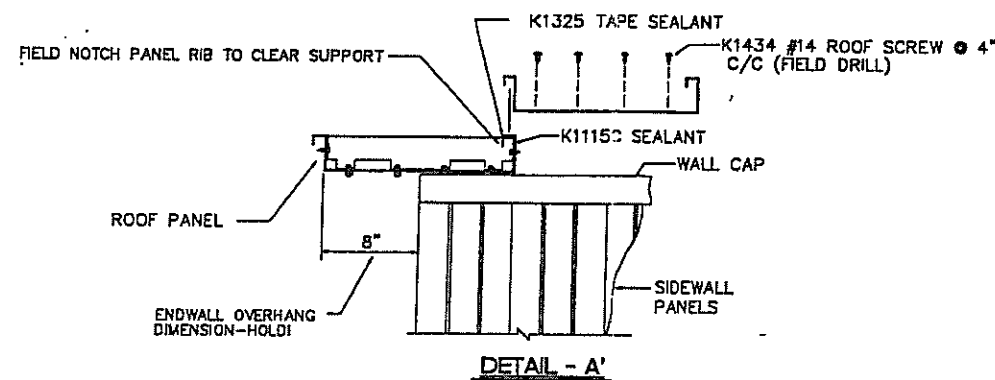
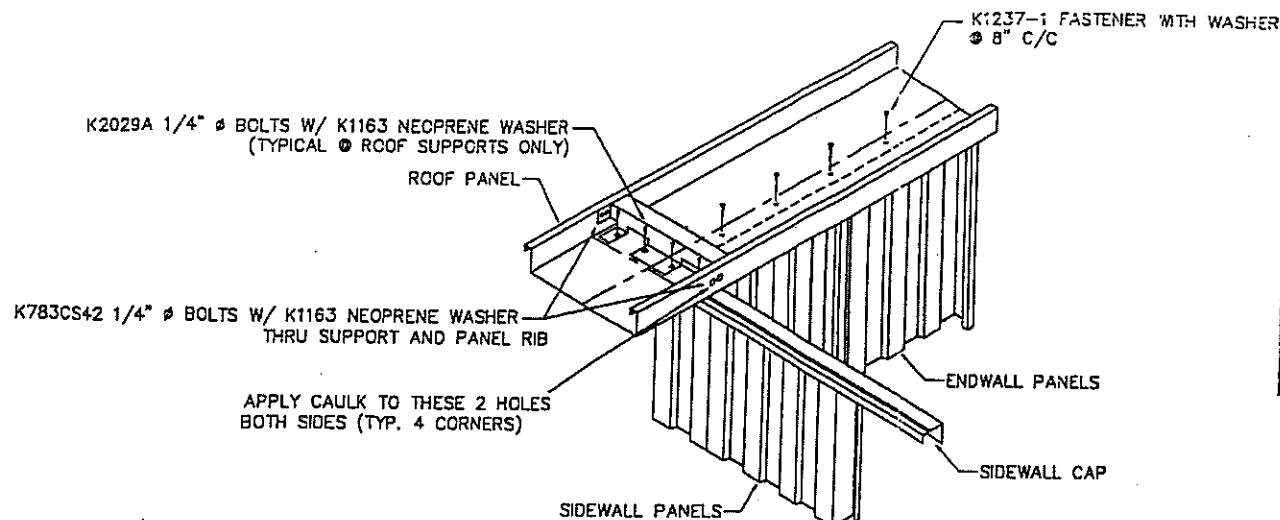
Always use fall protection while working around roof openings.

NOTES

1. REMOVE OIL AND DIRT FROM ALL PARTS TO BE CAULKED.
2. **BUILDINGS WITH GUTTER ONLY**
INSTALL ROOF PANELS WITH THE END HAVING 5 HOLES TOWARD LOW SIDE OF BUILDING.
(4 HOLES ON 6" RIB ROOF)
3. **BUILDINGS WITH 6" RIB ROOF AND GUTTER ONLY**
DUE TO 6" LEG ROOF PANELS BEING 12" WIDE, THE FACTORY PUNCHED HOLES IN THE GUTTER TRIM AND ROOF PANELS WILL ONLY LINE UP EVERY 4TH PANEL. FIELD DRILL REMAINING HOLES IN GUTTER TRIM USING HOLES IN ROOF PANEL AS A GUIDE.
4. **BUILDINGS WITH BUTLER CEILING SYSTEM ONLY**
INSTALL AND INSULATE CEILING BEFORE ROOF IS INSTALLED. SEE DRAWING B-104 BEFORE STARTING ROOF ERECTION.
5. **BUILDINGS WITH SKYLIGHTS ONLY**
DETERMINE SKYLIGHT POSITIONS AND INSTALL PANELS ACCORDINGLY.
WARNING: NEVER INSTALL TWO SKYLIGHT PANELS SIDE BY SIDE. THERE MUST BE AT LEAST ONE SOLID PANEL BETWEEN SKYLIGHTS.
6. **BUILDINGS WITH THERMA ROOF ONLY**
SEE THERMA-ROOF INSTALLATION DRAWING B-105 BEFORE STARTING ROOF ERECTION.
7. **BUILDINGS WITH ROOF HANGERS ONLY**
IF ROOF HANGERS ARE REQUIRED THEY MUST BE INSTALLED DURING ROOF ERECTION. ROOF HANGERS ARE USED ON WIDER BUILDINGS TO SUPPORT THE THERMA ROOF SYSTEM AND CEILINGS. THEY ARE ALSO USED TO HANG LIGHTS, DUCTWORK, ETC. FROM ROOF. EACH HANGER CAN SUPPORT A MAXIMUM OF 20 LBS. ERECTOR MUST DETERMINE LOCATIONS PRIOR TO BEGINNING ROOF INSTALLATION. SEE DETAIL TO LEFT.



ROOF HANGER DETAIL



ROOF ERECTION

- STEP 1. CHECK BUILDING FOR PLUMB AND SQUARE.
- STEP 2. APPLY K1325 3/8" TAPE SEALANT ALONG TOP OF WALL CAPS 1/2" IN FROM OUTSIDE EDGE OF CAPS.
- STEP 3. PLACE FIRST ROOF PANEL WITH CUT TURNED (FEMALE) RIB, TOWARD THE OUTSIDE OF BUILDING. SNAP CHALKLINE AT CENTERLINE (8") OF ROOF PANEL. CENTER OF PANEL SHOULD LINE UP WITH OUTSIDE EDGE OF ENDWALL CAP TO MAINTAIN 8" ENDWALL OVERHANG. MAKE SURE THAT SIDEWALL OVERHANG DIMENSION IS ALSO MAINTAINED. TEMPORARILY CLAMP INTO POSITION. (DO NOT INSTALL FASTENERS)
- STEP 4. PUT TAPE SEALANT (K1325) ALONG TOP OF (MALE) PANEL RIB AS SHOWN. SWEEP TUBE SEALANT (K1115C) ALONG SIDE OF EACH PANEL RIB AS SHOWN.
- STEP 5. INSTALL ADJACENT ROOF PANEL LOCKING FEMALE RIB OVER THE MALE RIB OF THE ROOF PANEL THAT IS IN PLACE. BE SURE THAT ROOF SIDEWALL OVERHANG DIMENSION IS MAINTAINED. FIELD DRILL HOLES USING #8 BIT THRU PANEL AND WALL CAP AT CENTERLINE OF WALL CAP 4" C/C AT EACH END. FASTEN ROOF PANEL TO WALL CAP WITH K1434 FASTENERS.
- STEP 6. REPEAT STEPS 5 AND 6 UNTIL ALL ROOF PANELS ARE INSTALLED. DO NOT FASTEN THE LAST PANEL.
- STEP 7. INSTALL 98070A ROOF SUPPORT IN FIRST AND LAST ROOF PANELS AT ALL 4 CORNERS. FIELD DRILL 5/16" HOLES AND APPLY CAULKING TO THE 2 "INTERIOR" HOLES IN ROOF PANELS AND TO THE 2 "INTERIOR" HOLES IN ROOF PANEL LEG. FASTEN ROOF SUPPORT INTO PLACE WITH K2029A 1/4" BOLTS AND K783CS42 1/4" BOLTS AS SHOWN. WHEN INSTALLING ROOF SUPPORT BE CERTAIN THAT BOLTS GO THROUGH 458A BACK-UP PLATE. (SEE DWG. B-100)
- STEP 8. FASTEN STARTING AND FINISHING ROOF PANELS TO END WALL CAPS WITH K1237-1 FASTENERS AT 8" C/C.

REVISIONS	BY
3-4-93	RLJ
4-20-93	RLJ
4-29-94	DB
11-5-98	KAG
11-01-00	DLR

BUTLER
Butler Manufacturing Company
Kansas City, MO. USA
Burlington, ONT. Canada

ROOF PANEL INSTALLATION DETAILS
TYPE PL-1 BUILDINGS

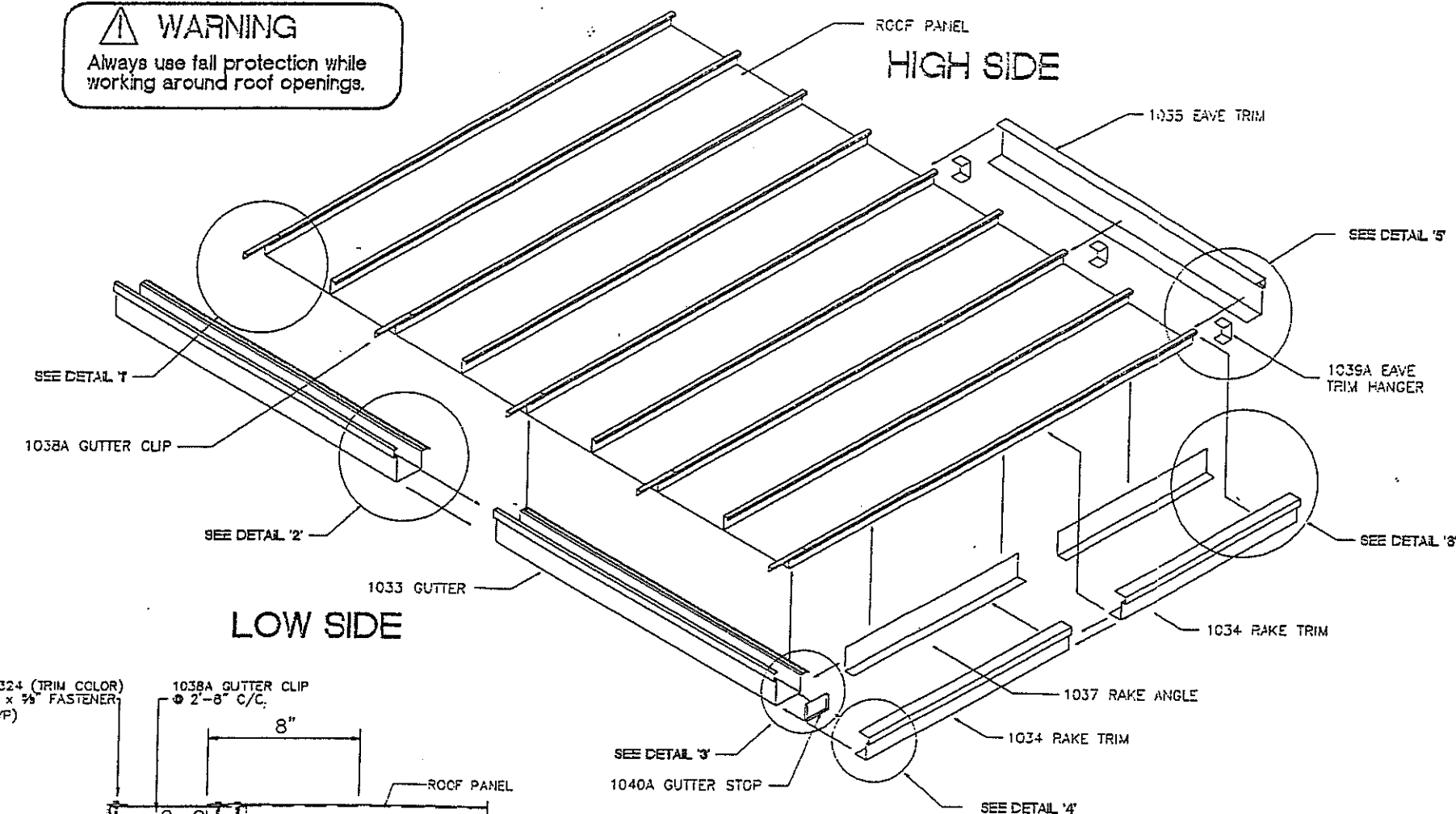
DATE 7-9-92
DRAWN BY DC
SCALE N.T.S.
ORDER NO.
REVISION 5
DWG. NO. B-101



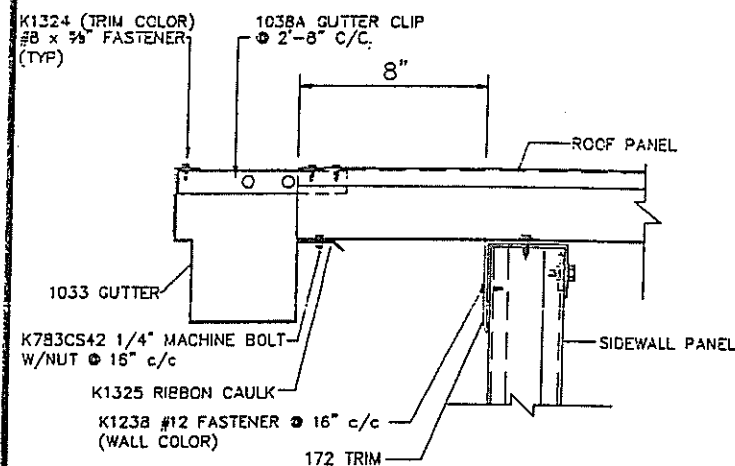
WARNING

Always use fall protection while working around roof openings.

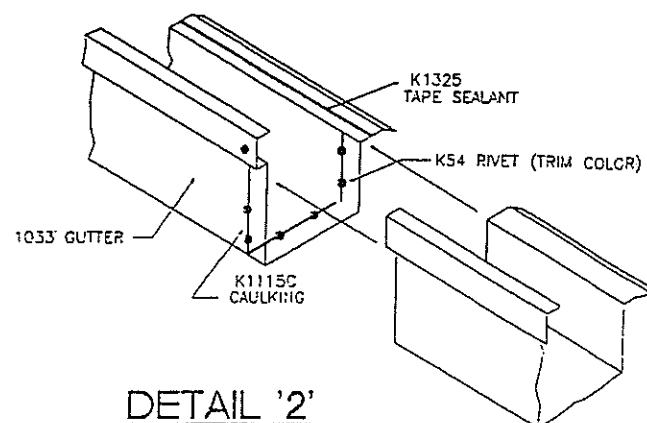
HIGH SIDE



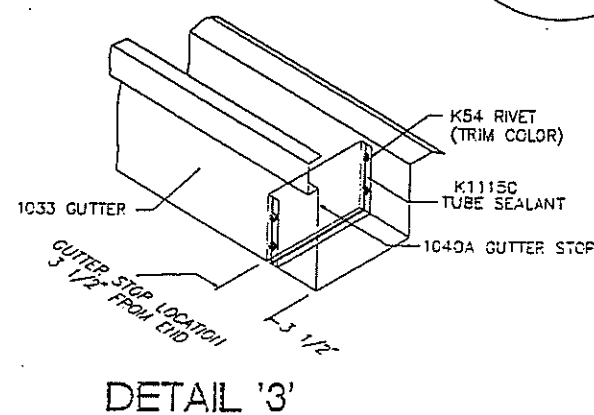
LOW SIDE



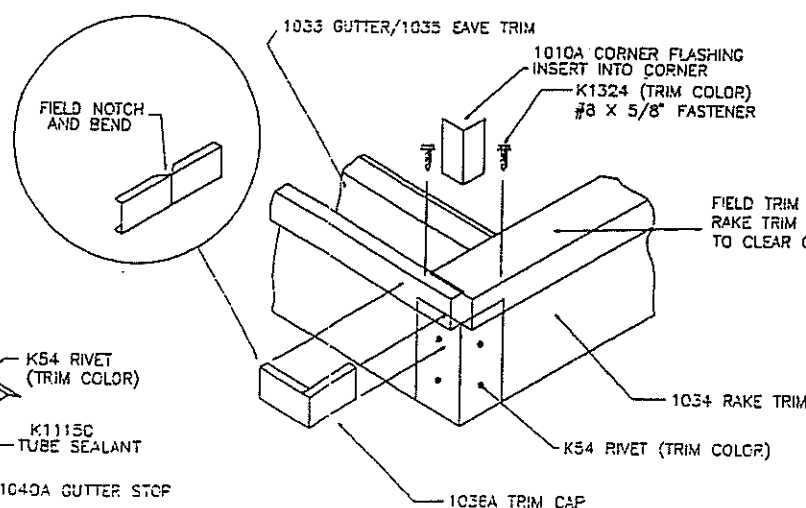
DETAIL '1'



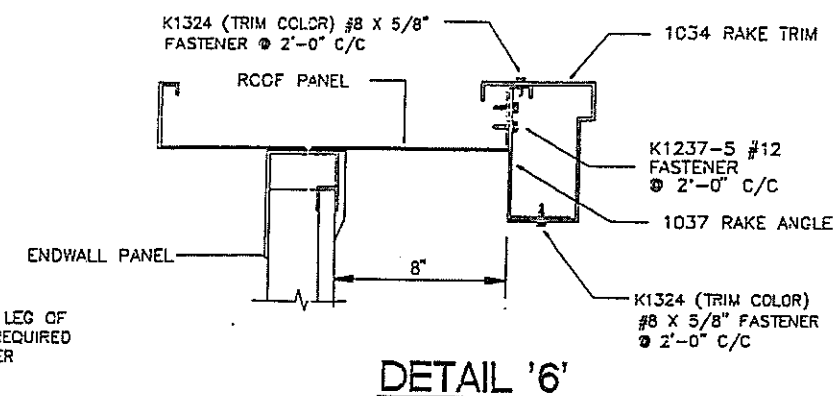
DETAIL '2'



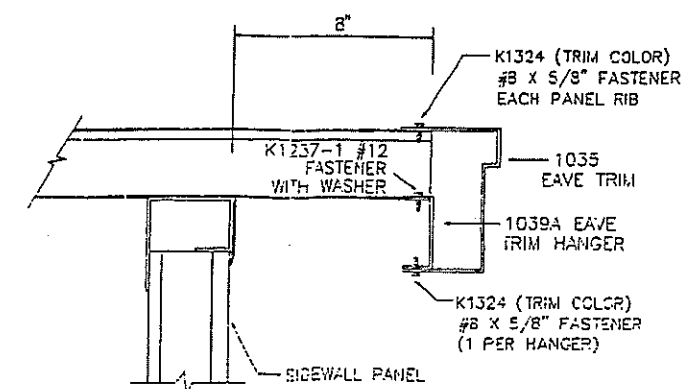
DETAIL '3'



DETAIL '4'



DETAIL '6'



DETAIL '5'

INSTALLATION PROCEDURE

NOTES: a) REMOVE PROTECTIVE FILM FROM TRIM BEFORE INSTALLATION.
b) GUTTER AND RAKE TRIM ARE FORMED TO SLIP FIT AT SPLICES. TEST FIT PIECES ON GROUND BEFORE INSTALLATION.

- STEP 1. ATTACH 1038A GUTTER CLIP TO TOP OF FIRST ROOF PANEL RIB AND EVERY OTHER RIB THEREAFTER (2'-8" c/c) DOWN TO AND INCLUDING THE LAST PANEL RIB ON THE LOW SIDE OF THE BUILDING. FASTEN CLIP TO ROOF PANEL RIBS WITH (2) K1324 FASTENERS PER CLIP. FOR CLIP LOCATION (SEE DETAIL '1').
- STEP 2. PLACE GUTTER ON FLAT SURFACE AND REMOVE PROTECTIVE FILM. IF SPLICE IS REQUIRED, TEST PIECES FOR SLIP FIT. (SEE DETAIL '2').
- STEP 3. WHILE ON GROUND, CUT HOLES IN SECTIONS OF GUTTER REQUIRING OUTLET DROPS. APPLY K1115C SEALANT AROUND FLANGE OF K1269B OUTLET DROP AND FASTEN TO GUTTER WITH K54 RIVETS (SEE DWG. # B-102-2 FOR DOWNSPOUT INSTALLATION). INSTALL 1040A GUTTER STOPS PER (SEE DETAIL '3').
- STEP 4. RUN K1325 TAPE SEALANT FULL LENGTH OF GUTTER AND ATTACH GUTTER TO ROOF PANELS WITH (1) K783CS42 1/4" Ø BOLT PER PANEL. GUTTER SHOULD EXTEND PAST ROOF 3 1/2" (FIELD CUT AS REQUIRED). AT SPLICES, CAULK AREA AT LAP WITH K1115C SEALANT. SLIP GUTTER PIECES TOGETHER AND RIVET INTO PLACE. (SEE DETAIL '2'). ATTACH GUTTER TO CLIPS WITH (1) K1324 FASTENER PER CLIP (SEE DETAIL '1').
- STEP 5. INSTALL EAVE TRIM ON HIGH SIDE OF BUILDING BY INSTALLING 1039A EAVE TRIM HANGERS ON ROOF PANELS WITH (1) K1237-1 FASTENER PER (SEE DETAIL '5'). CLIP. INSTALL HANGER ON FIRST ROOF PANEL AND Ø 2'-8" CENTERS THEREAFTER INCLUDING THE LAST PANEL.
- STEP 6. INSTALL 1035 EAVE TRIM OVER PANEL RIBS AND ATTACH TO RIB WITH (1) K1324 FASTENER PER RIB (BE SURE AND MAINTAIN 1" OVERLAP OF PANEL RIB). FASTEN BOTTOM OF TRIM TO HANGER WITH (1) K1324 FASTENER PER HANGER (SEE DETAIL '5'). TRIM SHOULD EXTEND PAST ROOF 3 1/2" EA. END (FIELD CUT AS REQUIRED). AT SPLICES, SLIP THE TRIM TOGETHER AND RIVET INTO PLACE. NO SEALANT REQUIRED.
- STEP 7. AT ENDS OF ROOF, INSTALL 1037 RAKE ANGLE TO PANEL RIBS WITH K1237-5 FASTENER AT 2'-0" c/c. PLACE 1034 RAKE TRIM OVER PANEL RIBS AND ANGLE. ENDS OF TRIM SHOULD BE FLUSH WITH GUTTER AND EAVE TRIM (SEE DETAIL '4'). FIELD CUT AS REQUIRED. AT SPLICE, SLIP TRIM PIECES TOGETHER AND RIVET IN PLACE. FASTEN TRIM TO PANEL RIB AND RAKE ANGLE W/ K1324 FASTENER Ø 2'-0" c/c (SEE DETAIL '6').
- STEP 8. INSTALL TRIM CAPS Ø 4 CORNERS. FASTEN W/ K1324 FASTENER. (SEE DETAIL '4').

REVISIONS	BY
12-30-92	DC
3-4-93	RLJ
5-7-93	RLJ
4-21-94	DB
11-5-96	KAG
03-31-00	DLR

BUTLER
Butler Manufacturing Company
Kansas City, MO, USA
Burlington, ONT, Canada

JOB DESCRIPTION
**GUTTER AND RAKE TRIM
INSTALLATION DETAILS**
SHEET TITLE
PL - 1 BUILDINGS

DATE 7-24-92
DRAWN BY DC
SCALE NTS (1/8")
ORDER NO.
REVISION 1 6
DWG. NO.

B-102-1

INSTALLATION PROCEDURE

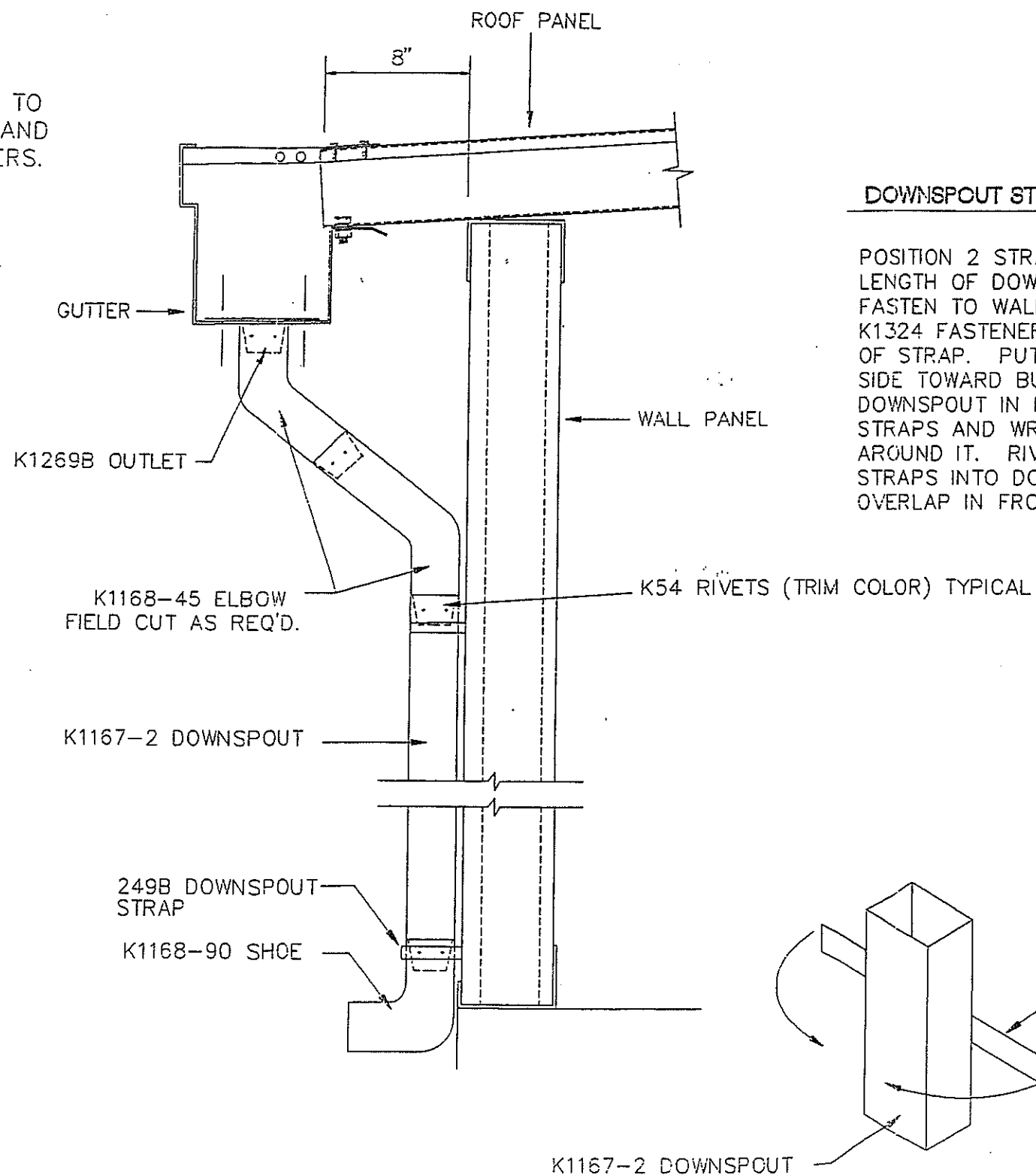
- STEP 1.** FIELD CUT HOLES IN GUTTER BOTTOM FOR OUTLETS (K1269B) USING OUTLET AS TEMPLATE. INSERT OUTLETS AND SEAL AND FASTEN WITH RIVETS.
- STEP 2.** ASSEMBLE ELBOWS AS SHOWN AND THEN ATTACH TO OUTLET DROP. POSITION DOWNSPOUT ON ELBOWS AND FASTEN TO WALL THROUGH STRAPS WITH FASTENERS. (SEE DETAIL) FIELD CUT AS REQUIRED.

MAXIMUM DOWNSPOUT SPACING* IN FEET

RAIN INTENSITY INCHES/ HR.	TYPE PL-1 BUILDING WIDTHS				
	5'-4"	6'-8"	8'-0"	10'-8"	12'-0"
3.0	100'	100'	100'	100'	100'
4.0	100'	100'	100'	100'	100'
5.0	100'	100'	100'	100'	90'
6.0	100'	100'	100'	80'	70'
7.0	100'	100'	90'	70'	60'
8.0	100'	90'	80'	60'	50'
9.0	100'	80'	70'	50'	50'
10.0	100'	70'	60'	50'	40'
11.0	90'	60'	60'	50'	40'

* CHART ASSUMES THAT BUILDINGS WITH A SINGLE DOWN-
SPOUT WILL HAVE THE DOWNSPOUT CENTERED IN THE
BUILDING LENGTH (1/2 OF ALLOWABLE LENGTH ON EACH
SIDE OF THE DOWNSPOUT).

NOTE: DOWNSPOUT SHOULD BE EVENLY SPACED ALONG THE BUILDING LENGTH.



DOWNSPOUT STRAP DETAIL

POSITION 2 STRAPS PER 10'
LENGTH OF DOWNSPOUT AND
FASTEN TO WALL PANEL WITH
K1324 FASTENER THRU CENTER
OF STRAP. PUT COLORED
SIDE TOWARD BUILDING. PUT
DOWNSPOUT IN PLACE OVER
STRAPS AND WRAP STRAPS
AROUND IT. RIVET THRU
STRAPS INTO DOWNSPOUT AT
OVERLAP IN FRONT.

[illegible]

Butler Manufacturing Company
 Kansas City, MO. USA
 Burlington, ONT. Canada

JOB DESCRIPTION	DOWNSPOUT DETAIL
SHEET TITLE	PL-1 BUILDING

DATE	
DRAWN BY	
SCALE	N.T.S.
ORDER NO.	
REVISION	4
PWG. NO.	
B-102-2	

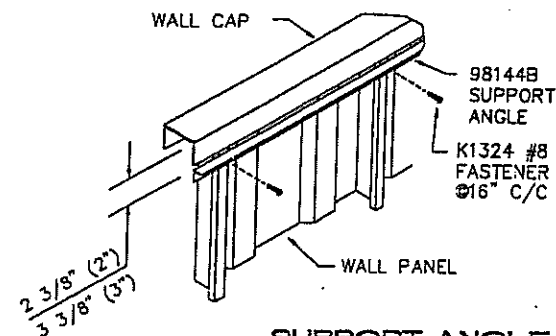
NOTE: THE THERMA-ROOF INSULATION SYSTEM IS
INSTALLED AS A PART OF THE ROOF PANEL
ERECTION SEQUENCE.

STEP #3

PLACE FIRST INSULATION BOARD IN POSITION WITH WHITE FACE DOWN (FIELD CUTTING MAY BE REQUIRED). TO INSURE THAT THE 145 SUPPORT "T" RUNS EVEN WITH A ROOF PANEL RIB, MEASURE INTERIOR LENGTH OF BUILDING (RIB TO RIB). DEDUCT AS MANY 4'-0" INCREMENTS AS POSSIBLE FROM LENGTH AND DIVIDE REMAINDER BY TWO. THIS GIVES THE WIDTH OF THE STARTING AND FINISHING INSULATION BOARD PIECES. THIS PROCEDURE IS HELPFUL WHEN THE ROOF HAS SKYLIGHTS AND ROOF OPENINGS.

STEP #4

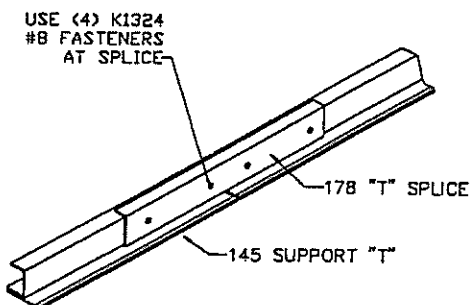
IF THE BUILDING INTERIOR IS WIDER THAN 12'-0" (RIB TO RIB), SPLICING OF MORE THAN ONE INSULATION BOARD WILL BE NECESSARY. THE SPLICE IS MADE USING A 195A CROSS "T" TO SUPPORT THE ENDS OF THE INSULATION BOARDS BEING SPLICED. (SEE CROSS "T" SUPPORT DETAIL)



SUPPORT ANGLE DETAIL

STEP #1

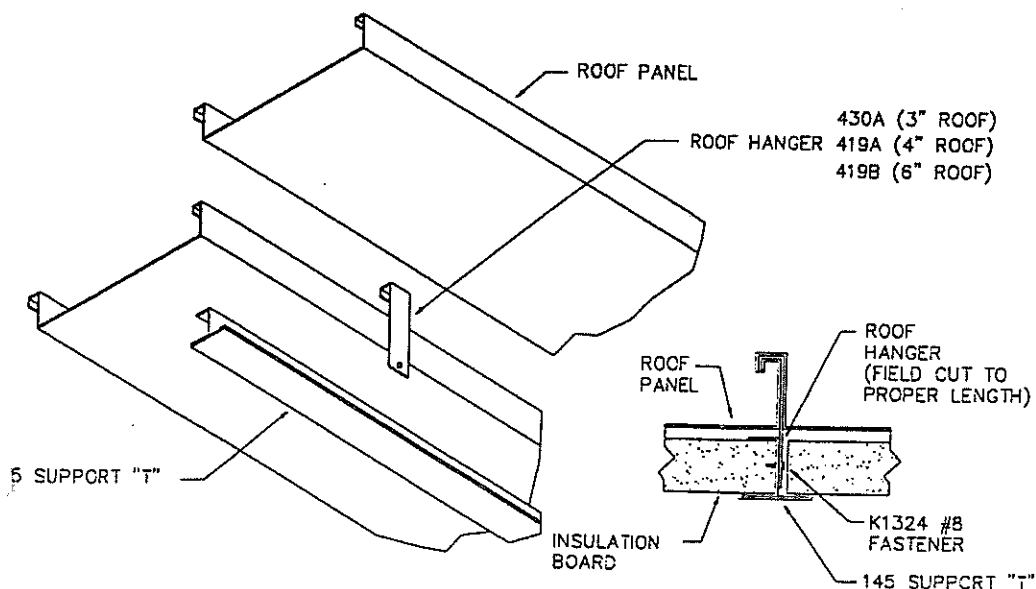
IF LINER IS TO BE INSTALLED IN THE BUILDING, THE SUPPORT ANGLE IS INSTALLED ONLY AT THE SIDEWALLS. THE LINER CEILING TRIM WILL SUPPORT THE INSULATION BOARD AT THE ENDWALLS. IF NO LINER IS TO BE INSTALLED, THE SUPPORT ANGLE IS INSTALLED ALONG THE FULL PERIMETER OF THE BUILDING. POSITION ANGLE $3/8"$ PLUS THE THICKNESS OF THE INSULATION BELOW TOP OF WALLCAP.



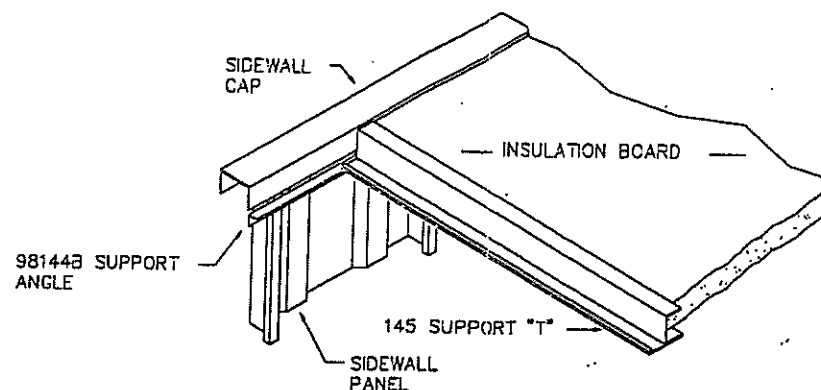
SUPPORT "T" SPLICE DETAIL

STEP #2

PLACE FIRST 145 SUPPORT "T" IN POSITION RESTING EACH END ON THE SIDEWALL SUPPORT ANGLE. THE LENGTH OF THE SUPPORT "T" WILL BE 6 1/8" LESS THAN THE WIDTH OF THE BUILDING, SO SOME FIELD CUTTING MAY BE REQUIRED. IF THE BUILDING WIDTH IS MORE THAN 12'-6", THE SPlicing OF TWO SUPPORT "T" PIECES WILL BE NECESSARY. (SEE SUPPORT "T" SPLICE DETAIL) IF THE BUILDING WIDTH IS MORE THAN 16'-0", IT WILL BE NECESSARY TO INSTALL A ROOF HANGER AT THE CENTER OF THE ROOF PANEL TO HELP SUPPORT THE SUPPORT "T". MEASURE AND CUT ROOF HANGER TO REQUIRED LENGTH AND FASTEN TO SUPPORT "T" USING K1324 FASTENER. (SEE ROOF HANGER DETAIL)



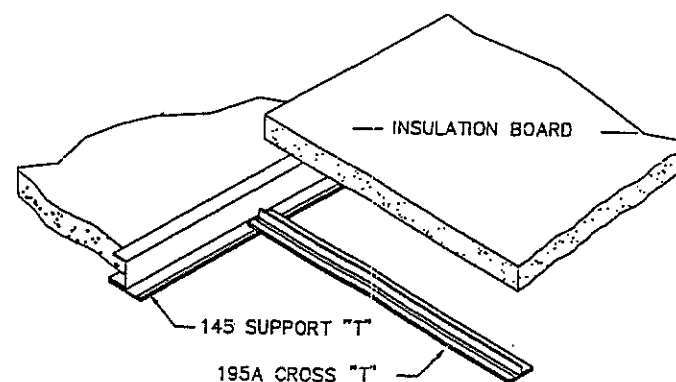
ROOF HANGER DETAIL



SUPPORT "T" INSTALLATION DETAIL

STEP #5

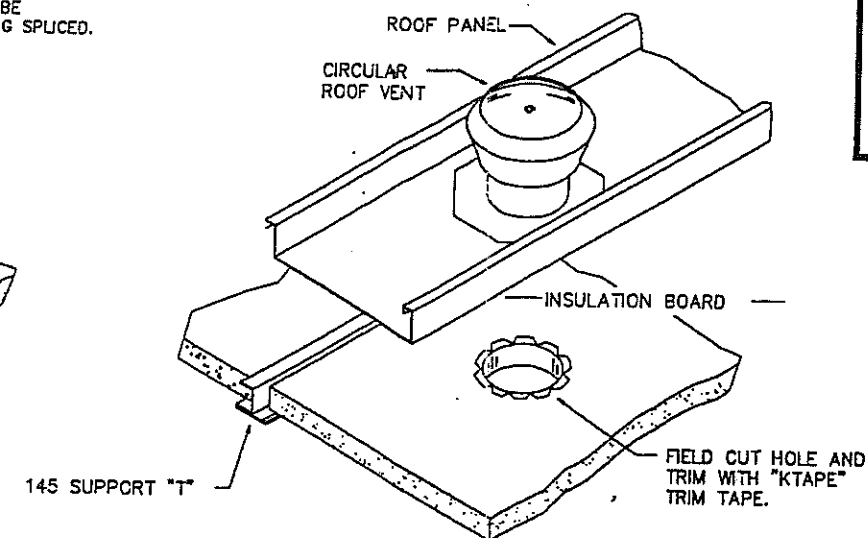
IF THE INSULATION THICKNESS IS TO BE 3" THICK, THERE WILL BE A 1" THICK INSULATION BOARD ON BOTTOM (WHITE FACE DOWN) AND A 2" THICK INSULATION BOARD ON TOP. ALL SPLICE JOINTS OF THE BOTTOM INSULATION BOARDS ARE TO BE OFFSET FROM THE SPLICE JOINTS OF THE TOP INSULATION BOARDS. THIS IS DONE BY CUTTING THE STARTING 2" (TOP) INSULATION BOARD 6" NARROWER THAN THE STARTING 1" (BOTTOM) INSULATION BOARD. USE SAME PROCEDURE FOR LENGTH SPLICES (IF REQUIRED).



CROSS "T" SUPPORT DETAIL

STEP #6

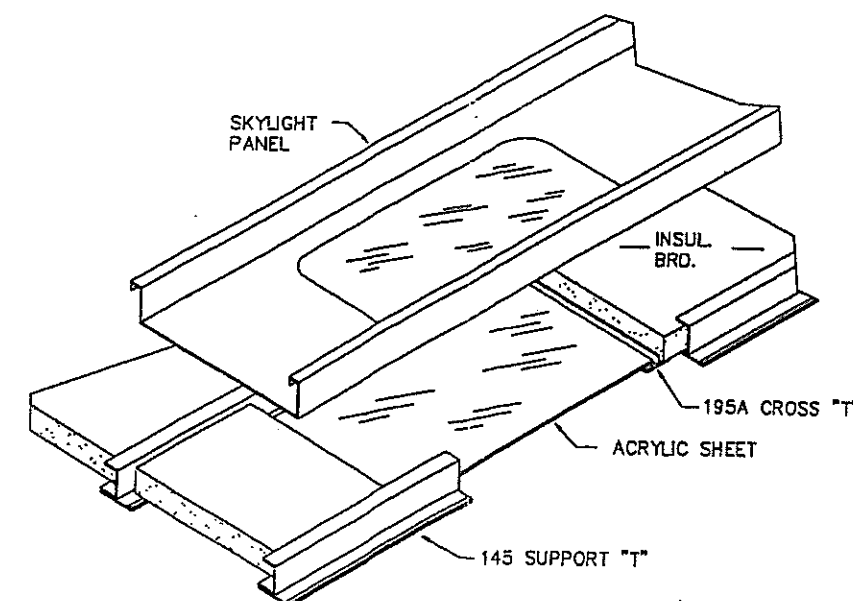
ONCE THE FIRST SECTION OF INSULATION BOARD IS IN PLACE,
INSTALL ROOF PANELS UP TO THE SUPPORT "I" AND THEN REPEAT
STEP #2 THROUGH STEP #6.



ROOF VENT DETAIL

STEP #7

IF A CIRCULAR VENT IS TO BE INSTALLED IN THE ROOF, A CIRCULAR HOLE IS CUT IN THE INSULATION BOARD TO CORRESPOND TO THE VENT HOLE IN THE ROOF PANEL. THE EXPOSED EDGES OF THE INSULATION BOARD ARE TAPED USING TRIM TAPE "KTAPE". (SEE ROOF VENT DETAIL)



INSULATED SKYLIGHT DETAIL

STEP #8

IF SKYLIGHTS OR ROOF PANEL OPENINGS ARE TO BE INSTALLED IN ROOF, WORK THE INSULATION SYSTEM OVER TO THE EDGE OF THE SKYLIGHT OR ROOF OPENING, FRAME AROUND SKYLIGHT SECTION IN PANEL OR ROOF OPENING USING 145 SUPPORT "T" AND 195A CROSS "T" SECTIONS AND CUTTING THE INSULATION BOARD AS NECESSARY. TO INSULATE A SKYLIGHT PANEL, ONCE THE OPENING IS FRAMED, A PIECE OF ACRYLIC SHEET IS PLACED INSIDE THE FRAME. (SEE INSULATED SKYLIGHT DETAIL)

[illegible]

Butler Manufacturing Company
 Kansas City, MO. USA
 Burlington, ONT. Canada

Therma-Roof Insulation Installation Instructions

TYPE "PL-T" BUILDING

DATE 11-27-96

DRAWN BY KAG

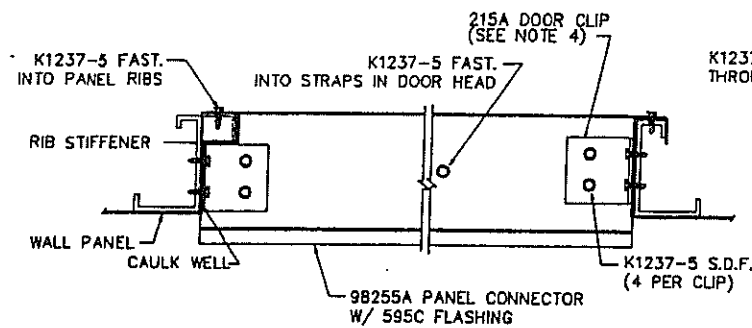
SCALE NTS

ORDER NO.

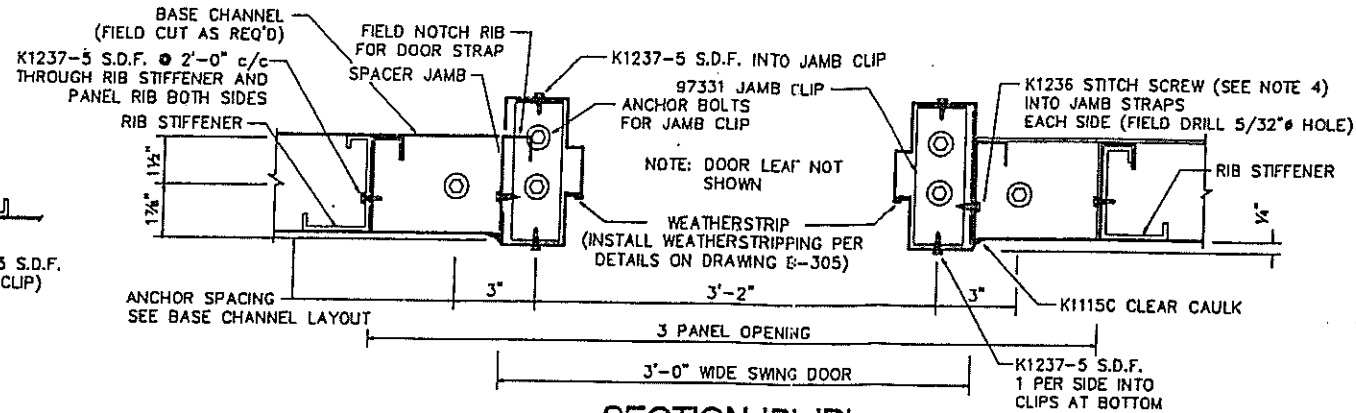
REVISION	1
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DWG. NO.

B-105



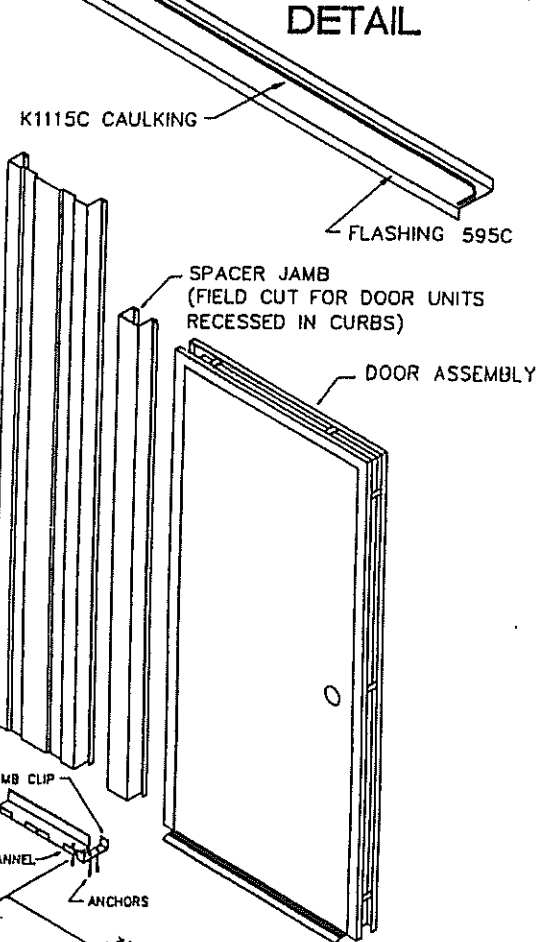
SECTION 'A'-A'



SECTION 'B'-B'

FIELD NOTCH FLASHING USING PANEL CONN. AS TEMPLATE

PANEL CONNECTOR FLASHING CAULKING DETAIL

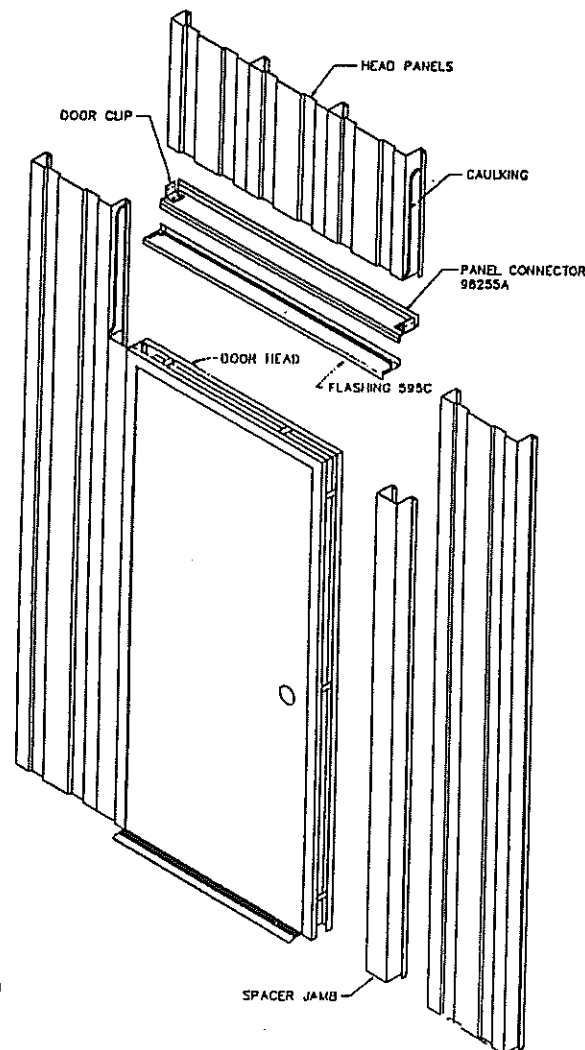


(IF DOOR UNIT IS RECESSED IN CURB USE THIS AS CLEAR CURB OPENING)

STEP 1
FASTEN JAMB CLIPS TO FOUNDATION (SEE SECT. B-B & BASE CHANNEL LAYOUT). PLACE SPACER JAMB ON LEFT INTO POSITION & FASTEN TO BACK OF BASE CHANNEL. SET DOOR ASSY. OVER CLIPS AND FASTEN PER SECT. B-B. ATTACH DOOR JAMBS TO PANEL RIBS WITH K12356 SCREWS THRU DOOR JAMB STRAPS (SECTION B-B)

STEP 2

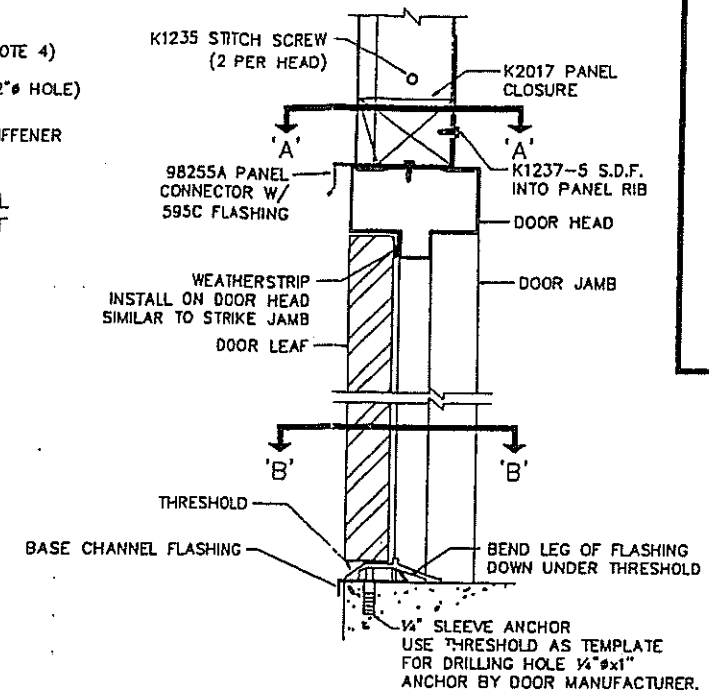
PUT SPACER JAMB ON RIGHT INTO POSITION AND ATTACH TO BASE CHANNEL & DOOR JAMB. CAULK PANEL CONNECTOR (98255A) AND FLASHING (595C) PER DETAIL ABOVE. PLACE PANEL CONNECTOR / FLASHING INTO POSITION AND FASTEN TO HEAD (SEE SECT. A-A). CAULK FROM TOP OF WALL PANEL TO DOOR HEAD AS SHOWN. THEN PLACE HEAD PANELS INTO POSITION AND FASTEN TO BACK OF PANEL CONNECTOR (SEE SECT. THRU DOOR). CAULK HEAD PANEL AS SHOWN. THEN INSTALL PANEL TO RIGHT OF OPENING.



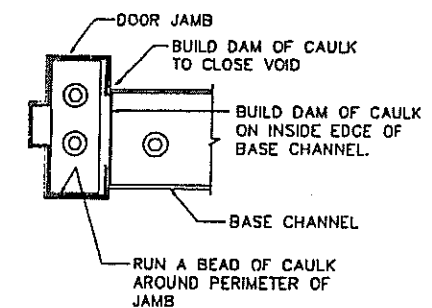
NOTE:
IF DOOR CLOSER IS TO BE INSTALLED REFER TO DRAWING B-305 BEFORE BEGINNING DOOR INSTALLATION.

STEP 3

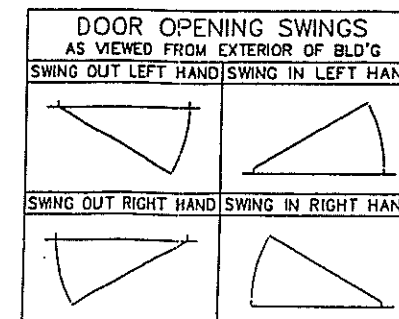
LOCK RIB STIFFENERS (97302) INTO PANEL RIBS AS SHOWN IN SECT. A-A AND FASTEN THROUGH PANEL RIBS TO STIFFENERS (SEE SECT. B-B FOR LOCATION) INSTALL 215A DOOR CLIPS TO PANEL CONNECTOR AND THRU PANEL RIBS INTO RIB STIFFENERS (SECT. A-A). SURFACE CAULK DOOR FRAME W/ K1115C CLEAR CAULK AS SHOWN IN SECTION B-B.



SECTION THRU DOOR



TYP. CAULKING DETAIL BASE OF DOOR JAMB



NOTE:

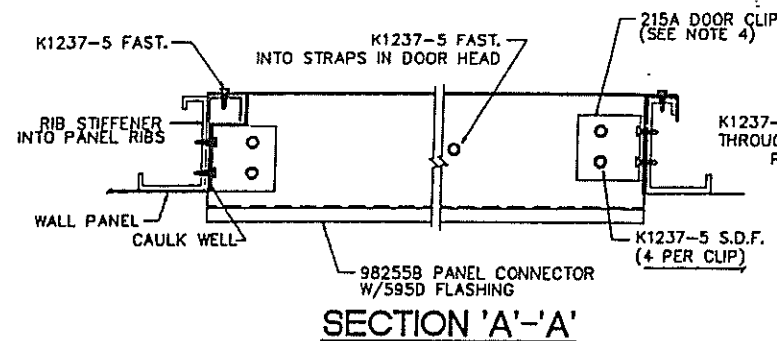
1. SINGLE SWING OUT DOOR ASSY. SEE FLOOR PLAN FOR DOOR SWNG.
2. DOOR FRAMING MUST BE INSTALLED AS WALL PANEL ARE ERECTED.
3. DOOR MUST BE INSTALLED SQUARE AND PLUMB.
4. DOOR INSTALLATION HARDWARE LOCATED IN BOX MARKED **KXDR**.
5. INSTALL WEATHERSTRIP ON DOOR AS SHOWN IN DETAIL ON DRAWING B-305.
6. CHECK INSIDE OF DOOR FRAME FOR ADDITIONAL HARDWARE ITEMS SUCH AS KNOBS, ETC.

REVISIONS	BY
3-9-93	RLJ
3-10-94	WS
4-25-94	DB
11-30-94	DB
7-23-97	CBP
	???

BUTLER
Butler Manufacturing Company
Kansas City, MO, USA
Burlington, ONT, Canada

JOB DESCRIPTION
3'-0" WIDE WALK DOOR
INSTALLATION
SHEET TITLE
PANEL-LINE BUILDING

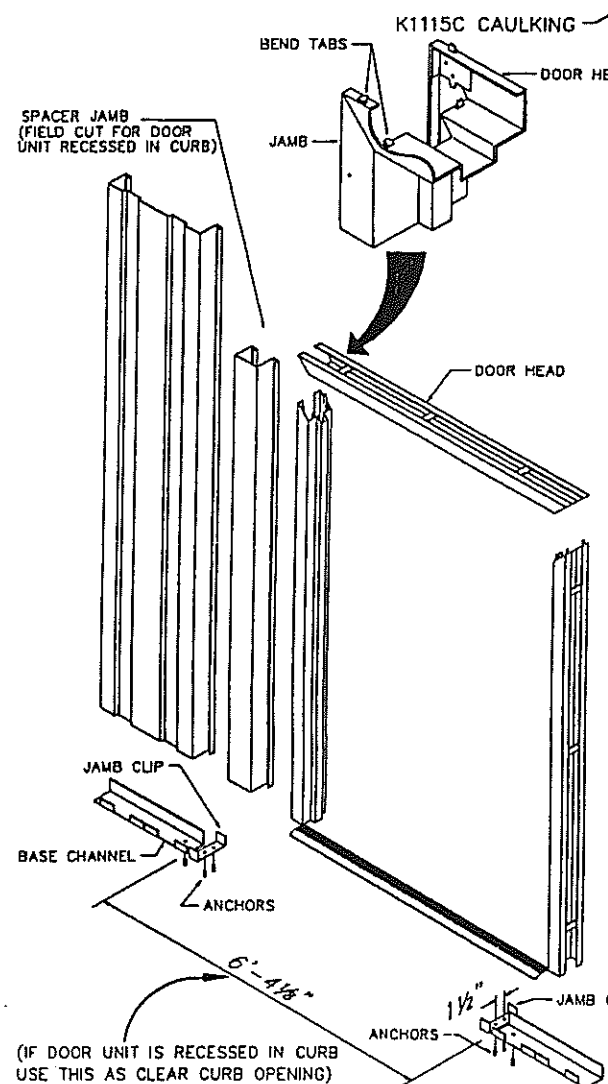
DATE 12-18-81
DRAWN BY DC
SCALE NTS
ORDER NO.
REVISION 5
DWG. NO.
B-301



SECTION 'A'-A'

FIELD NOTCH FLASHING USING PANEL CONN. AS TEMPLATE

PANEL CONNECTOR FLASHING CAULKING DETAIL

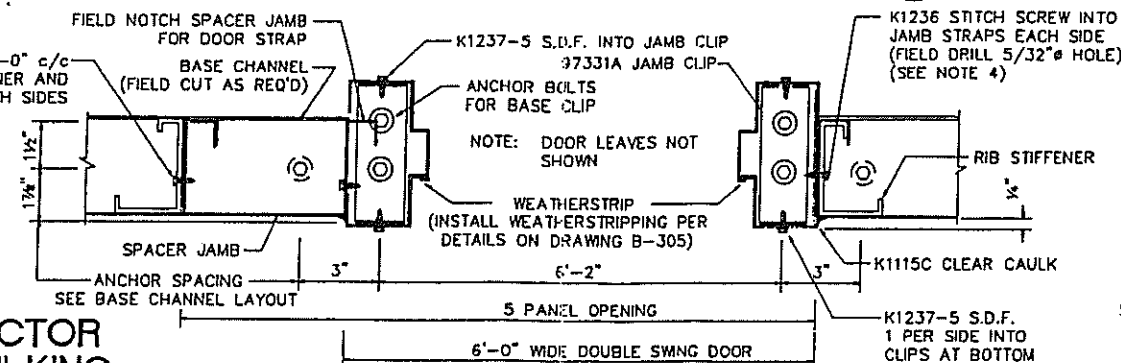


STEP 1

FASTEN JAMB CLIPS TO FOUNDATION (SEE SECTION B-B & BASE CHANNEL LAYOUT). PLACE SPACER JAMB ON LEFT INTO POSITION & FASTEN TO BACK OF BASE CHANNEL. PLACE JAMBS INTO POSITION AND SCREW THROUGH SPACER JAMBS AS SHOWN IN SECT. B-B.

STEP 2

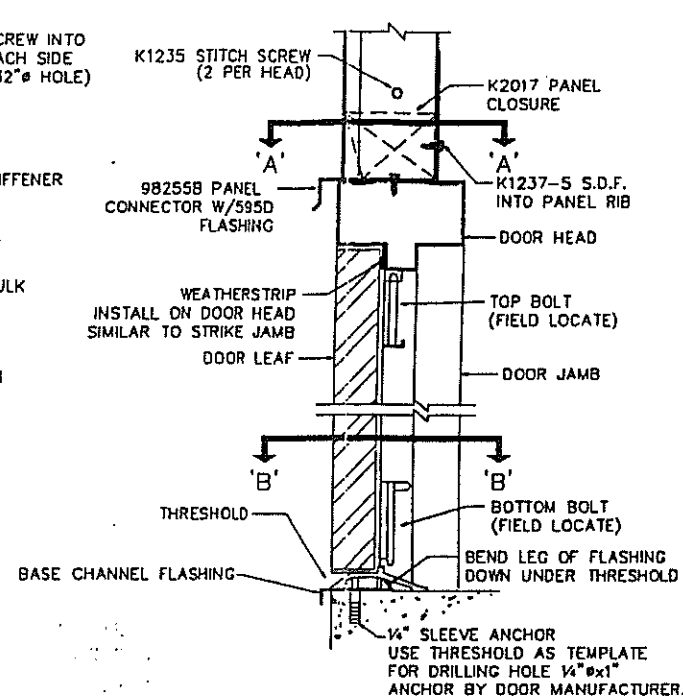
PLACE DOOR HEAD OVER JAMB TABS AND BEND TABS DOWN TO HOLD HEAD & JAMBS SECURE. CAULK PANEL CONNECTOR (98255B) AND FLASHING (595D) PER DETAIL ABOVE. PLACE PANEL CONNECTOR/FLASHING OVER DOOR HEAD. FASTEN & CAULK AS SHOWN IN SECTION A-A, ALSO CAULK FROM TOP OF WALL PANEL TO TOP OF HEAD AS SHOWN. THEN PLACE HEAD PANELS IN POSITION AND FASTEN TO BACK OF PANEL CONNECTOR. BEFORE INSTALLING NEXT PANEL RUN BEAD OF CAULKING UP PANEL LEG BETWEEN HEAD PANEL AND FULL PANEL AS SHOWN.



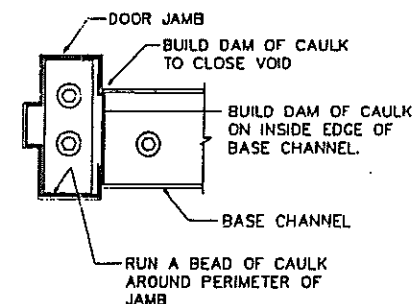
SECTION 'B'-B'

NOTE:

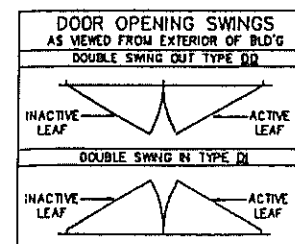
IF DOOR CLOSER IS TO BE INSTALLED REFER TO DRAWING B-305 BEFORE BEGINNING DOOR INSTALLATION.



SECTION THRU DOOR



TYP. CAULKING DETAIL BASE OF DOOR JAMB



NOTE:

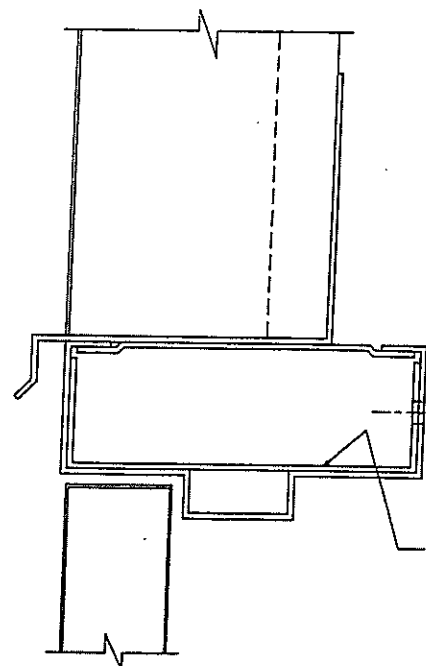
1. DOUBLE SWING OUT DOOR ASSY. SHOWN, SEE FLOOR PLAN FOR DOOR SWING.
2. DOOR FRAMING MUST BE INSTALLED AS WALL PANELS ARE ERECTED.
3. DOOR MUST BE INSTALLED SQUARE AND PLUMB.
4. DOOR INSTALLATION HARDWARE LOCATED IN BOX MARKED KXDB.
5. INSTALL WEATHERSTRIP ON DOOR AS SHOWN IN DETAILS ON DRAWING B-305.
6. CHECK INSIDE OF DOOR FRAME FOR ADDITIONAL HARDWARE ITEMS SUCH AS KNOBS, ETC.

REVISIONS	BY
3-10-93	RLV
4-5-94	WS
4-15-94	DB
11-30-94	DB
2-1-96	EAB
7-23-97	CBP
	???

BUTLER
Butler Manufacturing Company
Kansas City, MO. USA
Burlington, ONT. Canada

JOB DESCRIPTION	6' - 0" WIDE WALK DOOR INSTALLATION
SHEET TITLE	PANEL-LINE BUILDING

DATE	12-23-81
DRAWN BY	DC
SCALE	NTS
ORDER NO.	
REVISION	6
DWG. NO.	B-303



NOTE:

REINFORCING SLEEVE IS PRE-INSTALLED IN HEADER. DETERMINE POSITION OF DOOR CLOSER AND SLIDE SLEEVE INTO POSITION BEFORE INSTALLING DOOR UNIT INTO BUILDING.

DRILL 13/64" Ø HOLES. USE 1/4"-20 SELF TAPPING SCREWS.

REINFORCING SLEEVE

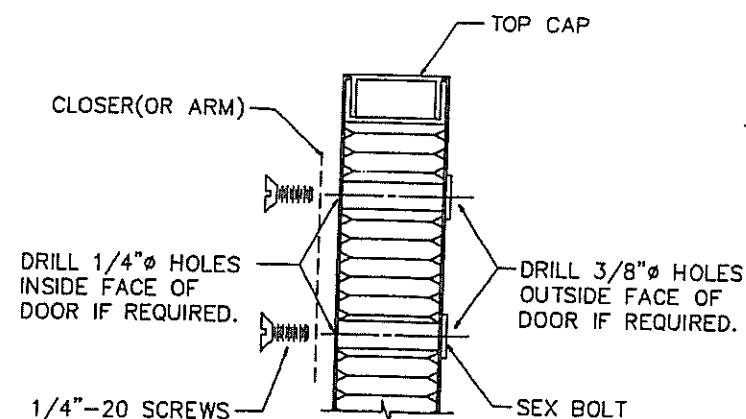
SECTION THRU HEAD

NOTE:

WHEN USING TEMPLATE OR MEASURING BOTH SIDES OF DOOR, BE SURE TO ALLOW FOR BEVELED EDGE OF DOOR, MAKING CERTAIN THAT HOLES ALIGN.

EXACT HOLE SIZE SHOWN IS IMPORTANT. DO NOT OVERSIZE.

SEE INSTRUCTIONS PACKED IN DOOR CLOSER BOX FOR CLOSER INSTALLATION.

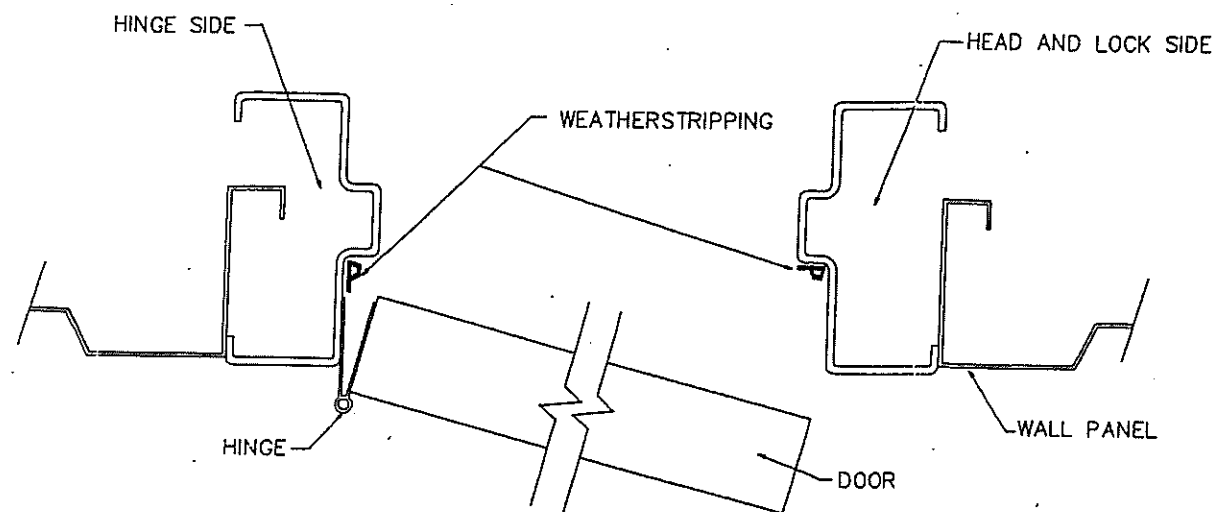


SECTION THRU DOOR

NOTE:

REGULAR ARM MOUNTING OF CLOSER IS NOT RECOMMENDED WHEN CLOSER IS INSTALLED ON "PUSH-SIDE" OF DOOR.

OPTIONAL DOOR CLOSER MOUNTING DETAILS



WEATHERSTRIPPING DETAIL

WEATHERSTRIPPING INSTALLATION

- STEP 1. STRIP ABOUT 20" OF BACKING PAPER OFF.
- STEP 2. PRESS WEATHERSTRIPPING INTO PROPER POSITION STARTING AT THE TOP.
- STEP 3. WORK YOUR WAY DOWN STRIPPING ADDITIONAL PAPER BACKING AS REQUIRED.
- STEP 4. WHEN BOTTOM IS REACHED, CUT TO REQUIRED LENGTH.

WARNING

WEATHERSTRIPPING CAN ONLY BE APPLIED TO A CLEAN DRY SURFACE. THE TEMPERATURE MUST BE ABOVE 50° FOR SATISFACTORY INSTALLATION.

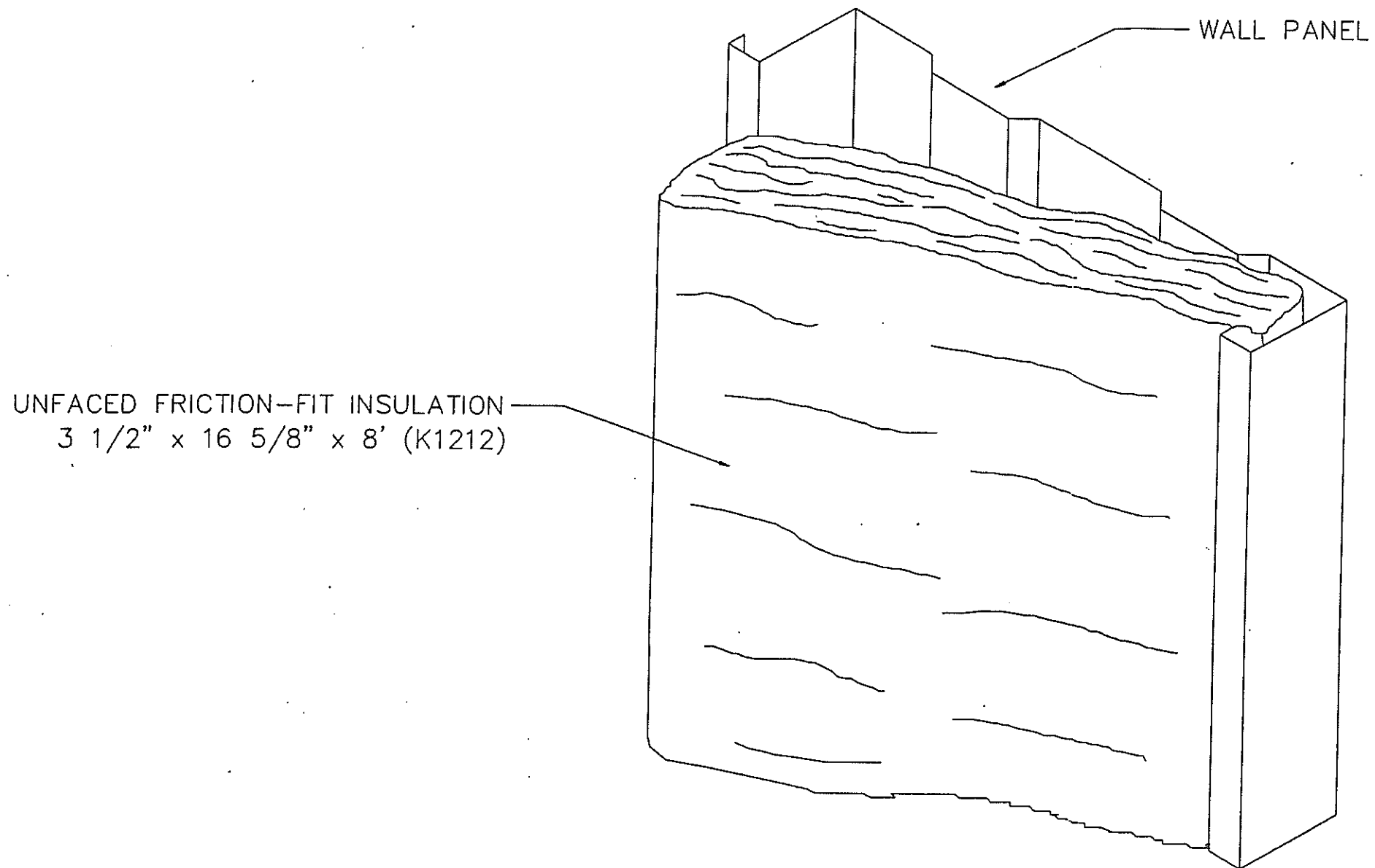
DOOR WEATHERSTRIPPING DETAILS

REVISIONS	BY
7-28-97	CBP

BUTLER
Butler Manufacturing Company
Kansas City, MO. USA
Burlington, ONT. Canada

DOOR CLOSER MOUNTING AND
WEATHER STRIPPING DETAILS

DATE	7-14-97
DRAWN BY	JEH
SCALE	N.T.S.
ORDER NO.	
REVISION	1
DWG. NO.	B-305

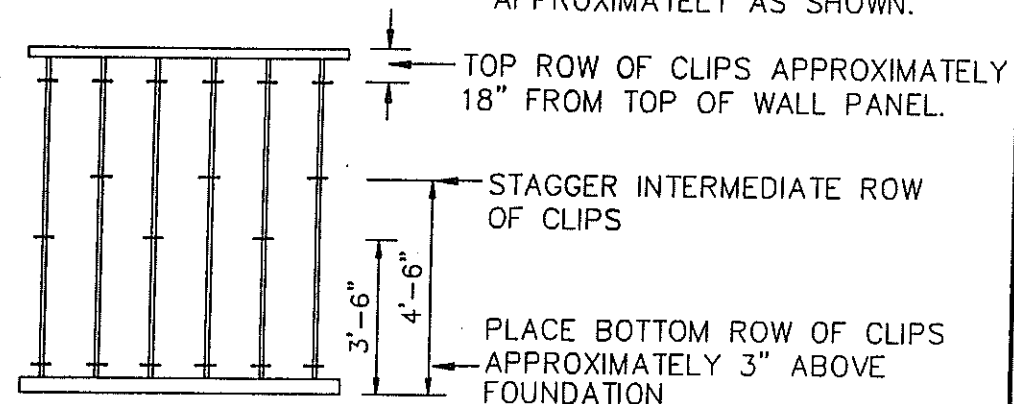


INSTALL RIGHT SIDE OF FRICTION-FIT
INSULATION IN PANEL RIB AND THEN
PRESS OTHER SIDE INTO PLACE.

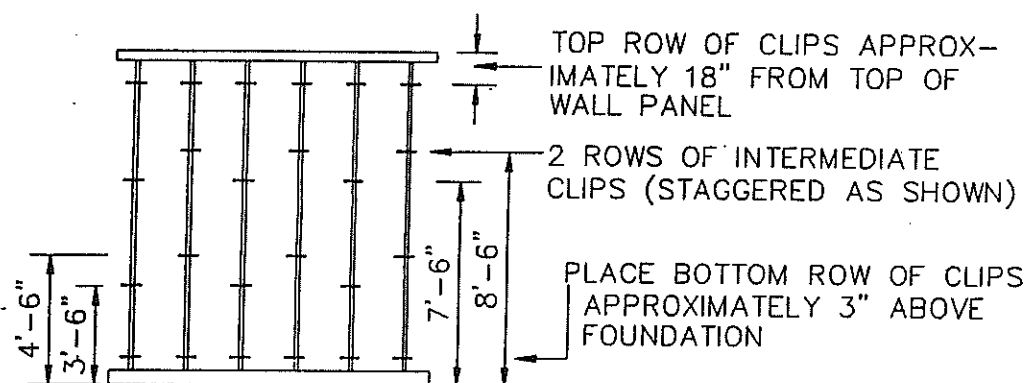
REVISION NO. 1	REVISION NO. 2	REDRAWN :	 <i>Butler Manufacturing Company</i> Kansas City, MO. USA Burlington, ONT. Canada	PANL - LINE BUILDING	DRAWING TITLE : FRICTION-FIT INSTALLATION	AG FILE NO :	REV.
DATE 10-20-94	DATE 02-17-00	SCALE : 3" = 1'				GROUP :	2
DRAWN BY : DB	DRAWN BY : DLR					DRAWING NUMBER : B-318	
CHECKER	CHECKER						

STEP 1) INSTALL CLIPS

EXACT CLIP SPACING NOT
NECESSARY, PLACE BY EYE,
APPROXIMATELY AS SHOWN.



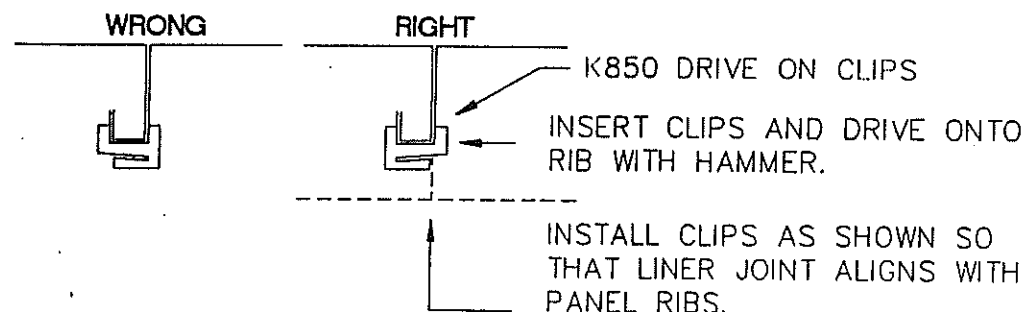
8' AND 10' WALLS



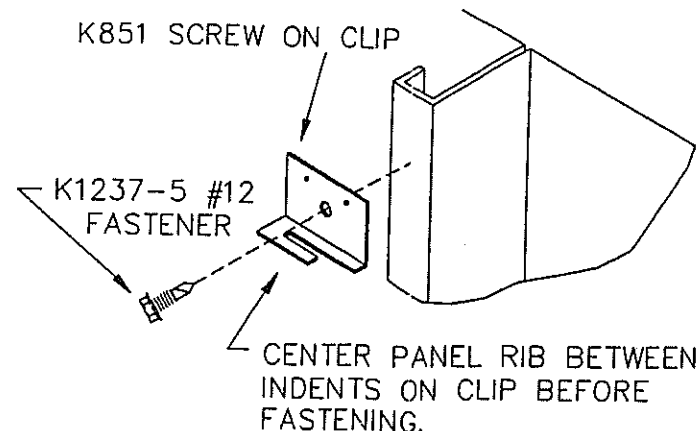
12' AND 14' WALLS

NOTE:

AT OPENINGS, PLACE CLIPS SO THAT SHORT LINER PANELS INTERLOCK WITH AT LEAST TWO CLIPS.



AT LOCATIONS WHERE DRIVE-ON CLIP K850 CANNOT BE USED (SUCH AS BEHIND OR ADJACENT TO SOME DOOR JAMBS) USE K851 SCREW-ON TYPE CLIPS.



STEP 2) INSTALL LINER PANELS

1. INSTALL K1212 3" WALL INSULATION (OPTIONAL) IN ALL PANELS, SPACERS, AND FRAMED OPENING JAMBS AND HEADS AS REQUIRED.

CAUTION: HANDLE PANELS BY THE EDGE TO PREVENT CRIMPING OF PANEL FACE. CHECK FOR BENT PANEL FLANGES. A BENT FLANGE CAN CAUSE AN OFFSET AT JOINTS.

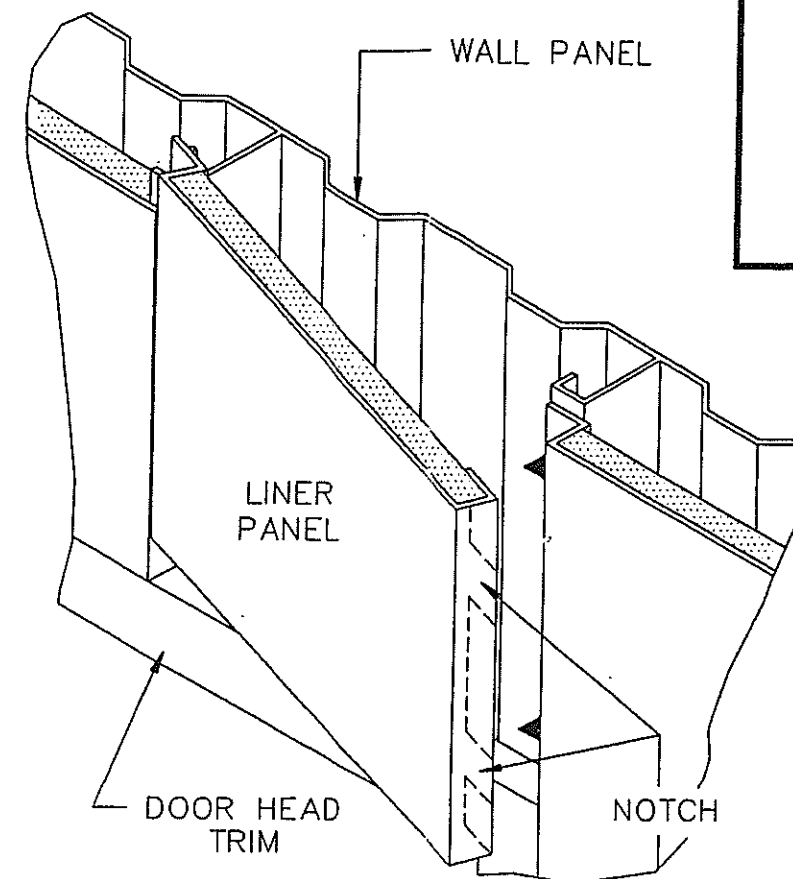
2. INSTALL LINER PANELS FROM LEFT TO RIGHT STARTING AT THE RIGHT OF A DOOR OPENING. INSTALL SPACER JAMB LINER PANELS AS WALL LINER IS BEING ERECTED.



3. INSTALL LAST PANEL (DOOR HEAD PANEL) BY NOTCHING PANEL FLANGE APPROX. 1/2" BELOW CLIP LOCATION. RAISE THE PANEL SO THAT NOTCH IS AT CLIP AND SLIDE INTO PLACE. (SEE DETAIL @ DOOR HEAD)

NOTE: IN ORDER TO MAKE THE REMOVAL OF A DAMAGED PANEL MUCH EASIER. THE ERECTOR MAY WANT TO INSTALL SEVERAL OF THESE NOTCHED PANELS THROUGHOUT THE BUILDING. LOCATION OF THESE NOTCHED PANELS CAN BE MARKED AT A SPOT COVERED BY THE BASE TRIM.

4. BE SURE EACH LINER PANEL IS COMPLETELY IN PLACE BEFORE INSTALLING THE NEXT LINER PANEL. IT IS VERY DIFFICULT TO CLOSE A JOINT AFTER MORE PANELS ARE IN PLACE.



DETAIL • DOOR HEAD

STEP 3) INSTALL TRIM

1. ACCESSORY FILLER PANELS AND CERTAIN TRIM MUST BE INSTALLED AS LINER PANELS ARE ERECTED. REFER TO ACCESSORY TRIM DRAWING AS EACH OPENING IS REACHED.
2. WHEN ATTACHING BASE AND CEILING TRIM TO LINER PANEL, DRILL OR PUNCH 1/16" DIA. HOLE IN PANEL TO AVOID STRIPPING OF SCREWS.

NOTE:

LINER PANELS THAT ARE 16" OR TALLER ARE
FACTORY CUT. LINER PANELS SHORTER THAN 16"
MUST BE FIELD CUT FROM FULL LENGTH LINER PANELS.

[illegible]

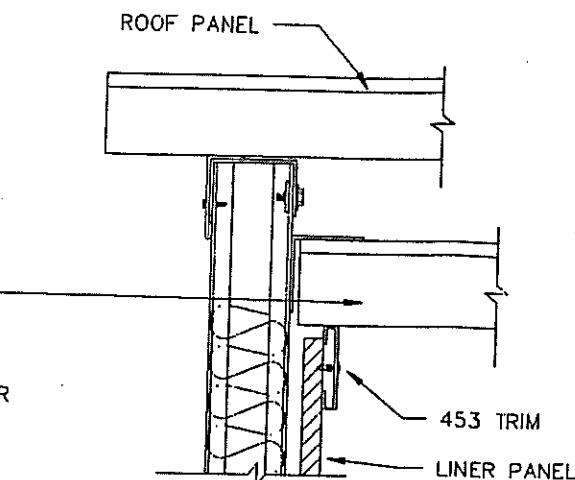
Butler Manufacturing Company
 Kansas City, MO. USA
 Burlington, ONT. Canada

CLIP-IN LINER INSTALLATION INSTRUCTIONS

DATE	10-20-9
DRAWN BY	DC
SCALE	NTS
ORDER NO.	
REVISION	3

DWG. NO.

B-320-1



SIDEWALL SECTION

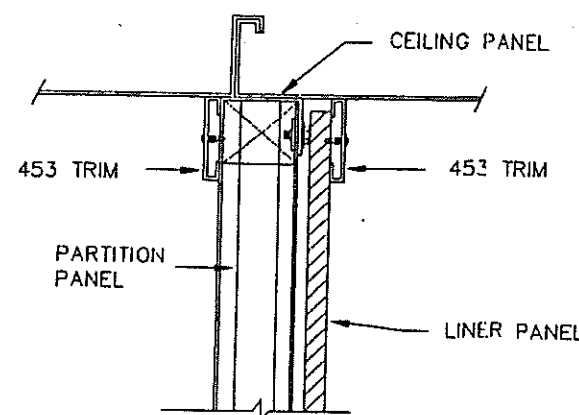
TYPE 'PL-1' BUILDINGS WITH OPTIONAL
CEILING SHOWN. WITHOUT CEILING, LINER
EXTENDS TO UNDERSIDE OF ROOF.



CORNER DETAIL • TOP

TYPE PL-2' BUILDINGS WITHOUT CEILING
(NOTE: CEILING TRIM IS OPTIONAL ON 'PL-2' BUILDINGS WITHOUT CEILING.)

- 1 CORNER LINER, 8" WIDE AND 4" WIDE LINER PANELS ARE PROVIDED IN STANDARD LENGTHS. FIELD CUTTING MAY BE REQUIRED.
- 2 LINER PANELS LESS THAN 16" IN LENGTH MUST BE FIELD CUT FROM FULL LENGTH LINER PANELS.



PARTITION SECTION

TYPE 'PL-1' AND 'PL-2' BUILDINGS WITH OPTIONAL
CEILING SHOWN. WITHOUT CEILING, PARTITION AND LINER
EXTENDS TO UNDERSIDE OF ROOF.
(NOTE: CEILING TRIM IS OPTIONAL ON 'PL-2' BUILDINGS WITHOUT CEILING.)



Butler Manufacturing Company
 Kansas City, MO. USA
 Burlington, ONT. Canada

**TRIM DETAILS FOR
CLIP-IN LINER**

SHEET TITLE

DATE 10-20-92

DRAWN BY DC

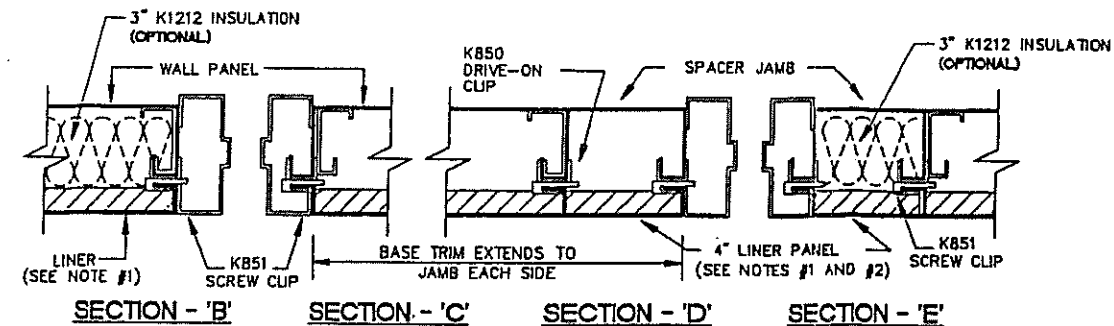
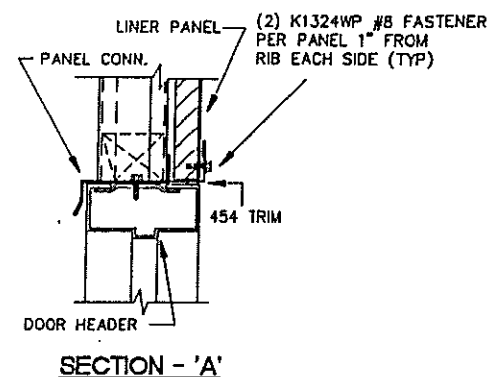
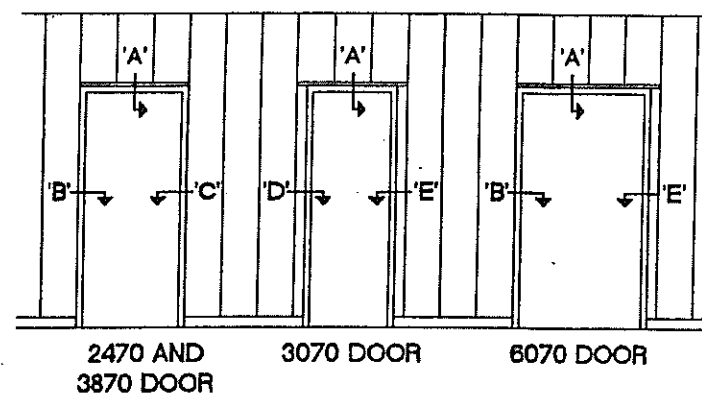
SCALE N.T.S.

ORDER NO.

REVISION	7
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DWG. NO.

B-320-2



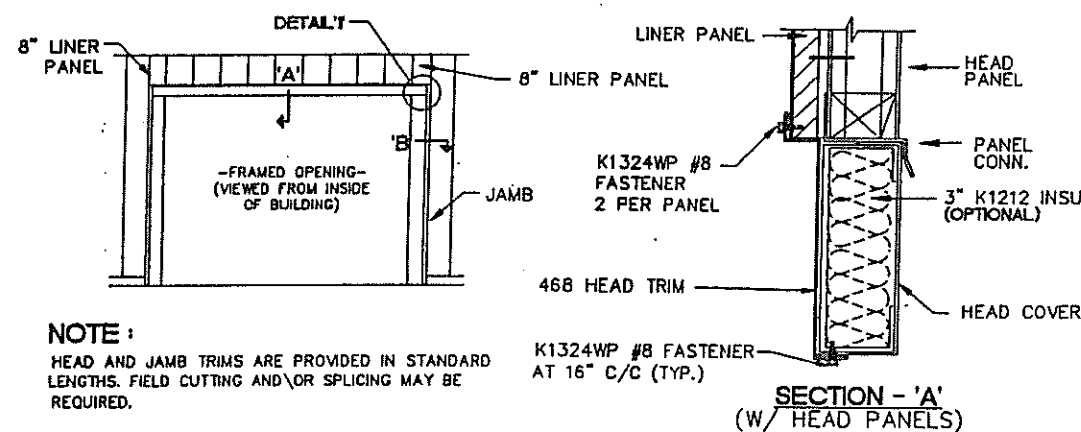
NOTE #1:
LINER PANELS ADJACENT TO LEFT SIDE OF
DOOR FRAMES MUST BE FIELD NOTCHED TO
INSTALL ON SCREW CLIPS. REFER TO DRAWING
B-320-1, SEC II, STEP 3 FOR SIMILAR
NOTCHING INSTRUCTIONS.

NOTE #2:
4" LINER PANELS ARE PROVIDED IN STANDARD LENGTHS. FIELD CUTTING MAY BE REQUIRED.

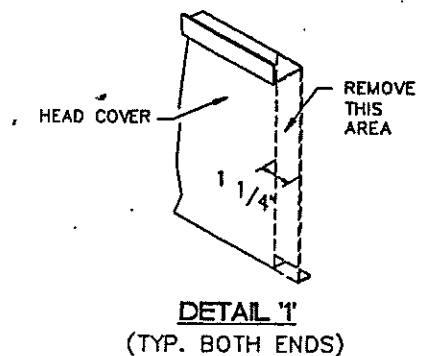
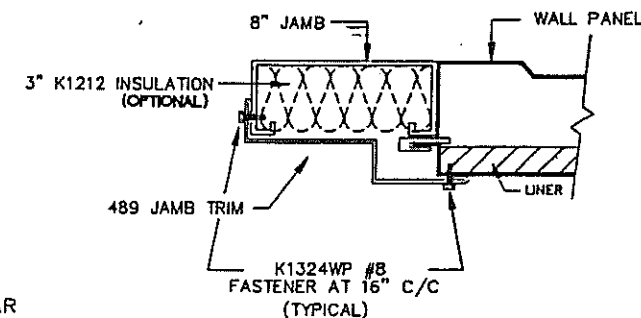
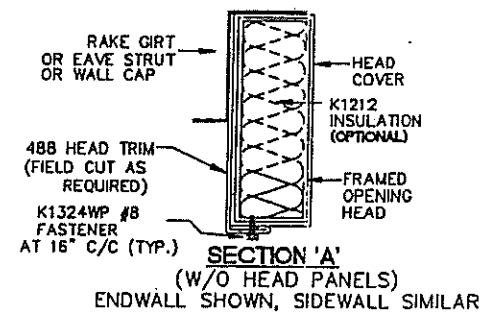
NOTE #3:
LINER PANELS THAT ARE 16" OR TALLER ARE FACTORY CUT. LINER PANELS THAT ARE SHORTER THAN 16" ARE TO BE FIELD CUT FROM FULL LENGTH LINER PANELS.

NOTE #3:
LINER PANELS THAT ARE 16" OR TALLER ARE
FACTORY CUT. LINER PANELS THAT ARE
SHORTER THAN 16" ARE TO BE FIELD CUT
FROM FULL LENGTH LINER PANELS.

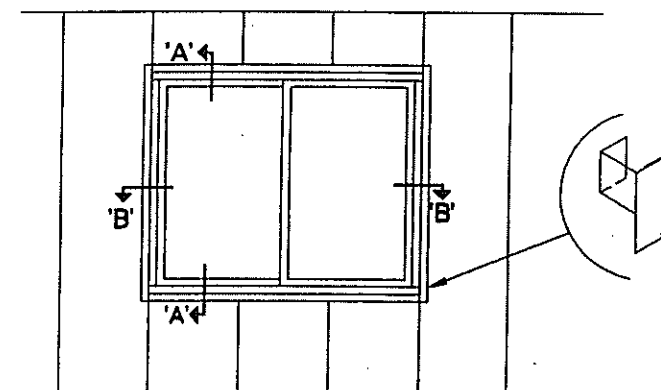
WALK DOOR DETAILS



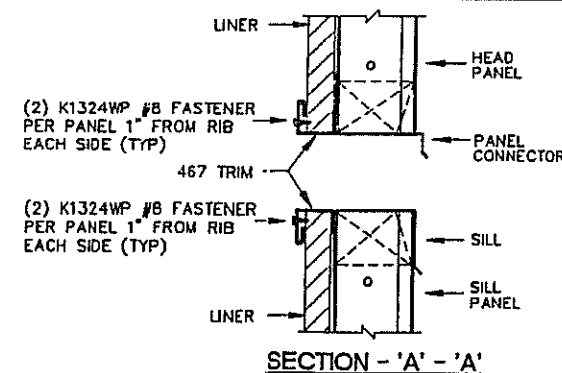
NOTE :
HEAD AND JAMB TRIMS ARE PROVIDED IN STANDARD LENGTHS. FIELD CUTTING AND/OR SPLICING MAY BE REQUIRED.



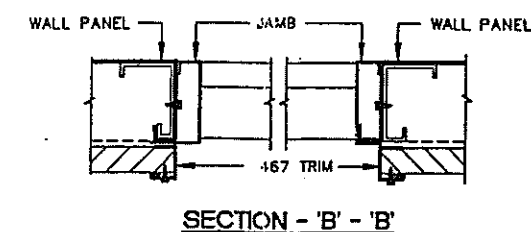
FRAMED OPENING DETAILS



NOTE:
FIELD CUT TO LENGTH AND
NOTCH SIDE TRIM AT TOP AND
BOTTOM AS SHOWN

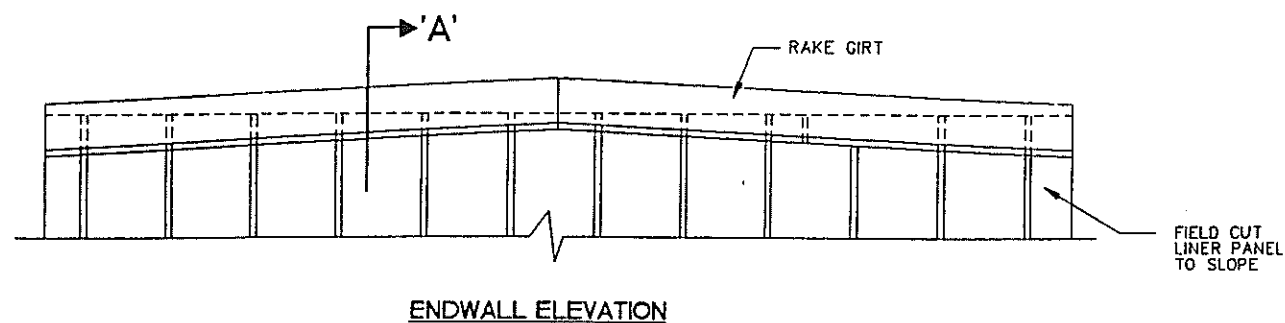


NOTE: LINER PANELS AT WALL OPN'G KITS W/ FILLER
PANELS MUST BE FIELD CUT AND NOTCHED
FROM FULL LENGTH LINER PANELS.

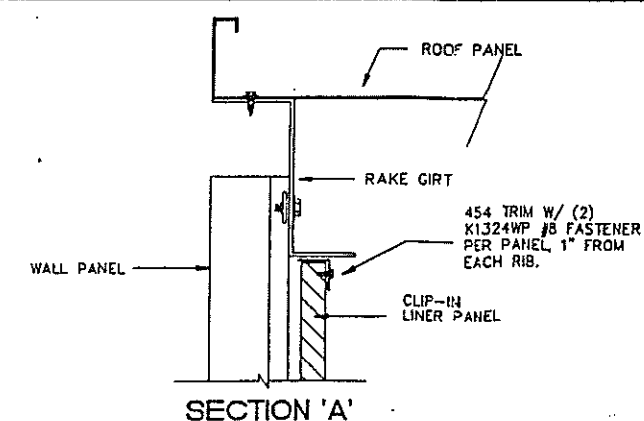


NOTE: FASTEN TRIM W/ K1324WP #8 FASTENER @
16" C/C (TYP) UNLESS NOTED.

WALL OPENING KIT, WINDOW AND LOUVER DETAILS



GABLE LINER DETAIL
FOR 'PL-2' BUILDING WITHOUT CEILING



REVISIONS	BY
12-27-93	WS
1-13-94	WS
3-3-94	WS
12-5-96	KAG
9-30-98	DLR
	MYSCALE

BUTLER®
Butler Manufacturing Company
Kansas City, MO. USA
Burlington, ONT. Canada

DESCRIPTION	ACCESSORY TRIM DETAILS FOR CLIP-N LINER
-------------	--

DATE		10-27-92	
DRAWN BY		DC	
SCALE		N.T.S.	
ORDER NO.			
REVISION		8	
DWG. NO.			
B-320-3			



Butler Order No: 20-077213-1
Customer: LBM CONSTRUCTION INC
12'-0" Wide x 20'-0" Long x 10'-0" High
Building Type: PL1
BM Number: 10900
Customer PO #: PFOHL BROS.

FINAL ERECTION DRAWINGS

10900-1	FLOOR PLAN
10900-2	ROOF PLAN
10900-3	BASE CHANNEL / ANCHOR LAYOUT
10900-4	WALL ELEVATIONS
B-000	GENERAL INSTRUCTIONS
B-001	FASTENER IDENTIFICATION
B-002	BASE CHANNEL INSTALLATION
B-003	8" WALL PANEL INSTALLATION DETAILS
B-007	FOUNDATION LOAD REQUIREMENTS
B-100	PL-1 WALL ERECTION DETAILS
B-101	PL-1 ROOF ERECTION DETAILS
B-102-1	PL-1 RAKE, GUTTER AND EAVE TRIM DETAILS
B-102-2	PL-1 DOWNSPOUT DETAILS
B-105	PL-1 THERMA ROOF INSTALLATION DETAILS
B-301	3'-0" WIDE WALK DOOR DETAILS
B-303	6'-0" WIDE WALK DOOR DETAILS
B-305	DOOR DETAILS FOR CLOSER AND WEATHERSTRIPPING
B-318	FRICTION FIT INSULATION DETAILS
B-320-1	CLIP-IN WALL LINER DETAILS
B-320-2	CLIP-IN WALL LINER DETAILS
B-320-3	CLIP-IN WALL LINER DETAILS

IT IS A VIOLATION Of New York State Code
Title VIII Article 130 Subarticle 145 Section 7209.2 to alter
any item in this document in any way unless acting under the
supervision of a licensed Professional Engineer who must
note, sign, date, and seal such alterations.

Thomas S. Harding

10-12-84

ORDER NUMBER : 10900

PAGE 1 OF 6

[illegible]

MARK KEY ON PANELS ! ! ! !

BUTLER MANUFACTURING COMPANY - BUILDINGS DIVISION

Letter of Design Certification

Date: September 28, 2001

cc Klaus
Tom R

John Myers
LBM Construction Inc.
5784 Ellis Road
Orchard Park, NY 14127

PL-1 - 12'-0" Wide, 20'-0" Long, 10'-0" High
Pfohl Bros.- Landfill Site
Cheektowaga, Erie Co., NY
BMC Order Number: 20-077213-1
Cust. Order Number: PFOHL BROS

To Whom It May Concern:

Please accept this letter as our Certification that the Butler components of the subject building is designed in accordance with the ninth edition of the AISC Specification for Structural Steel Buildings and the 1986 Edition of the AISI Specification for the Design of Cold-Formed Steel Structural Members. [The basic loads of the subject building meet or exceed the County Climatic Data as published in the 1996 Edition of the MBMA Low Rise Building Systems Manual.]

The governing design code is the 1996 BOCA National Building Code. The following loads are applied in accordance with the governing code:

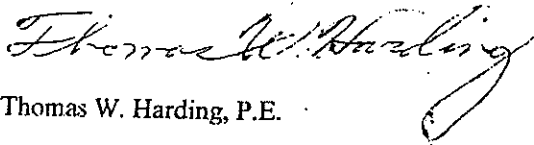
Dead Load	Actual + Frame Weight
Roof Live or Snow Load	40 psf
Wind Speed	80 mph (I = 1.00)
Wind Exposure	C
Seismic:	$A_a = 0.10$, $A_v = 0.10$

[Collateral load is included with (live/snow) load in determining critical stresses. The building is designed for a drifting snow load in accordance with the Low Rise Building Systems Manual which meets or exceeds the governing code.]

Load combinations are in accordance with the governing code.

These Butler components, when properly erected on an adequate foundation in accordance with the erection drawings as supplied and using the components as furnished, will meet the above loading requirements. The design of this building for wind load assumes that doors not supplied by Butler are designed to sustain the same wind pressures and suctions as the walls in which they are installed. This certification does not cover field modifications or design of material not furnished by Butler Manufacturing Company.

Cordially yours,


Thomas W. Harding, P.E.

C

C

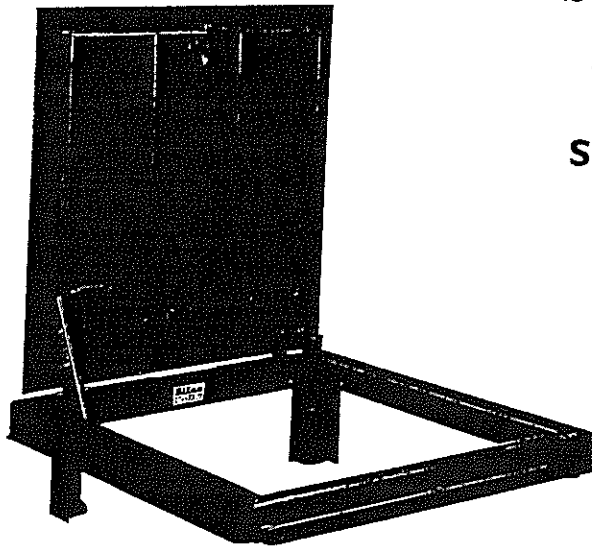
C

APPENDIX B-16

METER CHAMBER AND WET WELL HATCHES

Floor, Vault and Sidewalk Doors

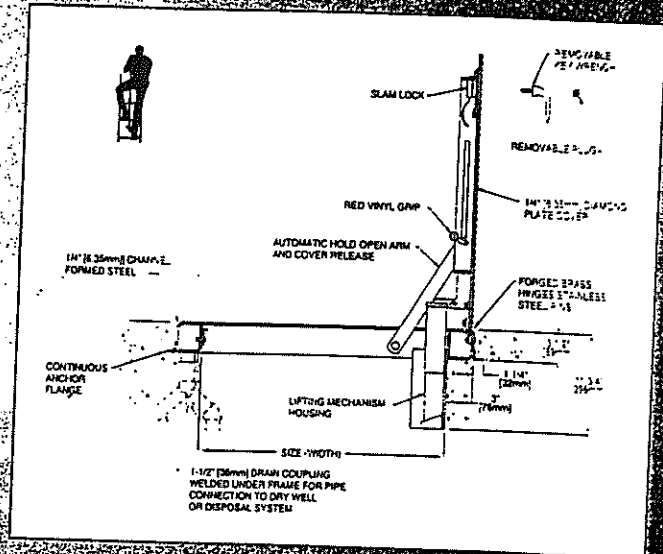
Bilco JD-3AL



Single or double leaf covers are constructed of 1/4" (6.35mm) diamond pattern plate and reinforced for a 300 lb/ft² (1464 kg/m²) live load. Features zinc plated and chromate sealed hardware and heavy forged brass hinges.

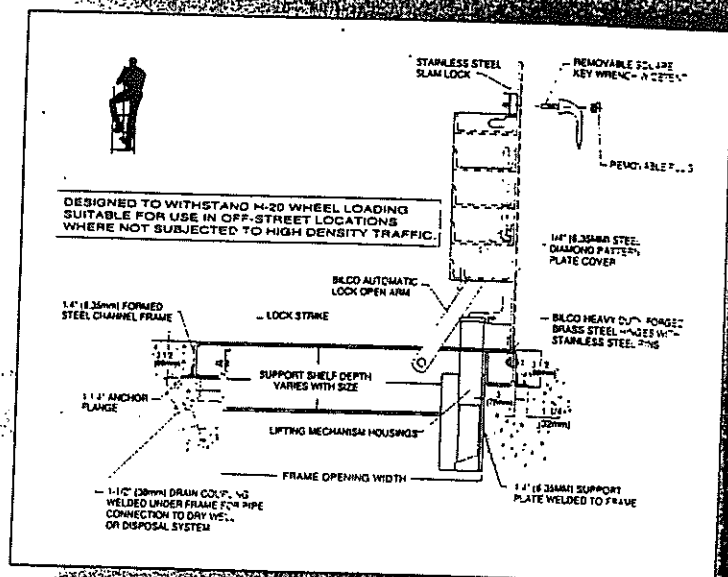
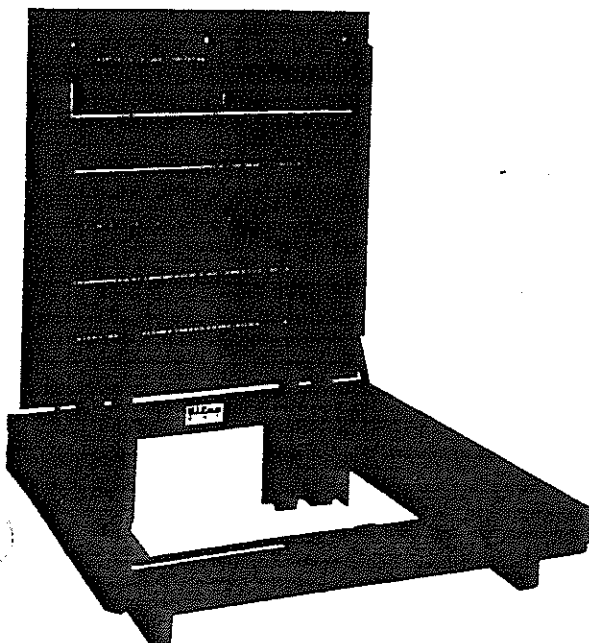
Type J & JD

Single or Double Leaf Steel Construction



Type J-H2O & JD-H2O

Single or Double Leaf Steel Construction



Designed to withstand vehicular traffic. Single or double leaf covers are constructed of diamond pattern plate and reinforced for loading. Features zinc plated and chromate sealed heavy forged brass hinges.

and Sidewalk Doors

Standard Sizes and Weights Other sizes, materials and configurations available

DRAINAGE DOORS

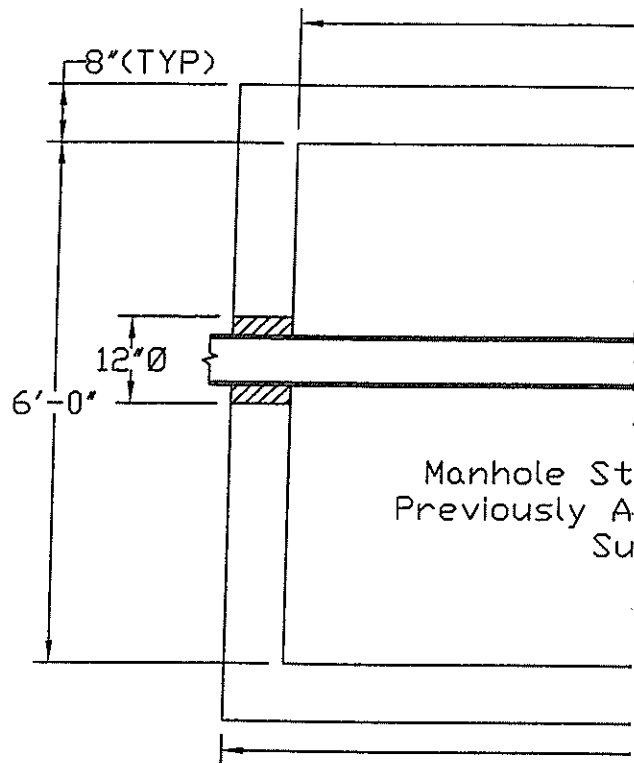
LIVE LOAD = 300 LB/FT ² (1464 KG/M ²)	PIT, VAULT, TRENCH, SIDEWALK & FLOOR INSTALLATION				PRECAST INSTALLATION ALUMINUM		ODOR RESISTANT DOOR ALUMINUM	
	STEEL		ALUMINUM					
	SIZES (width x length)	MODEL #	WEIGHT	MODEL #	WEIGHT	MODEL #	WEIGHT	MODEL #
2'0" x 2'0" (610 x 610 mm)	J-1	179 lbs (81 kg)	J-1AL	65 lbs (30 kg)	PCM-1	71 lbs (32 kg)	J-1AL-R	60 lbs (28 kg)
2'6" x 2'6" (762 x 762 mm)	J-2	231 lbs (105 kg)	J-2AL	88 lbs (40 kg)	PCM-2	93 lbs (42 kg)	J-2AL-R	75 lbs (35 kg)
3'0" x 2'6" (914 x 762 mm)	J-3	274 lbs (124 kg)	J-3AL	97 lbs (44 kg)	PCM-3	100 lbs (46 kg)	J-3AL-R	85 lbs (39 kg)
3'0" x 3'0" (914 x 914 mm)	J-4	300 lbs (136 kg)	J-4AL	108 lbs (49 kg)	PCM-4	116 lbs (53 kg)	J-4AL-R	100 lbs (46 kg)
3'6" x 3'6" (1067 x 1067 mm)	J-5	402 lbs (182 kg)	J-5AL	135 lbs (61 kg)	PCM-5	145 lbs (66 kg)	J-5AL-R	146 lbs (67 kg)
4'0" x 2'6" (1219 x 762 mm)	JD-1	365 lbs (166 kg)	JD-1AL	145 lbs (66 kg)	PDCM-1	146 lbs (66 kg)	Consult Factory	
4'0" x 4'0" (1219 x 1219 mm)	JD-2	498 lbs (226 kg)	JD-2AL	173 lbs (79 kg)	PDCM-2	158 lbs (71 kg)	Consult Factory	
4'0" x 6'0" (1219 x 1829 mm)	JD-3	652 lbs (296 kg)	JD-3AL	234 lbs (106 kg)	PDCM-3	250 lbs (113 kg)	Consult Factory	
5'0" x 5'0" (1524 x 1524 mm)	JD-4	663 lbs (301 kg)	JD-4AL	241 lbs (109 kg)	PDCM-4	242 lbs (110 kg)	Consult Factory	
HIGH LOAD	VEHICLE LOAD (AASHTO H20 WHEEL LOAD) OFF STREET WHEEL LOADING				200 LB/IN ² (14KG/CM ²)+30% IMPACT EXTREME LOAD INSTALLATIONS			
	STEEL		ALUMINUM		STEEL			
	SIZES (width x length)	MODEL #	WEIGHT	MODEL #	WEIGHT	MODEL #	WEIGHT	WEIGHT
2'0" x 2'0" (610 x 610 mm)	J-1 H20	250 lbs (113 kg)	J-1AL H20	110 lbs (50 kg)	HLC-1	425 lbs (193 kg)		
2'6" x 2'6" (762 x 762 mm)	J-2 H20	350 lbs (159 kg)	J-2AL H20	124 lbs (56 kg)	HLC-2	590 lbs (268 kg)		
3'0" x 2'6" (914 x 762 mm)	J-3 H20	425 lbs (193 kg)	J-3AL H20	165 lbs (75 kg)	HLC-3	750 lbs (340 kg)		
3'0" x 3'0" (914 x 914 mm)	J-4 H20	490 lbs (222 kg)	J-4AL H20	190 lbs (86 kg)	HLC-4	1014 lbs (460 kg)		
3'6" x 3'6" (1067 x 1067 mm)	J-5 H20	635 lbs (288 kg)	J-5AL H20	235 lbs (106 kg)	Consult Factory			
4'0" x 2'6" (1219 x 762 mm)	JD-1 H20	532 lbs (241 kg)	JD-1AL H20	201 lbs (91 kg)	Consult Factory			
4'0" x 4'0" (1219 x 1219 mm)	JD-2 H20	815 lbs (370 kg)	JD-2AL H20	293 lbs (133 kg)	Consult Factory			
4'0" x 6'0" (1219 x 1829 mm)	JD-3 H20	1235 lbs (560 kg)	JD-3AL H20	485 lbs (220 kg)	Consult Factory			
5'0" x 5'0" (1524 x 1524 mm)	JD-4 H20	1180 lbs (535 kg)	JD-4AL H20	500 lbs (227 kg)	Consult Factory			
NON-DRAINAGE DOORS								

NON-DRAINAGE DOORS

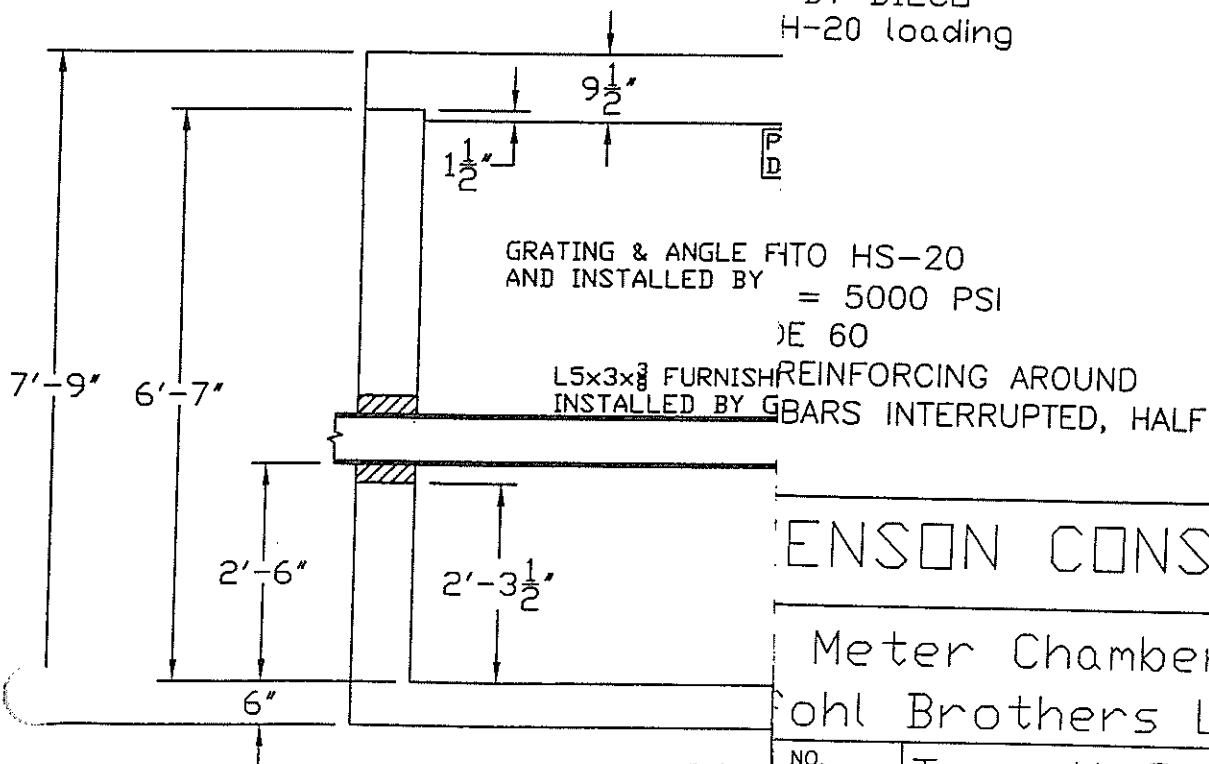
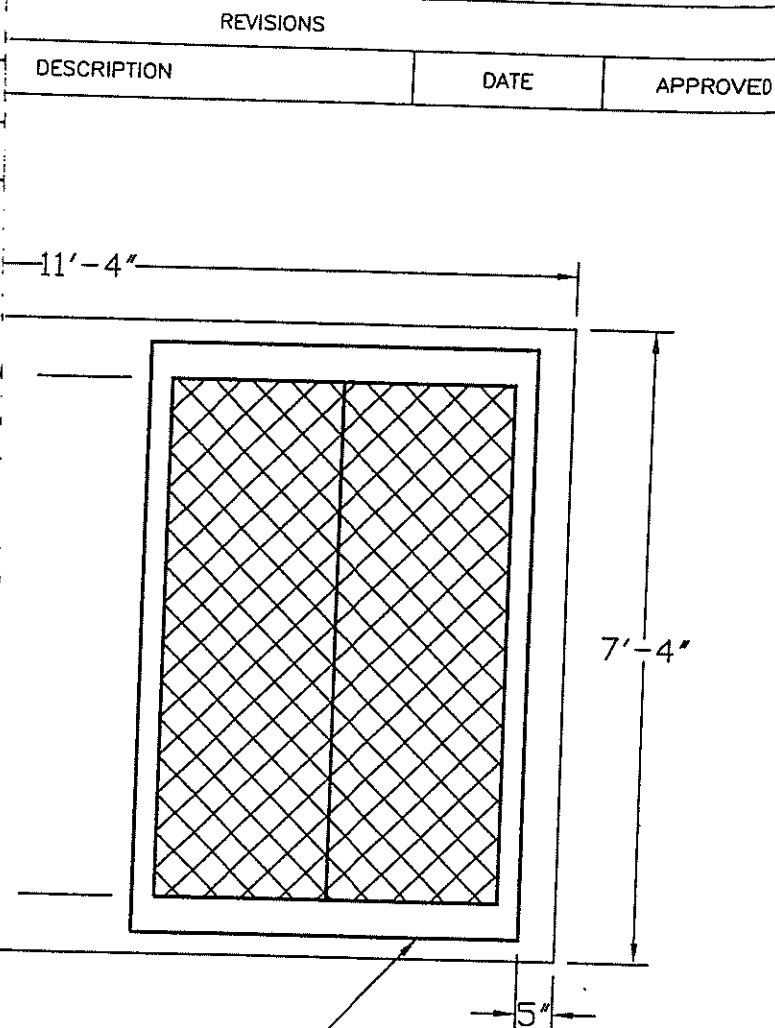
LIVE LOAD = 150 LB/FT ² (732KG/M ²)	PIT, VAULT, SIDEWALK & FLOOR INSTALLATION				FLOOR INSTALLATION FOR COVERING	
	STEEL		ALUMINUM		ALUMINUM	
	SIZES (width x length)	MODEL #	WEIGHT	MODEL #	WEIGHT	MODEL #
2'0" x 2'0" (610 x 610 mm)	Q-1	122 lbs (55 kg)	K-1	50 lbs (23 kg)	T-1	53 lbs (24 kg)
2'6" x 2'6" (762 x 762 mm)	Q-2	166 lbs (75 kg)	K-2	65 lbs (30 kg)	T-2	68 lbs (31 kg)
3'0" x 2'6" (914 x 762 mm)	Q-3*	190 lbs (86 kg)	K-3	77 lbs (35 kg)	T-3	81 lbs (37 kg)
3'0" x 3'0" (914 x 914 mm)	Q-4	219 lbs (100 kg)	K-4	86 lbs (39 kg)	T-4	91 lbs (41 kg)
3'6" x 3'6" (1067 x 1067 mm)	Consult Factory		K-5	109 lbs (50 kg)	T-5	113 lbs (51 kg)
4'0" x 4'0" (1219 x 1219 mm)	Consult Factory		KD-2	152 lbs (69 kg)	TD-2	172 lbs (78 kg)
4'0" x 6'0" (1219 x 1829 mm)	Consult Factory		KD-3	214 lbs (97 kg)	TD-3	224 lbs (102 kg)
5'0" x 5'0" (1524 x 1524 mm)	Consult Factory		KD-4	222 lbs (101 kg)	TD-4	230 lbs (104 kg)
LIVE LOAD = 150 LB/FT ² (732KG/M ²)	FLOOR INSTALLATION FOR CONCRETE, TILE, ETC			FIRE RATED FLOOR INSTALLATION		
	ALUMINUM			ALUMINUM		
	SIZES (width x length)	MODEL #	WEIGHT	MODEL #	CLEAR OPENING	WEIGHT
2'0" x 2'0" (610 x 610 mm)	TER-1	100 lbs (45 kg)				
2'6" x 2'6" (762 x 762 mm)	TER-2	110 lbs (50 kg)				
3'0" x 2'6" (914 x 762 mm)	TER-3	120 lbs (54 kg)	FR-2	2'1.5" x 2'1"	231 lbs (105 kg)	
3'0" x 3'0" (914 x 914 mm)	TER-4	130 lbs (59 kg)	FR-3	2'7.5" x 2'1"	253 lbs (115 kg)	
3'6" x 3'6" (1067 x 1067 mm)	TER-5	165 lbs (75 kg)	FR-4	2'7.5" x 2'7"	286 lbs (130 kg)	
2'6" x 4'0" (762 x 1219 mm)	Consult Factory		FR-5	3'1.5" x 3'1"	341 lbs (155 kg)	
4'0" x 4'0" (1219 x 1219 mm)	TRD-2	200 lbs (91 kg)	FR-6	2'1.5" x 3'7"	289 lbs (131 kg)	
4'0" x 6'0" (1219 x 1829 mm)	TRD-3	275 lbs (125 kg)	Consult Factory			
5'0" x 5'0" (1524 x 1524 mm)	TRD-4	285 lbs (129 kg)	Consult Factory			
Consult Factory						

Models with "D" in the Model # indicate double leaf construction.

Models with "D" in the Model # indicate double leaf configuration.
* Model Q-3 is hinged on the 3'0" side.



TOP VIEW



ENSON CONSTRUCTION

Meter Chamber
ohl Brothers Landfill

SIDE

NO.

Transit Road

REV
8/23

DRAWN BY: JDB

SHEET 1 OF 2

8" TYP

6'-0"

12"Ø

DESCRIPTION

DATE

APPROVED

11'-4"

CAST-IN
HATCH
JD-3AL
H-20

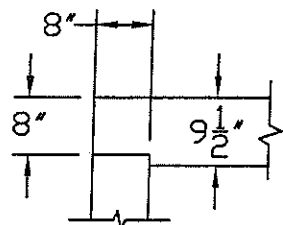
7'-4"

TO

ROOF

#4 DIAG TRIM BARS
5pcs @ 5'0" LONG

#5 BAR @ 12" o.c.
6pcs @ 6'4" LONG



ROOF TO WALL
JOINT DETAIL

1" CC

#4 BAR @ 12" o.c.

#4 BAR @ 12" o.c.

6'-7"

6"

SIDE

CONCRETE: 5000 PSI @ 28 days
REINFORCEMENT:
ASTM A615 GRADE 60
ASTM A185 GRADE 65
ENTRAINED AIR: 5% - 7%

5913

YARDS: 1.46

28878

YARDS: 7.13

ENSON CONSTRUCTION

Meter Chamber
ohl Brothers Landfill

NO.

Transit Road

REV
5/01

DRAWN BY: JDB

SHEET 2 OF 2

Project: PFOHL BROTHERS LANDFILL Contractor: SEVENSON ENVIROMENTAL

Drawn By: JDB

Date: 4/4/01

DRAWING No.: 35

k No.: ROOF DETAIL

Inside Dia. 72"Ø

Rim Elev.:

Adj.:

T.O.C.:

Roof:

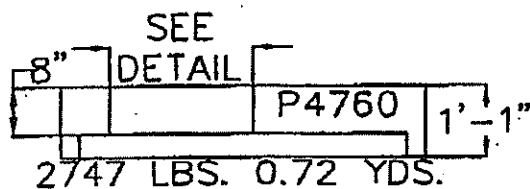
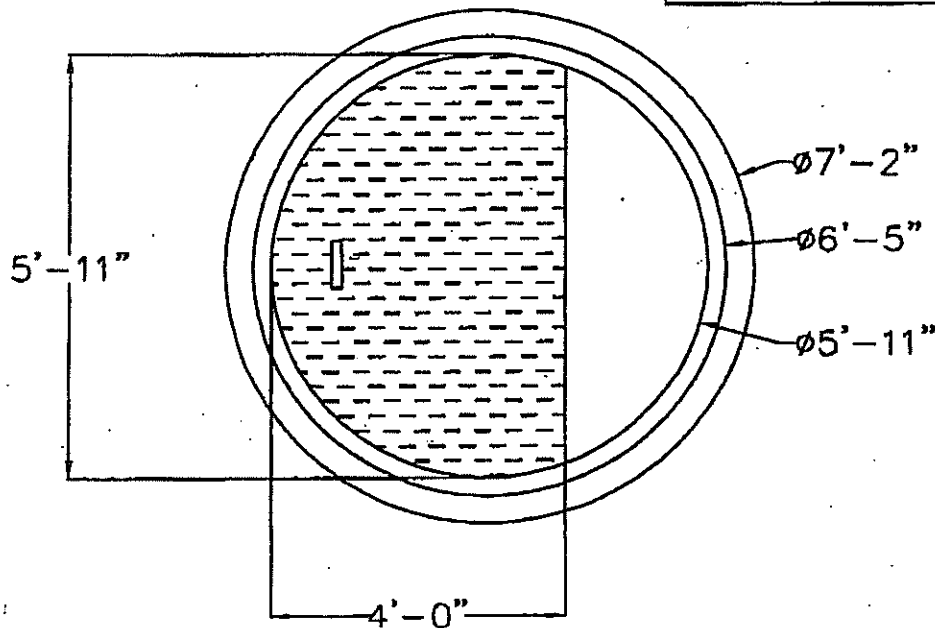
T.O.W.:

Inv.:

Sump:

T.O.S.:

FOR USE ON WET WELL-1 thru 6
(TOTAL QUANTITY OF 6)



PIPE
INV.
HOLE
CATCH

A	B	C	D

NOTE	Std. Base	FLANGED BASE		PAINTING ()			GASKETS (REQ)		MANHOLE STEPS	
		ASTM	SPEC.	IN	OUT	SS	RUBBER	BUTYL	PLASTIC	OTHER
S	X						X		X	
NO		X	X	X	X	X		X		X

Billing Height:

FT.

Mark No.: ROOF DETAIL



SERIES R1R ACCESS DOOR

(ROUND EMBED REGULAR)

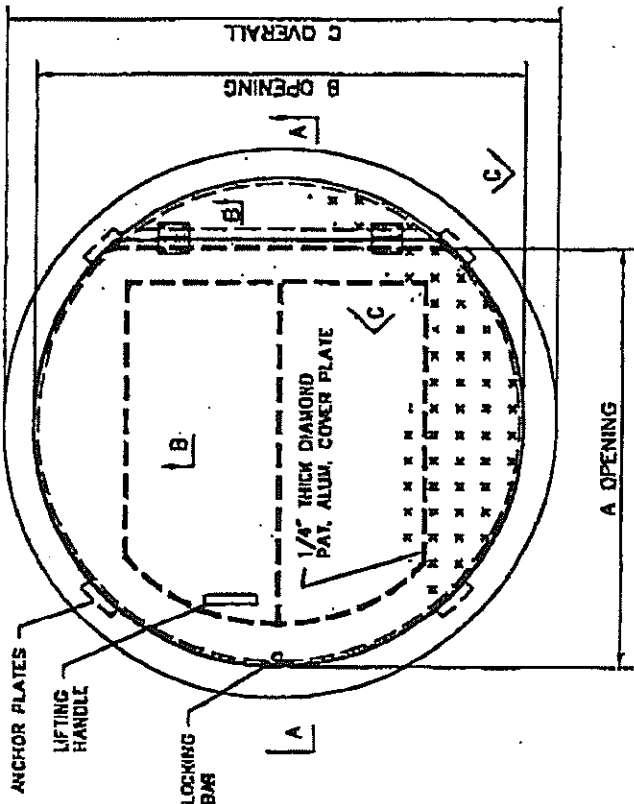
STANDARD FEATURES:

- AUTO-LOCK T-316 STAINLESS STEEL HOLD OPEN ARM WITH RELEASE HANDLE
- T-316 STAINLESS STEEL HINGES AND ATTACHING HARDWARE
- NON-CORROSIVE LOCKING BAR AND HANDLE
- EMBED FRAME
- SINGLE LEAF CONSTRUCTION FOR MAXIMUM ACCESS
- 300 LBS. PER SQ. FT. LOAD RATING
- LIFETIME GUARANTEE

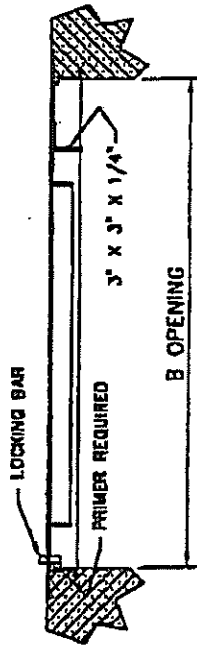
SPECIFICATIONS

THE R1R SERIES (SINGLE LEAF) ACCESS FRAMES AND COVERS AS MANUFACTURED BY HALLIDAY PRODUCTS, INC. OF ORLANDO, FLORIDA SHALL HAVE A 1/4" THICK, MILL FINISH, EXTRUDED ALUMINUM FRAME, INCORPORATING EMBED ANCHOR PLATES. THE DOOR PANEL SHALL BE 1/4" ALUMINUM DIAMOND PLATE, REINFORCED TO WITHSTAND A LIVE LOAD OF 300 LBS. PER SQ. FT. DOOR SHALL OPEN TO 90° AND AUTOMATICALLY LOCK WITH A T-316 STAINLESS STEEL HOLD OPEN ARM WITH ALUMINUM RELEASE HANDLE. DOOR SHALL CLOSE FLOSH WITH THE FRAME, HINGES AND ALL FASTENING HARDWARE SHALL BE T-316 STAINLESS STEEL. UNIT SHALL LOCK WITH A NON-CORROSIVE LOCKING BAR AND HAVE A NON-CORROSIVE HANDLE. UNIT SHALL CARRY A LIFETIME GUARANTEE AGAINST DEFECTS IN MATERIAL AND/OR WORKMANSHIP.

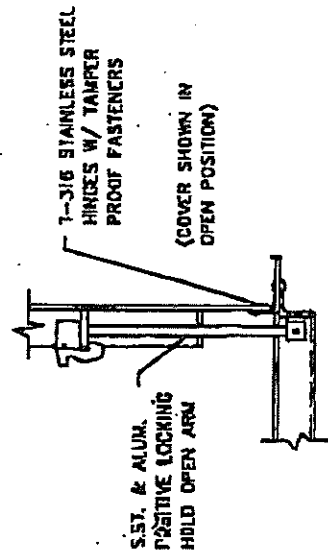
MODEL NO.	DIMENSIONS			UNIT	
	A	B	C	WT.	
R1R48	32"	47"	53"	86 LBS.	
R1R60	40"	59"	65"	136 LBS.	
R1R72	48"	71"	77"	175 LBS.	



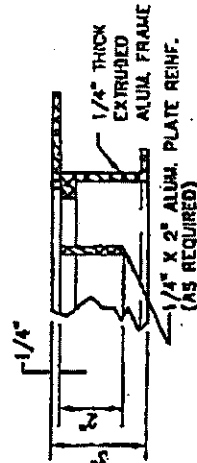
PLAN



SECTION A-A



SECTION B-B



SECTION C-C

APPENDIX B-17

HDPE PIPE



• DIVERSIFIED PIPE & PUMP SYSTEMS
• INDUSTRIAL • MINING • ENVIRONMENTAL PRODUCTS

Mailing Address: Box 35, Charleroi, PA 15022

Shipping Address: 1st & Lincoln Avenue, Charleroi, PA 15022

• Phone: (724) 483-3543

• 1-800 353-3747

• Fax: (724) 483-0577

0

1

2

3

4

5

6

7

GAS VENT PIPING
6" ϕ

6" SDR 11 MOLDED
90° ELBOWS

6" SDR 11 PIPE

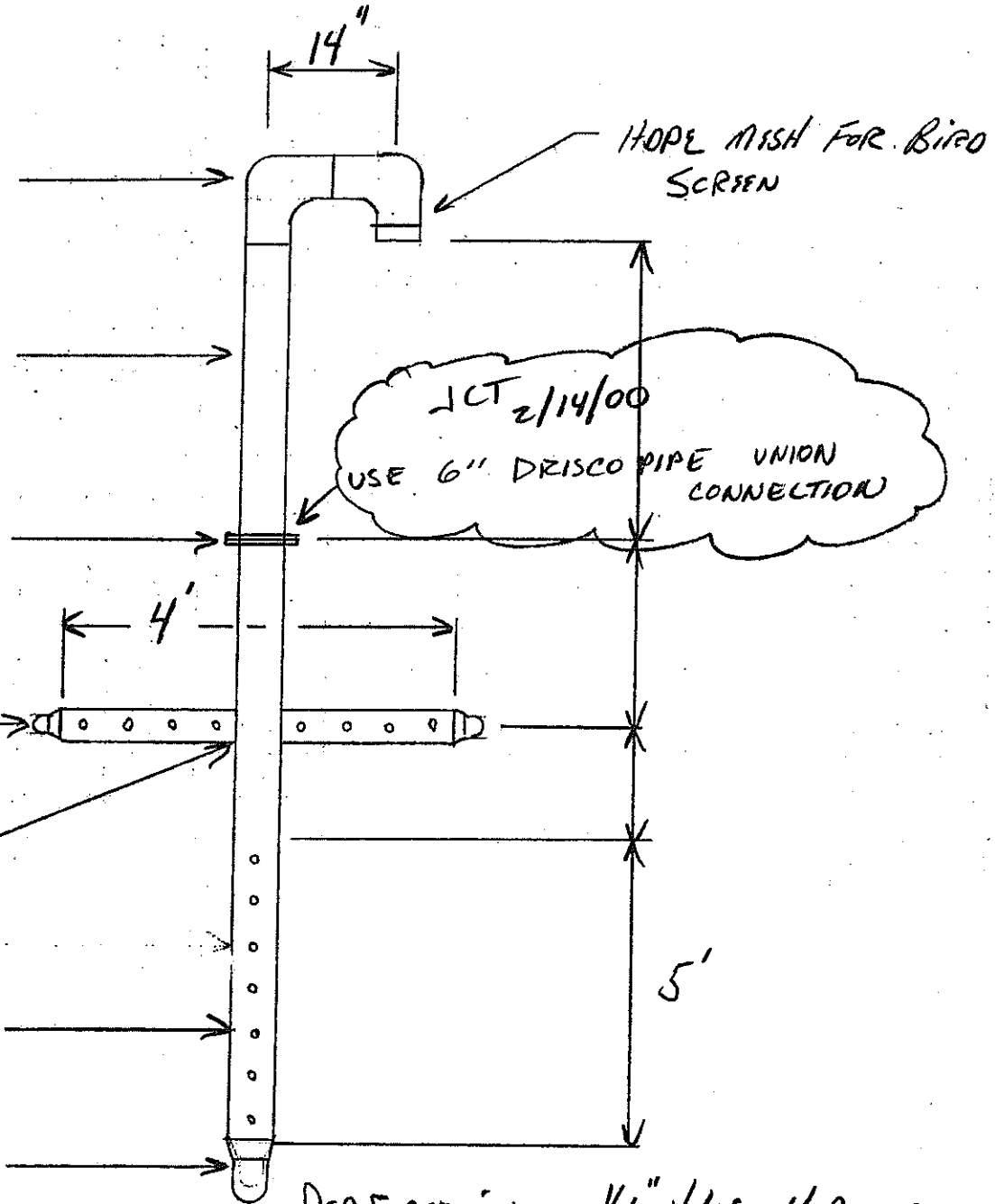
~~6" FLANGES~~

6" MOLDED CAPS

6" FABED
CROSS

6" SDR 26 PIPE

6" MOLDED CAP



PERFORATION - 1/4" HOLES, 4 ROWS
SPACED AT 4" AND STAGGERED
ALONG PIPE

ATE _____

TECHNICIAN _____

PROJECT NAME _____

COMPANY _____

APPROVED BY _____

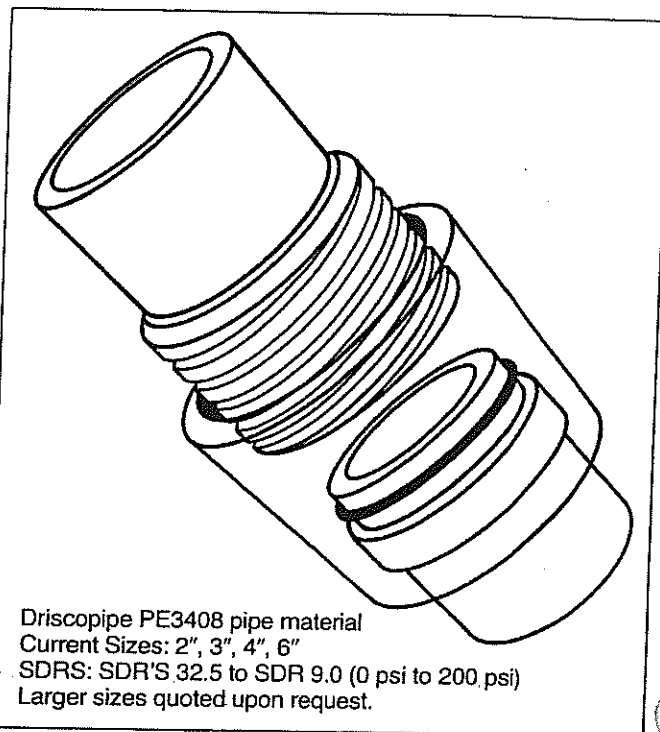
The Driscopipe® Union Connection

For your above-ground Polyethylene Pipe needs...

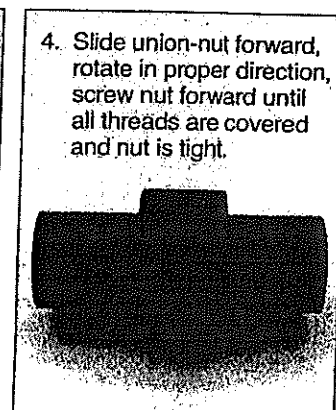
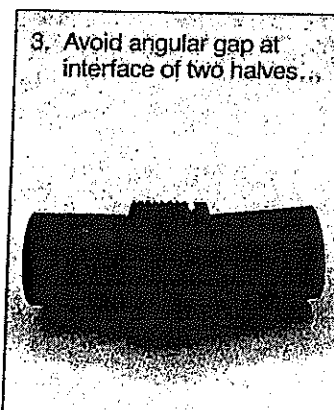
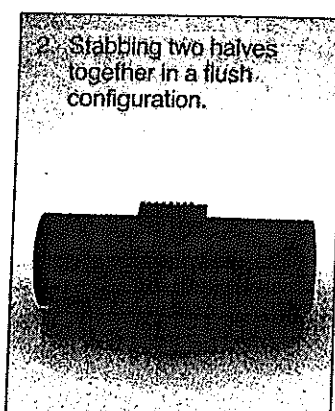
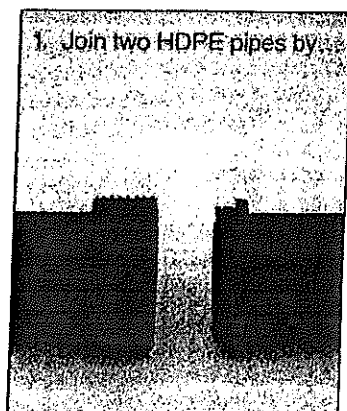
- Temporary Piping
- Agricultural
- Irrigation
- Chemical Piping
- Mining
- Process Piping
- Industrial
- Municipal
- Dredging
- Short Pipe Runs
- Sewers
- Pulp & Paper
- Power Plants
- Slurry Pipelines

Offers you outstanding benefits...

- Quick, easy, joining and dis-assembly.
- All Polyethylene body (no metal) with Buna-N O-Ring Seal.
- Reliable connection using precision cut mechanical threads.
- Heat fusion to pipe in field or fabricating shop.
- Superior outdoor weathering characteristics.
- This strong and durable Union Connection does not rust, rot, pit, or corrode and provides good abrasion resistance.



Assembly



This document reports accurate and reliable information to the best of our knowledge but our suggestions and recommendations cannot be guaranteed because the conditions of use are beyond our control. The user of such information assumes all risk connected with the use thereof. Phillips 66 Company and its subsidiaries assume no responsibility for the use of information presented herein and hereby expressly disclaims all liability in regard to such use.

To secure product information or leave a message for a Sales Engineer or Technical Service Representative:

U.S. Domestic Toll Free
(800) 527-0662
TWX: 910-867-4818
FAX: 214-783-2689

DISTRIBUTED BY:

**PLASTICS WITH
POWER TO WIN®**



Phillips Driscopipe, Inc.
A Subsidiary of Phillips 66 Company



Customer Benefits

High quality Driscopipe® 1000 is manufactured from extra high molecular weight, high density PE 3408 polyethylene pipe grade resin.

Butt Fusion Conditions: 75 psig interfacial fusion pressure required at 375-400°F

This black, weather-resistant pipe exhibits...

- Outstanding Chemical & Corrosion Resistance
- High Environmental Stress Crack Resistance
- Excellent Flow Characteristics
- Toughness & Ductility
- Flexibility & Ease of Installation
- Abrasion Endurance
- Fatigue Endurance
- Reliability
- Available Sizes: 3/4" through 54"

Suggested Industries and Applications

- Acid / caustic lines
- Agriculture
- Aquaculture
- Brine
- Cement Plants
- Coal Slurry/ Coal Prep
- De-watering
- Dredging/ Sand/ Gravel
- Dual containment
- Fertilizer
- Fly ash lines
- Golf courses
- Hard Rock Disposal
- Hazardous Wastes
- High purity processes
- Ice Rinks
- Industrial
- Inorganic Chemicals
- Irrigation
- Leachate collection
- Marinas
- Metal (Cu, Al, Fe, etc.)
- Mining
- Organic Chemicals
- Petrochemicals
- Pulp/ Paper/ Wood
- River crossings
- Salt Mines
- Sludge piping
- Snow Melting/ Making
- Storage tank piping
- Sugar Mills
- Swimming Pools
- SX acid mining
- Tailings Slurry
- Temporary pipelines
- Utility/ process piping

...and many others

Specification Data

The resin, pipe, & fittings comply
with these accepted (and other)
dustry standards

ASTM F 714 (Pipe)
ASTM D 3261 (Fittings)
Cell Classification
ASTM D 3350 - 345444C

PPI - PE3408 Designation
Factory Mutual (by size per order)

Typical Physical Properties* of Driscopipe® 1000 (PE 3408) Polyethylene Pipe Resin

Property	Test Method	Unit	Value
Material Designation	PPI / ASTM	-----	PE 3408
Material Classification	ASTM D 3350	-----	Type III; PE34
Cell Classification	ASTM D 3350	-----	345444C
Density (3)	ASTM D 1505	gms/cm ³	0.955
Melt Flow (4)	ASTM D 1238(2.16/190)	gms/10 min.	0.11 ♦
Flex Modulus (5)	ASTM D 790	psi	110,000
Tensile Strength (4)	ASTM D 638	psi	3,200
ESCR (4)	ASTM D 1693	F ₀ , Hours	>5,000**
HDB @ 73.4°F (4)	ASTM D 2837	psi	1,600
U-V Stabilizer (C)	ASTM D 1603	% C	> 2
Hardness	ASTM D 2240	Shore D	65
Tensile Strength @ Yield (Type IV Specimen)	ASTM D 638 (2"/min.)	psi	3,200
Tensile Strength @ Break (Type IV Specimen)	ASTM D 638	psi	5,000
Elongation at Break	ASTM D 638	%, minimum	750
Modulus of Elasticity (Young's Modulus)	ASTM D 638	psi	130,000
ESCR (Cond A,B, C: Mold. Slab) (Compressed Ring - pipe)	ASTM D 1693 ASTM F 1248	F ₀ , Hours F ₀ , Hours	>5,000 >3,500
Impact Strength (IZOD) (.125" Thick)	ASTM D 256 (Method A)	In-lb/in. notch	42
Linear Thermal Expansion Coeff.	ASTM D 696	in/ in/ °F	1.2 x 10 ⁻⁴
Thermal Conductivity	ASTM D-177	BTU-in/ft ² / hrs/°F	2.7
Brittleness Temperature	ASTM D 746	°F	< -180
Vicat Softening Temperature	ASTM D 1525	°F	257

* This list of typical physical properties is intended for basic characterization of the material and does not represent specific determinations or specifications. The Physical properties values reported herein were determined on compression molded specimens prepared in accordance with Procedure C of ASTM D-1928 and may differ from specimens taken from the pipe.

♦ Average Melt Index value with a standard deviation of 0.01

** Tests were discontinued because of no failures and no indication of stress crack initiation

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PLASTIC AND FITTING ASSOCIATION

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To secure product information or leave a message for a sales engineer or technical service representative:
Phone: 1-800-527-0662
Fax: 1-972-669-5959
www.driscopipe.com



Phillips Driscopipe
A DIVISION OF PHILLIPS PETROLEUM COMPANY

3/4" (1.050 OD)

SDR 11	160 psi	0.12 lbs./ft.	0.860 ID	.095 wall
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1" (1.315 OD)

SDR 11	160 psi	0.19 lbs./ft.	1.075 ID	.120 wall
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1-1/4" (1.660 OD)

SDR 11	160 psi	0.31 lbs./ft.	1.358 ID	.151 wall
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1-1/2" (1.900 OD)

SDR 11	160 psi	0.41 lbs./ft.	1.554 ID	.173 wall
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2" (2.375 OD)

SDR 7	267 psi	0.94 lbs./ft.	1.697 ID	.339 wall
SDR 9	200 psi	0.76	1.847	.264
SDR 11 •	160 psi	0.64	1.943	.216
SDR 13.5	128 psi	0.53	2.023	.176
SDR 15.5	110 psi	0.47	2.069	.153
SDR 17	100 psi	0.43	2.095	.140

3" (3.500 OD)

SDR 7	267 psi	2.05 lbs./ft.	2.500 ID	.500 wall
SDR 9	200 psi	1.66	2.722	.389
SDR 11 •	160 psi	1.39	2.864	.318
SDR 13.5	128 psi	1.15	2.982	.259
SDR 15.5	110 psi	1.02	3.048	.226
SDR 17 •	100 psi	0.93	3.088	.206
SDR 19	89 psi	0.84	3.132	.184
SDR 21	80 psi	0.77	3.166	.167
SDR 26	64 psi	0.62	3.230	.135
SDR 32.5	51 psi	0.50	3.284	.108

4" (4.500 OD)

SDR 7	267 psi	3.39 lbs./ft.	3.214 ID	.643 wall
SDR 9	200 psi	2.74	3.500	.500
SDR 11 •	160 psi	2.29	3.682	.409
SDR 13.5	128 psi	1.90	3.834	.333
SDR 15.5 •	110 psi	1.68	3.920	.290
SDR 17 •	100 psi	1.54	3.970	.265
SDR 19	89 psi	1.39	4.026	.237
SDR 21	80 psi	1.26	4.072	.214
SDR 26 •	64 psi	1.03	4.154	.173
SDR 32.5	51 psi	0.83	4.224	.138

5-3/8" (5.375 OD)

SDR 17	100 psi	2.20 lbs./ft.	4.743 ID	.316 wall
SDR 21	80 psi	1.80	4.863	.256
SDR 26	64 psi	1.47	4.961	.207
SDR 32.5	51 psi	1.18	5.045	.165

5" (5.563 OD)

SDR 7	267 psi	5.17 lbs./ft.	3.973 ID	.795 wall
SDR 9	200 psi	4.18	4.327	.618
SDR 11	160 psi	3.51	4.551	.506
SDR 13.5	128 psi	2.91	4.739	.412
SDR 15.5	110 psi	2.57	4.845	.359
SDR 17	100 psi	2.35	4.909	.327
SDR 19	89 psi	2.12	4.977	.293
SDR 21	80 psi	1.93	5.033	.265
SDR 26	64 psi	1.57	5.135	.214
SDR 32.5	51 psi	1.27	5.221	.171

6" (6.625 OD)

SDR 7	267 psi	7.33 lbs./ft.	4.733 ID	.946 wall
SDR 9	200 psi	5.93	5.153	.736
SDR 11 •	160 psi	4.97	5.421	.602
SDR 13.5	128 psi	4.13	5.643	.491
SDR 15.5	110 psi	3.63	5.771	.427
SDR 17 •	100 psi	3.34	5.845	.390
SDR 19	89 psi	3.01	5.927	.349
SDR 21 •	80 psi	2.73	5.995	.315
SDR 26 •	64 psi	2.23	6.115	.255
SDR 32.5 •	51 psi	1.80	6.217	.204

7" (7.125 OD)

SDR 7	267 psi	8.49 lbs./ft.	5.089 ID	1.018 wall
SDR 9	200 psi	6.86	5.541	.792
SDR 11	160 psi	5.75	5.829	.648
SDR 13.5	128 psi	4.78	6.069	.528
SDR 15.5	110 psi	4.21	6.205	.460
SDR 17	100 psi	3.86	6.287	.419
SDR 19	89 psi	3.48	6.375	.375
SDR 21	80 psi	3.16	6.445	.340
SDR 26 •	64 psi	2.58	6.577	.274
SDR 32.5	51 psi	2.08	6.685	.220

8" (8.625 OD)

SDR 7	267 psi	12.43 lbs./ft.	6.161 ID	1.232 wall
SDR 9	200 psi	10.05	6.709	.958
SDR 11 •	160 psi	8.42	7.057	.784
SDR 13.5	128 psi	7.00	7.347	.639
SDR 15.5	110 psi	6.16	7.513	.556
SDR 17 •	100 psi	5.65	7.611	.507
SDR 19	89 psi	5.10	7.717	.454
SDR 21 •	80 psi	4.64	7.803	.411
SDR 26 •	64 psi	3.79	7.961	.332
SDR 32.5 •	51 psi	3.05	8.095	.265

**10" (10.750 OD)**

SDR 7	267 psi	19.32 lbs./ft.	7.678 ID	1.536 wall
SDR 9	200 psi	15.61	8.362	1.194
SDR 11 ●	160 psi	13.09	8.796	.977
SDR 13.5	128 psi	10.87	9.158	.796
SDR 15.5	110 psi	9.58	9.362	.694
SDR 17 ●	100 psi	8.78	9.486	.632
SDR 19	89 psi	7.92	9.618	.566
SDR 21 ●	80 psi	7.21	9.726	.512
SDR 26 ●	64 psi	5.87	9.924	.413
SDR 32.5 ●	51 psi	4.75	10.088	.331

12" (12.750 OD)

SDR 7	267 psi	27.16 lbs./ft.	9.108 ID	1.821 wall
SDR 9	200 psi	21.97	9.916	1.417
SDR 11 ●	160 psi	18.41	10.432	1.159
SDR 13.5	128 psi	15.29	10.862	.944
SDR 15.5 ●	110 psi	13.48	11.104	.823
SDR 17 ●	100 psi	12.36	11.250	.750
SDR 19	89 psi	11.14	11.408	.671
SDR 21 ●	80 psi	10.13	11.536	.607
SDR 26 ●	64 psi	8.26	11.770	.490
SDR 32.5 ●	51 psi	6.67	11.966	.392

13" (13.386 OD)

SDR 7	267 psi	29.24 lbs./ft.	9.562 ID	1.912 wall
SDR 9	200 psi	23.62	10.412	1.487
SDR 11	160 psi	20.30	10.952	1.217
SDR 13.5	128 psi	16.87	11.402	.992
SDR 15.5	110 psi	14.85	11.658	.864
SDR 17	100 psi	13.62	11.812	.787
SDR 19	89 psi	12.28	11.976	.705
SDR 21	80 psi	11.16	12.112	.637
SDR 26	64 psi	9.12	12.356	.515
SDR 32.5	51 psi	7.36	12.562	.412

14.000 OD

SDR 7	267 psi	32.76 lbs./ft.	10.00 ID	2.000 wall
SDR 9	200 psi	26.50	10.888	1.556
SDR 11 ●	160 psi	22.20	11.454	1.273
SDR 13.5	128 psi	18.44	11.926	1.037
SDR 15.5	110 psi	16.24	12.194	.903
SDR 17 ●	100 psi	14.91	12.352	.824
SDR 19	89 psi	13.43	12.526	.737
SDR 21	80 psi	12.22	12.666	.667
SDR 26 ●	64 psi	9.96	12.924	.538
SDR 32.5	51 psi	8.05	13.138	.431

16.000 OD

SDR 9	200 psi	34.60 lbs./ft.	12.444 ID	1.778 wall
SDR 11 ●	160 psi	29.00	13.090	1.455
SDR 13.5	128 psi	24.09	13.630	1.185
SDR 15.5	110 psi	21.21	13.936	1.032
SDR 17 ●	100 psi	19.46	14.118	.941
SDR 19	89 psi	17.54	14.316	.842
SDR 21 ●	80 psi	15.96	14.476	.762
SDR 26 ●	64 psi	13.01	14.770	.615
SDR 32.5	51 psi	10.50	15.016	.492

18.000 OD

SDR 9	200 psi	43.79 lbs./ft.	14.000 ID	2.000 wall
SDR 11 ●	160 psi	36.69	14.728	1.636
SDR 13.5	128 psi	30.48	15.334	1.333
SDR 15.5 ●	110 psi	26.84	15.678	1.161
SDR 17 ●	100 psi	24.64	15.882	1.059
SDR 19	89 psi	22.19	16.106	.947
SDR 21	80 psi	20.19	16.286	.857
SDR 26 ●	64 psi	16.47	16.616	.692
SDR 32.5	51 psi	13.30	16.892	.554

20.000 OD

SDR 9	200 psi	54.05 lbs./ft.	15.556 ID	2.222 wall
SDR 11 ●	160 psi	45.30	16.364	1.818
SDR 13.5	128 psi	37.63	17.038	1.481
SDR 15.5	110 psi	33.14	17.420	1.290
SDR 17 ●	100 psi	30.41	17.648	1.176
SDR 19	89 psi	27.42	17.894	1.053
SDR 21	80 psi	24.93	18.096	.952
SDR 26 ●	64 psi	20.34	18.462	.769
SDR 32.5 ●	51 psi	16.41	18.770	.615

21.500 OD

SDR 9	200 psi	62.47 lbs./ft.	16.722 ID	2.389 wall
SDR 11	160 psi	52.37	17.590	1.955
SDR 13.5	128 psi	43.51	18.314	1.593
SDR 15.5	110 psi	38.30	18.726	1.387
SDR 17	100 psi	35.16	18.970	1.265
SDR 19	89 psi	31.68	19.236	1.132
SDR 21	80 psi	28.82	19.452	1.024
SDR 26	64 psi	23.51	19.846	.927
SDR 32.5	51 psi	18.98	20.176	.862

22.000 OD

SDR 9	200 psi	65.40 lbs./ft.	17.112 ID	2.444 wall
SDR 11 •	160 psi	54.82	18.000	2.000
SDR 13.5	128 psi	45.56	18.740	1.630
SDR 15.5	110 psi	40.10	19.162	1.419
SDR 17	100 psi	36.80	19.412	1.294
SDR 19	89 psi	33.16	19.684	1.158
SDR 21	80 psi	30.18	19.904	1.048
SDR 26 •	64 psi	24.61	20.308	.846
SDR 32.5 •	51 psi	19.86	20.646	.677

24.000 OD

SDR 9	200 psi	77.85 lbs./ft.	18.666 ID	2.667 wall
SDR 11 •	160 psi	65.24	19.636	2.182
SDR 13.5	128 psi	54.21	20.444	1.778
SDR 15.5	110 psi	47.72	20.904	1.548
SDR 17 •	100 psi	43.81	21.176	1.412
SDR 19	89 psi	39.46	21.474	1.263
SDR 21 •	80 psi	35.91	21.714	1.143
SDR 26 •	64 psi	29.30	22.154	.923
SDR 32.5 •	51 psi	23.62	22.524	.738

26.000 OD

SDR 11	160 psi	76.57 lbs./ft.	21.272 ID	2.364 wall
SDR 13.5	128 psi	63.62	22.148	1.926
SDR 15.5	110 psi	56.00	22.646	1.677
SDR 17	100 psi	51.39	22.942	1.529
SDR 19	89 psi	46.30	23.264	1.368
SDR 21	80 psi	42.14	23.524	1.238
SDR 26	64 psi	34.39	24.000	1.000
SDR 32.5 •	51 psi	27.74	24.400	.800

28.000 OD

SDR 11	160 psi	88.78 lbs./ft.	22.910 ID	2.545 wall
SDR 13.5	128 psi	73.78	23.852	2.074
SDR 15.5	110 psi	64.95	24.388	1.806
SDR 17 •	100 psi	58.63	24.706	1.647
SDR 19	89 psi	53.73	25.052	1.474
SDR 21	80 psi	48.86	25.334	1.333
SDR 26	64 psi	39.88	25.846	1.077
SDR 32.5 •	51 psi	32.19	26.276	.862

30.000 OD

SDR 11	160 psi	101.92 lbs./ft.	24.546 ID	2.727 wall
SDR 13.5	128 psi	84.69	25.556	2.222
SDR 15.5	110 psi	74.56	26.130	1.935
SDR 17	100 psi	68.45	26.470	1.765
SDR 19	89 psi	61.67	26.842	1.579
SDR 21 •	80 psi	56.12	27.142	1.429
SDR 26	64 psi	45.78	27.692	1.154
SDR 32.5 •	51 psi	36.93	28.154	.923

800 mm (31.496 OD)

SDR 13.5	128 psi	93.35 lbs./ft.	26.830 ID	2.333 wall
SDR 15.5	110 psi	82.20	27.432	2.032
SDR 17	100 psi	75.45	27.790	1.853
SDR 19	89 psi	67.98	28.180	1.658
SDR 21	80 psi	61.85	28.496	1.500
SDR 26	64 psi	50.44	29.074	1.211
SDR 32.5	51 psi	40.71	29.558	.969

32.000 OD

SDR 13.5	128 psi	96.35 lbs./ft.	27.260 ID	2.370 wall
SDR 15.5	110 psi	84.87	27.870	2.065
SDR 17	100 psi	77.86	28.236	1.882
SDR 19	89 psi	70.15	28.632	1.684
SDR 21	80 psi	63.84	28.952	1.524
SDR 26	64 psi	52.10	29.538	1.231
SDR 32.5 •	51 psi	42.04	30.030	.985

34.000 OD

SDR 13.5	128 psi	108.81 lbs./ft.	28.962 ID	2.519 wall
SDR 15.5	110 psi	95.81	29.612	2.194
SDR 17	100 psi	87.91	30.000	2.000
SDR 19	89 psi	79.17	30.422	1.789
SDR 21	80 psi	72.06	30.762	1.619
SDR 26	64 psi	58.81	31.384	1.308
SDR 32.5	51 psi	47.43	31.908	1.046

36.000 OD

SDR 13.5	128 psi	121.98 lbs./ft.	30.666 ID	2.667 wall
SDR 15.5	110 psi	107.41	31.354	2.323
SDR 17	100 psi	98.57	31.764	2.118
SDR 19	89 psi	88.81	32.210	1.895
SDR 21 •	80 psi	80.78	32.572	1.714
SDR 26 •	64 psi	65.94	33.230	1.385
SDR 32.5 •	51 psi	53.20	33.784	1.108

• denotes standard sizes

DRISCOPIPE**1000 Series****Sizes & Dimensions****1000 mm (39.370 OD)**

SDR 17	100 psi	117.88 lbs./ft.	34.738 ID	2.316 wall
SDR 19	89 psi	106.18	35.226	2.072
SDR 21	80 psi	96.64	35.620	1.875
SDR 26	64 psi	78.83	36.342	1.514
SDR 32.5	51 psi	63.69	36.948	1.211

42.000 OD

SDR 17	100 psi	134.16 lbs./ft.	37.058 ID	2.471 wall
SDR 19	89 psi	120.89	37.578	2.211
SDR 21	80 psi	109.97	38.000	2.000
SDR 26 ●	64 psi	89.71	38.770	1.615
SDR 32.5 ●	51 psi	72.37	39.416	1.292

1200 mm (47.244 OD)

SDR 19	89 psi	152.94 lbs./ft.	42.270 ID	2.487 wall
SDR 21	80 psi	139.16	42.744	2.250
SDR 26 ●	64 psi	113.53	43.610	1.817
SDR 32.5 ●	51 psi	91.62	44.336	1.454

54.000 OD

SDR 26 ●	64 psi	148.33 lbs./ft.	49.846 ID	2.077 wall
SDR 32.5 ●	51 psi	119.70	50.676	1.662

● denotes standard sizes

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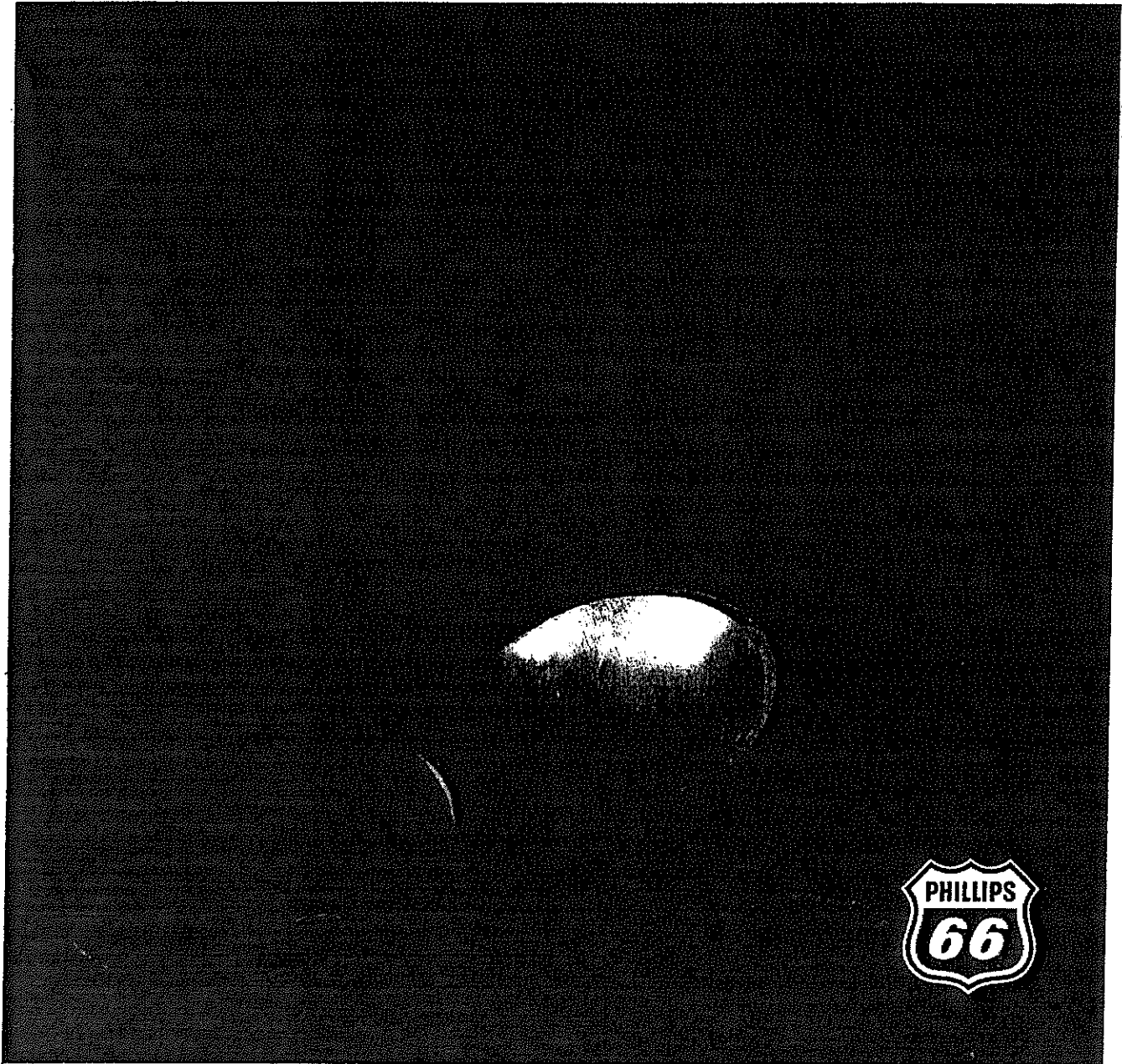
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Driscopipe® 1000

High Density Polyethylene Pipe For Industrial And Municipal Applications



Driscopipe® 1000 Polyethylene Piping Systems

Introduction

The Driscopipe® 1000 polyethylene piping system is lightweight, flexible and chemical and abrasion resistant, allowing it to be used in a number of diverse applications. Driscopipe 1000 is also protected from ultra-violet degradation and thermal degradation, giving it a long service and storage life in above ground, exposed installations. Driscopipe 1000 can meet the National Sanitation Foundation requirements for potable water. See your Phillips Driscopipe, Inc. representative for details.

Specifications

Driscopipe 1000 is a PE 3408 high density, high extra molecular weight polyethylene piping system. It may be specified by ASTM D3350 as having a cell classification of PE 345434C. Dimensions and workmanship are specified by ASTM F714.



A copy of nominal physical properties for Driscopipe 1000 is available from your Phillips Driscopipe, Inc. representative. Sample specifications for water distribution, force - main and gravity flow sewers are also available.

Chemical Resistance

Driscopipe 1000 has outstanding chemical resistance. Most chemicals, acids, salts and hot soils will not attack Driscopipe or cause it to degrade. It does not rust, rot or corrode. It does not promote or support algae or bacterial growth.

Flow Factors

Driscopipe polyethylene pipe has an extremely smooth inside surface. It maintains its excellent flow properties throughout its service life due to its excellent chemical and abrasion resistance. Because of its smooth walls and non-wetting characteristics, a higher flow capacity and a reduced friction loss is possible with Driscopipe 1000, resulting in operating cost savings. A "C" factor of 155 is used with the Hazen-Williams equation for pressurized fluid flow and an "n" factor of .009 is used with the Manning Formula for gravity flow. Flow charts and additional system design information are available through your Phillips Driscopipe Inc. representative.

Direct Burial

Driscopipe 1000 is buried utilizing flexible pipe/soil system design practices. The pipe actually gains strength from the surrounding soil allowing it to



support additional loads. Through proper pipe and backfill selection, Driscopipe 1000 may be buried at depths in excess of 100 feet. At normal burial depths, a backfill of 85% of Standard Proctor density (AASHTO-99) can limit the ring deflection of Driscopipe to 2% of the original diameter.

Since Driscopipe pipe can be butt fused above ground in long lengths, narrow trench widths can be used to save on installation costs. Due to the ease of handling Driscopipe, it may be readily placed in the trench, thus necessitating a minimum amount of open trench. Trench and trench bottom, embedment materials, and bedding and installation practices are specified in ASTM D 2321.



Primary Properties – Cell Classification – ASTM D3350-84 345434C*

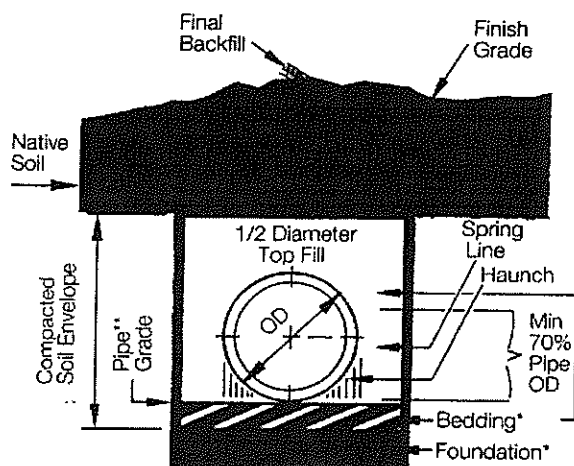
Property	Test Method	0	1	2	3	4	5	6
1 - Density, g/cm ³	D1505		0.910-0.925	0.926-0.940	0.941-0.955	>0.955		
2 - Melt index-condition E (gms/10 min)	D1238		>1.0	1.0-0.4	<0.4-0.15	<0.15		
3 - Flexural modulus, MPa (psi)	D790		<138 (<20,000)	138-<276 (<20,000-<40,000)	276-<552 (40,000-<80,000)	552-<758 (80,000-<110,000)	758-<1103 (110,000-160,000)	<1103 (<160,000)
4 - Tensile strength at yield, MPa (psi)	D638		<15 (<2200)	15-<18 (2200-<2600)	18-<21 (2600-<3000)	21-<24 (3000-<3500)	24-<28 (3500-<4000)	<28 (>4000)
5 - Environmental stress crack resistance:	D1693							
a. Test condition			A	B	C			
b. Test duration, h			48	24	192			
c. Failure, max, %			50	50	20			
6 - Hydrostatic design basis, MPa (psi), (23°C)	D2837	NPR ^a	5.52 (800)	6.89 (1000)	8.62 (1250)	11.03 (1600)		
Color and UV Stabilizer	A	B	C		D	E		
	Natural	Colored	Black with 2% minimum carbon black		Natural with UV stabilizer	Colored with UV		

^aNPR = Not Pressure Rated

*NOTE: Refer to Driscopipe 1000 Data Sheet for complete nominal physical properties documentation, features/advantages/benefits, and listings of major industrial and municipal applications.

Driscopipe pipe may be cold-bent to a minimum radius of 20-40 times the pipe diameter as it is installed, thus eliminating the need for elbows at slight bends. The minimum bending radius which can be applied to the pipe without kinking varies with the diameter and wall thickness of the pipe. If adequate space is not available for the required radius, a fitting of the desired angle may be fused into the piping system to obtain the necessary change in direction.

Trench Construction and Terminology



*In suitable soils the construction of a bedding and/or a foundation may not be required.

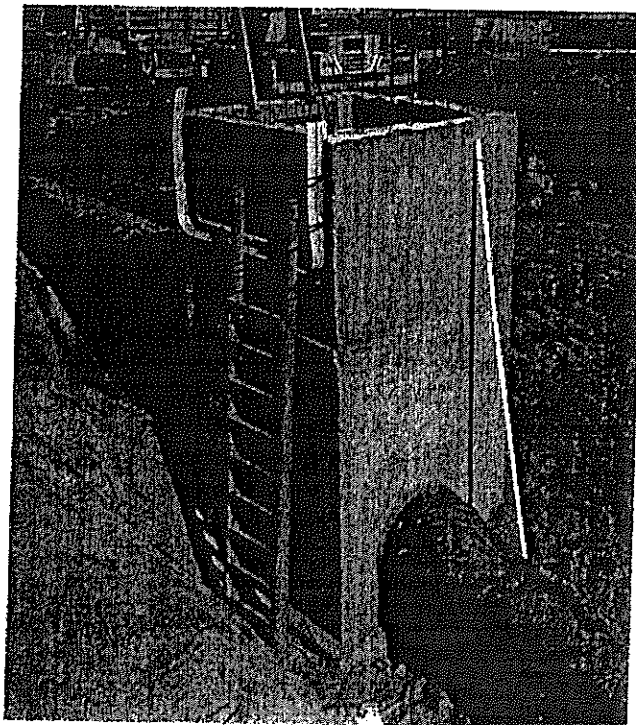
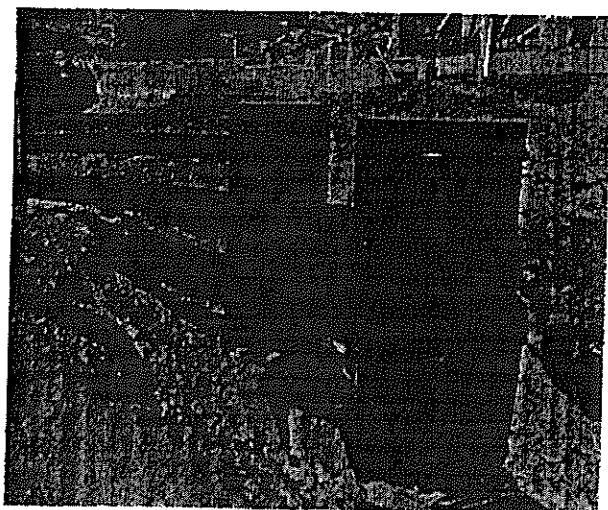
**Gravity flow Driscopipe sewers may be accurately laid to grade using laser beam scoping.

Temperature Range

Driscopipe 1000 may be used in pressure applications up to an operating temperature of 140°F. Short term and gravity flow applications operating at higher temperatures are considered. At lower temperatures, tests have been conducted on Driscopipe 1000 showing that Driscopipe gains strength at sub-zero temperatures. Driscopipe 1000 maintains its flexibility and integrity to lower than -180°F.

The pressure capabilities of polyethylene materials are rated for operating temperatures other than 73.4°F. Driscopipe 1000 has been tested for thousands of hours at elevated temperatures without thermal degradation. These tests are used to obtain the pressure rating factors.

Temperature, Degree F	Pressure Rating Factor
50	1.14
73.4	1.00
100	0.79
140	0.50



Joining System

Driscopipe is joined by the fusion technique. This simple, visual procedure utilizes controlled temperature and pressure to produce a fused, leak-free joint stronger than the pipe itself in both tension and hydrostatic loading. Pioneered and developed by Phillips, the heat fusion joint is recognized in the industry as a joining system of high integrity and reliability. Driscopipe may also be joined to itself and transitioned to other materials with flanges, compression couplings and other mechanical means.

Insert Renewal (Sliplining)

1. Inspect The Line

A TV survey will locate laterals, defects and provide the best insight on how to repair the line.

2. Economically Select Excavations For Insertion

From the TV survey and engineering drawings, locate excavations at cave-ins or changes in line or grade.

3. Specify The Correct O.D. Of The Liner

Normally, if the old line is in reasonable condition, a 10% clearance is adequate for sliplining.

4. Prepare The Liner

Determine and measure lengths of pipe required. Fuse the single joints into prescribed lengths and attach pulling head* and tag line if required.

5. Clean The Line

Clear and clean the old line sufficiently in order to insert the liner without undue stress.

6. Insert The Liner

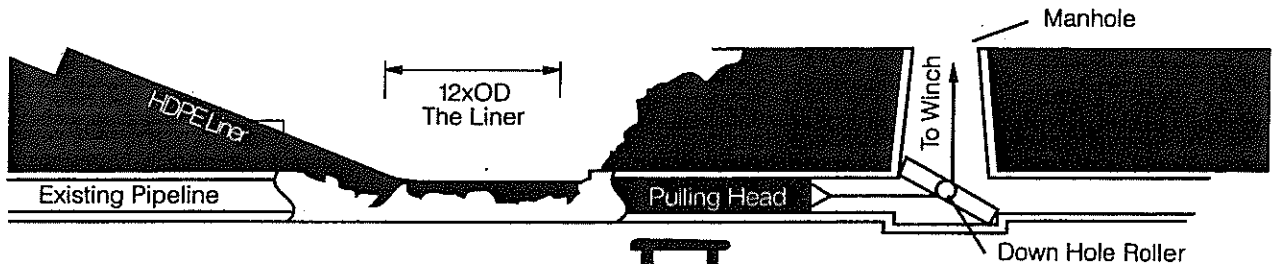
Establish pulling cable and rig. Attach cable to pulling head and slope excavation minimum of 2:1; then pull the liner into place. Alternately, the liner may be pushed into place using a choker strap.

7. Close The Job

Properly seal or grout around liner at manholes and cut inverts. Close excavations.

*See P.D.I. tech note #20 on pull head design.

Pull Technique



Push Technique



A Driscopipe representative can advise you on sizing your liner for external water head and other factors. Design brochures and reprints of ASTM F 585-78 "Insertion of Flexible Polyethylene Pipe into Existing Sewers" are available on request.

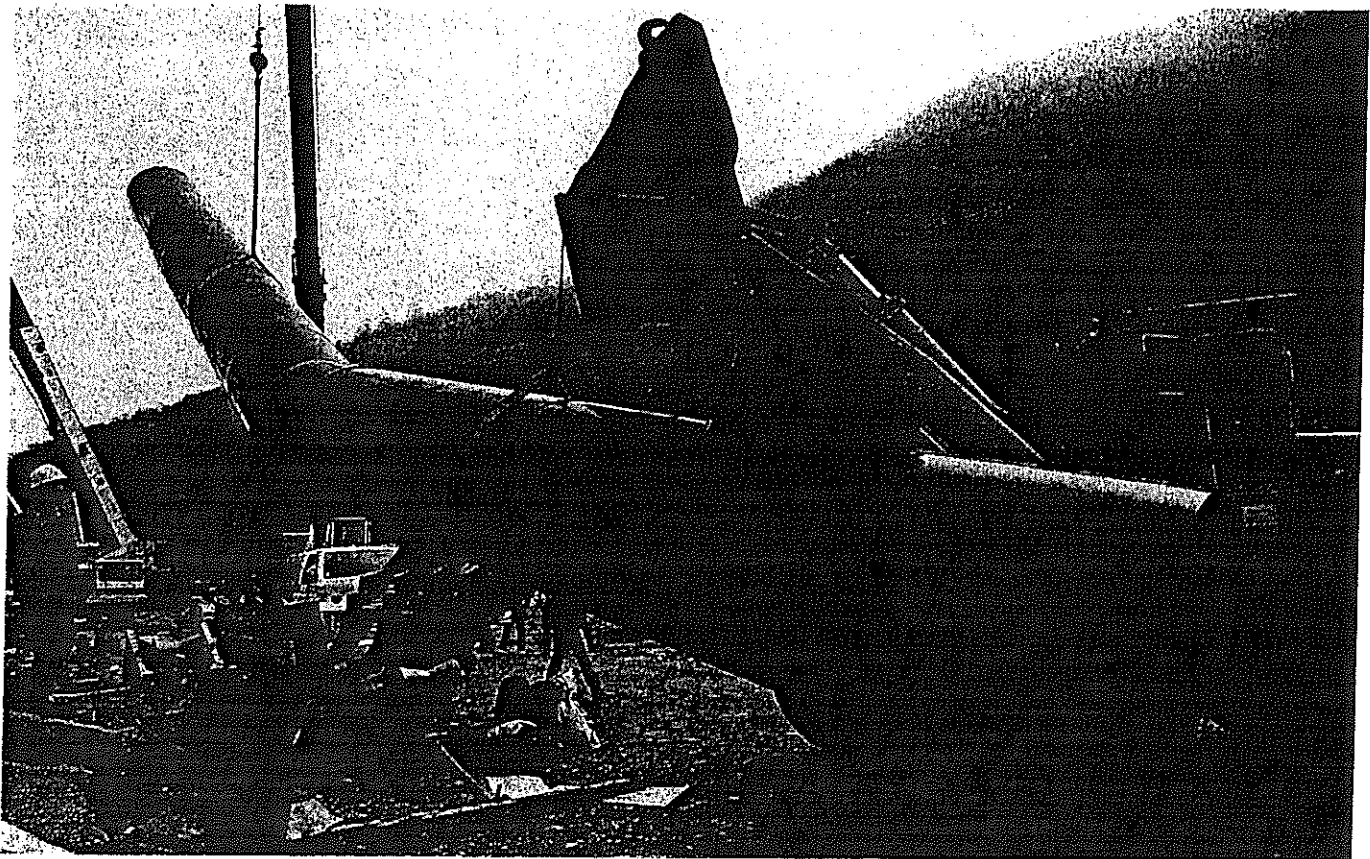
Insert renew sewers to save money while enhancing community relations

- Streets remain open to traffic
- Fewer excavations/fewer manholes
- No loss of services
- Quickest and most effective method of repair/renewal
- No infiltration with strong, fused joints
- Excellent flow properties of Driscopipe will restore the capacity of the system; no infiltration or exfiltration
- Low maintenance, almost immune to blockages & erosion
- Immune to sewer gases & most chemicals
- No algae or bacterial build-up
- No joint separation of butt-fusions due to earth or live loads



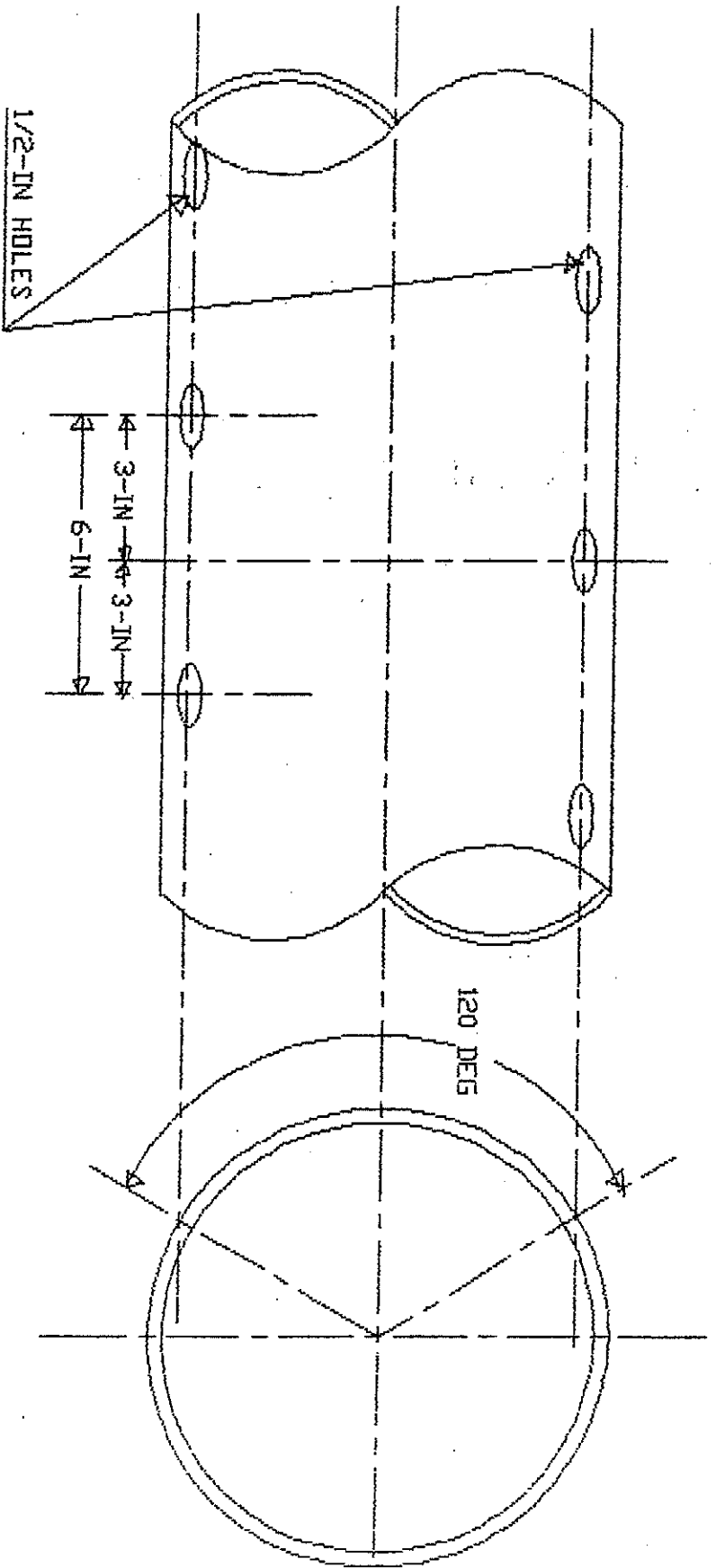
Additional Information

Technical design brochures and detailed installation brochures are available on request from a Phillips Driscopipe, Inc. representative.



Standard Perforation Pattern

8" HDPE
Collection System



8" SDK 11

PERFORATION PATTERN

2 ROWS 120 DEGREES APART
6-INCH CENTERS
1/2-INCH HOLES
STAGGERED

LEE SUPPLY COMPANY INC
FIRST & LINCOLN AVE.
CHARLESTON, PA 15022

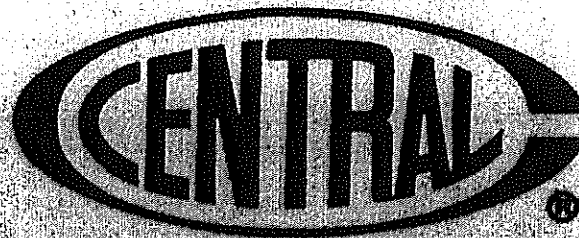
DRAWING NUMBER 2612012S

Note: SEVENSON bid is based on the above
STANDARD PERFORATION PATTERN

9/25/95

c:\SKETCH3\PERFORATION

12/12/95, PLT



Polyethylene Fitting Specifications

LEE SUPPLY CO., INC.
P.O. BOX 35
305 FIRST & LINCOLN AVE.
CHARLEROI, PA 15022
(724) 483-3543

Material Properties Section

Following are the ASTM Specifications and test values of the materials used in the manufacture of Central Polyethylene Fusion Fittings.

Physical Properties of Central Polyethylene Fittings

Property	ASTM Test Method	Nominal Value	
		PE 2406 (yellow)	PE 3408 (black)
Density, gm/cc	D1505	0.940	0.955
Melt Index, gm/10 min	D128-E	0.20	0.12
High Load Melt Index, gm/10 min	D1238-F	18	15.0
Tensile Strength @ Break, psi @ Yield, psi	D638	4500 2800	4500 3300
Elongation, %	D638	>800	>800
Flexural Modulus, psi	D790	80,000	120,000
Environmental Stress Cracking resistance	D1693		
F ₅₀ , hours (50°C)	Condition B (25% IGE PAL)	>2000	>2,000
F ₂₀ , hours (100°C)	Condition C	>5000	>5000
Brittleness Temperature °C	D746	<-117	<-118
Melting Point, °C	D789	127	129
Vicat Softening Temperature °C	D1525	120	126
Shore D Hardness	D2240	63	68
Volume Resistivity ohm-cm	D257	10 ¹⁵	1.9 x 10 ¹⁶
Hydrostatic Design Basis @60°C, psi @23°C, psi	D2837	1000 1250	630 1600
Thermal Expansion (1"/°C)	D696		1.4 x 10 ⁻⁴
Notched Izod Impact (ft. - Lb/in)	D256	10	6.0

Pressure Ratings @ °73F (23°C)

Pressure Ratings (Central Socket Fittings):

PE 2406 SDR 7 Fittings Pressure Rating = 210 PSI

PE 3408 SDR 7 Fittings Pressure Rating = 265 PSI

Pressure Ratings (Central Butt Fusion Fittings):

PE 2406 SDR 9.3 Fittings Pressure Rating = 150 PSI

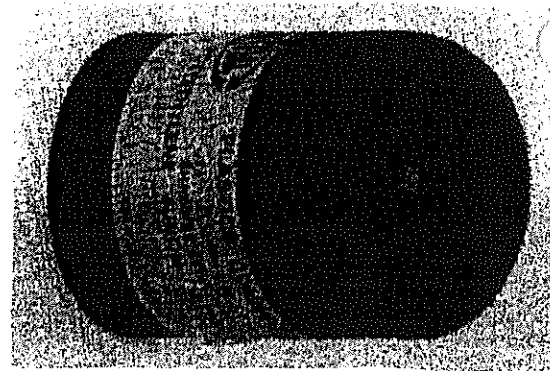
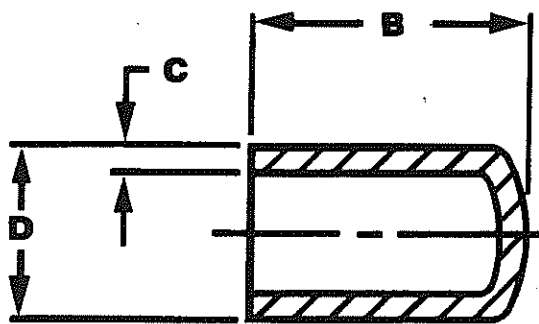
PE 3408 SDR 9.3 Fittings Pressure Rating = 190 PSI

PE 2406 SDR 11 Fittings Pressure Rating = 125 PSI

PE 3408 SDR 11 Fittings Pressure Rating = 160 PSI

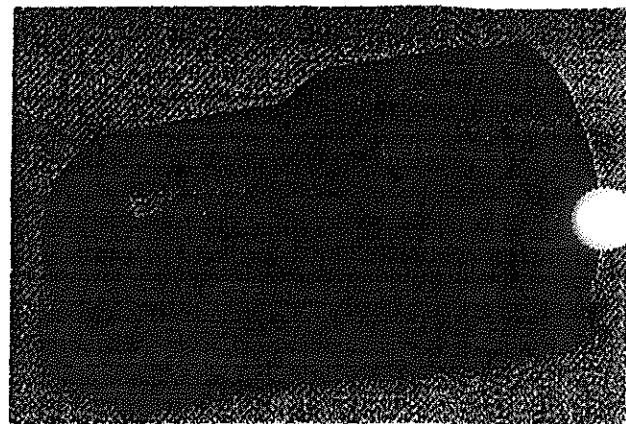
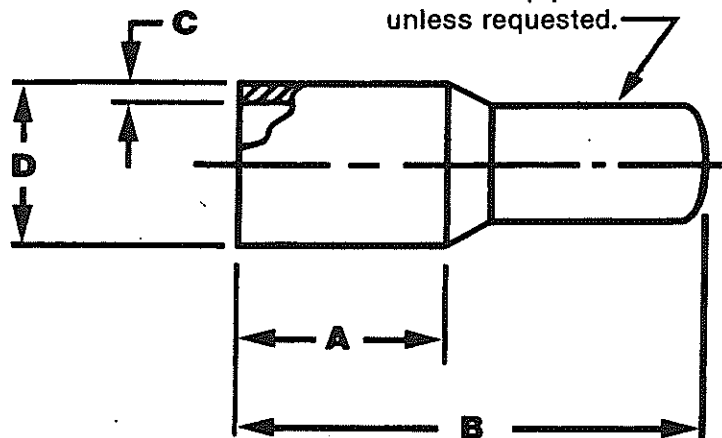
Butt Fusion Fittings

End Caps (Butt)



NOMINAL SIZE	A DIMENSION	B DIMENSION	C MINIMUM WALL	D DIAMETER
1 1/4" IPS SDR 10	N/A	3.25	.165 $\begin{smallmatrix} +.033 \\ -.000 \end{smallmatrix}$	1.660 $\pm .010$
1 1/4" IPS SDR 11	N/A	3.25	.151 $\begin{smallmatrix} +.030 \\ -.000 \end{smallmatrix}$	1.660 $\pm .010$
1 1/2" IPS SDR 9.3	N/A	3.50	.204 $\begin{smallmatrix} +.041 \\ -.000 \end{smallmatrix}$	1.900 $\pm .010$

Note: This end not machined to a nominal pipe diameter unless requested.



Nominal Size	Dimension A	Dimension B	Dimension C	Diameter D
2" SDR 11	3.125	7.000	.216 $\begin{smallmatrix} +.043 \\ -.000 \end{smallmatrix}$	2.375 $\pm .010$
3" SDR 11	2.875	7.125	.318 $\begin{smallmatrix} +.064 \\ -.000 \end{smallmatrix}$	3.500 $\pm .012$
4" SDR 11	2.875	7.750	.409 $\begin{smallmatrix} +.082 \\ -.000 \end{smallmatrix}$	4.500 $\pm .015$
6" SDR 11	4.125	10.500	.602 $\begin{smallmatrix} +.120 \\ -.000 \end{smallmatrix}$	6.625 $\pm .018$
8" SDR 11	4.187	11.125	.784 $\begin{smallmatrix} +.157 \\ -.000 \end{smallmatrix}$	8.625 $\pm .025$

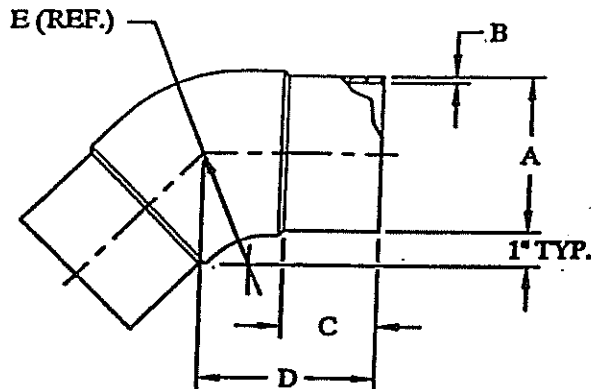
Items shown are standard sizes and wall thicknesses. Fitting sizes other than those shown can be furnished upon request.

45° ELBOW

BUTT FUSION FITTINGS

(BUTT)

BUTT45ELWK4
10/22/96



8" HDPE
Collection
System
CLEANOUT

NOMINAL SIZE	DIAMETER A	DIMENSION B	DIMENSION C	DIMENSION D	DIMENSION E (REF.)
3" IPS (SDR 9.3)	3.500 ± 0.12	.377 ^{+0.075} / _{-.000}	3.13	5.00	2.976
88.90mm	88.90mm	9.58mm	79.50mm	127.00mm	75.59mm
3" IPS (SDR 11)	3.500 ± 0.12	.318 ^{+0.064} / _{-.000}	3.13	5.00	2.976
88.90mm	88.90mm	8.08mm	79.50mm	127.00mm	75.59mm
4" IPS (SDR 9.3)	4.500 ± 0.15	.484 ^{+0.097} / _{-.000}	3.13	5.00	3.518
114.30mm	114.30mm	12.29mm	79.50mm	127.00mm	89.36mm
4" IPS (SDR 11)	4.500 ± 0.15	.409 ^{+0.061} / _{-.000}	3.13	5.00	3.518
114.30mm	114.30mm	10.39mm	79.50mm	127.00mm	89.36mm
6" IPS (SDR 11)	6.625 ± 0.18	.603 ^{+0.121} / _{-.000}	4.38	8.45	4.668
168.28mm	168.28mm	15.32mm	111.25mm	214.63mm	118.57mm
8" IPS (SDR 11)	8.625 ± 0.25	.785 ^{+0.157} / _{-.000}	6.00	11.00	5.570
219.28mm	219.08mm	19.94mm	152.40mm	279.40mm	146.05mm
10" IPS (SDR 11)	10.750 ± 0.27	.978 ^{+0.186} / _{-.000}	6.00	13.25	6.900
273.05mm	273.05mm	24.84mm	152.40mm	336.55mm	175.26mm
12" IPS (SDR 11)	12.750 ± 0.36	1.160 ^{+0.232} / _{-.000}	7.50	15.75	7.982
323.85mm	219.08mm	29.46	190.50mm	400.05mm	202.74mm

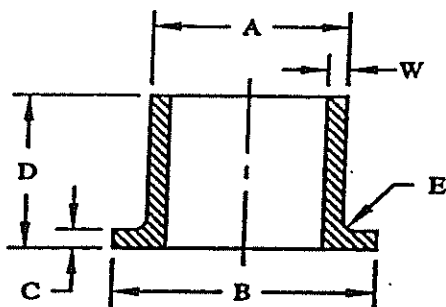
Item shown are standard sizes and wall thicknesses. Fitting sizes other than those shown can be furnished upon request

Flange Adapters/Stub Ends

BUTT FUSION FITTINGS

(BUTT) IPS

FLANADAP.WK4
03/17/97



NOMINAL SIZE	A O.D.	B DIAMETER	C DIMENSION	W DIMENSION SDR RANGE	D DIMENSION	E RADIUS
2" IPS	2.375 ±010	3.938	.390	7 through 32.5	6.00	.25
60.33mm	60.33mm	100.03mm	9.91mm		152.40mm	6.35mm
3" IPS	3.500 ±012	5.000	.625	7 through 32.5	6.00	.25
88.90mm	88.90mm	127.00mm	15.88mm		152.40mm	6.35mm
4" IPS	4.500 ±015	6.600	.750	7 through 32.5	6.00	.38
114.30mm	114.30mm	167.64mm	19.05mm		152.40mm	9.35mm
*6" IPS	6.625 ±018	8.500	*1.00	*9 through 32.5	*8.00	.38
168.28mm	168.28mm	215.90mm	25.40mm		203.20mm	9.35mm
*8" IPS	8.625 ±025	10.625	*1.00	*11 through 32.5	*11.00	.38
219.08mm	219.08mm	269.88mm	25.40mm		279.40mm	9.35mm
*10" IPS	10.750 ±027	12.750	*1.282	*11 through 32.5	*12.00	.38
273.05mm	273.05mm	323.85mm	32.56mm		304.80mm	9.35mm
*12 IPS	12.750 ±036	15.000	*1.544	*11 through 32.5	*12.00	.38
323.85mm	323.85mm	381.00mm	39.22mm		304.80mm	9.35mm
14" IPS	14.000 ±063	17.500	1.500	11 through 32.5	12.00	.50
355.60mm	355.60mm	444.50mm	38.10mm		304.80mm	12.70mm
16" IPS	16.000 ±072	20.000	1.750	11 through 32.5	12.00	.50
406.40mm	406.40mm	508.00mm	44.45mm		304.80mm	12.70mm
18" IPS	18.000 ±081	21.375	1.875	11 through 32.5	12.00	.50
457.20mm	457.20mm	542.93mm	47.63mm		304.80mm	12.70mm
20" IPS	20.000 ±090	23.470	2.273	11 through 32.5	12.00	.50
508.00mm	508.00mm	596.14mm	57.73mm		304.80mm	12.70mm
*24" IPS	24.000 ±108	27.850	.	.	12.00	.50
609.60mm	609.60mm	707.39mm	.		304.80mm	12.70mm

*FOR 6" IPS (SDR's 7, 7.3) DIMENSION C = 1.100 (27.94mm)

8" IPS (SDR's 7, 7.3, 9) DIMENSION C = 1.570 (39.88mm) - DIMENSION D = 9.00 (228.60mm)

10" IPS (SDR 7) DIMENSION C = 1.90 (48.26mm) - DIMENSION D = 9.00 (228.60mm)

10" IPS (SDR 9) DIMENSION C = 1.60 (40.64mm) - DIMENSION D = 9.00 (228.60mm)

12" IPS (SDR 7) DIMENSION C = 2.28 (57.91mm) - DIMENSION D = 9.00 (228.60mm)

12" IPS (SDR 9) DIMENSION C = 1.90 (48.26mm) - DIMENSION D = 9.00 (228.60mm)

24" IPS (SDR 9, 11) DIMENSION C = 2.822 (38.10mm)

24" IPS (SDR 17) DIMENSION C = 1.765 (44.83mm)

Larger sizes can be furnished upon request.

Notes: (1) Dimension W (wall thickness) is determined by the SDR number.
Refer to SDR table.

(2) Dimension C (flange thickness) to meet or exceed Dimension W (wall thickness).

IPP Deltaflex® Flange Engineering

Improved Piping Products, Inc. (IPP) has patented the second generation convoluted pipe flanges and markets that technology under the registered trade name IPP Deltaflex® pipe flanges/backup rings. The unique design technology significantly reduces the weight of a flange without reducing its pressure performance.

IPP has employed and continues to employ qualified, full time stress analysts. The finite element analysis (FEA) tool utilized by IPP is ANSYS 5.3. Using these tools the company has examined the stress levels inside standard piping flange joints and in the adjacent pipewalls. From this analysis IPP has confirmed that nationally recognized pipe flanges are very conservatively stressed while the adjacent pipe walls often exceed allowable code stress values, in many cases approaching the yield point of the piping material. See figure 1 below and the Technical Information section on pages 32 – 35 "IPP Deltaflex® Flange Performance on Steel Stub-ends."

In response to this IPP Deltaflex® flanges are designed to allowable code stress levels with a safety factor of two. Even with this generous safety factor IPP Deltaflex® flanges are much lower stressed than the abutting pipe wall material. Therefore a properly selected IPP Deltaflex® flange is not the weakest link in a pipe system when the adjacent pipewall is closely examined. See figure 2.

IPP Deltaflex® flanges are safe, functional structures with an attractive economic dimension. They conserve

material and energy resources from manufacture to point of installation. The lower weight translates into several benefits:

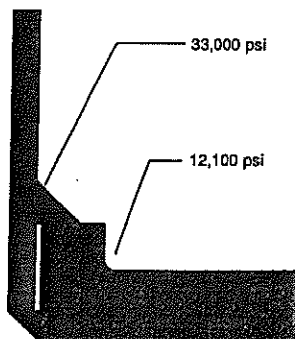
- Lower cost of raw material and energy
- Reduced shipping costs
- Ease of handling and installation

The IPP Deltaflex® flanges can be substituted for a conventional pipe flange as called out in ANSI B16.5, B16.47 and AWWA C207. Its unique cross section can save up to 40% of the weight of one of these national pipe standard flanges. Some installation practices have thinned the standard flanges for economic reasons. In these instances using IPP Deltaflex® flanges design principles can reduce the critically high stress levels to a stated safety factor. This performance is achieved by using IPP Deltaflex® flange engineering to increase the section modulus of the flange without increasing its weight.

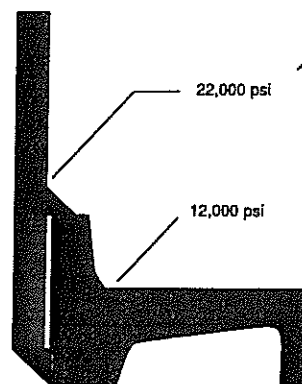
IPP has installed literally millions of its patented convoluted flange in the entire spectrum of code controlled commercial and industrial pipe systems. To our knowledge there has never been a reported failure of an IPP Deltaflex® flange in operation in sizes to 63" and ANSI pressure categories through Class 400 (34" size). The design technology has consistently been the specification choice of world renowned piping engineers.

The IPP Deltaflex® flange truly satisfies the claim of being a modern high performance pipe flange. Pound for pound there exists no other pipe flange that can safely carry structural loads as efficiently as an IPP Deltaflex® flange.

We welcome your inquiry and presentation request.



A. Standard 24" slip-on
FIGURE 1

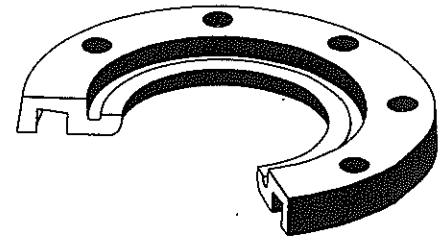
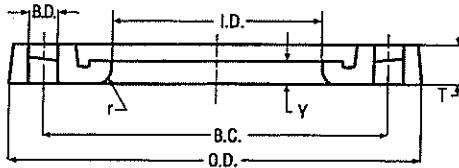


B. IPP Deltaflex 24" slip-on
FIGURE 2

LEE SUPPLY CO., INC.
P.O. BOX 35
305 FIRST & LINCOLN AVE.
CHARLESTON, PA 15022
(724) 483-3543

Ductile Iron

BUPP—Flange/Backup Ring



- **Description** Utilizes the patented IPP Deltaflex® flange cross section
- **Utilization** HDPE, stainless steel, and carbon steel stub-ends
- **Material** Cast in ductile iron A536 (65/45/12) tensile 65,000 psi; yield 45,000 psi; 12% elongation
- **Dimensions** Bolt circle is ANSI/B16.5 class 150. Mates with ANSI B16.5, B16.47, AWWA C207
- **Finish** Red oxide primer, hot dipped galvanized, epoxy coated

Pipe Diameter	Product Code	Outside Dia. O.D.	Flange Thick. T	Inside Dia. I.D.	Y	Bolt Count N	Bolt Hole B.D.	Bolt Circle B.C.	Radius R	Weight (lbs/pc)	HDPE ¹ Operating Pressure	Steel ² Operating Pressure
3/4"	BUPP 0075" C	3.88	.50	1.11	.22	4	.63	2.75	.13	1	275	275
1"	BUPP 01" C	4.25	0.56	1.38	0.22	4	0.63	3.13	0.13	2	275	275
1 1/4"	BUPP 0125" C	4.63	.63	1.72	.22	4	.63	3.50	.19	1	275	275
1 1/2"	BUPP 0150" C	5.00	0.69	1.97	0.25	4	0.63	3.88	0.21	2	275	275
2"	BUPP 02" C	6.00	0.75	2.46	0.23	4	0.75	4.75	0.13	3	275	275
2 1/2"	BUPP 0250" C	7.00	0.88	2.97	0.50	4	0.75	5.50	0.31	3.5	275	275
3"	BUPP 03" C	7.50	0.94	3.60	0.50	4	0.75	6.00	0.38	4	275	275
4"	BUPP 04" C	9.00	0.94	4.60	0.50	8	0.75	7.50	0.44	6	275	275
5"	BUPP 05" C	10.00	0.94	5.69	0.50	8	0.88	8.50	0.44	7	275	275
6"	BUPP 06" C	11.00	1.00	6.75	0.56	8	0.88	9.50	0.50	8	275	275
8"	BUPP 08" C	13.50	1.12	8.75	0.56	8	0.88	11.75	0.50	12	275	275
10"	BUPP 10" C	16.00	1.19	10.92	0.60	12	1.00	14.25	0.50	17	275	275
12"	BUPP 12" C	19.00	1.25	12.92	0.63	12	1.00	17.00	0.50	23	275	275
14"	BUPP 14" C	21.00	1.38	14.18	0.70	12	1.13	18.75	0.50	29	172	252
16"	BUPP 16" C	23.50	1.44	16.19	0.70	16	1.13	21.25	0.50	37	146	214
18"	BUPP 18" C	25.00	1.56	18.20	0.88	16	1.25	22.75	0.50	41	157	230
2"	BUPP 02" B	6.00	0.75	2.63	0.23	4	0.75	4.75	0.13	3	275	275
3"	BUPP 03" B	7.50	0.94	3.75	0.25	4	0.75	6.00	0.13	4	275	275
4"	BUPP 04" B	9.00	0.94	4.75	0.25	8	0.75	7.50	0.13	6	275	275
5"	BUPP 05" B	10.00	0.94	5.81	0.27	8	0.88	8.50	0.13	7	275	275
6"	BUPP 06" B	11.00	1.00	6.88	0.28	8	0.88	9.50	0.13	8	275	275
8"	BUPP 08" B	13.50	1.12	8.88	0.30	8	0.88	11.75	0.13	12	275	275
10"	BUPP 10" B	16.00	1.19	11.00	0.60	12	1.00	14.25	0.38	17	275	275
12"	BUPP 12" B	19.00	1.25	13.13	0.63	12	1.00	17.00	0.31	23	275	275
14"	BUPP 14" B	21.00	1.38	14.38	0.70	12	1.13	18.75	0.40	28	172	252
16"	BUPP 16" B	23.50	1.44	16.38	0.70	16	1.13	21.25	0.40	37	146	214
18"	BUPP 18" B	25.00	1.56	18.38	0.88	16	1.25	22.75	0.38	41	157	230
20"	BUPP 20" B	27.50	1.69	20.38	0.88	20	1.25	25.00	0.31	54	145	213
22"	BUPP 22" B	29.50	2.13	22.22	0.55	20	1.38	27.25	0.50	91	129	180
24"	BUPP 24" B	32.00	1.88	24.25	0.90	20	1.38	29.50	0.50	76	144	211
26"	BUPP 26" B	34.25	2.00	26.38	1.00	24	1.38	31.75	0.25	86	103	151
28"	BUPP 28" B	36.50	2.06	28.38	1.00	28	1.38	34.00	0.31	103	96	141
30"	BUPP 30" B	38.75	2.06	30.38	1.00	28	1.38	36.00	0.25	102	73	107
32"	BUPP 32" B	41.75	2.06	32.38	1.00	28	1.63	38.50	0.31	118	66	97
34"	BUPP 34" B	43.75	2.14	34.38	0.60	32	1.63	40.50	0.31	137	60	88
36"	BUPP 36" B	46.00	2.06	36.38	1.00	32	1.63	42.75	0.31	142	49	72
40"	BUPP 40" S	50.75	3.45	39.75	0.94	36	1.63	47.25	0.50	341	89	118
42"	BUPP 42" B	53.00	2.00	42.38	1.10	36	1.63	49.50	0.50	191	16	23
48"	BUPP 48" B	59.50	2.00	48.50	1.35	44	1.63	56.00	0.25	251	23	34
54"	BUPP 54" B	66.25	3.75	54.62	0.90	44	1.38	62.75	0.19	401	25	37
63/60"	BUPP 63" M	73.00	2.80	64.00	0.60	52	1.38	69.25	0.10	277	36	53

1. Operating pressure on an HDPE stub-end with a safety factor of 2. 2. Operating pressure on a steel stub-end with a safety factor of 1.5.

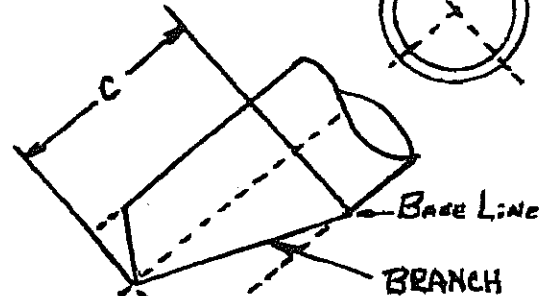
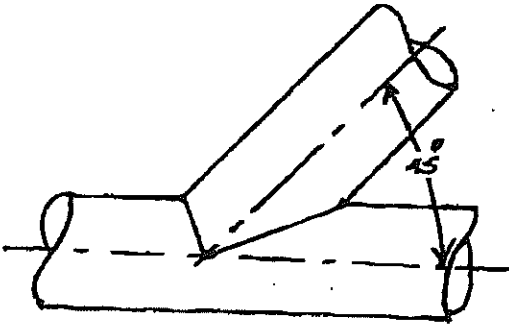
Notes: "B" and "C" shown adjacent to pipe diameter refers to flanges of different inside diameters to accommodate fusion bead clearance, metric or oversize pipe.

"M" refers to a 60" bolt circle used for a 63" flange.

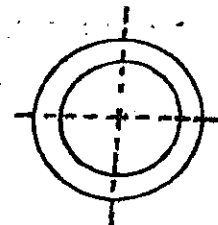
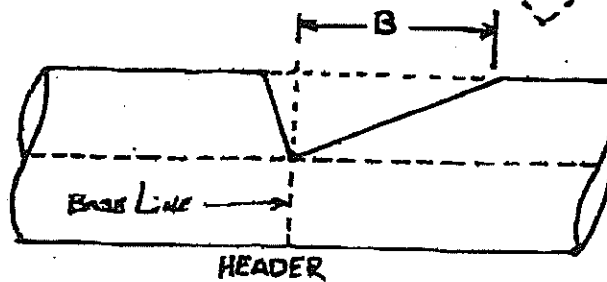
"S" refers to a 40" nominal pipe size, 1,000mm actual pipe size for HDPE pipe.

LEE SUPPLY CO., INC.

P.O. BOX 35
305 FIRST & LINCOLN AVE.
CHARLEROI, PA 15022
(724) 483-3543



For Collection System
Cleanouts
(8" ϕ)



Pipe Size Inches	Main Line	B Inches	C Inches	Outlet
1 1/4	24	1.5	2	18
1 1/2	24	1 7/8	2 5/16	18
2	24	2 1/8	2 7/8	18
2 1/2	24	3	3 1/2	18
3	24	3 3/4	4 1/4	18
3 1/2	24	4 5/16	4 13/16	18
4	24	4 15/16	5 7/16	18
5	24	6 1/8	6 3/4	18
6	36	7 1/4	8	28
8	40	9 11/16	10 7/16	30
10	42	12 1/4	13	32
12	46	14 5/8	15 3/8	36
14	48	16 1/8	16 7/8	38
16	56	18 9/16	19 5/8	48
18	56	21	21 3/4	48
20	72	23 1/8	24 1/8	54
24	76	28	29	58

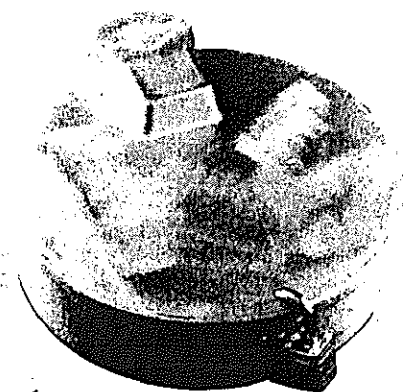


LOCKING WELL CAPS

PREVENTS VANDALISM
IDEAL FOR MONITORING WELLS

For-Water Well and Water Systems Industry and Ground Water Monitoring

CAPS AVAILABLE ★ Without IMPRINTING or PERSONALIZED IMPRINTED
★ ALUMINUM



*For Collection System
CLEANOUTS (8"Ø PIPE)*

LOCKING CAPS - With ¾" Conduit
O.D. of casing 6 5/8"
FOR MAXIMUM WELL PROTECTION

LOCKING CAPS - With 1" Conduit
O.D. of casing 6 5/8" and 8 1/4"



Order all sizes by O.D. of casing
O.D. of casing Order Well
Cap Size

2 3/8"	2 3/8"
4 1/2"	4 1/2"
5 5/8"	5 5/8"
6 5/8"	6 5/8"
7"	7"
8 3/4"	8 3/4"
10 3/4"	10 3/4"
12 3/4"	12 3/4"

Personalized Well Caps Imprint On Well Caps

At a small additional cost
It's Smart Advertising
And Identification

YOUR - Name, Phone and Address cast
as illustrated for a small additional charge
per cap in addition to the cap price. See
price sheet. MINIMUM ORDER FOR
IMPRINTED CAPS 30. A 10% deviation
of order possible on imprinted caps.

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For A Free Catalog From...

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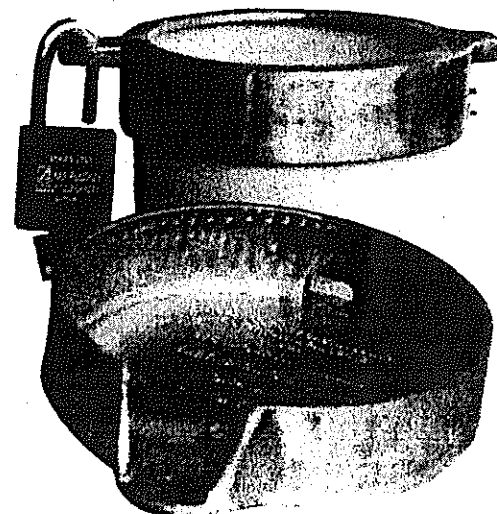
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Well Log Pad On All Caps
- At no Additional Cost
RECORDS ★ Well Depth ★ Date
★ Amount of casing
★ Gallons per minute

Our new locks will last a lifetime

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KEYED DIFFERENT

PADLOCKS for LOCKING WELL CAP OUTDOOR and MARINE QUALITY

★ Special anodizing means incredible
corrosion-resistance Lock Body



MODEL NUMBER	LOCK BODY WIDTH THICK	SHACKLE DIAMETER CLEARANCE	Security
1105	1 1/2" 3/4"	1/4"	1"

NEW CAPS

6 5/8" LOCKING CONDUIT
w/1" Conduit
8 1/4" LOCKING CONDUIT
w/1" Conduit

8 3/4" WATERTIGHT
w/1" Conduit
See Page#3

APPENDIX B-18

CONTRACTORS/SUPPLIERS

Well Installation:

SJB Services
5167 South Park Avenue
Hamburg, NY 14075
Phone: 649-8110

VFPE Liner:

Atlantic Lining Co. Inc.
12 Saddlebrook Road
Robbinsville, NJ 08691
Phone: 609-448-6891

Fencing:

Fox Fences
2637 Lockport Road
Niagara Falls, NY 14305
Phone: 284-1444 or 631-3380

Wetland Plantings:

Southern Tier Consulting, Inc.
2701-A Route 305
PO Box 30
West Clarksville, NY 14786
Phone: 968-3120

Control Building:

LBM Construction Inc.
5784 Ellis Road
Orchard Park, NY 14127
Phone: 662-2139

HDPE Pipe:

Manufacturer: Driscopipe
Supplier: Lee Supply Company Inc.
305 First St. and Linclon Ave.
PO Box 35
Charleroi, PA 15022
Phone: 724-483-3543
800-353-3747

Wet Well And Meter Pit Hatches:

Manufacturer: Wet wells: Halliday Products
Meter Pit: The Bilco Company
Supplier: Reifler Concrete Products
5690 Camp Road
Hamburg, NY 14075
Phone: 649-3260

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