Makotherm
Thermal / Catalytic Oxidizer
Operation and Maintenance Manual

GENERAL INFORMATION FOR UNIT

The Thermal / Catalytic Oxidizer with a Blower Package is used for the remediation of soils with volatile organic compounds which are present from leakage or spillage. The unit is most effective when the soil vapor concentration yield is nominally between 500 and 15,000 parts per million by volume.

Soil vapors are extracted with the blower through the entrained liquid separator, which removes the majority of the water brought up from the soil during the vacuum extraction process. Dilution air is added if necessary and the vapors proceed to the oxidizer chamber where the burner heats them to their final temperature of 1,450^{o} F +. The vapors come into contact with the flame and combust into water vapor and carbon dioxide. The destruction efficiency for the unit is 98% or above.

The unit is described more thoroughly in the technical specification section of this document.

TECHNICAL SPECIFICATIONS

- **VOC Processing Capability:** The Thermal / Catalytic Oxidizer can treat up to 15,000 ppmv of BTEX type VOC's including MTBE.
- **Destruction Efficiency:** The Destruction Efficiency is 98% +.

Major Components

- **Entrainment Separator:** The Entrainment Separator is provided to remove water that is brought up during vapor extraction from the vapor stream. It has a tangential inlet that cyclonically separates the water from the vapors with 99% + efficiency. It also has a demister element to remove incoming particulate and water droplets.
- **Vacuum Blower:** The Vacuum Blower extracts the vapors from the soil and can produce vacuum levels from 1 inch of water to 350 inches of water. The pump is powered by a motor, which is sized to provide enough horsepower to generate the flow required at the specified vacuum level for the system. (see your specific quotation and specifications for exact blower / horsepower for your unit).

- **Oxidizer Chamber:** The Oxidizer Chamber is constructed of 3/16 inch carbon steel and lined with a 5 inch ceramic fiber high temperature lining that provides a safe cold face temperature while operating at 1450^{o} F + on the hot face.
- **Burner and Fuel Train:** An excess air burner is installed on the oxidizer chamber. This provides the necessary heat for the pre-heating of the incoming vapors. The operating range for the burner is 1450^{o} F to 1800^{o} F. The fuel train is a NFPA double blocking valve type with proportional gas modulation depending on temperature.
- **Control Panel:** The Control Panel contains a main disconnect, on/off switches, operator interface lights, controllers, chart recorder, fuses, motor starters, relays and wiring. The panel is a NEMA 4 type for outdoor use.
- **Valves:** The Entrainment Separator comes equipped with two butterfly valves, which are actuated by a drive motor. One is a Process Isolation Valve that is provided to isolate the vapors during start-up, when an alarm occurs or when the oxidizer is not at temperature. The other is a Dilution Valve that continually modulates and maintains the outlet temperature at a pre-set level.
- **Auto Drain Pump:** A Liquid Pump is provided to remove the water accumulated in the entrainment separator. The pump is activated when the water reaches the high liquid level switch and shuts off when it reaches the low-level switch. The pump transfers the water to a receptacle provided by the client at the site.
- **Liquid Level Switches:** Liquid Level Switches are provided on the entrainment separator and the oil seal tank. A High Liquid Level Switch activates the liquid transfer pump when it is triggered.
- **Flow Transmitter:** The Flow Transmitter receives a high and low air pressure signal from the pitot tube or orifice plate in the process line and transmits a signal to the chart recorder. The chart recorder records the total volumetric flow rate passing to the oxidizer.
- **Temperature Controller:** The Temperature Controller receives a signal from the control thermocouple and maintains the pre-set temperature by modulating the fuel-train drive motor and valve.
- **Dilution Controller:** The Dilution Controller receives a signal from the stack thermocouple and maintains the pre-set temperature by modulating the dilution drive motor and valve.
- **High Limit Temperature Controller:** The High Limit Temperature Controller receives a signal from the stack thermocouple and shuts the oxidizer off if the exhaust temperature exceeds 1800^{o} F in the Thermal mode or 1150^{o} F in the Catalytic mode.

Treatment System
SYSTEM WARNINGS

The Treatment System utilizes high temperatures, high voltages and flammable vapors to operate. All personnel operating the Treatment System must be trained in the operation and maintenance of the system as well as the safety devices provided with the system.

1. **Do not attempt to bypass any of the safety interlocks provided in an attempt to operate the unit. Unless authorized by Mako personnel for diagnostic purposes only. Bypassing safety switches will void the warranty and can cause major damage to equipment and personnel.**
2. **Do not modify or bypass the transformers, fuse blocks, or controllers in order to make the system operational unless authorized by Mako personnel.**
3. **Do not remove any equipment from the unit in order to make the unit operational.**
4. **Keep all body parts clear of the exhaust stack, oxidizer chamber, burner, air intake valves and moving parts due to burns from high temperature conditions and severe bodily injury situations that can occur as a result of body contact with these parts.**
5. **Do not restrict, block or close the exhaust stack during operation.**
6. **Disconnect incoming voltage to the unit control panel before attempting to work on the panel or other electrical components on the unit. Use a voltage meter to determine that the power is off. Have only qualified personnel work on the electrical components, preferably a qualified electrician.**
7. **Verify that propane is secure and that no there are no leaks in the lines.**
8. **Shutdown the system and contact Mako immediately if you are experiencing any unsafe conditions.**

SYSTEM INSTALLATION AND START-UP

Follow each step listed here in exactly the order listed. For your safety, do not skip any steps or perform any steps out of order.

Installation:

1. Operate the unit on a level dry surface.
2. Connect the properly rated electrical supply with a ground from the generator to the control panel main disconnect using a qualified electrician.
3. Check voltage, wire size and amperage rating of electricity installed, making sure that it matches the manufacturers panel specifications and electrical drawings for your specific system before proceeding.
4. Check 120-volt power circuit to see that controllers are powered up.
5. Check rotation of the Vacuum blower, combustion blower and liquid transfer pump making sure they are correct.
6. Check natural gas / propane supply making sure it is connected to the inlet piping from the supply source. Insure there is no leakage from any of the lines with a soap bubble test.

Start-up Procedures:

1. Verify that the **"Main Disconnect Switch"** on the control panel is in the **"Off"** position.
2. Open the system control panel door and have a qualified electrician verify that the voltage at top of the **"Main Disconnect"** is set to the specified voltage.
3. With the control panel door closed and latched, turn the **"Main Disconnect"** switch to the **"On"** position.
4. Turn the **"Control Power"** switch to the **"On"** position.
5. Push the **"Start"** button, the vacuum blower should come on after pushing the Start Button.
6. Press the **"Limits Reset"** Button the limits operational light should come on if all limits are in a safe condition.
7. The unit should purge for 60 seconds and then attempt to light the burner.
8. If the unit burner lights, the unit will heat the unit to 1400 degrees at which time the well isolation valve should open and the unit will begin to process vapors. In the Catalytic mode the unit should heat to 600 degrees and then open the process valve.

System Alarms

1. **High Water Alarm Entrained Liquid Tank:** Water level is above the high/high level switch in the entrained liquid separator. Blower immediately shuts off and unit is shutdown.
2. **Low Gas Pressure Fuel Train:** Gas pressure is below 4" water column at the inlet to the fuel train. Unit closes the process valve and shuts off the burner. Unit will re-light if the condition corrects itself within 30 minutes.
3. **High Gas Pressure Fuel Train:** Gas pressure is above 1 pound at the inlet to the fuel train. Unit closes the process valve and shuts off the burner. Unit will re-light if the condition corrects itself within 30 minutes.
4. **High Temperature Oxidizer Exhaust:** Exhaust temperature in the oxidizer stack has exceeded 1800 degrees F in the Thermal Mode or 1150 degrees F in the Catalytic Mode. Unit closes the process valve and shuts off the burner. Unit shuts down in 30 minutes and needs to be manually reset.
5. **Combustion Air Flow Alarm:** Combustion air blower is not producing enough airflow or is off. Unit closes the process valve and shuts off the burner. Unit shuts down in 30 minutes and needs to be manually reset.
6. **Flame Failure Burner:** Burner did not light. Unit closes the process valve and shuts off the burner. Unit shuts down in 30 minutes and needs to be manually reset.

MAINTENANCE SHEDULE

- Check Blower — <u>Monthly</u>
  (Maintenance procedure in product bulletin)
- Grease Motor fittings — <u>Monthly</u>
  (Use grease gun on zirk fittings, give two pumps to the fittings)
- Check Panel Wire connections — <u>Monthly</u>
  (Tighten them if necessary)
- Check Entrainment Separator Filter — <u>Tri-Yearly</u>
  (Remove Entrainment Separator lid, clean or replace as needed)
- Clean out Entrainment Separator — <u>Weekly</u>
  (Use clean water to rinse sides and remove hand clean out for debris)
- Clean Level Switches and Site Glass — <u>Weekly</u>
  (Use clean water to rinse out debris)
- Check Water Pump — <u>Monthly</u>
  (Insure proper operation)
- Check Flow Transmitter — <u>Weekly</u>
- Check Thermocouple wiring at Thermocouple — <u>Bi-Yearly</u>
  (Open T/C head and inspect wiring, change if necessary)
- Check Drive Motor linkage on valves — <u>Monthly</u>
- (Check adjustment screws, tighten if necessary)
- Lubricate Butterfly Valves — <u>Weekly</u>
  (Spray WD-40 into valve area under vacuum)
- Check level switches — <u>Monthly</u>
  (Insure proper operation)

Catalytic Operation

When converting unit to catalytic operation do the following prior to use while catalyst installed or damage can occur to the cell:

1. **Cool unit down to safe temperature range to work on unit**
2. **Open side door hatch – catalyst receptacle should be clean and free of debris.**
3. **Install catalyst cell with refractory cement as a caulking seal below lower outer edge of catalyst and shelf ledge.**
4. **Re-seal catalyst cell door with ceramic gasket in place and all fasteners tight.**
5. **Access temperature controller and change controller set point to 650 degrees.**
6. **Change alarm 1 set point in temperature controller to 600 degrees.**
7. **Change dilution controller set point to 1000 degrees**
8. **Change high limit controller set point to 1150 degrees.**

AA...A2
Installation Instructions

DUNGS®

SPECIFICATIONS

AA...A2 SPDT differential pressure switch for pressure and/or vacuum ranges. The differential pressure acts via the diaphragm against the force of the setting spring on the microswitch. The pressure switch operates without any auxiliary power.

Gases
Air and non-aggressive gases only. **Not** suitable for natural gas, propane, butane or other combustable gases.

Switch
SPDT

Switch action
Pressure, vacuum or differential pressure switch.

Contact Rating
5 A resistive, 2.5 A inductive @120 Vac

Electrical Connection
Screw terminals via 1/2" NPT conduit connection

Enclosure
NEMA Type 4

Maximum Operating Pressure
7 PSI (500 mbar)

Ambient / Medium Temperature
-40 °F to +140 °F (-40 °C to +60 °C)

Materials in contact with Gas

Housing:	Polycarbonate
Switch:	Polycarbonate
Diaphragms:	NBR-based rubber
Switching contact:	Silver (Ag)

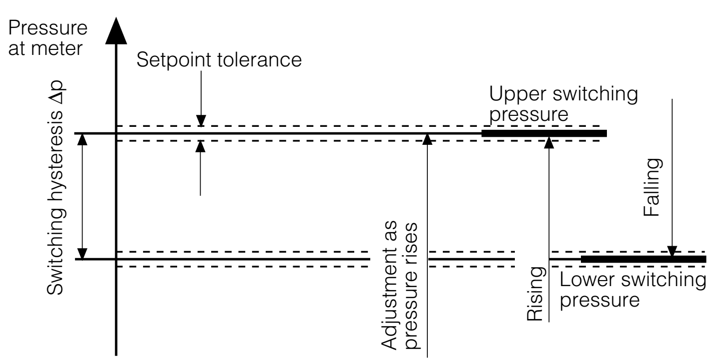
Approvals
UL Listed: File No. MH 16628
CSA Certified: Certification # 201527
FM Approved: Report J.I. 1T7A8.AF

ATTENTION

- Read these instructions carefully.
- Failure to follow them and/or improper installation may cause explosion, property damage and injuries.
- Installation must be done with the supervision of a licensed burner technician.
- The system must meet all applicable national and local code requirements.
- Check the ratings in the specifications and on the switch to make sure that it is suitable for your application.
- Never perform work if gas pressure or power is applied, or in the presence of an open flame.
- Once installed, perform a complete checkout including leak testing.
- Label all wires prior to disconnection when servicing. Wiring errors can cause improper and dangerous operation
- Verify proper operation after servicing.

OPERATION

Definition of switching hysteresis Δp
The pressure difference between the upper and lower switching pressures.



Installation position
Standard installation position is **vertical** upright diaphragm. When installed **horizontally**, the pressure switch switches at a pressure higher by approx. 0.2 in. W.C. When installed **upside down**, the pressure switch switches at a pressure lower by approx. 0.2 in. W.C. When installed in **other positions**, the pressure switch switches at pressure deviating from the set reference value by max. ± 0.2 in. W.C.

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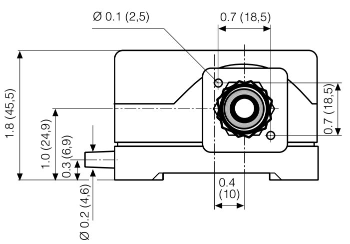
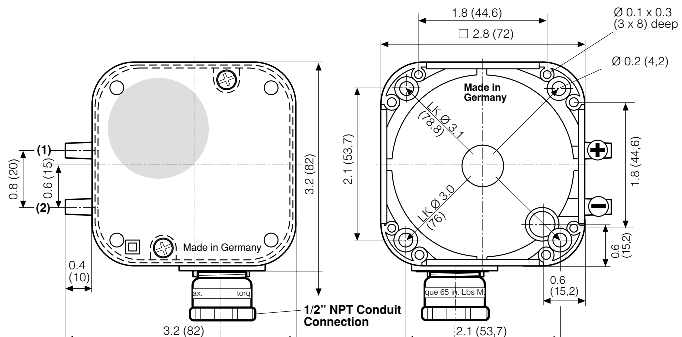
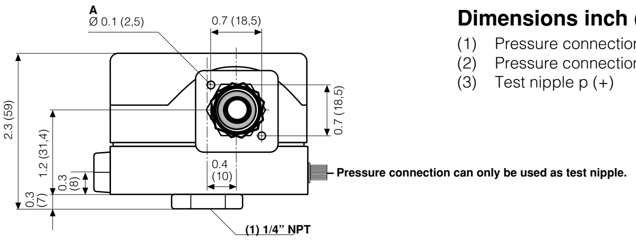
PRESSURE CONNECTIONS

AA...A2-4 Hose Connection

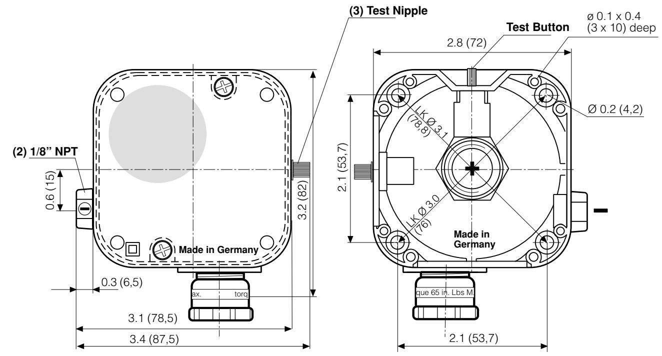




AA...A2-6 Threaded Connection



Dimensions inch (mm)
(1) Pressure connection (+)
(2) Pressure connection (–)
(3) Test nipple p (+)



AA...A2-4 Mounting Procedure

- Use suitable hoses for the medium.
- Use a maximum 5/32” ID. hose
- Secure the hoses with a cable tie or a cable clip.

AA...A2-6 Mounting Procedure

- Apply good quality pipe sealant to the male threads only.
- Use 13/16” Wrench to secure the switch to the pipe.
  DO NOT Exceed 45 lb-in of Torque on 1/8” Connections
  DO NOT Exceed 60 lb-in of Torque on 1/4” Connections
- After installation is complete, perform a leak test.

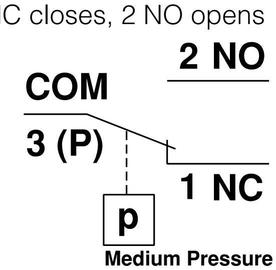
A2 test button

When the test button is pressed the **1/4" NPT** pressure connection is interrupted and the pressure below the diaphragm is relieved. The pressure switch changes the contact position from NO to NC. When the test button is released, the pressure is built up again and the switch changes to its original position.

WIRING

- Remove the clear cover from the switch.
- Use 14 or 16 AWG wire rated for at least 75°C
- Route the wires through the conduit connector
- Connect the wiring to the appropriate screw terminals.
- Replace the clear cover from the switch.

AA...A2 switching function
As pressure rises:
1 NC opens, 2 NO closes
As pressure falls:
1 NC closes, 2 NO opens



⚠ **CAUTION:** All wiring must comply with local electrical codes, ordinances and regulations.

⚠ **CAUTION:** Do not exceed the switch ratings given in the specifications and on the switch.

ADJUSTMENT

Adjusting the Set Point

- Remove the clear cover from the switch.
- Adjust the set point to the desired set point pressure by turning the dial until the desired pressure is opposite the white arrow on the blue dial face.
- After adjusting the set point for normal operation check to see that the gas pressure switch operates as intended.
- Use an accurate pressure gauge connected upstream from the switch to measure the actual pressure.
- Replace the clear cover.

Automatic Reset

The NC contact of the AA...A2 breaks when pressure rises above the set point. It makes automatically when pressure falls below set point.

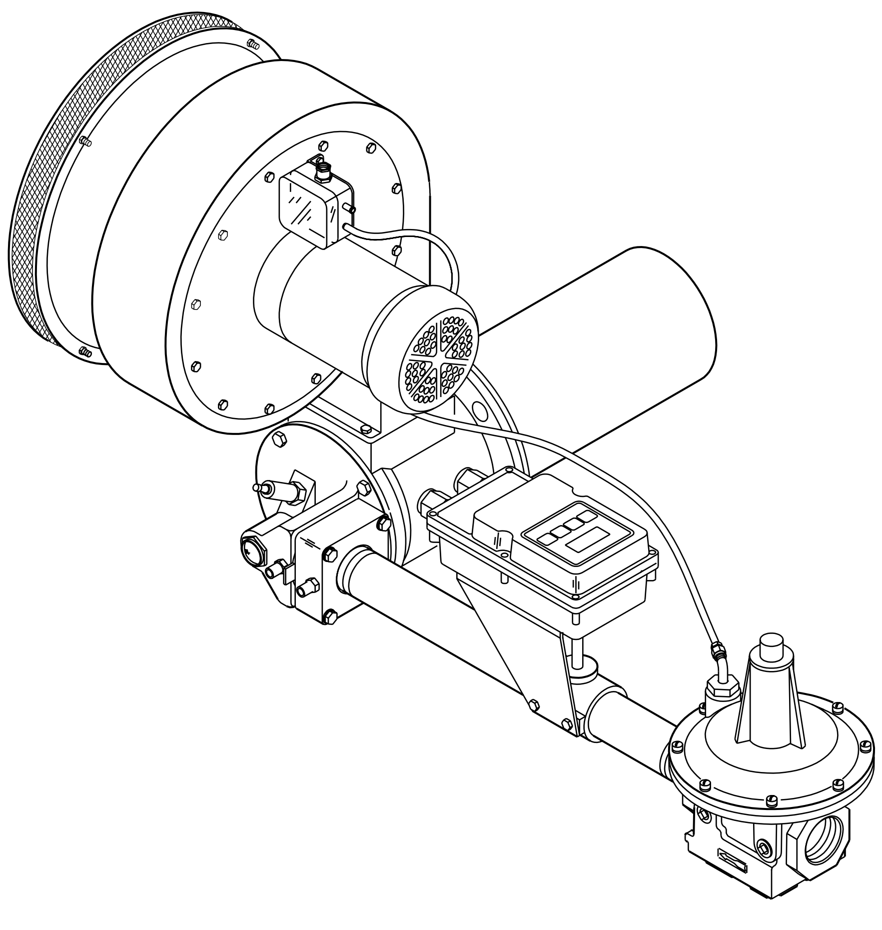
Design Guide 114
10/01

Eclipse Combustion

ThermAir Burners

TA Series

version 1.10



ECLIPSE™

Innovative Thermal Solutions

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DISCLAIMER NOTICE

We reserve the right to change the construction and/or configuration of our products at any time without being obliged to adjust earlier supplies accordingly.

The material in this manual is believed adequate for the intended use of the product. If the product, or its individual modules or procedures, are used for purposes other than those specified herein, confirmation of their validity and suitability must be obtained. Eclipse Combustion, Inc. warrants that the material itself does not infringe any United States patents. No further warranty is expressed or implied.

We have made every effort to make this manual as accurate and complete as possible. Should you find errors or omissions, please bring them to our attention so that we may correct them. In this way we hope to improve our product documentation for the benefit of our customers. Please send your corrections and comments to our Documentation Manager.

LIABILITY AND WARRANTY

It must be understood that Eclipse Combustion's liability for its products, whether due to breach of warranty, negligence, strict liability, or otherwise, is limited to the furnishing of such replacement parts and Eclipse Combustion will not be liable for any other injury, loss, damage or expenses, whether direct or consequential, including but not limited to loss of use, income of or damage to material arising in connection with the sale, installation, use of, inability to use or the repair or replacement of Eclipse Combustion's products.

Any operation expressly prohibited in this Guide, any adjustment, or assembly procedures not recommended or authorized in these instructions shall void the warranty.

About this manual

AUDIENCE

This manual has been written for people who are already familiar with all aspects of a nozzle-mix burner and its add-on components, also referred to as "the burner system."

These aspects are:

- design/selection
- use
- maintenance.

The audience is expected to have had experience with this kind of equipment.

THERMAIR DOCUMENTS

Design Guide No. 114

- This document

ThermAir Data Sheets, Series 114

- Available for individual TA models
- Required to complete design & selection

Installation Guide No. 114

Used with Data Sheet to complete installation

ThermAir Price List No. 114

Used to order burners

RELATED DOCUMENTS

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Info Guides: 710, 732, 742, 760, 818, 832, 852, 854, 856, 610, 620, 630, 826, 820, 930, I-354.

Purpose

The purpose of this manual is to ensure that the design of a safe, effective, and trouble-free combustion system is carried out.

DOCUMENT CONVENTIONS

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows below. Please read it thoroughly.

Danger:

Indicates hazards or unsafe practices which WILL result in severe personal injury or even death.
Only qualified and well trained personnel are allowed to carry out these instructions or procedures.
Act with great care and follow the instructions.

Warning:

Indicates hazards or unsafe pratices which could result in severe personal injury or damage.

Act with great care and follow the instructions.

Caution:

Indicates hazards or unsafe practices which could result in damage to the machine or minor personal injury,Act carefully.

Note:

Indicates an important part of the text. Read thoroughly.

HOW TO GET HELP

If you need help, contact your local Eclipse Combustion representative.You can also contact Eclipse Combustion at any of the addresses listed on the back of this document.

Table of contents

Introduction

1

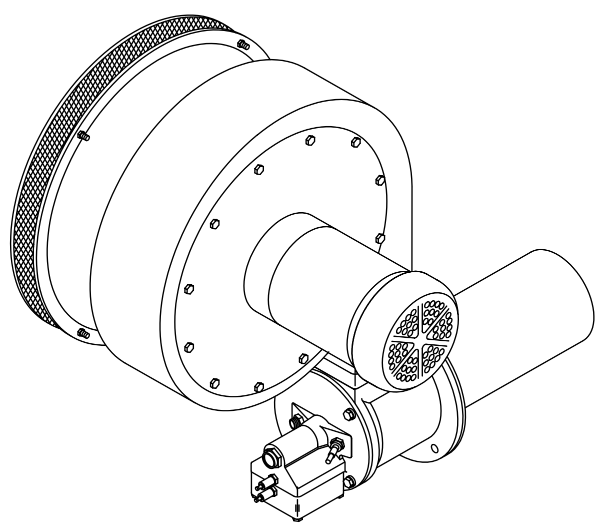
Product Description

The ThermAir burner (TA Series) is a nozzle-mix burner with a packaged combustion air blower that is designed to fire with fixed combustion air over a wide gas turndown range. An integral gas orifice is provided to ease burner setup. The burner is designed to facilitate:

- fixed air operation
- direct spark ignition
- simple gas control
- multiple fuel capability

The burner is suitable for direct and indirect air heating for a wide range of applications on industrial furnaces and ovens.

Figure 1.1 ThermAir Burner



Safety

2

INTRODUCTION

This section is provided as a guide for the safe operation of the ThermAir burner system. All involved personnel should read this section carefully before operating this system.

SAFETY

Danger:

The ThermAir burners, described herein, are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled, or maintained.

Do not bypass any safety feature; fire or explosion could result.

Never try to light a burner if it shows signs of damage or malfunction.

Warning:

The burner might have HOT surfaces. Always wear protective clothing when approaching the burner.

Note:

This manual provides information in the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits described herein without written advice from Eclipse Combustion.

Read the entire manual before attempting to start this system. If you do not understand any part of the information contained in this manual, contact your local Eclipse representative or Eclipse Combustion before continuing.

Capabilities

Only qualified personnel, with good mechanical aptitude and experience on combustion equipment, should adjust, maintain, or troubleshoot any mechanical or electrical part of this system.

Operator Training

The best safety precaution is an alert and trained operator.

Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment and its operation. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency.

Replacement Parts

Order replacement parts from Eclipse Combustion only. All Eclipse Combustion approved, customer supplied valves or switches should carry UL, FM, CSA, CGA, and/or CE approval, where applicable.

System Design

3

DESIGN

Design structure

The design process is divided into the following steps:

1. **Burner Option Selection including:**
   - Burner Model / Size Selection
   - Fuel Type
   - Air Supply
   - Combustor
   - Burner Configuration
   - Control Motor
   - Gas Control Options
   - Flame Supervision
   - Air Flow Switch
2. **Blower Option Selection including:**
   - Power Supply Frequency
   - Pressure & Flow
   - Blower Motor Type
   - Blower Inlet
   - Motor Orientation
3. **Control Methodology including:**
   - Burner Control
   - Trial for Ignition
4. **Ignition System including:**
   - Ignition Transformer
5. **Flame Monitoring Control System including:**
   - Flame Sensor
   - Flame Monitoring Control
6. **Main Gas Shut-Off Valve Train including:**
   - Component Selection
   - Valve Train Size

Step 1: Burner Option Selection

Step 1 describes how to select burner options to suit an application. Use the ThermAir Price List 114 and Data Sheets, Series 114 when following this selection process.

> *Caution:*
> *Consult EFE-825, Eclipse Combustion Engineering Guide, or contact Eclipse Combustion if you have special conditions or questions.*

Burner Model / Size Selection

Consider the following when selecting the burner size:

- **Heat Input.** Calculate the required heat input to achieve the required heat balance.
- **Power Supply Frequency.** Burner capability to fire against elevated chamber pressures will be affected by the power supply frequency (50Hz or 60Hz power).
- **Combustion Chamber Pressure**. Consider the effects that large or varying chamber pressures have on burner performance.
- **Altitude.** The maximum burner capacity is reduced by approximately 3% each 1000 feet (300 meters) above sea level.
- **Combustion Air Supply.** Combustion air should be fresh (20.9% O_2) and clean (without corrosives).
- **Combustion Air Temperature.** Higher air supply temperatures will reduce the burner maximum capacity. Contact Eclipse for maximum capacities at elevated combustion air temperatures. The combustion air supply temperature should not exceed 250° F into the blower.
- **Fuel Type.** Variation in calorific value and density will affect burner performance.

Fuel Type

Fuel	Symbol	Gross Heating Value	Specific Gravity
Natural gas	CH_4 90%+	1000 BTU/ft^3 (40 MJ/m^3)	0.60
Propane	C_3H_8	2570 BTU/ft^3 (103 MJ/m^3)	1.52
Butane	C_4H_{10}	3250 BTU/ft^3 (130 MJ/m^3)	1.95
BTU/ft^3 @ standard conditions (MJ/m^3 @ normal conditions)			

If using an alternative fuel supply, contact Eclipse Combustion with an accurate breakdown of the fuel components.

Air Supply

When a standard ThermAir burner is ordered, a combustion air blower is supplied and mounted directly to the burner body.

Combustor Type

All ThermAir burners come equipped with 310SS combustors for applications up to 1500ºF (815ºC). For higher temperature applications, consult factory.

Control Motor (Applies to Basic and Complete Configurations)

Select a control motor. Standard control motor options include various models which Eclipse will mount to the gas control valve. ThermAirs can be ordered with control motor bracket and mounting hardware only. Customer supplied control motors must conform to the these specifications:

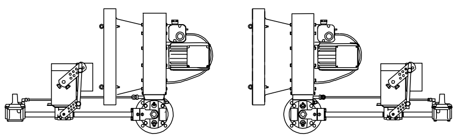
- rotation not to exceed 2 rpm.
- minimum torque of 25 in-lb. (2,8 Nm)
- 90° stroke.
- continuous modulating or high/low modulating control.
- reversible direction of rotation.
- certain applications may require control motors with a limit switch or switches if:
  - the burner capacity is to be limited to fit an application.
  - the chamber is to be fired with positive or negative pressure.
  - the chamber pressure is outside the range -1” w.c. to +1” w.c. (-2,5 to 2,5 mbar)
  - there is a need to indicate a high and/or low fire gas butterfly valve (BV) position.

Burner Configuration

Select configuration.

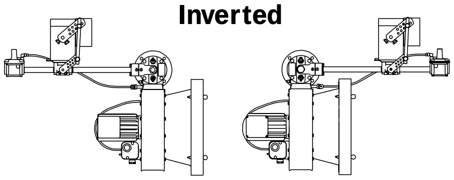
Burner Configurations

Upright



Left Hand Piping   Right Hand Piping

Inverted



Left Hand Piping   Right Hand Piping

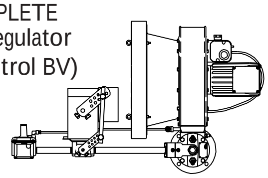
Gas Control Options

Select the gas pipe thread type and the gas control options desired. Gas control options are:

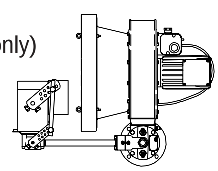
- Stripped, N.P.T. or Rc connections
- Basic, Modulating gas control valve (N.P.T. or Rc)
- Complete, Modulating gas control valve and ratio regulator

Gas Control Options

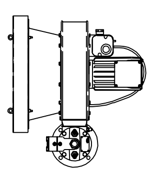
COMPLETE
(ratio regulator
and control BV)



BASIC
(control BV only)



STRIPPED
(Less ratio regulator
and control BV)



Flame Supervision

Select a flame rod or “No Sensor Included” option. If a flame rod is selected, it will be factory mounted in the burner. If “No Sensor Included” option is selected, a U.V. scanner must be ordered separately. Flame rods are available for all ThermAir Burners up to and including the TA100. Larger burners must be monitored with a U.V. scanner.

__Note:__

Access for the installation of certain UV scanners can be limited with specific piping arrangements on certain size burners . Access is restricted by the blower housing scroll and the orientation of the ½” NPT UV scanner port on the burner’s rear cover.

Verify that the UV scanner model you have selected is able to be installed on the burner in your desired burner configuration.

Step 1: Burner Option Selection *(continued)*

Air Flow Switch

The air flow switch provides a signal to the monitoring system when there is not enough air pressure from the blower. If a switch is selected, it will be factory mounted.

Warning:

Eclipse Combustion supports the NFPA regulation requiring, as a minimum standard for main gas shut-off systems, the use of an air pressure switch in conjunction with other system components.

Step 2: Blower Option Selection

Note:
Standard blower options are listed in Price List 114, additional blower options are available through Eclipse Combustion. Price and leadtime may vary.

Power Supply Frequency

Select the 50Hz or 60Hz option. The 50Hz blower motors have IEC frames and are CE marked. The 60Hz motors have NEMA frames.

Pressure & Flow

ThermAirs include a combustion air blower.

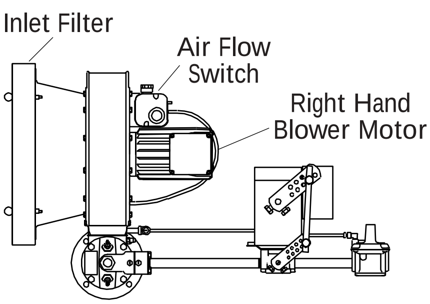
Blower Motor Type

Motor types include various options: voltages, single or three phase, TEFC or automotive duty enclosures.

Blower Inlet

When selecting an inlet, consider the following:

- amount and size of particles in the air.
- sound requirements.
- space limitations.
- cleanliness requirements of the process.



Motor Orientation

All ThermAirs are assembled with either a right-hand or left-hand blower motor orientation.

Step 3: Control Methodology

Gas Turndown

The entire ThermAir burner family is capable of gas turndown of greater than 30:1 based upon starting at high fire. A typical single burner installation would be controlled by a modulating gas valve. Leakage flow through this valve in the closed position could exceed the desired low fire input. If this is the case, consider an alternate control method to obtain your desired low fire.

Control Methods

There are numerous gas control options possible to provide a reliable gas control/ignition system. The method of control you select and the type of “Gas Control Options” you select will have a large impact on burner performance and ignition reliability. These options and their variations are outlined in the following schematics.

With Ratio-Regulator

A ThermAir burner equipped with a packaged blower and a ratio-regulator is ignited via direct spark at low fire.

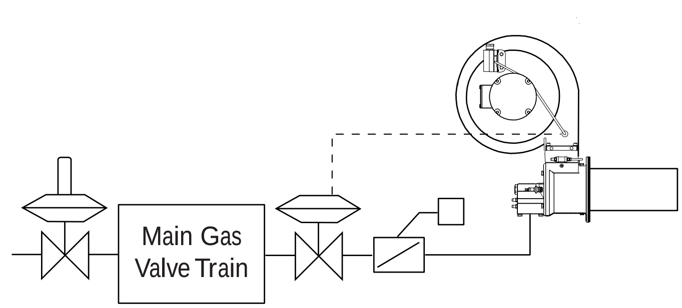
1. Air

Air flow to the burner is fixed.

2. Gas

High fire gas flow is limited by a metering gas orifice, sized for a given loading line pressure to the ratio-regulator, installed in the burner at the gas inlet. Gas flow to the burner is controlled by the modulating gas valve in the gas line. Although the Ratio-Regulator does not control gas flow, it will provide for ease of burner set-up and additional safety if there is reduced combustion air pressure and/or flow.

Figure 3.1 Packaged blower with ratio-regulator



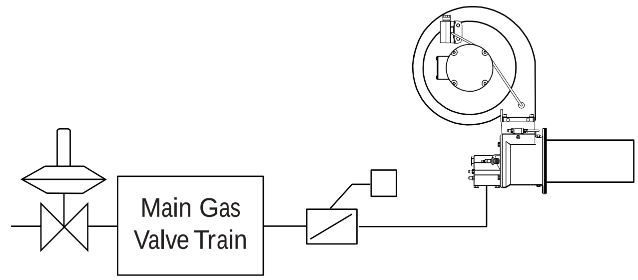
Without Ratio-Regulator

Refer to "Packaged Blower Burner Adjustment" in ThermAir Installation Guide for Start and Stop Adjustment instructions.

1. **Air**
   Air flow to the burner is fixed.

2. **Gas**
   High fire gas flow of a ThermAir burner not equipped with a ratio-regulator is controlled by the outlet pressure of the main gas pressure regulator. The main gas pressure regulator must be adjusted to change high fire gas flow (ref: Figure 3.2).

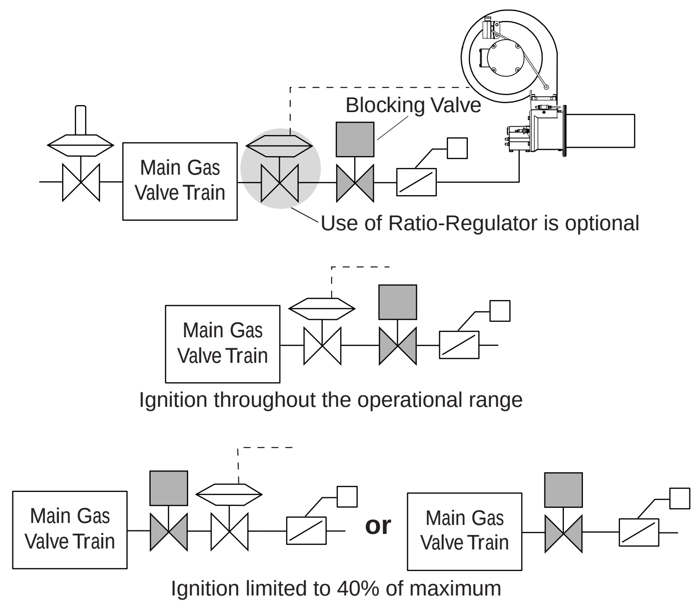
Figure 3.2 Packaged blower without ratio-regulator



The Use of Blocking Valves

Note:

The position of the gas blocking valve(s) relative to the ratio-regulator will have an impact on burner performance.



Trial for Ignition

It is recommended that low fire start be used. Local safety and insurance codes require limits on the maximum trial for ignition period. These limits vary from one location to the next. Ensure that you are in compliance with the strictest requirement applicable to your installation.

The time it takes for a burner to ignite depends upon:

- the distance from the gas shut-off valve to the burner
- the gas flow at start conditions

It is possible to have low fire too low to ignite the burner within the trial for ignition period. Under these circumstances you must consider one of the following options:

- start at a higher input level
- resize and/or relocate the gas controls
- use bypass start gas

Bypass Start Gas (Optional)

A bypass start gas circuit provides gas flow around gas control valves during the trial for ignition period. Bypass start gas may be required if the automatic gas control valves are not located close to the burner.

The solenoid valve in the bypass line plus the automatic gas shut-off valves are opened during the trial for ignition period. If a flame is established, the bypass solenoid closes at the end of the trial for ignition period while the automatic gas control valves remain open. If a flame is not established, then both the bypass solenoid and the automatic shut-off valves close.

Bypass start gas circuit schematics

Key points to consider when providing bypass start gas for ignition.

1. Locate the bypass solenoid valve as close to the burner as possible.

2. Provide some means for flow adjustment.

3. To provide the bypass start gas circuit with a constant gas pressure:

  A. Connect to the main gas line downstream of the main gas pressure regulator (see Figure 3.3).

  B. Provide a bypass gas pressure regulator (see Figure 3.4)

4. The downstream gas connection can be either through the peepsight location in the rearcover or into the main gas line to the burner.

Figure 3.3 Bypass gas pressure regulated via main gas pressure regulator.

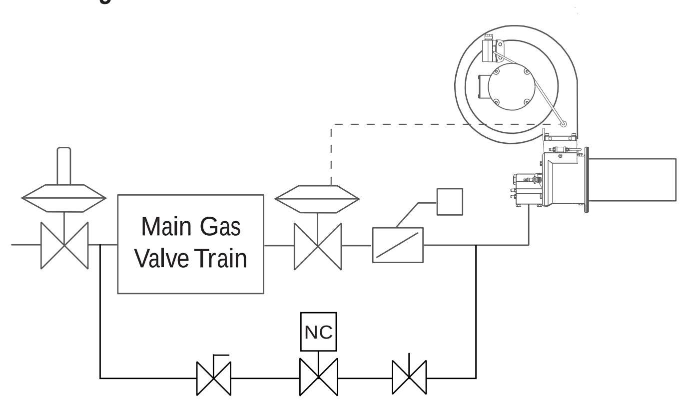
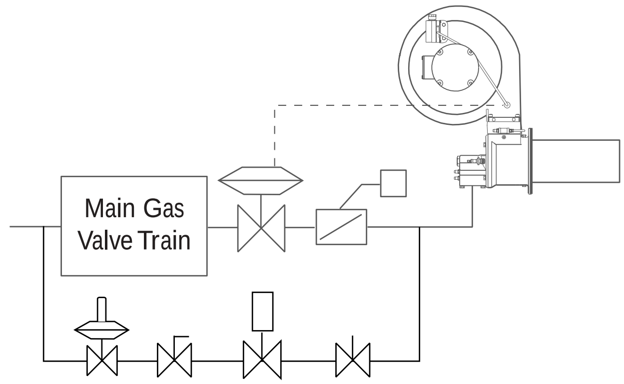


Figure 3.4

Bypass gas pressure regulated via independent pressure regulator.



Step 4: Ignition System

Ignition Transformer

For the ignition system, use a transformer with:

- secondary voltage 6,000 to 8,000 VAC.
- minimum secondary current 0.02 amps continuous.
- full wave output.

DO NOT USE the following:

- twin outlet transformer
- distributor type transformer
- half wave transformer
- high voltage >8,000VAC
- low voltage <6,000VAC

Step 5: Flame Monitoring Control System

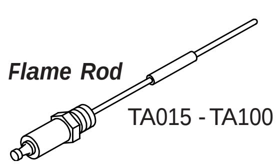
The flame monitoring control system consists of two main components:

- Flame Sensor
- Flame Monitoring Control

Flame Sensor

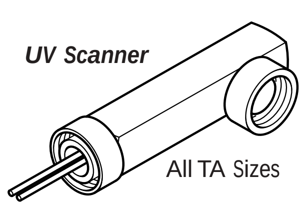
Two types can be used on ThermAir Burners:

- flame rod
- U.V. scanner



Flame rods are available for ThermAir Burner sizes TA015 through TA100. Further information can be found in:

- Info Guide 832



U.V. scanners can be used on all ThermAir Burner sizes. Further information can be found in:

- Info Guide 852; 90° U.V. scanner
- Info Guide 854; straight U.V. scanner
- Info Guide 856; self-check U.V. scanner

Flame Monitoring Control

The Flame Monitoring Control processes the signal from the flame rod, or U.V. scanner, and controls the start-up sequence and the main gas shut-off valve sequence.

Eclipse Combustion recommends the use of flame monitoring control systems which maintain a spark for the entire trial for ignition period when using U.V. scanners. Some of these flame monitoring models are:

- Veri-Flame; see Bulletin / Info Guide 610, 620, 630
- Bi-Flame series; see Instruction Manual 826
- Multi-Flame series 6000; see Instruction Manual 820

DO NOT USE:

- PCI Automatic flame monitoring
- Honeywell RM7890 series flame monitoring
- Flame monitoring relays which interrupt the trial for ignition when the flame is detected.

Step 6: Main Gas Shut-Off Valve Train

Component Selection

Eclipse Combustion can help in the design of a main gas shut-off valve train that satisfies the customer and complies with all local safety standards and codes set by the authorities within that jurisdiction. Contact Eclipse Combustion for further information.

Note:
Eclipse Combustion supports NFPA regulations (two gas shut-off valves as a minimum standard for main gas shut-off systems).

Valve Train Size

Fuel pressure supplied to the ratio regulator inlet (when used)must be at least 15”w.c. (37.5mbar). It should not exceed the maximum pressure rating of the ratio-regulator. The valve train should be sized sufficiently to provide the specified pressure.

Warning:
Do not operate ThermAirs with gas inlet pressure less than the loading line pressure. Lower gas inlet pressures may cause the ratio regulator to remain fully open with reduced air flow. This could result in the possible accumulation of unburned fuel in the burner which, in extreme situations, could cause a fire or an explosion.

Appendix

Conversion Factors

Metric to English.

From	To	Multiply By
cubic meter (m^3)	cubic foot (ft^3)	35.31
cubic meter/hour (m^3/h)	cubic foot/hour (cfh)	35.31
degrees Celsius (ºC)	degrees Fahrenheit (ºF)	(ºC x 1.8) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	BTU/hr	3414
meter (m)	foot (ft)	3.28
millibar (mbar)	inches water column (“w.c.)	0.401
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}
MJ/m^3 (normal)	BTU/ft^3 (standard)	2.491×10^{-2}

Metric to Metric.

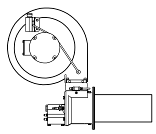
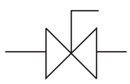
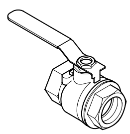
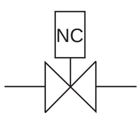
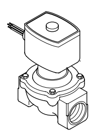
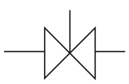
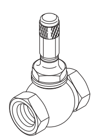
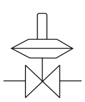
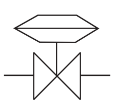
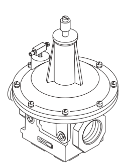
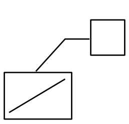
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric.

From	To	Multiply By
BTU/hr	kilowatt (kW)	0.293×10^{-3}
cubic foot (ft^3)	cubic meter (m^3)	2.832×10^{-2}
degrees Fahrenheit (ºF)	degrees Celsius (ºC)	(ºF – 32) ÷ 1.8
foot (ft)	meter (m)	0.3048
inches (in)	millimeter (mm)	25.4
inches water column (“wc)	millibar (mbar)	2.49
pound (lb)	kilogram (kg)	0.454
pounds/sq in (psi)	millibar (mbar)	68.95
BTU/ft^3 (standard)	MJ/m^3 (normal)	40.14

Key to System Schematics

These are the symbols used in the schematics.

Symbol	Appearance	Name	Remarks	Bulletin/ Info Guide
		ThermAir		
Main gas shut-off valve train		Main Gas Shutoff Valve Train	Eclipse Combustion, Inc. strongly endorses NFPA as a minimum	756
		Gas Cock	Gas cocks are used to manually shut off the gas supply on both sides of the main gas shut-off valve train.	710
		Solenoid Valve (normally closed)	Solenoid valves are used to automatically shut off the gas supply on a bypass gas system or on small capacity burners.	760
		Adjustable Limiting Orifice	Adjustable limiting orifices are used for fine adjustment of gas flow.	730
		Pressure Regulator	A pressure regulator reduces gas pressure to a stable, usable pressure.	684
		Ratio Regulator	The ratio regulator adjusts the gas flow in ratio with the air flow. It contro;s the outlet pressure equal to the impulse line pressure. The impulse line is connected between the top of the ratio regulator and the blower housing.	742
		Automatic Gas Control Valve	An automatic gas control valve adjusts gas flow to the burner based on control system requirements.	720
--------		Impulse Line		

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Eclipse Combustion

Data 114-3
12/02

ThermAir Burners

Model TA040

Version 1.10

Main Specification – TA040

PARAMETER		BLOWER SIZE							
		3"w.c. Packaged				**6"w.c. Packaged**			
Maximum input (Btu/hr)	**Frequency**	**Capacity at Chamber Pressure**				**Capacity at Chamber Pressure**			
		BTU/hr	"w.c.	kW	mbar	BTU/hr	"w.c.	kW	mbar
	60 Hz Packaged Blower	403,000	-1.0	118	-2,5	467,000	-1.0	137	-2,5
		375,000	0.0	110	0,0	400,000	0.0	117	0,0
		345,000	1.0	101	2,5	370,000	1.0	108	2,5
	50 Hz Packaged Blower	**Not Available**				434,000	-1.0	127	-2,5
						406,000	0.0	119	0,0
						376,000	1.0	110	2,5
Minimum input		**BTU/hr**	**kW**			**BTU/hr**	**kW**		
Natural gas, Propane/Butane		8,000	2,3			13,000	3,8		
Main Gas Inlet Pressure		**" w.c.**	**mbar**			**" w.c.**	**mbar**		
• *Fuel pressure at gas inlet (Tap "B")*	Natural gas	4.1	14,7			5.8	16		
	Propane	7.7	19,2			6.7	17		
	Butane	6.5	16,2			6.7	17		
High Fire Flame Length		**inches**	**mm**			**inches**	**mm**		
• *Measured from the outlet end of combustor*	Natural gas	35	889			31	787		
	Propane	39	991			31	787		
	Butane	39	991			28	711		
Maximum Chamber Temperature		**ºF**	**ºC**						
	Alloy Tube	1500	820						
	SIC Tube	1900	1038						
Flame Detection		Flame rod or UV scanner							
Fuel		Natural gas, Propane, or Butane. *For any other mixed gas, contact Eclipse Combustion for orifice sizing*							

- All information is based on laboratory testing in neutral (0.0”w.c.) chamber with standard combustor design. Different chamber conditions and/or combustor design will affect the data.
- Maximum inputs are given for the standard combustion air blower without an air filter.
- All inputs based upon gross calorific values and standard conditions: 1 atmosphere, 70º F (21ºC).
- Blower motor service factors greater than 1.0 may be required when firing into negative chamber pressure applications. For specific application questions, contact your Eclipse Combustion representative.
- Eclipse reserves the right to change the construction and/or configuration of our products at any time without being obliged to adjust earlier supplies accordingly.

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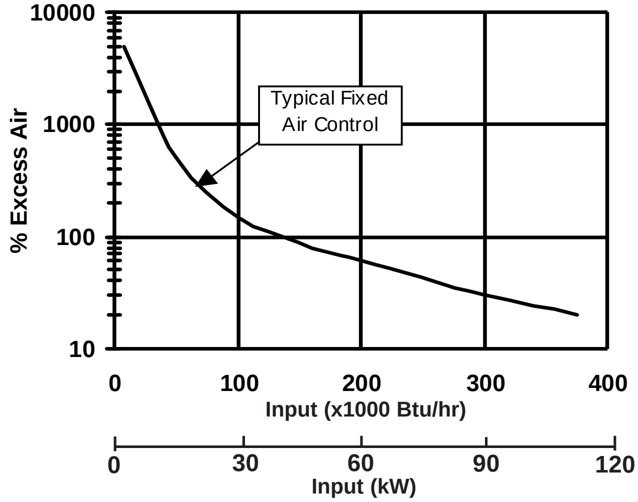
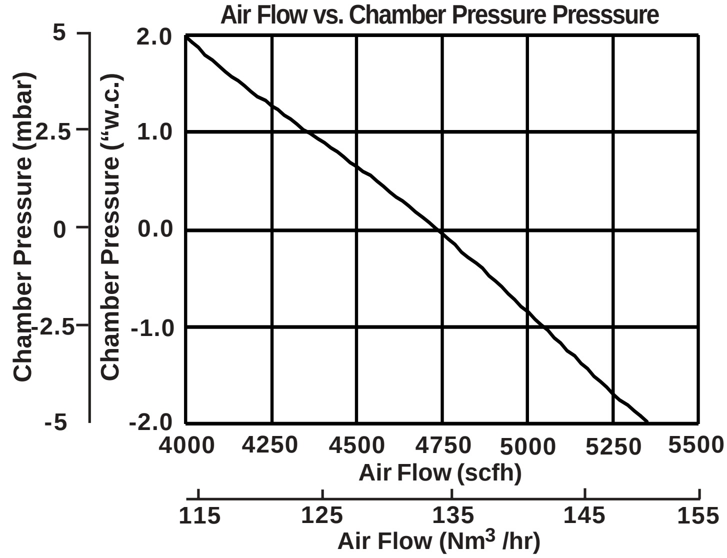
Performance Graphs
ThermAir TA040

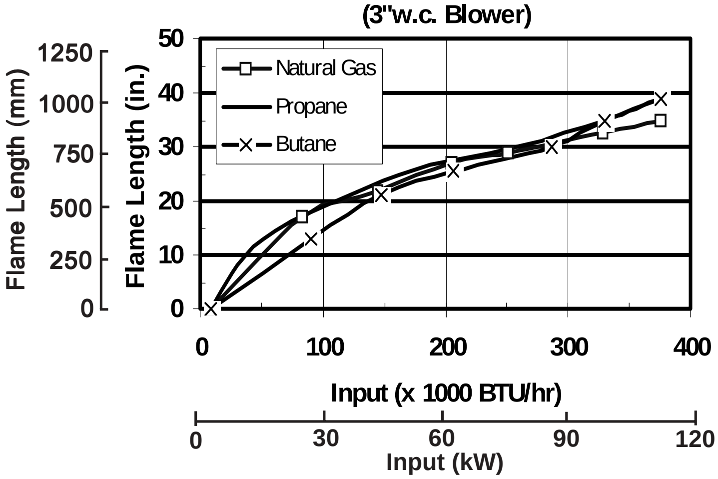
Control & Operation Zone



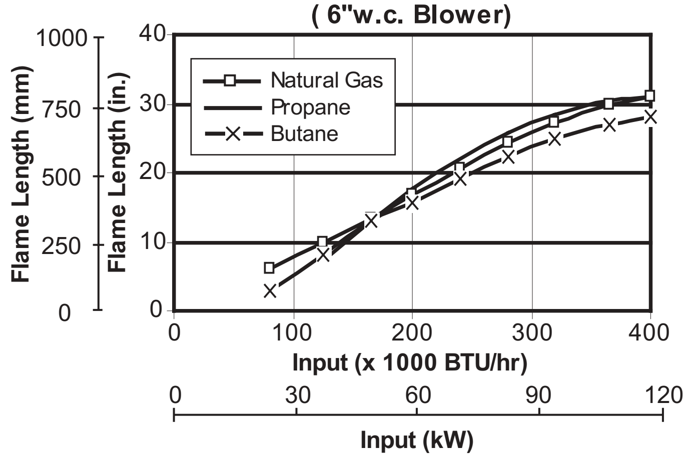
Air Flow vs. Chamber Pressure Presssure



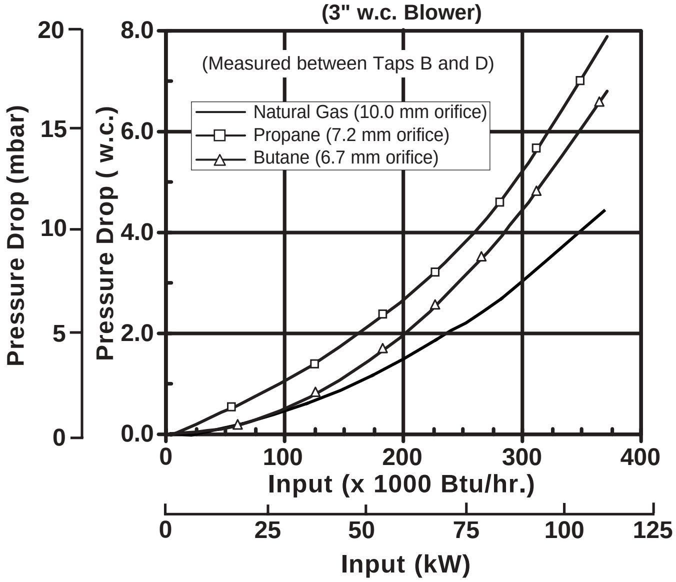
Burner Flame Length (3"w.c. Blower)



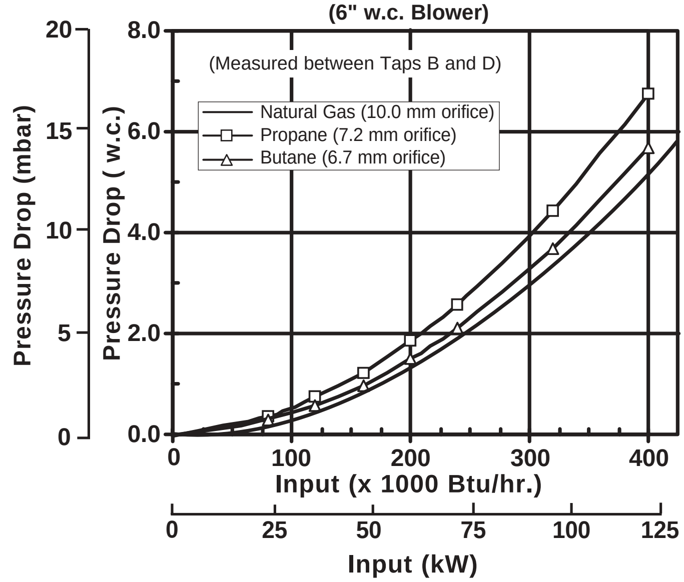
Burner Flame Length (6"w.c. Blower)



Fuel Orifice ∆P vs. Input (3" w.c. Blower)

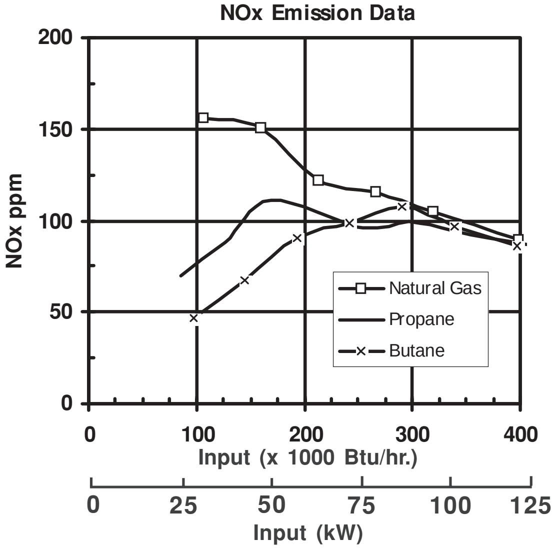


Fuel Orifice ∆P vs. Input (6" w.c. Blower)



Performance Graphs (Continued)

ThermAir TA040



Notes on emission data

NOx emission data is given for:

- Ambient combustion air ~70° F (20° C)
- Minimal process air velocity
- ppm volume dry at 3% O_2
- Neutral chamber pressure

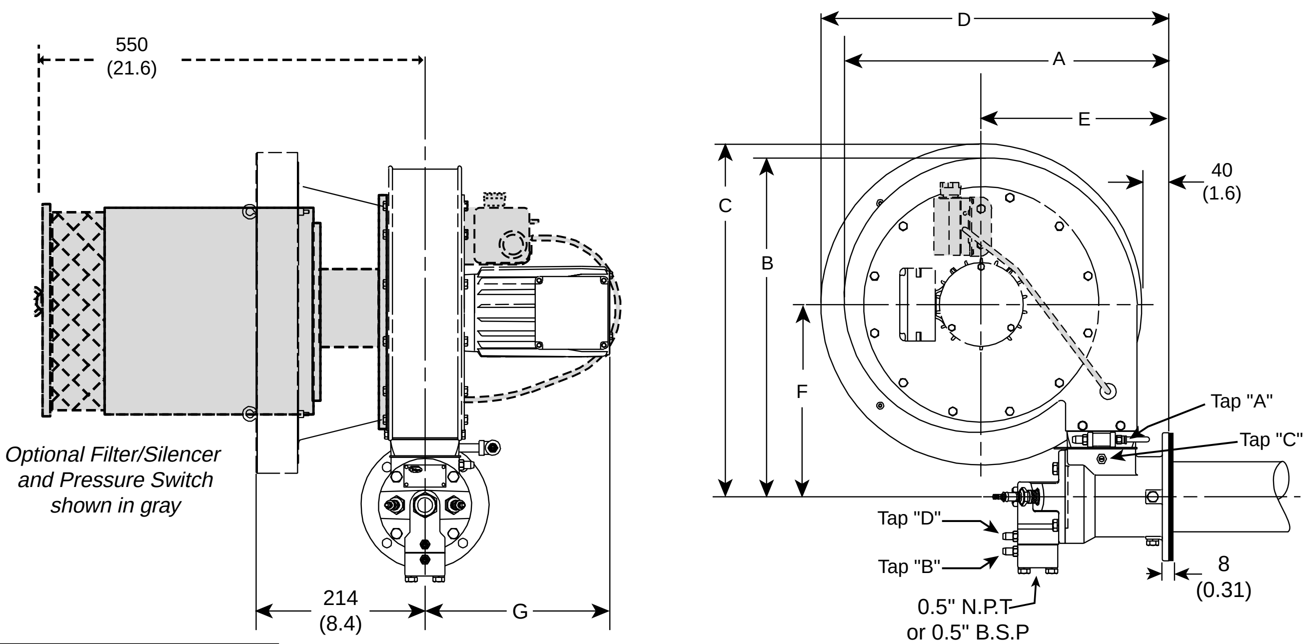
Emissions are influenced by:

- Chamber conditions
- Fuel type
- Firing rate
- Combustion air temperature

CO emission is largely influenced by chamber conditions. Contact your local Eclipse Combustion representative for an estimate of CO emission on your application.

Dimensions-TA040

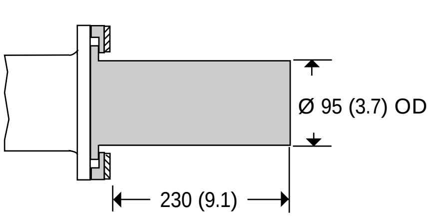
mm (in)



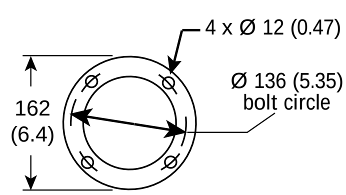
Port Connection	
Sparkplug	14mm
Flamerod or scanner	0.5" N.P.T.
Peepsight	0.75" N.P.T.

Weights	lb	kg
Burner, w/ blower	65	29
Burner, less blower	24	11
Filter/Silencer	21	10

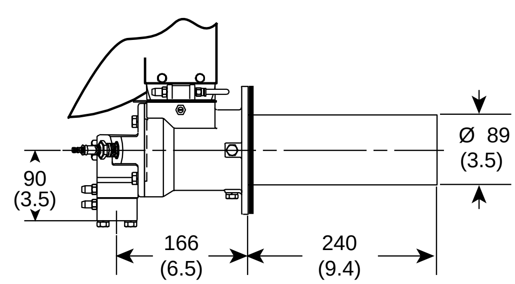
Blower 6" w.c.														
	A		B		C		D		E		F		G	
Hz	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
50	469	18.5	498	19.6	N/A	N/A	N/A	N/A	265	10.4	283	11.1	285	11.2
60	411	16.2	429	16.9	447	16.9	440	17.3	237	9.3	243	9.6	234	9.2
Blower 3" w.c.														
60	329	12.9	360	14.2	N/A	N/A	N/A	N/A	198	7.8	209	8.2	179	7.0



SiC Tube

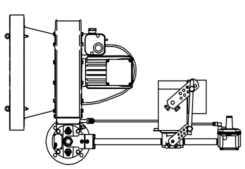
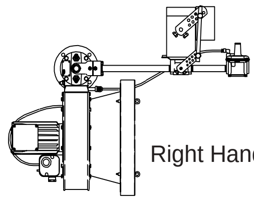
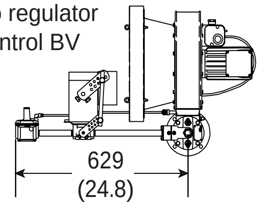
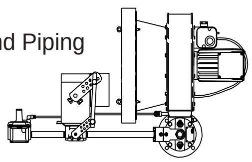
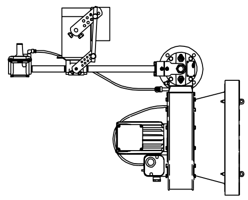
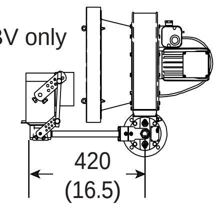
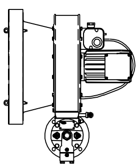
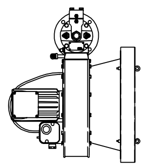
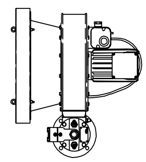


Mounting Pattern



310 Stainless Steel Alloy Tube

Piping

Orientation				Piping Options	
Upright		Inverted			
Right Hand Piping			Right Hand Piping	With ratio regulator and control BV	
LeftHand Piping			Left Hand Piping	With control BV only	
No Piping			No Piping	Less ratio regulator and control BV	

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Eclipse Combustion

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Honeywell

ST 3000 Smart Transmitter

Release 300 and SFC Smart Field Communicator Model STS103

Installation Guide

34-ST-33-39C
7/00

TotalPlant

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About This Publication

This manual is intended as a handy guide for installing ST 3000® Release 300 Smart Transmitters. It provides data for checking out, mounting and wiring the transmitter as well as detailed wiring diagrams for reference. Much of this same information is also included in the *ST 3000 Smart Transmitter Release 300 and SFC® Smart Field Communicator Model STS 103 User's Manual 34-ST-25-14* which is the main reference document. We supply this information with each transmitter as an aid in completing installation tasks as quickly as possible.

Procedures in this manual that involve using a **Smart Field Communicator** (**SFC**) to "talk" to the transmitter are based on using our latest SFC Model STS103. You can also use the **Smartline Configuration Toolkit** (**SCT 3000**) software program to perform transmitter configuration and start up. The SCT 3000 contains an on-line user manual and help information that provides details for setting up the transmitter.

If you will be digitally integrating the ST 3000 transmitter with our **TotalPlant®** Solution (TPS) system, you will need to supplement this information with data in the *PM/APM Smartline® Transmitter Integration Manual* which is supplied with the TDC 3000®X bookset. TPS is the evolution of TDC 3000X.

This guide does **not** apply to **Series 100e, non Release 300 Series 100/900** and **Series 600** transmitter models. If you have one of these ST 3000 Smart Transmitter Series, refer to the *Installation Guide* and *User's Manual* supplied with the transmitter for information.

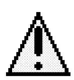
Patent Notice

This product is covered by one or more of the following U.S. Patents: 4,520,488; 4,567,466; 4,494,183; 4,502,335; 4,592,002; 4,553,104; 4,541,282; 4,806,905; 4,797,669; 4,735,090; 4,768,382; 4,787,250; 4,888,992; 5,811,690; 5,875,150; 5,765,436; 4,734,873; 6,041,659 and other patents pending.

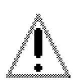
References

Publication Title	Publication Number	Binder Title	Binder Number
ST 3000 Smart Transmitter Release 300 and SFC Smart Field Communicator Model STS 103 User's Manual	34-ST-25-14		
ST 3000 Smart Transmitter Series 100 and Series 900 , Release 300 Quick Reference Guide	34-ST-09-06		
SCT 3000 Smartline Configuration Toolkit Start-Up and Installation Manual	34-ST-10-08		
Smart Field Communicator Model STS103 Operating Guide	34-ST-11-14		
For R400 and later:			
PM/APM Smartline Transmitter Integration Manual	PM12-410	Implementation/ PM/APM Optional Devices	TDC 2045

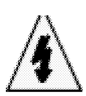
Symbol Definitions



This CAUTION symbol on the equipment refers the user to the Product Manual for additional information. This symbol appears next to required information in the manual.

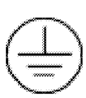


This WARNING symbol on the equipment refers the user to the Product Manual for additional information. This symbol appears next to required information in the manual.



WARNING: risk of electrical shock. This symbol warns the user of a potential shock hazard where HAZARDOUS LIVE voltages greater than 30 Vrms, 42.4 Vpeak, or 60 VDC may be accessible.

ATTENTION, Electrostatic Discharge (ESD) hazards. Observe precautions for handling electrostatic sensitive devices



Protective Earth (PE) terminal. Provided for connection of the protective earth (green or green/yellow) supply system conductor.

Table of Contents

Figures and Tables

Acronyms

AP .... Absolute Pressure
APM .... Advanced Process Manager
AWG .... American Wire Gauge
DE .... Digital Enhanced Communications Mode
DP .... Differential Pressure
EMI .... Electromagnetic Interference
GP .... Gauge Pressure
HP .... High Pressure
HP .... High Pressure Side (DP Transmitter)
inH_2O .... Inches of Water
KCM .... Kilo Circular Mils
LGP .... In-Line Gauge Pressure
LP .... Low Pressure
LP .... Low Pressure Side (DP Transmitter)
LRV .... Lower Range Value
mA .... Milliamperes
mmHg .... Millimeters of Mercury
NPT .... National Pipe Thread
PCB .... Printed Circuit Board
PM .... Process Manger
PROM .... Programmable Read Only Memory
PSI .... Pounds per Square Inch
PSIA .... Pounds per Square Inch Absolute
RFI .... Radio Frequency Interference
SCT .... Smartline Configuration Toolkit
SFC .... Smart Field Communicator
URL .... Upper Range Limit
URV .... Upper Range Value
Vdc .... Volts Direct Current
XMTR .... Transmitter

Technical Assistance

If you encounter a problem with your ST 3000 Smart Transmitter, check to see how your transmitter is currently configured to verify that all selections are consistent with your application.

If the problem persists, you can reach Honeywell's Solution Support Center for technical support by telephone during normal business hours. An engineer will discuss your problem with you. Please have your complete model number, serial number, and software revision number on hand for reference. You can find the model and serial numbers on the transmitter nameplates. You can also view the software version number using the SFC or SCT 3000 software application.

By Telephone

Honeywell Solution Support Center Phone:
1-800-423-9883 (U.S. only)
Outside the U.S. call: **1-602-313-6510**

Additional Help

You may also seek additional help by contacting the Honeywell distributor who supplied your ST 3000 transmitter.

By E-mail

You can also e-mail your technical questions or comments about this product to:
Honeywell Solution Support Center e-mail: **ace@honeywell.com**

Problem Resolution

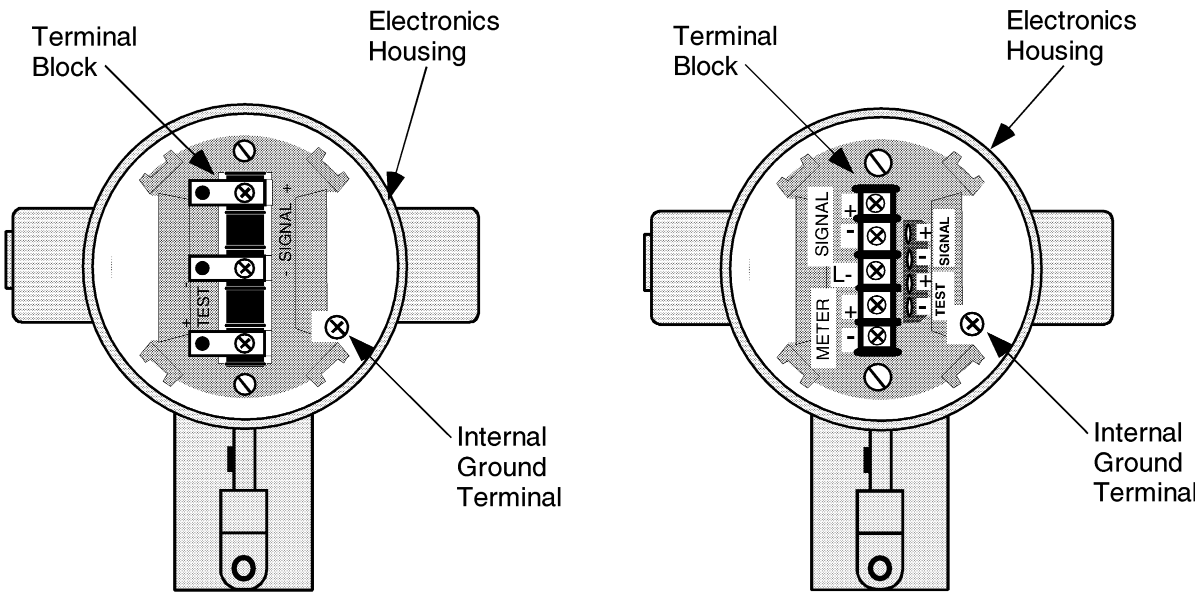
If it is determined that a hardware problem exists, a replacement transmitter or part will be shipped with instructions for returning the defective unit. Please do not return your transmitter without authorization from Honeywell's Solution Support Center or until the replacement has been received.

— IMPORTANT —

Before You Begin, Please Note

Transmitter Terminal Blocks

Depending on your transmitter options, the transmitter may be equipped with either a 3-screw or 5-screw terminal block inside the electronics housing. This may affect how to connect the loop wiring and meter wiring to the transmitter. See Section 4.3 for the terminal block connections for each type terminal. Section 5 provides additional wiring diagrams showing alternate wiring methods.



3-Screw Terminal Block

5-Screw Terminal Block

Section 1 —Getting Started

1.1 CE Conformity (Europe) Notice

About conformity and special conditions

This product is in conformity with the protection requirements of **89/336/EEC**, the EMC Directive. Conformity of this product with any other "CE Mark" Directive(s) shall not be assumed.

Deviation from the installation conditions specified in this manual, and the following special conditions, may invalidate this product's conformity with the EMC Directive.

- You must use shielded, twisted-pair cable such as Belden 9318 for all signal/power wiring.
- You must connect the shield to ground at the power supply side of the wiring only and leave it insulated at the transmitter side.

ATTENTION

ATTENTION

The emission limits of EN 50081-2 are designed to provide reasonable protection against harmful interference when this equipment is operated in an industrial environment. Operation of this equipment in a residential area may cause harmful interference. This equipment generates, uses, and can radiate radio frequency energy and may cause interference to radio and television reception when the equipment is used closer than 30 meters (98 feet) to the antenna(e). In special cases, when highly susceptible apparatus is used in close proximity, the user may have to employ additional mitigating measures to further reduce the electromagnetic emissions of this equipment.

1.2 Preliminary Checks

Checking ST 3000 shipment

Along with this Installation Guide you should have received

- the ST 3000 Smart Transmitter you ordered, and
- an optional mounting bracket assembly, if applicable.

Before you dispose of the shipping container, be sure you have removed all the contents and visually inspected the transmitter for signs of shipping damage. Report any such damage to the carrier.

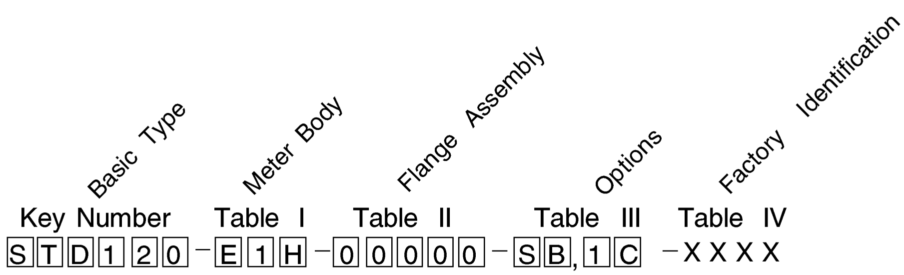
Contact us if there is a problem with the order or an item is missing.

Series and model number data

Honeywell's line of ST 3000 Smart Transmitters includes these two major series designations:

- Series 100
- Series 900

Each series includes several models to meet various process pressure measurement and interface requirements. Each transmitter comes with a nameplate located on the top of the electronics housing that lists its given "model number". The model number format consists of a Key Number with several Table selections as shown below.



You can quickly identify what series and basic type of transmitter you have from the third and fourth digits in the key number. The letter in the third digit represents one of these basic transmitter types:

A = Absolute Pressure

D = Differential Pressure

F = Flange Mounted

G = Gauge Pressure

R = Remote Seals

The number in the fourth digit matches the first digit in the transmitter Series. Thus, a "1" means the transmitter is a Series 100 and a "9" is a Series 900.

Continued on next page

Series and model number data, continued

For a complete breakdown of the table selections in your model number, please refer to the appropriate Specification and Model Selection Guide that is provided as a separate document.

ATTENTION

Previous models of the ST 3000 transmitter with designations of Series 100, Series 100e, Series 600, and Series 900 have been supplied at various times since the ST 3000 was introduced in 1983. While all these transmitters are functionally alike, there are differences in housing and electronics design. This Installation Guide only applies for **Release 300, Series 100 transmitters** with software version 3.0 or greater and **Release 300, Series 900 transmitters** with software version b.0 or greater.

Release 300 transmitters can be identified by the "**R300**" designation on the nameplate.

Earlier Release ST3000 Transmitters

If you have a Series 100e or a Series 900 non-release 300 transmitter, you must refer to the *ST 3000 Smart Transmitter Installation Guide 34-ST-33-31* instead.

Communicating with the ST3000 Transmitter

Communication with your ST 3000 Smart Transmitter can be accomplished by using any of the following interfaces:

- Honeywell's hand-held Smart Field Communicator (SFC).
- Smartline Configuration Toolkit (SCT 3000) that runs on a variety of Personal Computer (PC) platforms.
- Global Universal Station (GUS), if the transmitter is digital integrated with Honeywell's TPS system.

Continued on next page

Communicating with the ST3000 Transmitter, continued

Using the SFC:

If you ordered an SFC along with your transmitter, locate it and follow the instructions supplied with the SFC Model STS103 to prepare it for operation. Otherwise, be sure you have a fully charged SFC Model STS103 on hand to check the operation of your transmitter.

NOTE: SFC model STS103 with software version 5.0 or greater is fully compatible with all Series 100 and 900, Release 300, ST 3000 transmitters and smart meters. The SFC will operate with transmitters that have older software versions, but functions will be limited to those applicable for the transmitter software.

If your SFC is a Model STS102 instead, you must refer to the *ST 3000 Smart Field Communicator for Series 3000 Transmitters Operating Guide 34-ST-11-10* for keystroke details.

Using the SCT:

The SCT 3000 Smartline Configuration Toolkit runs on a variety of PC platforms using MS-DOS 5.0 or higher and Windows 95©, Windows 98 and Windows NT 4.0. It is a bundled Microsoft Windows software and PC-interface hardware solution that allows quick, error-free configuration of Honeywell Smartline field instruments.

NOTE: SCT 3000 software Release 3.12.2 or greater is compatible with all Series 100 and 900, Release 300, ST 3000 transmitters. Please contact your Honeywell representative for more information.

Using reference data

The *ST 3000 Smart Transmitter Release 300 and SFC Smart Field Communicator Model STS 103 User's Manual, 34-ST -25-14* was shipped separately to a person designated on the order. The User's Manual contains complete configuration, operation, calibration, service, and replacement parts information for the transmitter, so you may want to have it on hand for reference. It also includes the same installation data contained in this installation guide to minimize cross reference. But, the optional bench check function and reference dimension drawings list are included in this guide only.

Appendix A —Smart Meter Reference contains configuration and operating information for using the the ST 3000 when it is equipped with the smart meter option (option SM).

Section 2 —Optional Bench Check

2.1 Connecting Power and SCT/SFC

About the bench check

The bench check is an optional procedure for checking your transmitter before you install it by:

- Connecting a power source and an SFC (or a PC running SCT 3000 software) to the transmitter
- Running a communication test with an SFC (or SCT 3000)
- Checking the operation status and checking the configuration database

Also, if your transmitter was not configured at the factory, you can do so during this procedure. See the Configuration section in the *ST 3000 Smart Transmitter, Release 300 and SFC Smart Field Communicator Model STS 103 User's Manual 34-ST-25-14* for details.

When using the SCT 3000, configuration instructions and device templates are provided on-line to aid in configuring your transmitter.

Factory Calibration

Each ST 3000 Transmitter is factory calibrated before shipment.

- First a full range calibration is performed.
- Next, a turndown calibration is done which is typically between 25% to 50% of its full range.
- Then it is calibrated to a range specified by your purchase order. This means there is no need to calibrate the transmitter during installation. (If no range is specified, the transmitter is calibrated to the turndown factory default.)
- If you need any calibration information, see the appropriate section in the *ST 3000 Smart Transmitter, Release 300 and SFC Smart Field Communicator Model STS 103 User's Manual*.
- If you have a transmitter with optional local zero and span adjustments, you may just want to go to Appendix A for the local zero and span adjustments procedure.

Procedure

Use the procedure in Table 1 to connect a power supply and an SFC Model STS103 to your transmitter on a bench. See Figure 1 for reference.

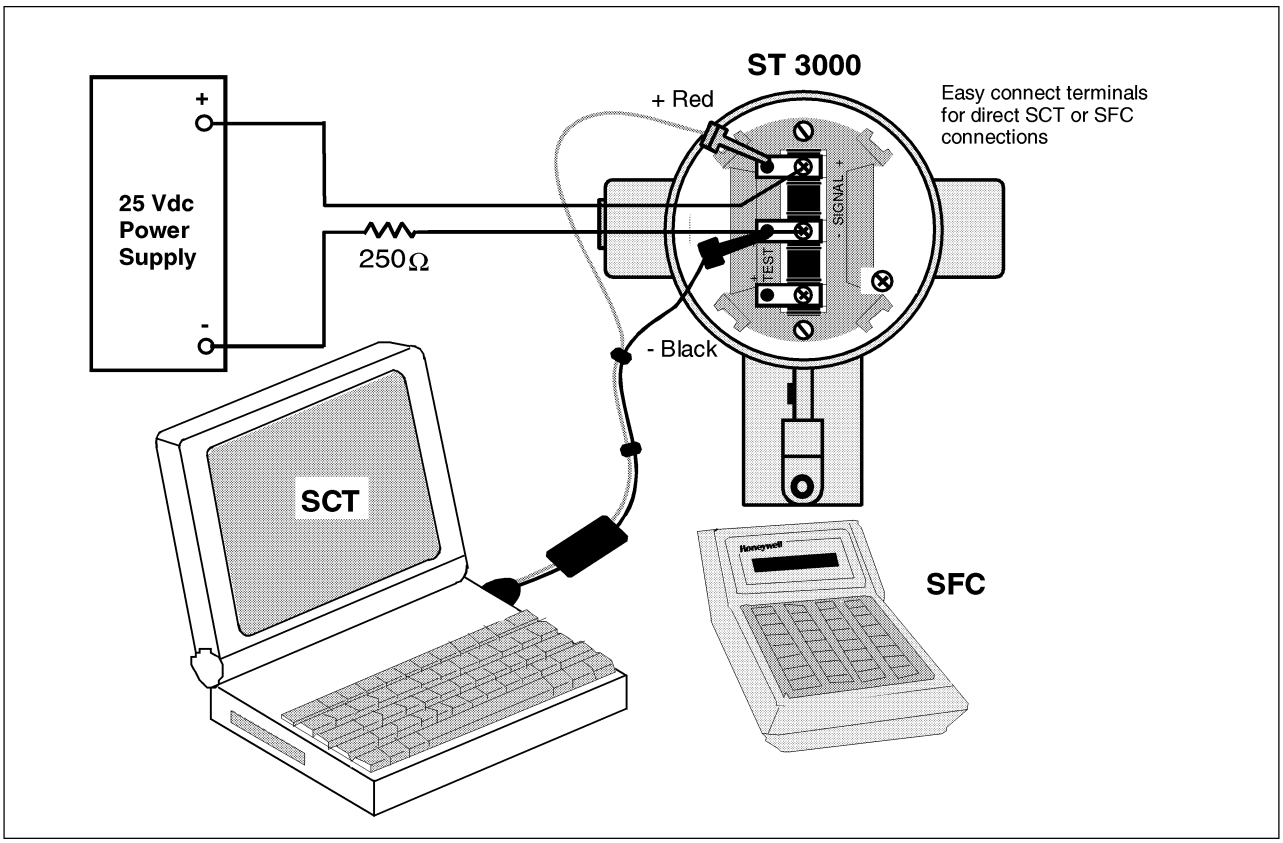
Continued on next page

CAUTION Do not try to remove the transmitter housing end-cap before loosening the end-cap lock on the transmitter housing.

Table 1 Connecting Power Supply and SFC to ST 3000

Step	Action
1	Use a 1.5 mm allen wrench to loosen the end-cap lock on the terminal side of the transmitter housing. Unscrew and remove the end cap from the housing
2	If the transmitter is supplied with an optional integral analog meter, unsnap the meter from the terminal block to expose the wiring connections.
3	Observing polarity, connect a 25 Vdc power supply to the transmitter's SIGNAL terminals as shown in Figure 1. **ATTENTION** Be sure there is a minimum of 250 ohms resistance between the power supply and the transmitter.
4	Connect the SCT or SFC to the transmitter - red lead to SIGNAL positive and black lead to SIGNAL negative. See Figure 1.
5	• If you are using the SCT, Select Tag ID icon from the SCT toolbar to establish on-line commnications with the transmitter. • If you are using the SFC, go to Section 2.2.

Figure 1 Typical Power Supply and SCT/SFC Connections to ST 3000.



2.2 Testing Communications

Background

Once you connect power and the SCT or SFC to the transmitter, you are ready to test communications with the transmitter.

Procedure

The procedure in Table 2 outlines the steps using an SFC for initiating communications with an ST 3000 transmitter without an assigned tag number.

Table 2 Testing Communications with Transmitter.

Step	Press Key	Read Display or Action	Description
1		Slide power switch on left side of SFC to ON position.	SFC runs its self check and displays initial prompt.
2		PUT LOOP IN MAN **OR** DE-XMTR PRESS ID	If this prompt appears, transmitter is in Analog mode of operation. This is the factory default mode of operation setting. Put your control loop in the manual mode of operation before initiating SFC communications. Note that you must do this separately through the receiving device in the loop. If this prompt appears, transmitter is in Digital (DE) mode of operation.
3	DE READ A ID	TAG NO. TRIPS SECURED?? **OR** Go to Step 5	Be sure any switches that may trip alarms or interlocks associated with analog loop are secured or turned off. Go to Step 4. This prompt does not appear for transmitters operating in DE mode. See DE transmitter display response in Step 5.
4	NON-VOL ENTER (Yes)	Confirms that "TRIPS" are secured. Go to Step 5 for display response.	Required for transmitters operating in analog mode only.

Continued on next page

Procedure, continued

Table 2 Testing Communications with Transmitter, Continued

Step	Press Key	Read Display or Action	Description
5		TAG NO. SFC WORKING...	Message exchange is taking place Note that communications with transmitter are blocked until [**ID**] key is pressed
		LIN DP TAG NO. _ **OR**	Transmitter is in analog transmission mode. “LIN” means transmitter is set for linear output instead of square root (SQRT). “DP” means transmitter is differential pressure type instead of gauge pressure (GP) or absolute pressure (AP). Last eight columns in bottom row are blank when no tag number has been assigned to this transmitter. Go to Step 8.
		DE–XMTR TAG NO. _ **OR**	Transmitter is in digital (DE) transmission mode. Last eight columns in bottom row are blank when no tag number has been assigned to this transmitter. Go to Step 7.
		TAG NO. NO XMTR RESPONSE	Communication error messages are cycled at two second intervals and display returns to initial prompt. Go to Step 6.
6		There is a communication problem, check the • power and SFC connections - Is the polarity correct; red to positive and black to negative? • loop resistance - Is there a minimum of 250 ohms resistance between the SFC and the power supply? • power supply - Is power applied, is there greater than 11 volts at the transmitter, and are you within the operating area on the curve in Figure 13?	Correct any wiring, resistance, or power supply problems, and try communicating again - Press [**ID**] key. If you are still not getting the correct display, note error messages and refer to Troubleshooting section in the transmitter’s *User’s Manual 34-ST-25-14* for probable cause.

Continued on next page

Procedure, continued

Table 2 Testing Communications with Transmitter, Continued

Step	Press Key	Read Display or Action	Description

7	^ SHIFT
	
	DE READ
	A ID
		`DE–XMTR TAG NO.`
		`SHIFT–`
		
		`TAG NO.`
		`SFC WORKING–.33%`
		
		`LIN DP TAG NO.`
		`_`
			Initiates shift key selection.
			
			Begins upload of configuration database from transmitter. Operation completion rate is shown in percent. Note that display for ID response reverts to style used for transmitter in analog mode when upload is completed.

8	F/S DIR
	U STAT
		`STATUS`
		`SFC WORKING...`
		
		`STATUS`
		`STATUS CHECK=OK`
		
		`LIN DP`
		`READY...`
			Initiates status check.
			
			If messages other than this one are cycled in display, refer to the Troubleshooting section in this manual for an explanation of the message, the probable cause, and any corrective action.
			Signals end of status messages for display.
			
			ATTENTION When assigned, the transmitter's tag number also appears in the top row of the display.

9		You have established communications with transmitter and are ready to initiate other SFC operations. Go to Section 2.3.	**ATTENTION** If you want to change the transmitter's communication mode from Analog (A) to digital (DE), see the Changing Mode of Operation section in the transmitter's *User's Manual 34-ST-25-14* for details.

2.3 Verifying Configuration Data

Procedure

Use the procedure in Table 3 to display all the basic transmitter database parameters to be sure they are correct. Note that the values/selections shown in displays are for example purposes only.

ATTENTION

- This procedure assumes that you have established communications with the transmitter as outlined in Table 2.
- If any parameter is not set to the correct value/selection or your transmitter was not configured, you can do so now. Refer to the Configuration Section in the *ST 3000 Smart Transmitter, Release 300 and SFC Smart Field Communicator Model STS 103 User's Manual, 34-ST-25-14* for details.

Table 3 Verifying Transmitter's Configuration Data (Using the SFC)

Step	Press Key	Read Display or Action	Description
1	DE READ A ID	TAG NO. TRIPS SECURED??	This prompt only appears for transmitters in analog mode.
	NON-VOL ENTER (Yes)	TAG NO. SFC WORKING...	This is only required for transmitters in analog mode.
		LIN DP TAG NO. SPT 1ØØ1	Transmitter's assigned tag number "SPT 1001" appears in bottom row.
2	C DAMP	DAMP 1 SPT 1ØØ1 Ø.3 SECONDS	Present damping time setting.

Continued on next page

Procedure, continued

Table 3 Verifying Transmitter's Configuration Data, Continued

Step	Press Key	Read Display or Action	Description
3	[B CONF]	ST CONFIG CONFORMITY?	Access configuration menu.
	NON-VOL [ENTER (Yes)]	CONFORMITY LINEAR	Present output conformity is linear
	[CLR (No)]	ST CONFIG CONFORMITY?	Exit menu selection.
	[▲ H NEXT]	ST CONFIG Meter Config?	Call up next menu selection.
	NON-VOL [ENTER (Yes)]	Meter Config SFC WORKING... Meter Config Meter Bd Present	Enters meter configuration function and confirms that local smart meter is present. Timed prompt - See next display. **ATTENTION** If prompt "No Meter Present" appears, prompt times out in a few seconds, as described above, and calls up the "Configure Meter?" prompt. This means that you can access the meter configuration function without the local smart meter installed. If prompt "Mtr not Supportd" appears, prompt times out and returns to previous ST CONFIG prompt. This means that you are working with a pre-release 300 transmitter that does not support the local smart meter option and, therefore, can not access the meter configuration function.
		Meter Config Configure Meter?	Prompt asks if you want to configure smart meter.
	NON-VOL [ENTER (YES)]	Meter Eng Units " H2O_39F	Calls up present meter Engineering Unit selection.
	[CLR (No)]	ST CONFIG Meter Config?	Exit menu selection.
4	[D UNITS]	UNITS 1 SPT 1ØØ1 " H2O_39F	SFC will display range values in inches of water @ 39° F (4° C).

Continued on next page

Procedure, continued

Table 3 Verifying Transmitter's Configuration Data, Continued

Step	Press Key	Read Display or Action	Description
5	E LRV 0%	LRV 1 SPT 1ØØ1 Ø.ØØØØ "H2O_39F	Present Lower Range Value setting.
6	F URV 100%	URV 1 SPT 1ØØ1 3ØØ.ØØ "H2O_39F	Present Upper Range Value setting.
7	^ SHIFT	URV 1 SPT 1ØØ1 SHIFT–	Initiate shift key selection.
	DE CONF I MENU ITEM	DE CONF SPT 1ØØ1 SFC WORKING...	Access DE configuration menu. These parameters apply for transmitters in DE mode only.
		DE CONF SPT 1ØØ1 Single Rng w/SV	Present output mode setting for transmitter in DE mode.
	H ▲ NEXT	DE CONF SPT 1ØØ1 w/DB (6 Byte)	Present broadcast format setting for transmitter in DE mode.
	H ▲ NEXT	DE CONF SPT 1ØØ1 F/S = B/O Hi	Present failsafe mode setting for transmitter in DE mode.
	CLR (No)	LIN DP SPT 1ØØ1 READY...	Exit DE configuration menu.
8	^ SHIFT	LIN DP SPT 1ØØ1 SHIFT–	Initiate shift key selection.
	F/S DIR U STAT	F/S DIR SPT 1ØØ1 F/SAFE UPSCALE	Default failsafe direction for analog output. This applies for transmitter in analog mode only.
9	^ SHIFT	F/S DIR SPT 1ØØ1 SHIFT–	Initiate shift key selection.
	URL Y SPAN	URL 1 SPT 1ØØ1 4ØØ.ØØ "H2O_39F	Factory set Upper Range Limit. This can not be changed.
10		Turn off power and SFC. Remove power leads and SFC leads from transmitter. Replace integral meter, if applicable; replace end-cap; and tighten end-cap lock	This completes bench check unless you want to change default failsafe direction for analog output and/or position of optional write protect jumper. If you do want to change failsafe direction or write protect jumper, go to Section 2.4 or 2.5, respectively. Otherwise, you can now install transmitter.

2.4 Changing Default Failsafe Direction

Background

Transmitters are shipped with a default failsafe direction of upscale. This means that the transmitter's output will be driven upscale (maximum output) when the transmitter detects a critical status.

You can change the direction from upscale to downscale (minimum output) by cutting jumper W1 on the printed wiring assembly (PWA).

Analog and DE mode differences

If your transmitter is operating in the analog mode, an upscale failsafe action will drive the transmitter's output to greater than 21 mA or a downscale action will drive its output to less than 3.8 mA.

If your transmitter is operating in the DE mode, an upscale failsafe action will cause the transmitter to generate a "+ infinity" digital signal, or a downscale failsafe action will cause it to generate a "– infinity" digital signal. The STIMV IOP module interprets either signal as "not a number" and initiates its own configured failsafe action for the control system. The STDC card initiates the failsafe mode configured through the transmitter when either signal is generated.

ATTENTION

The failsafe direction display that you can access through the SFC only shows the state of the failsafe jumper in the transmitter as it correlates to analog transmitter operation. The failsafe action of the digital control system may be configured to operate differently than indicated by the state of the jumper in the transmitter.

Procedure

The procedure in Table 4 outlines the steps for cutting the failsafe jumper on the transmitter's PWA. Figure 2 shows the location of the failsafe jumper on the PWA for Release 300 transmitters.

The nature of the integrated circuitry used in the transmitter's PWA makes it susceptible to damage by stray static discharges when it is removed from the transmitter. Follow these tips to minimize chances of static electricity damage when handling the PWA.

- Never touch terminals, connectors, component leads, or circuits when handling the PWA.
- When removing or installing the PWA, hold it by its edges or bracket section only. If you must touch the PWA circuits, be sure you are grounded by staying in contact with a grounded surface or wearing a grounded wrist strap.
- As soon as the PWA is removed from the transmitter, put it in an electrically conductive bag or wrap it in aluminum foil to protect it.

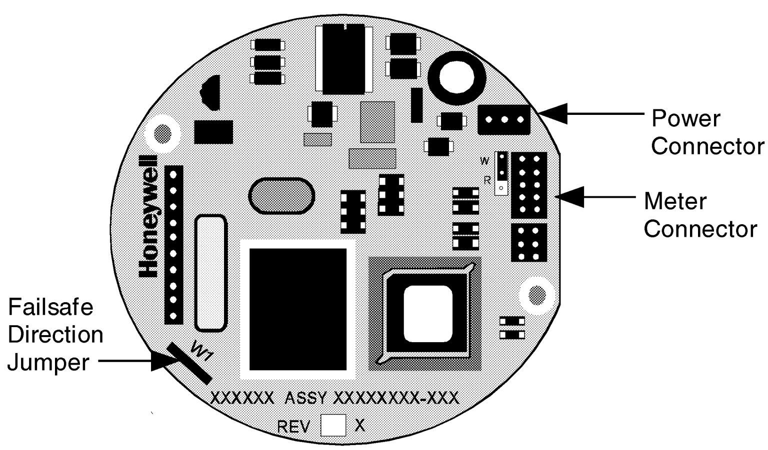
Continued on next page

Procedure, continued

Table 4 Cutting Failsafe Direction Jumper

Step	Action
1	With transmitter on bench and no power applied. Loosen end-cap lock and unscrew end cap from electronics side of transmitter housing.
2	• If applicable, unsnap Local Smart Meter from PWA mounting bracket and unplug cable from connector on back of meter assembly. • Loosen two retaining screws and carefully pull mounting bracket and PWA from housing. • Using retaining clip remove flex-tape connector from PWA. • Remove 2-wire power connector from PWA, and then remove PWA and mounting bracket assembly.
3	With component side of PWA facing you, locate failsafe jumper W1 and cut it in half with small wire cutter such as dykes. See Figure 2. This changes failsafe action from upscale to downscale.
4	Reverse applicable previous steps to replace PWA.
6	Turn ON transmitter power.

Figure 2 Location of Failsafe Direction Jumper on PWA.



2.5 Optional Write Protect Jumper

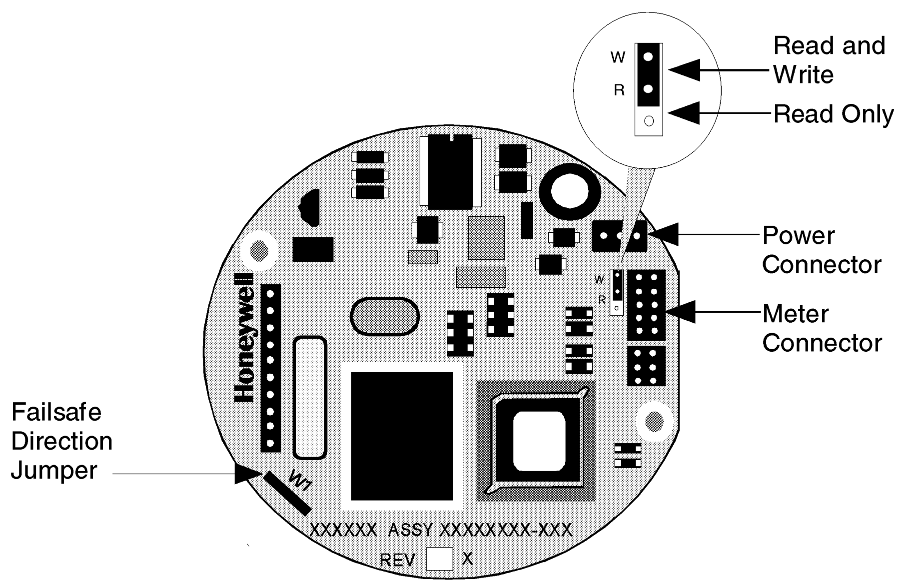
Write protect option

The ST 3000 transmitters are available with a “write protect option”. It consists of a jumper located on the transmitter’s PWA that you can position to allow read and write access or read only access to the transmitter’s configuration database. When the jumper is in the read only position, you can only read/view the transmitter’s configuration and calibration data. Note that the factory default jumper position is for read and write access.

There is no need to check the jumper position unless you want to change it. Refer to the steps in Table 4 to remove the PWA from the transmitter and Figure 3 to reposition the jumper.

Figure 3 shows the location of the write protect jumper on the PWA for Release 300 transmitters.

Figure 3 Write Protect Jumper Location and Selections.



2.6 Setting Range Values Using Local Adjustments

Local zero and span option

For transmitter applications that do not require an SFC nor digital integration with Honeywell's TPS systems, ST 3000 transmitters are available with optional local zero and span adjustments.

About local adjustments

The transmitter's range values can be set by using the pushbuttons on the face of the local zero and span option or smart meter. Refer to the procedure for setting the range values to applied pressures using local zero and span adjustments in *Appendix A —Smart Meter Reference* in this guide.

Section 3 —Preinstallation Considerations

3.1 Considerations for ST 3000 Transmitter

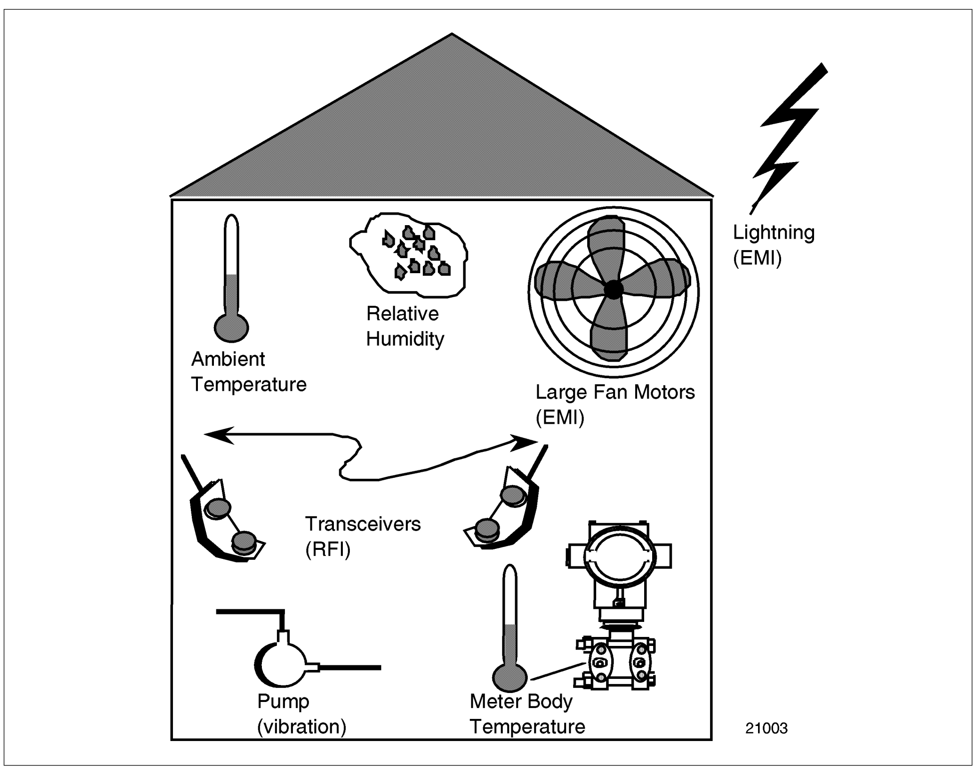
Evaluate conditions

The ST 3000 transmitter is designed to operate in common indoor industrial environments as well as outdoors. To assure optimum performance, evaluate these conditions at the mounting area relative to published transmitter specifications and accepted installation practices for electronic pressure transmitters.

- Environmental Conditions
  - Ambient Temperature
  - Relative Humidity
- Potential Noise Sources
  - Radio Frequency Interference (RFI)
  - Electromagnetic Interference (EMI)
- Vibration Sources
  - Pumps
  - Motorized Valves
  - Valve Cavitation
- Process Characteristics
  - Temperature
  - Maximum Pressure Rating

Figure 4 illustrates typical mounting area considerations to make before installing a transmitter.

Figure 4 Typical Mounting Area Considerations Prior to Installation



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Temperature limits

Table 5 lists the operating temperature limits for the various types of transmitters with silicone fill fluids. See transmitter specifications for temperature limits of tranmsitters with alternative fill fluids.

Table 5 Operating Temperature Limits (Transmitters with Silicone Fill Fluids)

Transmitter Type and Model	Ambient Temperature		Process Interface Temperature	
	°C	°F	°C	°F
Draft Range STD110	-40 to 70	-40 to 158	-40 to 70	-40 to 158
Differential Pressure STD125	-40 to 85	-40 to 185	-40 to 85	-40 to 185
STD120, STD130, STD170	-40 to 93	-40 to 200	-40 to 125	-40 to 257
STD904, STD924, STD930, STD974	-40 to 85	-40 to 185	-40 to 125	-40 to 257
Gauge Pressure				
STG140, STG170, STG180, STG14L, STG17L, STG18L	-40 to 93	-40 to 200	-40 to 125	-40 to 257
STG14T	-40 to 93	-40 to 200	-40 to 150 †	-40 to 302 †
STG93P	-15 to 65	5 to 149	-15 to 95 ††	5 to 203 ††
STG944, STG974	-40 to 85	-40 to 185	-40 to 125	-40 to 257
STG90L, STG94L, STG97L, STG98L	-40 to 85	-40 to 185	-40 to 110	-40 to 230
Absolute Pressure STA122	-40 to 93	-40 to 200	See Specification Sheet	
STA140	-40 to 93	-40 to 200	-40 to 80	-40 to 176
STA922	-40 to 85	-40 to 185	See Specification Sheet	
STA940	-40 to 85	-40 to 185	-40 to 80	-40 to 176
Flange Mounted STF128, STF132, STF12F, STF13F	-40 to 93	-40 to 200	-40 to 125	-40 to 257
STF14F	-40 to 85	-40 to 185	-40 to 85	-40 to 185
STF14T	-40 to 93	-40 to 200	-40 to 150 †	-40 to 302 †
STF924, STF932, STF92F, STF93F	-40 to 85	-40 to 185	-40 to 125	-40 to 257
Remote Diaphragm Seals				
STR12D, STR13D, STR14G, STR17G, STR14A	See Specification Sheet		See Specification Sheet	
STR93D, STR94G	-40 to 85	-40 to 185	See Specification Sheet	

† Process temperatures above 125 °C (257 °F) require a reduction in the maximum ambient temperature as follows:

Process Temperature	Ambient Temperature Limit
150 °C (302 °F)	50 °C (122 °F)
140 °C (284 °F)	60 °C (140 °F)
125 °C (257 °F)	85 °C (185 °F)

†† Process temperatures above 65 °C (149 °F) require a 1:1 reduction in maximum ambient temperature.

NOTE: For transmitters with local meter option see Table A-2.

Continued on next page

Pressure ratings

Table 6 lists maximum working pressure and overpressure ratings for a given transmitter Upper Range Limit (URL).

The maximum working pressure is the pressure used for the approval body safety calculations. The overpressure rating is the maximum pressure that may be applied during service or cleaning without damage to the transmitter.

Table 6 Transmitter Overpressure Ratings

Transmitter Type	Upper Range Limit (URL)	Maximum Working Pressure Rating	Overpressure Rating
Draft Range	10 inches H_2O (25 mbar)	50 psi (3.5 bar)	50 psi (3.5 bar) (No overpressure protection is provided)
Differential Pressure	400 inches H_2O (1 bar)	3000 psi (210 bar)	3000 psi (210 bar)
	100 psi (7 bar)	3000 psi (210 bar)	3000 psi (210 bar)
	3000 psi (210 bar)	3000 psi (210 bar)	3000 psi (210 bar)
Gauge Pressure	100 psi (7 bar)	100 psi (7 bar)	150 psi (10.3 bar)
	300 psi (21 bar)	300 psi (21 bar)	450 psi (31 bar)
	500 psi (35 bar)	500 psi (35 bar)	750 psi (52 bar)
	3000 psi (210 bar)	3000 psi (210 bar)	4500 psi (310 bar)
	6000 psi (415 bar)	6000 psi (415 bar)	9000 psi (620 bar)
Absolute Pressure	780 mmHg Absolute (1 bar)	780 mmHg Absolute (1 bar)	Full vacuum to 1550 mmHg Absolute (2 bar)
	500 psia (35 bar)	500 psia (35 bar)	750 psia (52 bar)

Note: To convert bar values to kilopascals (kPa), multiply by 100.
For example, 3.5 bar equals 350 kPa.

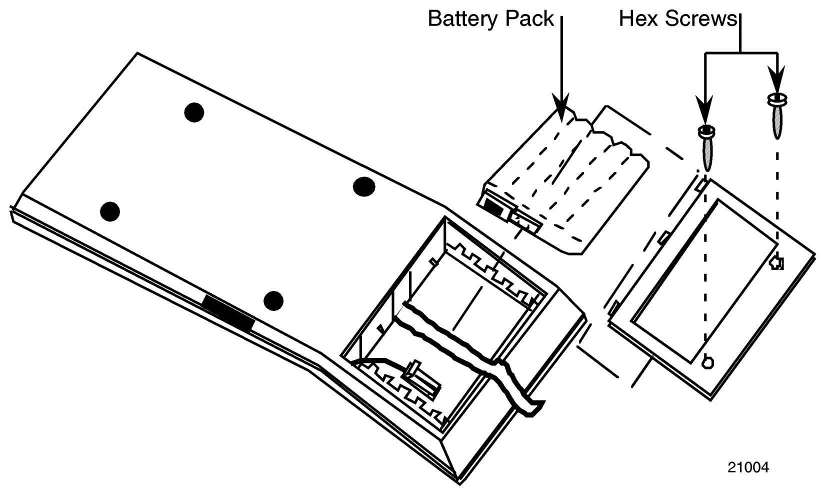
3.2 Considerations for SFC/SCT

Install SFC battery pack

If the SFC battery pack was removed for shipping and/or storage, you will have to install the battery pack and charge the batteries before you can operate the SFC.

The procedure in Table 7 outlines the steps for the battery pack.

Table 7 Installing and Charging SFC Battery Pack

Step	Action
1	Turn SFC face down on working surface. Use metric hex wrench (2.5 mm) to remove screws in battery compartment cover and remove cover.
2	Insert battery pack in compartment and connect plug in compartment to pin on battery back Example - Battery pack installation. 
3	Replace cover and tighten hex screws
4	Connect lead from battery charger to recessed connector on left side of SFC. **WARNING** The SFC battery charger is not intrinsically safe. Always recharge the SFC battery pack in a nonhazardous location. The SFC itself is an intrinsically safe device.

Continued on next page

Install SFC battery pack, continued

Table 7 Installing and Charging SFC Battery Pack, Continued

Step	Action
5	Plug battery charger into any standard 120 Vac outlet or universal-European 240 Vac outlet as applicable for charger power rating. If 240 Vac charger is supplied with stripped leads instead of universal-European plug, lead identification for 240 Vac charger is as follows. **Lead Color…** — **Function…** Blue — Neutral Brown — Hot Green/Yellow — Ground **ATTENTION** It takes up to 16 hours to fully recharge the battery pack and you can use the SFC continuously for up to 24 hours before the battery pack needs recharging.

Temperature Limits

The ambient operating temperature limits for the SFC are -10 to 50 °C (14 to 122 °F) with relative humidity in the range of 10 to 90% RH.

Usage guidelines

- For transmitters operating in the Analog mode, be sure to put an analog control loop into its manual mode before initiating SFC communications with the transmitter. Also, be sure any switches that may trip alarms or interlocks associated with the analog loop are secured or turned OFF. Communication superimposes digital signals on the loop wiring that could affect the analog control signal.
- Be sure the power supply voltage does not exceed 45Vdc. The ST 3000 transmitter and SFC were designed to operate with voltages below 45Vdc.
- Be sure there is at least 250 ohms of resistance between the SFC and the power supply for proper communications.

SCT 3000 Requirements

The Smartline Configuration Toolkit (SCT 3000) consists of the software program which is contained on diskettes and a Smartline Option Module which is the hardware interface used for connecting the host computer to the ST 3000 transmitter.

Be certain that the host computer is loaded with the proper operating system necessary to run the SCT program. See the *SCT 3000 Smartline Configuration Toolkit Start-up and Installation Manual 34-ST-10-08* for complete details on the host computer specifications and requirements for using the SCT 3000.

3.3 Considerations for Local Smart Meter Option

Smart meter reference specifications

If your ST 300 transmitter is equipped with a Local Smart Meter option, you may want refer to the design and operating specifications for this option. See *Appendix A —Smart Meter Reference* in the back of this guide.

Section 4 —Installation

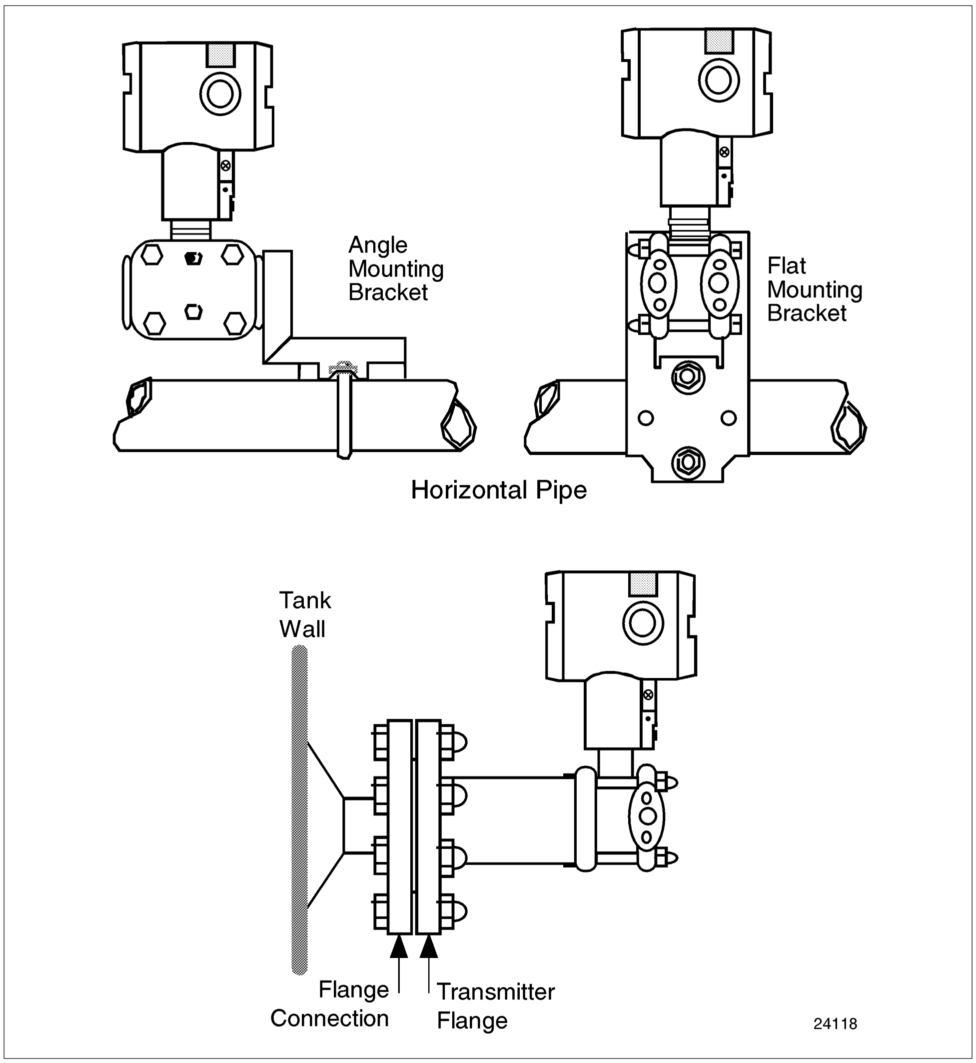
4.1 Mounting ST 3000 Transmitter

Summary

You can mount all transmitter models (except flush mount models and those with integral flanges) to a 2-inch (50 millimeter) vertical or horizontal pipe using our optional angle or flat mounting bracket, or a bracket of your own. Flush mount models are mounted directly to the process pipe or tank by a 1-inch weld nipple. Those models with integral flanges are supported by the flange connection.

Figure 5 shows typical bracket mounted and flange mounted transmitter installations for comparison.

Figure 5 Typical Bracket Mounted and Flange Mounted Installations



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Dimensions

Detailed dimension drawings for given transmitter series and types are listed in Section 5 for reference. Note that abbreviated overall dimensions are also shown in the specification sheets for the given transmitter models.

This section assumes that the mounting dimensions have already been taken into account and the mounting area can accommodate the transmitter.

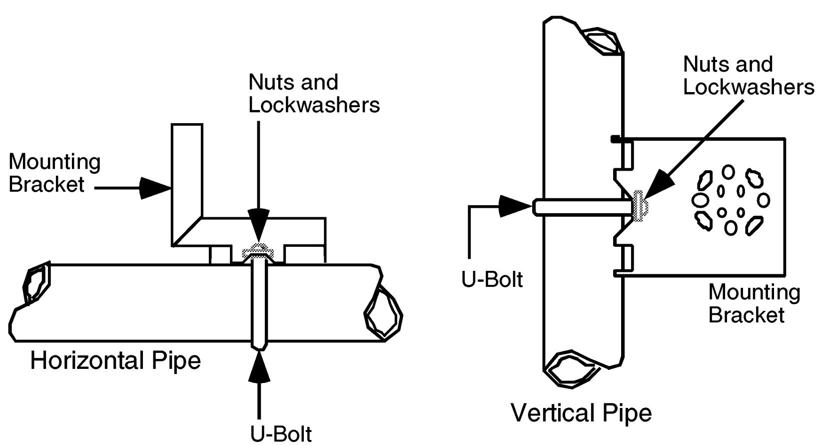
Bracket mounting

Table 8 summarizes typical steps for mounting a transmitter to a bracket.

Table 8 Mounting ST 3000 Transmitter to a Bracket

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>
<table>
<tr><th>If you are using an…</th><th>Then…</th></tr>
<tr><td>optional mounting bracket</td><td>go to Step 2.</td></tr>
<tr><td>existing mounting bracket</td><td>go to Step 3.</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>Position bracket on 2-inch (50.8 mm) or, and install “U” bolt around pipe and through holes in bracket. Secure with nuts and lockwashers provided.

Example - Angle mounting bracket secured to horizontal or vertical pipe.



</td></tr>
</table>

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Bracket mounting, continued

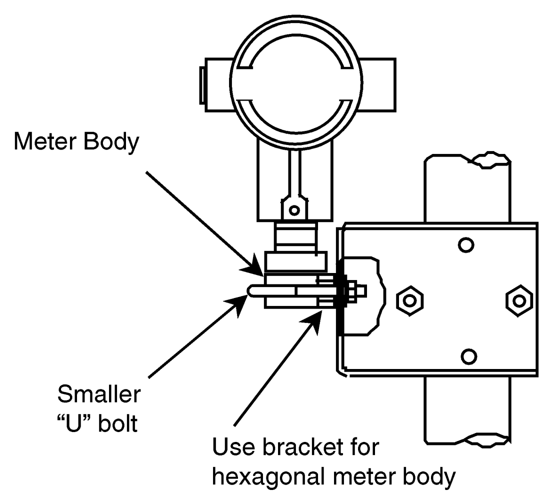
Table 8 Mounting ST 3000 Transmitter to a Bracket, continued

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>3</td><td>
Align appropriate mounting holes in transmitter with holes in bracket and secure with bolts and washers provided.

<table>
<tr><th>If transmitter is …</th><th>Then …</th></tr>
<tr><td>DP type with double-ended process heads and/or remote seals</td><td>use alternate mounting holes in end of heads.</td></tr>
<tr><td>GP and AP with single-ended head</td><td>use mounting holes in side of meter body.</td></tr>
<tr><td>In-line GP
(LGP model)</td><td>use smaller “U” bolt provided to attach meter body to bracket.
See figure below.</td></tr>
<tr><td>Dual head GP and AP</td><td>use mounting holes in end of process head.</td></tr>
</table>

Example – LGP model transmitter mounted to optional angle mounting bracket.

LGP Models



NOTE: If the meter body is hexagonal, you must use the additional bracket supplied. If meter body is round, discard the bracket.
</td></tr>
</table>

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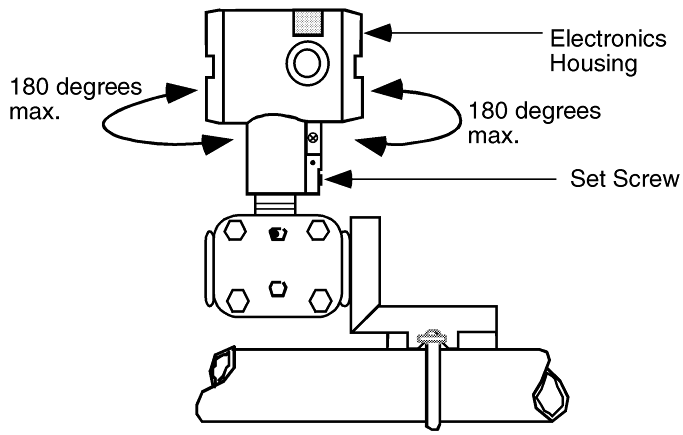
Bracket mounting, continued

Table 8 Mounting ST 3000 Transmitter to a Bracket, continued

Step	Action
4	Loosen set screw on outside neck of transmitter one full turn. Rotate Transmitter housing in maximum of 180 degree increment in left or right direction from center to position you require and tighten set screw (1.46 to 1.68 Nùm/13 to 15 lb-in). Example - Rotating Transmitter housing.  **ATTENTION** The metric socket head wrench kit supplied with the SFC includes 2.5, 3, and 4mm size wrenches. You will need the 4mm size wrench for the outside set screw.

Continued on next page

ATTENTION

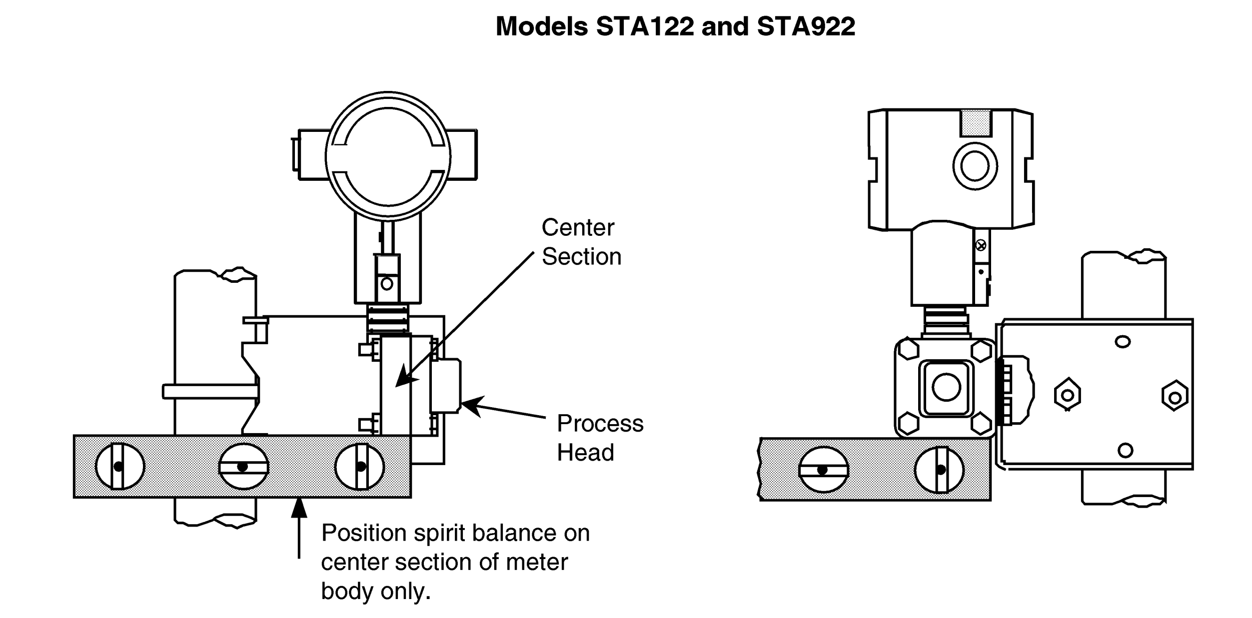
The mounting position of a model STA122 or STA922 Absolute Pressure Transmitter or a model STD110 Draft Range Differential Pressure Transmitter is critical as the transmitter spans become smaller. A maximum zero shift of 2.5 mm Hg for an absolute transmitter or 1.5 in H_2O for a draft range transmitter can result from a mounting position which is rotated 90 degrees from vertical. A typical zero shift of 0.12 mm Hg or 0.20 in H_2O can occur for a 5 degree rotation from vertical.

Precautions for Mounting Transmitters with Small Absolute or Differential Pressure Spans

To minimize these positional effects on calibration (zero shift), take the appropriate mounting precautions that follow for the given transmitter model.

For a model STA122 or STA922 transmitter, you must ensure that the transmitter is vertical when mounting it. You do this by leveling the transmitter side-to-side and front-to-back. See Figure 6 for suggestions on how to level the transmitter using a spirit balance.

Figure 6 Leveling a Model STA122 or 922 Absolute Pressure Transmitter.



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Precautions for Mounting Transmitters with Small Absolute or Differential Pressure Spans, continued

For a transmitter with a small differential pressure span, you must ensure that the transmitter is vertical when mounting it. You do this by leveling the transmitter side-to-side and front-to-back. See Figure 6 for suggestions on how to level the transmitter using a spirit balance. You must also zero the transmitter by following the steps in Table 9 below.

Table 9 Zero Corrects Procedure for STD110

Step	Action
1	Attach the transmitter to the mounting bracket but do not completely tighten the mounting bolts
2	Connect a tube between the input connections in the high pressure (HP) and low pressure (LP) heads to eliminate the affects of any surrounding air currents.
3	Connect 24 Vdc power to the transmitter and connect a digital voltmeter or SFC to read the transmitter's output. See Figure 1 for typical SFC connection or connect a voltmeter across the 250 ohm resistor, if desired.
4	Use the SFC (or SCT) and establish communications with the transmitter. Follow the steps in Table 2, if needed.
5	While reading the transmitter's output on an SFC or a voltmeter, position the transmitter so the output reading is at or near zero and then completely tighten the mounting bolts.
6	Do an input zero correct function using the SFC and following the steps below. This corrects the transmitter for any minor error that may occur after the mounting bolts are tightened.
7	Initiate shift key selection. Press [^ SHIFT] key Press [INPUT J OUT-PUT] key. Read applied input pressure. Press [RESET K COR-RECT] key. Prompt asks if the applied input pressure equals zero input. If it is zero input, go to next keystroke. If it is not, press [**CLR**] key to exit function and repeat keystrokes. Press [NON-VOL ENTER (Yes)] key. Zero input is set equal to applied input pressure.
8	Remove the tube from between the input connections, the power, and the digital voltmeter or SFC.
9	Continue with the remaining installation tasks.

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Flange mounting

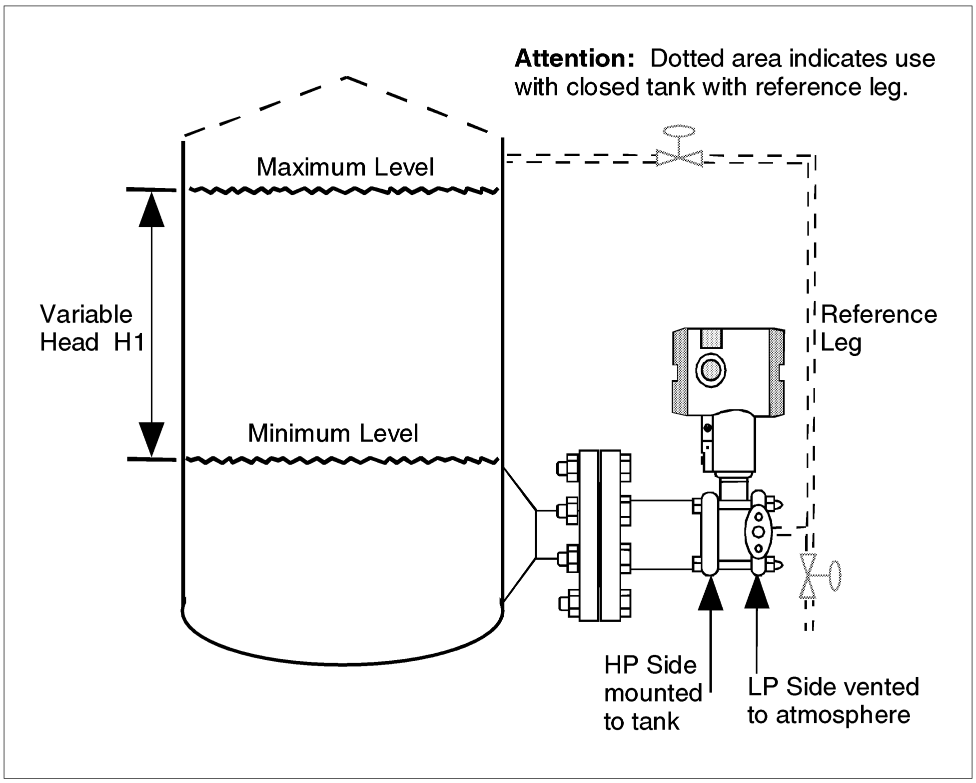
To mount a flange mounted transmitter model, bolt the transmitter's flange to the flange pipe on the wall of the tank. Tighten the bolts to a torque of 47.4 to 54.2 N · m (35 to 40 lb-ft).

ATTENTION

On insulated tanks, remove enough insulation to accommodate the flange extension.

Figure 7 shows a typical installation for a transmitter with the flange on the high pressure (HP) side so the HP diaphragm is in direct contact with the process fluid. The low pressure (LP) side of the transmitter is vented to atmosphere (no connection).

Figure 7 Typical Flange Mounted Transmitter Installation



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Flush mounting

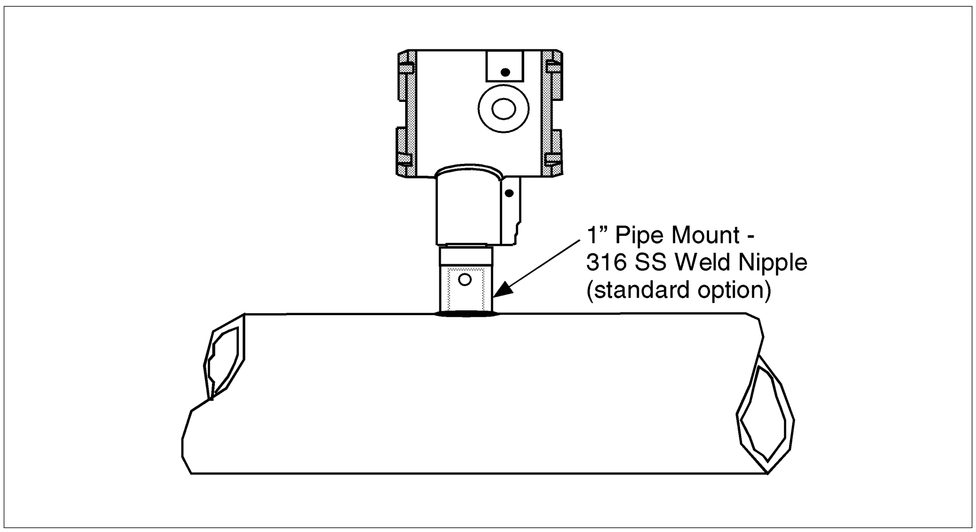
To mount a flush mounted transmitter model, cut a hole for a 1-inch standard pipe in the tank or pipe where the transmitter is to be mounted. Weld the 1-inch mounting sleeve to the wall of the tank or to the hole cut on the pipe. Insert the meter body of the transmitter into the mounting sleeve and secure with the locking bolt. Tighten the bolt to a torque of 8.1 to 13.5 N · m (6 to10 lb-ft). Figure 8 shows a typical installation for a transmitter with a flush mount on a pipe.

Once the transmitter is mounted, the transmitter housing can be rotated to the desired position. See Table 8, step 4.

ATTENTION

On insulated tanks, remove enough insulation to accommodate the mounting sleeve.

Figure 8 Typical Flush Mounted Transmitter Installation



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High Temperature Transmitter Mounting

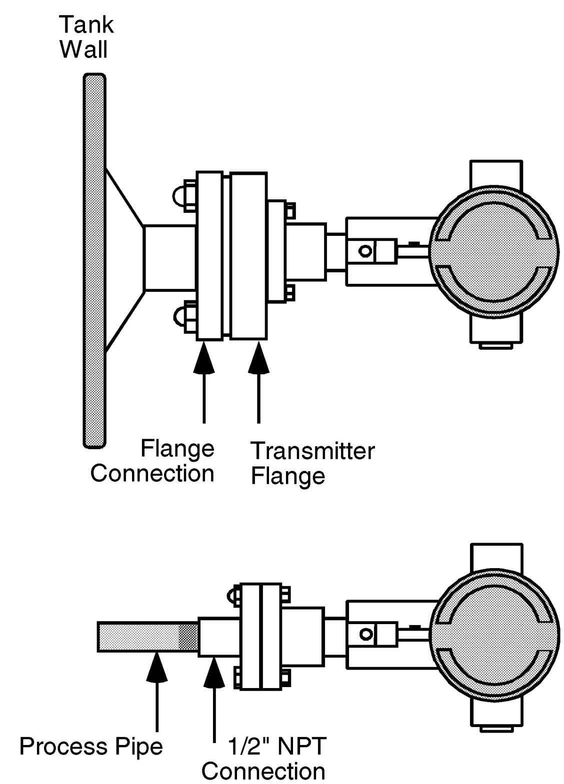
You can mount the high temperature transmitter directly to the process flange connection or the process piping. Figure 9 shows typical pipe and flange mounted transmitter installations for comparison.

To mount a flange mounted transmitter model, bolt the transmitter's flange to the flange on the wall of the tank or process pipe. Tighten the bolts to a torque of 47.4 to 54.2 N·m (35 to 40 lb-ft).

Once the transmitter is mounted, the transmitter housing can be rotated to the desired position. See Table 8, step 4.

ATTENTION On insulated tanks, remove enough insulation to accommodate the flange extension.

Figure 9 Typical Pipe and Flange Mounted Installations



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Remote seal mounting

Use the procedure in Table 10 to mount a remote diaphragm seal transmitter model. Figure 10 shows a typical installation for a remote diaphragm seal transmitter for reference.

ATTENTION

Mount the transmitter flanges within the limits stated here for the given fill-fluid in the capillary tubes with a tank at one atmosphere.

IF the fill fluid is…	THEN mount the flange…
Silicone DC 200 Oil	no greater than 22 feet (6.7 meters) below the transmitter
Silicone DC 704 Oil	no greater than 19 feet (5.8 meters) below the transmitter
Chlorotrifluorethylene	no greater than 11 feet (3.4 meters) below the transmitter.

NOTE: The combination of tank vacuum and high pressure capillary head effect should not exceed 9 psi (300 mm Hg) absolute.

Table 10 Mounting Remote Diaphragm Seal Transmitter

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Mount transmitter at a remote distance determined by length of capillary tubing.</td></tr>
<tr><td>2</td><td>
<table>
<tr><th>If Transmitter Model Number is…</th><th>Then Connect Remote Seal on…</th></tr>
<tr><td>STR93D or STR12D</td><td>high pressure (HP) side of transmitter to lower flange mounting on tank wall for variable head H1.</td></tr>
<tr><td>STR13D</td><td>low pressure (LP) side of transmitter to lower flange mounting on tank wall for variable head H1.</td></tr>
</table>
ATTENTION On insulated tanks, remove enough insulation to accommodate the flange extension.
</td></tr>
</table>

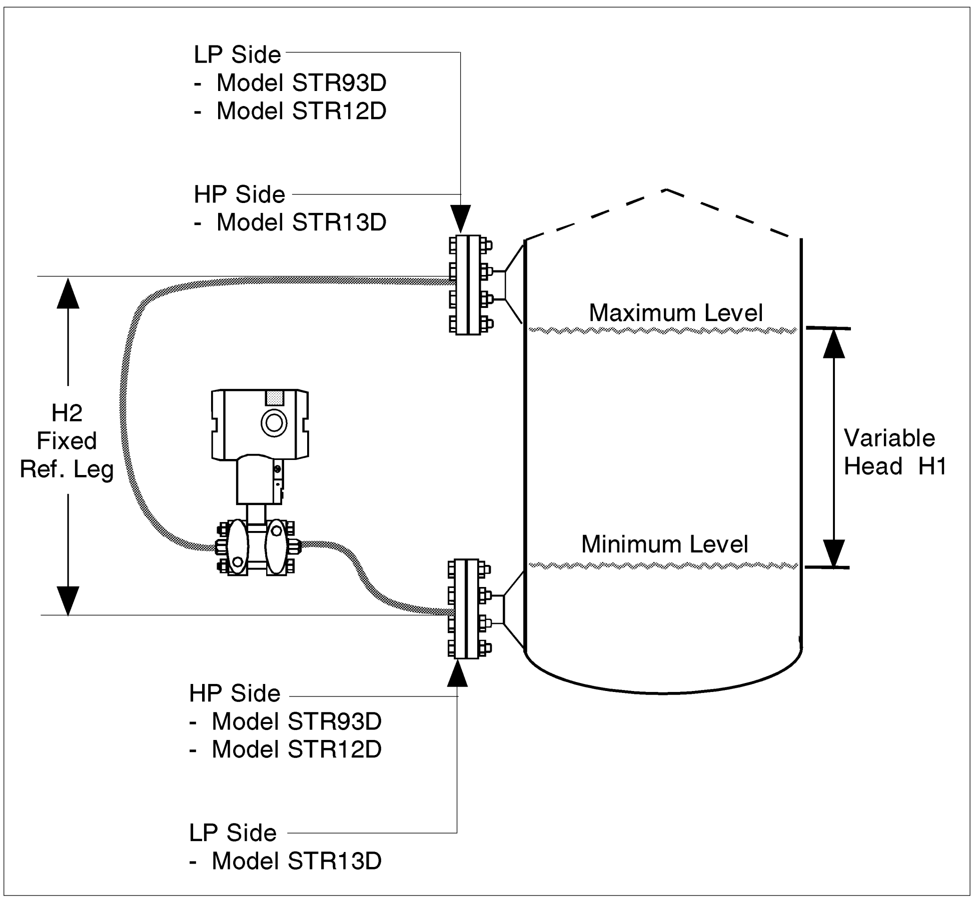
Continued on next page

Remote seal mounting, continued

Table 10 Mounting Remote Diaphragm Seal Transmitter, continued

Step	Action
3	<table><tr><th>If Transmitter Model Number is…</th><th>Then Connect Remote Seal on…</th></tr><tr><td>STR93D or STR12D</td><td>low pressure (LP) side of transmitter to upper flange mounting on tank wall for fixed or constant head H2.</td></tr><tr><td>STR13D</td><td>high pressure (HP) side of transmitter to upper flange mounting on tank wall for fixed or constant head H2.</td></tr></table> * **ATTENTION** On insulated tanks, remove enough insulation to accommodate the flange extension.
4	Tighten bolts to torque of 45.4 to 54.2 N·m (35 to 40 ft-lb).

Figure 10 Typical Remote Diaphragm Seal Transmitter Installation.



4.2 Piping ST 3000 Transmitter

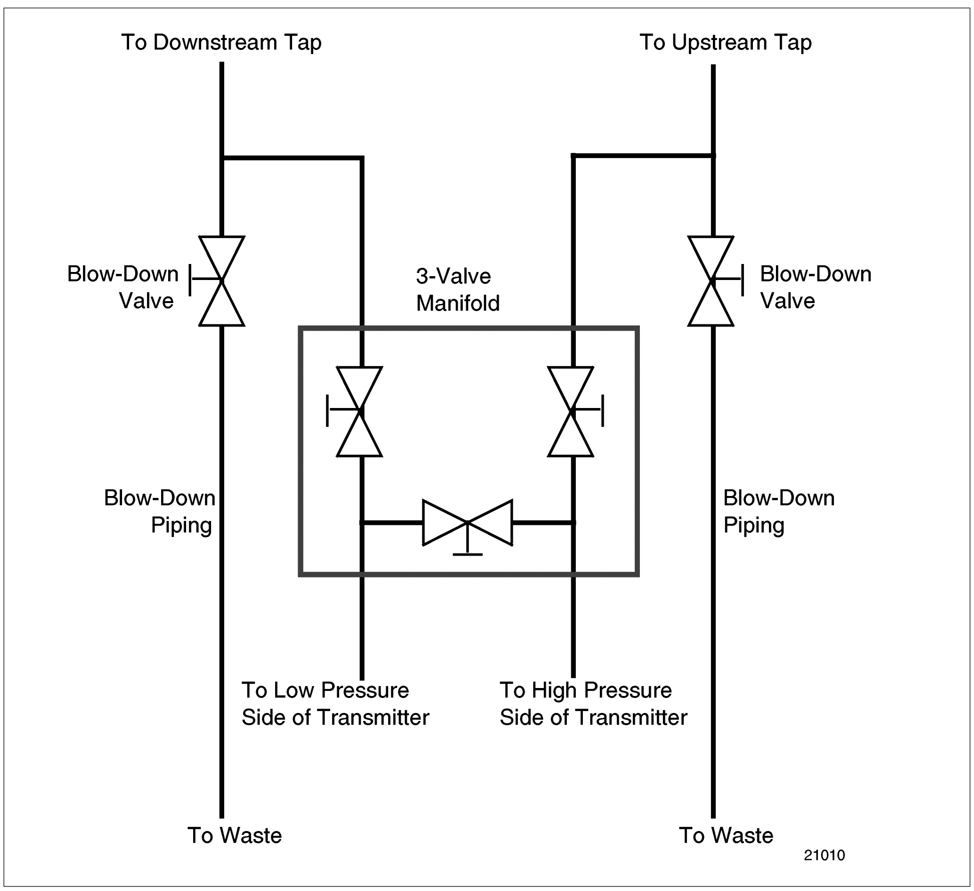
Summary

The actual piping arrangement will vary depending upon the process measurement requirements and the transmitter model. Except for flanged and remote diaphragm seal connections, process connections are made to ¼ inch or ½ inch NPT female connections in the process head of the transmitter's meter body. For example, a differential pressure transmitter comes with double ended process heads with ¼ inch NPT connections but they can be modified to accept ½ inch NPT through optional flange adapters. Some gauge pressure transmitters may have a ½ inch NPT connection which mounts directly to a process pipe.

The most common type of pipe used is ½ inch schedule 80 steel pipe. Many piping arrangements use a three-valve manifold to connect the process piping to the transmitter. A manifold makes it easy to install and remove or rezero a transmitter without interrupting the process. It also accommodates the installation of blow-down valves to clear debris from pressure lines to the transmitter.

Figure 11 shows a diagram of a typical piping arrangement using a three-valve manifold and blow-down lines for a differential pressure transmitter being used to measure flow.

Figure 11 Typical 3-Valve Manifold and Blow-Down Piping Arrangement.



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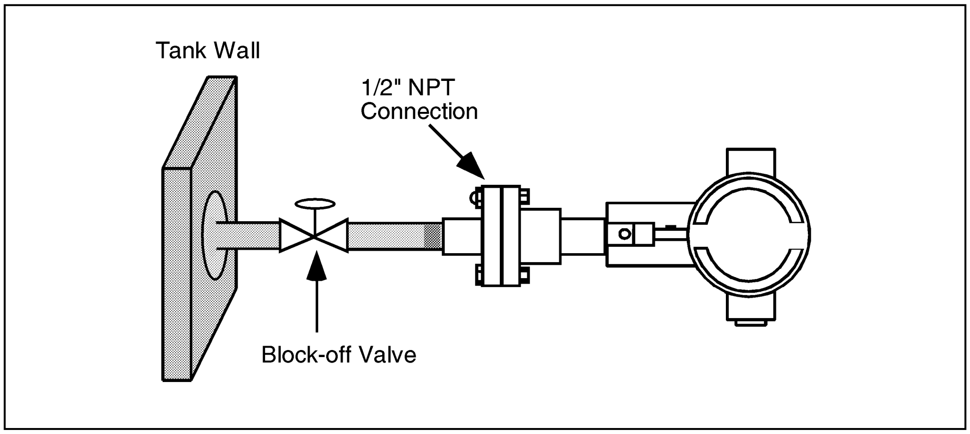
Piping Arrangements, continued

Another piping arrangement uses a block-off valve and a tee connector in the process piping to the transmitter as shown in Figure 12.

Figure 12 Typical Arrangement for ½" NPT Process Connection Piping



Transmitter location

Table 11 lists the mounting location for the transmitter depending on the process.

Table 11 Suggested Transmitter Location for Given Process

Process	Suggested Location	Explanation
Gases	Above the gas line	The condensate drains away from the transmitter.
Liquids	1. Below but close to the elevation of the process connection. 2. Level with or above the process connection.	1. This minimizes the static head effect of the condensate. 2. This requires a siphon to protect the transmitter from process steam. The siphon retains water as a "fill fluid."

ATTENTION

For liquid or steam, the piping should slope a minimum of 25.4 mm (1 inch) per 305 mm (1 foot). Slope the piping down towards the transmitter if the transmitter is below the process connection so the bubbles may rise back into the piping through the liquid. If the transmitter is located above the process connection, the piping should rise vertically above the transmitter; then slope down towards the flowline with a vent valve at the high point. For gas measurement, use a condensate leg and drain at the low point (freeze protection may be required here).

Continued on next page

ATTENTION

Care must be taken when installing transmitters on hot processes. The operating temperature limits for the device (as listed in Table 6) must not be exceeded. Impulse piping may be used to reduce the temperature of the process that comes into contact with the transmitter meter body. As a general rule there is a 56 degree C drop (100 °F) in the temperature of the process for every foot (305 mm) of ½ inch uninsulated piping.

Process connections

Table 12 describes typical process connections for a given type of transmitter.

Table 12 Process Connections

Transmitter Type	Process Connection
Differential Pressure	• Process heads with 1/4-inch NPT female connection. • Flange adapters and manifolds with 1/2-inch female connection are optional. • Models with pseudo flange on one side include 2- or 3-inch ANSI class 150 flange.
Gauge Pressure	• Process head with 1/2-inch NPT female connection (Series 100 transmitters). • In-line 1/2-inch NPT female connection (STGxxL). • Process heads with 1/4-inch NPT female connection (STG9x4). • Flange adapters and manifolds with 1/2-inch female connections are optional (STG9x4). • 2-inch Sanitary Tri-Clamp (STG1xT). • Flush mount in 1-inch weld sleeve, with O-ring and locking bolt (STG9xP).
Absolute Pressure	• Process head with 1/2-inch NPT female connection. (STAx2, x40).
Flange Mounted Liquid Level	• Small flange 1/2-inch, 1-, 1 ½ - and 2-inch (STFxxT) • 3- or 4-inch flange with flush or 2-, 4- or 6-inch extended diaphragm (See Table 13) on high pressure side.* • 2- or 3-inch flange with pseudo flush diaphragm (See Table 13) on either high or low pressure side.* • Sanitary 3-A approved flange designed to mount on a 4-inch nominal diameter tank spud with a 2- or 6-inch extension using a 4-inch Tri-Clover Tri-Clamp.*
Remote Diaphragm Seals	See Model Selection Guide for description of available Flanged, Threaded, Chemical Tee, Saddle, and Sanitary process connections.

* Reference side has standard differential pressure process head.

Continued on next page

Flange descriptions

Table 13 describes the available flange connections for flange mounted liquid level transmitters.

Table 13 Flange Description

Diaphragm Type	Description
Flush	3-inch, 150 lbs serrated-face flange with 4 holes 19 mm (3/4 in) diameter on 152 mm (6 in) diameter bolt circle and an outside diameter of 190 mm (7-1/2 in).
	3-inch, 300 lbs serrated-face flange with 8 holes 22 mm (7/8 in) diameter on 168 mm (6-5/8 in) diameter bolt circle and an outside diameter of 209 mm (8-1/4 in).
Extended	3-inch, 150 lbs serrated-face flange with 4 holes 19 mm (3/4 in) diameter on 152 mm (6 in) diameter bolt circle and an outside diameter of 190 mm (7-1/2 in).
	4-inch, 150 lbs serrated-face flange with 8 holes 19 mm (3/4 in) diameter on 184 mm (7-1/4 in) diameter bolt circle and an outside diameter of 229 mm (9 in).
	3-inch, 300 lbs serrated-face flange with 8 holes 22 mm (7/8 in) diameter on 168 mm (6-5/8 in) diameter bolt circle and an outside diameter of 209 mm (8-1/4 in).
	4-inch, 300 lbs serrated-face flange with 8 holes 22 mm (7/8 in) diameter on 200 mm (7-7/8 in) diameter bolt circle and an outside diameter of 254 mm (10 in).
Pseudo Flush	2-inch, 150 lbs serrated-face flange with 4 holes 15.9 mm (5/8 in) diameter on 120.6 mm (4-3/4 in) diameter bolt circle and an outside diameter of 152.4 mm (6 in).
	3-inch, 150 lbs serrated-face flange with 4 holes 19 mm (3/4 in) diameter on 152 mm (6 in) diameter bolt circle and an outside diameter of 190 mm (7-1/2 in).
Flush Mount	1-inch pipe mount. (316L SS standard option.)

General piping guidelines

- When measuring fluids containing suspended solids, install permanent valves at regular intervals to blow-down piping.
- Blow-down all lines on new installations with compressed air or steam and flush them with process fluids (where possible) before connecting these lines to the transmitter's meter body.
- Be sure all the valves in the blow-down lines are closed tight after the initial blow-down procedure and each maintenance procedure after that.

Continued on next page

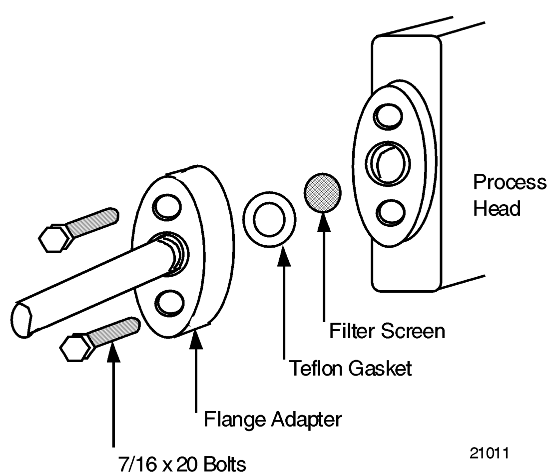
Installing flange adapter

Table 14 gives the steps for an optional flange adapter on the process head.

ATTENTION

Slightly deforming the gasket supplied with the adapter before you insert it into the adapter may aid in retaining the gasket in the groove while you align the adapter to the process head. To deform the gasket, submerse it in hot water for a few minutes then firmly press it into its recessed mounting groove in the adapter.

Table 14 Installing Flange Adapter

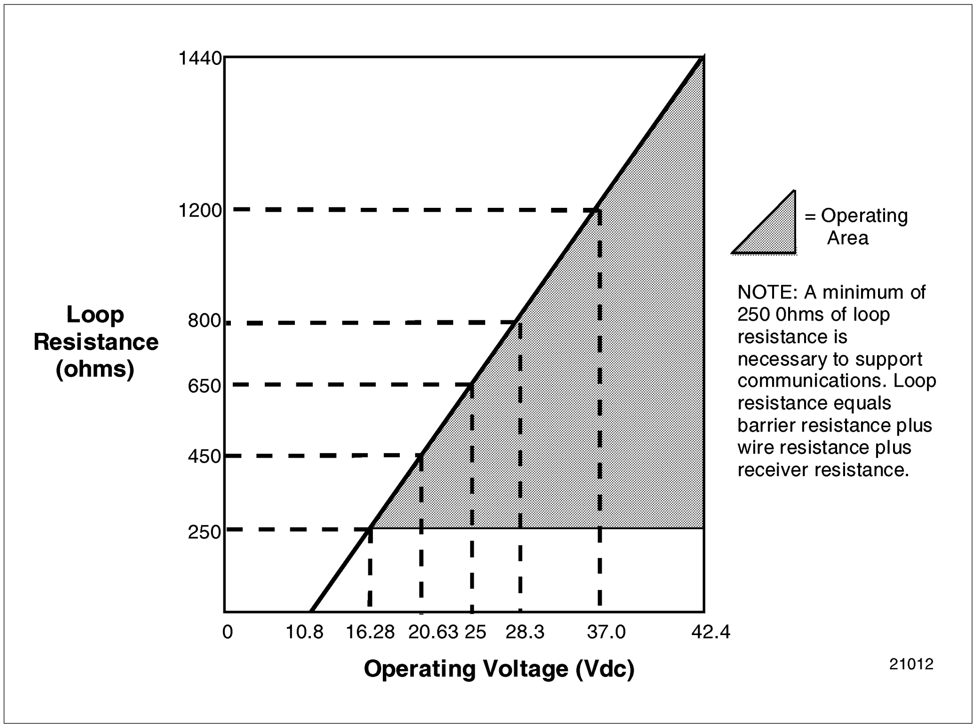
Step	Action
1	Insert filter screen (if supplied) into inlet cavity of process head.
2	Carefully seat Teflon (white) gasket into adapter groove.
3	Thread adapter onto 1/2-inch process pipe and align mounting holes in adapter with holes in end of process head as required.
4	Secure adapter to process head by hand tightening 7/16-20 hex-head bolts. Example - Installing adapter on process head.  **ATTENTION** Apply an anti-seize compound on the stainless steel bolts prior to threading them into the process head.
5	Evenly tighten adapter bolts to a torque of 47.5 to 54 N·m (35 to 40 ft-lb).

4.3 Wiring ST 3000 Transmitter

Summary

The transmitter is designed to operate in a two-wire power/current loop with loop resistance and power supply voltage within the operating range shown in Figure 13.

Figure 13 Operating Range for ST 3000 Transmitters.



Loop wiring is connected to the transmitter by simply attaching the positive (+) and negative (–) loop wires to the positive (+) and negative (–) SIGNAL screw terminals on the terminal block in the transmitter's electronics housing shown in Figure 14.

Each transmitter includes an internal ground terminal to connect the transmitter to earth ground. A ground terminal can be optionally added to the outside of the electronics housing. While it is not necessary to ground the transmitter for proper operation, we suggest that you do so to minimize the possible effects of "noise" on the output signal and provide additional protection against lightning and static discharge damage. Note that grounding may be required to meet optional approval body certification. Refer to Section 1 CE Conformity (Europe) Notice for special conditions.

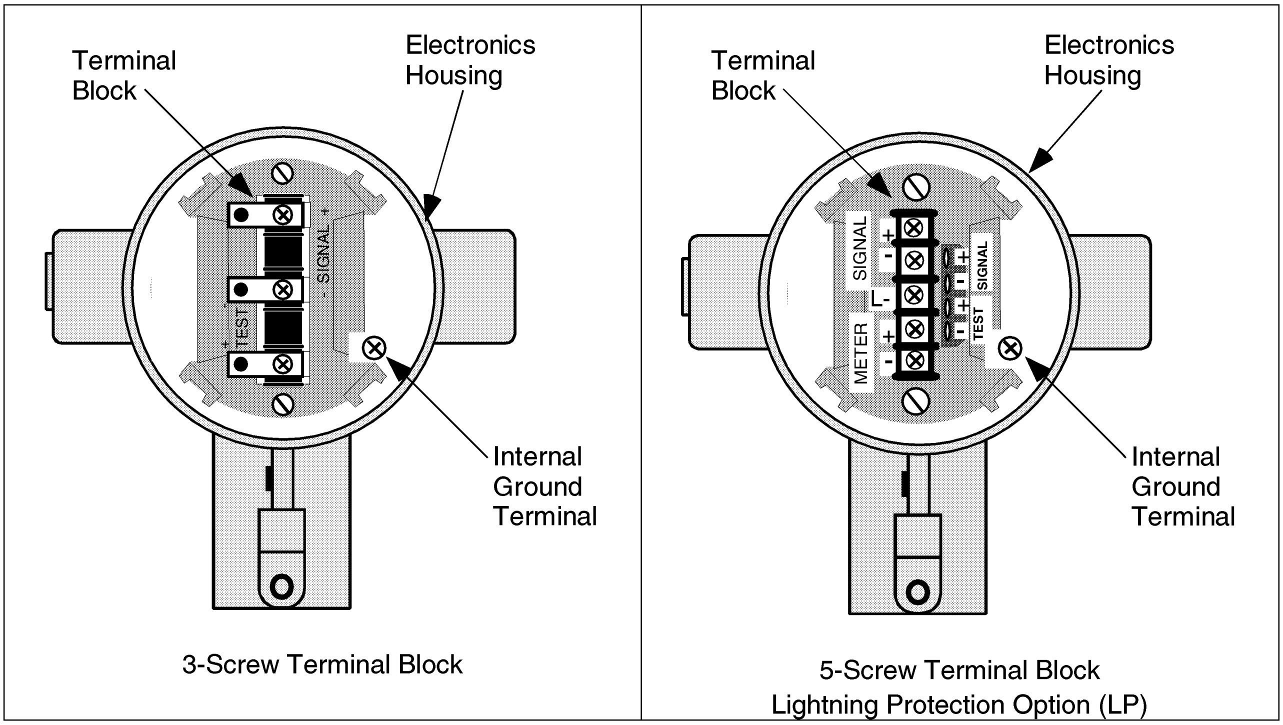
Optional lightning protection (option LP) can be ordered for transmitters that will be installed in areas highly susceptible to lightning strikes. Figure 14 shows the 5-screw terminal block used when the lightning protection option is ordered.

Continued on next page

Summary, continued

Barriers can be installed per manufacturer's instructions for transmitters to be used in intrinsically safe applications.

Figure 14 ST 3000 Transmitter Terminal Block



3-Screw Terminal Block

5-Screw Terminal Block
Lightning Protection Option (LP)

TPS reference

Transmitters that are to be digitally integrated to Honeywell's TPS system will be connected to the Smart Transmitter Interface Module in the Process Manager, Advanced Process Manager or High Performance Process Manager through a Field Termination Assembly. Details about Honeywell's TPS system connections are given in the *PM/APM Smartline Transmitter Integration Manual PM12-410* which is part of the TDC 3000^{X} system bookset.

Allen-Bradley PLC

If you are digitally integrating the ST 3000 to an Allen Bradley PLC, the same FTA and wiring procedures used with Honeywell's TPS system are also used with the Allen-Bradley 1771 and 1746 platforms.

For more information, contact:

ProSoft Technology, Inc.
(800) 326-7066 or
http://www.psft.com

Continued on next page

Wiring connections

The procedure in Table 15 shows the steps for connecting power to the transmitter. For loop wiring and external wiring diagrams, refer to the installation drawings presented in Section 5. Detailed drawings are provided for transmitter installation in non-intrinsically safe areas and for intrinsically safe loops in hazardous area locations. If you are using the transmitter with Honeywell's TPS system, see the previous TPS reference.

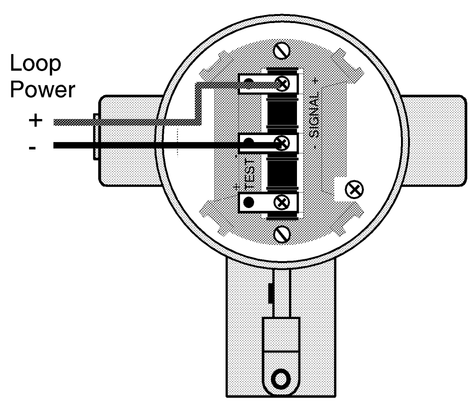
ATTENTION

- All wiring must comply with local codes, regulations, and ordinances.
- If you will be using the transmitter in a hazardous area, be sure to review the hazardous location reference data included in Appendix A of this manual before operating the transmitter.

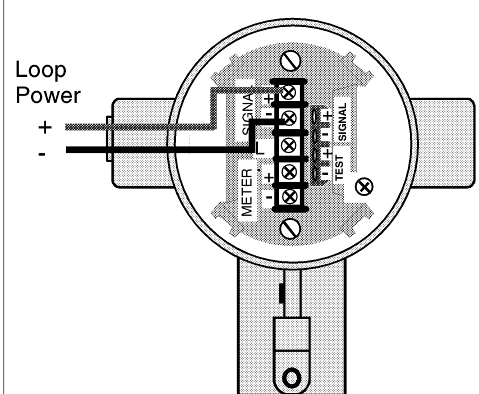
Table 15 Wiring the Transmitter

Step	Action
1	Loosen end-cap lock using a 1.5 mm allen wrench and remove end-cap cover from terminal block end of transmitter housing.
2	Feed loop power leads through one of conduit entrances on either side of transmitter housing. Plug whichever entrance you do not use. **ATTENTION** The transmitter accepts up to 16 AWG wire.
3	Observing polarity, connect positive loop power lead to SIGNAL + terminal and negative loop power lead to SIGNAL – terminal. Example - Connecting loop power to transmitter.

3-screw terminal block



5-screw terminal (option LP)



Step	Action
4	Replace end-cap, and tighten end-cap lock.

Continued on next page

Approval body requirements

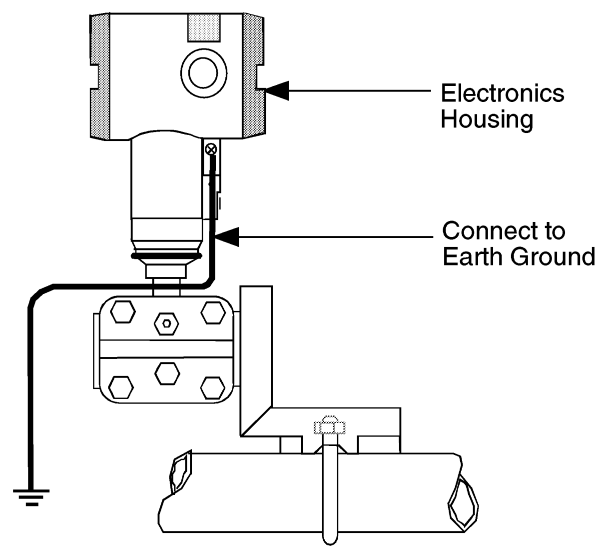
If your transmitter was ordered with Table III option 3N for self-declared approval per 94/9/EC (ATEX4), you must use a power supply that includes a voltage limiting device that will keep the voltage to the transmitter from exceeding 42 Vdc. You can achieve this by using a battery as the supply or one of these voltage limiting means.

- Double wound mains transformer per BS 3535 or equivalent.
- An adequately rated zener diode whose voltage is not significantly higher than the rated voltage.
- An adequately rated semiconductor voltage regulator.

Lightning protection

When your transmitter is equipped with optional lightning protection, you must connect a wire from the transmitter to ground as shown in Figure 15 to make the protection effective. We recommend that you use a size 8 (American Wire Gage) or ($8.37mm^2$) bare or green covered wire.

Figure 15 Ground Connection for Lightning Protection.



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Conduit seal

Transmitters installed as explosionproof in a Class I, Division 1, Group A Hazardous (Classified) Location in accordance with ANSI/NFPA 70, the US National Electrical Code (NEC), require a "LISTED" explosionproof seal to be installed in the conduit, within 18 inches of the transmitter. Crouse-Hinds® type EYS/EYD or EYSX/EYDX are examples of "LISTED" explosionproof seals that meets this requirement.

Transmitters installed as explosionproof in a Class I, Division 1, Group B, C or D Hazardous (Classified) Locations do not require an explosionproof seal to be installed in the conduit.

NOTE: Installation should conform to all national and local electrical code requirements.

WARNING

When installed as explosionproof in a Division 1 Hazardous Location, keep covers tight while the transmitter is energized. Disconnect power to the transmitter in the non-hazardous area prior to removing end caps for service.

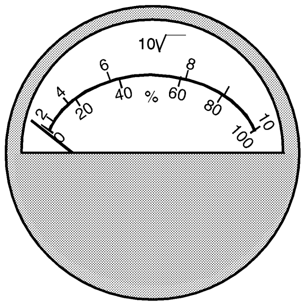
When installed as nonincendive equipment in a Division 2 Hazardous Location, disconnect power to the transmitter in the non-hazardous area, or determine that the location is non-hazardous prior to disconnecting or connecting the transmitter wires.

Continued on next page

Existing meter connections

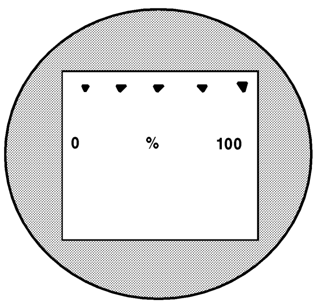
Existing analog meters and SM 3000 Smart Meters can be connected to Release 300 transmitters. Examples of each meter type are shown below.

Analog Meter



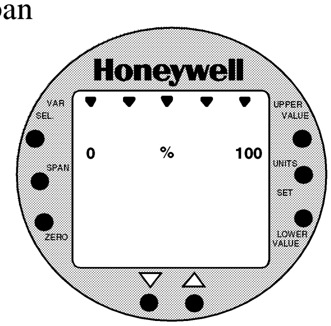
Analog Meter Connections —You can connect the analog meter (2-wires) integrally to Release 300 transmitter's terminal block inside the electronics housing. However, there are alternate wiring methods for connecting an analog meter remotely with the loop wiring. Section 13 in this manual illustrates alternate wiring methods for connecting an analog meter to Release 300 transmitters.

Smart Meter



SM 3000 Smart Meter Connections —The smart meter (3-wires) can be connected remotely to a Release 300 transmitter. Section 13 in this manual illustrates alternate wiring methods for connecting this smart meter to Release 300 transmitters.

New Smart Meter with Local Zero and Span



New Smart Meter Connections – The new integral smart meter (8-wires) is connected directly to the transmitter's PWA and is mounted to the electronics module assembly inside the electronics housing. The new integral smart meter is designed for the ST 3000 Release 300 transmitter and provides functionality not available with other smart meter designs.

NOTE: Only one smart meter should be installed integrally to the transmitter.

ATTENTION

Be aware that the RMA 300 remote meter does not have custom and flow units capability like the new smart meter. Therefore, if you use a local smart meter that is configured to display readings in custom or flow units in conjunction with an RMA 300 remote meter, the readings of the two meters will be in different units.

Section 5 —Reference Drawings

5.1 Wiring Diagrams and Dimension Drawing List

Contents

This section contains external wiring diagrams for guidance in wiring the transmitter and remote meters in hazardous and nonhazardous locations. Tables listing the available dimension drawings for ST 3000 transmitters are provided for reference.

External Wiring Diagrams

These wiring diagrams are included in numerical order behind this section for wiring reference.

ST 3000 Release 300 Series 100, 900 Transmitters

Description	Drawing Number
For non-intrinsically safe application	30753607
For intrinsically safe application (FM)	51204241
For intrinsically safe application (CSA)	51204242
For intrinsically safe application (CENELEC)	51204243

Continued on next page

Dimension Drawings

The tables on the following pages list available dimension drawings for reference. If you need a copy of a drawing, please determine the appropriate drawing number from the following tables and contact your Honeywell representative to obtain a copy.

Dimension Drawings - Series 100 and Series 900

Transmitter Type and Key Number	Table Selections	Mounting				Drawing Number
		Angle Bracket (MB), (SB)		Flat Bracket (FB)		
		Vertical Pipe	Horizontal Pipe	Vertical Pipe	Horizontal Pipe	
Differential Pressure						
STD110, STD120, STD125*,	See Key Number	51205895		51205893		⇐
STD130, STD170	Column		51205894		51205892	⇐
*STD125	–	Tank HTG				30756435-000
STD904, STD924, STD930,	Table I -	51500357		51500355		⇐
STD974	C, D, G, H, K, L		51500356		51500354	⇐
STD924, STD930	Table I -	X		X		
	A, B, E, F, J		X		X	

Transmitter Type and Key Number	Equipped with A-G manifold part #	Angle Bracket (MB), (SB)		Flat Bracket (FB)		Drawing Number
		Vertical Pipe	Horizontal Pipe	Vertical Pipe	Horizontal Pipe	
Differential Pressure (with Anderson-Greenwood 3-way valve manifold)						
STD110, STD120, STD125*,	M4AV1	51500426	51500424	51500428	51500422	⇐
STD130, STD170	M4TV1	51500427	51500425	51500429	51500423	⇐
STD924, STD930	M4AV1	51500431	51500433	51500435	51500437	⇐
	M4TV1	51500430	51500432	51500434	51500436	⇐
STD904, STD924, STD930,	M4AV1	51500442	51500440	51500444	51500438	⇐
STD974	M4TV1	51500443	51500441	51500445	51500439	⇐

Continued on next page

Dimension Drawings - Series 100 and Series 900, Continued

Transmitter Type and Key Number	Table Selections	Mounting				Drawing Number
		Angle Bracket (MB), (SB)		Flat Bracket (FB)		
		Vertical Pipe	Horizontal Pipe	Vertical Pipe	Horizontal Pipe	
Gauge and Absolute Pressure						
STG944, STG974	See Key Number	51500411		51500409		⇐
	Column		51500410		51500408	⇐
STG140, STG170, STG180,	See Key Number	51500362		51500360		⇐
STA122, STA140	Column		5500361		51500359	⇐
STA922, STA940		51500366		515004364		⇐
			51500365		51500363	⇐
STG14L, STG17L, STG18L		51500373		51500371		⇐
			51500372		51500370	⇐
STG90L, STG94L, STG97L,		51500377		51500375		⇐
STG98L			51500376		51500374	⇐
STG14T (High Temperature)	½-inch NPT					51404482
	Flush Sanitary Seal					51404484

Continued on next page

Dimension Drawings – Series 100 and Series 900, Continued

Transmitter Type and Key Number	Table Selections	Mounting	Drawing Number
Flange Mount			
STF128, STF132	Table II (Flush) 0_1F0, 0_2F0, 0_3F0	–	51500404
	Table II (Extended) 0_5_0	–	51500405
	Table I Z_ _ (Sanitary) Table II 0S0_0	–	51500418
STF924, STF932	Table II (Flush) 0_1F0, 0_2F0, 0_3F0	–	51500406
	Table II (Extended) 0_5_0	–	51500407
	Table I Z_ _ (Sanitary) Table II 0S0_0	–	51500419
STF12F, STF13F	–	–	51500420
STF92F, STF93F	–	–	51500421
STF14F	–	Tank HTG	30756436-000 30755981-000
STF14T (High Temperature)	½, 1, 1 ½, and 2-inch Flange	–	51404481
Flush Mount			
STG93P	–	–	51404716-000

Continued on next page

Dimension Drawings - Series 100 and Series 900, Continued

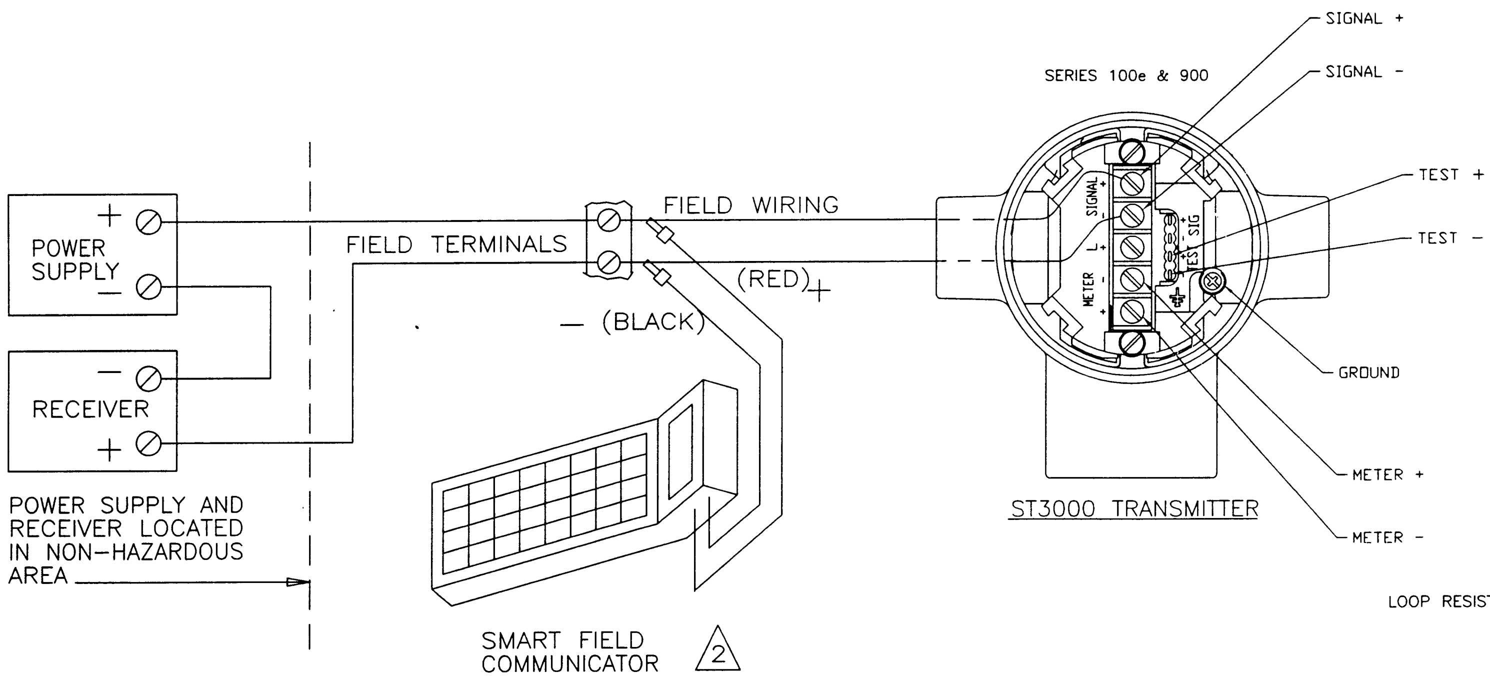
Transmitter Type and Key Number	Table Selections	Mounting				Drawing Number
		Angle Bracket (MB), (SB)		Flat Bracket (FB)		
		Vertical Pipe	Horizontal Pipe	Vertical Pipe	Horizontal Pipe	
Remote Seals						
STR14A**	–	51500415		51500413		⇐
	–		51500414		51500412	⇐
STR12D**, STR13D**	Table I 2_ _	51500399		51500397		⇐
			51500398		51500396	⇐
	Table I 1_ _, 3_ _	51500403		51500401		⇐
			51500402		51500400	⇐
STR12D**	Table I _ _D	–				51500386
STR93D **	Table I 1_ _, 3_ _	51500395		51500393		⇐
			51500394		51500392	⇐
	Table I 2_ _	51500391		51500389		⇐
			51500390		51500388	⇐
	Table I _2_ or _6_	–				51402418-000
STR14G**, STR17G**	–	51500381		51500379		⇐
	–		51500380		51500378	⇐
STR14G, STR17G, STR94G	Table I _2_ or _6_	–				51402418-000
STR94G**	–	51500385		51500383		⇐
	–		51500384		51500382	⇐
STR94G**	Table I _ _D	–				51500387

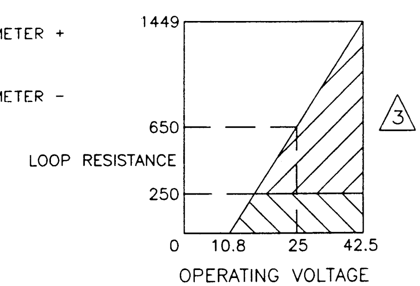
(See next page for ** reference)

Continued on next page

Dimension Drawings - Series 100 and Series 900, Continued

Transmitter Type and Key Number	Table Selections	Mounting	Drawing Number
****STR_ _ _***	***Table II***		
Flush Flange 3.5" diaphragm	_ _ _A_ _ _ _ _ _ _ _	–	51305141-000
Off Line Flange 2.4" diaphragm	_ _ _B _ _ _ _ _ _ _		51305138-000
Off Line Flange 2.9" diaphragm	_ _ _C _ _ _ _ _ _ _ _		51305139-000
Off Line Flange 4.1" diaphragm	_ _ _D _ _ _ _ _ _ _ _		51305140-000
Extended Flange 2.9" diaphragm	_ _ _E _ _ _ _ _ _ _ _		51305137-000
Extended Flange 3.5" diaphragm	_ _ _F_ _ _ _ _ _ _ _		51305137-000
Pancake Seal	_ _ _G_ _ _ _ _ _ _ _		51305144-000
Chemical Tee "Taylor" Wedge	_ _ _H_ _ _ _ _ _ _ _		51305144-000
Threaded Connection 2.4" diaphragm	_ _ _J_ _ _ _ _ _ _ _		51305148-000
Threaded Connection 2.9" diaphragm	_ _ _K_ _ _ _ _ _ _ _		51305148-000
Threaded Connection 4.1" diaphragm	_ _ _L_ _ _ _ _ _ _ _		51305148-000
Sanitary Seal 1.9" diaphragm	_ _ _M_ _ _ _ _ _ _ _		51305143-000
Sanitary Seal 2.4" diaphragm	_ _ _N_ _ _ _ _ _ _ _		51305143-000
Sanitary Seal 2.9" diaphragm	_ _ _P_ _ _ _ _ _ _ _		51305143-000
Sanitary Seal 4.1" diaphragm	_ _ _Q_ _ _ _ _ _ _ _		51305143-000
Saddle Seal	_ _ _R_ _ _ _ _ _ _ _		51305142-000





SHEET	1	2	3	4	5
SIZE		C		·	

ISS	REVISION & DATE	APPD
1	RELEASED 062383	KG
2	REV'D 9-10-91	JK
3	REV'D 4-3-95 C0952172 #10	JK
4	REV'D 07/07/00 F202130	RGV

PRE REL

30753607

ST3000 Series 100 / 900 Non-Intrinsically Safe			
Lightning Proof Option		Non-Lightning Proof Option	
Sht. 1	Non-Intrinsically Safe	Sht. 2	Non-Intrinsically Safe

3. CROSS HATCHED AREA IS USABLE OPERATING AREA; A MINIMUM OF 250 OHMS OF LOOP RESISTANCE IS NECESSARY TO SUPPORT COMMUNICATION.

2. SMART FIELD COMMUNICATOR MAY BE CONNECTED AT ANY POINT IN THE LOOP BETWEEN THE BARRIERS(S) AND THE ST3000 TRANSMITTER AT WHICH CONNECTIONS ARE ACCESSIBLE.
THERE MUST BE A MINIMUM SERIES RESISTANCE OF 250 OHMS BETWEEN THE SMART FIELD COMMUNICATOR CONNECTION POINT AND POWER SUPPLY. SEE INSTRUCTION MANUAL.

1. LOOP RESISTANCE EQUALS WIRE RESISTANCE + RECEIVER RESISTANCE.

NOTES:

PROJECTION	DRAWN	CADCAM	061383
	CHECKED	K/G	6/14/83
LINEAR MEASURE INCH	DEV ENGR	F.H.	6/24/83
MATERIAL	MFG ENGR		
	QA ENGR MAT ENGR	JFS	6/23/83
FINISH			

Honeywell

EXTERNAL WIRING DIAGRAM
ST3000 SERIES TRANSMITTER
NON INTR. SAFE SYS MODEL

B/A3 30753607

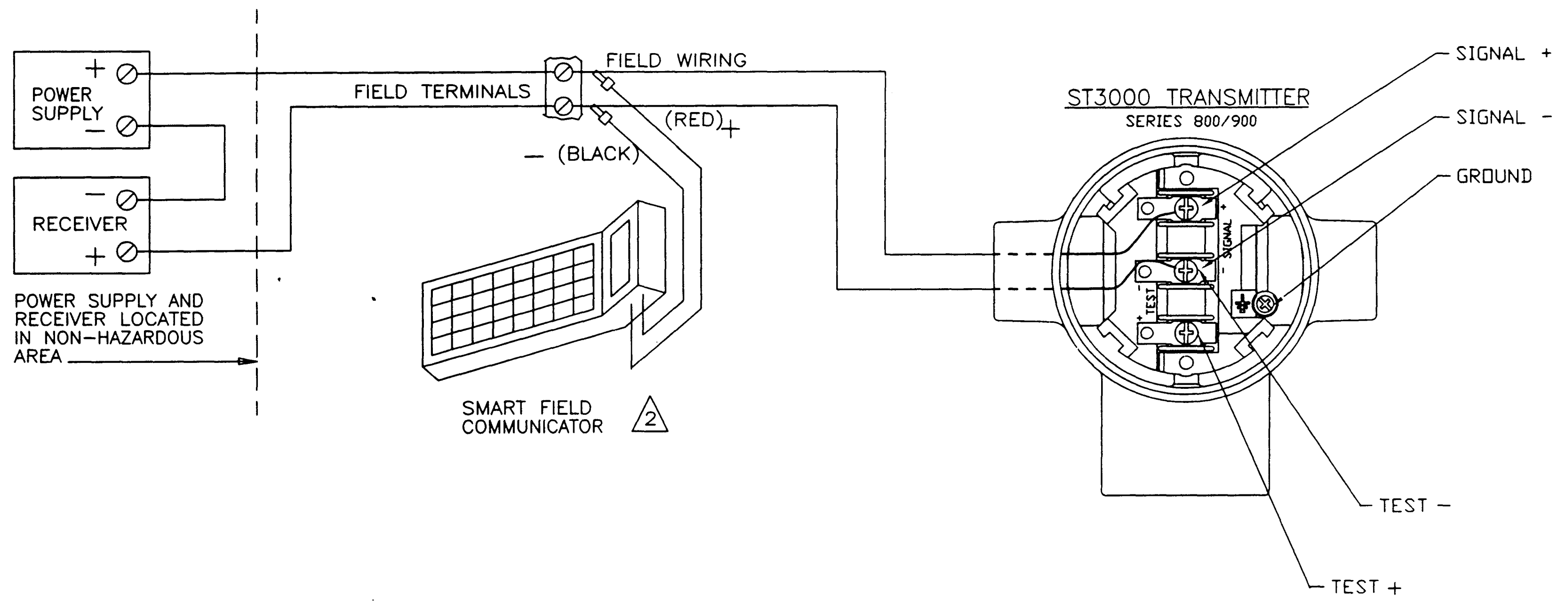
SCALE none | USED ON | SHT 1 OF 2

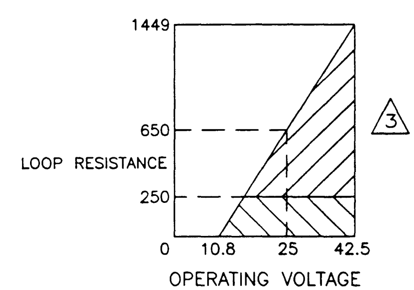
CAD

AMx CA KM BH PXc FW

CADFILE #:753607-1.DWG

DO NOT SCALE DRAWING





3. CROSS HATCHED AREA IS USABLE OPERATING AREA; A MINIMUM OF 250 OHMS OF LOOP RESISTANCE IS NECESSARY TO SUPPORT COMMUNICATION.

2. SMART FIELD COMMUNICATOR MAY BE CONNECTED AT ANY POINT IN THE LOOP BETWEEN THE BARRIERS(S) AND THE ST3000 TRANSMITTER AT WHICH CONNECTIONS ARE ACCESSIBLE. THERE MUST BE A MINIMUM SERIES RESISTANCE OF 250 OHMS BETWEEN THE SMART FIELD COMMUNICATOR CONNECTION POINT AND POWER SUPPLY. SEE INSTRUCTION MANUAL.

1. LOOP RESISTANCE EQUALS WIRE RESISTANCE + RECEIVER RESISTANCE.

NOTES:

Honeywell C/A3 30753607
SCALE NONE REV 4 DATE 07/07/00 SHT 2 OF 2

CADFILE #: 753607-3 DWG

DO NOT SCALE DRAWING

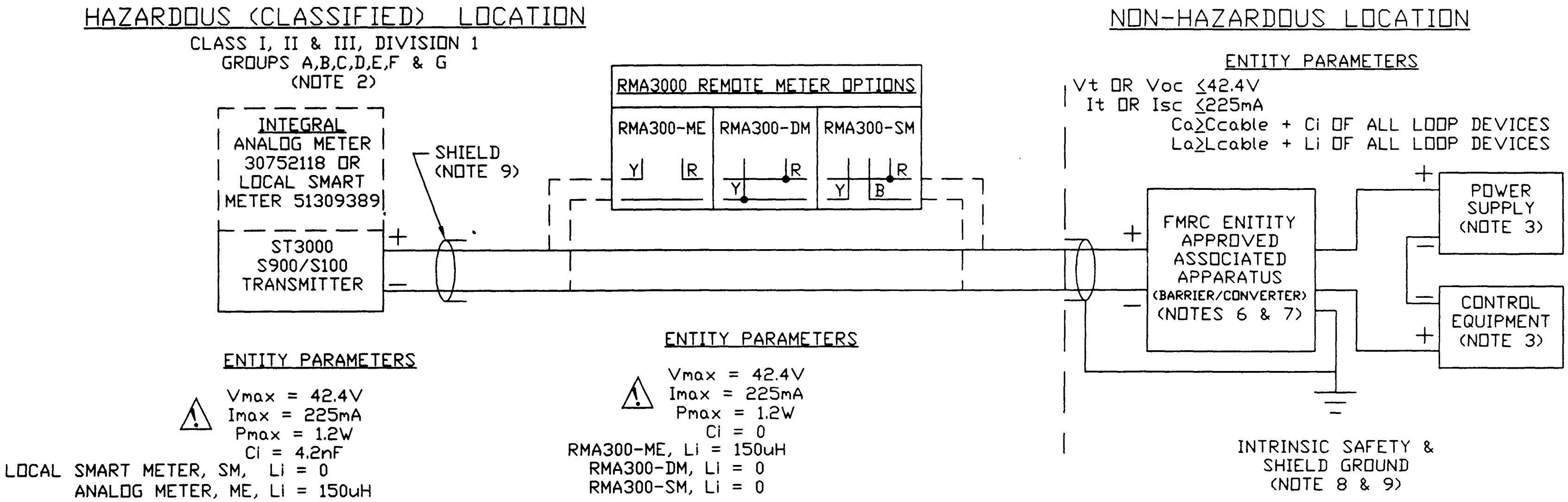
CAD

30753607 C

51204241

SHEET	1	2	3	4	5	6	7	8	9
REV	C	C	C	C	C	C	C	C	C

ISS	REVISION & DATE	APPD
A	RELEASE F972430 9/29/97	D.A.
B	REV'D F992235 10/13/99	WF
C	REV'D F202130 07/07/00	RGV



CERTIFICATION DOCUMENT
ENGINEERING CHANGES (ECO'S) MUST BE AUTHORIZED BY APPROVALS SPECIALIST

NOTES:

1. Vmax ≥Voc OR Vt, Imax ≥ Isc OR It, ΣCi + Ccable ≤ CaΣ Li + Lcable ≤La.
2. FOR CLASS II & CLASS III INSTALLATIONS WHERE RIGID METAL CONDUIT IS NOT USED, SEAL CABLE ENTRIES AGAINST DUST AND FIBERS USING A NRTL LISTED CABLE GLAND FITTING.
3. CONTROL EQUIPMENT CONNECTED TO ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250V.
4. INSTALLATION MUST BE IN ACCORDANCE WITH ARTICLE 504 OF THE NEC®, ANSI/NFPA 70, AND ANSI/ISA RP12.6.
5. NO REVISION TO THIS DRAWING IS PERMITTED WITOUT FMRC APPROVAL.
6. ASSOCIATED APPARATUS MUST BE FMRC APPROVED. ASSOCIATED APPARATUS MAY BE INSTALLED IN CLASS I, DIVISION 2 HAZARDOUS (CLASSIFIED) LOCATION IF SO APPROVED.
7. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
8. NON-GALVANICALLY ISOLATED ASSOCIATED APPARATUS (ZENER BARRIERS) MUST BE CONNECTED TO A SUITABLE GROUND ELECTRODE PER NFPA 70, ARTICLE 504. THE RESISTANCE OF THE GROUND PATH MUST BE LESS THAN 1 OHM.
9. SHIELDED WIRE IS REQUIRED FOR CE CONFORMITY AND RECOMMENDED FOR OTHER APPLICATIONS. SHIELD GROUNDED AT SUPPLY (BARRIER) END ONLY.

ST3000 Series 100 / 900 Intrinsically Safe FM			
Lightning Proof Option		Non-Lightning Proof Option	
Sheets 1 to 5		Sheets 6 to 9	
Sheets 1	Intrinsically Safe - FM	Sheets 6	RMA 3000 - SM
Sheets 2	RMA 3000 - SM	Sheets 7	RMA 3000 - ME
Sheets 3	RMA 3000 - ME	Sheets 8	ME (Analog Meter)
Sheets 4	ME (Analog Meter)	Sheets 9	RMA 3000 - DM
Sheets 5	RMA 3000 - DM		

PROJECTION | LINEAR MEASURE: INCH | MATERIAL | FINISH

DRAWN	R.D.G.	5/1/97
CHECKED		
DEV ENGR	J.G.	9/10/97
MFG ENGR	F.F.	9/18/97
QA ENGR / MAT ENGR	T.H.	9/12/97

Honeywell

ST 3000 S900/S100
CONTROL DRAWING
INTRINSICALLY SAFE-FM

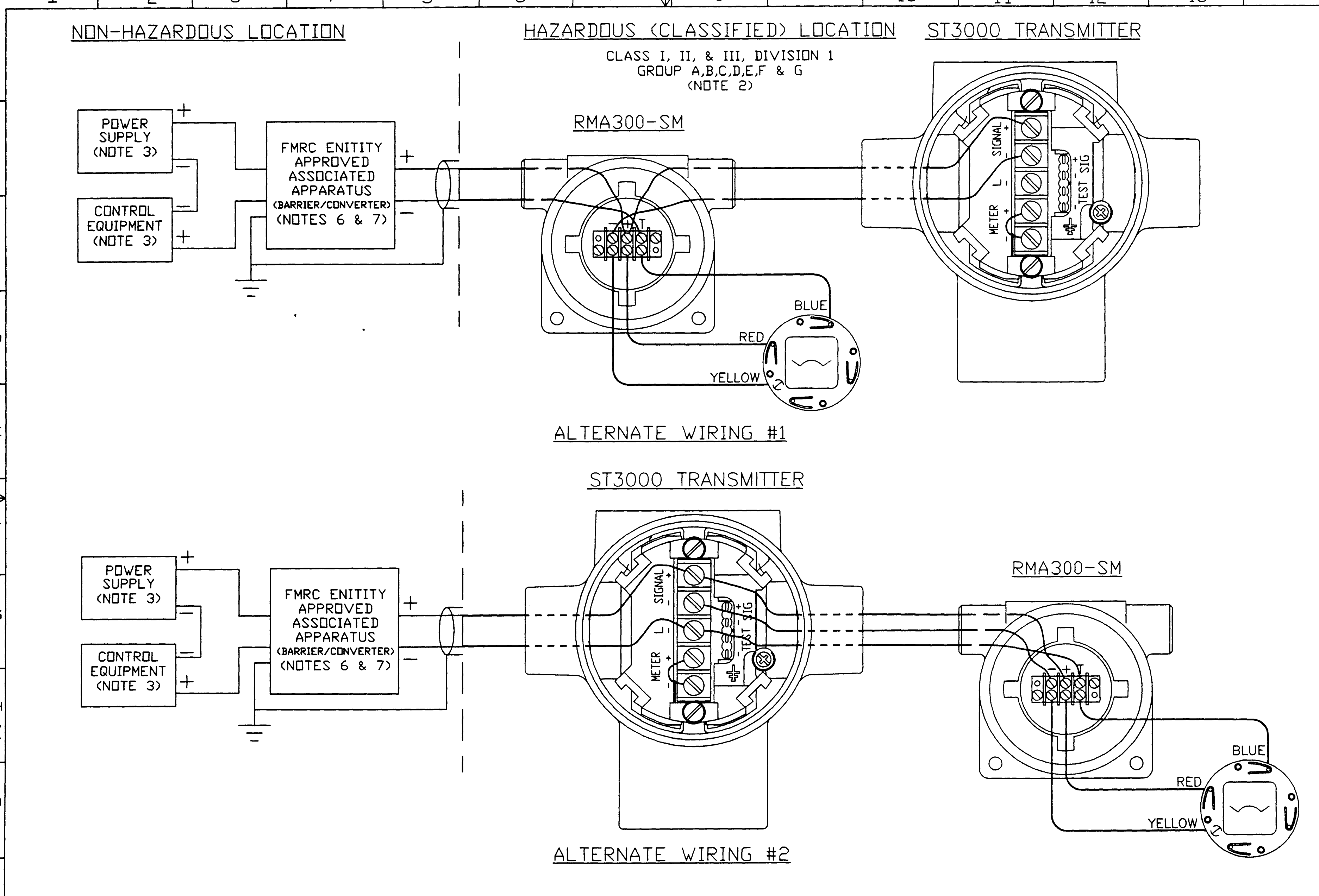
C A2 51204241

SCALE NONE | USED ON | SHT 1 OF 9

DO NOT SCALE DRAWING

CADFILE: 204241-1.DWG

C 51204241



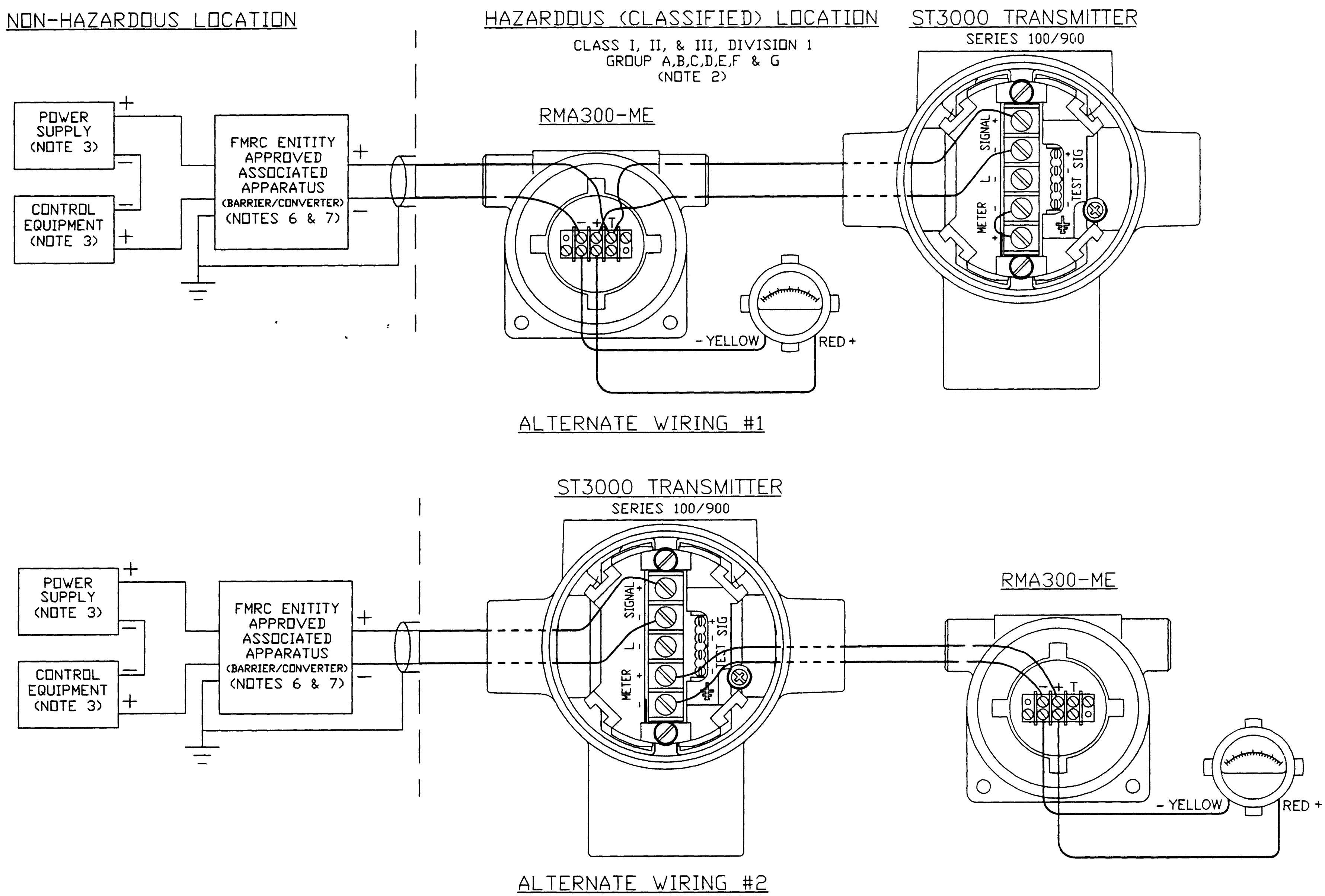
RMA3000 REMOTE METER OPTION
SMART METER MODEL RMA300-SM

Honeywell C/A3 51204241

SCALE NONE | REV C | DATE07/07/00 | SHT 2 OF 9

CADFILE #: 204241-2.DWG

DO NOT SCALE DRAWING



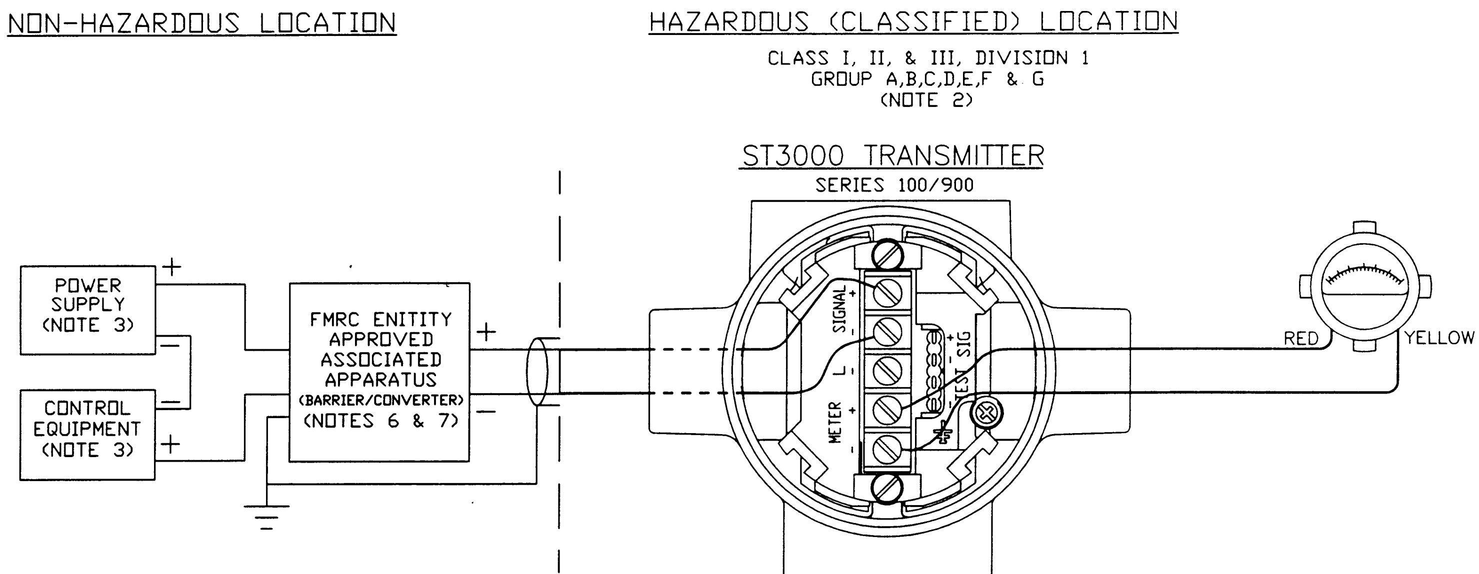
RMA3000 REMOTE METER OPTION
ANALOG METER MODEL RMA300-ME

Honeywell	C/A3	51204241	
SCALE NONE	REV C	DATED 07/07/00	SHT 3 OF 9

CADFILE #: 204241-3.DWG

DO NOT SCALE DRAWING

51204241 C

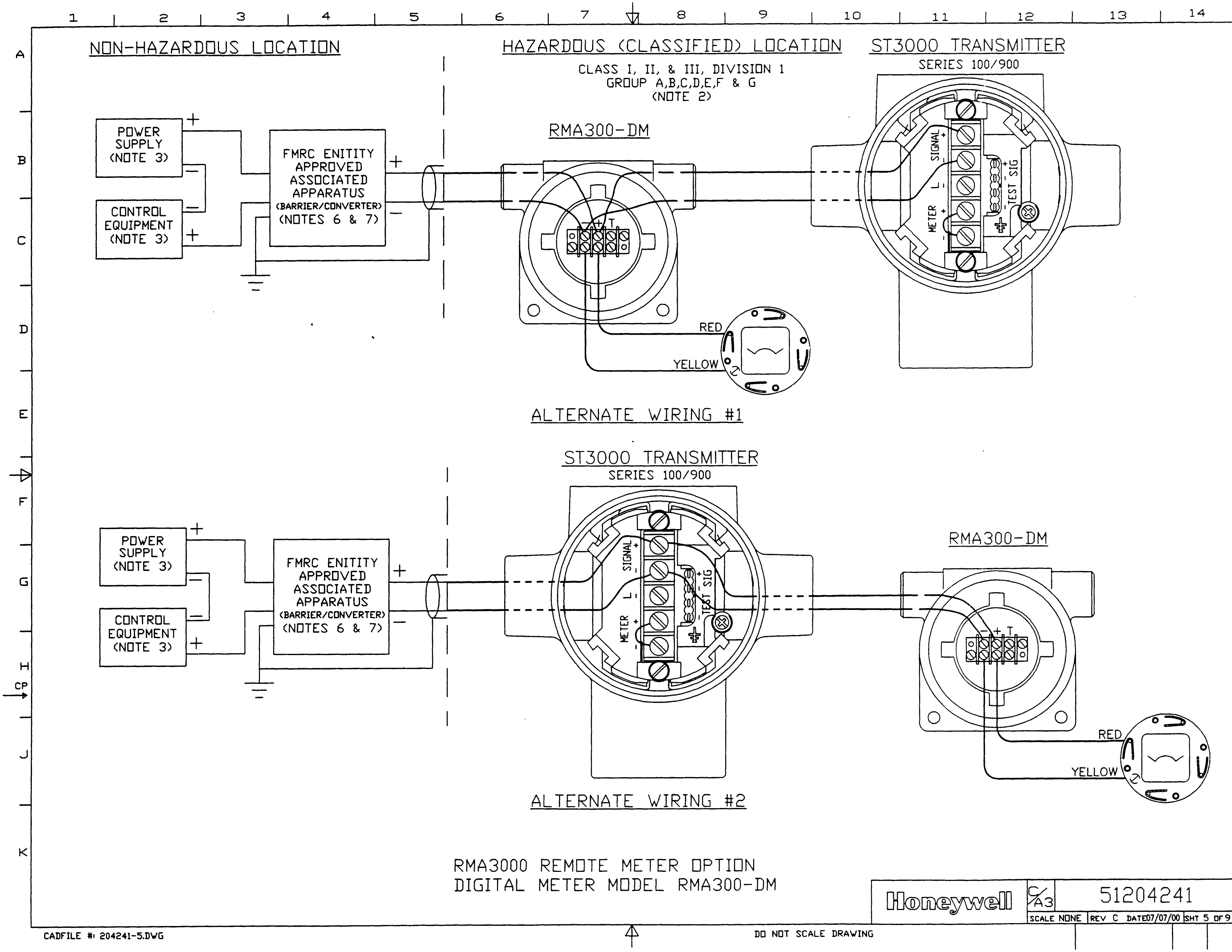


INTEGRAL METER OPTION (ME)

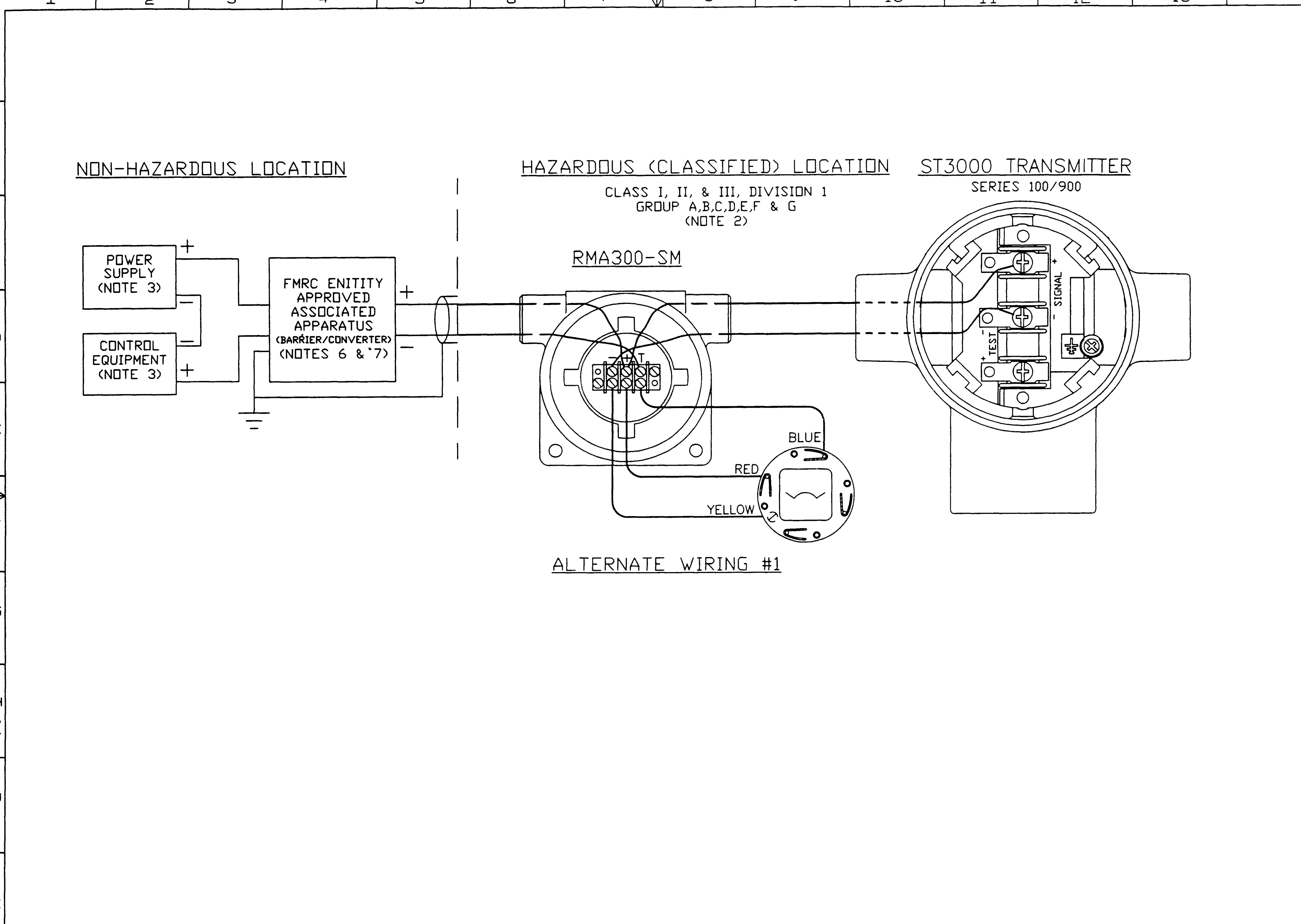
Honeywell	C/A3	51204241
SCALE NONE	REV C DATED 07/07/00	SHT 4 OF 9

CADFILE #: 204241-4.DWG

DO NOT SCALE DRAWING



NON-HAZARDOUS LOCATION
HAZARDOUS (CLASSIFIED) LOCATION
CLASS I, II, & III, DIVISION 1
GROUP A,B,C,D,E,F & G
(NOTE 2)
ST3000 TRANSMITTER
SERIES 100/900
POWER SUPPLY (NOTE 3)
CONTROL EQUIPMENT (NOTE 3)
FMRC ENITITY APPROVED ASSOCIATED APPARATUS (BARRIER/CONVERTER) (NOTES 6 & 7)
RMA300-DM
SIGNAL
L
METER
TEST SIG
RED
YELLOW
ALTERNATE WIRING #1
ST3000 TRANSMITTER
SERIES 100/900
POWER SUPPLY (NOTE 3)
CONTROL EQUIPMENT (NOTE 3)
FMRC ENITITY APPROVED ASSOCIATED APPARATUS (BARRIER/CONVERTER) (NOTES 6 & 7)
RMA300-DM
RED
YELLOW
ALTERNATE WIRING #2
RMA3000 REMOTE METER OPTION
DIGITAL METER MODEL RMA300-DM
Honeywell
C/A3
51204241
SCALE NONE REV C DATE07/07/00 SHT 5 OF 9
CADFILE #: 204241-5.DWG
DO NOT SCALE DRAWING



Honeywell C/A3 51204241
SCALE NONE | REV C | DATE07/00/00 | SHT 6 OF 9

CADFILE #: 204241-6.DWG

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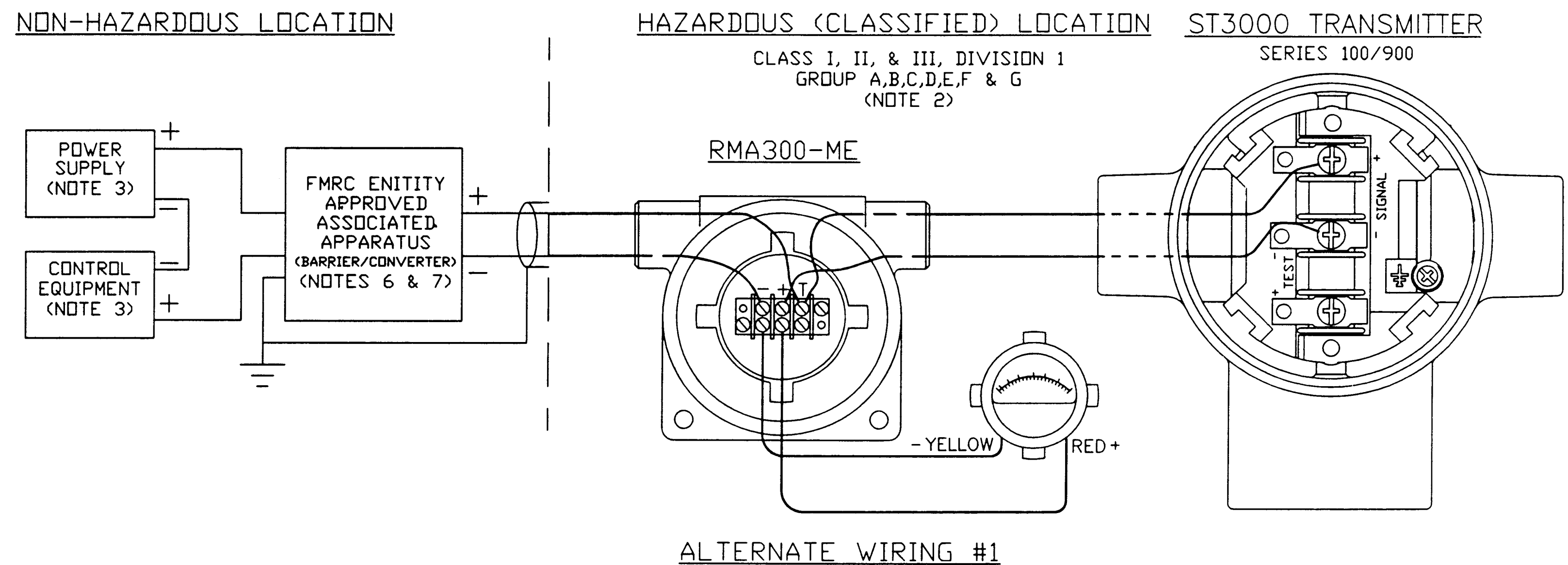
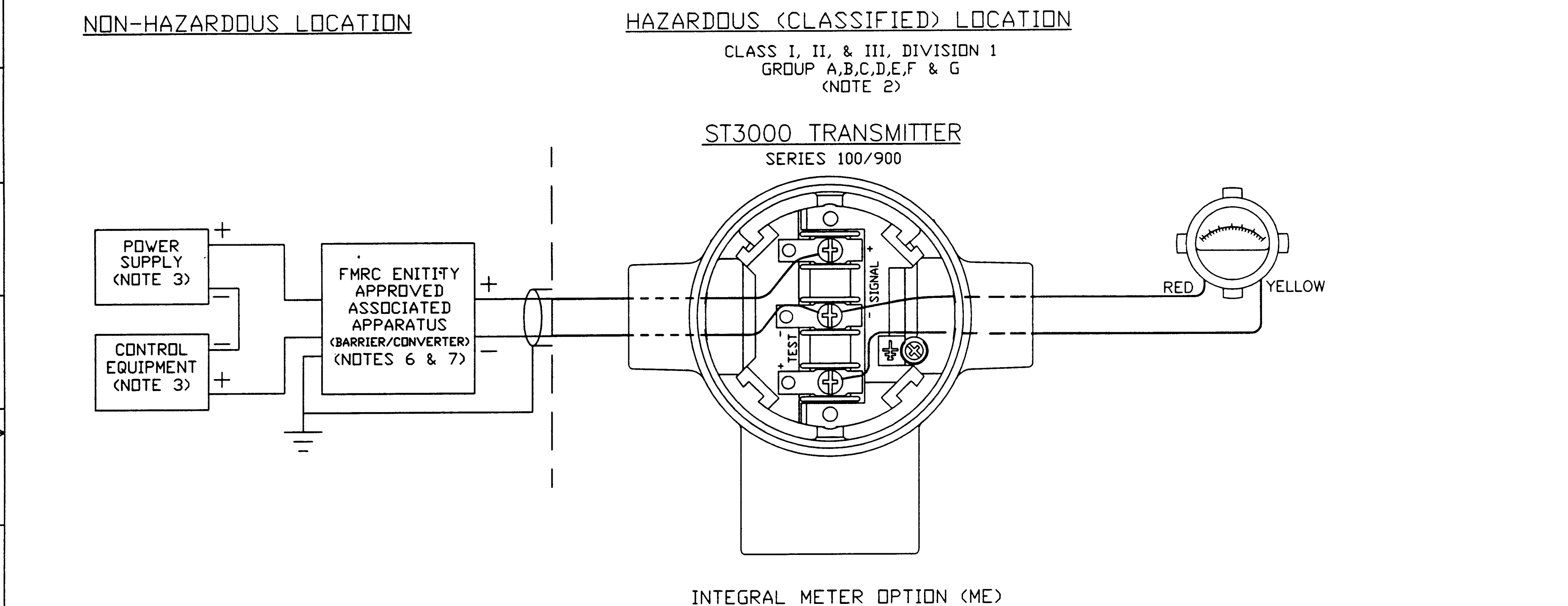

NON-HAZARDOUS LOCATION
HAZARDOUS (CLASSIFIED) LOCATION
CLASS I, II, & III, DIVISION 1
GROUP A,B,C,D,E,F & G
(NOTE 2)
ST3000 TRANSMITTER
SERIES 100/900
POWER SUPPLY (NOTE 3)
CONTROL EQUIPMENT (NOTE 3)
FMRC ENITITY APPROVED ASSOCIATED APPARATUS (BARRIER/CONVERTER) (NOTES 6 & 7)
RMA300-ME
SIGNAL
TEST
- YELLOW
RED +
ALTERNATE WIRING #1



Honeywell | C/A3 | 51204241

SCALE NONE | REV C | DATED 07/07/00 | SHT 8 OF 9

CADFILE #: 204241-8.DWG

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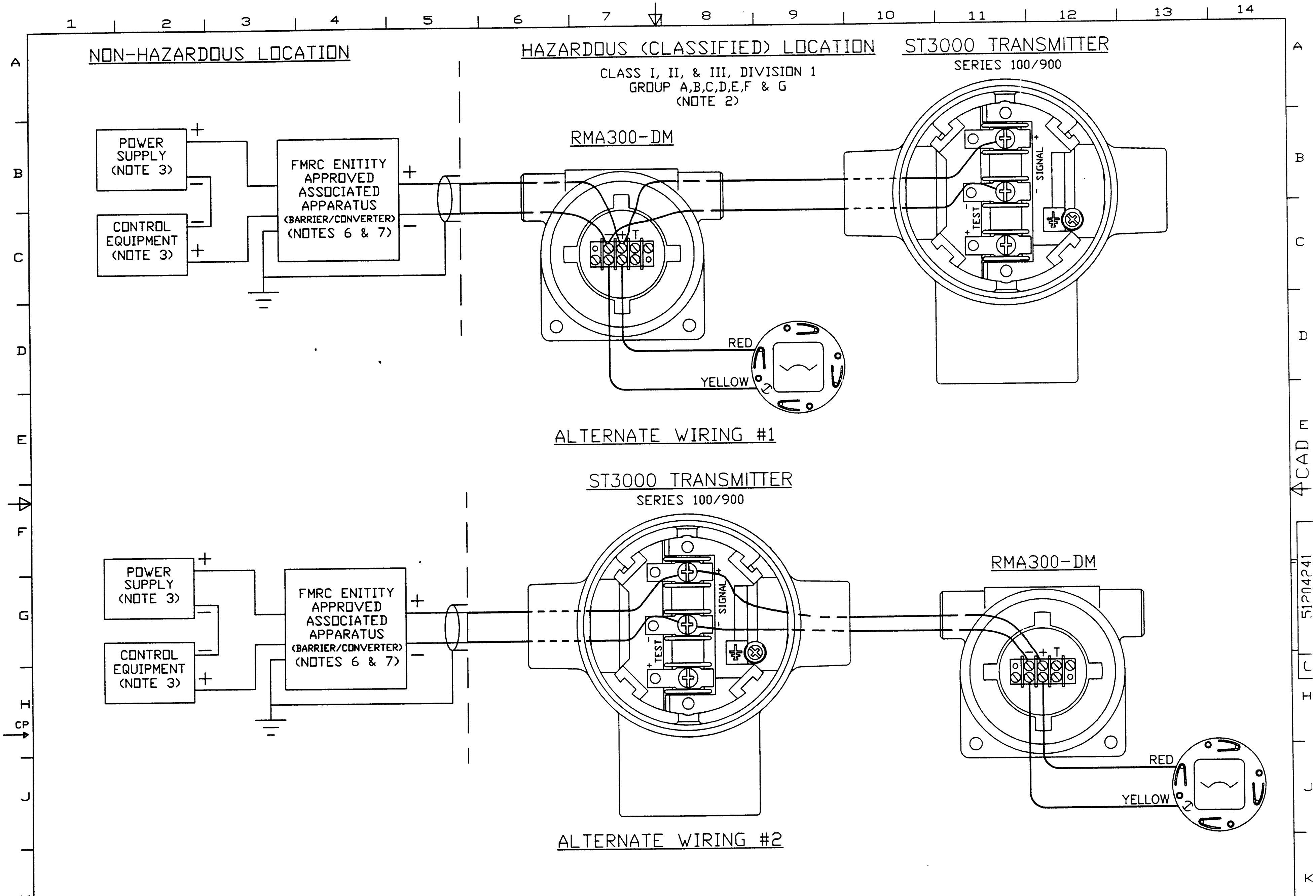


RMA3000 REMOTE METER OPTION
DIGITAL METER MODEL RMA300-DM

Honeywell	C/A3	51204241
SCALE NONE	REV C DATE 07/07/00	SHT 9 OF 9

DO NOT SCALE DRAWING

CADFILE #: 204241-9.DWG

SHEET	1	2	3	4	5	6	7	8	9
SIZE	C	C	C	C	C	C	C	C	C

PRE REL			
ISS	REVISION & DATE		APPD
A	RELEASE 9/29/97	F972430	D.A.
B	REV'D 07/07/00	F202130	RGV

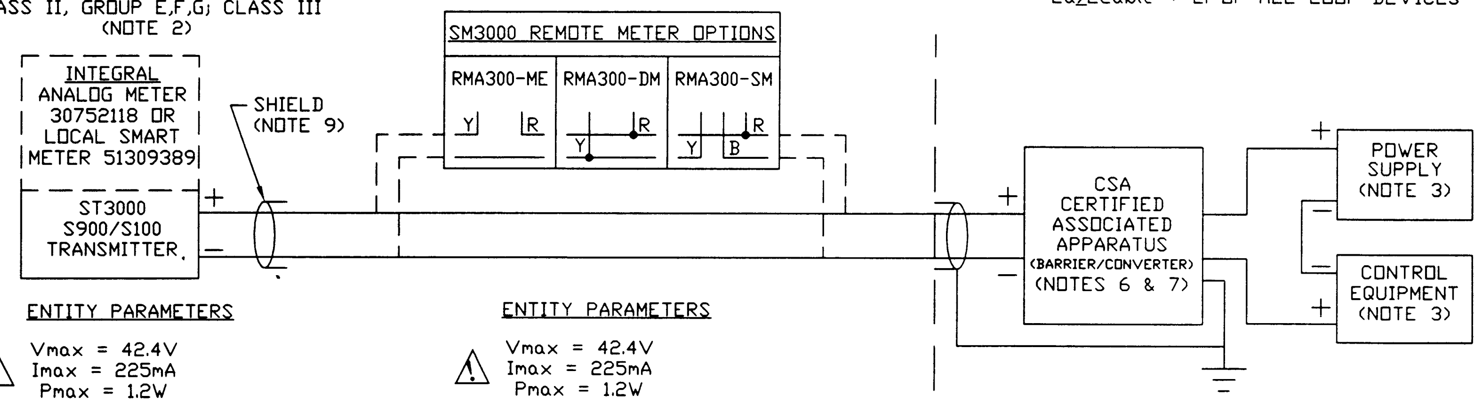
HAZARDOUS (CLASSIFIED) LOCATION

'Exia'
INTRINSICALLY SAFE/SECURITE INTRINSEQUE
CLASS I, GROUP A,B,C,D
CLASS II, GROUP E,F,G; CLASS III
(NOTE 2)

NON-HAZARDOUS LOCATION

ENTITY PARAMETERS

Voc ≤42.4V
Isc ≤225mA
Ca≥Ccable + Ci OF ALL LOOP DEVICES
La≥Lcable + Li OF ALL LOOP DEVICES



ENTITY PARAMETERS

Vmax = 42.4V
Imax = 225mA
Pmax = 1.2W
Ci = 4.2nF
LOCAL SMART METER, SM, Li = 0
ANALOG METER, ME, Li = 150uH

ENTITY PARAMETERS

Vmax = 42.4V
Imax = 225mA
Pmax = 1.2W
Ci = 0
RMA300-ME, Li = 150uH
RMA300-DM, Li = 0
RMA300-SM, Li = 0

INTRINSIC SAFETY &
SHIELD GROUND
(NOTE 8 & 9)

NOTES:

1. CSA PARAMETRIC OR ENTITY CERTIFIED BARRIERS MAY BE USED, BARRIERS MUST BE INSTALLED IN ACCORDANCE WITH MANUFACTURES INSTRUCTIONS, FOR THE ENTITY EVALUATION Vmax ≥Voc, Imax ≥ Isc, CI≤ Co, Li ≤Lo.
2. FOR CLASS II & CLASS III INSTALLATIONS WHERE RIGID METAL CONDUIT IS NOT USED, SEAL CABLE ENTRIES AGAINST DUST AND FIBERS USING A NRTL LISTED CABLE GLAND FITTING.
3. CONTROL EQUIPMENT CONNECTED TO ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250V.
4. INSTALLATION MUST BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE, PART 1.
5. NO REVISION TO THIS DRAWING IS PERMITTED WITOUT CSA APPROVAL.
6. ASSOCIATED APPARATUS MUST BE CSA CERTIFIED. ASSOCIATED APPARATUS MAY BE INSTALLED IN CLASS I, DIVISION 2 HAZARDOUS (CLASSIFIED) LOCATION IF SO CERTIFIED.
7. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
8. RESISTANCE OF THE GROUND PATH MUST BE LESS THAN 1 OHM.
9. SHIELDED WIRE IS REQUIRED FOR CE CONFORMITY AND RECOMMENDED FOR OTHER APPLICATIONS. SHIELD GROUNDED AT SUPPLY (BARRIER) END ONLY.
10. SUITABLE FOR INSTALLATION WITHOUT BARRIERS IN CLASS I DIV2 GROUPS A,B,C,D WHEN INSTALLED IN (OR THROUGH THE WALL OF) A SUITABLE ENCLOSURE WITH PROVISION FOR CONNECTION OF RIGID CONDUIT PER CANADIAN ELECTRICAL CODE, AS ACCEPTABLE TO THE LOCAL INSPECTION AUTHORITY HAVING JURISDICTION.
11. IN DIV 2 INSTALLATIONS (WITHOUT BARRIERS), OBSERVE THE FOLLOWING WARNINGS.
    WARNING EXPLOSION HAZARD
    DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

    AVERTISSEMENT: RISQUE D'EXPLOSION
    AVANT DE DECONNECTTER L'EQUIPMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DESIGNE NON DANGERUX.
12. IF BARRIERS WITH VOLT/OHM PARAMETERS ARE USED, THE FOLLOWING PARAMETERS SHALL APPLY:
    30V(MAX), 300 OHMS(MIN)
    28V(MAX), 300 OHMS(MIN)
    22V(MAX), 180 OHMS(MIN)

CERTIFICATION DOCUMENT
ENGINEERING CHANGES (ECO'S) MUST BE AUTHORIZED BY APPROVALS SPECIALIST

ST3000 Series 100 / 900 Intrinsically Safe CSA			
Lightning Proof Option		Lightning Proof Option	
Sheets 1 to 5		Sheets 6 to 9	
Sheets 1	Intrinsically Safe - CSA	Sheets 6	RMA 3000 - SM
Sheets 2	RMA 3000 - SM	Sheets 7	RMA 3000 - ME
Sheets 3	RMA 3000 - ME	Sheets 8	ME (Analog Meter)
Sheets 4	ME (Analog Meter)	Sheets 9	RMA 3000 - DM
Sheets 5	RMA 3000 - DM		

PROJECTION	DRAWN	R.O.G.	5/1/97
LINEAR MEASURE: INCH	CHECKED		
MATERIAL	DEV ENGR	J.G.	9/18/97
	MFG ENGR	T.H.	9/12/97
	QA ENGR MAT ENGR	F.F.	9/18/97
FINISH	TOLERANCE UNLESS NOTED		
	ANGULAR DIMENSION		

Honeywell

ST 3000 S900/S100
CONTROL DRAWING
INTRINSICALLY SAFE-CSA

C A2 51204242

SCALE NONE | USED ON | SHT 1 OF 9

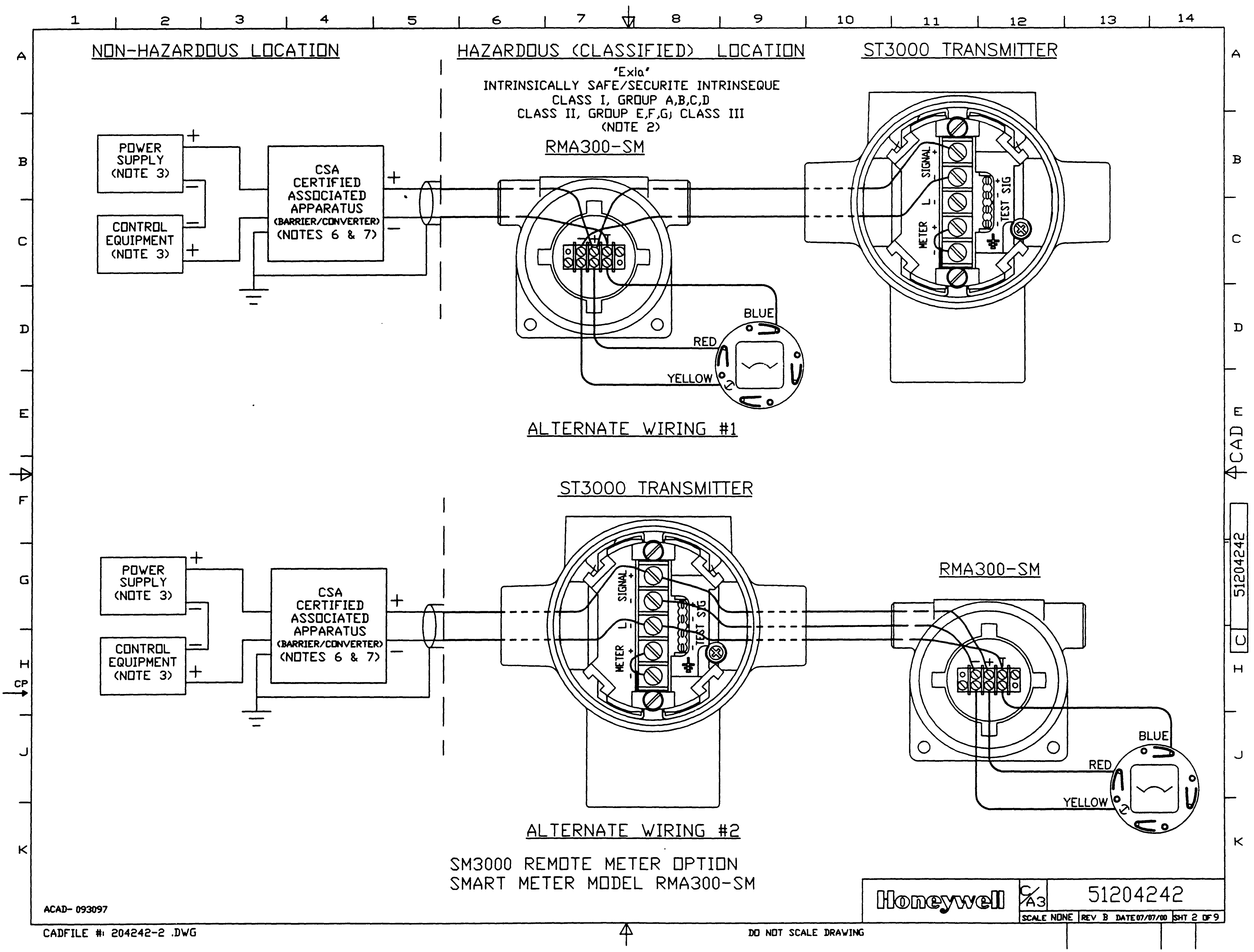
DO NOT SCALE DRAWING

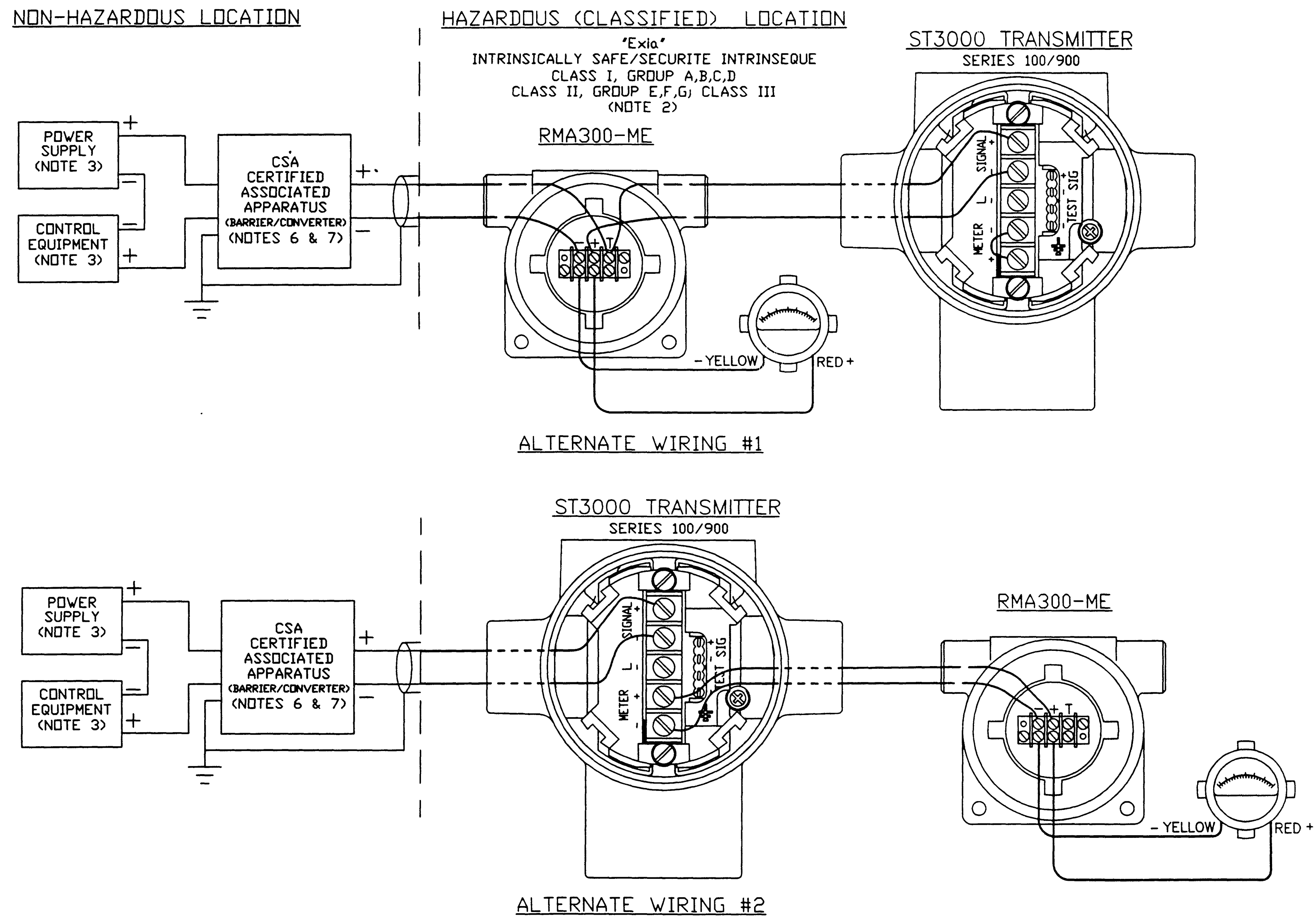
ACAD- 093097

CADFILE #: 204242-1 .DWG

C 51204242

FW


NON-HAZARDOUS LOCATION
HAZARDOUS (CLASSIFIED) LOCATION
'Exia'
INTRINSICALLY SAFE/SECURITE INTRINSEQUE
CLASS I, GROUP A,B,C,D
CLASS II, GROUP E,F,G; CLASS III
(NOTE 2)
ST3000 TRANSMITTER
RMA300-SM
POWER SUPPLY (NOTE 3)
CONTROL EQUIPMENT (NOTE 3)
CSA CERTIFIED ASSOCIATED APPARATUS (BARRIER/CONVERTER) (NOTES 6 & 7)
SIGNAL
L
METER
TEST SIG
BLUE
RED
YELLOW
ALTERNATE WIRING #1
ST3000 TRANSMITTER
RMA300-SM
POWER SUPPLY (NOTE 3)
CONTROL EQUIPMENT (NOTE 3)
CSA CERTIFIED ASSOCIATED APPARATUS (BARRIER/CONVERTER) (NOTES 6 & 7)
BLUE
RED
YELLOW
ALTERNATE WIRING #2
SM3000 REMOTE METER OPTION
SMART METER MODEL RMA300-SM
Honeywell
C/A3
51204242
SCALE NONE
REV B
DATE 07/07/00
SHT 2 OF 9
ACAD- 093097
CADFILE #: 204242-2 .DWG
DO NOT SCALE DRAWING
CAD
C
51204242



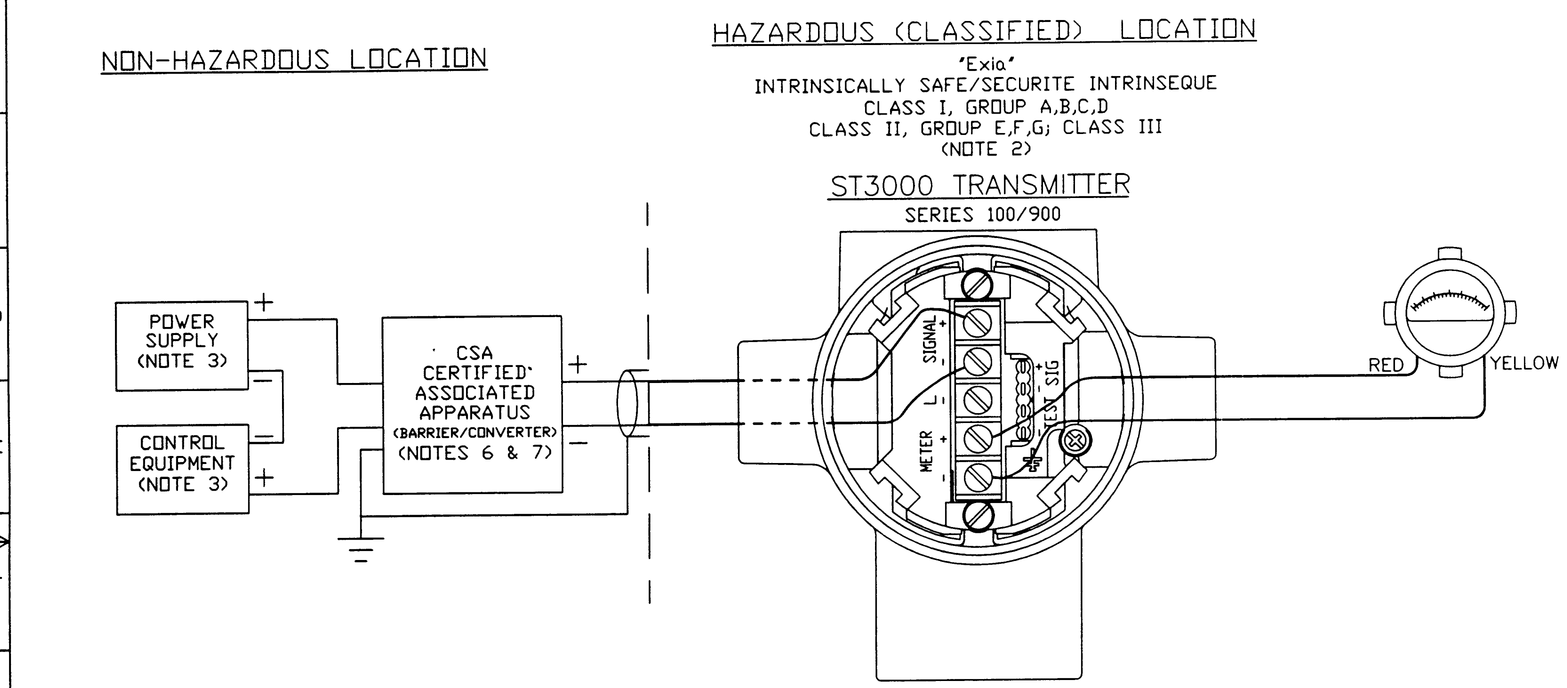
SM3000 REMOTE METER OPTION
ANALOG METER MODEL RMA300-ME

Honeywell	C/A3	51204242
SCALE NONE	REV B DATE 07/07/00	SHT 3 OF 9

ACAD- 070700

CADFILE #: 204242-3 .DWG

DO NOT SCALE DRAWING



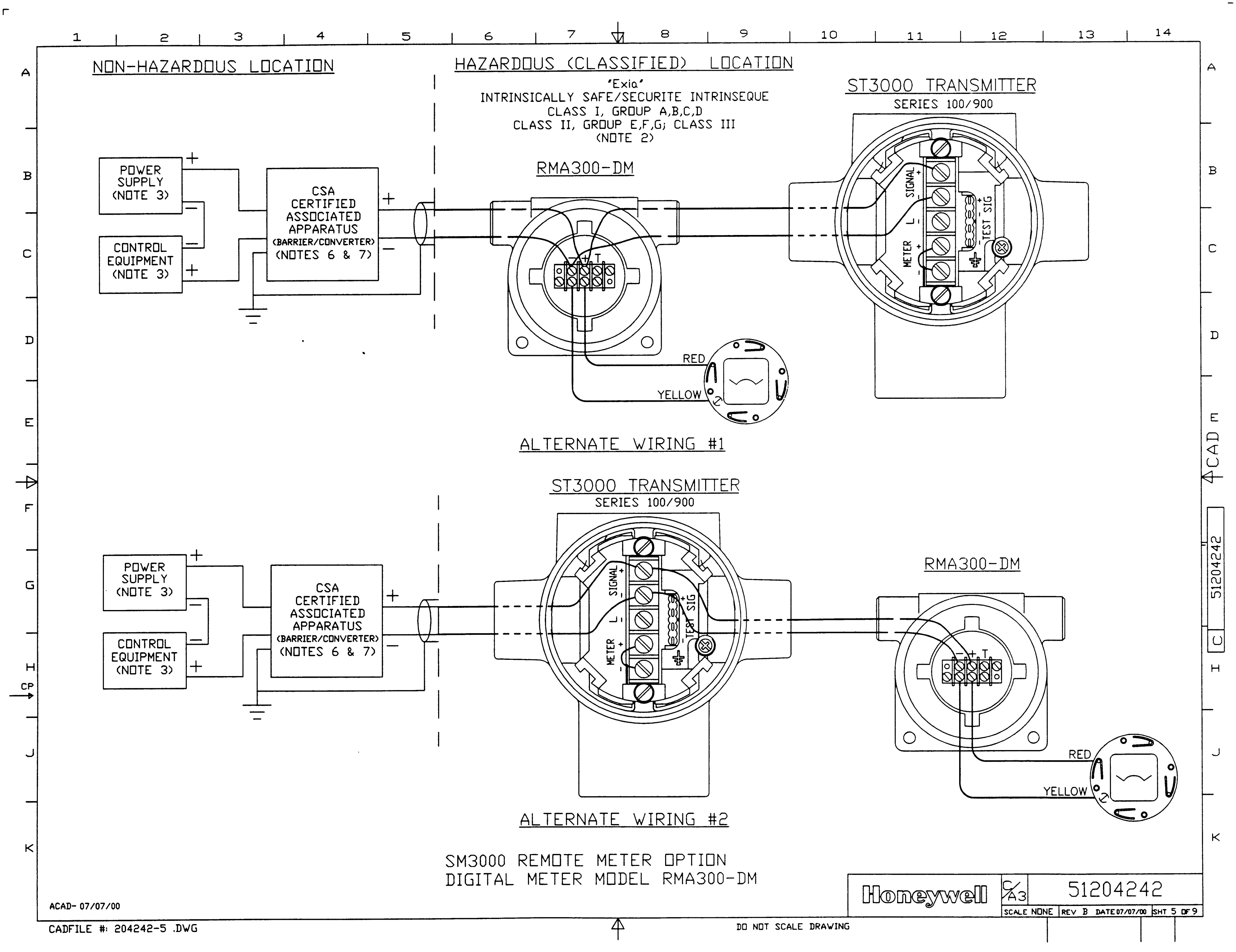
Honeywell C/A3 51204242

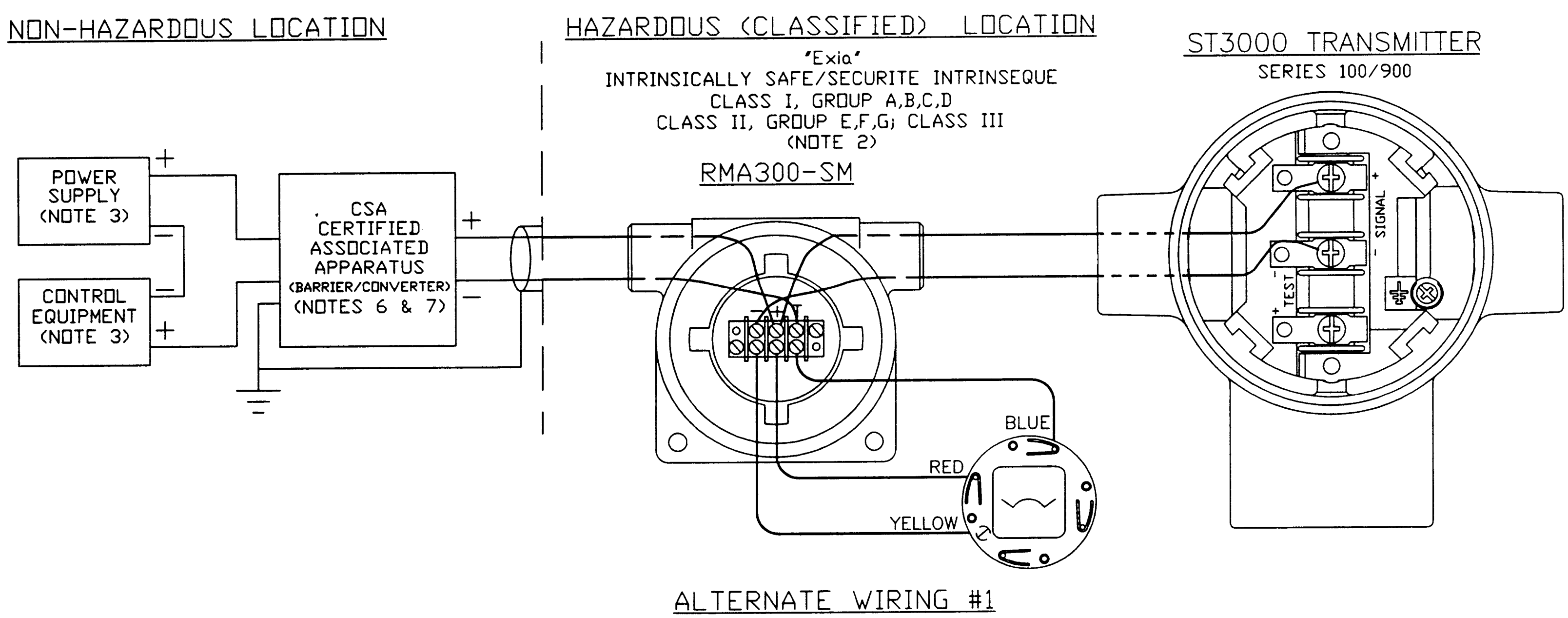
SCALE NONE | REV B | DATE 07/07/00 | SHT 4 OF 9

ACAD- 07/07/00

CADFILE #: 204242-4 .DWG

DO NOT SCALE DRAWING


NON-HAZARDOUS LOCATION
HAZARDOUS (CLASSIFIED) LOCATION
'Exia'
INTRINSICALLY SAFE/SECURITE INTRINSEQUE
CLASS I, GROUP A,B,C,D
CLASS II, GROUP E,F,G; CLASS III
(NOTE 2)
POWER SUPPLY (NOTE 3)
CONTROL EQUIPMENT (NOTE 3)
CSA CERTIFIED ASSOCIATED APPARATUS (BARRIER/CONVERTER) (NOTES 6 & 7)
RMA300-DM
ST3000 TRANSMITTER
SERIES 100/900
SIGNAL
L
METER
TEST SIG
RED
YELLOW
ALTERNATE WIRING #1
ST3000 TRANSMITTER
SERIES 100/900
RMA300-DM
RED
YELLOW
ALTERNATE WIRING #2
SM3000 REMOTE METER OPTION
DIGITAL METER MODEL RMA300-DM
Honeywell
C/A3
51204242
SCALE NONE
REV B
DATE 07/07/00
SHT 5 OF 9
ACAD- 07/07/00
CADFILE #: 204242-5 .DWG
DO NOT SCALE DRAWING
51204242
C



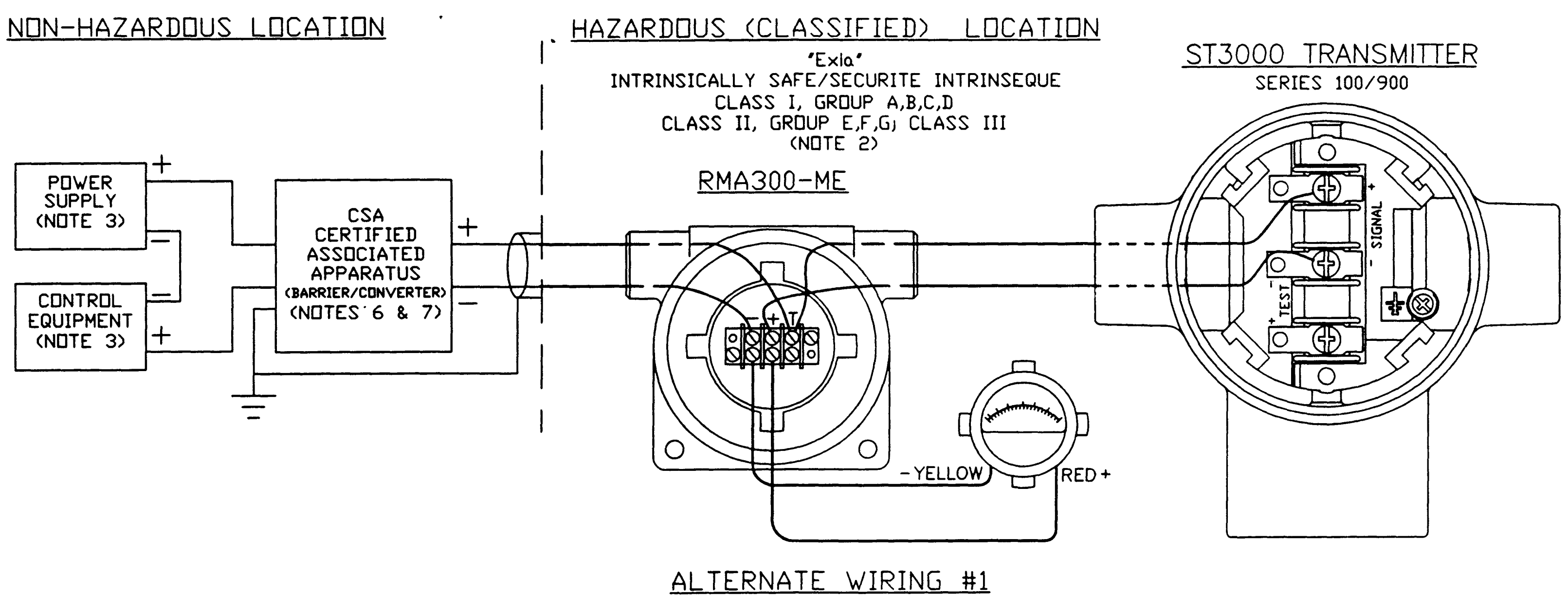
ACAD- 07/07/00

CADFILE #: 204242-6.DWG

DO NOT SCALE DRAWING

Honeywell C/A3 51204242

SCALE NONE | REV B | DATE 07/07/00 | SHT 6 OF 9



ACAD- 07/07/00

CADFILE #: 204242-7 .DWG

DO NOT SCALE DRAWING

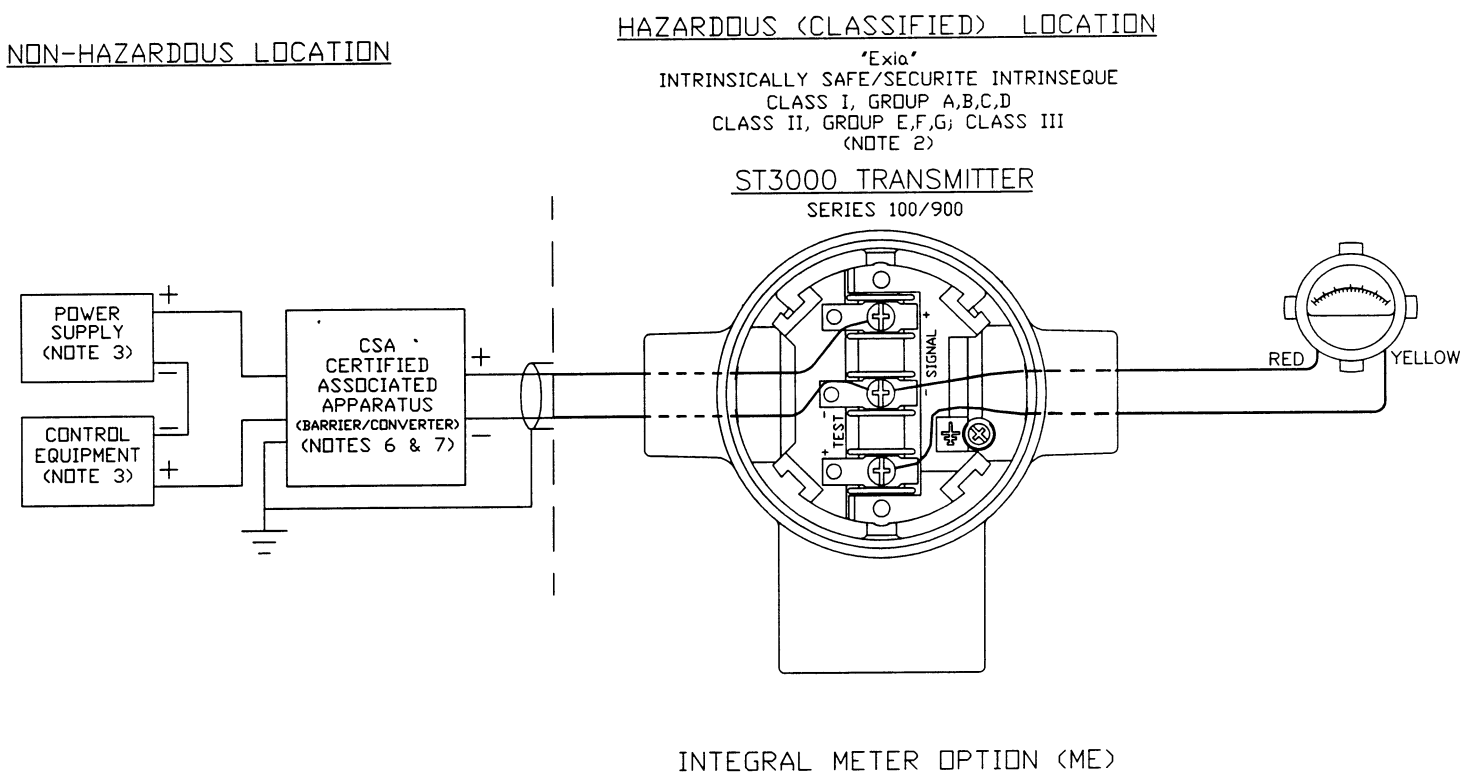
Honeywell

C/A3 51204242

SCALE NONE | REV B | DATE 07/07/00 | SHT 7 OF 9

CAD

C 51204242

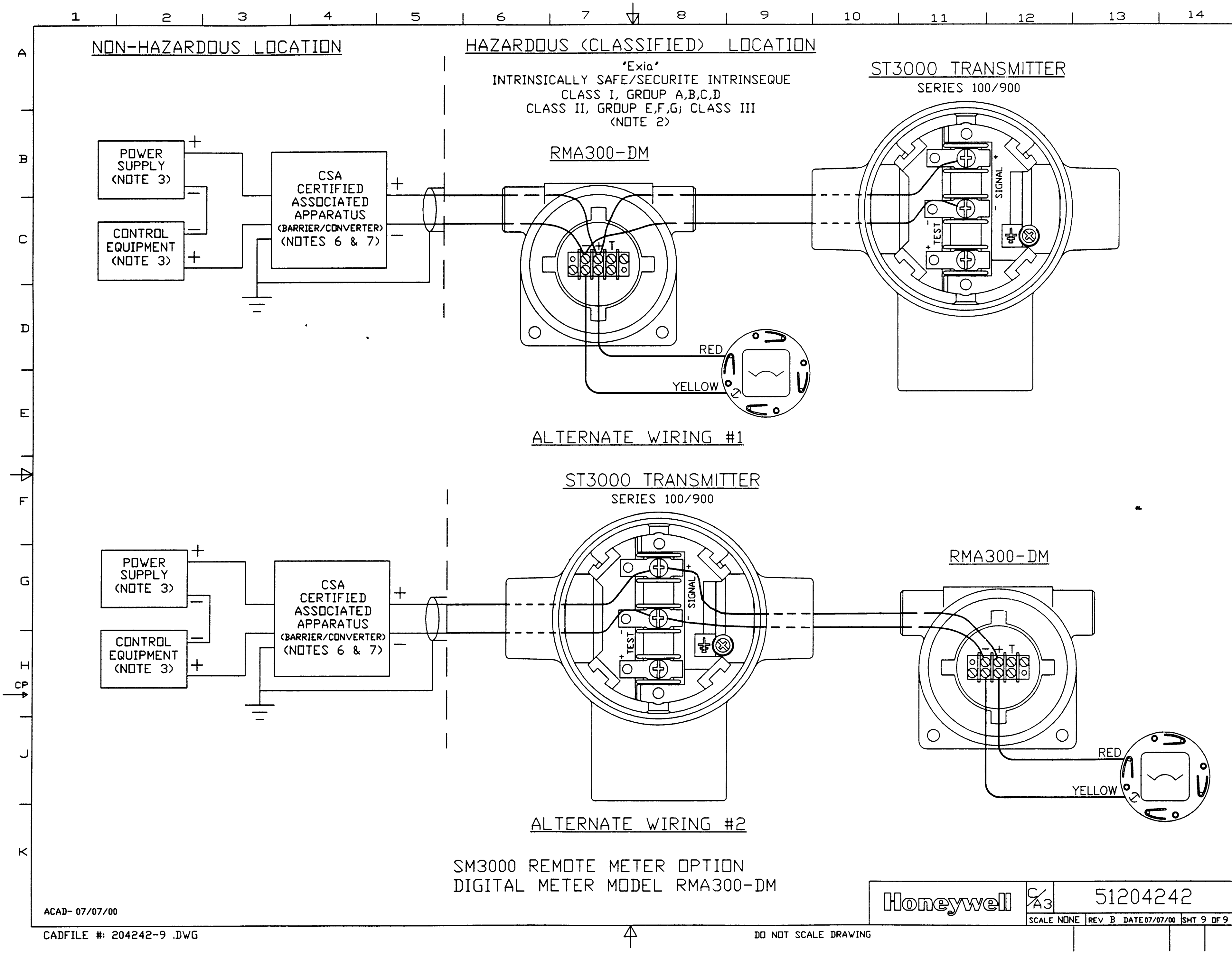


ACAD- 07/07/00

Honeywell	C/A3	51204242		
SCALE NONE	REV B	DATE 07/07/00	SHT 8 OF 9	

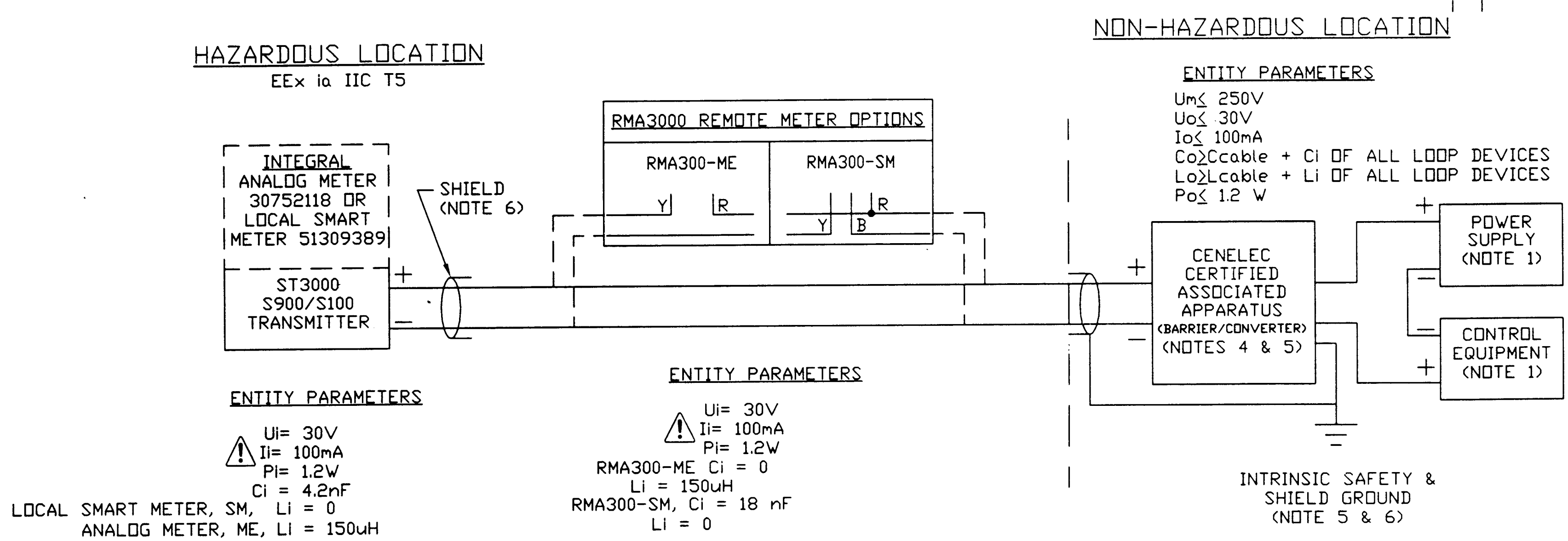
CADFILE #: 204242-8 .DWG

DO NOT SCALE DRAWING


NON-HAZARDOUS LOCATION
HAZARDOUS (CLASSIFIED) LOCATION
'Exia'
INTRINSICALLY SAFE/SECURITE INTRINSEQUE
CLASS I, GROUP A,B,C,D
CLASS II, GROUP E,F,G; CLASS III
(NOTE 2)
POWER SUPPLY (NOTE 3)
CONTROL EQUIPMENT (NOTE 3)
CSA CERTIFIED ASSOCIATED APPARATUS (BARRIER/CONVERTER) (NOTES 6 & 7)
RMA300-DM
ST3000 TRANSMITTER
SERIES 100/900
SIGNAL
TEST
RED
YELLOW
ALTERNATE WIRING #1
ST3000 TRANSMITTER
SERIES 100/900
POWER SUPPLY (NOTE 3)
CONTROL EQUIPMENT (NOTE 3)
CSA CERTIFIED ASSOCIATED APPARATUS (BARRIER/CONVERTER) (NOTES 6 & 7)
RMA300-DM
RED
YELLOW
ALTERNATE WIRING #2
SM3000 REMOTE METER OPTION
DIGITAL METER MODEL RMA300-DM
Honeywell
C/A3
51204242
SCALE NONE
REV B
DATE 07/07/00
SHT 9 OF 9
ACAD- 07/07/00
CADFILE #: 204242-9 .DWG
DO NOT SCALE DRAWING

PRE REL		
ISS	REVISION & DATE	APPD
A	RELEASED 072799 F992234	W.F.
B	REV'D 07/07/00 F202130	RGV

51204243



CERTIFICATION DOCUMENT
ENGINEERING CHANGES (ECO'S) MUST BE AUTHORIZED BY APPROVALS SPECIALIST

ST3000 Series 100 / 900 Intrinsically Safe Cenelec			
Lightning Proof Option		Non-Lightning Proof Option	
Sheets 1 to 4		Sheets 5 to 7	
Sheets 1	Intrinsically Safe - Cenelec	Sheets 5	RMA 3000 - SM
Sheets 2	RMA 3000 - SM	Sheets 6	RMA 3000 - ME
Sheets 3	RMA 3000 - ME	Sheets 7	ME (Analog Meter)
Sheets 4	ME (Analog Meter)		

NOTES:

1. CONTROL EQUIPMENT CONNECTED TO BARRIERS MUST NOT USE OR GENERATE MORE THAN 250V.
2. INSTALLATION MUST BE IN ACCORDANCE WITH THE APPLICBLE PORTIONS OF EN 50039 AND EN 60079-14.
3. NO REVISION TO THIS DRAWING IS PERMITTED WITHOUT LCIE APPROVAL.
4. BARRIERS MUST BE CENELEC CERTIFIED AND THE BARRIER MANUFACTURE'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
5. NON-GALVANICALLY ISOLATED BARRIERS MUST BE CONNECTED TO A SUITABLE EARTH ELECTRODE PER prEN 50154. 12.2.4. THE RESISTANCE OF EARTH GROUND PATH MUST BE LESS THAN 1 OHM.
6. SHIELDED WIRE IS REQUIRED FOR CE CONFORMITY AND RECOMMENDED FOR OTHER APPLICATIONS. SHIELD GROUNDED AT SUPPLY (BARRIER) END ONLY.

PROJECTION
LINEAR MEASURE: INCH
MATERIAL
FINISH

DRAWN	R.O.G.	10/2/97
CHECKED	W.F.	7/27/99
DEV ENGR	R.A.	7/27/99
MFG ENGR	F.X.F.	7/27/99
QA ENGR MAT ENGR	D.S.	7/27/99

Honeywell

ST3000 S900/S100
CONTROL DRAWING
INTRINSICALLY SAFE-CENELEC

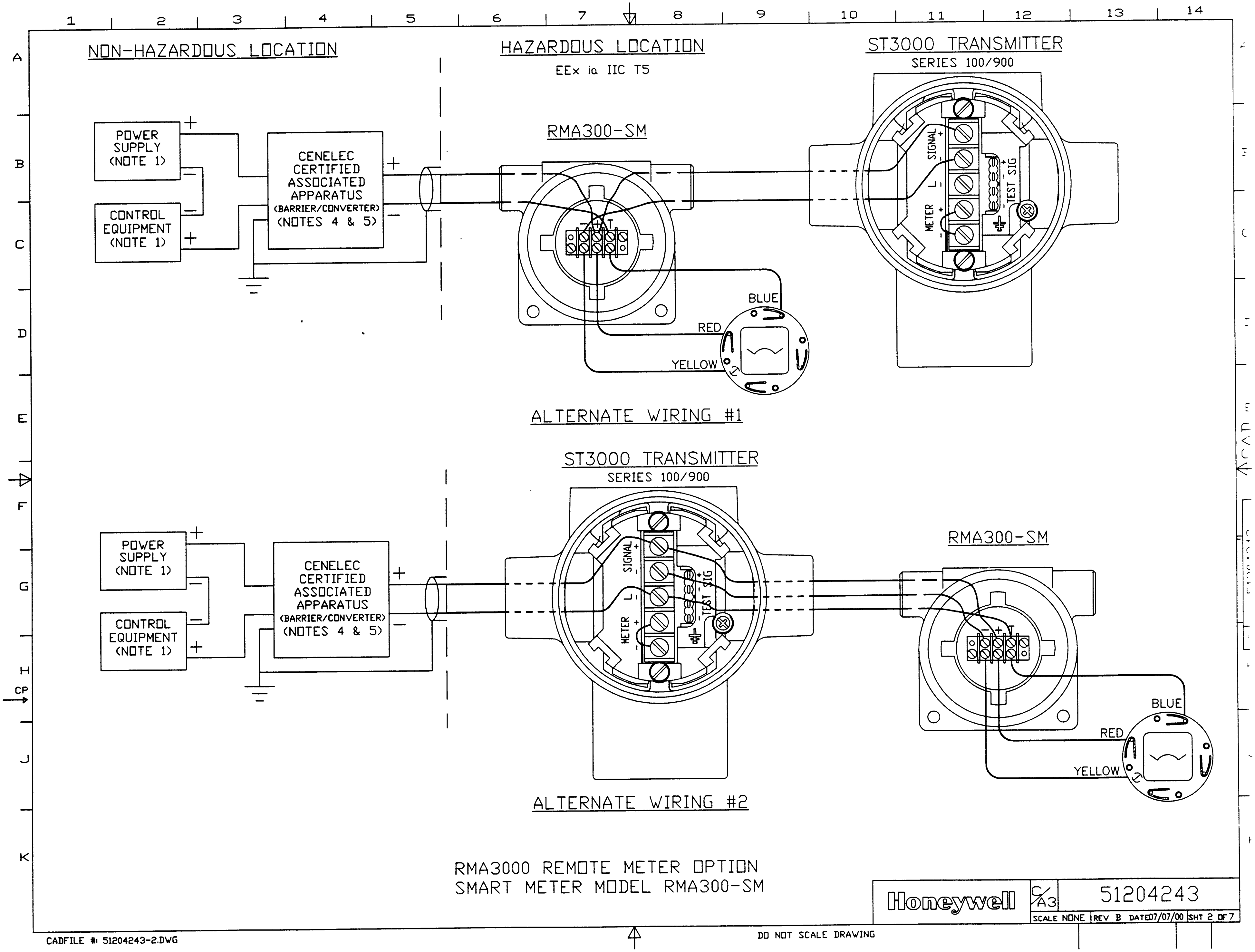
C A2 51204243

SCALE NONE | USED ON | SHT 1 OF 7

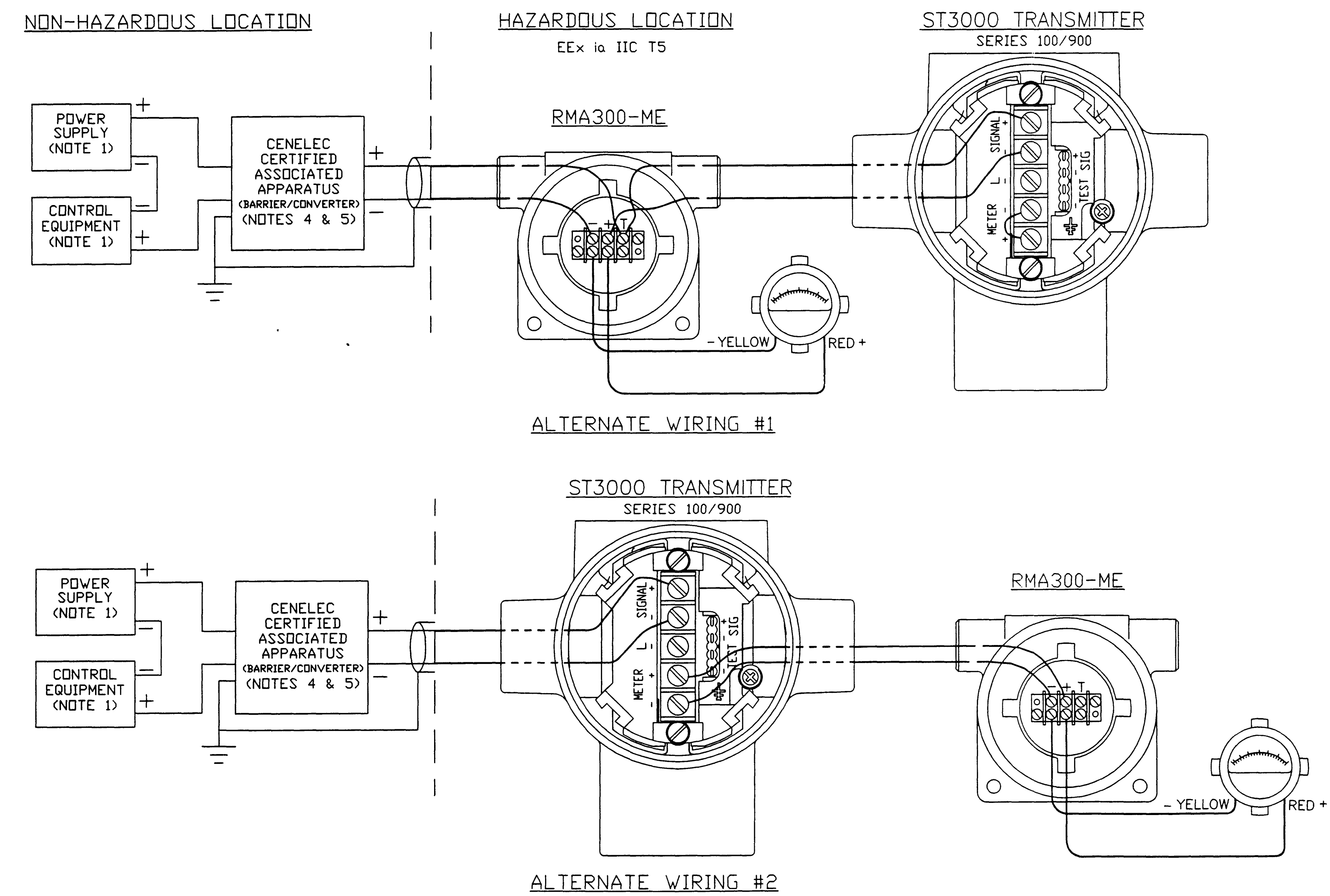
DO NOT SCALE DRAWING

C 51204243

CADFILE: 51204243-1.DWG



NON-HAZARDOUS LOCATION
HAZARDOUS LOCATION
EEx ia IIC T5
ST3000 TRANSMITTER
SERIES 100/900
POWER SUPPLY (NOTE 1)
CONTROL EQUIPMENT (NOTE 1)
CENELEC CERTIFIED ASSOCIATED APPARATUS (BARRIER/CONVERTER) (NOTES 4 & 5)
RMA300-SM
SIGNAL
L
METER
TEST SIG
BLUE
RED
YELLOW
ALTERNATE WIRING #1
ST3000 TRANSMITTER
SERIES 100/900
POWER SUPPLY (NOTE 1)
CONTROL EQUIPMENT (NOTE 1)
CENELEC CERTIFIED ASSOCIATED APPARATUS (BARRIER/CONVERTER) (NOTES 4 & 5)
RMA300-SM
BLUE
RED
YELLOW
ALTERNATE WIRING #2
RMA3000 REMOTE METER OPTION
SMART METER MODEL RMA300-SM
Honeywell
C/A3
51204243
SCALE NONE
REV B
DATE 07/07/00
SHT 2 OF 7
CADFILE #: 51204243-2.DWG
DO NOT SCALE DRAWING



RMA3000 REMOTE METER OPTION
ANALOG METER MODEL RMA300-ME

Honeywell C/A3 51204243
SCALE NONE | REV B | DATE 07/07/00 | SHT 3 OF 7

CADFILE #: 51204243-3.DWG

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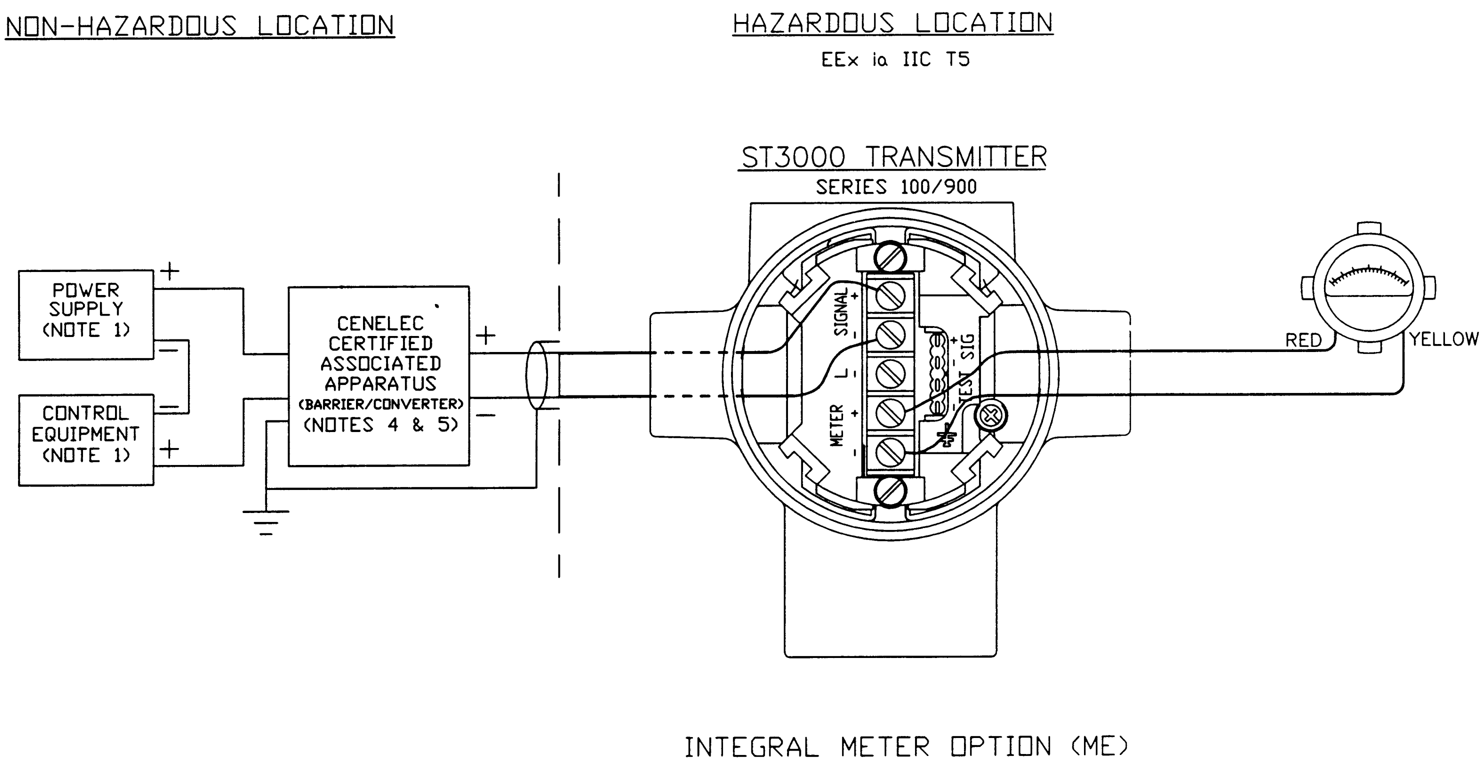

Honeywell C/A3 51204243
SCALE NONE REV B DATE 07/07/00 SHT 4 OF 7

CADFILE #: 5120424304.DWG

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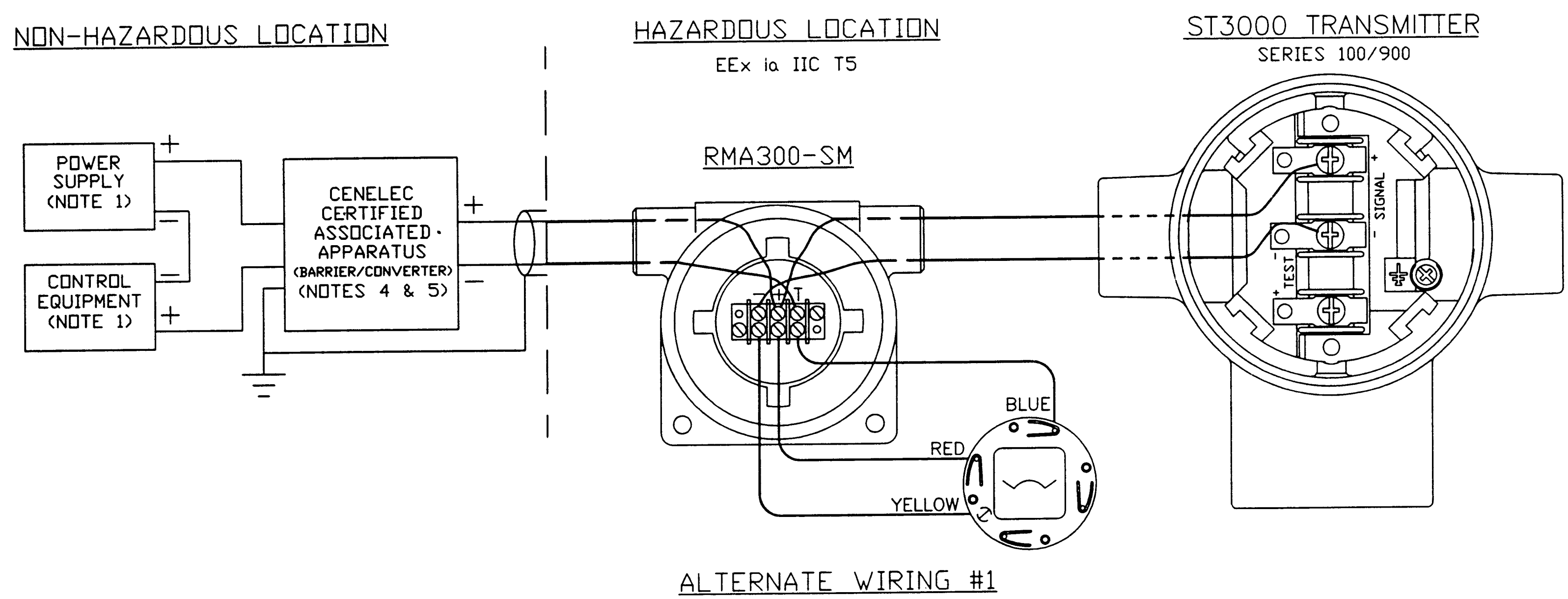

CAD

51204243 C

Honeywell C/A3 51204243

SCALE NONE | REV B | DATE 07/07/00 | SHT 5 OF 7

CADFILE #: 51204243-5.DWG

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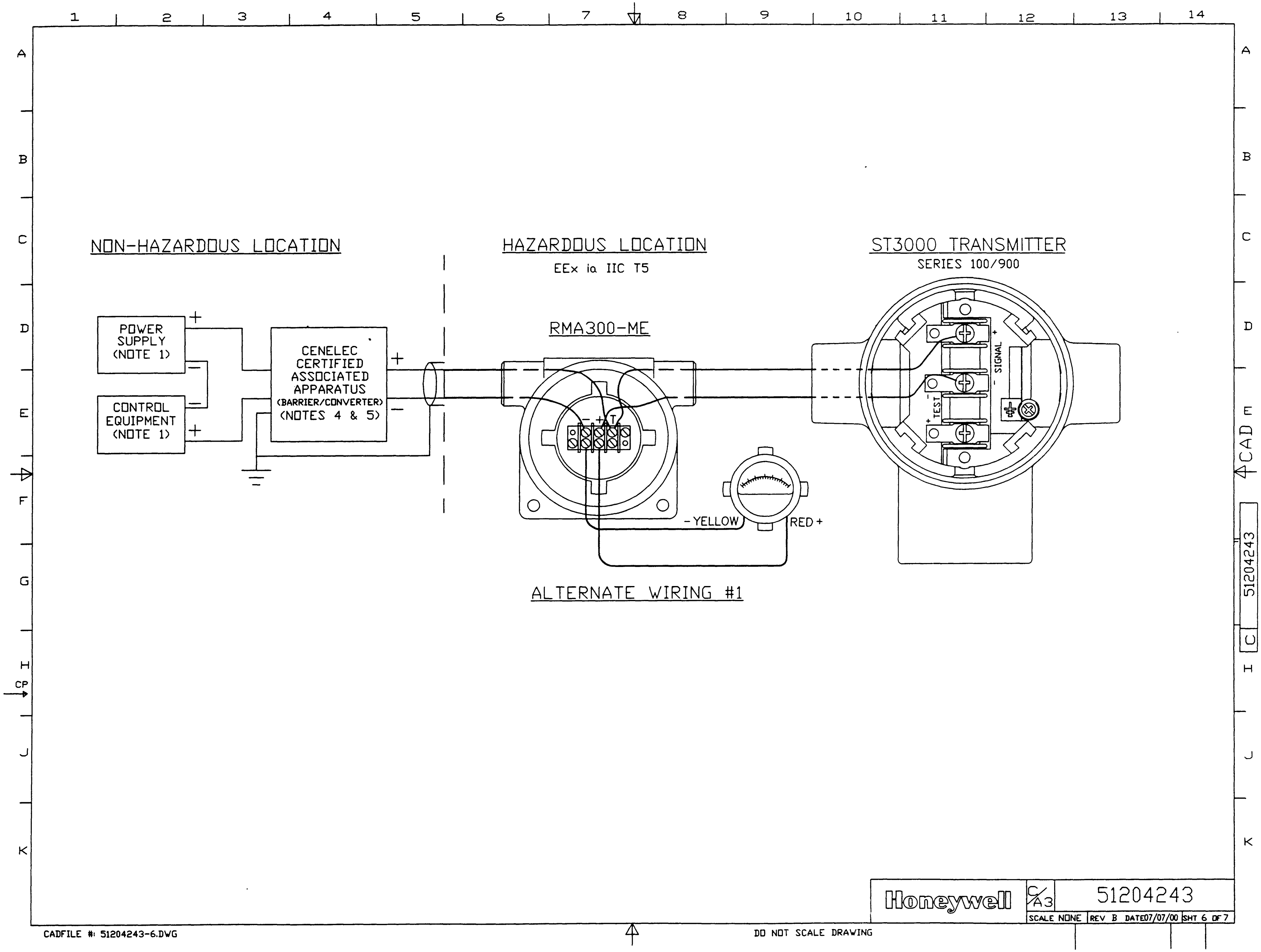
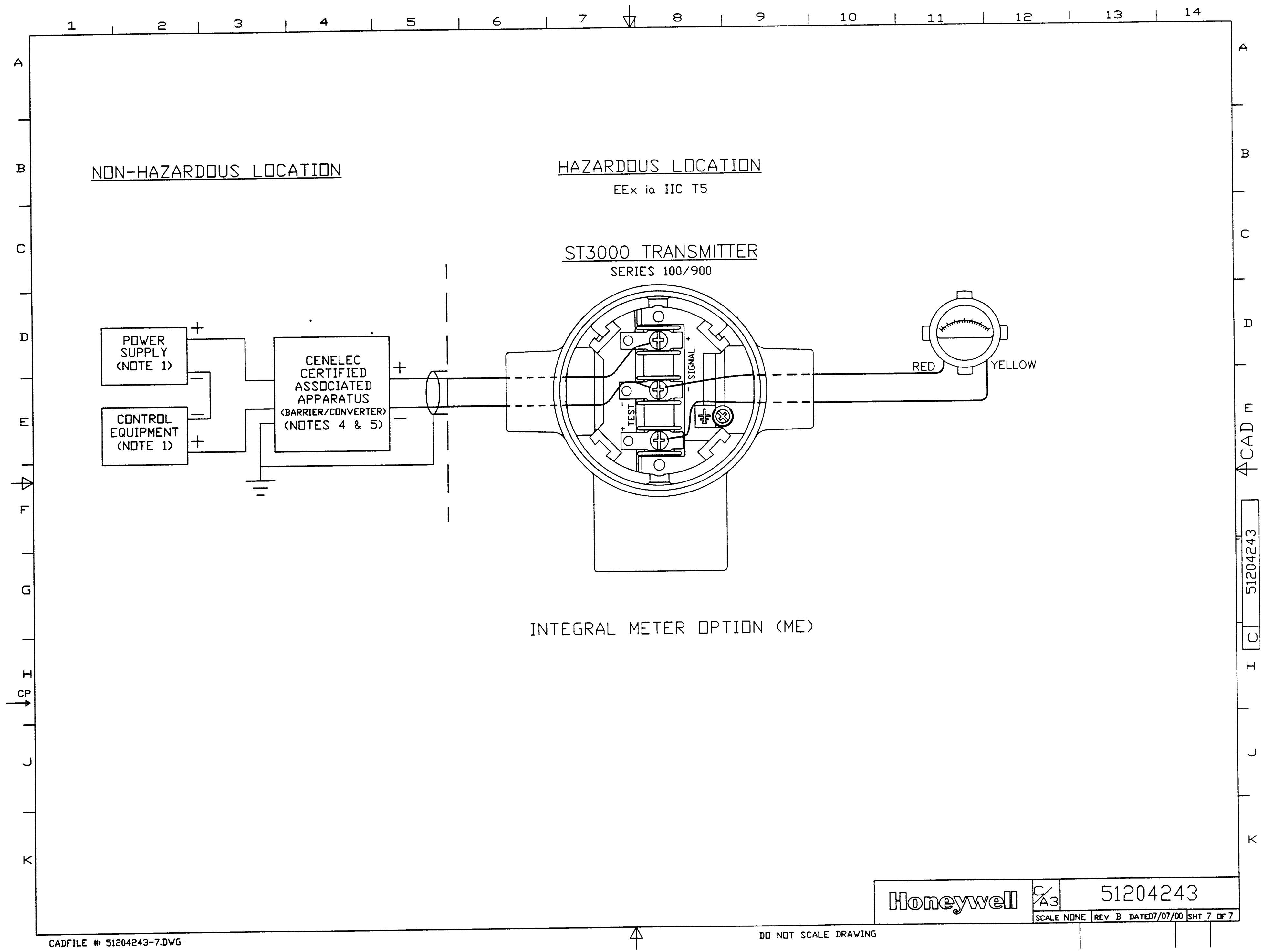

NON-HAZARDOUS LOCATION
HAZARDOUS LOCATION
EEx ia IIC T5
ST3000 TRANSMITTER
SERIES 100/900
POWER SUPPLY (NOTE 1)
CONTROL EQUIPMENT (NOTE 1)
CENELEC CERTIFIED ASSOCIATED APPARATUS
(BARRIER/CONVERTER)
(NOTES 4 & 5)
RMA300-ME
SIGNAL
TEST
- YELLOW
RED +
ALTERNATE WIRING #1
CAD
51204243
C
Honeywell
C/A3
51204243
SCALE NONE
REV B
DATE07/07/00
SHT 6 OF 7
CADFILE #: 51204243-6.DWG
DO NOT SCALE DRAWING



NON-HAZARDOUS LOCATION
HAZARDOUS LOCATION
EEx ia IIC T5
ST3000 TRANSMITTER
SERIES 100/900
POWER SUPPLY (NOTE 1)
CONTROL EQUIPMENT (NOTE 1)
CENELEC CERTIFIED ASSOCIATED APPARATUS (BARRIER/CONVERTER) (NOTES 4 & 5)
SIGNAL
TEST
RED
YELLOW
INTEGRAL METER OPTION (ME)
CAD
51204243
C
Honeywell
C/A3
SCALE NONE
REV B
DATE07/07/00
SHT 7 OF 7
CADFILE #: 51204243-7.DWG
DO NOT SCALE DRAWING

Appendix A —Smart Meter Reference

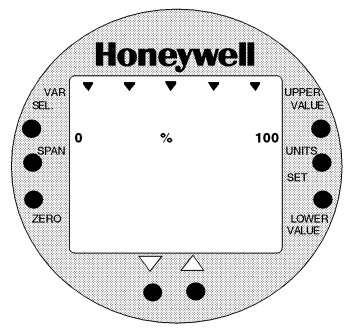
A.1 Introduction

Smart Meter Option

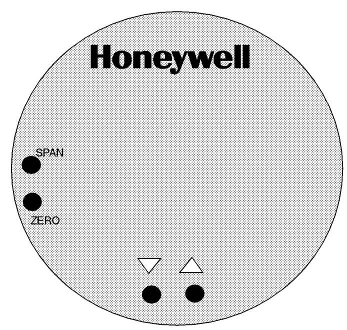
Depending upon your transmitter model, you can equip the ST 3000 transmitter with the Smart Meter option (option SM). This new integral smart meter is designed for ST 3000 Release 300 Transmitters and provides functionality not available with other smart meter designs.

The smart meter provides an LCD local interface that displays both analog and digital indications of the transmitter output and can be configured to display pressure in user-selected engineering units. There are two meter option types:

1. Smart Meter with local Zero and Span Adjustments – Features smart meter LCD interface, pushbuttons for setting engineering units and lower range/upper range values, and zero/span adjustments.



2. Local Zero and Span Adjustments only – Provides pushbuttons to make zero and span adjustments.



NOTE: The Model STD110 does not support local zero and span adjustments.

Smart Meter Set up

The smart meter can be set up to display pressure in a number of user-selected engineering units or even custom units, if required. The meter display set up is part of the transmitter configuration database and can be performed when configuring the transmitter. You can use either the Smartline© Configuration Toolkit (SCT 3000) software program or the Smart Field Communicator (SFC) to configure the transmitter and the smart meter. You can also use the pushbuttons on the front of the meter to set up the smart meter display. The procedures for meter set up using any of these configuration devices are provided in this appendix.

A.2 Smart Meter Display

Display description

Figure A-1 shows a smart meter display with all its indicators and segments lit for reference.
Table A-1 shows a smart meter with the pushbuttons highlighted and a brief description of each pushbutton. The pushbuttons are used for setting up the smart meter display and making zero and span adjustments.

Figure A-1 Smart Meter Display with All Indicators Lit.

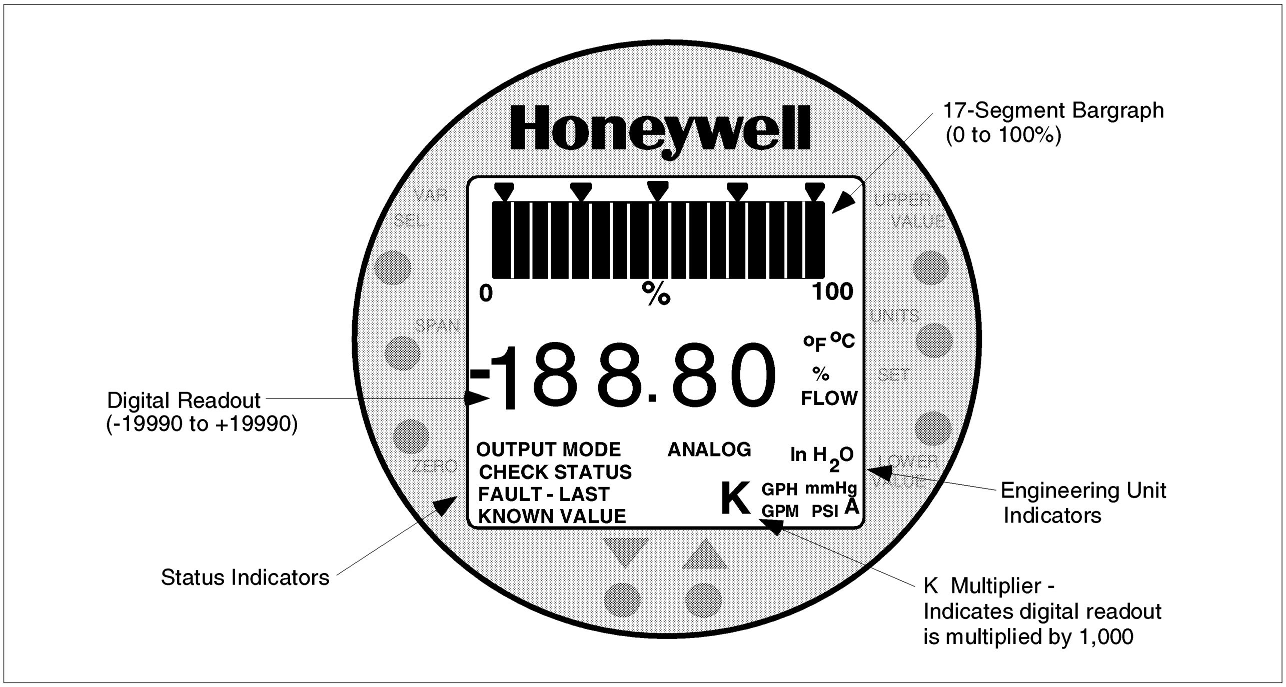
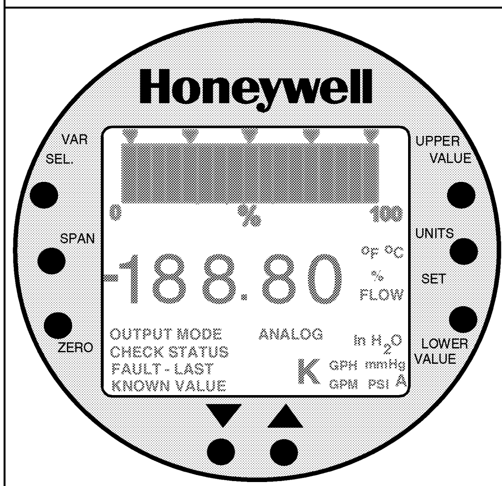


Table A-1 Smart Meter Pushbutton Description

Smart Meter Pushbuttons	Pushbutton	Function
	VAR SEL.	Not functional when installed with ST 3000 transmitters.
	SPAN	Selects Span range setting (URV).
	ZERO	Selects Zero range setting (LRV).
	UPPER VALUE	Selects Upper Range Value setting (URV).
	UNITS SET	Selects engineering units for meter display.
	LOWER VALUE	Selects Lower Range Value (LRV).
	▼	Decrease pushbutton
	▲	Increase pushbutton

A.3 Smart Meter Specifications

Operating Conditions and Specifications

Before installing a transmitter equipped with a smart meter or installing the smart meter in an existing transmitter, please note the specifications and operating limits of the meter in Table A-2.

Table A-2 Smart Meter Specifications.

Operating Conditions			
Parameter		**Rated**	**Extreme, Transportation and Storage (See below)**
Ambient Temperature	°F °C	–40 to 176 –40 to 80	–58 to 194 –50 to 90
Relative Humidity	%RH	10 to 90	0 to 100
Design			
Accuracy		No error. Reproduces transmitter signal exactly within its resolution.	
Display Resolution	Bargraph	±3% of reading	Shown as:
	Digital Readout	±0.005 for ±19.99 reading range, ±0.05 for ±199.9 reading range, ±0.5 for ±1999 reading range, ±5 for ±19990 reading range, ±50 for ±199900 reading range, ±500 for ±1999000 reading range, ±5000 for ±19990000 reading range.	19.99 199.9 1999 19.99 K 199.9 K 1999 K 19990 K
Display Update Rate		Above 32°F (0°C): ½ second @ or below 32°F (0°C): 1½ seconds	

Meter Display at High and Low Temperature Extremes

The rated temperature limits for the meter are listed above and are true in that no damage to the meter will occur over these temperatures, however the readability of the LCD is affected if taken to these temperature extremes:

- The LCD will turn black at some temperature between 80 to 90 °C (176 and 194 °F), rendering the display unreadable. This effect is only temporary, and normally occurs at 90 °C (194 °F).
- At low temperatures, the update rate of the display is lengthened to 1.5 seconds due to the slower response time of the display.
  At -20 °C (-4 °F) the display becomes unreadable due to slow response of the LCD. This is also only temporary and normal readability will return when temperature returns above -20 °C (-4 °F).

A.4 Setting Range Values (Local Zero and Span)

Local zero and span option

ST 3000 Release 300 transmitters are available with optional local zero and span adjustments. This option is for applications that do not require an SFC nor digital integration with our TPS system.

About local adjustments

You must apply equivalent zero and span pressures to make the local zero and span adjustments. This is similar to setting the LRV and URV to applied pressures using the SFC.

ATTENTION

After making any adjustments to the smart meter, keep the transmitter powered for at least 30 seconds so that the new meter configuration is written to non-volatile memory. If power is turned off before 30 seconds, the changes may not be saved so that when the transmitter power is restored, the meter configuration will revert to the previous settings.

Procedure

The procedure in Table A-3 shows the steps for setting the range values to applied pressures using local zero and span adjustments. See Figure A-2 for typical local adjustment setup details.

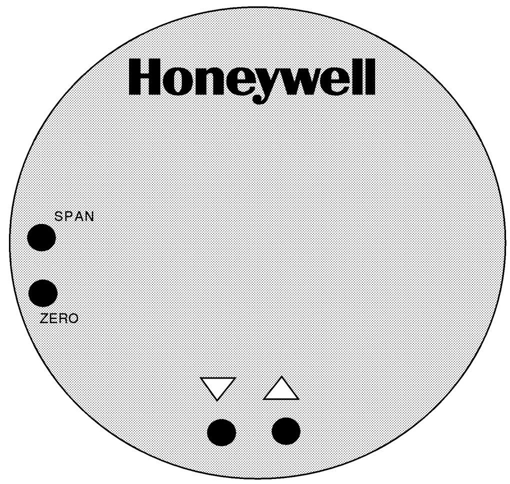
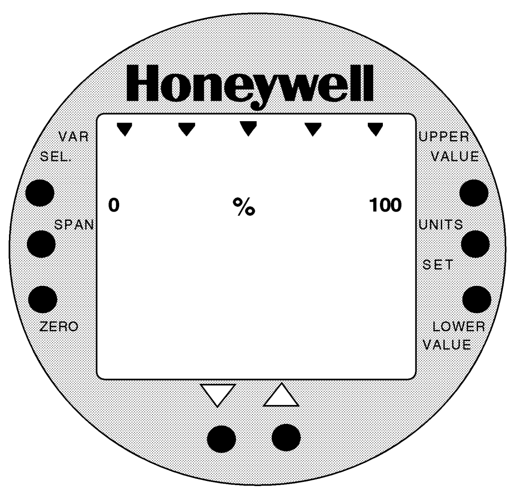
Table A-3 Setting Range Values Using Local Zero and Span Adjustments

Step	Action
1	Turn OFF transmitter power. Loosen end-cap lock and remove end-cap from terminal block side of electronics housing.
2	Observing polarity, connect a milliammeter across positive (+) and negative (–) TEST terminals. **ATTENTION** If you have the smart meter with local zero and span adjustment option, you may use the Smart Meter in place of the milliammeter.

Continued on next page

Procedure, continued

Table A-3 Setting Range Values Using Local Zero and Span Adjustments, Continued

Step	Action
3	Loosen end-cap lock and remove end-cap from PWA side of electronics housing to expose local zero and span assembly or smart meter with zero and span adjustments. Example – Local zero and span assembly.  Example – Smart meter with zero and span adjustments. 

Continued on next page

Procedure, continued

Table A-3 Setting Range Values Using Local Zero and Span Adjustments, Continued

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>4</td><td>Turn ON transmitter power and let it warm up for a few minutes. Using an accurate pressure source, apply desired zero equivalent pressure to transmitter.

ATTENTION For differential pressure transmitters, apply pressure to the high pressure head for positive range values or vent both heads to atmosphere for zero. If zero is to equal a negative value, apply the equivalent pressure to the low pressure head. For example, if zero is to equal –10 inH_2O, you would apply 10 inH_2O to the low pressure head and vent the high pressure head for the zero adjustment.</td></tr>
<tr><td>5</td><td>Check that milliammeter reading is 4 mA.
<table><tr><th>If reading …</th><th>Then…</th></tr><tr><td>is less or greater than 4 mA</td><td>go to Step 6.</td></tr><tr><td>is correct</td><td>go to Step 7.</td></tr></table>
ATTENTION If you have the smart meter with local zero and span adjustment option, you may substitute the smart meter readings for the milliammeter readings. For example, with zero input pressure applied assume that the meter reads 4 inH2O instead of 0 inH2O. In this case, the meter reading is greater than 0 (or 4 mA).</td></tr>
<tr><td>6</td><td>a. Press and hold ZERO button on local zero and span assembly or smart meter.

ATTENTION The smart meter readings revert to the default unit of percent (%) during this operation. If the error code <code>Er0</code> appears on the display, you are working with a model STD110 transmitter that does not support the local zero and span adjustments.

b. Press Decrease ▼ button once to complete this function.

ATTENTION The smart meter display goes blank for a 1/2 second and then returns reading 0%.

c. Check that milliammeter reading equals 4 mA and release ZERO button.

ATTENTION If milliammeter reading doesn’t change, be sure you are not working with a model STD110 transmitter that ignores local adjustments. The smart meter readings return to the set engineering units after you release the ZERO button.</td></tr>
</table>

Continued on next page

Procedure, continued

Table A-3 Setting Range Values Using Local Zero and Span Adjustments, Continued

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>7</td><td>Using an accurate pressure source, apply pressure equivalent to desired upper range value to transmitter.

ATTENTION For differential pressure transmitters, apply pressure to the high pressure head and be sure that the pressure to the low pressure head is at its reference value.</td></tr>
<tr><td>8</td><td>Check that milliammeter reading is 20 mA.
<table><tr><th>If reading …</th><th>Then…</th></tr><tr><td>is not exactly 20 mA</td><td>go to Step 9.</td></tr><tr><td>is correct</td><td>go to Step 10.</td></tr></table>
ATTENTION If you have the smart meter with local zero and span adjustment option, you may substitute the smart meter readings for the milliammeter readings. For example, with URV input pressure applied assume that the meter reads 396 inH2O instead of 400 inH2O. In this case, the meter reading is less than 100% (or 20 mA).</td></tr>
<tr><td>9</td><td>a. Press and hold SPAN button on local zero and span assembly or smart meter.

ATTENTION The smart meter readings revert to the default unit of percent (%) during this operation. If the error code <code>Er0</code> appears on the display, you are working with a model STD110 transmitter that does not support the local zero and span adjustments. If the error code <code>Er4</code> appears, you are trying to set a SPAN value that is outside acceptable limits for your transmitter. Readjust applied pressure to be within acceptable range limits and repeat this procedure.

b. Press Increase ▲ button once to complete this function.

ATTENTION The smart meter display goes blank for a 1/2 second and then returns reading 100%.

c. Check that milliammeter reading equals 20 mA and release SPAN button.

ATTENTION If milliammeter reading doesn’t change, be sure you are not working with a model STD110 transmitter that ignores local adjustments. The smart meter readings return to the set engineering units after you release the SPAN button.</td></tr>
</table>

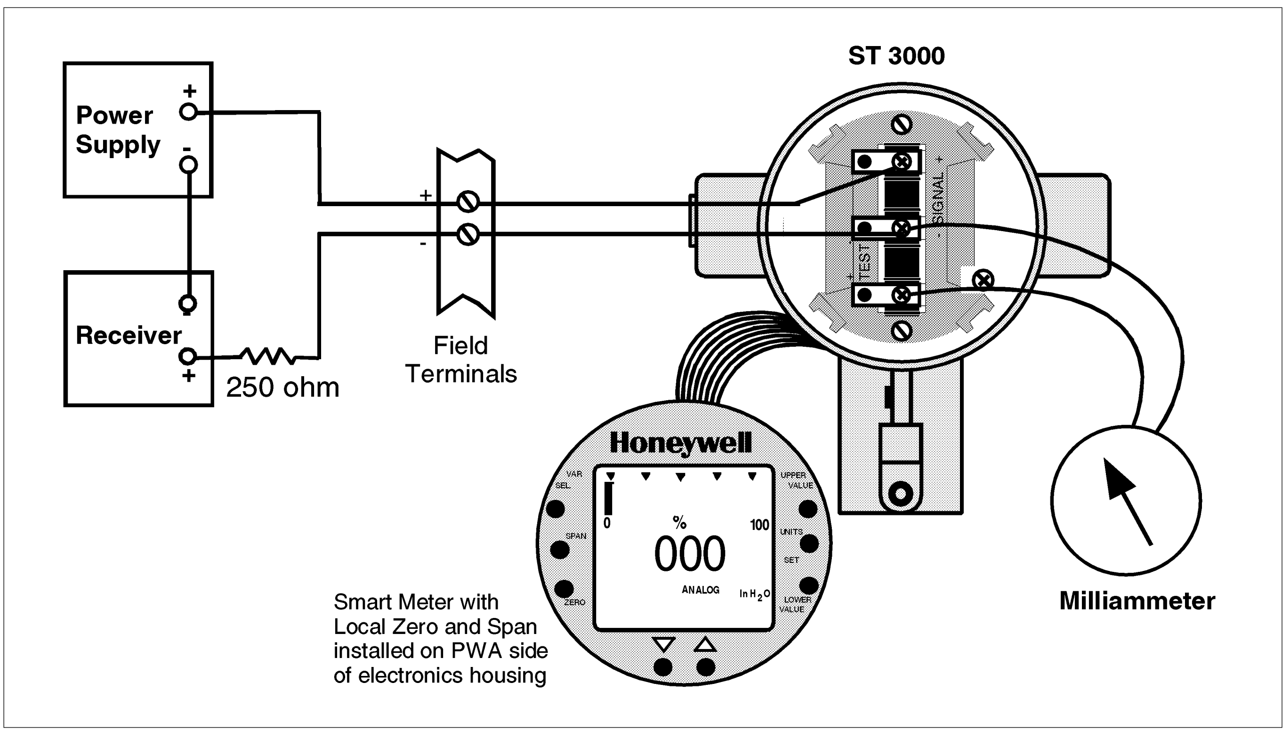
Continued on next page

Procedure, continued

Table A-3 Setting Range Values Using Local Zero and Span Adjustments, Continued

Step	Action
10	Wait 30 seconds so that changes have been copied to the transmitter's non-volatile memory.
11	Remove applied pressure and turn OFF transmitter power.
12	Replace end-cap on PWA side of electronics housing and tighten lock.
13	Remove milliammeter from TEST terminals and replace end-cap and tighten lock.
14	Turn ON transmitter power and check smart meter reading, if applicable.

Figure A-2 Typical Setup for Setting Range Values Using Local Zero and Span Adjustments.



A.5 Configuring Smart Meter Using Pushbuttons

Using Pushbuttons on Meter to Configure Smart Meter Display

The smart meter can be set to show the PV out in engineering units that are appropriate for your process application. You can select an available engineering unit or enter a custom one including upper and lower display limit settings for the smart meter's digital readout using buttons on the face of the meter.

Using the Smart Meter

Follow these guidelines when configuring the smart meter:

- If you initiate an SFC command at the same time a button is pressed on the smart meter, the smart meter will respond to the command it receives last. In other words, the last command wins.
- In most cases, you can press and release a button for one-shot operation, or press and hold a button for continuous, 1/2 second, repetitive operation.
- Active setup field will begin to flash at one second rate if next action is not initiated within one second. And, if no action is taken within 30 seconds, the setup function will time out and the meter will return to its previous state.

Transmitter Output Conformity and Smart Meter Configuration

Normally when using a differential type transmitter, you can select the transmitter's output to represent a straight linear calculation or a square root calculation for flow measurement applications. This linear or square root output parameter selection is called output conformity or output form. (See ST 3000 User Manual for more details.)

When configuring the smart meter to display the transmitter output measurement, there are certain rules to keep in mind which are dependent on the output conformity selection. These rules are described in the following paragraphs.

1. The output conformity setting of the transmitter restricts the engineering units you can select for the smart meter display.
   - When the transmitter is configured for an output conformity of **LINEAR**, you can select only pressure type engineering units. (See Table A-4.)
   - When the transmitter is configured for an output conformity of **SQUARE ROOT**, you can select only flow type engineering units GPM and GPH.
   - The percent and custom engineering units can be selected regardless of output conformity configuration.

2. Additionally, the output conformity setting restricts the setting of the lower and upper display limits to represent transmitter's 0 to 100% output.

Continued on next page

Transmitter Output Conformity and Smart Meter Configuration, continued

- If you select pressure type engineering units, you cannot set the lower or upper display limits. These values are automatically set when you select the engineering units.
- You can set only the upper display limit when the transmitter is configured for **SQUARE ROOT** output conformity. The lower display limit is fixed at zero (0) for a transmitter in square root mode and cannot be changed.
- You can set both the lower and upper display limits when you have selected custom engineering units (EUF) and the transmitter output conformity is set to **LINEAR**.

When setting the lower and upper display limits, if you let either the lower or upper display limit setting time out (after thirty seconds), the meter will discard the newly set values and will revert to its previous settings. The meter forces you to set both limits by automatically initiating the next limit setting, either lower or upper, depending upon which limit you set first.

3. If you change the transmitter's output conformity, you must reconfigure the smart meter as outlined in Tables A-5, A-7 and A-8.

Table A-4 Smart Meter Engineering Units Code

Smart Meter Code	Engineering Unit	Transmitter Output Conformity
EU0	% *	Linear or Square Root
EU1	in H_2O *	Linear
EU2	mmHg *	
EU3	PSI *	
EU4	kPa †	
EU5	MPa †	
EU6	mbar †	
EU7	bar †	
EU8	g/cm^2 †	
EU9	kg/cm^2 †	
EUA	mmH_2O †	
EUB	inHg †	
EUC	mH_2O †	
EUD	GPM *	Square Root
EUE	GPH *	Square Root
EUF	Custom †	Linear or Square Root

* These selections have indicators on smart meter display.
† Use stick-on labels provided for other engineering units.

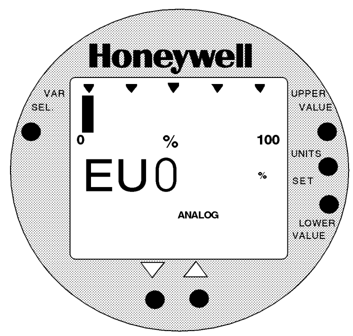
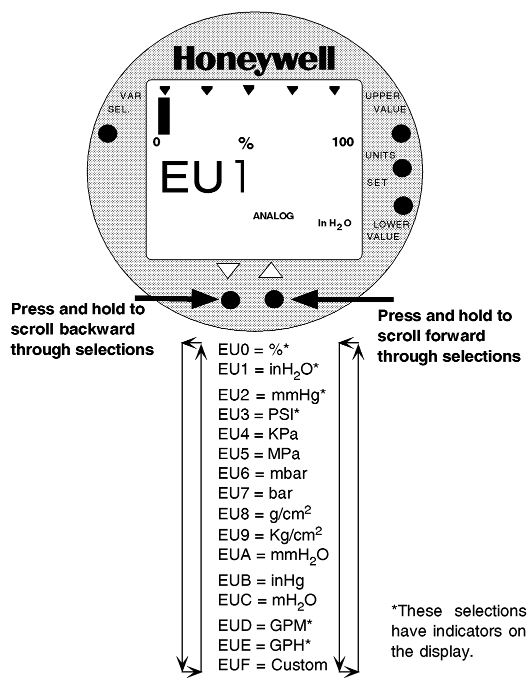
Selecting Engineering Units

The procedure in Table A-5 outlines the steps for selecting the desired engineering units for a smart meter using its local adjustments on the face of the meter. **You will be selecting the unit of measurement that you want the smart meter to indicate during normal operation.**

WARNING

When the transmitter's end-cap is removed, the housing is not explosionproof.

Table A-5 Selecting Engineering Units

Step	Action	Meter Display
1	Loosen lock on meter end-cap and unscrew cap from housing. Be sure transmitter power is ON.	
2	Press UNITS SET button.	Display shows code for current engineering units setting. 
3	Press Increase ▲ key to call up next code or Decrease ▼ key to call up previous code. Repeat this action until desired code is on display. You can hold down the Increase or Decrease key to scroll forward or backward through the codes. **ATTENTION** Remember that if transmitter is configured for SQUARE ROOT output conformity the only valid code selections are `EU0` (%) `EUD` (GPM) `EUE` (GPH) `EUF` (Custom) If transmitter is configured for LINEAR output conformity `EU0` (%) to `EUC` and `EUF` (CUSTOM) are valid code selections.	Selection codes for engineering units  *These selections have indicators on the display.

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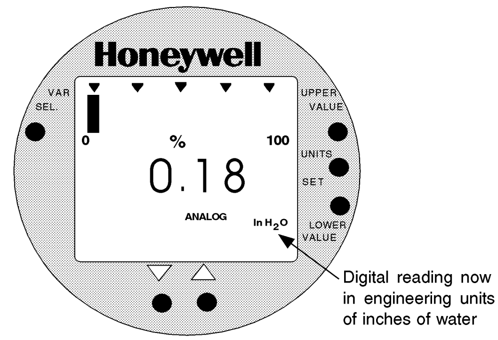
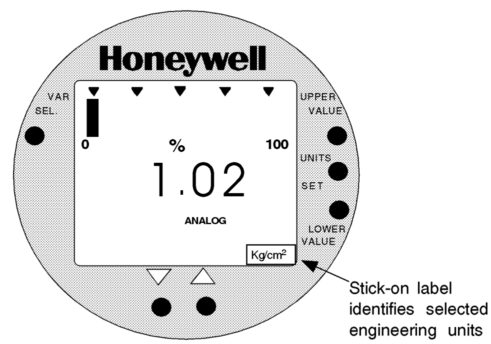
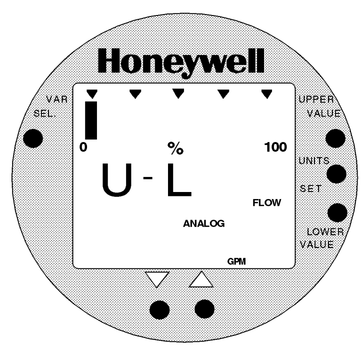
Selecting Engineering Units, continued

Table A-5 Selecting Engineering Units, continued

Step	Action	Meter Display
4	Press UNITS SET button to lock in selected code. **ATTENTION** If you select an invalid code according to the selections in Step 3, the meter display will show an error code `Er1` for one second and then return to the previous engineering units selection. Goes blank for 1/2 second and returns with reading in engineering units.	
5	If selected engineering unit does not match one of six unit indicators on meter, peel off matching stick-on unit label from sheet (drawing number 30756918-001) and paste it in lower right hand corner of meter.	Use stick-on label for engineering units without indicators on display. 
6	If you selected Custom or Flow engineering units, go to Tables A-7 and A-8 to set lower and upper display limits for smart meter display.	Lower and upper display limits have not been set for Custom or Flow engineering units. 

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Setting Lower and Upper Display Values

The Table A-6 shows the restrictions on setting the display values for given engineering units and output conformity selections.

Table A-6 Smart Meter Restrictions for Setting Display Values

Engineering Units code	Output Conformity	Set Lower Display Value?	Set Upper Display Value?
EU0 through EUC (Pressure type units)	Linear	No (set automatically)	No (set automatically)
EU0, EUD, EUE,and EUF (%, GPM, GPH, or Custom)	Square root	No (fixed at zero)	Yes Use Table A-8
EUF (Custom)	Linear	Yes Use Table A-7	Yes Use Table A-8

Setting Lower and Upper Display Values

To set the lower and upper display limit values for the meter display perform the procedures in Tables A-7 and A-8. Also note that in each procedure you must:

- First set the **magnitude range** for each display value. This enables the multiplier (K) on the display for indicating larger ranges (greater than 19999 and shifts the decimal point of the digital display left or right depending on the precision you want to show for that value).
- Next set the **display value**. This procedure sets the display limit of the meter to represent minimum and maximim transmitter output (0% and 100 % output).

Note: Magnitude range and display values are set for both upper and lower (if applicable) display limits.

During normal operation, the display range of the meter digital readout is ±19,990,000 and is automatically ranged to provide the best precision possible for the digits available up to 1/100th of a unit.

Setting Lower Display Values

The procedure in Table A-7 outlines the steps for setting the lower display limit to represent the 0 percent (LRV) output of the transmitter.

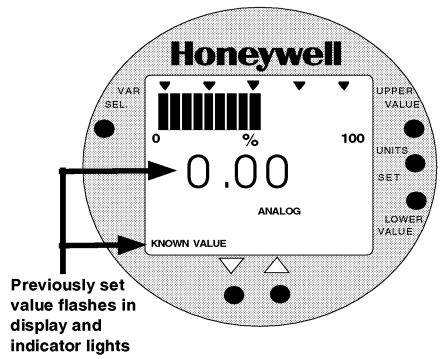
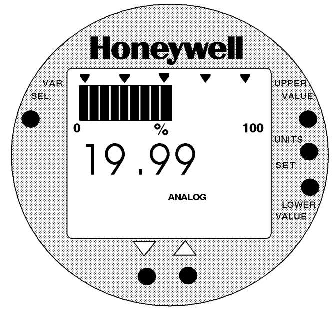
ATTENTION

For example purposes, the procedures in Tables A-7 and A-8 assume that the lower value is to be set at 0 and the upper value is to be set at 19,990,000 for a CUSTOM unit in a transmitter with a LINEAR output, and the transmitter's present output is exactly 50 percent.

Continued on next page

Setting Lower Display Values, continued

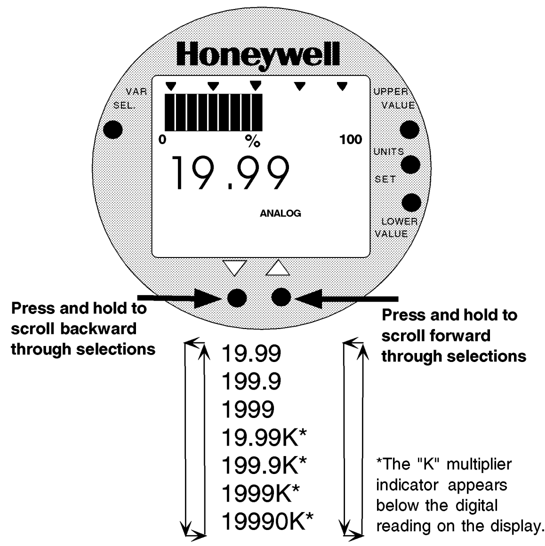
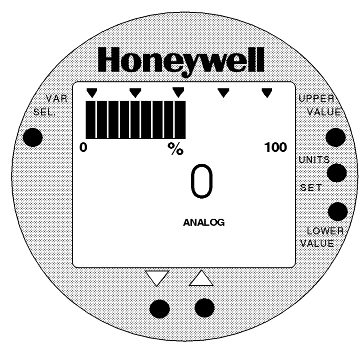
Table A-7 Setting Lower Display Values for Smart Meter Display

Step	Action	Meter Display
1	You have completed units selection in Table A-5 and `U-L` appears on the display. Press LOWER VALUE button to initiate lower display limit setting function. **ATTENTION** This procedure is only applicable for Custom (`EUF`) engineering unit selection in a transmitter configured for LINEAR output conformity. The lower display value for transmitters configured for SQUARE ROOT output conformity is fixed at zero (0.00) and cannot be changed.	If lower limit display value was previously set, KNOWN VALUE indicator lights and set value flashes in display. 
2	Press LOWER VALUE button again within 5 seconds. Otherwise, meter exits limit setting function.	Display shows magnitude range selection.  **ATTENTION** The magnitude range selection only applies for setting the display limits. This selection does not affect the normal operation of the meter. During normal operation, the display is automatically ranged to provide the best precision possible.

Continued on next page

Setting Lower Display Values, continued

Table A-7 Setting Lower Display Values for Smart Meter Display, continued

Step	Action	Meter Display
3	Press Increase ▲ button to call up next available magnitude range selection or Decrease ▼ button to call up previous magnitude range selection. NOTE: This action enables the multiplier (K) for indicating larger ranges and shifts the decimal point of the digital display left or right depending on which button is pushed. The display shows largest positive number for given range selection so you can select a range that is just larger than the range to be set for best display precision. Hold respective key to scroll forward or backward through the selections. Repeat this action until desired selection is on display.	Magnitude range selections. 
4	Press LOWER VALUE button to initiate lower value setting.	Readout goes blank except for first active digit which will be 0 unless lower value was set before. 

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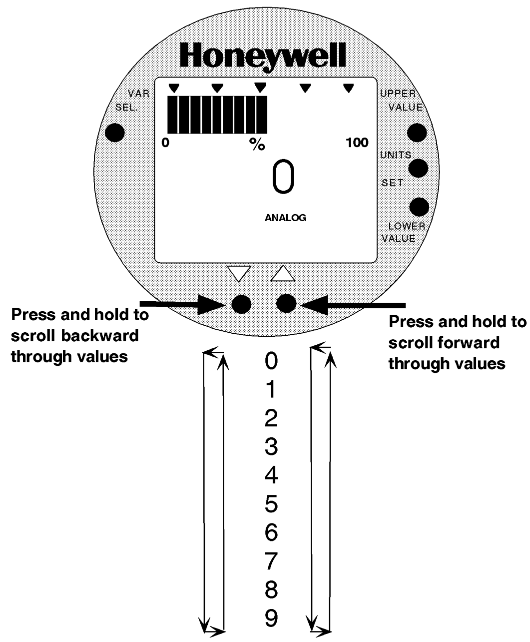
Setting lower display values, continued

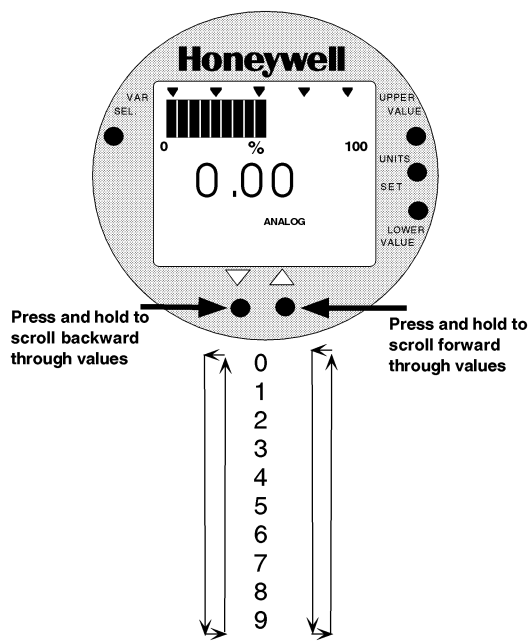
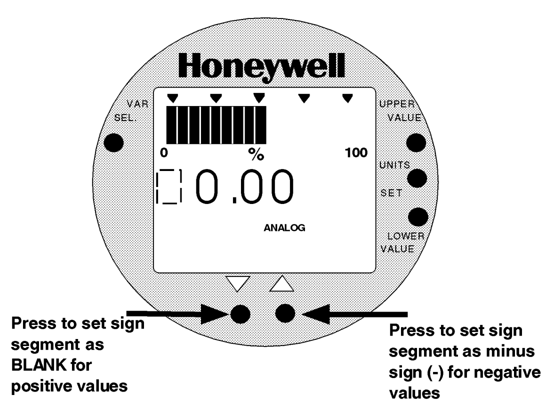
Table A-7 Setting Lower Display Values for Smart Meter Display, continued

Step	Action	Meter Display
5	Press Increase ▲ button to select the next available digit value or Decrease ▼ button to select the previous digit value. Repeat this action until desired value is on display.	First digit value setting. 
6	Press LOWER VALUE button to lock-in first digit and activate next active digit. Readout now displays next active digit which will be zero unless lower value was set before.	
7	Press Increase ▲ button to select the next available digit value or Decrease ▼ button to select the previous digit value. Repeat this action until desired value is on display.	
8	Press LOWER VALUE button to lock-in second digit and activate next active digit. Readout now displays next active digit which will be zero unless lower value was set before.	

Continued on next page

Setting lower display values, continued

Table A-7 Setting Lower Display Values for Smart Meter Display, continued

Step	Action	Meter Display
9	Press Increase ▲ button to select the next available digit value or Decrease ▼ button to select the previous digit value. Repeat this action until desired value is on display.	Third digit value setting. 
10	Press LOWER VALUE button to lock-in third digit and activate next active digit. Readout now displays next active digit which will be BLANK unless lower value was set to 1 before.	
11	Press Increase ▲ button to set digit to 1 or Decrease ▼ button to set it to BLANK..	
12	Press LOWER VALUE button to lock-in "1" digit and activate sign segment. Readout now displays sign segment which will be BLANK for positive values unless lower value was set for negative (–) values before.	
13	Press Increase ▲ button to set sign segment to minus sign for negative values or Decrease ▼ button to set it to BLANK. for positive values.	Sign segment setting. 
14	Press LOWER VALUE button to lock in current settings as lower display value limit. **ATTENTION** For CUSTOM unit in transmitter with LINEAR output, you must set both lower and upper display limits for values to take effect. If you let either the lower or upper display limit time out (after 30 seconds), the meter discards both newly set values and reverts back to the previously set values.	

- If you have not yet set the upper display limit value, the meter automatically enters the upper display setting function after it displays previously set value, if applicable. Go to Table A-8.
- If you have already set the upper display limit value, this completes the lower and upper display limits setting function for Custom engineering units in the transmitter. Meter returns to normal operation.

Continued on next page

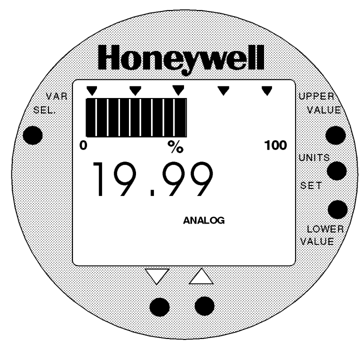
Setting Upper Display Values

The procedure in Table A-8 outlines the steps for setting the upper display limit to represent the 100 percent (URV) output of the transmitter.

ATTENTION

This procedure applies only for Flow units (GPM or GPH) in a transmitter configured for SQUARE ROOT output conformity, or CUSTOM unit in a transmitter configured for linear or square root output conformity.

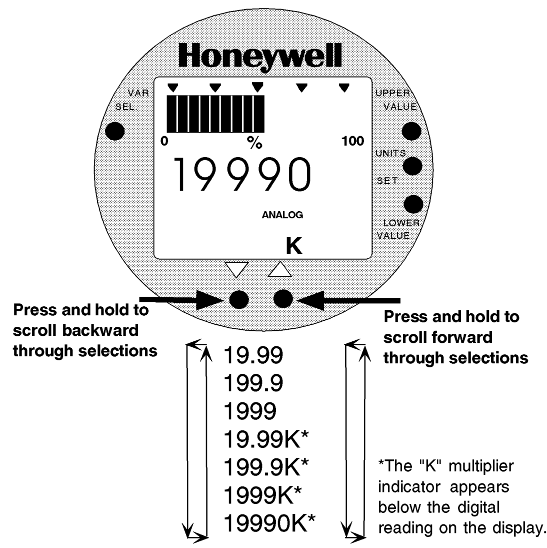
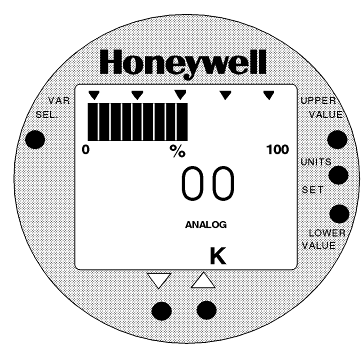
Table A-8 Setting Upper Display Value for Smart Meter Display

Step	Action	Meter Display
1	Press UPPER VALUE button to initiate upper display limit setting function.	If upper limit display value was previously set, KNOWN VALUE indicator lights and set value flashes in display.
2	Press UPPER VALUE button again within 5 seconds. Otherwise, meter exits limit setting function.	Display shows magnitude range selection.  **ATTENTION** The magnitude range selection only applies for setting the display limits. This selection does not affect the normal operation of the meter. During normal operation, the display is automatically ranged to provide the best precision possible.

Continued on next page

Setting Upper Display Values, continued

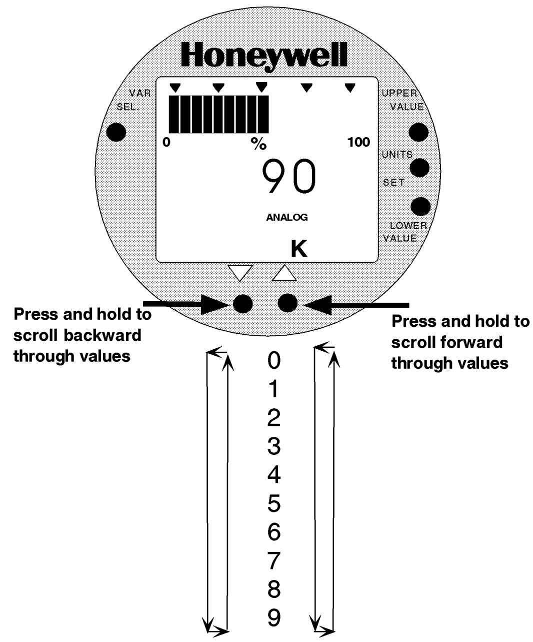
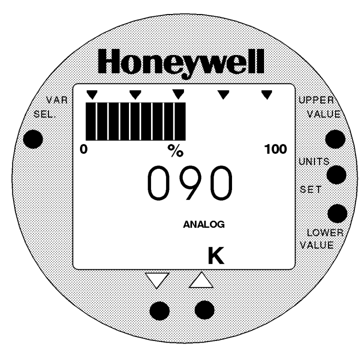
Table A-8 Setting Upper Display Value for Smart Meter Display, continued

Step	Action	Meter Display
3	Press Increase ▲ button to call up next available magnitude range selection or Decrease ▼ button to call up previous magnitude range selection. NOTE: This action enables the multiplier (K) for indicating larger ranges and shifts the decimal point of the digital display left or right depending on which button is pushed. The display shows largest positive number for given range selection so you can select a range that is just larger than the range to be set for best display precision. Hold respective key to scroll forward or backward through the selections. Repeat this action until desired selection is on display. For example purposes only, largest range 19990K is selected in this procedure.	Magnitude range selections with largest range selected. 
4	Press UPPER VALUE button to initiate upper value setting.	Readout goes blank except for first active digit which will be 0 unless upper value was set before. 

Continued on next page

Setting Upper Display Values, continued

Table A-8 Setting Upper Display Value for Smart Meter Display, continued

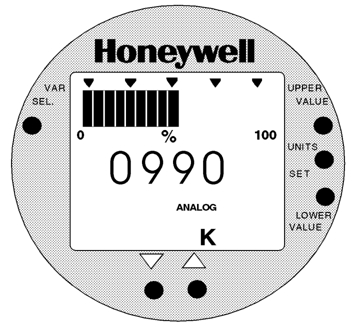
Step	Action	Meter Display
5	Press Increase ▲ button to select the next available digit value or Decrease ▼ button to select the previous digit value. Repeat this action until desired value is on display – use 9 for example purposes.	First digit value setting is set to 9. 
6	Press UPPER VALUE button to lock-in first digit and activate next active digit. Readout now displays next active digit which will be zero unless upper value was set before.	
7	Press Increase ▲ button to select the next available digit value or Decrease ▼ button to select the previous digit value. Repeat this action until desired value is on display.	

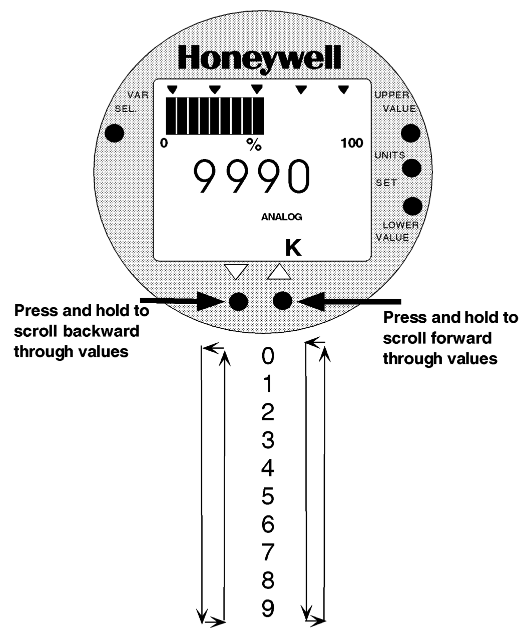
Continued on next page

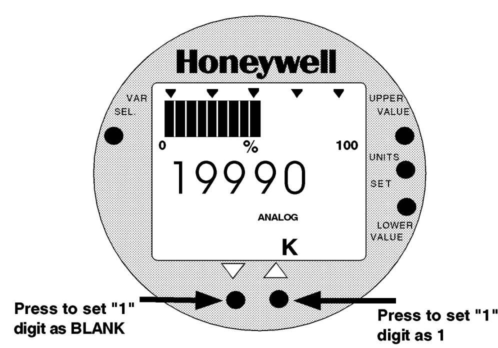
Setting Upper Display Values, continued

Table A-8 Setting Upper Display Value for Smart Meter Display, continued

<table>
<tr><th>Step</th><th>Action</th><th>Meter Display</th></tr>
<tr><td>8</td><td>Press UPPER VALUE button to lock-in second digit and activate next active digit.

Readout now displays next active digit which will be zero unless upper value was set before.</td><td>
</td></tr>
<tr><td>9</td><td>Press Increase ▲ button to select the next available digit value or Decrease ▼ button to select the previous digit value.

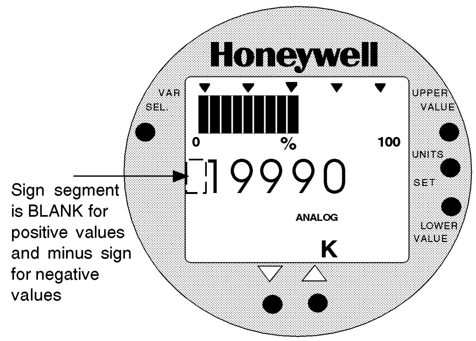
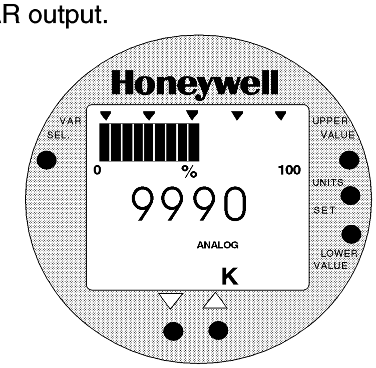
Repeat this action until desired value is on display – use 9 for example purposes.</td><td rowspan="2">Next digit value setting is set to 9.

</td></tr>
<tr><td>10</td><td>Press UPPER VALUE button to lock-in third digit and activate next active digit.

Readout now displays next active digit which will be BLANK unless upper value was set to 1 before.</td></tr>
<tr><td>11</td><td>Press Increase ▲ button to set digit to 1 or Decrease ▼ button to set it to BLANK.</td><td>"1" digit value setting is set to 1.

</td></tr>
</table>

Continued on next page

Setting Upper Display Values, continued

Table A-8 Setting Upper Display Value for Smart Meter Display, continued

Step	Action	Meter Display
12	Press UPPER VALUE button to lock-in "1" digit and activate sign segment.	Readout now displays sign segment which will be BLANK for positive values unless upper value was set for negative (–) values before. 
13	Press Increase ▲ button to set sign segment to minus sign for negative values or Decrease ▼ button to set it to BLANK. for positive values.	
14	Press UPPER VALUE button to lock in current settings as upper display value and return to previous display. Upper display limit setting is now complete. **ATTENTION** For CUSTOM unit in transmitter with LINEAR output, you must set both lower and upper display limits for values to take effect. If you let either the lower or upper display limit time out (after 30 seconds), the meter discards both newly set values and reverts back to the previously set values.	Display goes blank for a 1/2 second and returns to display readout equal to 50% output. In this example, readout is 9, 990,000 CUSTOM unit for 50% display range of 0 to 19,990,000 CUSTOM for transmitter with LINEAR output. 

- If you have not yet set the lower display limit value for CUSTOM unit in a transmitter configured for LINEAR output mode, the meter automatically enters the lower display setting function after it displays previously set value, if applicable. Go to Table A-7, Step 3.
- If you have already set the lower display limit value, this completes the lower and upper display limits setting function for CUSTOM unit in a transmitter configured for LINEAR output mode. Meter returns to normal operation.
- If you have just set the upper display limit for Flow unit or CUSTOM unit in a transmitter configured for SQUARE ROOT output mode, this completes the limit setting function. Meter returns to normal operation.

A.6 Configuring Smart Meter Using SFC

Using the SFC to Configure the Smart Meter Display

You can select an available engineering unit or enter a custom one including upper and lower limit settings for the smart meter's digital readout using the SFC.

Transmitter Output Conformity and Smart Meter Configuration

Normally when using a differential type transmitter, you can select the transmitter's output to represent a straight linear calculation or a square root calculation for flow measurement applications. This linear or square root output parameter selection is called output conformity or output form. (See ST 3000 User manual for more details.)

When configuring the smart meter to display the transmitter output measurement, there are certain rules to keep in mind which are dependent on the output conformity selection. These rules are described in the following paragraphs.

1. The output conformity setting of the transmitter restricts the engineering units you can select for the smart meter display.
   - When the transmitter is configured for an output conformity of **LINEAR**, you can select only pressure type engineering units. (See Table 6.)
   - When the transmitter is configured for an output conformity of **SQUARE ROOT**, you can select only flow type engineering units GPM and GPH.
   - The percent and custom engineering units can be selected regardless of output conformity configuration.

2. Additionally, the output conformity setting restricts the setting of the lower and upper display limits to represent transmitter's 0 to 100% output.
   - If you select pressure type engineering units, you cannot set the lower or upper display limits. These values are automatically set when you select the engineering units.
   - You can set only the upper display limit when the transmitter is configured for **SQUARE ROOT** output conformity. The lower display limit is fixed at zero (0) for a transmitter in square root mode and cannot be changed.

Continued on next page

Transmitter Output Conformity and Smart Meter Configuration, continued

- You can set both the lower and upper display limits when you have selected custom engineering units (Custom) and the transmitter output conformity is set to **LINEAR**.
  When setting the lower and upper display limits, if you let either the lower or upper display limit setting time out (after thirty seconds), the meter will discard the newly set values and will revert to its previous settings. The meter forces you to set both limits by automatically initiating the next limit setting, either lower or upper, depending upon which limit you set first.

3. If you change the transmitter's output conformity, you must reconfigure the smart meter as outlined in Table A-9.

ATTENTION

After making any adjustments to the smart meter, keep the transmitter powered for at least 30 seconds so that the new meter configuration is written to non-volatile memory. If power is turned off before 30 seconds, the changes may not be saved so that when the transmitter power is restored, the meter configuration will revert to the previous settings.

Procedure

The procedure in Table A-9 outlines the steps for setting up the configuration for a smart meter using an SFC.

Table A-9 Setting Up Smart Meter Configuration Using an SFC

Step	Press Key	Read Display or Action	Description
1	B CONF	ST CONFIG CONFORMITY?	Calls up first configuration prompt.
2	▲ H NEXT	ST CONFIG Meter Config?	Calls up next configuration prompt. Prompt asks if you want to access meter configuration function. If you want to access it, go to Step 3. If you do not want to access it, press [**CLR**] key to exit function or [**▲ NEXT**] key to call up next configuration parameter.

Continued on next page

Procedure, continued

Table A-9 Setting Up Smart Meter Configuration Using an SFC, continued

Step	Press Key	Read Display or Action	Description
3	NON-VOL [ENTER (YES)]	Meter Config SFC WORKING... Meter Config Meter Bd Present	Enters meter configuration function and confirms that smart meter is present. Timed prompt - Proceed to Step 4. **ATTENTION** If prompt "No Meter Present" appears, prompt times out in a few seconds, as described above, and calls up the Configure Meter? prompt. This means that you can access the meter configuration function without the smart meter installed. Proceed to Step 4. If prompt "Mtr not Supportd" appears, prompt times out and returns to previous ST CONFIG prompt (See Step 2.). This means that you are working with a pre-release 300 transmitter that does not support the smart meter option and, therefore, can not access the meter configuration function.
4		Meter Config Configure Meter?	Prompt asks if you want to configure Smart Meter. If you want to configure it, go to Step 5. If you do not want to configure it, press [**CLR**] key to exit function.

Continued on next page

Procedure, continued

Table A-9 Setting Up Smart Meter Configuration Using an SFC, continued

<table>
<tr><th>Step</th><th>Press Key</th><th>Read Display or Action</th><th>Description</th></tr>
<tr><td>5</td><td>NON-VOL
ENTER (YES)

DECONF
MENU ITEM</td><td>Meter Eng Units
" H2O_39F

MmHg_0C
PSI
KPa
MPa
mBAR
BAR
g/cm^2
Kg/cm^2
mmH2O_4C
inHg_32F
mH2O_4C
GPM
GPH
Custom
%</td><td>Calls up present meter Engineering Unit selection. (Note that unit “H2O_39F is shown for example purposes only.)

Repeatedly press [MENU ITEM] key to step through other selections. For example purposes, stop when PSI unit is on display.</td></tr>
<tr><td>6</td><td></td><td><table><tr><th>If EU is …</th><th>Then…</th></tr><tr><td>Custom, GPM, or GPH</td><td>go to Step 7.</td></tr><tr><td>other than Custom, GPM, or GPH</td><td>go to Step 13.</td></tr></table></td><td></td></tr>
</table>

Continued on next page

Procedure, continued

Table A-9 Setting Up Smart Meter Configuration Using an SFC, continued

Step	Press Key	Read Display or Action	Description
7	NON-VOL ENTER (YES)	Meter Eng Units SFC WORKING. . . Meter Eng Units Data Downloaded Eng Units Hi-Lo SFC WORKING. . . EU Hi Custom >RANGE	Selected engineering unit is downloaded to transmitter and high/low display limit setting function is initiated. (Note that Custom unit is shown for example purposes only.) **ATTENTION** If you select GPM or GPH unit with the transmitter in its LINEAR mode, the prompts “INVALID REQUEST”, “Download Error”, and “MtrNotInFlowMode” are sequentially displayed after the SFC WORKING. . . prompt and display returns to the Configure Meter prompt. Transmitter must be in its SQUARE ROOT (Flow) mode for GPM or GPH to be a valid unit selection. Press [▼ **PREV**] key , if you want to view present high and low display limits loaded in the transmitter.
8	5 S 2 W 5 S	EU Hi Custom 5_ EU Hi Custom 52_ EU Hi Custom 525_	Key in 525 as upper display limit for Custom unit. **ATTENTION** The display range of the meter is ±19,990,000. If you enter larger values, they will not be displayed.
9	NON-VOL ENTER (YES)	EU Hi Custom ENTERED IN SFC EU Lo Custom >RANGE	Enters upper display limit in SFC and calls up lower display limit setting.
10	+/– 5 S	EU Lo Custom -_ EU Lo Custom -5_	Key in –5 as lower display limit for Custom unit in transmitter configured for LINEAR output mode. (Note that lower limit value is referenced to configured LRV.) **ATTENTION** Zero (0) is only valid entry for GPM or GPH unit, or CUSTOM unit with transmitter in SQUARE ROOT output mode.

Continued on next page

Procedure, continued

Table A-9 Setting Up Smart Meter Configuration Using an SFC, continued

Step	Press Key	Read Display or Action	Description
11	NON-VOL ENTER (YES)	EU Lo Custom ENTERED IN SFC Eng Units Hi-Lo ENTER CHANGES?	Enters lower display limit in SFC and prompt asks if you want to enter changes in transmitter. If you want to enter changes, go to Step 12. If you do not want to enter changes, press [**CLR**] key to exit function.
12	NON-VOL ENTER (YES)	Eng Units Hi-Lo SFC WORKING. . . Eng Units Hi-Lo Data Downloaded Meter Config Configure Meter?	Downloads changes to transmitter and returns to Configure Meter? prompt. Press [**CLR**] key to return to ST CONFIG menu. Skip Step 13.
13	NON-VOL ENTER (YES)	Meter Eng Units SFC WORKING. . . Meter Eng Units Data Downloaded Meter Eng Units MtrNotInFlowMode Meter Config Configure Meter?	Downloads selected pressure engineering unit to transmitter. Press [**CLR**] key to return to ST CONFIG menu. **ATTENTION** If you select a pressure unit with the transmitter in its SQUARE ROOT (Flow) mode, the prompts “INVALID REQUEST” and “Download Error” are sequentially displayed after the SFC WORKING. . . prompt and the EU Hi prompt is called up for display. At this point, you can change the upper display limit as shown in Step 8 or press the [▲ **NEXT**] key to call up the EU Lo prompt. See Step 10 to change the lower display limit or press the [▲ **NEXT**] key and then the [**CLR**] key to exit the function.
14		If you selected one of these engineering units: %, inH2O, mmHg, PSI, GPM, or GPH; verify that corresponding unit indicator is lit on Smart Meter display.	If selected engineering unit does not match one of six unit indicators on meter, you can use a stick-on label from Honeywell drawing 30756918-001. Just peel off matching engineering unit label from drawing and carefully paste it in lower right hand corner of display.

Continued on next page

A.7 Configuring Smart Meter Using SCT 3000

Using the SCT to Configure Smart Meter Display

You can select an available engineering unit or enter a custom one including upper and lower limit settings for the smart meter's digital readout using the SCT 3000.

To configure the smart meter using the SCT, click on the *Local Meter* tab in the ST 3000 device window. Use the information fields on the tab to select and enter the engineering unit and lower and upper display limits, if applicable. Refer to the SCT on-line User Manual for more information on smart meter set up using the SCT.

ATTENTION

The same rules apply for meter set up and the transmitter's output conformity selection. See "Transmitter Output Conformity and Smart Meter Configuration" in Subsection A.6 for details and restrictions.

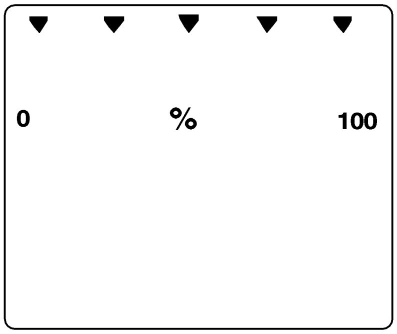
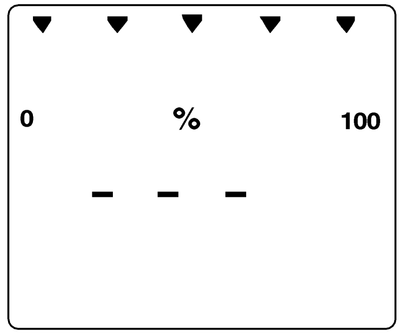
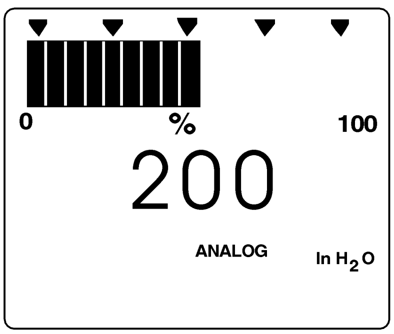
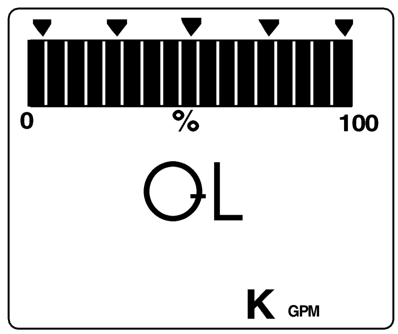
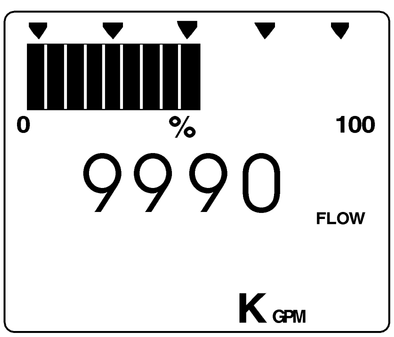
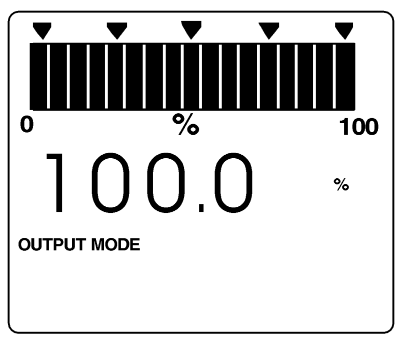
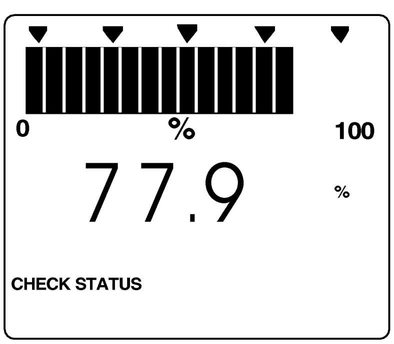
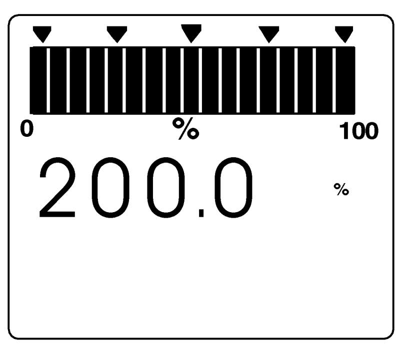
The smart meter does **not** have to be installed for you to configure it through the SCT.

A.8 Typical Smart Meter Indications

Typical operation indications

Table A-10 summarizes typical smart indications. meter Note that other combinations of status messages are possible.

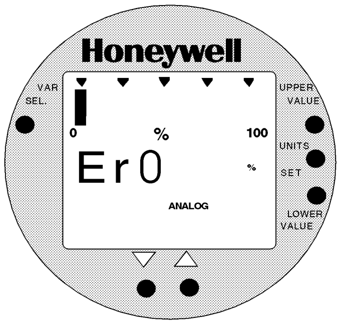
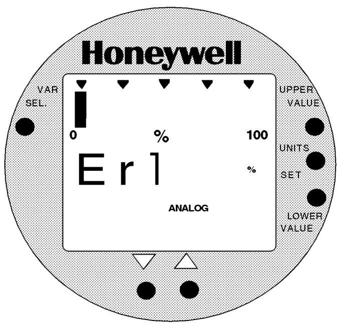
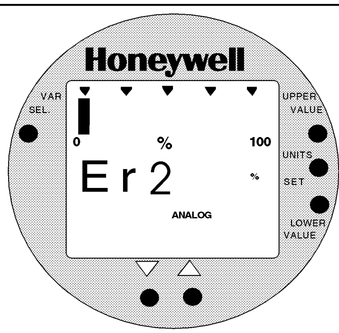
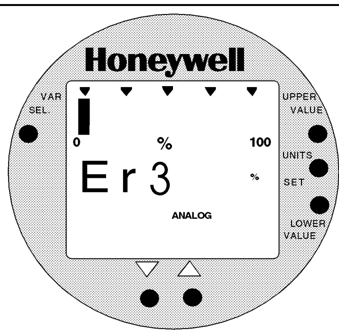
Table A-10 Summary of Typical Smart Meter Indications.

Meter Indication	What It Means	Meter Indication	What It Means
	No power applied.		Meter has detected transmitter output that is not-a-number.
	Normal display for transmitter in Analog mode with digital readout in inches of water.		Display range is Over Limit. Upper value is 19,990,000 and transmitter output is over 100%.
	Normal display for transmitter in DE mode and square root output. Digital readout is gallons per minute with 1000 multiplier.		Transmitter is in output mode. Bargraph and readout show value that was entered through SCT or SFC.
	Transmitter in DE mode is in non-critical status. Displayed value may not be valid. If display is "- - -" instead of a value, transmitter is in critical status.		Input pressure equal to or greater than 200%. Display flashes between 200% (or twice current URV in EU) and O-L. Transmitter locks output at 200% and will go no higher regardless of input.

Continued on next page

Operation error codes Table A-11 identifies possible meter error codes and what they mean.

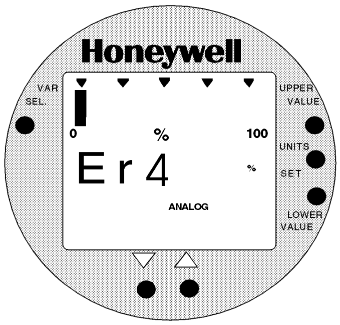
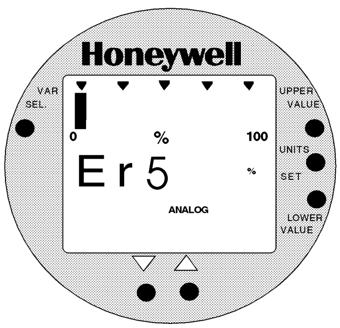
Table A-11 Smart Meter Error Codes and Descriptions.

If error indication is . . .	Then, it means
	You have tried to set local Zero or Span adjustment in a Series 100 transmitter that does not support this option.
	You have tried to set a pressure type engineering unit for a transmitter in SQUARE ROOT mode (FLOW) or have tried to set a flow type engineering unit for a transmitter in LINEAR mode (pressure). After this error is displayed, the meter will return to the unit # (EU#) of the Engineering Unit it was displaying before the set function was invoked. You may then select another unit or exit in the normal fashion.
	You have tried to select a process variable for the transmitter using the VAR SEL. button. The Variable Select button is non-functioning on the ST 3000 R300 transmitter.
	You have tried to set Lower or Upper display limit for pressure type engineering units (`EU1` to `EUC`), or Lower display limit for flow type engineering units (`EUD, EUE`) or CUSTOM unit (`EUF`) in transmitter configured for SQUARE ROOT output. Or, you have tried to set upper display limit for flow or Custom unit in transmitter with SQUARE ROOT output and URV set to zero (0). In SQUARE ROOT mode, the transmitter's URV cannot equal zero. The Lower and Upper display limits only apply for CUSTOM (`EUF`) unit in transmitter configured for LINEAR output. The Upper display limit also applies for FLOW (`EUD,EUE`) and CUSTOM (`EUF`) units with transmitter in SQUARE ROOT mode , but the Lower display limit is fixed at zero (0) and cannot be changed.

Continued on next page

Operation error codes, continued

Table A-11 Smart Meter Error Codes and Descriptions, continued.

If error indication is . . .	Then, it means
	You have tried to set a span value that is outside acceptable limits for your transmitter.
	You have tried to invoke a smart meter set function with the transmitter's Write Protect jumper in its Read Only position. You cannot make changes in the smart meter settings when the transmitter's configuration is write protected.

Meter/transmitter interaction

- Cycling transmitter power OFF/ON will have no affect on meter configuration. The meter digital readout will be in the previously set engineering units and applicable upper and lower display limits will be intact when transmitter power is restored. (See **ATTENTION** in Subsection A.4 when setting range values and configuring the meter display.)
- If you switch the transmitter mode from Analog to DE, the ANALOG indicator on the meter will go out. If you switch from DE to Analog mode, the ANALOG indicator will light.
- If you reconfigure the transmitter output conformity from SQUARE ROOT to LINEAR, the meter's digital readout will automatically revert to the default engineering unit of percent and the FLOW indicator will go out when the change is downloaded to the transmitter. Likewise, if you reconfigure the transmitter output conformity from LINEAR to SQUARE ROOT, the meter's digital readout will automatically revert to the default engineering unit of percent and the FLOW indicator will light when the change is downloaded to the transmitter. In either case, you must reconfigure the transmitter as outlined in Subsections A.5 or A.6 of this manual.

Appendix B —Hazardous Locations Reference

Reference Information

Information is provided to clarify the Hazardous Location installation requirements in North America and internationally. An explanaition of the applicalbel enclosure classification systems is also provided.

B.1 North American Classification of Hazardous Locations

Electrical Codes

Installation of electrical apparatus within hazardous (classified) locations of the United States is conducted under the provisions of the National Electrical Code (NEC), ANSI/NFPA 70, Article 500; and within Canada, under the provisions of the Canadian Electrical Code (CEC) C22.1, Part 1, Section 18.

Classifications

In both the United States and Canada, hazardous locations are classified into one of these three classes.

Class	Description of Hazardous Location
I	Presence of flammable gases or vapors may be present in quantities sufficient to produce explosive or ignitable mixtures.
II	Presence of combustible dusts, powders or grains.
III	Presence of easily ignitable fibers or flyings.

Divisions

The classes listed above are further classified into one of the following divisions based upon the level of risk present.

Division	Description of Risk
1	Locations in which hazardous concentrations of flammable gases or vapors, or combustible dust in suspension are continuously, intermittently or periodically present under normal operating conditions.
2	Locations in which flammable gases or vapors are present, but normally confined within closed containers or systems from which they can escape only under abnormal or fault conditions. Combustible dusts are not normally in suspension nor likely to be thrown into suspension.

Continued on next page

Examples

Given the above criteria, the following examples are made:

- A **Class III, Division 1** location is a location in which easily ignitable fibers or material processing combustible flyings are handled, manufactured or used.
- A **Class III, Division 2** location is a location in which easily ignitable fibers are stored or handled.

Groups

Flammable gases, vapors and ignitable dusts, fibers and flyings are classified into one of the following groups according to the energy required to ignite the most easily-ignitable mixture within air.

Class I Group	Description of Atmosphere
A	Atmospheres containing acetylene.
B	Atmospheres containing hydrogen, fuel and combustible process gases containing more than 30 percent hydrogen by volume, or gases or vapors of equivalent hazard
C	Atmospheres such as ethyl ether, ethylene, or gasses or vapors of equivalent hazard.
D	Atmospheres such as acetone, ammonia, benzene, butane, cyclopropane, ethanol, gasoline, hexane, methanol, methane, natural gas, naphtha, propane or gases or vapors of equivalent hazard.
Class II Group	**Description**
E	Atmospheres containing combustible metal dusts including aluminum, magnesium, and their commercial alloys, and other metals of similarly hazardous characteristics.
F	Atmospheres containing combustible carbonaceous dusts including carbon black, charcoal, coal or other dusts that have been sensitized by other materials so that they present an explosion hazard.
G	Atmospheres containing combustible dusts not included in Group E or F, including flour wood, grain, and other dusts of similarly hazardous characteristics.

B.1 North American Classification of Hazardous Locations,

Continued

Methods of Protection

The following table summarizes available methods of protection for use in given locations.

Protection Concept	Designation	Permitted Use	Principle
Explosionproof	XP	Division 1 & 2	Contains explosion and quenches flame.
Intrinsic Safety	IS	Division 1 & 2	Limit energy of sparks under normal and fault conditions.
Pressurized	Type X and Y	Division 1	Keeps flammable gas out.
Pressurized	Type Z	Division 2	Keeps flammable gas out.
Nonincendive	NI	Division 2	No arcs, sparks or hot surfaces under normal conditions

Temperature Classification

Equipment intended for installation directly within the hazardous location classification must also be classified for the maximum surface temperature that can be generated under normal or fault conditions as referenced to either 40°C (104°F) or the maximum operating ambient of the equipment (whichever is greater). The maximum surface temperature must be less than the minimum autoignition temperature of the hazardous atmosphere present. The temperature shall be indicated in identification numbers as listed in the following table.

Maximum Temperature		Identification Number
Degrees C	Degrees F	
450	842	**T1**
300	572	**T2**
280	536	**T2A**
260	500	**T2B**
230	446	**T2C**
215	419	**T2D**
200	392	**T3**
180	356	**T3A**
165	329	**T3B**
160	320	**T3C**
135	275	**T4**
120	248	**T4A**
100	212	**T5**
85	185	**T6**

Continued on next page

Apparatus Parameters

The **Intrinsically Safe Apparatus Parameters** are defined as follows.

Parameter	Description
Vmax	Maximum safe voltage which can be applied to the apparatus terminals.
Imax	Maximum safe current which can be applied to the apparatus terminals.
Ci	Unprotected capacitance in the apparatus which can be considered present at the terminals.
Li	Unprotected inductance in the apparatus which can be considered present at the terminals.

The **Associated Apparatus Parameters** are defined as follows.

Parameter	Description
Voc	Maximum output voltage which can be delivered to the hazardous (classified) location. This voltage is the maximum from a single channel.
Isc	Maximum output current which can be delivered to the hazardous (classified) location. This current is the maximum from a single channel.
*Vt	Maximum output voltage which can be delivered to the hazardous (classified) location. This voltage is the maximum across any combination of terminals of a multiple channel configuration.
*It	Maximum output current which can be delivered to the hazardous (classified) location. This current is the maximum through any combination of terminals of a multiple channel configuration.
Ca	Maximum capacitance which can be connected to the apparatus.
La	Maximum inductance which can be connected to the apparatus.

*CSA does not recognize these parameters at this time.

Continued on next page

Entity Concept

Under entity requirements, the concept allows interconnection of intrinsically safe apparatus to associated apparatus, not specifically examined in such combination. The criteria for interconnection is that the voltage (Vmax) and current (Imax), which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal to or greater than the voltage (Voc or Vt) and current (Isc or It) levels which can be delivered by the associated apparatus, considering faults and applicable factors. In addition, the maximum unprotected capacitance (Ci) and inductance (Li) of the intrinsically safe apparatus, including interconnecting wiring, must be less than or equal to the capacitance (Ca) and inductance (La) which can be safely connected to the associated apparatus. If these criteria are met, then the combination may be connected and remain intrinsically safe. Both FMRC and CSA d entity parameters are defined in Table B-1 and B-2.

Table B-1 Factory Mutual (FM) Approval

Code	Description
1C	Explosionproof for Class I, Division 1, Groups A, B, C & D. Dust-Ignitionproof for Class II, Division 1, Groups E, F & G. Suitable for Class III, Division 1. Conduit seals required within 18” of enclosure, Group A only. Intrinsically Safe for use in Class I, Division 1, Groups A, B, C & D; Class II, Division 1, Groups E, F & G; Class III, Division 1, T4 at 40°C, T3A at 93°C maximum ambient, when connected in accordance with Honeywell drawing 51204241. Nonincendive for use in Class I, Division 2, Groups A, B, C & D; Suitable for Classes II & III, Division 2, Groups F & G, T4 at 93°C maximum ambient, hazardous locations. 42 Vdc max. Environmental: Indoor and outdoor hazardous locations (NEMA 4X).

Continued on next page

B.1 North American Classification of Hazardous Locations,

Continued

Table B-1 Factory Mutual (FM) Approval, Continued

Intrinsic Safety Entity Parameters [1]	Class I, II, III, Divisions 1 and 2, Groups A - G
$V_{Max} \leq$ 42.4 V	
I_{Max} = 225 mA	
P_{Max} = 1.2 W	
C_i = 4.2 nF	
L_i = 0	With no integral indicator, or with integral Smart Meter, option SM.
L_i = 150 µH	With Analog Meter, option ME.

[1] Install in accordance with Honeywell drawing 51204241.

Table B-2 Canadian Standards Association (CSA)

Code	Description
2j	Explosion Proof for Class I, Division 1, Groups B, C & D. Dust-Ignition-Proof for Class II, Division 1, Groups E, F & G; Class III, Division 1. Conduit seals not required. 42 Vdc max. Intrinsically Safe for Class I, Groups A, B, C & D; Class II, Groups E, F & G; Class III, Divisions 1, T4 at 40°C, T3A at 93°C maximum ambient. Install per Honeywell drawing 51204242. Suitable for Class I, II & III, Division 2, Groups A, B, C, D, E, F & G hazardous locations, T4 at 93°C. 42 Vdc max. Environmental: Indoor and outdoor hazardous locations (Encl 4X).

CSA Certified Barriers [1]	Class I, II, III, Division 1 and 2, Groups
28V / 200 Ω	A - G
20V / 150 Ω	C - G

[1] Install in accordance with Honeywell drawing 51204242.

B.2 International Electrotechnical Commission (IEC) Classification of Hazardous Locations

About IEC

The IEC has established a number of recommendations applying to the construction of explosion protected electrical apparatus identified. These recommendations are found within IEC 79-0 through 79-15 and 79-28.

For all EC countries as well as various neighboring countries (CENELEC member states), the European Standards EN 50 014 to EN 50 020 and EN 50 039 apply for the construction of explosion protected electrical apparatus. They were established on the basis of the IEC. However these recommendations are much more detailed by comparsion.

Zones

Hazardous locations, within IEC7-10, are classified into one of these three zones.

ZONE	Description of Hazardous Location
0	Explosive gas atmosphere is present continuously, or is present for long periods.
1	Explosive gas atmosphere is likely to occur in normal operation.
2	Explosive gas atmosphere is not likely to occur in normal operation and, if it does occur, it will exist for a short period only.

IEC Groups

Flammable gases, vapors and mists are further classified into groups according to the energy required to ignite the most easily-ignitable mixture within air. Apparatus is grouped according to the atmospheres it may be used within as follows:

Group	Description of Atmosphere
IIC	Atmospheres containing acetylene, hydrogen, fuel and combustible process gases or vapors of equivalent hazard.
IIB	Atmospheres such as ethyl ether, ethylene, or gasses or vapors of equivalent hazard.
IIA	Atmospheres such as acetone, benzene, butane, cyclopropane, ethanol, gasoline, hexane, methanol, methane, natural gas, naphtha, propane or gases or vapors of equivalent hazard.

Continued on next page

B.2 International Electrotechnical Commission (IEC) Classification of Hazardous Locations, Continued

IEC Methods of Protection

The following table summarizes available methods of protection for use in given locations.

Protection Concept	Designation	Permitted Use	Principle
Flameproof	d	Zone 1 & 2	Contains explosion and quenches flame.
Intrinsic Safety	ia	Zone 0, 1 & 2	Limits energy of sparks under 2 faults.
	ib	Zone 1 & 2	Limits energy of sparks under 1 fault
Pressurized	p	Zone 1	Keeps flammable gases out.
Encapsulation	m	Zone 1 & 2	Keeps flammable gases out.
Increased Safety	e	Zone 1 & 2	No arcs, sparks or hot surface.
Powder Filled	q	Zone 1 & 2	Contains explosion and quenches flame.
Oil Immersion	o	Zone 1 & 2	Keeps flammable gases out.
Non-sparking	nA	Zone 2	No arcs, sparks or hot surfaces under normal conditions.
Enclosed Break	nC	Zone 2	Contains explosion and quenches flame.
Limited Energy	nA	Zone 2	Limits energy of sparks and surface temperature under normal conditions.
Restricted Breathing	nR	Zone 2	Keeps flammable gases out.

Continued on next page

B.2 International Electrotechnical Commission (IEC) Classification of Hazardous Locations, Continued

IEC Temperature Classification

Equipment intended for installation directly within the hazardous location must also be classified for the maximum surface temperature that can be generated under normal or fault conditions as referenced to the maximum operating ambient of the equipment. The maximum surface temperature must be less than the minimum autoignition temperature of the hazardous atmosphere present. The temperature shall be indicated in identification numbers as listed in the following table.

Maximum Temperature		Identification Number
Degrees C	Degrees F	
450	842	**T1**
300	572	**T2**
200	392	**T3**
135	275	**T4**
100	212	**T5**
85	185	**T6**

Certification and Conformity Details

Table B-3 CENELEC / LCIE Certification

Code	Description
3D	Flameproof, Supply ≤ 45 Vdc, IP 66/67EEx d IIC T6.
3A	Intrinsically Safe EEx ia IIC T5, –40 ≤ Ta ≤ 93°C. Flameproof, Supply ≤ 45 Vdc, IP 66/67 EEx d IIC T6.

LCIE Intrinsic Safety Parameters [1]	
U_i = 30 V	
I_i = 100 mA	
P_i = 1.2 W	
C_i = 4.2 nF	
R_i = 0	
L_i = 0	With no integral indicator, or with integral Smart Meter, option SM.
L_i = 150 μH	With Analog Meter, option ME.

(1) Install in accordance with Honeywell drawing 51204243.

Certification and Conformity Details, continued

Table B-4 Standards Australia (LOSC) Certification

Code	Description
4H	Intrinsically Safe Ex ia IIC T4 Class I Zone 0. Flameproof Ex d IIC T6 Class I Zone 1 Non-Sparking Apparatus - Type of Protection 'n' Ex n IIC T6 Class I Zone 2

LOSC Intrinsic Safety Parameters [1]	
Ui = 42.4 V	
Ii = 225 mA	
Pi = 1.2 W	
Ci = 4.2 nF	
Li = 0	With no integral indicator, or with integral Smart Meter, option SM.
L_i = 150 µH	With Analog Meter, option ME.

(1) Install in accordance with Honeywell drawing 51204309.

Table B-5 Zone 2 (Europe) Declaration of Conformity

Code	Description
3N	Electrical Apparatus With Type of Protection "n" per IEC 79-15. IP 66/67. Ex II 3 GD T[1] X (Council Directive 94/9/EC) –40 ≤ Ta ≤ 93°C.

Zone 2 Parameters
$U_i \leq$ 42 V
$I_i \leq$ 22 mA
Temp. Code [1] T4 at Ta 93°C Maximum Ambient
Temp. Code [1] T5 at Ta 80°C Maximum Ambient
Temp. Code [1] T6 at Ta 65°C Maximum Ambient

B.3 Enclosure Ratings

NEMA and IEC Recognition

The NEMA (National Electrical Manufacturer's Association) enclosure classifications are recognized in the US. The IEC Publication 529 Classifications are recognized throughout Europe and those parts of the world that use the IEC standards as a basis for product certifications. The following paragraphs provide a discussion of the Comparison Between NEMA Enclosure Type Numbers and IEC Enclosure Classification Designations.

IEC Classifications

IEC Publication 529, *Classification of Degrees of Protection Provided by Enclosures*, provides a system for specifying the enclosures of electrical equipment on the basis of the degree of protection provided by the enclosure. IEC 529 does not specify degrees of protection against mechanical damage of equipment, risk of explosion, or conditions such as moisture (produced for example by condensation), corrosive vapors, fungus, or vermin.

IEC Designations

Basically, the IEC designation consists of the letters IP followed by two numerals. The first characteristic numeral indicates the degree of protection provided by the enclosure with respect to persons and solid foreign objects entering the enclosure. The second characteristic numeral indicates the degree of protection provided by the enclosure with respect to the harmful ingress of water.

NEMA Standards

NEMA Standards Publication 250, *Enclosures for Electrical Equipment (1000 Volts Maximum),* does test for environmental conditions such as corrosion, rust, icing, oil, and coolants. For this reason, and because the tests and evaluations for other characteristics are not identical, the IEC enclosure classification designations cannot be exactly equated with NEMA enclosure type numbers.

Continued on next page

IEC Designations, continued

Table B-6 provides an approximate conversion from NEMA enclosure type numbers to IEC enclosure classification designations. The NEMA types meet or exceed the test requirements for the associated IEC classifications; **for this reason the Table cannot be used to convert from IEC classifications to NEMA types.**

Table B-6 NEMA Enclosure Type Numbers and Comparable IEC Enclosure Classification

NEMA Enclosure Type Number	IEC Enclosure Classification Designation
1	IP 10
2	IP 11
3	IP 54
3R	IP 14
3S	IP 54
4 and 4X	IP 56
5	IP 52
6 and 6P	IP 67
12 and 12K	IP 52
13	IP 54

NOTE: This comparison is based on tests specified in IEC Publication 529

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ST 3000 Smart Pressure Transmitter, Release 300 and Smart Communicator Model STS 103

34-ST-99-14
8/02

Addendum
(to Installation Guide 34-ST-33-39C)

Overview

ATEX Directive 94/6/EC

The ATEX Directive 94/6/EC is a European CE Mark directive concerning products that are designed for use in potentially explosive environments. This "New Approach" directive is based on, and is an expansion of, European Norms (EN, CENELEC standards).

On June 30, 2003, the ATEX (ATmospheres EXplosibles) directive will replace directives currently in effect, and from that time, only products with the ATEX certification and with ATEX labeling will be approved for free movement in the 19 EU (European Union) and EFTA (European Free Trade Association) countries. As defined in the directive, "free movement" refers to:

– placing a product on the market, and/or

– placing a product into service.

The ATEX Directive 94/6/EC is a living (set of) document(s), subject to further change and refinement, whose details are beyond the scope of this addendum. Further information can be obtained in the Official Journal of the European Communities No L100/1, and in related publications such as Guidelines on the Application of Directive 94/9/EC. Both of these items are available at:

http://europa.eu.int/comm/enterprise/atex/index.htm

Products that have been previously certified under the EN and CENELEC European Norms, and which comply fully with all standards in the New Approach directive have, by application, received certification under ATEX Directive 94/6/EC.

The Honeywell ST3000 Smart Pressure Transmitter is now ATEX certified, and all units manufactured currently and in the future will include labeling that includes all markings required under the ATEX directive.

Inclusions

To ensure that all required information will be available to the user, the following items are include with this Addendum for reference:

1. Declaration of Conformity – ATEX CE0344 (Honeywell document number 51452504 Revision A).
2. Certificate of Manufacturer II G EEx nA ATEX CE (Honeywell document number 51452622 Revision A).

Purpose and Content of this Addendum

This Addendum includes information required under the ATEX Directive regarding:

1. The appearance and meaning of each certification mark (CE Mark) that appears on the label(s) affixed to the product.
2. Instructions for installation and use of the product.

   Information required for use of this product is given in:

   34-ST-25-14B - ST 3000 Smart Transmitter Release 300 and Smart Field Communicator Model STS103, and

   Installation information is given in

   34-ST-33-39C - ST 3000 Smart Transmitter Release 300 and Smart Field Communicator Model STS103 Installation Guide,

   of which this Addendum is a part.

Details regarding certification marks that appear in labeling for this product are given in this addendum.

> **Attention**
>
> The publications cited above and the functioning and construction (except for labeling) of the devices described therein are essentially unchanged. The purpose of this addendum is to provide details the purpose and appearance of the labels attached to each device under ATEX Directive 94/6/EC.

> **Attention**
>
> Before installing the equipment in a potentially explosive atmosphere, please read the information provided in this Addendum, which supports the ATEX certifications for this product.

CE Conformity

The ST 3000 Smart Pressure Transmitter is in conformity with the protection requirements of the following European Council Directives: 94/9/EC, the Explosive Atmospheres (ATEX) Directive, 89/336/EEC, the Electromagnetic Compatibility (EMC) Directive, and the Pressure Equipment (PED) directive.

In conformity with the ATEX directive, the CE mark on the certification nameplate includes the Notified Body identification number 0344 (KEMA 01ATEXQ3199) adjacent to the EC Type Examination Certificate number.

In conformity with the Pressure Equipment Directive, models rated greater than 200 bar (2,900 psi) have an additional CE mark applied to the meter body data plate in accordance with 97/23/EC, Article 15. Models rated at less than 200 bar have no CE mark on the meter body data plate per 97/23/EC, Article 3, Section 3.

Deviation from the installation conditions in this manual may invalidate this product's conformity with the Explosive Atmospheres, Pressure Equipment, and EMC Directives.

Conformity of this product with any other "CE Mark" Directive(s) shall not be assumed.

Marking, ATEX Directive

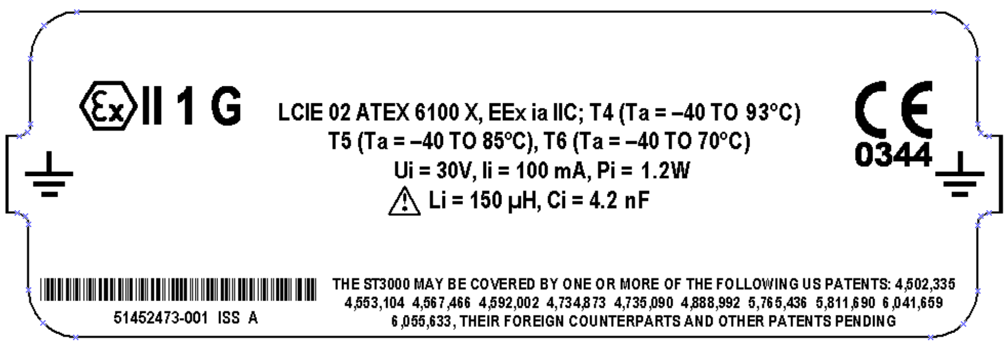
Honeywell's Model ST 3000 Smart Pressure Transmitter, with the following nameplates attached, has been certified to comply with Directive 94/9/EC of the European Parliament and the Council as published in the Official Journal of the European Communities No. L 100/1 on 19-April-1994.

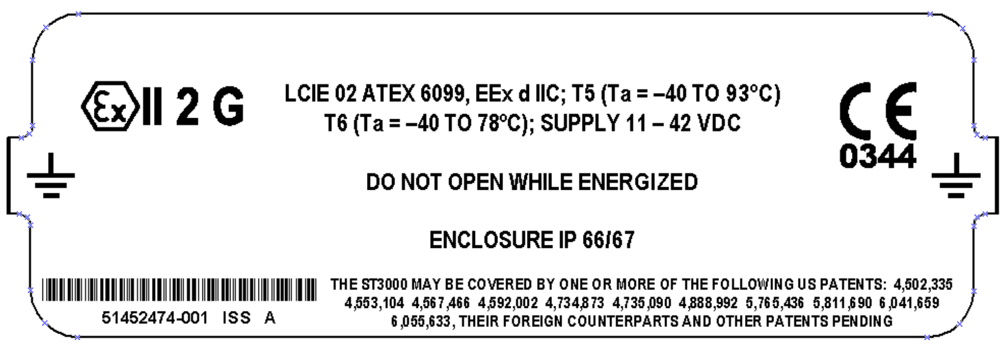
The following information is provided as part of the labeling of the transmitter:

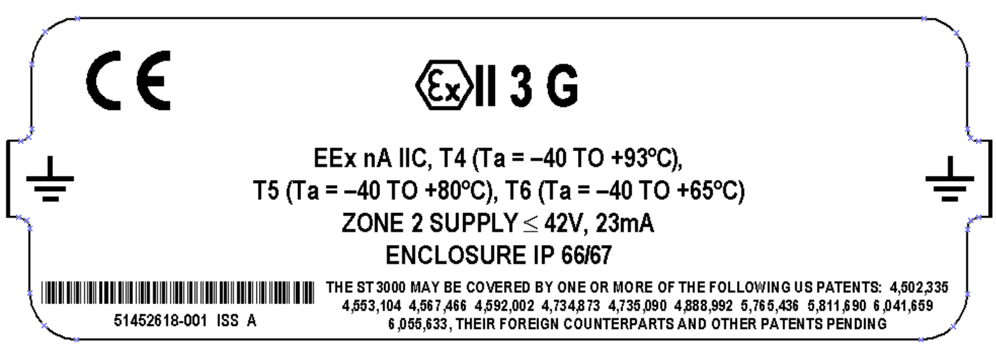
- Name and Address of the manufacturer: Honeywell, Phoenix, AZ 85053 USA.
- Notified Body identification: KEMA Quality B.V., Arnhem, the Netherlands

CE
0344

- For complete model number, see the Model Selection Guide for the particular model of pressure transmitter.
- The serial number of the transmitter is located on the Meter Body data-plate. The first two digits of the serial number identify the year (02) and the second two digits identify the week of the year (23); for example, 0223xxxxxxxx indicates that the product was manufactured in 2002, in the 23 rd week.







Specific Parameters for Intrinsic Safety

Field wiring terminals, (**+** , **–**):	Ui = 30 V,	Ii = 100 mA,	Pi = 1.2 W
Without local analog meter, ME:	Ci = 4.2 nF,	Ri = 0,	Li = 0
With local analog meter, ME:	Ci = 4.2 nF,	Ri = 0,	Li = 150 μH
With local smart digital meter, SM:	Ci = 4.2 nF,	Ri = 0,	Li = 0

Special conditions for safe use,

Intrinsic Safety (X)

The pressure transmitter is an intrinsically safe apparatus that can be installed in potentially explosive atmospheres.

The power terminals (+, **-**) must be connected only to a certified associated intrinsically safe apparatus.

The electrical parameters (U, I, and P) of the associated apparatus connected to the power terminals (+, **-**) must not exceed the following values:

Ui ≤ 30V
Ii ≤ 100 mA
Pi ≤ 1,2 W

Ambient temperature: - 50ºC to 93ºC

NOTE: -50ºC to 93ºC is the certification and “Operative Limits” for the product family. Refer to individual Specification Sheets for the standard “Rated Condition” ambient limits for a particular model that, as shown on the data-plate and certification nameplate, may be less than the certification limits.

Temperature classifications:

IS (ia) 4 – 20 mA / DE	Flameproof (d)
T4 up to Ta ≤ 93ºC	T5 up to Ta ≤ 93ºC
T5 up to Ta ≤ 85ºC	T6 up to Ta ≤ 78ºC
T6 up to Ta ≤ 78ºC	

Enclosure classification: IP 66/67, Type 4X

Specific Parameters for Flameproof Installation

Power supply to field wiring terminals, (**+**, **–**): Ucc ≤ 42 V

Output Signal: 4–20 mA

Special conditions for safe use, Flameproof Installation

Ambient operating temperature: - 50 to 93ºC

NOTE: -50ºC to 93ºC is the certification and “Operative Limits” for the product family. Refer to individual Specification Sheets for the standard “Rated Condition” ambient limits for a particular model that, as shown on the data-plate and certification nameplate, may be less than the certification limits.

Specific Parameters for Non-Sparking Zone 2 Installation

(Honeywell certified)

Supply Voltage:	11-42 Vdc
Supply Current:	23 mA
Ambient Temperate Limits:	- 50°C to 93°C
Temperature Classification:	T6 at Ta $\leq$ 65°C
	T5 at Ta $\leq$ 80°C
	T4 at Ta $\leq$ 93°C

Special Conditions for Safe Use, Non-Sparking Zone 2 Installation

(Honeywell certified)

- The installation of this equipment in Zone 2 hazardous areas must comply with VDE specification 0165, IEC 60079-14, EN 50021 and/or valid national standards for installation and operation.
- Before commissioning of this equipment, it must be verified that the power supply voltage cannot exceed the 42 Vdc maximum for 4-20 mA analog and DE equipment.
- The electronic assemblies in these units are non-repairable items and if faulty must be replaced. The electrical power supply must be switched off before any replacement and during any time that the wiring terminations are being connected or disconnected.

51452504, Revision A

DECLARATION OF CONFORMITY

Ex ATEX CE0344

We declare under our sole responsibility that the following products,

ST 3000 Smart Pressure Transmitters, Series 100 and 900,

Release 300 (per attached list)

to which this declaration relates, are in conformity with the protection requirements of Council Directive: 94/9/EC (ATEX Directive) on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres, and 89/336/EEC (EMC Directive) as amended by 92/31/EEC and 93/68/EEC on the approximation of the laws of the Member States relating to Electromagnetic Compatibility.

The models covered by this Declaration and evidence of conformity with the ATEX Directive are shown on the attached list. Conformity to the ATEX Directive is in accordance with the following European standards.

EN 50014-1997	Electrical Apparatus for Potentially Explosive Atmospheres - General Requirements
EN 50018-2000	Electrical Apparatus for Potentially Explosive Atmospheres - Flameproof Enclosure “d”
EN 50020-1994	Electrical Apparatus for Potentially Explosive Atmospheres - Intrinsic Safety "i"
EN 50284-1999	Special Requirements for Construction, Test and Marking of Electrical Apparatus of Equipment Group II, Category 1 G

Manufacturer: **Honeywell International Inc.**
16404 Black Canyon Highway
Phoenix, Arizona 85053 USA

The authorized signatory to this declaration, on behalf of the manufacturer, and the Responsible Person is identified below.

Honeywell International Inc.

Industrial Measurement & Control
1100 Virginia Drive
Fort Washington, PA 19034 USA

Frederick M. Kent
Standards & Approvals Engineer,
(ATEX Authorized Person)

Issue Date: 19 August, 2002

ST3000, R300 Pressure Transmitters

Certificate	Protection	Model	Description
LCIE 02 ATEX 6099	II 2 G, EEx d IIC	ST_ _ _ _-_ _ _-……-3D	Smart Pressure Transmitter, 4-20 mA / DE / HART / Fieldbus
LCIE 02 ATEX 6100X	II 2 G, EEx ia IIC	ST_ _ _ _-_ _ _-HC…-3S	Smart Pressure Transmitter, 4-20 mA / HART
LCIE 02 ATEX 6101X	II 1 G, EEx ia IIC	ST_ _ _ _-_ _ _-FF…-3S	Smart Pressure Transmitter, Fieldbus

Model	Series	Description
STA122	100	Absolute Pressure Transmitter
STA140	100	Absolute Pressure Transmitter
STD110	100	Differential Pressure Transmitter
STD120	100	Differential Pressure Transmitter
STD125	100	Differential Pressure Transmitter
STD130	100	Differential Pressure Transmitter
STD170	100	Differential Pressure Transmitter
STF128	100	Flange Mounted Liquid Level Transmitter
STF12F	100	Flange Mounted Liquid Level Transmitter
STF132	100	Flange Mounted Liquid Level Transmitter
STF13F	100	Flange Mounted Liquid Level Transmitter
STF14F	100	Flange Mounted Liquid Level Transmitter
STF14T	100	High Temperature Flange Mounted Pressure Transmitter
STG140	100	Gauge Pressure Transmitter
STG14L	100	Gauge Pressure Transmitter
STG14T	100	High Temperature Gauge Pressure Transmitter
STG170	100	Gauge Pressure Transmitter
STG17L	100	Gauge Pressure Transmitter
STG180	100	Gauge Pressure Transmitter
STG18L	100	Gauge Pressure Transmitter
STR12D	100	Remote Diaphragm Seal Pressure Transmitter
STR13D	100	Remote Diaphragm Seal Pressure Transmitter
STR14A	100	Remote Diaphragm Seal Pressure Transmitter
STR14G	100	Remote Diaphragm Seal Pressure Transmitter
STR17G	100	Remote Diaphragm Seal Pressure Transmitter
STA922	900	Gauge and Absolute Pressure Transmitter
STA940	900	Gauge and Absolute Pressure Transmitter
STD924	900	Differential Pressure Transmitter
STD930	900	Differential Pressure Transmitter
STD974	900	Differential Pressure Transmitter
STF904	900	Flange Mounted Liquid Level Transmitter
STF924	900	Flange Mounted Liquid Level Transmitter
STF92F	900	Flange Mounted Liquid Level Transmitter
STF932	900	Flange Mounted Liquid Level Transmitter
STF93F	900	Flange Mounted Liquid Level Transmitter
STG19L	900	High Pressure Gauge Transmitter
STG93P	900	Flush Mount Gauge Pressure Transmitter
STG944	900	Gauge and Absolute Pressure Transmitter

Model	Series	Description
STG94L	900	In-Line Gauge Pressure Transmitter
STG974	900	Gauge and Absolute Pressure Transmitter
STG97L	900	In-Line Gauge Pressure Transmitter
STG98L	900	In-Line Gauge Pressure Transmitter
STG99L	900	High Pressure Gauge Transmitter
STR93D	900	Remote Diaphragm Seal Pressure Transmitter
STR94G	900	Remote Diaphragm Seal Pressure Transmitter

51452622, Revision A

Certificate of Manufacturer

II 3 G EEx nA IIC ATEX

This certificate applies to the following equipment:

ST 3000 Smart Pressure Transmitters, Series 100 and 900, Release 100 and 900, 4-20 mA, DE, HART, and FOUNDATION™ Fieldbus (per attached list)

This equipment has no arcing or sparking parts and no ignition-capable hot surfaces, and therefore conforms to Clause 6.3.1.3 of VDE 0165/2.91, IEC 60079-14, and EN 50021 for operation in Zone 2 hazardous areas providing that the following conditions are observed. The equipment contains no intrinsically safe or energy-limiting components. The listed equipment are 2-wire devices that receive their power and signal carrier from the same 4-20 mA signal current or Fieldbus supply. In normal operation, the maximum current supply is 23 mA for ≤ 4-20 mA analog, DE or HART, and ≤ 260 mA for Fieldbus.

Conditions for the application of the above equipment in Zone 2 hazardous areas:

1. The installation of this equipment in Zone 2 hazardous areas must comply with VDE specification 0165, IEC 60079-14, EN 50021 and/or valid national standards for installation and operation.
2. Before commissioning this equipment, it must be verified that the power supply voltage cannot exceed the 42 Vdc maximum for 4-20 mA analog, DE and HART equipment, and 32 Vdc for Fieldbus equipment.
3. The electronic assemblies in these units are non-repairable items and if faulty, must be replaced. The electrical power supply must be switched off before any replacement and during any time that the wiring terminations are being connected or disconnected.
4. The technical data supplied by the manufacturer must be adhered to.

Specifications for Use in Zone 2		
	4-20 mA / DE / HART	**Fieldbus**
Supply Voltage:	11 – 42 Vdc	9 – 32 Vdc
Supply Current:	23 mA	260 mA
Ambient temperature limits:	–50 to 93ºC	
Temperature Classification:	T6 at Ta ≤ 65ºC T5 at Ta ≤ 80ºC T4 at Ta ≤ 93ºC	

Manufacturer:
Honeywell International Inc.
16404 Black Canyon Highway
Phoenix, Arizona 85053 USA

Honeywell International Inc.
Industrial Measurement & Control
1100 Virginia Drive
Fort Washington, PA 19034 USA

Frederick M. Kent
Standards & Approvals Engineer,
(ATEX Authorized Person)

Issue Date: 16 August, 2002

ST3000, R300 Pressure Transmitters

Model	Series	Description
STA122	100	Absolute Pressure Transmitter
STA140	100	Absolute Pressure Transmitter
STD110	100	Differential Pressure Transmitter
STD120	100	Differential Pressure Transmitter
STD125	100	Differential Pressure Transmitter
STD130	100	Differential Pressure Transmitter
STD170	100	Differential Pressure Transmitter
STF128	100	Flange Mounted Liquid Level Transmitter
STF12F	100	Flange Mounted Liquid Level Transmitter
STF132	100	Flange Mounted Liquid Level Transmitter
STF13F	100	Flange Mounted Liquid Level Transmitter
STF14F	100	Flange Mounted Liquid Level Transmitter
STF14T	100	High Temperature Pressure Transmitter
STG140	100	Gage Pressure Transmitter
STG14L	100	Gage Pressure Transmitter
STG14T	100	High Temperature Pressure Transmitter
STG170	100	Gage Pressure Transmitter
STG17L	100	Gage Pressure Transmitter
STG180	100	Gage Pressure Transmitter
STG18L	100	Gage Pressure Transmitter
STR12D	100	Remote Diaphragm Seal Pressure Transmitter
STR13D	100	Remote Diaphragm Seal Pressure Transmitter
STR14A	100	Remote Diaphragm Seal Pressure Transmitter
STR14G	100	Remote Diaphragm Seal Pressure Transmitter
STR17G	100	Remote Diaphragm Seal Pressure Transmitter
STA922	900	Gage and Absolute Pressure Transmitter
STA940	900	Gage and Absolute Pressure Transmitter
STD924	900	Differential Pressure Transmitter
STD930	900	Differential Pressure Transmitter
STD974	900	Differential Pressure Transmitter
STF904	900	Flange Mounted Liquid Level Transmitter
STF924	900	Flange Mounted Liquid Level Transmitter
STF92F	900	Flange Mounted Liquid Level Transmitter
STF932	900	Flange Mounted Liquid Level Transmitter
STF93F	900	Flange Mounted Liquid Level Transmitter
STG19L	900	High Pressure Gauge Transmitter
STG93P	900	Flush Mount Gage Pressure Transmitter
STG944	900	Gauge and Absolute Pressure Transmitter
STG94L	900	In-Line Gage Pressure Transmitter
STG974	900	Gauge and Absolute Pressure Transmitter
STG97L	900	In-Line Gauge Pressure Transmitter
STG98L	900	In-Line Gauge Pressure Transmitter
STG99L	900	High Pressure Gauge Pressure Transmitter
STR93D	900	Remote Diaphragm Seal Pressure Transmitter
STR94G	900	Remote Diaphragm Seal Pressure Transmitter

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By E-Mail College.Automation@Honeywell.com

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Title of Publication: **ST 3000 Release 300 Installation Guide** Issue Date: **7/00**

Publication Number: **34-ST-33-39C**

Writer: **Dave Taunton**

Comments: ____

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Fort Washington, Pennsylvania 19034

Honeywell

MODUTROL IV MOTORS

M9484 AND M9494 MODUTROL MOTORS ARE LOW VOLTAGE, REVERSING PROPORTIONAL CONTROL ACTUATORS FOR VALVES, DAMPERS AND AUXILIARY EQUIPMENT. THEY ARE ESPECIALLY DESIGNED **FOR COMMERCIAL OR INDUSTRIAL OIL OR** GAS BURNER CONTROL SYSTEMS.

•i Replace M941 motors.

☐ Oil immersed motor and gear train for reliable performance and long life.

☐ Wiring box provides NEMA 3 weather protection.

☐ Actuator motor and circuitry operate from 24 volts AC. Models available with factory installed transformer, or internal transformer can be field added.

☐ Quick-connect terminals standard **–** screw terminal adapter available.

Cl Adapter bracket for matching shaft height of older motors is standard with replacement motors.

☐ Field adjustable stroke **(90°** to **160°)** models available.

❑ Nominal timing of 30 seconds for **90°** and 60 seconds for **160°** stroke is standard. Other timings are available.

☐ Die-cast magnesium housing.

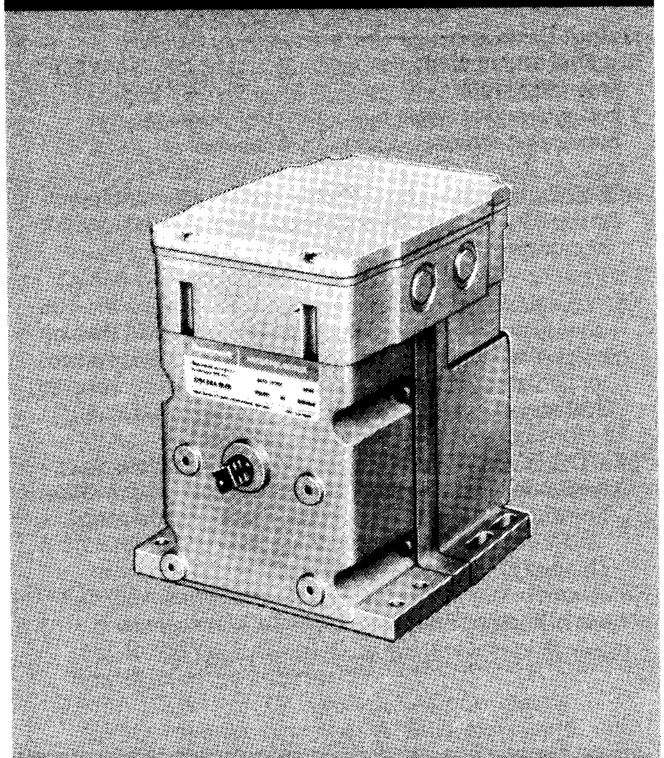
❑ Available accessories include valve and damper linkages, explosion proof housing, and auxiliary switches.

☐ Field addable interface modules can be mounted in wiring box to upgrade actuator to Series 70 (electronic) control.

•i Models available with tapped output shaft.

☐ **M9481,** M9484 rated for 150 lb.-in. torque at standard timings.

☐ **M9491,** M9494 rated for 300 lb.-in. torque at 2 or 4 minute timings for **160°** stroke.



M9484, M9481 M9494, M9491

S.M.
Rev. 11-90

Form Number 63-2195-l

SPECIFICATIONS

STANDARD MODELS

M9484D,E,F
M9494D

Control Type
94 is Series 90

Power Rating
8 is high torque 150 lb.-in. at standard timing
9 is high torque 300 **lb.-in.at** 2 or 4 min timing

Output Drive
4 is dual-ended shaft, non-spring return
1 is single-ended shaft, non-spring return

Suffix Letter
D: is adjustable stroke **(90°** to 1 **60°)** No auxiliary switches
E: is adjustable stroke **(90°** to 1 **60°)** 1 auxiliary switch
F: is adjustable stroke **(90°** to 1 **60°)** 2 auxiliary switches

NOTE: Some motors furnished to equipment manufacturers will have no adapter bracket, a single-ended shaft and/or no wiring box.

CONTROLLER TYPE: Series 90 Control Circuit-135 ohm series 90 proportioning controller. Series 90 high or low limit controller with manual minimum position potentiometer (with a combined total resistance of up to 500 ohms) may also be used in the control circuit.

MOTOR ROTATION: Normally **closed**[a]. The closed position is the limit of counterclockwise rotation as viewed from the power end of the motor. See Fig 2. **Motor opens** clockwise (as viewed from the power end). Motors are shipped in the closed position.

ELECTRICAL RATINGS:

	VOLTAGE **(V @ 50/ 60 Hz)**	CURRENT DRAW (A)	POWER **CONSUMPTION (W)**
Without Transformer	24	0.8	18
With internal Transformer	120	0.24	23
	208	0.14	23
	240	0.12	23

STROKE: Field adjustable from **90°** to **160°.** Start position of shaft changes with adjustment of stroke. (Midpoint of stroke remains fixed as stroke is adjusted, as shown in Fig. 2.) Stroke is adjusted by means of cams located in wiring compartment. (See Stroke Setting Procedure.) Motors are shipped with stroke set at **90°.**

DEAD WEIGHT LOAD ON SHAFT:
Power or Auxiliary End-200 lb. **[90.8** kg] maximum.
Maximum Combined Load-300 lb. **[136** kg].

AMBIENT TEMPERATURE RATINGS:
Maximum—150° F **[66°** C] **@** 25% duty cycle.
Minimum-minus **40°** F **[-40°** C].

CRANKSHAFT: **3/8** inch **[9.5mm]** square
M9484, M9494 have double-ended shaft.
M9481, M9491 have single-ended shaft.

[a]**The** normal position is the position the motor will assume with controller disconnected.

ORDERING INFORMATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR AUTHORIZED DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER.

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:

1. YOUR LOCAL HONEYWELL RESIDENTIAL **AND BUILDING CONTROLS SALES OFFICE (CHECK WHITE PAGES OF PHONE DIRECTORY).**

2. **RESIDENTIAL** AND BUILDING CONTROLS CUSTOMER SERVICE
HONEYWELL **INC., 1885** DOUGLAS DRIVE NORTH
MINNEAPOLIS, MINNESOTA 55422-4386 **(612)542-7500**

(IN CANADA-HONEYWELL LIMITED/HONEYWELL LIMITEE, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO MI P **2V9) INTERNATIONAL** SALES **AND SERVICE OFFICES IN** ALL PRINCIPAL CITIES OF THE WORLD.

AUXILIARY SWITCH RATINGS (amperes):
M94XXE has 1 spdt switch.
M94XXF has 2 spdt switches.

ONE CONTACT [a]	120v	240v
Full Load	7.2	3.6
Locked Rotor	43.2	21.6

[a]40 VA pilot duty, 1201240 Vac on opposite contact.

DIMENSIONS: See Fig. 1.
UNDERWRITERS LABORATORIES INC. LISTED
File No. E4436; Guide No. XAPX.
CANADIAN STANDARDS ASSOCIATION CERTIFIED:
General Listing File No. LR1620, 400-E-)

TIMING		TORQUE IN lb.-in. [mm]	
90° STROKE MOTORS	160° STROKE MOTORS	NORMAL RUNNING TORQUE	BREAKAWAY TORQUE[a]
15 sec	30 sec	75 [8.5]	150 [17.0]
30 sec	1 min	150 [17.0]	300 [34.0]
1.2 min	2,4 min[b]	300 134.01	600 168.01

[a]Breakaway torque is the maximum torque available to overcome occasional large loads such as a seized damper or valve. MOTOR MUST NOT BE USED CONTINUOUSLY AT THIS RATING.
[b]Stalling of 2,4 min motor will damage motor.

ACCESSORIES:
ES6501 17 Explosion-proof Housing-Encloses motor for use in explosive atmospheres. Not for use with Q601, Q618, and Q455 Linkages. Order from Nelson Electric Co. Requires Honeywell 7617DM Coupling.
Q607 External Auxiliary Switch-Controls auxiliary equipment as a function of motor position.
Q605 Damper Linkage-Connects motor to damper. INCLUDES MOTOR CRANK ARM.
0618 Linkage-Connects Modutrol motor to water or steam valve.
Q601 Bracket and Linkage Assembly-Connects Modutrol motor to water or steam valve.
Q100A,B Linkage-Connects Modutrol motor to butterfly valve. Requires adapter bracket packed with motor.
Q209E,F Potentiometer-Limits minimum position of motor.
Q68 Dual Control Potentiometer-Controls 1 through 9 additional motors.
Q181 Auxiliary Potentiometer-Controls 1 or 2 additional motors.
221455A Motor Crank Arm-Infinitely adjustable crank arm. Approximately 0.75 inches shorter than the 4074ELY crank arm, can rotate through downward position and clear base of motor without requiring use of adapter bracket.
220741A Screw Terminal Adapter-converts the standard quick-connect terminals to screws terminals.
Transformers-mounted internally, provide 24 Vac power to motor
198162JA—24 Vac; 50/60 Hz (for electrical isolation).
198162EA—120 Vac; 50/60 Hz.
198162GA—220 Vac; 50/60 Hz.
198162AA—120/208/240 Vac; 50/60 Hz.
Q7130A—Interface Module with selectable voltage ranges (4-7 Vdc, 6-9 Vdc, and 10.5-13.5 Vdc). Adapts motor to M71 XX function.
Q7230A—Interface Module, selectable voltage or current control, with adjustable null and span. Adapts motor to M72XX function; 4 to 20 mA or 2 to 10 Vdc.
Q7330A—Interface Module, for W936 economizer applications. Adapts motor to M73XX function.
Q7630A—Interface Module, 3-wire 14-17 Vdc control with minimum position capability. Adapts motor to M76XX function.
4074BYK—Control up to 6 M91XX motors in unison from one Series 90 controller.
4074EAU—Drive 2 or 3 M91 XX motors from a W973 Single-zone Logic Panel or W7100 Discharge Air Controller.
4074EDC—Drive one M91XX motor from a 4-20 mA Controller.
4074EED—Drive up to 4 M91 XX motors from a 4-20 mA Controller.
221508A Resistor Board-Plugs onto quick-connects in wiring box of M91XX motor. Can be used in place of 4074BYK, EAU, EDC, or EED resistor kits (functions described above).
7616ADW Motor Crank Arm-Approximately 0.75 inches shorter than the 7616BR crank arm, can rotate through the downward position and clear base of motor without requiring use of adapter bracket.

INSTALLATION

WHEN INSTALLING THIS PRODUCT...
1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

CAUTION

1. Disconnect power supply before beginning installation to prevent electrical shock and equipment damage.
2. Never turn the motor shaft by hand or with a wrench-this will damage the motor.
3. Always conduct a thorough checkout when installation is complete.

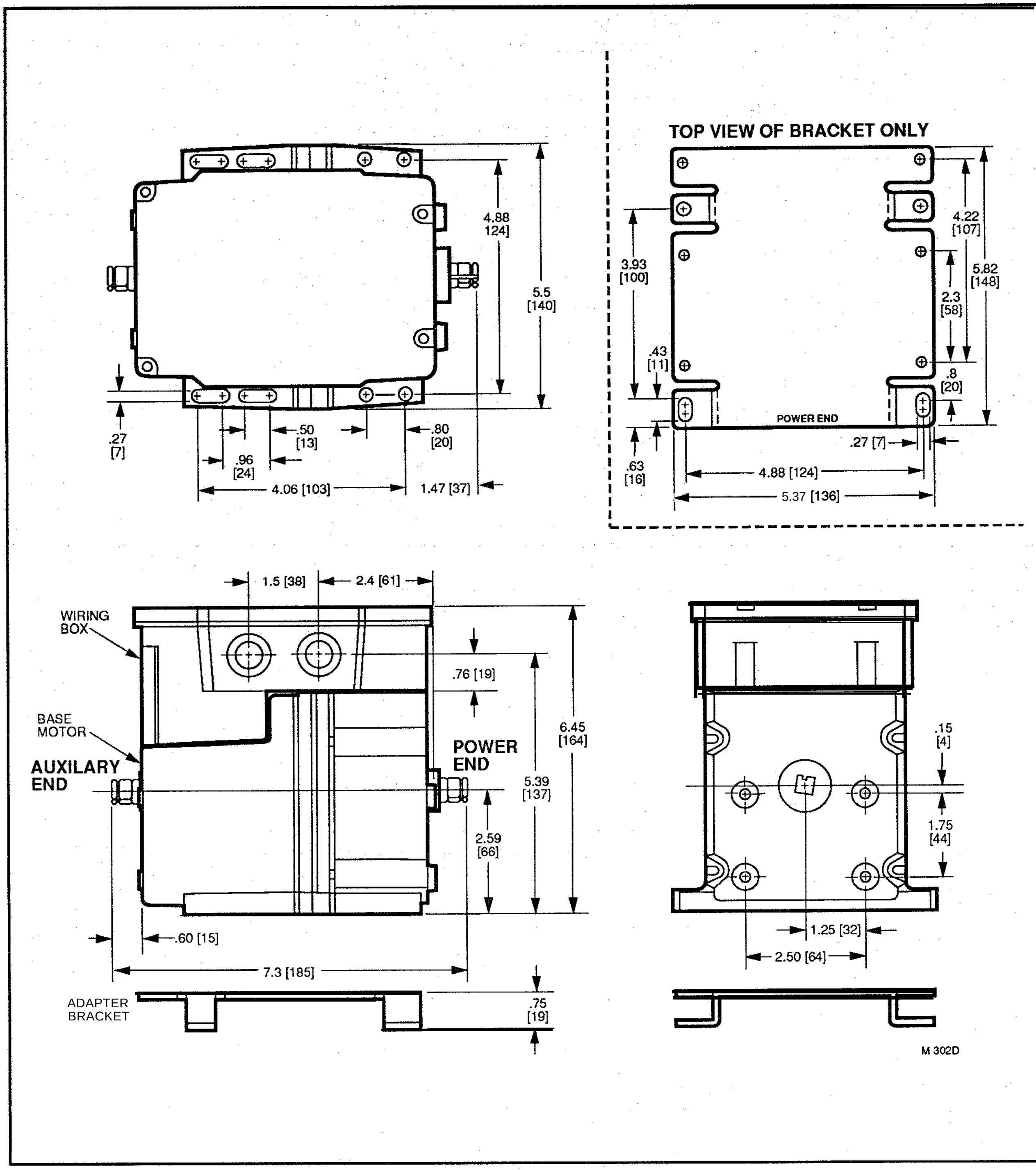


FIG. 1—DIMENSIONS IN in. [mm].

NOTE: M9481, M9491 do not have auxiliary shaft. All other dimensions are the same.

LOCATION

install the Modutrol motor in any location except where acid fumes or other deteriorating vapors might attack the metal parts, or in atmospheres of escaping gas or the explosive vapors.In excessive salt environments, mounting base and screws should be zincorcadmium plated, not stainless steel or brass: Use the 220738A adapter bracket for mounting on these surfaces.

Allow enough clearance for installing accessories and servicing the motor when selecting a location. See Fig. 1. If located outdoors, mount upright and use liquid-tight conduit connectors with wiring box to provide NEMA 3 weather protection.

MOUNTING

Always install motors with the crankshaft horizontal.

Mounting flanges extending from the bottom of the motor housing are drilled for 1/4 inch [6.4mm] machine screws or bolts.

Motors are shipped from the factory in closed position (at the limit of counterclockwise rotation as viewed from the power end of the motor, as shown in Fig. 2) with the stroke set at 90°.

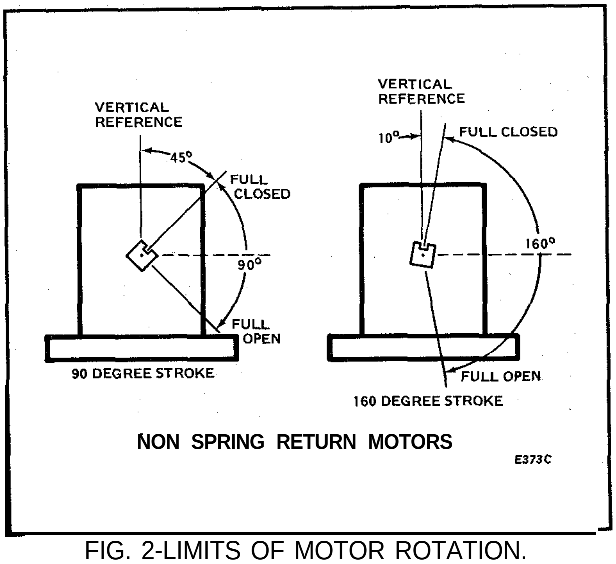


FIG. 2-LIMITS OF MOTOR ROTATION.

ADAPTER BRACKET

The 220738A Adaptor Bracket, positioned between the motor and the equipment, raises the shaft height of the M9484 motor by 0.75 inch to match that of the M941 motor. This is required on all valve linkage applications, Q607 External Auxiliary Switch applications, and on some damper linkage applications (either to provide clearance for the crank arm to rotate through the downward position, or to allow the damper linkage to reach the shaft).

To mount the motor with the bracket:

1. Mount the bracket to the equipment with existing or standard bolts.

2. Mount the motor to the bracket using the bolts provided into the threaded holes of the bracket (see Fig. 3).

For valve linkage applications, the bracket should first be mounted to the linkage (see Fig. 4). The bracket then provides a convenient base on which the motor can be positioned. After the motor shaft is aligned to the linkage, it can then be attached to the bracket with the 4 bolts provided. These bolts go through the inner set of holes in the motor flange and into the threaded holes of the bracket.

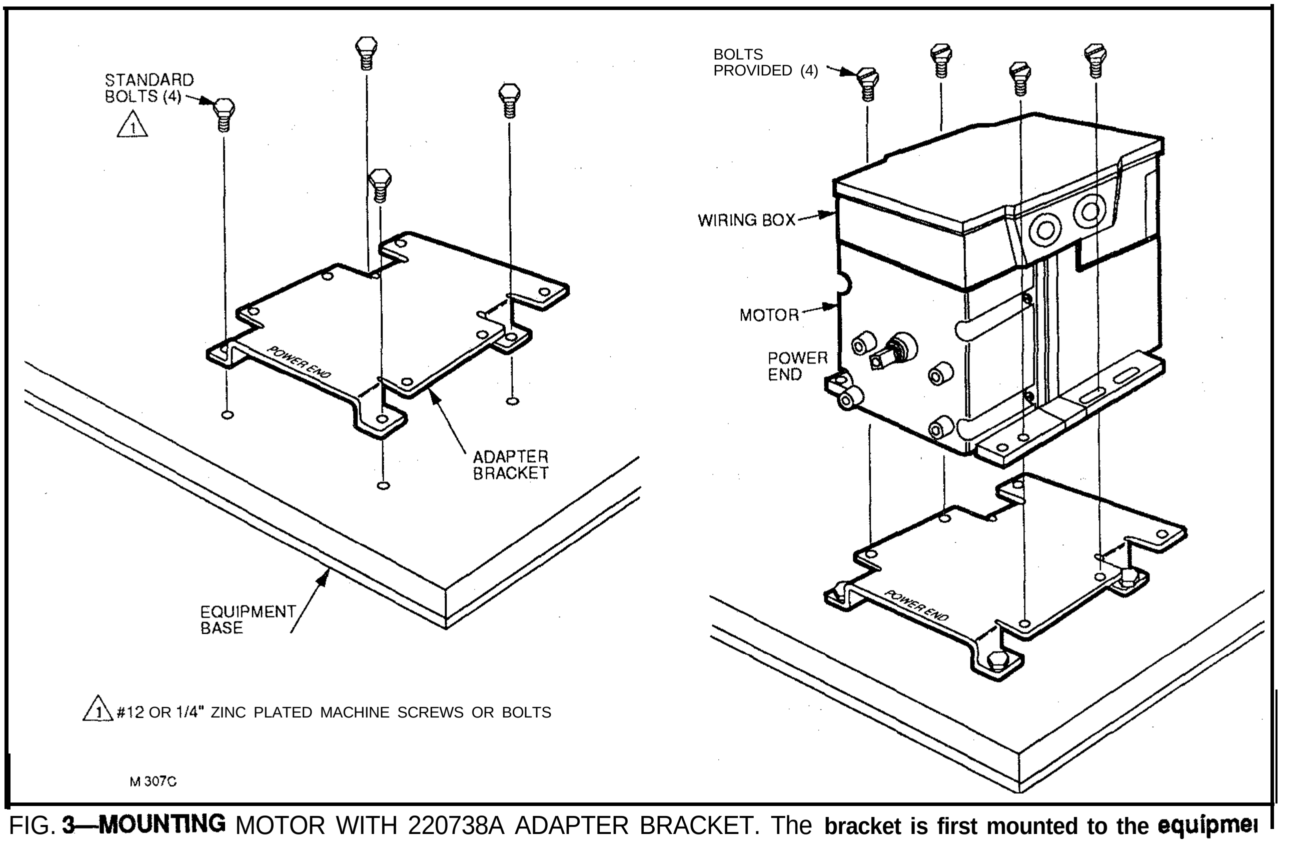


FIG. 3—MOUNTING MOTOR WITH 220738A ADAPTER BRACKET. The **bracket is first mounted to the equipment with standard bolts.** The motor is then mounted **to the bracket using the bolts provided with the bracket, which thread into the threaded bracket holes.**

DAMPER LINKAGES

A 220738A Adapter Bracket is packed with replacement motors. Use of this bracket is optional for many damper applications but may be needed in damper applications requiring the crank arm to rotate through the bottom plane of the actuator. If the bracket is not used in a replacement application, the damper linkage will have to be adjusted to the new shaft position.

The motor comes without a crank arm. The crank arm is included in the Q605 linkage or may be ordered separately (see Accessories).

For detailed instructions on the assembly of specific linkages, refer to the instruction sheet packed with each linkage. In general, however, check the following points of operation when installing a motor and linkage.

1. Linkages for valves and louver type dampers should be adjusted so that the damper or valve moves through only the maximum required distance when the motor moves through its full stroke.

2. With modulating control, maximum damper opening should be no more than 60°. Little additional airflow is provided beyond this point.

3. The motor must be stopped at the end of its stroke by the limit switch and must not be stalled by the damper or valve. The motor will be damaged if it is not permitted to complete its full stroke.

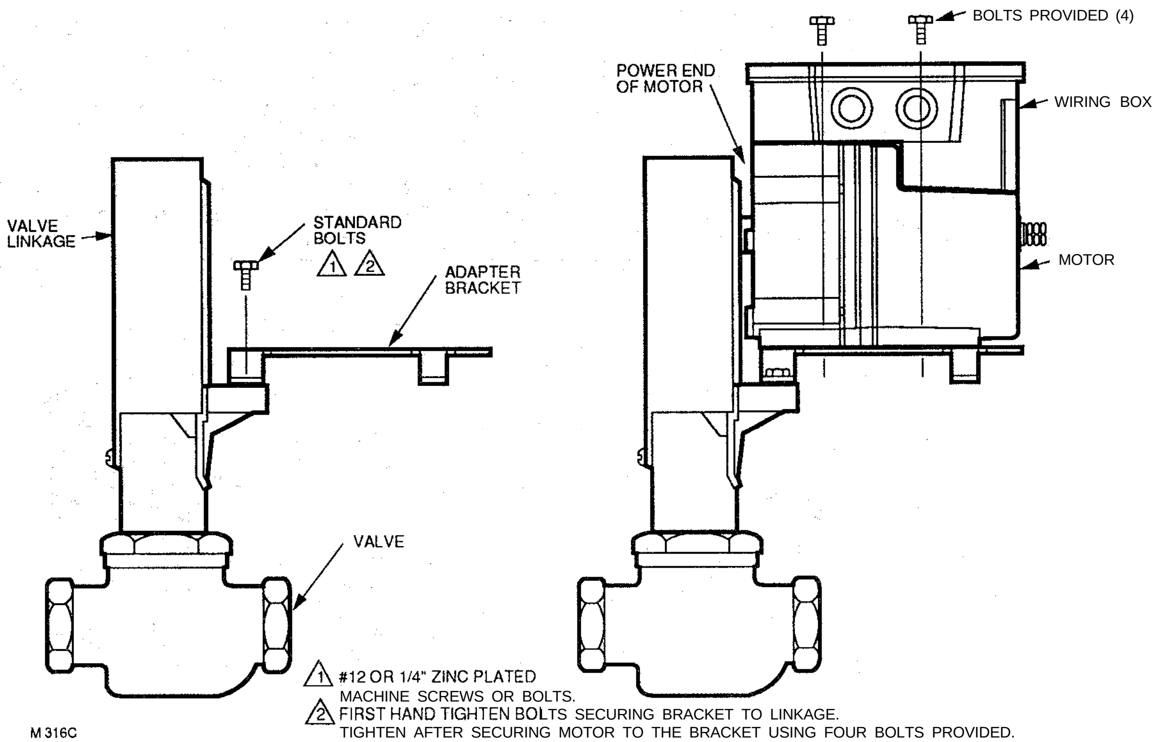


FIG. 4—MOTOR MOUNTING ON VALVE LINKAGE.

4. Do not exceed the motor ratings in any installation.
5. Do not turn motor shaft manually or with a wrench—this will damage the motor.

VALVE LINKAGES

The 220738A Mounting Bracket must be used with the Q100, Q601 and Q618 linkages in all valve applications.

WIRING

Disconnect power supply before wiring to prevent electrical shock or equipment damage. All wiring must agree with applicable codes, ordinances, and regulations.

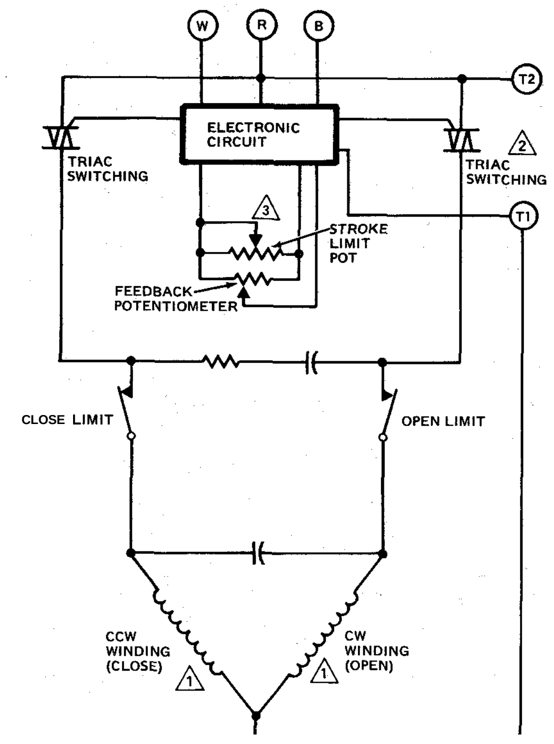
A transformer is required to supply 24 Vac power to the motor. Make sure that the power requirements stamped on the motor correspond to the characteristics of the power supply.

Figs. 5 and 6 show internal schematics.

The motor terminals are quick-connects located on top of theprintedcircuit boardshown in Fig. 7. A screwterminal adapter is standard on all Trade models and also may be added to all models. Access to the wiring compartment is gained by removing the 4 screws inthetoppf the wiring box and lifting off the cover.

WIRING BOX

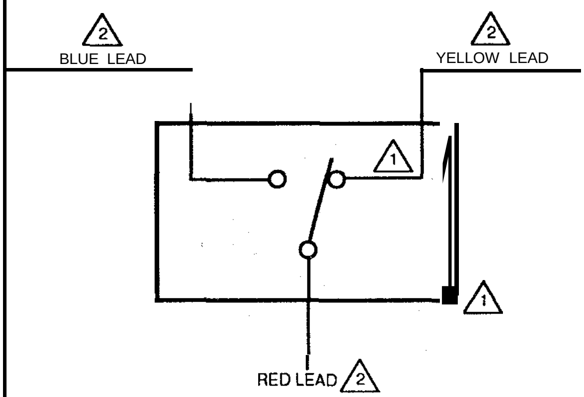
When used with liquid-tight conduit connectors, the wiring box provides NEMA 3 weather protection for the motor. The box also provides knockouts for wiring conduits and encloses terminals. The wiring box, standard with replacement motors, is required for housing an internal transformer, internal auxiliary switches or Series 70 Interface Modules.



1. DIRECTION OF MOTOR TRAVEL AS VIEWED FROM POWER END.
2. CONNECT 24V POWER TO T1-T2 TERMINALS ONLY. DO NOT CONNECT POWER SUPPLY TO CONTROLLER TERMINALS. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
3. TURN LIMIT POT FULL CLOCKWISE FOR 160° STROKE, FULL COUNTERCLOCKWISE FOR 90° STROKE.

E383B

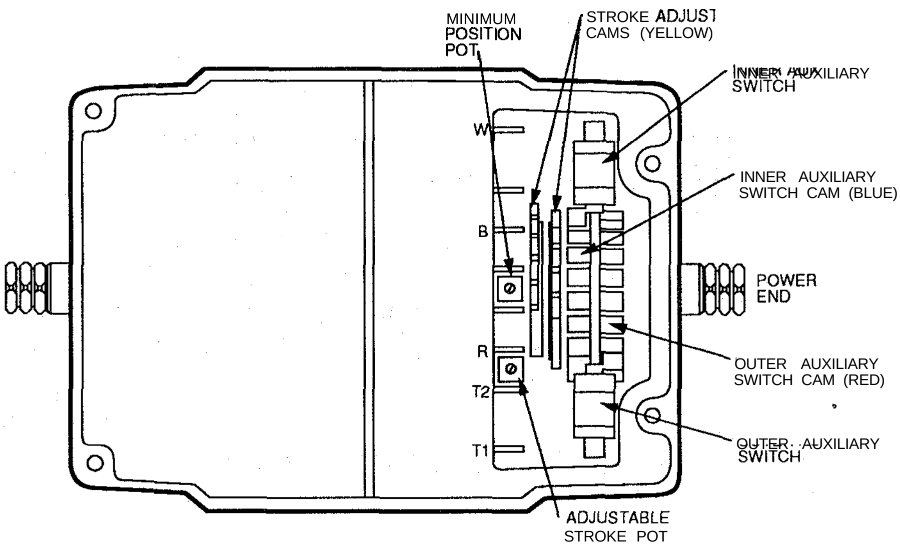
FIG. 5—INTERNAL WIRING OF M9484 MODUTROL MOTORS.



1. WIRING SHOULD BE NEC CLASS 1 UNLESS POWER SUPPLY MEETS CLASS 2 REQUIREMENTS. TAPE UNUSED LEADS. MAKE CERTAIN THE CURRENT DRAW OF THE EXTERNAL CIRCUIT IS LESS THAN CONTACT RATING OF SWITCH.
2. ON TWO-SWITCH MOTORS SECOND SWITCH HAS BLACK LEADS WITH BLUE, YELLOW. AND RED TRACERS.

M 254

FIG. 6—AUXILIARY SWITCH INTERNAL WIRING.



NOTE: FEATURES AVAILABLE ON SOME MODELS ONLY.

M 304A

FIG. 7-TERMINALS AND ADJUSTMENTS.

AUXILIARY SWITCH **CONNECTIONS**

CAUTION

Disconnect all power supplies to de-energize the **auxiliary switches before servicing.**

The **M9484E** has 1 internal auxiliary switch. The switch wires are color-coded as follows: solid yellow-normally closed (N.C.); solid red-common (COM.); solid blue-normally open (N.O.).

The **M9484F** has 2 internal auxiliary switches which may be used to prove low fire and high fire positions.

1. To prove **low** fire use red (common) and yellow wires connected to outer (left) switch. This switch makes red to yellow and breaks red to blue as motor closes.
2. Wires connected to the inner (right) switch are black with colored tracers. To prove high fire, use red tracer (common) and blue tracer wires. The right switch makes red tracer to blue tracer and breaks red tracer to yellow tracer as motor opens.

Color coding and switching action are tabulated below to aid the installer.

SWITCH/CAM COLOR-CODING:

TABLE 1

SWITCH LOCATION[a]	CAM ASSEMBLY LOCATION[a]	CAM COLOR CODE	SWITCH WIRES[b]	
			COLOR	DESIGNATION
Left	Outer	Red	Solid Yellow Solid Red Solid Blue	Normally Closed (N.C.) Common (COM.) Normally Open (N.O.)
Right	Inner	Blue	Yellow Tracer Red Tracer Blue Tracer	Normally Closed (N.C.) Common (COM.) Normally Open (N.O.)

[a]**Viewed** from power end of motor.
[b]**See** Fig. 6.

SWITCHING ACTION:

TABLE 2

SWITCH LOCATION[a]	NORMAL FUNCTION	MAKES	BREAKES	CAM POSITION[b]	MOTOR POSITION
Left	Proves Low Fire Position	Red to Yellow	Red to Blue	High portion of cam not in Contact with Cam follower.	Closing
Right	Proves High Fire Position	Red Tracer to Blue Tracer	Red Tracer to Yellow Tracer	High portion of cam in Contact with Cam follower.	Opening

[a]**Viewed** from power end of motor.
[b]**See** Fig. 9

STROKE SETTING

On **M94XXD,E,F** motors, stroke is field adjustable and can be set from **90°** to 160”. Motors are shipped in **90°** position. In order to set stroke, both mechanical and electrical adjustments are required. The mechanical adjustments (cams) establish the full open (clockwise, ↻ as viewed from the power end) and full closed (counterclockwise ↺) positions of the motor shaft. The electrical adjustment (trim pot) provides sufficient total stroke angle to ensure that cams will actuate both limit switches.

STROKE SETTING PROCEDURE

See Fig. 8.

CAUTION

Detach linkage from motor before adjusting stroke.

BEFORE SETTING STROKE:

1. Remove top cover from motor.
2. Disconnect controller from motor.
3. Connect **R,B,W** terminals on 135 ohm potentiometer (Q209 or S963) to matching terminals on motor.

SETTING 160° STROKE (Fig. 8):

1. Turn stroke pot fully clockwise ↻.
2. Drive motor to mid-position using 135 ohm pot (Q209 or **S963),** or by jumpering B-R-W.
3. Insert **1/8** in. screwdriver blade into slot on inner yellow cam and MOVE TOP OF SCREWDRIVER as far as possible counterclockwise ↺ (viewed from power end). Repeat in successive cam slots until inner cam is against counterclockwise ↺ stop.

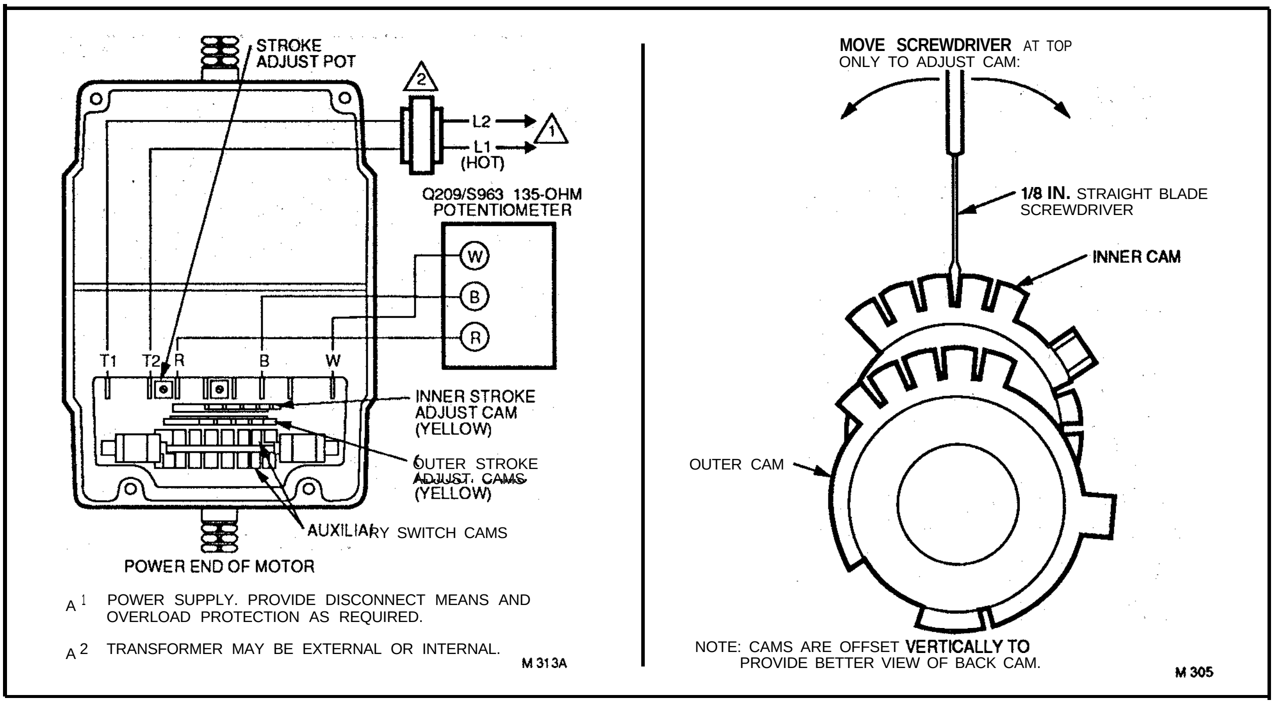


FIG. 8—STROKE ADJUSTMENT SETUP.

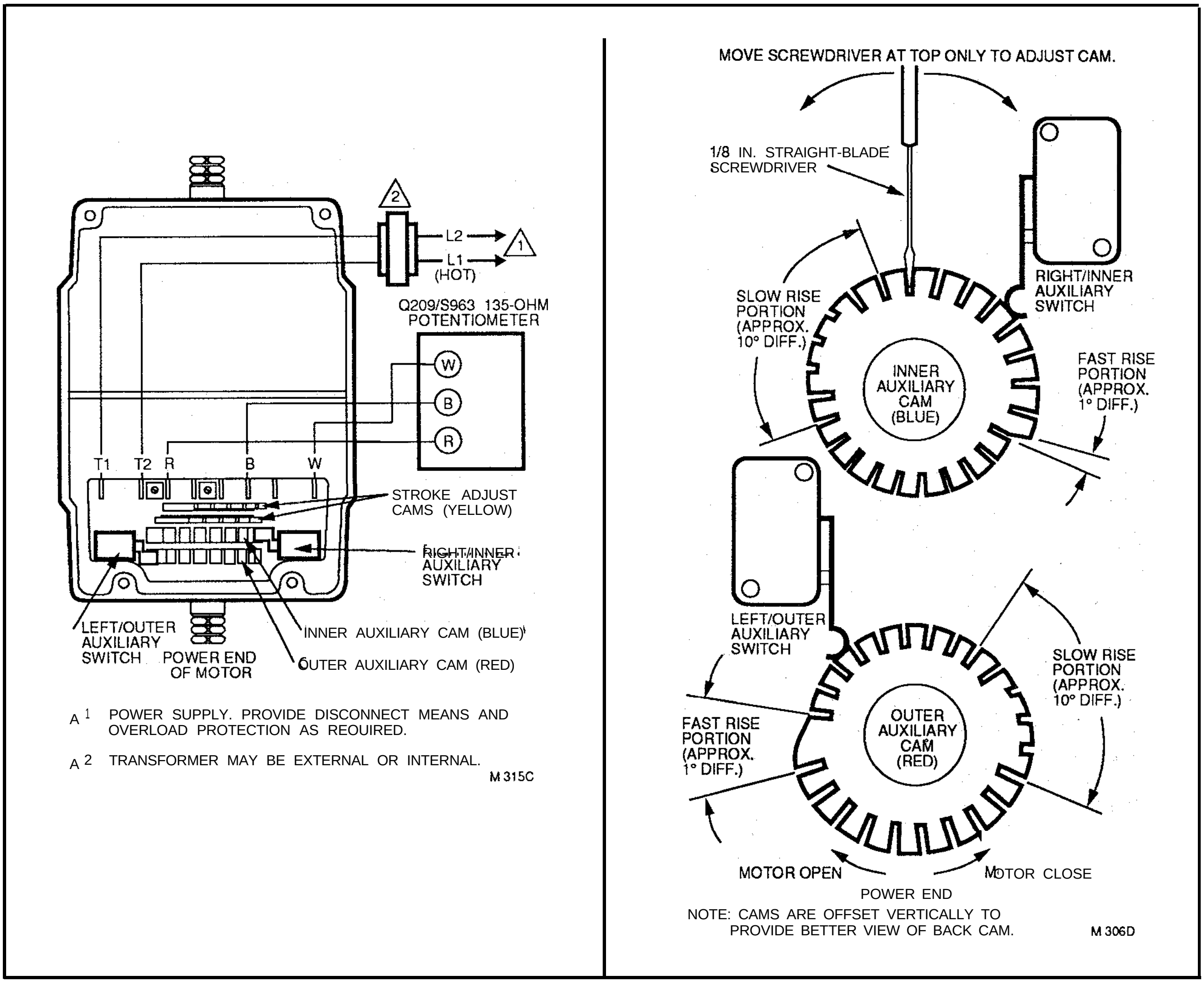


FIG. 9—AUXILIARY SWITCH ADJUSTMENT SETUP.

IMPORTANT

Set cams by moving top of screwdriver only. Pressing screwdriver against sides of cam slots could cause damage to motor end switches.

4. Insert 1/8 in. screwdriver blade into slot on outer yellow cam and MOVE TOP OF SCREWDRIVER as far as possible clockwise. Repeat in successive cam slots until outer cam is against clockwise stop.

NOTE: Excessive force will damage cam stop on hub.

5. Check motor stroke before connecting linkage.
6. Disconnect 135 ohm pot, reconnect controller, replace top cover on motor.
7. Attach linkage to motor.

SETTING 90° STROKE (Fig. 8):

1. Turn stroke pot fully counterclockwise.
2. Drive motor to mid-position, using 135 ohm pot (Q209 or S963), or by jumpering B-R-W.
3. Insert 1/8 in. screwdriver into slot on inner yellow cam and MOVE TOP OF SCREWDRIVER as far as possible clockwise (viewed from power end). Repeat in successive cam slots until inner cam is against clockwise stop.

NOTE: Excessive force will damage cam stop on hub.

4. Insert 1/8 in. screwdriver blade into slot on outer yellow cam and MOVE TOP OF SCREWDRIVER as far as possible counterclockwise. Repeat in successive cam slots until outer cam is against counterclockwise stop.

NOTE: Excessive force will damage cam stop on hub.

5. Check motor stroke before connecting linkage.
6. Disconnect 135 ohm pot, reconnect controller, replace top cover on motor.
7. Attach linkage to motor.

AUXILIARY SWITCHES

The auxiliary switches in M9484E,F motors are actuated by adjustable cams. The cams are mounted on the motor shaft at the power end of the motor. The settings of the cams determine the point in motor shaft rotation at which the auxiliary equipment will be switched on or off. These cams can be set to actuate switches at any angle within the stroke of the motor. Also each cam provides a fast rise portion for switching (1 ° differential) and a slow rise portion for slow switching (10° differential).

Switching action and color coding are shown in Tables 1 and 2 on page 8.

Motors with factory added auxiliary switches are shipped in the closed position (counterclockwise, as viewed from power end) with auxiliary cams set to actuate switches 30° from the closed position, and to provide 1° differential. Wiih motor in closed (full counterclockwise) position, auxiliary switch breaks R-B.

IMPORTANT

Do not turn motor shaft by hand or with a wrench as damage to the gear train and circuit board stroke limit contacts will result.

AUXILIARY SWITCH SETTING PROCEDURE (Fig. 9)

1. Removetopcoverfrom motor to gain access to motor terminals and cam adjustments.
2. Disconnect controller from motor and connect 135 ohm manual potentiometer with R-W-B terminals on pot connected to corresponding terminals on motor (Fig. 9).
3. Adjust 135 ohm pot so that motor shaft turns to position where auxiliary equipment is to be switched.
4. Insert a 1/8 in., straight-blade screwdriver into slot on cam associated with selected auxiliary switch. The inner (blue) cam actuates the inner (right) switch, the outer (red) cam actuates the outer (left) switch. MOVE TOP OF SCREWDRIVER to set cams.
5. For switch differential of 1 °, check continuity of auxiliary switch R-B contacts and rotate cam as follows:
   a. If contacts are open, rotate cam clockwise until R-B contacts close.
   b. If contacts are closed, rotate cam counterclockwise until R-B contacts open.
6. For switch differential of 10°, check continuity of auxiliary switch R-B contacts and rotate cam as follows:
   a. If contacts are open, rotate cam counterclockwise until R-B contacts close.
   b. If contacts are closed, rotate cam clockwise until R-B contacts open.
   c. Final adjustment in the proper direction should be made to obtain contact make or break at the desired position.
7. Check for proper differential and switching of auxiliaryequipmentby runningmotorthroughfullstroke (in both directions), using 135 ohm pot. Repeat adjustment if necessary.
8. Disconnect 135 ohm pot, reconnect controller, replace top cover on motor.

NOTE: If differential is changed from 1° to 10°, the switching action is reversed, thus: switch contacts R-B make and R-W break on acounterclockwise (closed) rotation.

OPERATION AND CHECKOUT

MODULATING SERIES 90 CIRCUIT

The potentiometers, one in the controller and one in the motor, along with resistor network, form a bridge circuit. As long as the value of the controlled medium remains at the controller set point, the circuit is balanced, and the motor does not run.

When the value of the controlled medium changes, the potentiometer wiper in the controller is moved, which unbalances the bridge circuit. This unbalance is amplified, and energizes Triac switching to run the motor in the direction necessary to correct the change in temperature or pressure. The motor turns the feedback potentiometer to rebalance the circuit and stop the motor.

CONNECTION DIAGRAMS (Figs. 10-13)

These motors are designed for use in series 90 proportioning control circuits employing a 135 ohm series 90 controller. Series 90 high or low limit controls or manual minimum position potentiometers may also be used in the control circuit.

The M9484 can also be used with some electronic controllers which provide a 4-20 mA control output. It is necessary to use a resistor kii (4074EED for controlling up to 6 motors) or Q7230 Interface Module to interface to the 4-20 mA source.

The standard series 90 controller has R, W, and B terminals. As the controller reduces Rto W resistance, the motor will drive closed (CCW as viewed from the power end).

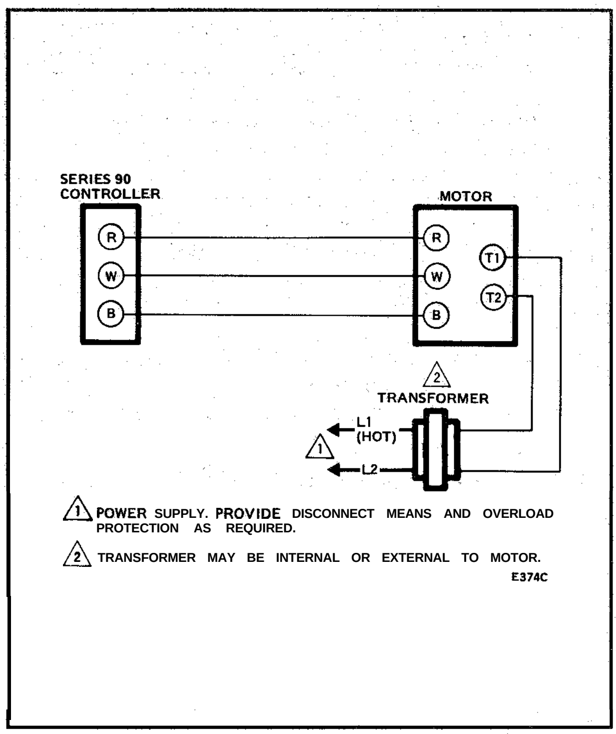


FIG. 10—CONNECTIONS TO SERIES 90 CONTROLLER.

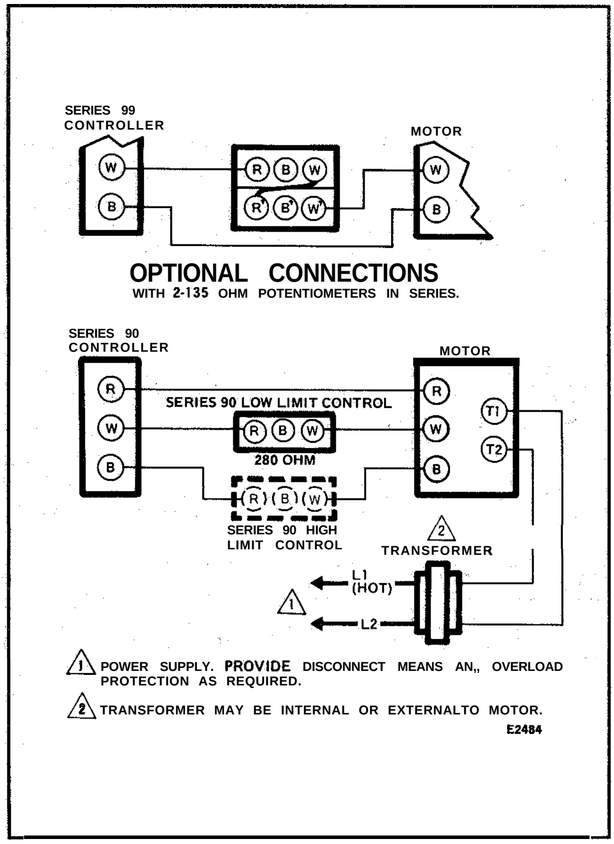


FIG. 1 I-MOTOR USED WITH A SERIES 90 CONTROLLER AND A SERIES 90 LOW OR HIGH LIMIT CONTROL.

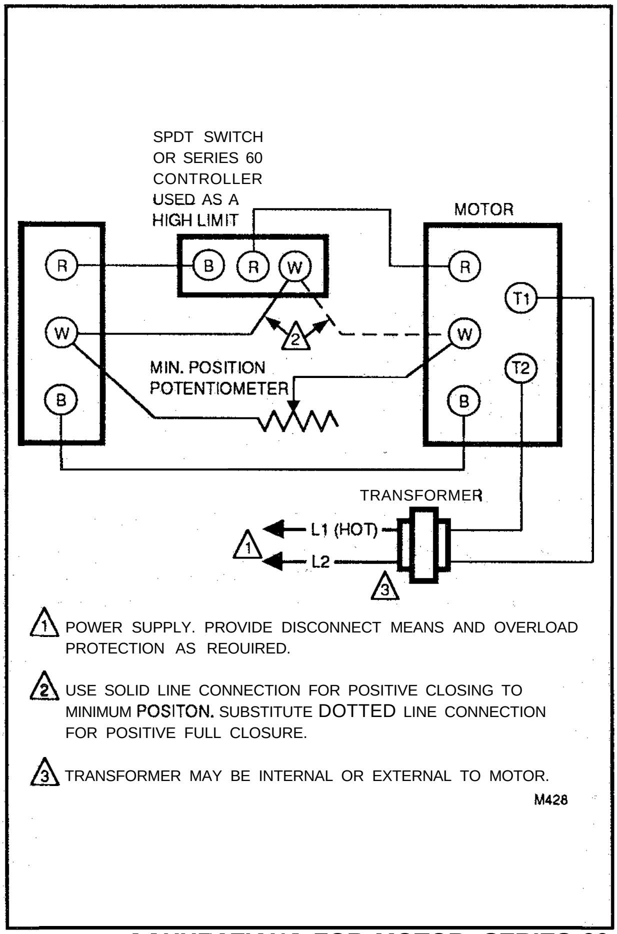


FIG. 12—CONNECTIONS FOR MOTOR, SERIES 90 CONTROLLER, MINIMUM POSITION POTENTIOMETER (ETC.).

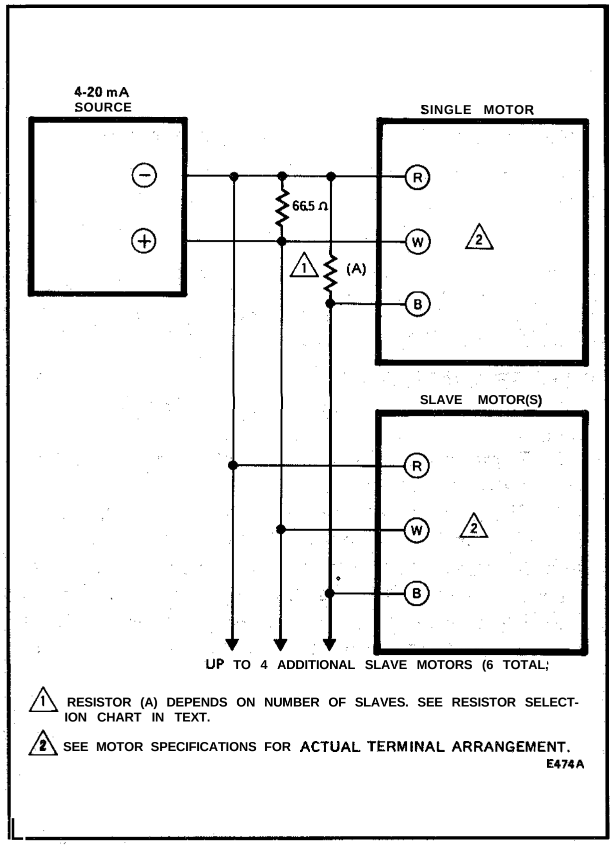


FIG. 13—CONNECTIONS FOR MOTOR USED WITH 4 TO 20 mA CONTROL.

4074EED RESISTOR SELECTION CHART FOR 4-20 mA

MOTORS	MIINIMUM OUTPUT VOLTAGE REQUIRED (Vdc)[b]	RESISTOR (A) (Ohms)	RESISTOR (A) Part No.
1	1.7	237	802139CDHA
2	2.0	150	802139BFAA
3			
4	2.3 2.7	124 113	802139BCEA 802139BBDA
5	3.0	105[a]	—
6	3.3	97.6”	—

[a] Not part of this **kit,** obtain separately.
[b] These values represent the controller output voltage required to drive the motors.

CHECKOUT

After installation and linkage adjustment, check the entire motor and control hookup to ensure that-

* The motor operates the damper or valve properly.
* The motor responds properly to the controller.

Inspect the motor, linkage, and valve or damper to see that all mechanical connections are correct and secure. In damper installations, the pushrod should not extend more than a few inches past the ball joints. Check to see that there is adequate clearance for the linkage to move through its stroke without binding or striking other objects.

Check to see that cams operate the auxiliary switches, if used, at the desired point of motor rotation.

NOTE: Motors are shipped in the fully closed position (the limit of counterclockwise rotation as viewed from the power end of the motor) with the stroke set at 90°.

SERIES 90 MOTORS OPERATION CHECK WITH MODUTROL MOTOR DISCONNECTED FROM CONTROLLER

STEP	ACTION	RESPONSE	IF NO OR LIMITED RESPONSE
1.	Apply 24 Vac[a].	None.	—
2.	Open terminal B and short W to R.	Motor drives closed.	Proceed to Step 6.
3.	Open terminal W and short B to R.	Motor drives open.	Proceed to Step 6.
4.	Connect terminals R to B to W.	Motor must drive to Mid-position.	Proceed to Step 6.
5.	Remove jumpers from R, B, and W. Check voltage between B and R, and W and R.	17 to 20 Vdc.	No voltage or out of range. Proceed to Step 7.
6.	Motor does not drive.	Motor is defective.	Replace motor.
7.	Voltage out of range.	Motor printed wiring board is defective.	Replace motor.
8.	Disconnect 24 Vac.	Spring return motors return to their normal mechanical position.	Spring mechanism defective -replace motor.

NOTES:
[a] Ensure motor transformer is sized properly. If a common transformer is used to power multiple motors, ensure power input is in phase with all motors.
[b] Motors may operate in Series 90 or two-position control applications. However, checking voltage between terminals R to B and R to W is necessary to confirm proper operation in electronic (W973, 4 to 20 mA etc.) applications.

CHANGE-OUT

DAMPER APPLICATION

1. Turn off power and remove wiring from the old actuator.
2. Remove crank arm from shaft of old actuator and remove the old actuator.
3. Check to see whether or not the mounting bracket is needed. If the linkage can reach the lowershaft position of the new actuator and if the crank arm has clearance for the needed rotation, then the bracket is not needed. Use 220738A Adapter Bracket or 221455A crank arm if crank arm must rotate through the bottom plane of the motor (for damper applications).

4a. If the bracket is not needed, mount the new actuator directly to the equipment and refer to the INSTALLATION, SETTINGS&ADJUSTMENTS,andCHECKOUTsections of these instructions as needed.

4b. If the bracket is needed, refer to the Adapter Bracket sections and see Fig. 3 as well as the INSTALLATION, SETTINGS &ADJUSTMENTS, and CHECKOUT sections of these instructions.

5. Use old mounting bolts to mount the new actuator.
6. Mountthedampercrankarmandlinkagetotheshaft of the new actuator.
8. Use the CHECKOUT procedures to test the proper adjustment of the crank arm and linkage.

VALVE APPLICATION

When installing a M9484, M9494 motor in a valve application which has a Q100, Q601 or Q618 it will be necessary to use the 220738A Adapter Bracket provided to raise the motorshafttothesame height asthatof the old motor. Ensure motor stroke is 160° to operate Honeywell V5011 two-way or V5013 three-way valves.

Honeywell Inc.
U.S.A.: **1885 Douglas Drive N. Golden Valley, MN 55422-4386**
CANADA: 740 Ellesmere Road **Scarborough, Ontario M1P 2V9**

International Sates Offices **in all** principal cities of the world. Manufacturing in **Australia, Canada, Finland, Franc%, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.**

PRINTED IN U.S.A.

QUALITY IS KEY

Operating Manual

eZtrend

Easy does it !

*(**easy** adj. **UNTROUBLED:** secure, prosperous, calm,
peaceful, tranquil, contented, unhurried, relaxing;
MANAGEABLE: simple, smooth)

43-TV-25-05 GLO Issue 3 09/01 UK

Table of Contents

Safety

The product range of instruments is compliant with the requirements of BS EN 61010-1:1993 “Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use”. If the equipment is used in a manner NOT specified, the protection provided by the equipment may be impaired.

Symbols

One or more of the following symbols may appear on the recorder labelling:

Symbol	Meaning
	Caution - refer to manual for instructions
	Caution - risk of electric shock
	Direct Current
	Protective conductor terminal
	Earth terminal

Static Electricity

All circuit boards and electronic modules associated with this recorder contain components which are susceptible to damage caused by electrostatic discharge. Should it be necessary to handle such components, appropriate precautions in accordance with BS CECC 00015 “Basic specification: protection of electrostatic sensitive devices” should be observed.

Installation Category

- Installation category - Installation category II, Pollution degree 2

For voltage, frequency and power see *“Specifications” on page 6.*

Fuses

There is one fuse situated on the power supply that can not be replaced by the operator.

Cables

To fully comply with the requirements of the CE Mark, all cables connected to the rear of the unit should use screened cable terminated at both ends. Also a low impedance earth cable (<1 mΩ) should be connected to the earthing stud on the rear of the recorder.

WARNINGS AND SAFETY PRECAUTIONS

Do's and Don'ts

1. Before any other connections are made to the recorder, the protective earth terminal should be connected to a protective conductor.
2.

> **DANGER**
>
> **IMPROPER INTERRUPTION OF CONNECTIONS**
>
> Any interruption of the protective conductor outside the recorder, or disconnection of the protective earth terminal is likely to make the recorder dangerous under some fault conditions. Intentional interruption of the protective conductor is dangerous.
>
> **Failure to comply with these instructions will result in death or serious injury.**

In order to comply with the requirements of safety standard EN61010, the recorder should have one of the following as a disconnecting device, located within easy reach of the operator, and be clearly labelled as the disconnecting safety device:

- A switch or circuit breaker which complies with the requirements of IEC947-1 and IEC947-3.
- A separable coupler which can be disconnected without the use of a tool.
- A separable plug, without a locking device, to mate with a socket outlet in the building.

3. Whenever it is likely that protection has been impaired, the recorder should be made inoperative and secured against operation. The manufacturer's service centre should be contacted.
4. Any adjustment, maintenance, and repair of the opened recorder in a powered condition is hazardous and should never be attempted.
5. Where conductive pollution such as condensation or conductive dust is present, adequate air conditioning, filtering and/or sealing must be installed.
6. This recorder contains a battery which must be treated and disposed of with care. Batteries must not be short circuited. Batteries should be disposed of in accordance with local regulations, they must not be disposed of with normal refuse. *See "Appendix B - Battery Safety Data Sheet" on page 85.*

7.

WARNING

IMPROPER SIGNAL AND SUPPLY WIRING

Signal and supply wiring should be kept separate. Where this is impractical, shielded cables should be used for the signal wiring. Where signal wiring is carrying, or could carry under fault conditions, hazardous voltage (defined as >30 V rms and 42.4 V peak, or >60 Vd.c.), double insulation must be used for all signal wiring.

Failure to comply with these instructions could result in death or serious injury.

8. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be inadequate.

9. In the case of portable equipment, the protective earth terminal must remain connected (even if the recorder is isolated from the mains supply) if any of the measuring, communications, or relay terminals are connected to hazardous voltages.

10. For transportation considerations, see *“Instrument Care” on page 79*

Hazardous Voltage

Hazardous Voltages are defined by EN61010-1 as follows:

WARNING

HAZARDOUS VOLTAGE LEVELS

Voltage levels above 30V rms and 42.4V peak or 60V dc are deemed to be **"Hazardous Live"**.

Refer to *“Appendix B - Battery Safety Data Sheet” on page 85* for further information

Failure to comply with these instructions could result in death or serious injury.

Maintenance and Unit Repair

See “Instrument Care” on page 79.

CAUTION

CONTROL UNIT DAMAGE

In the event of a malfunction with the recorder contact your nearest Service Department (or authorised agent) to arrange for the return of the unit for repair.

Failure to comply with these instructions may result in property damage

Chapter 1: Introduction

eZtrend V5

The ***eZtrend V5*** paperless chart recorder, is the latest development of the solid-state replacement for traditional paper chart recorders.

The ***eZtrend V5*** focuses on

- Ease 100 mm key recorderof use
- Low cost
- Reliability
- Strong visual design

Several options are available to meet a wide range of requirements within the pharmaceutical, water, process, gas and petrochemical industries, as well as power and environmental monitoring.

The ***eZtrend V5*** uses a 5” passive colour STN QVGA display, with brightness and contrast adjustments. The displays shows combinations of horizontal and vertical chart trends, real time bars and digital panel readouts - each input channel can also have a number of alarms assigned to them, as an option.

The ***eZtrend V5*** is available with up to 6 channels of Universal analogue inputs and with up to 32 alarms in any combination of any pen. Full Ethernet communications for direct connection of the recorder to a LAN or the Internet is available as standard.

eZtrend V5 can be fully programmed and re-configured locally via the integral keypad, or remotely from a PC. The configuration may be transferred from the PC to the recorder on a 3.5" 1.44 Mbyte floppy disk and stored in the internal flash memory.

Description

Model	Details
eZtrend V5	2, 4 or 6 channel recorder with 5” diagonal colour STN QVGA.

Storage Media

Media	Capacity
3.5” Floppy Disk	1.4 Mbytes
Internal Flash Memory	2 Mbytes

Specifications

Panel depth measurements do not include the thickness of the panel.

	eZtrend V5
Display Technology	5" passive colour STN QVGA Resolution 320 x 240 pixels
Dimensions (mm): **Bezel Size (w x h)** **Panel Depth** **Panel cut out**	 144 x 144 mm 200 mm (minimum) 138 x 138 mm
Number of Channels	2, 4, or 6
Power Supply	100 - 240 Va.c. (50/60 Hz) 24 Vd.c. (option)
Storage **Data Internal**	2 Mbytes Internal Flash Memory 1.44 MByte standard floppy
Power Consumption (max)	20 VA (ac), 20 W (dc) Max.
Alarm card **options**	4 x relay outputs or 6 x relay outputs and 2 x volt free inputs (non inductive, internally suppressed)
Communications	Ethernet as standard.
DC Isolation	≤300 V d.c. (channel to channel, channel to earth)
Relative Humidity	10% to 90% RH
Storage Temp	-10 to 60 °C
Operating Temp	0 to 40 °C
Number of Inputs	2, 4 or 6 Universal Inputs
Input Types	EMF (mV, V, mA), Thermocouple, RTD
Input Sampling Rate	100 mSec for all inputs
Input Sampling Method	Sample, Average, Min-Max
Logging Method	Sample, Average, Min-Max
Logging Type	Continuous, Events, Fuzzy
Logging Rates	100 mSec to 4 days per log
Clock	Calendar function - adjustable for daylight saving via Ethernet
Event Markers	44 character messages activated by cause and events
Alarm Set Pointers	Up to 32 integral ‘soft’ alarm points set for out of limit conditions
Languages	English, French, German, Italian, Spanish

Universal Input card

Analogue Inputs	Details
Analogue input options	±70 mV, ±100 mV, ±200 mV, ±1 V, ±10 V, ±10 mA, ±20 mA Resistance thermometer, Thermocouple
Resolution of analogues	16 bit 0.0015%
Accuracy of analogues	
Voltage	±70 mV, ±100 mV (±0.04) ±200 mV (±0.04) ±1 V, ±10 V (±0.04)
Current	±10 mA, ±20 mA For current inputs, accuracy will depend on the resistor used, see *"Current Inputs" on page 19*
Source Resistance	-T/C mV 0.5°C/100 Ω (1000 Ω max) approx. -RTD 0.1°C/Ω (40 Ω max) approx.

Universal Input card, performance

Linear and Thermocouple

Input Actuation (Linear)	Range	Accuracy	Temp. Stability
Millivolts dc Volts dc	-100 to 100 -2200 to 200 -1.0 to 1.0 -10 to 10	0.04% 0.04% 0.04% 0.04%	0.04%/°C 0.04%/°C 0.04%/°C 0.04%/°C

Input Actuation (Thermocouples)	Range		Accuracy			Temp. Stability ± Degrees Error per 1 degree
	°F	°C	±°F	±°C	±%Span	
B	**32 to 3182** 32 to 1112 1182 to 3182	**0 to 1820** 0 to 600 600 to 1750	18 7.2	10 4	0.7% 0.3%	0.15%/°C 0.13%/°C
C(W5)	**32 to 4172**	**0-2300**	9	5.5	0.3%	0.06%/°C
E	**32 to 4172**	**-200 to 1000**	3.6	2	0.3%	0.06%/°C
J	**-328 to 2174** -328 to 32 32 to 2174	**-200 to 1190** -200 to 0 0 to 1190	5.4 2.7	3 1.5	0.25% 0.15%	0.03%/°C 0.03%/°C
K	**-328 to 2462** -328 to 32 32 to 1832 1832 to 2462	**-200 to 1350** -200 to 0 0 to 1000 1000 to 1350	5.4 3.6 4.5	3 2 2.5	0.2% 0.15% 0.15%	0.03%/°C 0.03%/°C 0.03%/°C

Input Actuation (Linear)	Range		Accuracy			Temp. Stability
L	**-328 to 1652** -328 to 212 212 to 1652	**-200 to 900** -200 to 100 100 to 900	5 2.7	2.75 1.5	0.3% 0.3%	0.03%/°C 0.03%/°C
N (Nicrosil Nisil)	**-328 to 2372** -328 to 32 32 to 2372	**-200 to 1300** -200 to 0 0 to 1300	5.4 5	3 2.75	0.2% 0.2%	0.05%/°C 0.04%/°C
R	**32 to 3092** 32 to 572 572 to 3092	**0 to 1750** 0 to 300 300 to 1750	7.2 5.4	4 3	0.3% 0.2%	0.01%/°C 0.01%/°C
S	**32 to 3092** 32 to 572 572 to 3092	**0 to 1750** 0 to 300 300 to 1750	7.2 5.4	4 3	0.3% 0.2%	0.01%/°C 0.01%/°C
T	**-328 to 752** -328 to 32 32 to 752	**-200 to 400** -200 to 0 0 to 400	3.6 1.8	2 1	0.35% 0.2%	0.08%/°C 0.08%/°C
W	**1832 to 4172** 1832 to 3272 3272 to 4172	**1000 to 2300** 1000 to 1800 1800 to 2300	5.4 5.4	3 3	0.3% 0.3%	0.15%/°C 0.15%/°C
Cromel/Copel	**-74 to 1110**	**-50 to 600**	1.8	1	0.3%	0.05%/°C

Universal card performance, RTDs

Resistance Thermometer

Input Actuation (RTDs)	°F	°C	±°F	±°C	±%Span	Temp. Stability ± Degrees Error per 1 degree
PT100 100 ohms (To BS1904)	-328 to 1202	-200 to 650	2.7	1.5	0.2%	0.05%/°C
PT200 200 ohms	-328 to 356	-200 to 180	2.7	1.5	0.4%	0.05%/°C
CU53	32 to 300	0 to 150	2.7	1.5	0.9%	0.05%/°C
Ni120	-112 to 464	-80 to 240	2.7	1.5	0.5%	0.05%/°C

Reference Temperature	20°C
Reference Humidity	65% RH 15%
Reference Junction Accuracy	±1.0°C
CJC Temperature Effect	±0.05°C/°C
Long Term Stability	0.2%/year

Main Features

Recorder Function	Rationale
Ethernet comms	Access recorder data via an ethernet connection
Password protection	Allows restricted access to recorder menus at specific levels
Independent log rate on each pen.	Each input has specific logging response.
Adjustable chart speeds.	Data view and collection optimised to the process variables.
Independent logging criteria on each pen - Sample, Average, Max/Min, Fuzzy.	Data collection optimised to the process variable.
Programmable display of multicolour traces, digital instantaneous values and bars with 250mSec display update.	Process window customised to application and user preference.
Different pen colours for analog/waveforms.	Maximise user visibility.
Visual indication of process maximums and minimums on bargraph displays.	Prompt indication of process excursions.
Indication of alarm set-points and process over/under range on the bargraphs.	Timely indication of critical process deviations.
Programmable chart divisions.	Simulated “paper” background easily changed.
Programmable pen names, engineering units and tag descriptions (up to 20 characters).	Effective recorder and input identification.
Pen programmable maths expression.	Process input manipulated at the recorder.
Event marking and recording system using external switch inputs or keypad.	Specific event can be identified and recorded.
Self diagnostics within the recorder.	Distinct identification of unit failures.
Data replay in trend mode	Review of long term trends and data analysis.
Language sensitive firmware	Firmware available in 6 languages
Replay of historical and Realtime data	Stored and Realtime data can be graphed in the software.
Realtime data transfer	Stored data can be analysed in the software.
Comms Server	Manages the communication status of the recorder

Default Start-up Condition Table

Listed below are the recorder default settings for initial power up.

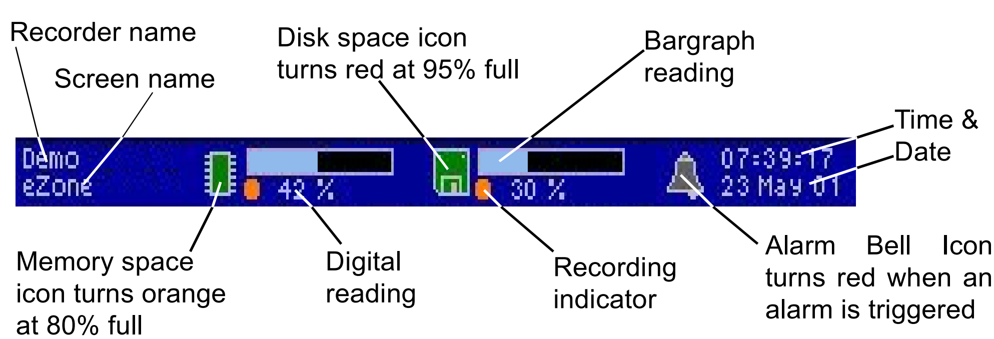
Menu	Function	Default
General Set up	Language	English (UK)
	Default Drive	Disk
	Password	Disabled
	Factory Drives	Disk 1.44 Mb floppy
Analogue In Set up	Inputs	Enabled
	Type	Volts
	Range	0-10V
	Sampling	500mS <2Hz>
	Pen	Enabled
Pens Set up	Scale	0-100% (Auto format/Auto Divs)
	Totaliser	Disabled
	Logging	Disabled
Recording Set up	Recording	Disabled
	Log to disk	Disabled
Layout	Screens 1 & 2	Enabled
	Screens 3 to 10	Disabled

Real-time Visuals

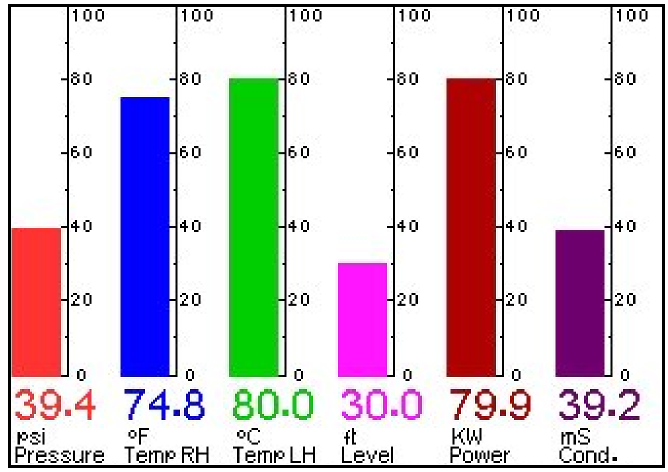
For a full display of the eight different screen layouts available on the ***eZtrend V5***, see *"Screen Layouts" on page 22.* To select a screen layout see *"Selecting and Re-naming Screens" on page 73*

Status Bar

The Status bar depicts the various process states active in the recorder

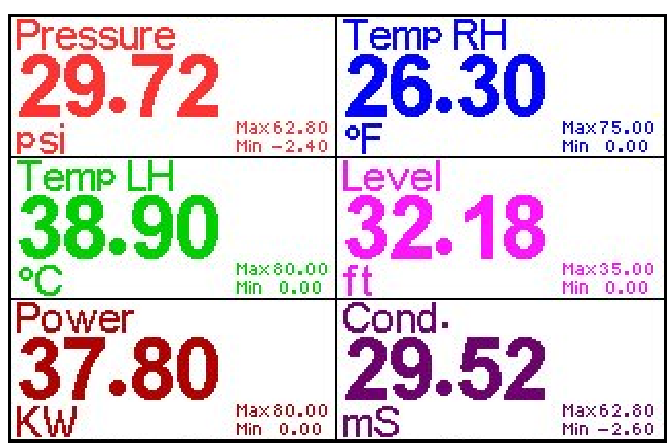


Bar



- Auto attach to trend.
- Over/under range indication.
- Horizontal or vertical.
- Major and Minor graduations.
- Variable screen position.

Digital



- Variable screen position.
- Max / Min. values.
- Over/under range indication.

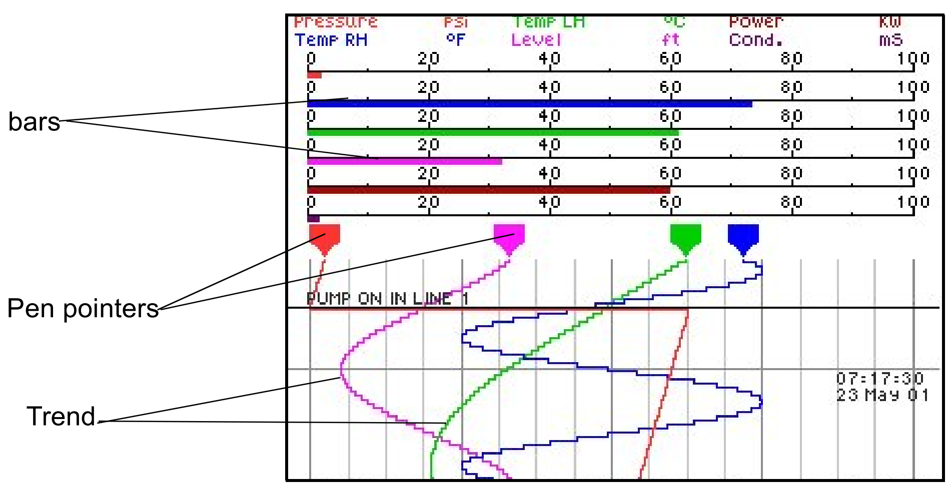
Alarm Indicators

- High alarm icon is red

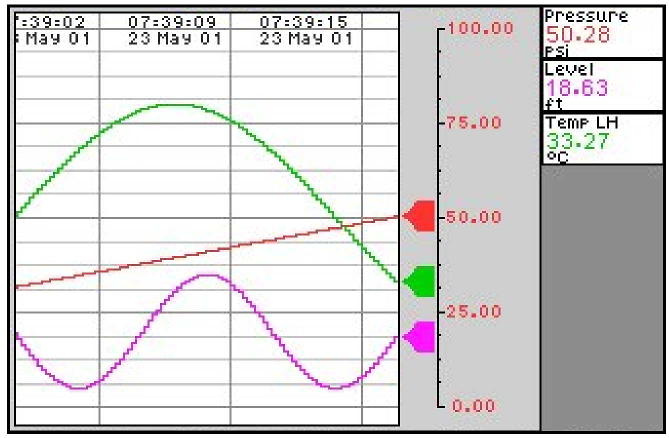
- Low alarm icon is red

Pen Pointers

- Provide pen pointers where bars are not required which move in real-time.
- Over/under range indication.



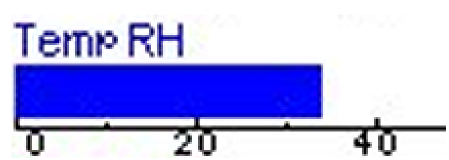
Trend



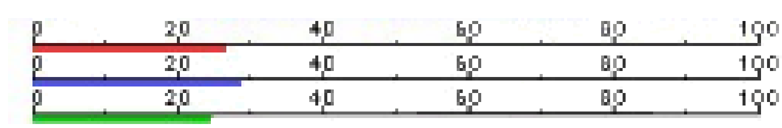
- Variable time per division.
- Text markers.
- Any combination of pens in tiled, conventional or waterfall mode.

Units and Scale

- Programmable text length up to 20 characters.



Scale



- Auto or definable scale.
- Horizontal or vertical.

Chapter 2: Installation

Unpacking

It is advisable to retain the packaging in which your ***eZtrend V5*** recorder arrived, should the recorder need to be returned.

NB. Should the original packing be destroyed, then **ONLY** pack the recorder in polystyrene granules if the recorder is **FIRST** sealed in a strong plastic bag, failing to do this will invalidate your warranty.

For transportation information see *"Instrument Care" on page 79.*

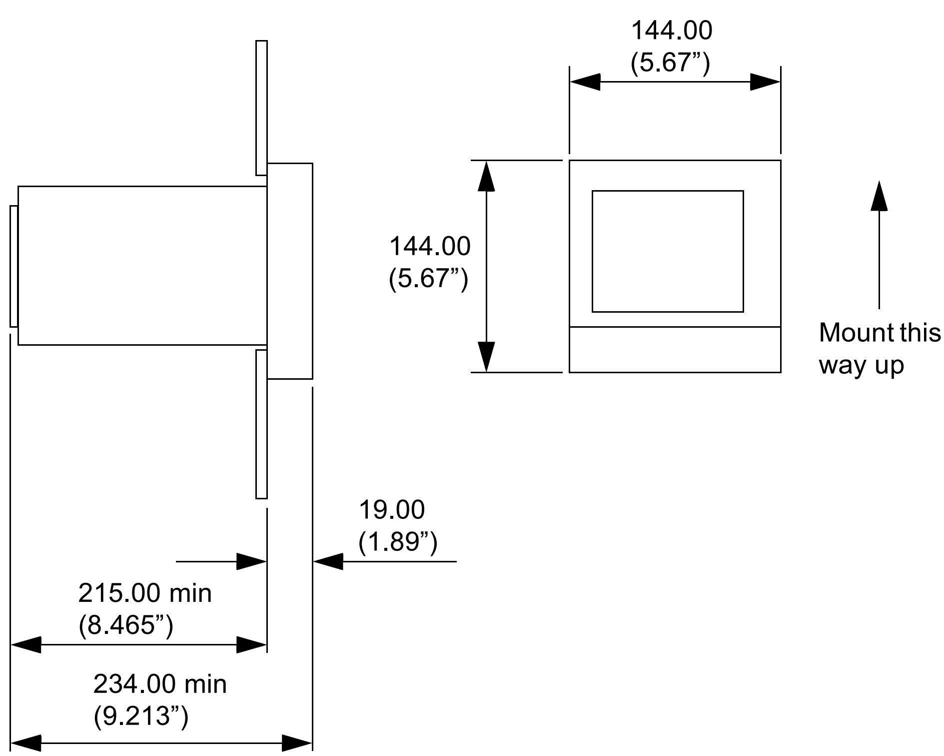
Battery

The ***eZtrend V5*** battery does not require any charging prior to use. There is a battery switch located on the side of the unit, see *"Case" on page 18*. With the battery switched on and the recorder power off, the battery will last for 6 months, with the battery and recorder power on, the battery should last for up to 10 years.

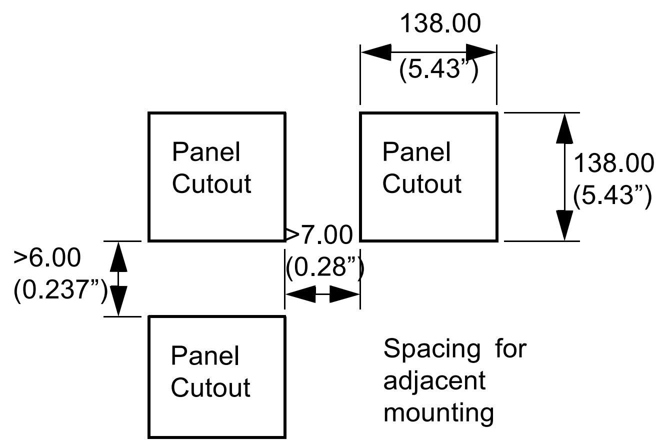
Mechanical

The ***eZtrend V5*** units are panel mounted as shown below. The recorder slides into the panel cut-out from the front and is held in place by two mounting clamps pressed against the rear of the panel by two screws.

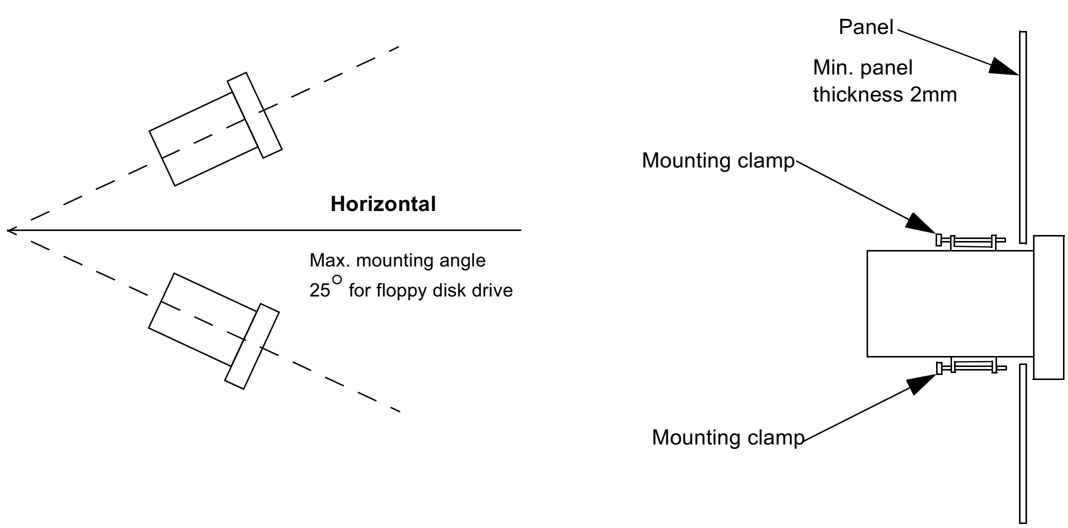
NB: For panel cutout size *See "Specifications" on page 6.*



Panel Cut-out



Panel Mounting



CAUTION

CONTROL UNIT DAMAGE

DO NOT OVERTIGHTEN MOUNTING CLAMP SCREWS
TORQUE SETTING 0.2 - 0.5 Nm/1.77 - 4.4 lbf-in

Electrical

All connections to the unit are made via the rear panel.

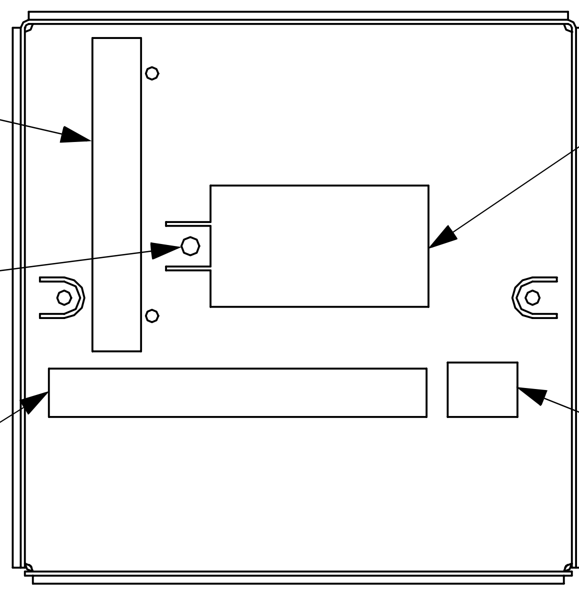
Cables

To comply with CE Mark, all cables connected to the rear of the unit should use screened cable terminated at both ends.

A.C. Power

A.C. supply is connected via the standard configuration IEC chassis plug on the rear panel.

NB: For the panel cut-out sizes, *See "Specifications" on page 6.*



WARNING

ENSURE SAFETY EARTH CONNECTION
Always ensure the unit is connected to safety earth when connecting to a D.C. supply.

Failure to comply with these instructions could result in death or serious injury.

NB: The ***eZtrend V5*** range is intended for panel-mount use and as such should be considered as permanently connected. Disconnection from the supply MUST be made possible by means of a switch, circuit breaker or other means of supply isolation. The disconnection device must be included in the panel installation, clearly marked, in close proximity to the equipment, and within easy reach of the operator. In the case of portable equipment, the protective earth terminal must remain connected (even if the recorder is isolated from the mains supply) if any of the analogue, communications, or relay terminals are connected to hazardous voltage.

Case

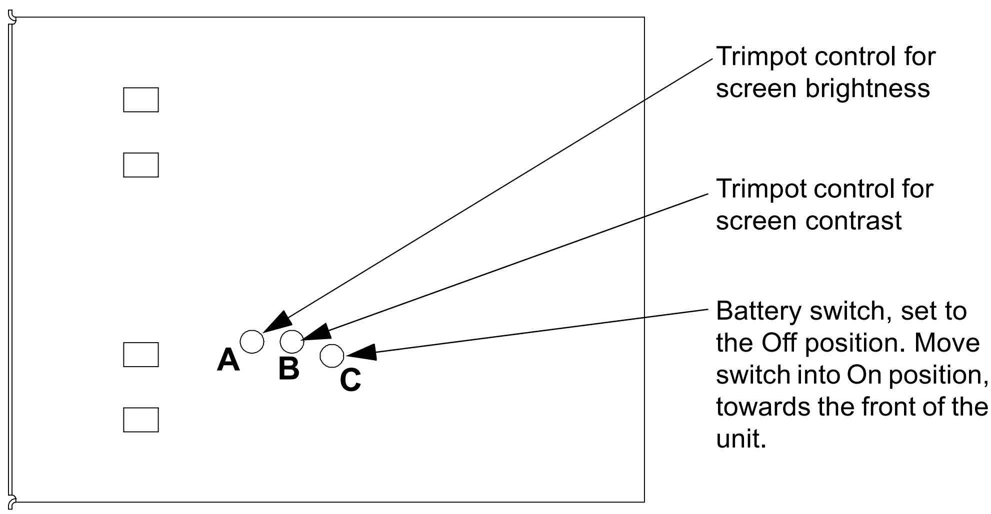
This view shows the right hand side of the case, the rectangular holes to the right are for the mounting clamps. The three round holes in the centre consist of two trimpots and a battery switch. The left hole is a trimpot adjustment that controls the ***Brightness*** of the screen. The centre hole is a trimpot adjustment that controls the ***Contrast*** of the screen. The third hole, to the right, is the ***Battery Switch*** his will be in the ***Off*** position by default. The unit will arrive with the battery switch in the off position to save battery life, place the switch into the ***On*** position, switched towards the front of the unit, to activate.

Display Trimpot Adjustments

A - Brightness control

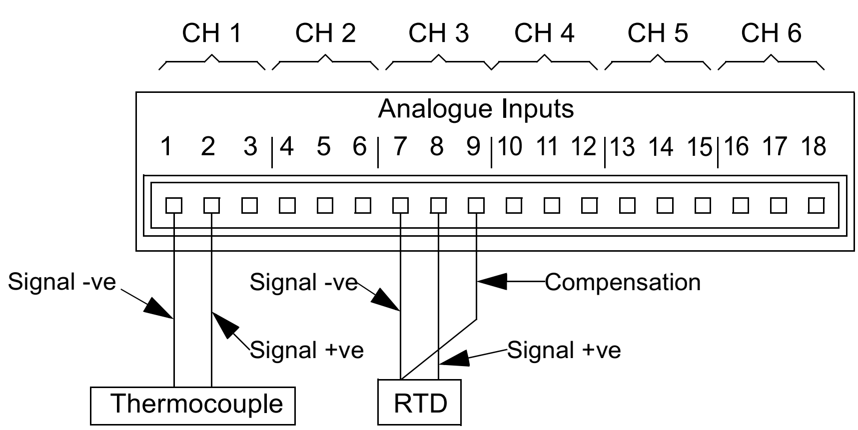
B - Contrast control

C - Battery switch



Universal Card

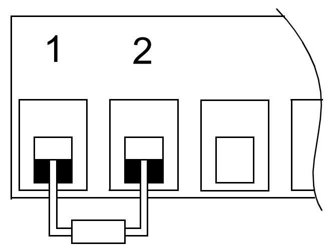
The ***Universal input card*** is used for connecting a range of input signals to a unit. These are connected as shown in the example below. For 18-way connector; torque setting 0.4Nm/3.5lbf-in. Do not over tighten.



Current Inputs

For current inputs an external resistor is required to be fitted across pins 1 and 2, 1 per channel. The resistor value should be 10Ω and a high tolerance such as 0.1%.

The resistor should been connected as shown, on the mating half connector, across the relevant pins according to which channels are to be set up for current input.
See “Analogue In Setup” on page 41.



This resistor connection is an example for a current input on channel 1

Current input channel number	Pin numbers to connect
1	1&2
2	4&5
3	7&8
4	10&11
5	13&14
6	16&17

Thermocouple

The ***Thermocouple*** is connected for internal compensation - details on how to connect thermocouples using other forms of compensation are given in *“Appendix C -Thermocouple Connections” on page 89.*

Details on setting up thermocouple and resistance thermometer inputs *See “Thermocouple” on page 47. Or see “Calibrate Input” on page 38.*

Alarm Card (option)

For set up of Alarms, See “Relay Alarm Cards” on page 63.

There are two ***Relay/Alarm Card*** options available on the ***eZtrend V5***. There is a 4 x relay output card and a 6 x relay output with 2 volt free digital inputs. The relay outputs will be activated by

- Alarm or set points
- Disk full

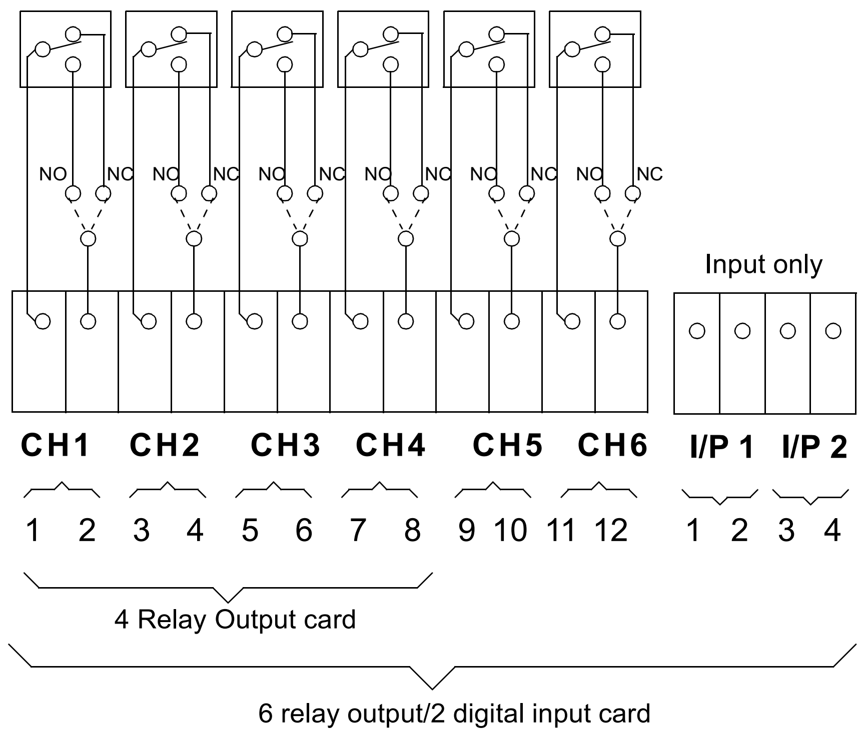
The volt free contact inputs will be available to

- Activate alarms and set points
- Recording control
- Change log rates. (Pause logging)

The pin-outs for the relay alarm card are numbered from the bottom of the unit to top, pins 1 to 12, for the relay outputs, and pins 1 to 4 for the 2 digital input connector. Devices driven by the relays are connected to a 12-way screw terminal plug similar to the one used on the Universal analogue inputs. Available alarm outputs start from alarm channel 1 up to the maximum number of alarms allocated. For 12-way connector; torque setting 0.4 Nm/3.5 lbf-in. Do not over tighten

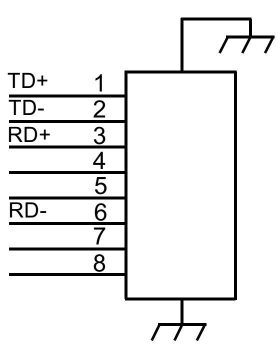
The Relay Card will be fitted with a link in the Normally Closed (NC) position on channels 1 to 6. The link can be moved manually to the Normally Open (NO) position if required.

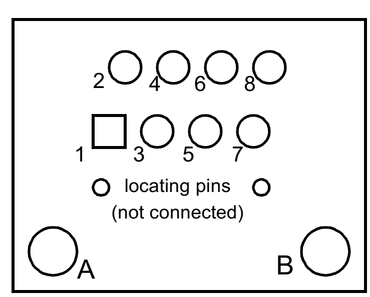
The Alarm cards are mounted vertically in the unit and the rear connections for the alarm card are vertical. If the 6 relay output/2 input card is fitted the inputs are located in the 4 pin connector towards the top of the recorder.



Ethernet Interface

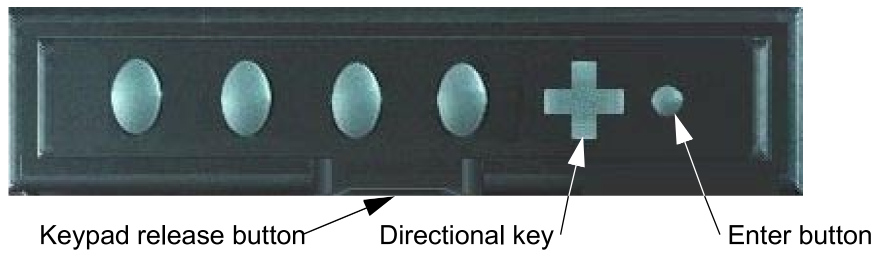
The Ethernet connection is part of the main pcb. A separate socket is provided at the rear of the unit. This is an 8-way RJ45 socket Molex 95040-288“ used for standard Ethernet connections.





Chapter 3: Quick Tour

The Keypad



Buttons

To select an option as displayed along the bottom of the screen, press the button immediately below the required option. The options displayed above the buttons change dependent upon the facilities available at that given time.

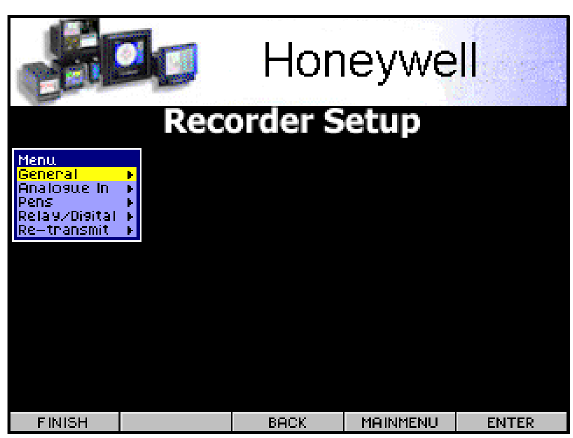
Directional Key

The ***Directional Key*** has four orientations Up, Down, Left or Right. Down and Left produce the same movement as each other in horizontal or vertical plane. The Right and Up buttons produce the same action in vertical or horizontal planes. This will be determined by which menu or screen is being displayed. The directional button has three functions

1. To navigate through a list of menu options
2. To select a specific option
3. Activating replay mode *(See “Replay Mode” on page 24.)*

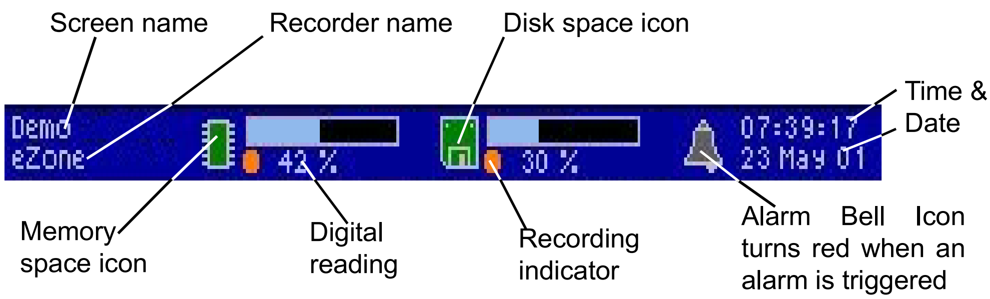
To choose an option from a drop down menu, use the directional button to navigate until the option required is highlighted and then press the enter button to select.

The Screen



On the ***eZtrend V5*** the data is displayed on a 5" diagonal passive colour STN Quarter VGA Industrial LCD. The display requires a warm up time of 60 minutes before any brightness or contrast adjustments should be made. *See “Display Trim-pot Adjustments” on page 18.*

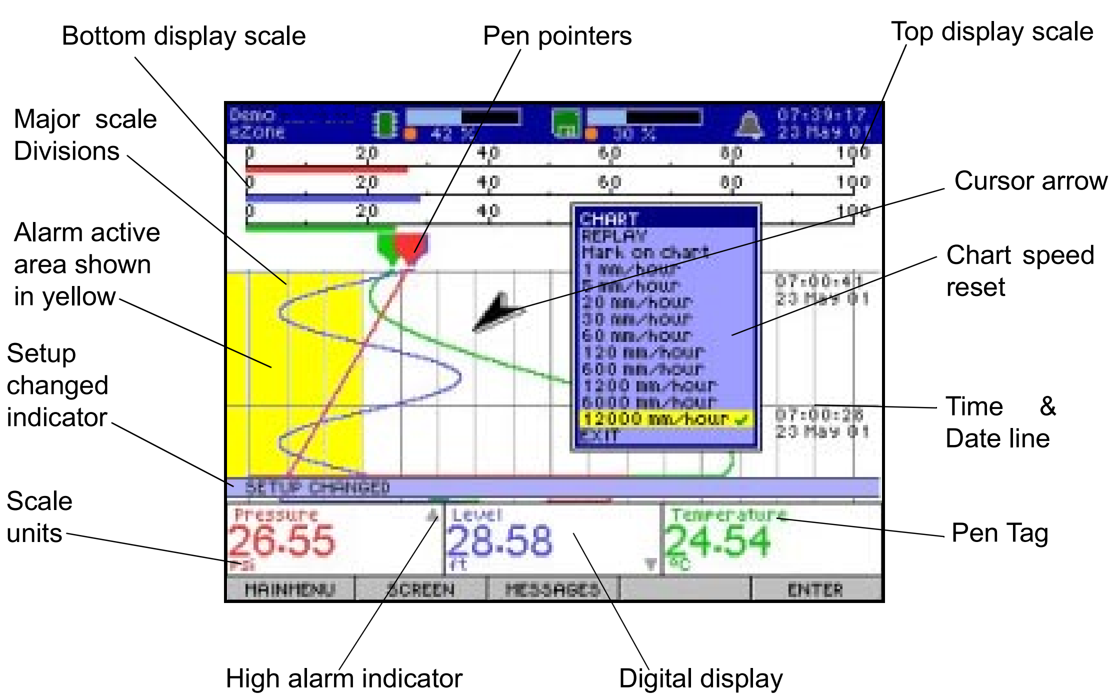
Status Bar



The icons for the ***Chip*** and ***Floppy Disk*** are green in normal operating conditions. The chip relates to the amount of memory space used and changes to orange when 80% full. The floppy disk icon represents the amount of space used on the floppy disk, which turns red when the disk is 95% full. The alarm bell icon which lights up red to indicate that an alarm has been triggered. Displayed on the left of the Status bar is the Recorder Name and the Screen number presently being displayed. On the far right, the Time and Date are displayed.

Screen Layouts

These are the display formats available for viewing data, 8 different layouts are available in varying combinations of trends, bars and digitals. All information specified in the set-up for a particular pen will be consistent in all screen displays. The screen can display 6 channels as chart trends, bars and or digitals. Selecting this item will cause all pens displayed on the screen in conventional mode to conform to the chart rate. If the directional key is operated whilst a chart is displayed a cursor arrow will appear. By depressing the directional key an on screen menu will appear and a chart rate can be selected. The yellow area of the chart indicates its in an alarm state.



Screen Displays

There are eight different layouts available with the ***eZtrend V5*** . To select a screen, see *“Selecting and Re-naming Screens” on page 73*

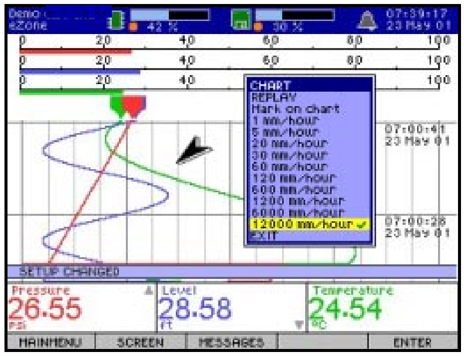


Chart V bars + digitals

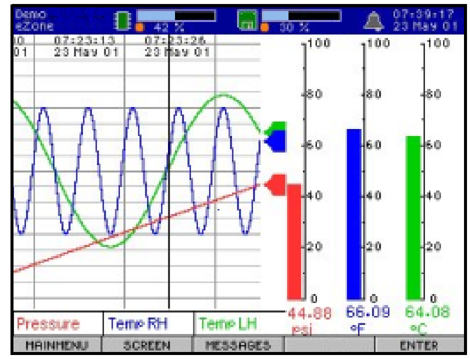
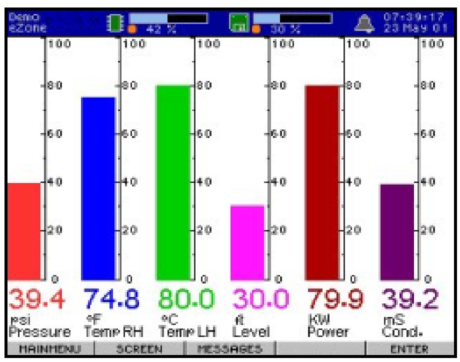
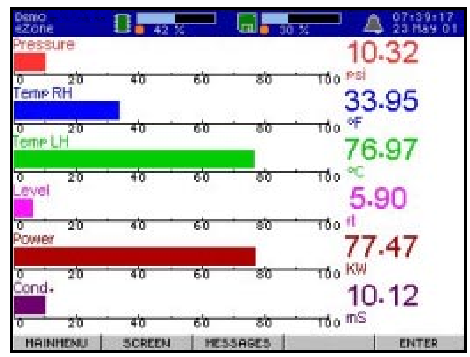


Chart H bars + digitals



Bars V (6 pens)



Bars H (6 pens)

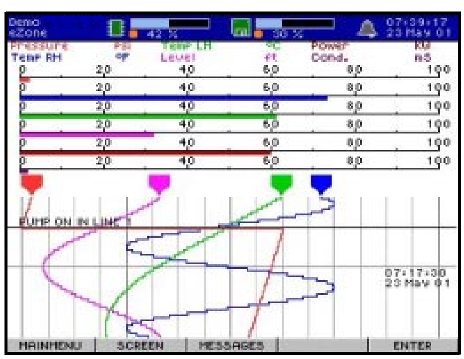


Chart V (6 pens)

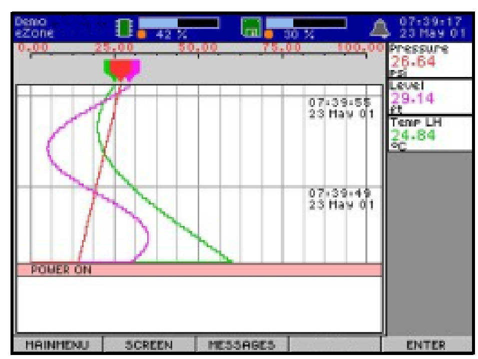
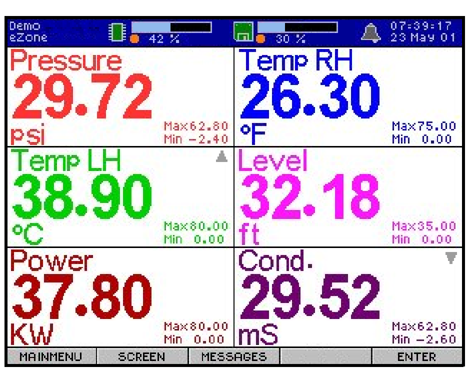


Chart & Digitals (V)



Digital Panel

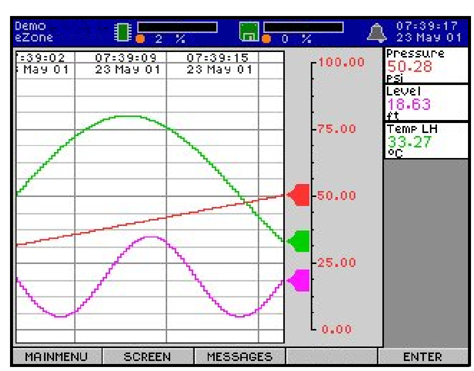
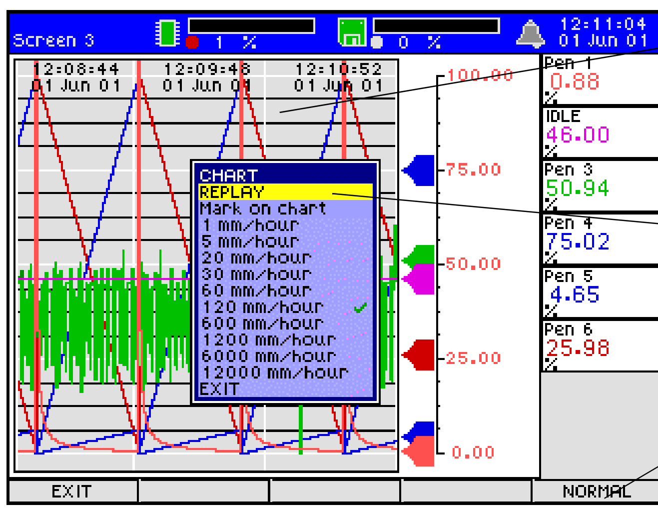


Chart & Digitals (H)

The screen display is ***non volatile*** which means the recorder will show the last screen displayed after a power down. The ***eZtrend V5*** offers a selection of 8 display layouts. Combinations of trends, charts and digitals display are available in horizontal and vertical modes. *See “Layout” on page 73.*

Replay Mode

Replay mode is only available when a chart is displayed on its own or with digitals or bars. This is activated by pressing the directional key to produce the cursor arrow and then press the enter button key to generate the on screen menu. Select ***Replay***, the chart will change to a grey background and the menu bar at the bottom of the screen will change. The right hand button of the menu bar will read ***Normal***, this is the speed at which the chart will travel when navigating using the directional key. Press the enter button to change between a ***Fast*** or ***Normal*** rate of travel. Use the left side of the directional key to go back in time and the right side to come forward to the present time. The chart pen pointers, bars and digitals stay in real time.



MaxMin: The minimum and maximum levels can be reset for bars and digitals. Use the directional key to navigate to the digitals or bars area of the screen and press to enter. The Bar Graph or Digitals menu will appear, select and press the directional key to reset using ***Reset MaxMin*** or by resetting all the channels using ***Reset All Max Mins.***

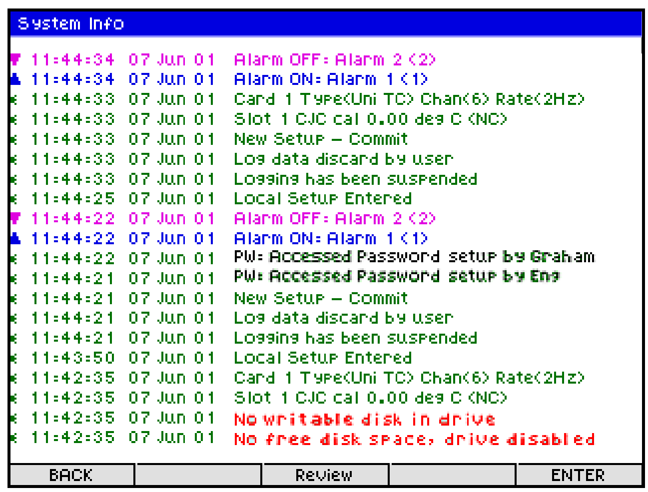
Mark on chart: This will place a line across the full width of the chart with text identification, at the precise time and date of entry. Up to 80 characters can be entered, the ***eZtrend V5*** can display the first 40 characters across the screen. The full text can be reviewed in the messages screen, shown as 2 lines of text.
Mark on chart can be used to indicate, for example, operator change over or for batch recognition. Mark on chart can also be used to notify when alarms are switched on or off, if an alarm card is fitted.
With a chart displayed, use the directional key to produce the cursor arrow in the chart area. Press the enter button to display the chart menu. Select ***Mark on chart*** and enter text required.
Preprogrammed markers can be composed in the ***TrendManager Pro V5 Suite*** and imported into the recorder as part of the setup. When mark on chart is selected a list of 20 preprogrammed markers will be displayed. Use the directional key to select a marker, these can be edited at any time. *See “Relay Alarm Cards” on page 63.* All activity is recorded in the messages screen. *See “Messages” on page 25.*

Messages

If a situation occurs where a warning message is indicated the MESSAGE button will flash amber. If an error occurs the MESSAGE button will flash red.

The messages screen records any setup activity that has been changed.

- Green - indicates normal status.
- Amber - indicates a warning message.
- Red - indicates an problem has occurred.
- Blue - indicates alarm on/digital on
- Magenta - indicates alarm off/digital off
- Dark Green - indicates user information e.g. mark on chart or password/user access



Press the ***Review*** button to reveal this menu bar

Press the ***Back*** button to return to the main screen. The ***Review*** button produces a different button bar at the bottom of the screen with the options of ***Exit*** which will return to the main messages screen and the ***Date On/Off*** facility which toggles on and off. ***Up***, ***Down*** are for scrolling by ***Page*** or use the directional key to scroll by ***Line*** or ***Page*** which is determined by pressing the Enter button. The ***Enter*** button will only become active when the directional key is used and a cursor arrow appears, then press ***Enter.*** This activates the ***Events list.***

Events List

The ***Events list*** is activated by entering the Messages screen, use the directional key to produce the cursor arrow. Then press the directional key to reveal the events list. From this list the ***Date*** option can be turned on or off and the ***Review*** menu bar can be activated. The ***Filter*** option allows specific event types only to be displayed such as indicating when an alarm has been triggered. ***Reset*** will clear all the messages that have been displayed up to that time and the ***Exit*** option will remove the events list menu.

Power Up

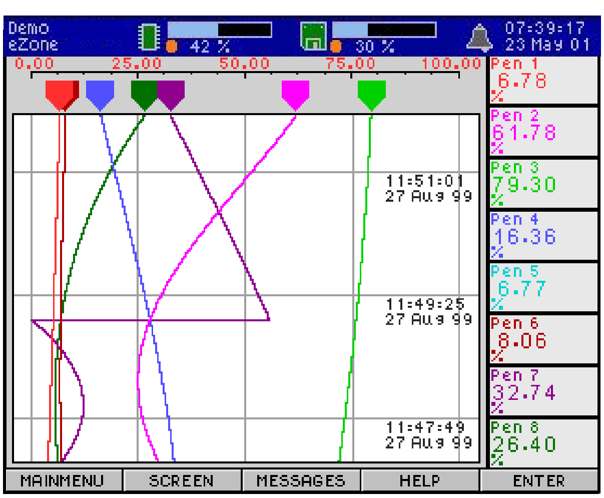
The first screen displayed is the ‘power up screen’ shown below. This only appears for a short time before changing to the last screen selected before the unit is switched off or, on first power up, it will default to the layout displaying horizontal chart trends with digits. To change screen layout press the ***Screen*** button and use the directional key to scroll up and down the selection menu. When the screen required is highlighted, press the enter button to select. Allow a warm up time for the display of 60 minutes before adjusting the brightness or contrast. *See “Display Trimpot Adjustments” on page 18.*

NB: The flag displayed in the top right corner of the screen indicates the initial default language.

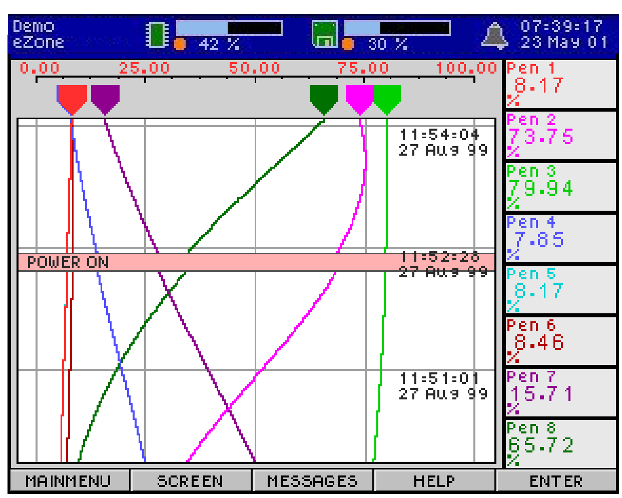
Power up screen

Non-Volatile Screen Display

The ***eZtrend V5*** features a non-volatile screen display. This means the screen will display data continued from the last power down or reset. Below is an example demonstrating the non-volatile screen display. The first chart shows the data before the power is cut or the recorder is reset. The second chart shows what happens when the power is restored. No data has been lost, and the full chart history is retained, in the same format, during power interrupt. The recorder will always power up to the screen being displayed before any power interrupt.



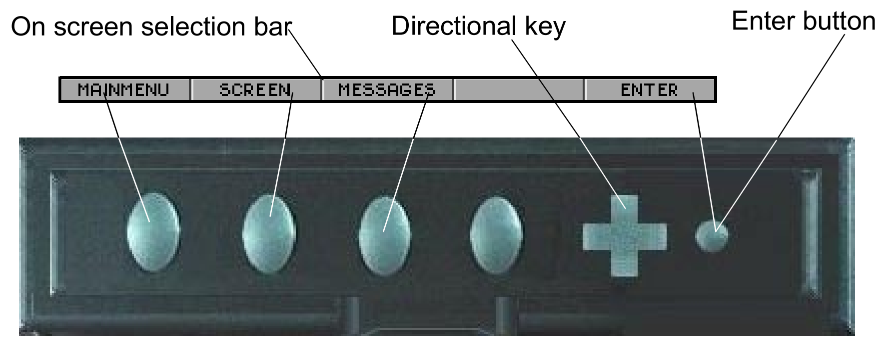
Before power down or reset



After power up or reset

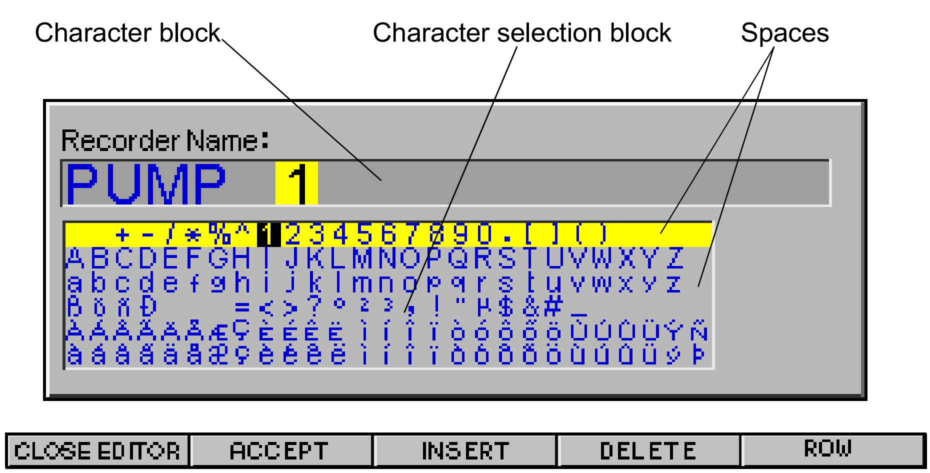
Menu Selection

The four main buttons on the keypad apply to the on screen selection bar, press to activate. The ***Directional Key*** is operated in either Up and Down or Left and Right depending on the screen being displayed. Use the directional key to scroll through menus and highlight options. When an option is highlighted press the Enter button. The ***Enter*** button, is the small round button to the right of the keypad, press to activate. Pressing any of the buttons or the directional key will cause the display to change or another ***Menu*** to appear.



Text Entry

Text entry is required for configuring many of the options in the set-up menu. The principle for all text entry follows a similar format. Using the directional key, highlight the required option on the menu and then press the enter button to select. This will activate a character block at the bottom of the screen. Press enter again to display the character selection box. Using the directional key, once again, highlight the specific row required, press the enter button to select the character. Continue until all characters are entered. To enter a space, move the cursor to a blank area within the character selection block and select. Finally press ***Accept*** then ***Finish*** and ***Apply*** on the on-screen selection bar when complete. Follow the on screen instructions for the ***Log Data History*** screen which appears when any changes are made to the ***Setup***.



Notice the on screen selection bar has changed. These are active and enable you to ***Cancel*** and return to the menu, ***Accept*** the information entered, ***Insert*** characters into the text or numbers block, ***Delete*** any entry which may be incorrect and finally the directional key function which when depressed will ***Select*** the row or character highlighted.

About

Select the Main Menu button, use the directional key to select the ***About*** option then press the enter button. This will display the technical specifications relevant to your recorder which may include:

•Firmware version

•Serial number

Options available; such as

•Maths

•Totals

•Events

•TrendScript

•Web Server

•E-mail

Communications facilities appertaining to your recorder; such as

•Ethernet

•Trendbus

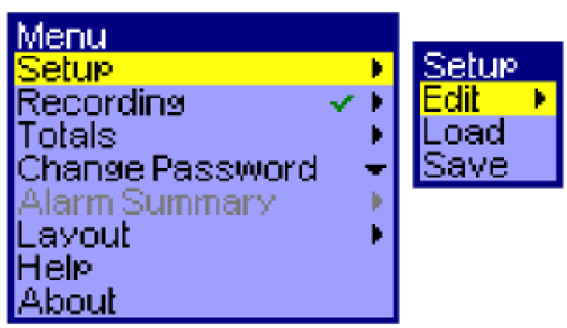
To remove the display from the screen press the button immediately below ***OK***.

Chapter 4: General Setup

Setup

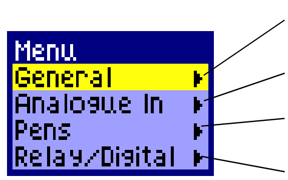
Use the on screen menu bar and the corresponding buttons below each item on the keypad, to select recorder options. Use the directional key to navigate through the recorder menus and highlight an option. Press the small round enter button to select an option.

To change the configuration of the recorder choose ***MainMenu*** from the on-screen selection bar displayed along the bottom of the screen by pressing the button immediately below. Use the directional key to highlight ***Setup*** then press the ***Enter*** button to select. The setup menu will appear showing three options. The ***Edit*** option is for configuring the setup of the recorder. The ***Load*** option is for importing setups from ***TrendManager Pro V5 Suite*** or another recorder. *See “Software” on page 75.* To load a setup *See “Load” on page 66.* The ***Save*** option will save imported setup. *See “Save” on page 66.*



Edit

Select ***Edit*** for recorder configuration. The following ***General*** menu will appear showing the options available. These options are detailed on the pages indicated below. A small black arrow to the right indicates a further menu. Menu items shown in grey means this particular option is not available.



See *”General Setup’ on page 29*

See.*”Analogue In Setup’ on page 41*

See *”Pen Setup’ on page 51*

See *”Relay/Digital’ on page 63*

General

Language

This is the first option on the ***General*** menu, select ***Language*** to activate the menu. Choose the language required and the reset window will appear, press the three buttons shown simultaneously to reset the recorder. The recorder will now display text in the chosen language.

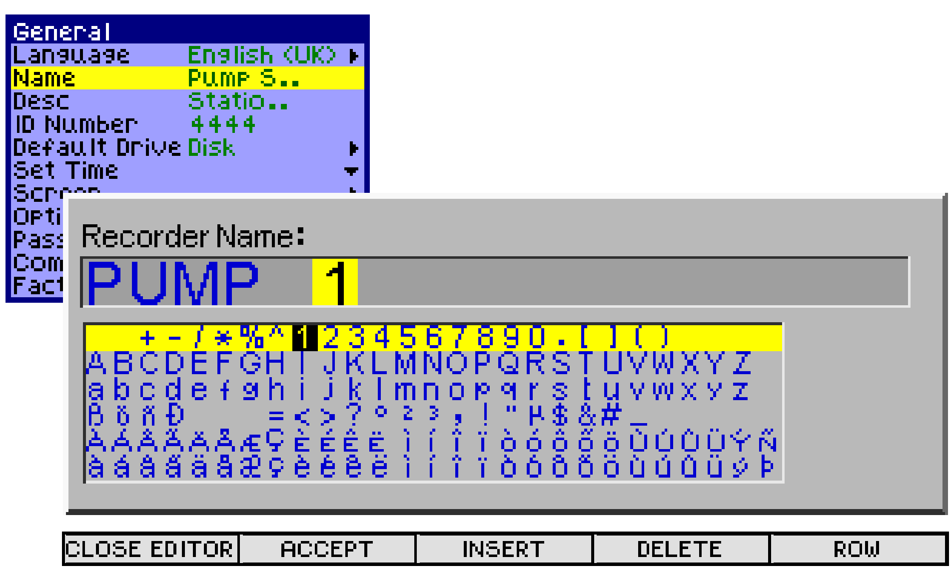
Name

Function: Recorder name

Type: 20 Character alpha/numeric

Description: User programmable identification

The second selection on the ***General*** menu is ***Name***, this is a user defined label. Highlight, using the directional key, and press the enter button to show the recorder name at the bottom of the screen, (the cursor will be on the first character) press enter again to display the character set available. To edit the text, navigate through the rows using the directional key and press enter when the row containing the letter required is highlighted. Use the directional key again to identify the specific character. Press enter to select the character. When the new name is complete, press the ***Accept*** button below the selection bar. *See “Setup Complete” on page 65.*



Description

Function: Recorder description

Type: 50 Character alpha/numeric

Description: User programmable identification

To display or change the description follow the instructions as for ***Name*** above.

ID Number

Function: Identification number of the recorder

Type: 4 Character numeric

Description: Address of recorder

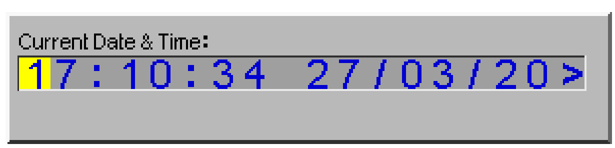
Default: 0001

Essential that recorders on communication networks have different ID numbers. To display or change the ***ID Number*** follow the instructions as for ***Name***.

Default Drive

This menu shows the logged data is going to the Floppy Disk Drive by default.

Set Time



Function: Time and date display

Type: 6 Character numeric (time), 8 Character numeric (date)

Description: Time and date setup for the recorders real time clock.

Default: 00:00:00 01/01/2001

From the ***Set Time*** option on the ***General*** menu as shown in *"Setup' on page 29*, press the thumbwheel to show the current date and time as shown here. To change the ***Time*** and/or ***Date*** follow the instructions as for ***Name.*** The time is shown in hours, minutes, and seconds with a colon in between to separate each pair of digits. The date is shown by day, month and then year using a forward slash in between. Provide a space in-between to define the time and the date.

Screen

Function: Reduce wear on the screen, change the screen background appearance.

Type: Menu select, Time-out 1 to 255 minutes

Description: Blanks the screen when there has been no activity for a specified time period. black or white background option.

Default: Screen saver is disabled, chart defaults to a white background

The brightness and contrast of the screen can be controlled by a trimpot adjustment, see *"Display Trimpot Adjustments' on page 18*.

The ***Saver*** function helps to reduce screen wear, highlight and toggle this option On or Off using the Enter button. Set the screen saver ***Timeout*** from 1 to 255 minutes. Highlight and select to produce a text box and enter the time-out period required.

Chart paper - This feature gives the option of having a black or white chart background colour. Use the directional key to highlight and the enter button to select which chart background colour is preferred.

Option Codes

Function: Serial number Identification and option availability

Type: 2 part 15 Character alpha/numeric.

Description: 6 character serial number, factory programmed for unit identification. Plus a 9 character option code, fully upgradeable with option enhancements.

Default: Individual factory set code

This ***Option Code*** is a unique serial number specific to your recorder which contains information enabling certain options. It can ONLY be changed when and if you purchase further options for this recorder. The first six digits of the code depicts the serial number of the recorder. The other nine digits are the coded options available. The whole code is CRC checked, invalid entries will not be accepted.

Password

Function: Protects entry to the system at various levels

Type: Text entry

Description: Restricts access within the recorder, providing password protection at different levels.

Default: Disabled

Password protection restricts user entry to different levels within the recorder. Passwords will be disabled on start up and the recorder will default to a predetermined password, which is displayed. **'Eng', is the highest level of access to all screens**. From here the Engineer can allocate other users and their levels of access to screens within the recorder. Each user creates their own password when they initially log on. Each user, including 'Eng' is responsible for remembering their own password, 'Eng' level cannot access the passwords for other users.

NB. If the user does forget the password the user must be deleted from the recorder and start again. If 'Eng' user forgets their password and no access is available, contact us at **Honeywell** and an override password can be issued.

This password system allows traceability by the users name, not the password.

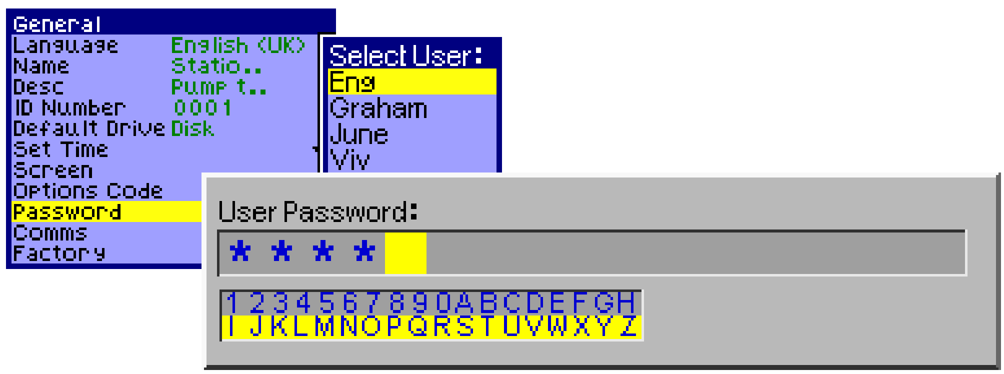
The messages screen will keep a record of all entries made into each level, by user name, and if access has been accepted or denied.

There are four levels of user:

- Engineer - Highest access to all levels, Supervisor, Technician and Operator.
- Supervisor - 2nd highest level including Technician and Operator access
- Technician - 3rd level including Operator access
- Operator - 4th and lowest level of access

Eng Password Entry

From the ***General*** menu select ***Password***, a ***Select User*** menu will appear. Initially only one ‘Eng’ will be available, enter a password in the text block, see *See “Text Entry” on page 27.* For other user password entry see *”User Password entry’ on page 35*



Enter the passwords carefully followed by the ***ACCEPT*** button from the on screen selection bar at the bottom of the screen.

Password Enable

When the ‘Eng password is entered, the password menu will appear, press the enter button to ***Enable***.

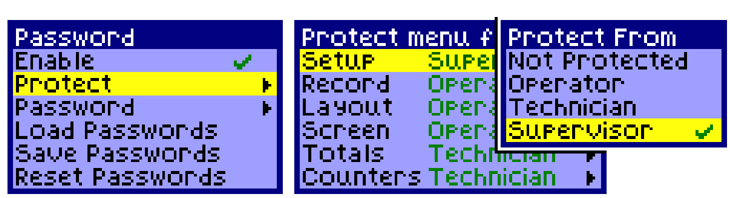
Password Protect

These menus are only available to ‘Eng’ level users.

There are six areas in the recorder which can be protected from users. Access to these areas can be assigned using the ***Protect*** and ***Protect From*** menus.

NB. Password protection is controlled by the highest user level defined as ‘Eng’.

Select each of the six areas, ***Setup, Record, Layout, Screen, Totals*** and ***Counters***. Decide at which user level each area is to be protected from, or not protected for all to access.



Notice the menu is labelled '***Protect From***', this table shows how to assign access. ***Protect From*** includes the highest user specified. i.e. if ***Setup*** is protected from the ***Supervisor***, neither the ***Supervisor's, Technician's*** or the ***Operator's*** passwords will work, so only the ***Engineer*** has access.

The Operator is the default access to the recorder, this is the lowest level, anybody using the recorder will have this level of access. No password will be required until an operator signs on as a User.

The password system is based around the following priority hierarchy.

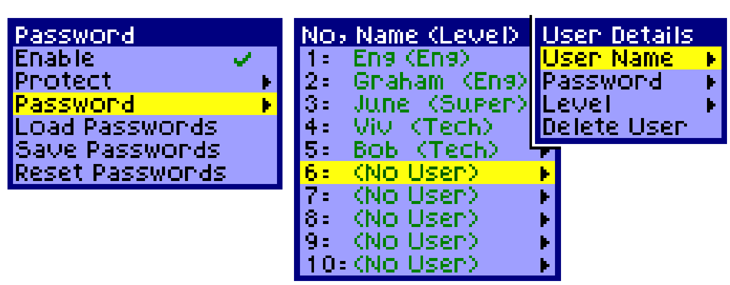
Priority table		
Top level	-	Engineer
	-	Supervisor
	-	Technician
Bottom level	-	Operator

Access only	Protect From enter	No access to
Engineer	Supervisor and below	Supervisor, Technician, Operator
Engineer and Supervisor	Technician and below	Technician and Operator
Eng, Super, Technician	Operator and below	Operator
Eng, Super, Tech, Operator	Not protected	Access to all users

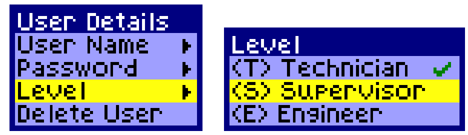
Password Allocation

Only 'Eng' level has access to these menus to add up to 10 User Names in to the recorder and assign a level to that user, Technician, Supervisor or Engineer. 'Eng' can not enter a password, the User enters their own when they first enter the password menu.

The ***User Name*** is entered using the text and character box. Once entered, press the button below ACCEPT from the on screen menu bar at the bottom of the screen.



Also entered here is the ***Level*** of the user, this will restrict entry to the screens already setup in password protect.



User Password entry

Other users apart from the initial ‘Eng’ user will have to be entered on to the recorder, and their level set, by ’Eng’. *See “Eng Password Entry” on page 33.*

When the user enters the password menu for the first time, they will be required to enter a new password. This must be re-entered to confirm. All users, apart from ‘Eng’ level, will not be able to proceed any further in to the password set up.

Once a users password is entered their level immediately applies and they will only be able to access the areas set up by the ‘Eng’ level user.

Each user, including ‘Eng’ is responsible for remembering their own password, ‘Eng’ level cannot access the passwords for other users. If the user does forget the password the user must be deleted and start again.

Change Password

To change a user password, go to the main menu and select ***Change Password.*** Select the user and enter the users current password. Enter the new password, then re-enter to confirm. This new password is now active.

Password User Traceability

Every time a ***User***, entered into the recorder, enters any of the areas that are protected, it will be logged to the messages screen. The message will display the users name and which area they wish to access. It will show if the user ***Accessed*** or was ***Denied*** access according to their allocated user level. The messages screen will also show if a password setup ***Failed.***

Load Passwords

Use this function to load the passwords setup’s, including their levels, from a disk into other recorder setups.

Save Passwords

The save function saves all the password setups, including the allocated levels, onto disk. This is useful when setting up other recorders that require the same password setup.

Reset Passwords

Reset does exactly what it says. All passwords will be reset or cleared apart from the initial password for ‘Eng’ fixed into the recorder.

Comms for Ethernet

Refer to the **Honeywell** Communications manual for full details on recorder setup, system configuration, connection and installation requirements.

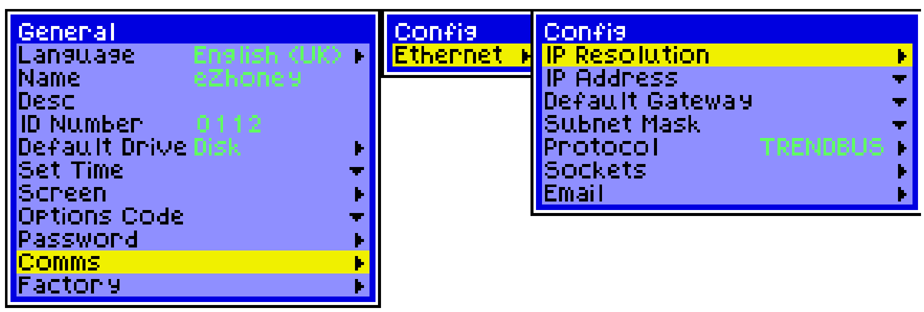
Function: External communications facility

Type: Menu select

Description: Ethernet communications ports to allow information to be transmitted and received.

Default: Enabled

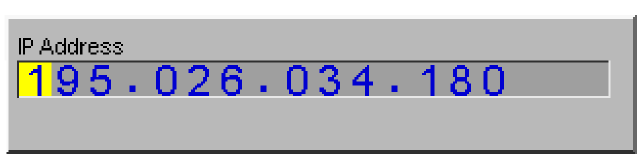
The Ethernet connection is fitted as standard into all ***eZtrend V5***s. To activate/de-activate the comms in the recorder go to the ***Factory*** option in the ***General Set*** up menu. Select ***Comms Ports*** and activate Ethernet in the menu. *See "Comms Ports" on page 40.* Go to the Comms option in the General menu to produce these sub menus to configure the Ethernet setup. *See "Appendix E - Ethernet & E-mail" on page 97.*



IP Resolution

IP Resolution is a mechanism which maps the IP Address to an Ethernet address. IP Resolution uses different types of protocol to translate the IP Address. The default is FIXED. Please see your IT systems administrator for selecting the type of resolution required.

IP Address



This is an identification address for communications between two peripherals. The IP Address identifies a specific recorder or device. Please see your IT systems administrator for allocating IP Addresses. Refer to the **Honeywell** Communications manual for full details (43-TV-25-08).

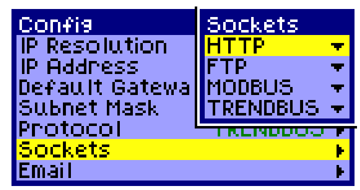
Default Gateway

This is a configuration parameter transmitted to each network device. Where an IP Address cannot be found in a local network, the default gateway sorts out getting traffic from one subnet to another. Please see your IT systems administrator for information on Default Gateways.

Protocol

Protocols define the format in which the data is transferred from the recorder to a PC or transfer between other devices and peripherals. The protocol for the ***eZtrend V5*** comms card using an ***Ethernet*** connection is ***Trendbus***. Trendbus is designed to allow the user to receive data from remote recorders, without having to retrieve the disk from the unit. If Trendbus is not required select ***None***. If None is selected, Ethernet can still be used for FTP down load or HTTP web browser. The None option just de-selects Trendbus without disabling the default options.

Sockets



The is a term given to a software object that connects an application to a network. It works by a using a program to open a socket and read and write data to and from the socket. Its a software object not a physical component.

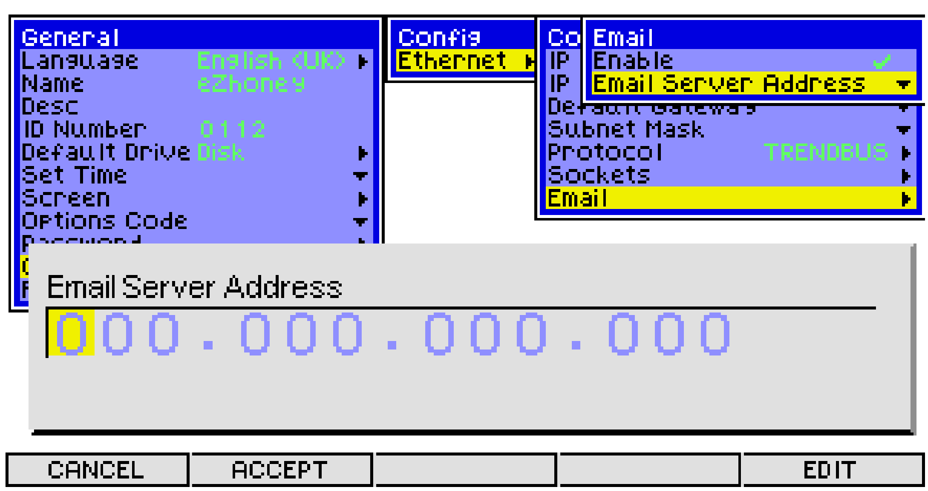
Socket number should not need to change. This must only be changed for networking by advanced users. The socket numbers are set according to each type of socket.

HTTP is used for web browsing using the ***TrendServer*** software via an Ethernet connection. ***FTP*** is used for importing data from the recorder using ***TrendServer*** software via an Ethernet connection.

Subnet Mask

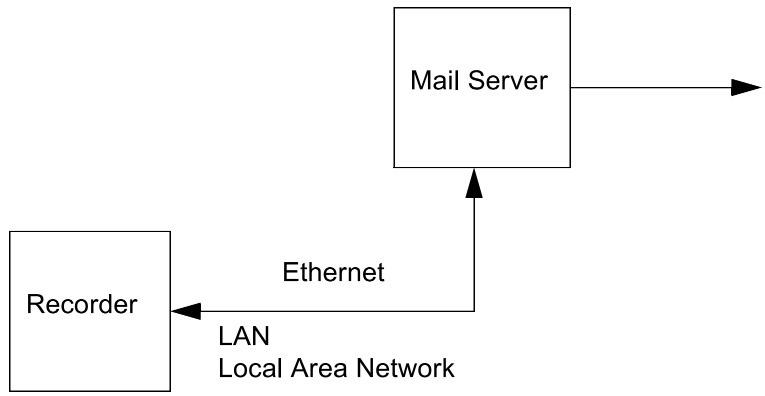
The Subnet mask acts as a filter when identifying IP Addresses. A single IP network can be divided into many subnets by using some of the bits of the host address portion of the IP address as a subnet. A mask is simply a screen of numbers that tells you which number to look at underneath. Please see your IT systems administrator for setting up the mask.

E-mail



The E-mail facility is used in conjunction with the ***TrendManager Pro V5 Suite.*** Set up e-mails in the ***TrendManager Pro V5 Suite*** to send information to a specific recorder or device. Use this menu option to set up an ***E-mail Server Address*** so that information being transmitted to the recorder can be directed effectively. Tick to enable.

The recorder sends messages for distribution by a remote e-mail server. The e-mail server is located by its IP address as set-up in the communications set-up options. When the recorder sends an e-mail message, it locates the e-mail server you have configured and uses SMTP (Simple Message Transfer Protocol) to send the message to the e-mail server. SMTP allows the recorder to send messages to an e-mail server without having its own e-mail address; because of this the e-mail server will not be able to send any reply back to the recorder.



Factory

Function: Unit Calibration and Alarm card setup

Type: Menu selection

Description: Calibration of analogue input card and configuration of Relay/Digital.

Default: N/A

From the ***Factory*** option on the ***General*** menu use the directional key to select, as shown in *"Setup' on page 29*, press the enter button to generate the sub menus. Use this menu route to calibrate the analogue card for input or output of analogue signal. The ***Drives*** item is for the 1.4 Mbyte floppy drive disk only. ***Reset Setup*** will reset to the factory settings, highlight and press enter button. Follow on-screen instructions during this procedure.

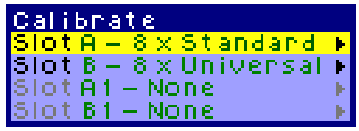
Calibrate Input

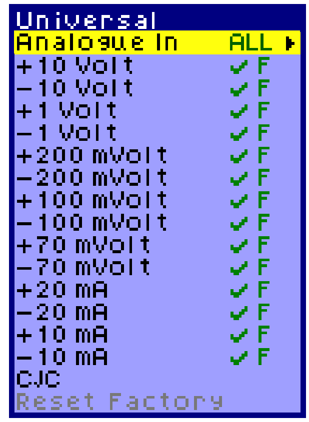
The type of Universal analogue card fitted in the unit has the following menu screens, within the ***Calibrate Input*** option. Up to 6 analogue channels are available. Individual input channels can be switched on or off by selecting ***Inputs*** and entering a tick or a cross in the ***Calibrate*** option.

Select Analogue In 'All' to identify which channels require calibration using a ✓.

'F' indicates the input is calibrated to the factory setting. If any power loss should occur the unit will retain the calibration settings at the time of power loss.

Input channels can be calibrated individually, indicated by the disappearance of the 'F'. The other inputs are not effected and will calibrate to the factory settings.





CJC Calibration

Function: CJC Calibration

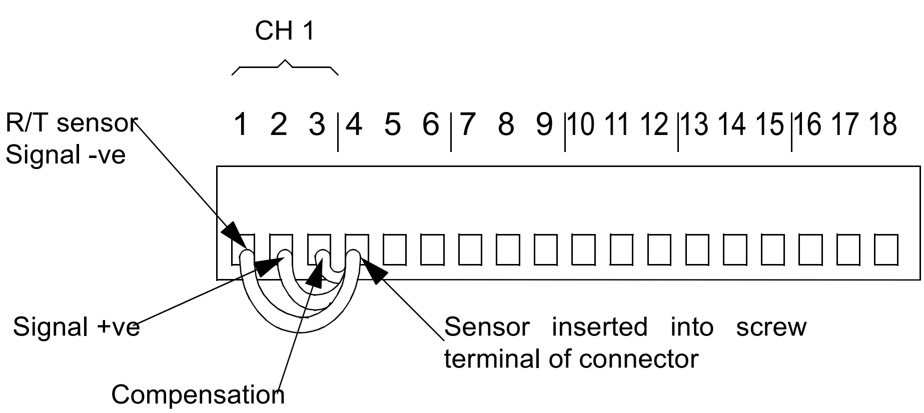
Type: Menu selection

Description: Calibration of the Cold Junction Compensator on the analogue card

Default: N/A

Use a Resistance Thermometer sensor to measure the actual temperature of the Thermocouple connections at the rear of the unit. Deviation in temperature, between the measured T/C connections and the CJC, result in a calculated adjustment being made to the CJC temperature. Follow the on screen instructions for calibrating the CJC.

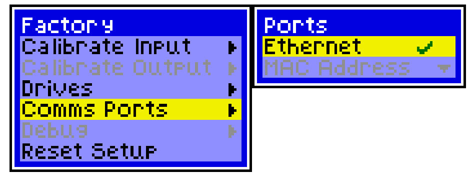
The diagram below shows how to wire an R/T across the first channel to measure the temperature of the terminal. This must be done on the first channel of each Analogue card fitted. For this calibration ensure channel 1 is enabled as an Resistance Thermometer and any other channel for the Type K Thermocouple.



Drives

Set up before leaving the factory, this menu will identify the type of drives fitted to the unit. Only the floppy drive is available on the ***eZtrend V5***.

Comms Ports



The Ethernet card has the option to connect to Web and E-mail (TCP/IP). The default state is with the Ethernet option enabled. *See "Comms for Ethernet" on page 36.*

The Ethernet card is required if the user wishes to import data using the ***TrendServer*** software package. The Ethernet option will also give access to recorder data on the Internet by use of a web browser.

MAC address

Short for Media Access Control address, a hardware address that uniquely identifies each node of a network. No action is required, the MAC address is a factory setting.

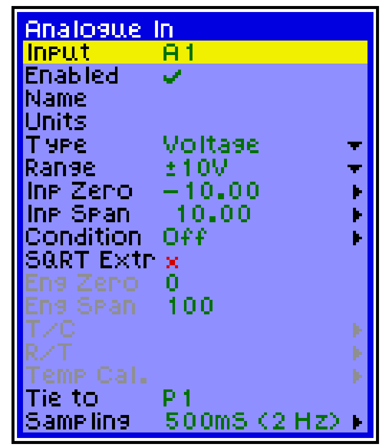
Reset Setup

This will clear all user configuration from the recorder except layout.

Chapter 5: Analogue In Setup

Analogue In

Highlight the ***Analogue In*** option on the ***Setup, Edit*** menu, from the Main Menu, and press the Enter button to generate the menu shown.



The Analogue In menu deals with the processing of analogue input signals and their conversion into a digital form, suitable for the later stages of the logging process such as ***Maths***. Depending on the options available on the unit, differing numbers of analogue channels can be selected. Channels can be set to the same configuration or set up with individual configurations.

We will now follow through the ***Analogue In*** menu.

Input

Function: Input channel identification

Type: Preset choice

Description: Identify and setup input channel configurations

Default: A1 (analogue input channel 1)

The ***Input*** is selecting the analogue input. On the ***eZtrend V5*** there are 2, 4 or 6 input channels available. The first input will be shown on the menu i.e. “A1” as indicated here. To set up the other inputs channels, press the enter button and use the directional key to navigate through to the required analogue channel. Press the enter button again to select when the relevant input is displayed.

Enabled

Function: To activate the analogue channels

Type: On/off switch

Description: Enables each analogue channel.

Default: Enabled

This enables the analogue input via a toggle switch, which shows as a **x** when off, or ✓ when active.

Name

Function: Analogue channel identifier

Type: 20 Character alpha/numeric

Description: User programmable identification

Default: N/A

This is the ***Name*** of the active analogue input channel. When this option is highlighted and the enter button is pressed for selection, the text box will be displayed along the bottom of the screen. Press enter again to reveal the character box. To edit the name follow the instructions in. *See "Text Entry" on page 27.*

Units

Function: Unit of measurement

Type: 11 Character alpha/numeric

Description: The measurement in units per input channel

Default: N/A

This is the unit of measurement for that particular input, e.g.***%*** or ***°C***. When this option is highlighted and the enter button pressed for selection, the text box will be displayed along the bottom of the screen. Press enter again to reveal the character box. To edit the ***Units*** follow the instructions in *See "Text Entry" on page 27.*

Type

Function: Type of Input signal

Type: Menu Selection

Description: Setting the type of input signal per channel

Default: Voltage

To choose an option, use the directional key to highlight the ***Type*** option and press the Enter button. Use the directional key again to select the required option and press enter.

For setting up instructions on Thermocouples and Resistance Thermometers *See "Thermocouple" on page 47.*

For further information on Thermocouple connections see, *"Appendix C -Thermocouple Connections" on page 89*

Range

Function: Specify the range for each input

Type: Menu Selection

Description: Selecting the value of the range

Default: ± 10V

The ***Range*** is dependent on the type of input selected previously. Use the directional key and the enter button to select an option. For Thermocouple or Resistance thermometer input ranges *See "Thermocouple" on page 47.*

Input Zero

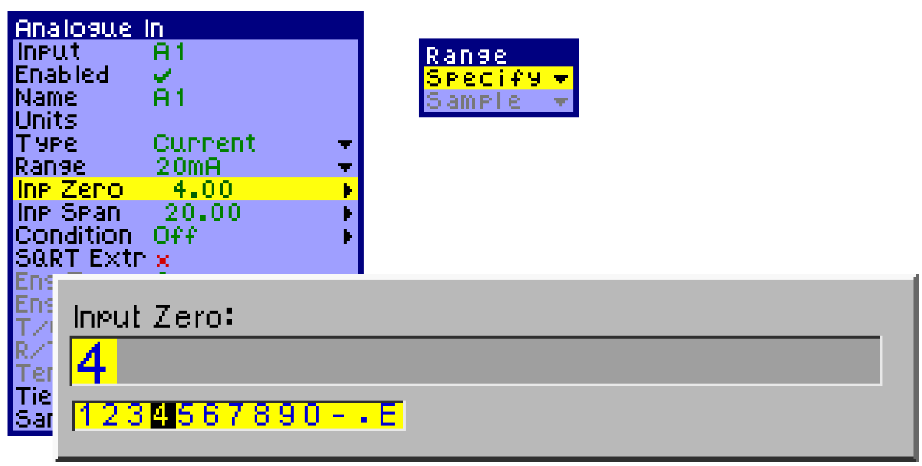
Function: Value at the bottom of the range.

Type: 10 Character numeric

Description: This is the input value that equates to the bottom of the scale.

Default: 0

When selecting ***Input Zero*** there are now two choices, either ***Specify***, which will call up the relative prompt requiring a value to be entered see *See “Text Entry” on page 27.* The other method of setting up an input is to apply ***Sample*** signals of known values to the input. These values are internally calibrated which means that the zero and span values selected are referenced to known values within the unit.



Input Span

Function: Value at the top of the range.

Type: 10 Character numeric

Description: Input value that equates to the top of the scale.

Default: 10.00

Refer to ***Input Zero*** for setting up instructions.

NB - The input zero and span must be within the selected range for correct operation

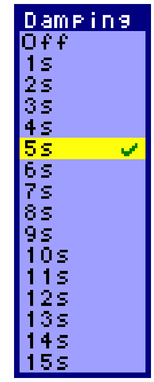
Conditioning

Function: Signal Conditioning

Type: Menu selection

Description: Damps noisy signals, filters transient anomalies

Default: Off



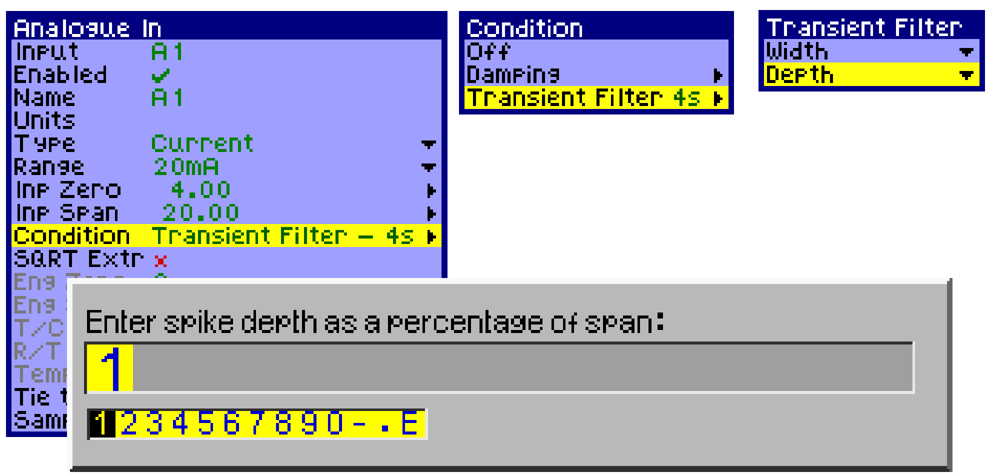
Damping

The damping option works by averaging sampled data over the allocated time. Signal damping can be set from 1 to 15 seconds irrespective of sample rate.

Transient Filter

Used to filter out any electrical interference from external influences.

The transient filter can be set up to ignore a momentary change in amplitude of a signal from its base line value to a higher or lower value, followed by a rapid return to the baseline value.



Set the ***Transient filter*** to disregard a specified type of pulse. The ***Width*** of the pulse, to be rejected, can be set from 1 to 15 seconds. The ***Depth*** of the pulse is entered as a percentage of the span. The span being defined by the Engineering span e.g. Eng Zero = -10, Eng Span = +10. Enter spike depth as a percentage of span = 20.

If the signal is within 20% of span, the point will be logged, if the signal is outside the 20% of span the signal will be logged as the previous point.

See “Engineering Zero and Engineering Span” on page 46.

Square Root Extraction

Function: To activate square root extraction

Type: On/off switch

Description: Enables square root extraction on a specific channel

Default: Disabled

This is a toggle switch which shows as a **x** when off, or a ✓ when active. It is a method for converting a non-linear signal into a linear scale.

The Square root extraction in the analogue input is used to linearise certain sensors that have a non linear output - for example in the calculation of flow. So when you check the Square root extraction in the Analogue input section it carries out the following calculation.

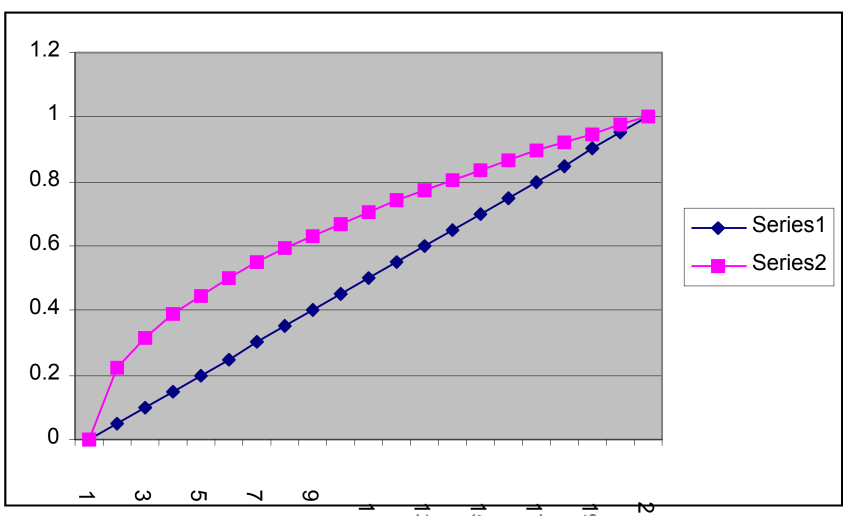
It ratios the anlogue input range that you set, to 0 to 1.

So any sensor input is represented by a number from 0 to 1.

We then take the square root.

We then re ratio the result back to the user set range.

The resultant 'linearisation carried out looks like this:



Engineering Zero and Engineering Span

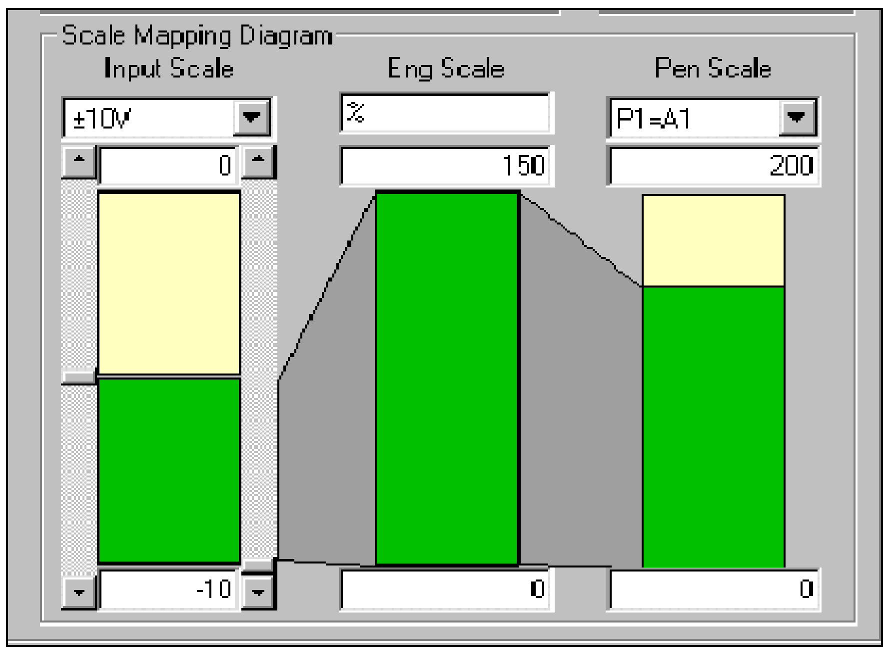
Function: Setting of engineering units

Type: 10 Character numeric

Description: To allocate engineering units to the zero and span analogue inputs.

Default: Engineering zero = 0, Engineering span = 100

This facility can be best described by utilising the ***Setup*** window in ***TrendManager Pro V5*** as shown below.



1. The input range is -10 to +10V. The sub-range is set to -10 to 0V

2. The input engineering scale is 0 to 150% but using span of -10 to 0 volts ie. 50% of input range

3. The pen scale is 0 to 200 but the input engineering scale is only 75% of that

The input range, left scale, is -10 to +10V, but data is only showing 50% of the scale. The engineering scale, in the middle, is 0-150% but only uses 50% of the data from the Input scale (-10 to 0). The effect is that of 'zooming in' on the signal i.e. the signal will appear bigger seeing 50% of the Input scale over the whole of the Engineering Input scale. The Pen scale, right scale, ranges from 0 to 200 but shows the Engineering Input scale reading only 75% of that. The effect will be 'zooming out' on the signal.

In this example -10V on the input will read zero on the pen scale, 0V on the input will read 150 on the pen scale. The top of the pen scale 150-200 will never be used

Thermocouple

Function: Temperature measurement

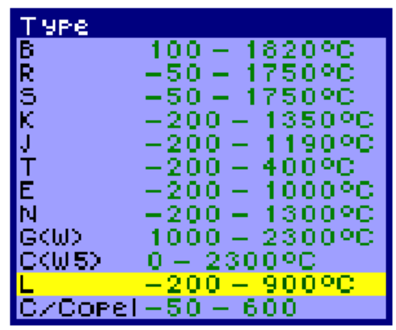
Type: Menu selection

Description: Selects thermocouple settings

Default: Type K

A ***Thermocouple*** is an electrical circuit comprising of two dissimilar materials. A voltage is generated which is dependent on the temperatures at the junctions forming the limits of the dissimilar materials.

Follow the on screen menus for each different type of input. For thermocouples enter the type, which reference junction is to be set for thermocouples, unit of measurement and finally specify upscale or downscale burn out.



Type

Function: Type of thermocouple input

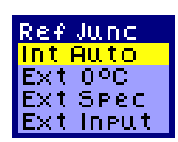
Type: Menu selection

Description: Setting the type of input signal per channel

Default: Type K

This is to specify the ***Type*** of thermocouple required. Different thermocouples are made from different materials which then measure over different ranges. Menu shown above.

Reference Junction



Function: Temperature reference

Type: Menu select

Description: Measures the temperature at the reference junction

Default: Int Auto

Int auto - Uses the cold junction sensor in the recorder as a variable reference temperature.

Ext 0°C - Assumes the cold junction is held at 0 °C to provide a 0mV reference, external to the recorder.

Ext Spec. - Uses a ***Reference Junction*** held at a constant temperature. Specify the temperature that the cold junction sensor is to be set at.

Ext Input - Use a thermocouple or resistance thermometer from another channel to measure as the cold junction sensor.

Units

Function: Unit of measurement

Type: Menu selection

Description: The measurement in units per input channel

Default: °C

Select from the menu box the units of measurement required for either thermocouple or resistance thermometer inputs.

Upscale Burn

Function: Takes the signal in a specified direction if there is a break in the T/C.

Type: Menu selection

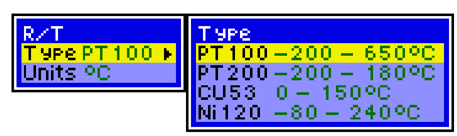
Description: Should the thermocouple break contact the signal will be driven in a specified direction if activated.

Default: Downscale

This enables the signal to be directed ***Upscale*** in the event of a break in the thermocouple. These operate via a toggle switch, which shows as a **x** when off or a ✓when active.

A ***Downscale*** function is also available which allows the signal to be directed downscale if there is a break in the thermocouple. There is also the ***Off*** option, to switch to no burn-out direction.

Resistance Thermometers



Function: Temperature measurement

Type: Menu selection

Description: Measurement of the resistance of the device produces its temperature

Default: Type - PT100, Units - °C

For the ***R/T (Resistance Thermometer)*** option, the ***Analogue In*** menu changes to allow the user to set up specific details.Follow the on screen menus for each different type of input. For resistance thermometer settings, just the unit of measure from this menu will be required. The resistance of an R/T increases with temperature.

Temperature Calibration

Function: Remove T/C and R/T inaccuracies

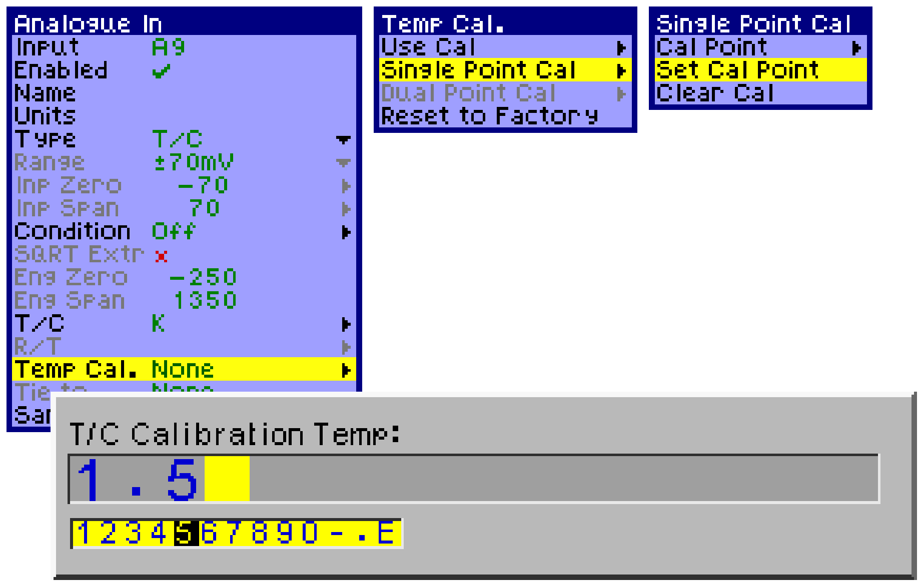
Type: Menu selection

Description: To allow adjustment to T/C and R/T measurements

Default: No Cal

Both thermocouples and resistance thermometers may require additional ***Temperature Calibration*** to eliminate system measurement errors. A single point calibration can be set up for each input using ***Set Cal Point.*** From the Inputs menu highlight and select ***Temp Cal***. To enable a calibration point to be set, highlight and select ***Use Cal***. From here another menu will give the options available.

Select and highlight the option required. Return to the ***Temp Cal*** menu. If ***Single or Dual point*** has been selected then the calibration point needs to be set in either ***Single Point Cal or Dual Point Cal***. Calibration can be in °C, °F, or Kelvin. Select ***Set Cal Point***, by using the directional key to highlight the option and the enter button to select the option required. Press the directional key again to produce the character selection blocks. *See “Text Entry” on page 27.*



Tie To

Function: To tie the input engineering scale to pen scale

Type: Pen selection

Description: To allow the Pen scale and the Engineering scale to be independent of each other or to be linked together

Default: None

This is an option to connect the information on this input to a particular pen. The default is ***Tie to***, so if you do not wish the input scales to change together this must be set to ***None***. When active, a connection is made between the pen scale, engineering scale and the input scale. So if the pen scale is changed, the engineering and input scales will change too. To change or edit a tie to, highlight Tie to, press the directional key to select the option. navigate using the directional key until the required pen ID is displayed, press the enter button to select that pen. Press ***Finish*** on the on-screen selection bar, then press ***Apply***.

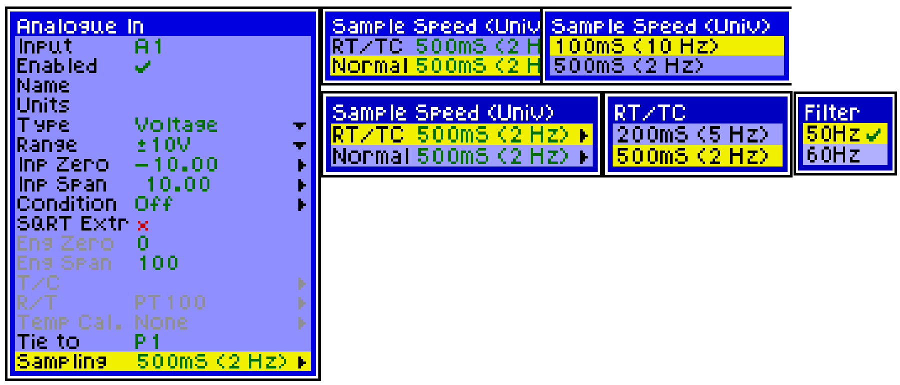
Sampling

Function: Analogue input sample speed

Type: Menu selection

Description: Sets the sampling for the base input card

Default: Normal, Sampling speed defaults to 500ms(2Hz)



Normal sampling refers to the speed at which the card will run if voltage or current inputs are used. RT/TC sampling refers to the speed at which the card will run if any one or more of the inputs are set to RT/TC.

Normal input sample speed	RT/TC Sample speed
100 mS (10 Hz) 5 times per sec	200 mS (5 Hz) 5 times per sec
500 mS (2 Hz) twice per sec	500 mS (2 Hz) twice per sec

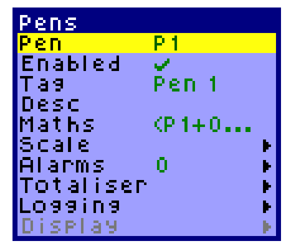
Pen speeds are not affected and the pen logging rate can be set higher than the sample speed for any input. The sample speed of 500 ms (2 Hz) will enable 50/60Hz ***Digital filter*** which will cut down external noise giving a more stable reading.

Chapter 6: Pen Setup

Pens

All available pens may be displayed as either a trend on a chart, a bargraph scale or as a digital panel meter or combinations of, see *“Screen Layouts” on page 22.* Pens can be displayed in groups using the Layout menu and assigning pens to a screen. *See “Layout” on page 73.* A pen can be assigned to show engineering units or display a maths expression. The ***eZtrend V5***, that has the Maths and Totalisers option fitted comes with 6 extra pens.

Highlight the ***Pens*** option on the ***Setup*** menu press the enter button to generate the menu shown opposite.



Pen

Function: Pen identification

Type: Preset choice

Description: Identify and setup pen configurations

Default: P1 (pen1)

The first pen will be shown on the menu ie. P1. To set up alternative pens, highlight the Pen option using the directional key and press the enter button to select. The available pens will scroll incrementally using the directional key. Press the enter button to select relevant pen.

Enabled

Function: Enables the pen

Type: Keypad activated on/off

Description: Activates each pen

Default: Enabled

This is a toggle switch which shows as a **x** when off, or a ✓ when active. Each pen can then be setup with information specific only to that pen.

Tag

Function: Active pen identifier

Type: 16 Character alpha/numeric

Description: A short name tag or identification for individual pens

Default: Pen 1

The ***Tag*** will be the identifier on any subsequent graph screens. Highlight this option using the directional key and then press the enter button for selection, the pen tag will be displayed along side the relevant bars or digital reading. To edit the tag follow the instructions in *“Text Entry” on page 27.*

Description

Function: Pen function

Type: 32 Character alpha/numeric

Description: For additional Pen information

Default: N/A

Use the directional key to highlight an option and the enter button to select. The pen ***Description*** will be displayed along the bottom of the screen. To edit the name follow the instructions in *“Text Entry” on page 27.*

Maths

Function: Maths calculations, available as an option

Type: 256 character alpha/numeric

Description: The maths expression allocated to this particular pen.

Default: A1 (for pen1)

Analogue signals may have a mathematical function performed on them before they are represented as a pen. Use the directional key to highlight an option and press the enter button for selection. The maths expression will be displayed along the bottom of the screen. For more information on maths *See “Appendix D- Maths Expressions” on page 93.* To edit the maths expression follow the instructions in *“Text Entry” on page 27.*

Scale

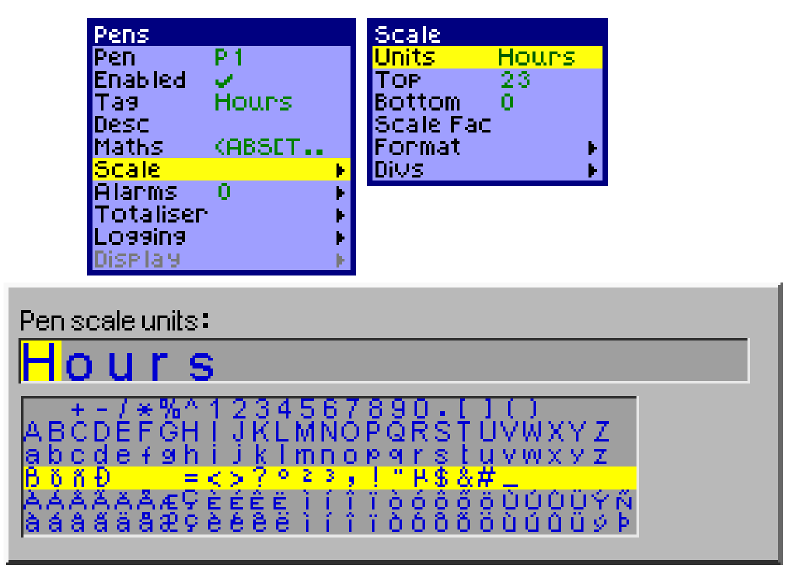
Function: Pen scale configuration

Type: Menu selection

Description: Information required to set up the pen scales

Default: N/A

Selecting ***Scale*** brings up a sub menu from which a further option menus appear, shown here. Highlight and select your entry using the directional key and the enter button. To edit the scale units follow the instructions in *“Text Entry” on page 27.*



Units

Function: Scale measurement units

Type: 10 Characters alpha/numeric

Description: The units which the pen is measured in.

Default: %

Enter here the ***Units*** required for the scale measurement. Use the directional key to highlight an option and the enter button to select. The units will be displayed along the bottom of the screen. To edit the units follow the instructions for *"Text Entry" on page 27.*

Top

Function: Top scale value

Type: 10 Character alpha/numeric

Description: Reading shown at the top of the scale

Default: 100

The ***Top*** value allows the user to set the numerical value at the top of the graph display for a pen. To change or edit these values follow the instructions for *"Text Entry" on page 27.*

Bottom

Function: Bottom scale value

Type: 10 Character alpha/numeric

Description: Reading shown at the bottom of the scale

Default: 0

This value allows the user to set the numerical value at the ***Bottom*** of the graph display. To change or edit these values follow the instructions for *"Text Entry" on page 27.*

Scale Factor

Function: Scale value multiplier

Type: 8 Character alpha/numeric

Description: Reference scaling factor for representational use.

Default: None

Use this to avoid having large numbers displayed on the graph. A scale factor can be entered, by which the values on the scale can be multiplied to give the actual value being represented. This is shown at the bottom of the graph. The ***Scale Factor*** has no effect on the value being displayed- it is only for the user's reference.To change or edit these values follow the instructions for *"Text Entry" on page 27.*

Format

Function: Number of decimal places on the pen scale

Type: Single numeric character

Description: Pen scale format for up to 6 decimal places

Default: Auto = Automatic enabled

Automatic formatting for the pen scale defaults to 3 decimal places. Deselect ***Automatic*** to allow entry to manually set the number of decimal places. See table for automatic decimal place settings.

.

span of scale less than	Number of decimal places
10	4
100	3
1000	2
10,000	1

Divs

Function: Set up for chart major and minor divisions

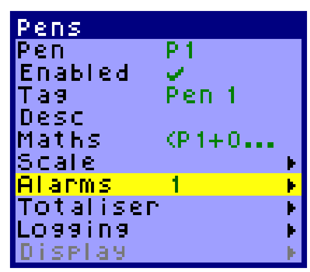
Type: Major and minor 10 character numeric

Description: Allows the display to be divided into major and minor divisions

Default: Auto enabled

The chart background is divided in to major and minor divisions represented by thin blue lines. The major divisions are also marked numerically on the bargraph. To change or edit these values follow the instructions for *"Text Entry" on page 27.*

Alarms



This is an option initially purchased with the unit or can be added to the recorder at any time.

Function: Pen specific alarm setup

Type: Menu select

Description: Configures alarms to a specific pen

Default: 0

There are two relay alarm cards available to the ***eZtrend V5*** either 4 relay output card or 6 relay output card with 2 volt free inputs. For connection details see *"Alarm Card (option)" on page 19.*

There are a total of up to 32 integral 'soft' alarms available in any combination for any pen to inform of selected out of limit conditions. So for example pen 1 could be allocated two alarms, pen 2 could have four alarms and pen 3 eight alarms, a total of 14 alarms out of a possible 32 alarms have been used. Pen 1 will use alarm numbers 1 & 2, pen 2 will use alarm numbers 3 to 6 and pen 3 will use alarm numbers 7 to 14. The procedure for setting each alarm is the same. Alarms can be configured to trigger at a specified levels and respond in various ways.

From the ***Pens*** menu, highlight and select ***Alarms***, using the directional key and the Enter button, this will produce the ***Alarms Menu***. An alarm can be allocated and configured to a pen using ***New Alarm*** *See "New Alarm" on page 55.* From here existing alarms can be edited by selecting ***Edit Alarm*** *See "Edit Alarm" on page 55.* Alarms can be deleted from specific pens using ***Delete Alarm*** *See "Delete Alarms" on page 55.*

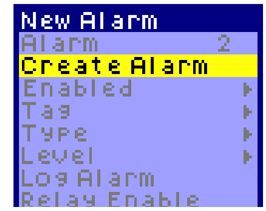
New Alarm

Function: Create a new alarm

Type: Menu select

Description: To setup one or more new alarms per pen

Default: Alarm 1



- Alarm - The alarm number defaults to 1, of a possible 32.
- Create Alarm - Activates the complete menu for the setup of that alarm. For full menu details *See “Edit Alarm” on page 55.*

Delete Alarms

Function: To delete an existing alarm

Type: Menu select

Description: Deletes existing alarm and setup

Default: First active alarm for that pen

- Alarm - select alarm for deletion by highlighting ***Alarm***, using the directional key and pressing the enter button to select. Navigate the directional key to highlight the correct number of the alarm and press the enter button to select.
- Delete - Highlight and press to delete using the directional key and the enter button.

Edit Alarm

Function: Edit alarm features

Type: Menu select

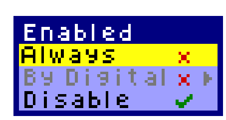
Description: View and modify existing alarms

Default: First active alarm for that pen

Use this menu to configure the alarm specifications for each pen.

Alarm - Select alarm number by highlighting and selecting ***Alarm***, use the directional key to scroll through the available alarms for that pen, press the enter button to select.

Enabled - The menu option is either ***Always*** or ***Disabled*** activated by navigating the directional key to highlight ***Enabled***, press the enter button to select, from the next menu highlight the selection which will toggle from on (✓) or off (**x**).



Tag - Or name by which each alarm can be identified. Highlight this option and press the enter button twice to display the text and character boxes. To edit the ***Tag*** follow the instructions in *“Text Entry” on page 27.*

Type - Specify whether the alarm is to be set high or low. Highlight ***Type*** and select, from the next menu select either ***High*** or ***Low***.

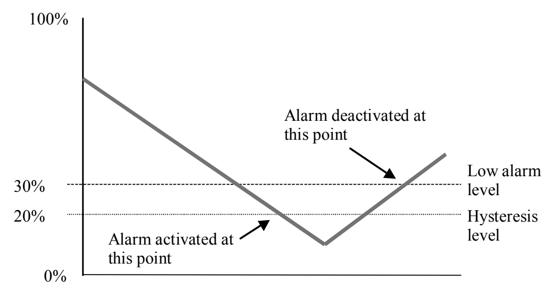
Level - The ***Level*** is the engineering units value and must be set within the ***Scale*** set for that particular pen. Highlight and select level, press the Enter button twice and follow the instructions. *“Text Entry” on page 27.*

Log Alarm - This is an on/off toggle ✓to enable **x** to disable. When activated, alarm activity will be logged in the system events screen, which can be located by pressing MESSAGES, found on the main screen selection bar during normal recording.

Relay Enable - Depending on the type of alarm card fitted there may be from 4 to 6 relays available. This menu shows the ***Relay*** state, each relay can be individually enabled on (✓) or off (**x**)**.** Select which relays are to be closed in the event of an alarm being triggered.

Relays - Only operative when ***Relay Enable*** is activated. This will show the relay number currently being edited, switch enable on or off using the toggle mode (✓) on or (**x**) off**.**

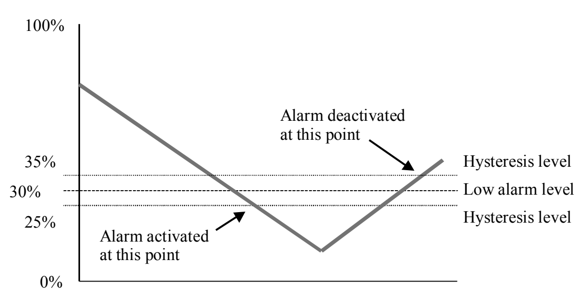
Hysteresis - This is effectively a tolerance level for an alarm level. When enabled, the ***Adjust Level*** can be set. This allows a specific percentage value of the engineering span to be added on to an alarm level.



In this example, if a ***Low*** alarm is selected with a hysteresis value of 10%, a logged reading will have to be below the alarm level by at least 10% of the overall scale before an alarm is triggered.

Enable - this is a toggle on (✓) off (**x)** switch.

Symmetrical - The hysteresis value is divided on either side of an alarm level. In this example the adjust level is still the same, 10 %, but if hysteresis is selected as ***Symmetrical*** then the logged reading would only have to drop as much as 5% of the full scale value below the alarm level to trigger the alarm. For the alarm condition to cease the logged reading would have to rise to over 5 % of the full scale value above the alarm.



Low alarm - 10% Symmetrical hysteresis

- Adjust Level - Highlight and select this option using the directional key and the enter button, press the enter button twice more to display the numeric bars for entering the adjustment level. To enter a value see *"Text Entry" on page 27.*

Damping - With this facility enabled, an alarm level must be breached for a specific period of time before an alarm is triggered.

For example, if a ***High*** alarm with ***Damping*** time of 3 minutes is set, the input signal must stay above the alarm level continuously for three minutes for the unit to activate an alarm. If the input signal drops below the alarm level before 3 minutes is up, the ***Damping*** timer will be reset and start again the next time the alarm level is breached.

Totaliser

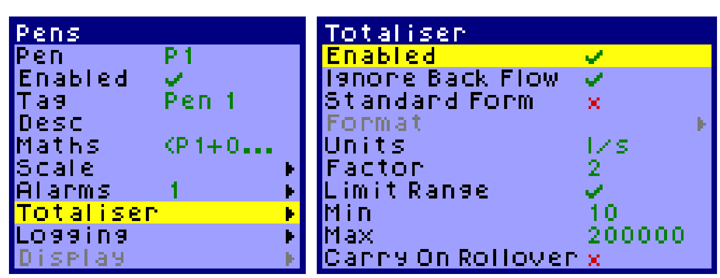
Function: Totalises the value of a pen

Type: Menu selection

Description: A total value measured over a timed period

Default: Disabled

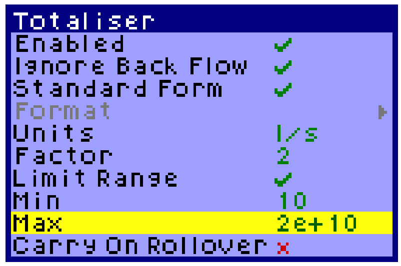
The ***Totaliser*** function is normally associated with flow monitoring applications, where the input to the recorder would be a measure of flow rate (ie. in litres per second) and the total amount that has flowed over a certain time period (ie.cubic metres). Totals can be assigned to individual pens. To setup the totals for a pen select ***Totaliser*** from the Pens setup menu, this will generate the totaliser sub-menu. Six extra pens are available with the Maths and Totaliser option.



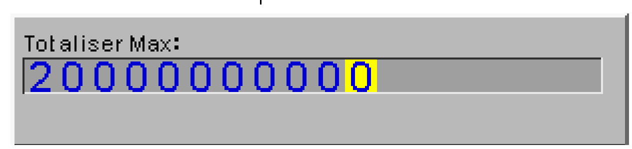
- **Enabled:** toggle switch on (✓) or off (**x**), enables the totaliser for that pen.

- **Ignore Back Flow:** If the flow reading should go into a negative value because the flow meter has been switched off, and the ***Ignore Back Flow*** option is non activate (**x**) the totaliser will start to subtract from the total value. When enabled (✓) any negative values are ignored and the total value will be held while the flow meter is off.

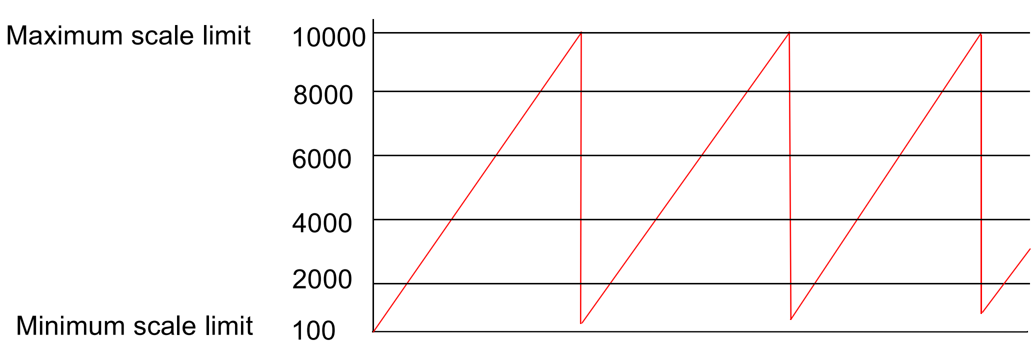
- **Standard Form:** With this function enabled the total values will always be displayed in standard form (eg.2.76823e+09) regardless of the length of the number.



Displaying Standard Form



- **Units:** This is the units of measure for the totaliser.
- **Factor:** This is the totalising Factor for the conversion from pen input units to totaliser value.
- **Limit Range:** Toggle switch (✓) to activate the minimum and maximum ranges.
- **Min:** Activated by enabling the Limit Range. Set the minimum limit for the totals to range from.
- **Max:** Activated by enabling the Limit Range. Set the maximum limit for the totals to range to.
- **Carry On Rollover:** Activated by enabling the Limit range. When the total exceeds the maximum scale limit the total will reset to the minimum limit. When activated it will carry over any amount in excess of the maximum scale limit.



This example has a scale range set from 100 to 10000 with increments every 500. When the reading reaches the maximum scale of 10000 it will be over range by 100 (starting at 100, 20 increments of 500 will equal 10100), with Carry On Rollover activated the residual of 100 is added to the next minimum scale limit.

Displaying Totals

Six extra pens are available with the Maths and Totaliser option. Choose a spare pen to display the total of another pen using the Maths expression. *See "Appendix D- Maths Expressions" on page 93.*

In this example pen 1 (P1) is being used to display the ***Total*** of pen 2 (2). Pen 2 (2) is shown here being divided by 10 (10), this divisor may be necessary to divide the ***Total*** so that it does not to exceed the pen scale limit of 1,000,000.

P1 = T[2,10]

NB: Do not omit the divider (10), a divisor must be added even if it is 1.

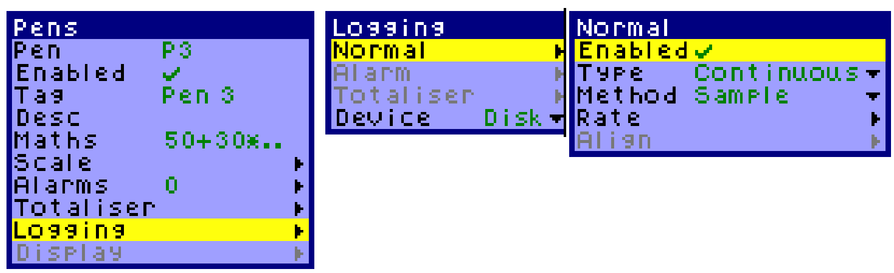
Logging

Function: Pen specific logging set up.

Type: Menu selection

Description: Storing data to disk by specifying relevant information

Default: Disabled



Selecting ***logging*** brings up sub menus from which further options appear. These will now be listed in detail.

Normal

Function: Normal log mode set up.

Type: Menu selection

Description: Specific pen during operation

Default: N/A

This takes you to further setup menus. When the unit has ***logging*** enabled it is then necessary to state the ***Type***, ***Method*** and ***Rate*** of logging.

Enabled

Function: Activate logging

Type: Keypad activated on/off

Description: Enables logging for each pen

Default: Disabled

This is a toggle switch which shows as a **x** when off, or a ✓ when active. Each Pen can then be setup with individual logging information for that pen.

Type

Function: Type of logging

Type: Menu selection

Description: The format in which data is logged

Default: Continuous

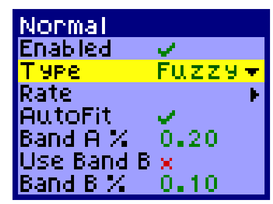
Once enabled the ***Type*** of logging can be ***Continuous***, only logging when an ***Event*** occurs or ***Fuzzy***.

For Continuous logging, highlight and select, then go to *"Method" on page 60*

Fuzzy logging was developed as a secure data storage technique which has self teaching data storage algorithm so the recorder stores data at a variable rate to match the process being monitored. *See "Appendix F- Fuzzy Logging" on page 99.*

Fuzzy logging has intelligent resources to enable the most effective and efficient way of using the Scan rate, Disk capacity and Recording time.

Select ***Fuzzy*** to produce this menu.



Enable Fuzzy logging with a ✓ and select the ***Rate*** option.

This will reveal two items, the ***Value*** and the ***Units***, set these to the desired rate for logging.

AutoFit ensures that the last sampled data point is logged before the signal goes out of the tolerance set in Band A or Band B. When displayed on a graph, the input signal will automatically fit to this last logged point.

Band A% is where the tolerance is set for the input signal. Specify, as a percentage, the tolerance band allowed above and below the input signal.

Use Band B to enable a second tolerance to be set, ✓ to activate.

Band B% This is where a tighter tolerance can be specified which must be set within the limits of Band A. Specify, as a percentage, the tolerance band allowed above and below the input signal.

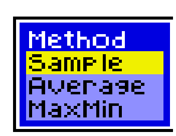
Method

Function: Style of logging

Type: Menu selection

Description: The way in which the logged data is collected.

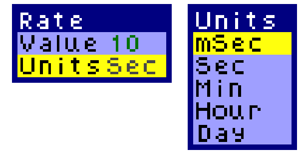
Default: Sample



The ***Continuous*** logging option will require a ***Method*** of how the data is to be logged.

- ***Sample*** logs the last sampled reading.
- ***Average*** logs the average of all the samples taken since last log.
- ***Max / Min*** logs the highest and the lowest of the sampled readings since last log.

Rate



Function: Logging rate, speed

Type: Menu selection

Description: Set this to how often data is logged

Default: Value = 10, Units = Secs

Rate of logging is determined by first entering the ***units*** of measurement then setting their ***value***. To change or edit these values follow the instructions in *"Text Entry" on page 27.*

If the units required are 'msec' the value screen will appear as shown here. This measures the value in Hertz (Hz), this measurement is then converted into the value in 'msec' i.e.: 5 Hz = 200 Msec.

NB. Hour and day logging rates are not available for Fuzzy logging.

Device

Function: Store logged data

Type: Menu selection

Description: Down load logged data to Floppy disk

Default: Disk

The only ***Device*** available on the ***eZtrend V5*** is 1.44 MByte floppy disk drive.

Chapter 7: Relay Alarm Cards

Relay/Digital can only be obtained on the recorder if the alarm card fitted is capable of both inputs and outputs. There are two different types of Relay/Alarm card available for the *eZtrend V5* but only one has both inputs and outputs.

Relay Alarm Cards	Ratings
4 channel relay alarm card (Output only)	3A 240V a.c.
6 channel relay output/2 volt free digital inputs	3A 240V a.c.

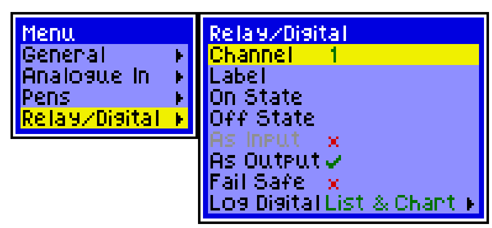
Relay/Digital

Function: Specify relay/digital I/O

Type: Menu select

Description: To configure relay/digital input or output status

Default: Channel 1, Label D1, On state On, Off state Off, As Input x, As Output ✓, Fail Safe x, Log digital Off.



Select each item required on the ***Relay/Digital*** menu:

Channel: Highlight and press the enter button, use the directional key to change the channel number. Select channel number required for configuration as a relay/digital input or output channel.

Label: 15 character alpha/numeric.
Highlight and press the enter button twice to activate the label block and the character display block. Allocate a name by which the relay/digital can be identified.

On State: 11 character alpha/numeric
Highlight and press the enter button twice to activate the Digital On State and character display block. This is what will be displayed in the messages list when an relay/digital is in its 'On State'.

Off State: 11 character alpha/numeric
Highlight and press the enter button twice to activate the Digital Off State and the character display block. This is what will be displayed in the messages list when an relay/digital is in its 'Off State'.

As Input: The first 6 channels are set to outputs. The 6 channel output/2 digital input card has two inputs available on channels 7 and 8 select these channels and enable as inputs. The 4 channel card will have this option greyed out as no inputs are available with this card.

As Output: The 4 channel relay output card will show this enabled for all 4 channels. The six channel output/2 digital input card will show this enable for channels 1 to 6 only, channels 7 & 8 are set to inputs.

Fail Safe: Toggle fail safe ✓On or **x** Off.

A ***Fail safe*** operation can be activated on the ***Output*** on a channel by channel basis. Fail safe, when enabled, holds the relay in an energised state until triggered by an alarm when the relay is de-energised. Any power failure will cause the same result.

N.B. Fail Safe and Maths

However, when using output relays in a maths expression be aware the maths is reporting the literal state of the relay.

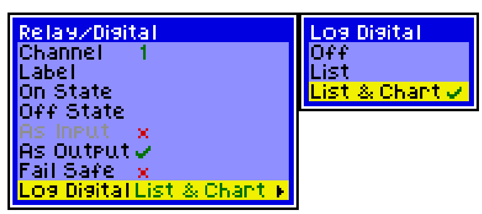
An example of this would be:-

If Pen 1 (P1) equals output channel 4 (O4) and Fail safe is On with no alarm triggered, the relay will be energised and P1 will return 1.

P1= O4

Log Digital:

Setup each Digital individually. Default is set to ***Off***, so no logging of any relay/digital events will be recorder on the Messages list or on any chart.



Use this box if digital activity is required to be logged to either ***List***, which is the Messages list, or to ***List & Chart*** which is recorded on both the chart and in the messages list. Repeat for each channel. *See “Messages” on page 25.*

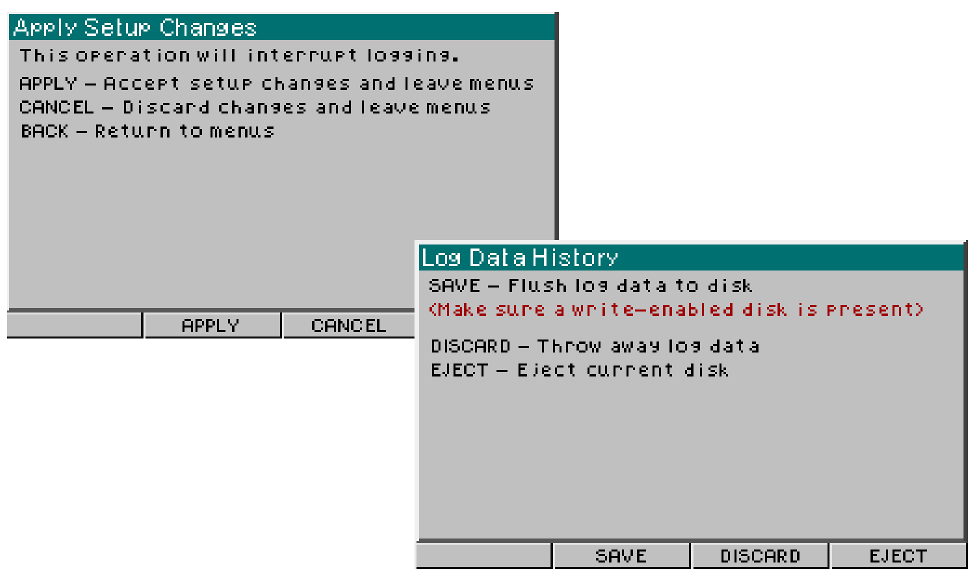
Chapter 8: Setup Complete

Setup complete

Whilst making alterations to the recorder setup, the recorder has still been recording data with the previous setup. When the new setup is complete select ***APPLY*** and the recorder will ask if you wish to save the previously logged data and setup to disk. If the data logged whilst creating the new setup is not required select ***DISCARD***.

When the setup is complete, select the ***FINISH*** button from the on screen selection bar at the bottom of the screen. The options are to ***APPLY*** the changes, ***CANCEL*** the changes and return to the main menu or go ***BACK*** to the previous menu.

APPLY - From here the options are to ***SAVE*** the log data, ***DISCARD*** the log data or ***EJECT*** the current disk for possible replacement. During ***SAVE*** an hourglass symbol will appear and the drive can be heard logging the data.



Load

Function: Import setup to the recorder

Type: Button activated

Description: To Import a setup from *TrendManager Pro V5 Suite* or other recorder

Default: N/A

Use this option to import data setups from disk when:

1. Setups have been exported to disk in ***TrendManager Pro V5 Suite*** previously.
2. Setup of one recorder is very similar to another, therefore only a minimal change would be required.
3. One recorder may be used to monitor several functions and may need more than one setup to do so.

Importing setups will interrupt logging and will cause the existing setup to be shut-down and saved, then the new setup will be executed.

Select setup from the ***Main Menu***, use the directional key to highlight the ***Load*** option, press the enter button to select. The ***Import*** screen will appear, there are two options available. Follow the on screen instructions to complete importing or to cancel this operation.

Save

Function: Save setup only (no data)

Type: Menu Selection

Description: To save the recorder setup for transfer on disk to *TrendManager Pro V5 Suite* or to another recorder

Default: N/A

After completing a new setup either through editing the menus or importing one select ***Save*** to store. Use this option to export the setup only to disk under the same circumstances as importing setups. Use the directional key to navigate until ***Save*** is highlighted, press the enter button to execute the action. Always check there is a disk in the drive prior to using this function.

Chapter 9: Recording

Recording

NB. Validate disk before recording. *See "Validate Disk" on page 68.*

From the MainMenu, select ***Recording*** to produce this menu.

Enabled

Function: To activate recording

Type: On/off switch

Description: Enables the recording of data

Default: Disabled

This is a toggle switch which shows as a **x** when off, or a ✓ to activate recording.

Log to Disk

Function: To activate logging to disk

Type: On/off switch

Description: Enables logging to disk

Default: Disabled

This is a toggle switch which shows as a **x** when off, or a ✓ when the disk drive is accessible.

Save Data and Eject Disk

Function: Down load sampled data

Type: Thumbwheel activated

Description: Allows data to be stored to disk at any time.

Default: N/A

This option allows stored data and the recorder setup to be copied to disk at any time, you do not have to wait for the recorder to make a timed dump of recorded data to disk. It is only available when a disk is loaded in the recorder. When ***Log To Disk*** is not enabled ***Save Data and Eject Disk*** is displayed in grey text, thereby indicating the option is unavailable. Always check there is a disk in the drive prior to using this function and use the ***Validate Disk*** function before saving to disk. *See "Validate Disk" on page 68.* Use this option to store blocks of recorded data to disk which may be in a queue awaiting automatic transfer to disk.

Validate Disk

Function: Check disk

Type: Thumbwheel activated

Description: Initiates and verifies disk status

Default: N/A

Before saving to disk, use the ***Validate Disk*** function to instruct the recorder that a disk is present. The busy egg timer will appear while the function initiates the disk and checks for any corruption.

Chapter 10: Totals

Totals will not be active from this menu until the ***Totaliser*** is enabled. *See "Totaliser" on page 57.,* for setting up totalisers in the Pen Setup Menu.

Start All Totals

Select the ***Start Totals*** option by using the directional key to highlight and activate by pressing the enter button. This takes immediate effect.

Stop All Totals

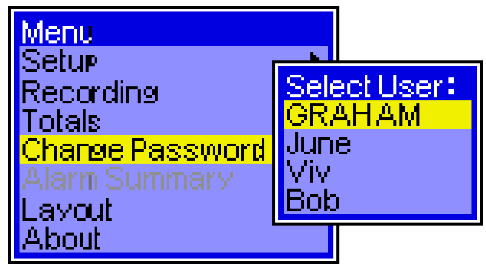
Select the ***Stop Totals*** option by using the directional key to highlight and activate by pressing the enter button. This takes immediate effect.

Reset All Totals

Select the ***Reset Totals*** option by using the directional key highlight and activate by pressing the enter button. This takes immediate effect.

Chapter 11: Change Password

Changing an Existing User Password



This is where the user can change their password, at any time.

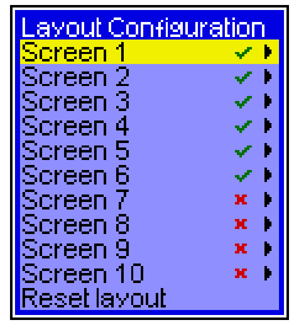
The User must already be entered on to the recorder and have an existing password. Users can only be entered on to the recorder by someone at 'Eng' level. The 'Eng' level user enters all the users and assigns their user level of access. *See "Password" on page 32.*

Select ***Change Password*** followed by the ***User*** name. Enter the current password, then enter the new password. This has to be re-entered to confirm the new password.

The new password is in the now in the system and will be required when the user logs on.

Chapter 12: Layout

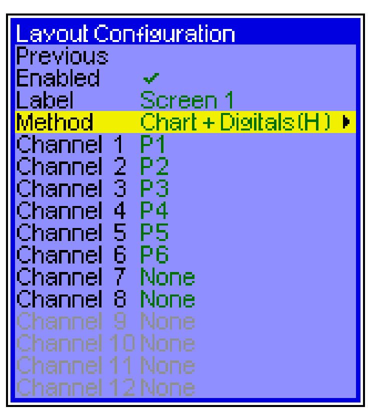
Layout Configuration

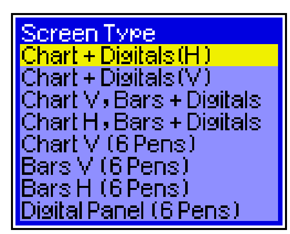


Selecting and Re-naming Screens

From the Layout configuration menu select a screen, e.g. ***Screen 1***, and press the enter button. The screen must be ***Enabled*** by placing a ✓ against it. Up to ten screens can be set up individually with different pens allocated to specific channels.

The ***Label*** is the name given to a screen and can be renamed, by highlighting the option using the directional key and then press the enter button. Press the enter button once more to activate the character box. Using the directional key navigate up and down the rows then press enter to select. Use the directional key again to travel right and left along the rows to select a character, then press the enter button. *See "Text Entry" on page 27.*





The ***Method*** in which the data on the screen is presented. The ***eZtrend V5*** has eight variations of screen layouts to choose from. All the layouts are displayed on *"Screen Layouts" on page 22.*

Scroll down to each channel on the Layout Configuration menu and assign the pen required to display each channel.

Data display evaluation

These charts shows the chart speed in millimetres per hour against the amount of time shown on the screen and the amount of time stored in the buffer.

eZtrend V5 chart speeds

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eZtrend V5					
Chart speed	*Screen display time*			*Buffered time available for replay*	
mm per hour	**Days**	**Hours**	**Mins**	**Days**	**Hours**
1	2.71	65.00	3900.00	59.29	1423.00
5	0.00	13.00	780.00	11.86	284.60
20		3.25	195.00	2.96	71.15
30		2.17	130.00	1.98	47.43
60		1.08	65.00	1.00	23.72
120			32.50		11.86
600			6.50		2.37
1200			3.25		1.19

A section of memory is allocated to 'Screen' data, this memory is in fixed areas. And can accurately relate the length of the 'chart' in time to the speed of the chart - shown in this table i.e. the faster the chart, the quicker the allocated memory is used up for that chart, the shorter the replay available.

Chapter 13: Software

The ***eZtrend V5*** recorder can be used in conjunction with the ***TrendManager V5 Software Suite***. The software is Windows 95, 98SE, 2000 and NT compatible, integrated software solution to configure recorders, archive and analyse data and distribute data plant wide.

Software License/Warranty

Please refer to the Software manual 43-TV-25-11 for software licence and warranty information.

Features

1. Conflict free graphing of the same recorder or real-time data source by several users simultaneously.
2. ***Time Bar*** indicating the time of the data displayed in units of: year, month, day, hours, minutes, seconds, tenths, hundreths and milliseconds.
3. Data from recorders in a different database can be graphed on the same graph.
4. ***Data Locator*** now optionally displayed on the graph screen.
5. Seamless graphing of data on local and remote databases.
6. Full client server implementation.
7. FTP (File Transfer Protocol) - used for transferring data files over the Internet providing access to down load and import data through remote Ethernet connection to one or many recorders.
8. Fuzzy logging - Self teaching storage rates recording data at a variable rate matching the process being monitored. 10:1 data compression, saving more data to disk and saving disk space.
9. Events system based on a ‘cause’ and ‘effect’ method with up to 9 possible causes triggering up to 8 different effects.
10. Windows™ 98SE, 2000 and NT compliant.
11. Password protection - protects screen entry, restricting access within the recorder and providing password protection at different level.
12. Web browse a recorder with an IP Address (network use).
13. Load up a setup from a PC to a recorder with an IP Address via Ethernet.
14. Event system now includes sending E-mails when an event is triggered.
15. Event View Filter allows the events displayed on the graph to be cut down to a specific type of event e.g. Alarm, Digital, System, User or Marker.
16. Audit Manager enables the user to setup an audit trail which records who’s logging on and off, when and what they did.
17. Realtime data transfer to ***TrendServer*** for display, graphing and logging.

18. A Communications Server to manage the communication status of the recorder on an Ethernet connection.
19. Remote Server and Database access via an Ethernet link.

Items 5, 6, 7, 8, 12, 13, 16, 17, 18 and 19 apply to ***TrendServer*** only.

.

Features	TrendViewer	TrendManager Pro	TrendServer Pro
Full Configuration of any recorders on PC		✓	✓
Simulate any of our recorder on PC		✓	✓
Import data from disk	✓	✓	✓
Print all graph data and recorder configurations	✓	✓	✓
Archive data on integral secure database		✓	✓
E-mail recorder configurations and data on www		✓	✓
Export using CSV format files	✓	✓	✓
Export using OPC links			✓
On Ethernet using TCP/IP			✓
Distribute all recorder data over LAN plant-wide			✓
FTP/IP Ethernet connection			✓
Fuzzy logging		✓	✓
Events system		✓	✓
Operates in Windows 98SE, 2000 and NT	✓	✓	✓
Password protection			✓
Web browse a recorder			✓
Send setup to recorder via ethernet			✓
Audit trail manager			✓
Replay of historical and Realtime data using a split screen format			✓
Realtime data retrieval used for graphing and logging			✓
Comms Server to manage the communications status of each recorder			✓
Local and remote links via Ethernet to access other servers			✓

System Requirements

TrendViewer and ***TrendManager Pro*** require the following minimum specification:

- 200 MHz Pentium processor
- 3.5" floppy disk drive
- LS120 super drive
- CD - ROM drive
- Monitor - recommended screen resolution 1024x768 minimum requirement, high colour.
- Windows™ 95, 98, 2000, NT ver. 4.0 with Service pack 3 (onwards)
- 32 Mbyte or more of RAM (64 Mbyte recommended)
- 10 Mbyte free hard disk space
- a Mouse

For ***TrendServer Pro*** the following minimum specifications apply:

- 450 MHz Pentium processor
- CD ROM
- LS120 super drive
- Monitor - recommended screen resolution 1024x768 minimum requirement, high colour.
- 2 Gbyte Hard-drive
- Windows™ 98SE, 2000, NT ver.4.0 with Service pack 3 (onwards)
- 128 Mbyte RAM (256 Mbyte recommended)
- TCP IP installed
- a mouse

TCP/IP = Transmission Control Protocol/Internet Protocol is the main transport protocol used on the Internet for connectivity and transmission of data across heterogeneous systems.

With all of the ***TrendManager Pro V5 Suite*** performance improves with more RAM, faster CPU's, and faster and larger hard disk drives.

NB: It is recommended that at least 100 Mbytes of free hard disk space is available for archiving data. Please note the more logging and data being stored, the more free space on the hard disk is required. This is not required with ***TrendViewer***.

Chapter 14: Instrument Care

> **WARNING**
>
> **PERSONAL INJURY**
>
> To avoid any personal injury or damage to the unit, ensure the recorder has the power turned off and mains has been disconnected before handling the unit.
>
> **Failure to comply with these instructions could result in death or serious injury.**

Your recorder is designed and manufactured to ISO9000 quality procedures and will give a long and trouble free life.

In the event of a unit failure contact your nearest Service Department (or an authorised agent) to arrange for the return of the unit for repair.

Battery Life

Your ***eZtrend V5*** will arrive with the battery switched off, to save battery life. The switch to turn on the battery is located on the right hand side of the case, see *"Display Trimpot Adjustments" on page 18*. Set the battery to the On position before powering up the recorder. Powered up the battery will last up to 10 years, powered off the battery life is dramatically reduced to 6 or seven months.

Cleaning Instructions

Switch recorder off prior to cleaning.

Cleaning the unit should be done with a soft lint cloth and warm soapy water. Solvents and prolonged exposure to detergents can cause damage to the front panel. It is recommended that any cloth used for cleaning is damp but NOT wet, to avoid water collecting in the unit.

Disk Drive

> **CAUTION**
>
> **AVOID DISK DAMAGE**
>
> To avoid damage to disk drive heads, ensure diskette is removed prior to transporting the recorder.
>
> **Failure to comply with these instructions may result in product damage.**

DO NOT insert any object, other than a 3.5" floppy diskette, or force a diskette into the disk drive. Disks should be removed gently on a parallel plane to the opening of the disk drive. Avoid tilting the disk side to side during removal as it may damage the drive.

If the disk is impeded during ejection from the disk drive, it may jam. DO NOT pull the disk out if there is any resistance. To remove the disk, lift the key pad by depressing a button located in a central position on the underside of the keypad. Pressing this button will release the keypad, lift the keypad flap to reveal the disk drive. The eject button can be found beneath the disk slot, press to eject the disk.

If the disk gets caught in the drive, DO NOT attempt to force it.
Contact **Honeywell** or an authorised agent.

Disk Drive Cleaning

The disk drive in your recorder is a highly reliable component that will give many years of trouble free operation if the following precautions are observed:-

1. Use only high quality diskettes. The recommended pre-formatted 1.44 MByte diskettes from Verbatim, Maxell, Fuji, and Sony.
2. ***Never*** use bulk supply “unbranded” diskettes, or diskettes “badged” by a component wholesale organization. Experience has shown that “unbranded” and “badged” diskettes, whilst often meeting ISO, ECMA, or ANSI standards, do not exhibit the longevity, or performance at temperature, available from diskettes sourced from reputable manufacturers.
3. Every six months (or more often in dusty or harsh environments), use a suitable cleaning diskette on the recording heads.
   - 1.44 Mbyte floppy disk drives - use a "dry" cleaning diskette

.

⚠ CAUTION

USE CORRECT DISK CLEANING MATERIALS

Refer to TEAC FD-235HF-7291 Micro Floppy Disk Drive Specification
Never use “wet” cleaning diskettes on these drives. These are not suitable.

Failure to comply with these instructions may result in product damage.

4. For critical applications, do not continually re-use the same diskette.
5. To minimise the risk of damaged or worn media, replace with new disks every 4 months.
6. Insert and remove diskette only when the “In Use” warning light is off.
7. Only touch the diskette on its cover - ***NEVER*** touch the recording media.
8. Do not place magnets near diskette.
9. Store diskette in a secure area, your data is valuable and you must protect the diskette from extremes of temperature, moisture and dust.
10. Never leave a diskette in the drive for a more than 2 months if not recording.

Cleaning Procedure

The disk drive should be regularly cleaned, at least every six months minimum. Use a suitable cleaning diskette on the recording heads, ie. for the 1.44 Mbyte floppy disk drive - use a ‘dry’ cleaning diskette. More frequent cleaning of the disk drive may be required for more dusty or harsh environments, and is left to the customers discretion.

Backlights

1. At room temperature and maximum brightness, the backlight MTTF is 15,000hrs. min.

   MTTF is defined as the time at which 50 % of a batch of backlights remain in excess of half their original brightness i.e. a display has a greater than 50 % chance of being half its original brightness at 15,000 hours old.

2. At extended temperatures these times are reduced.

3. Brightness and contrast control is available on the ***eZtrend V5*** adjusted by two trimpots which can be located on the right hand side of the unit, see *"Case" on page 18*. The trimpot hole nearest the display is for the brightness control and the middle hole is for adjusting the contrast. Reducing backlight brightness will extend backlight life.

Operating Temperature

Operating temperatures are described in *"Specifications" on page 6*. Prolonged operation at temperatures over 50 °C will cause degradation of the display and may lead to other damage.

If the unit has been moved from a cold environment into a warm one, ensure that the unit has reached a minimum temperature of 12 °C or is left to stand for 1 hour at room temperature before applying power, to ensure no condensation remains in the unit.

Front Panel

Care should be taken with the front panel when handling the unit. Sharp and hard objects may pierce the front panel and damage the display. Abrasive materials will damage the front panel.

Calibration

It is recommended that recorder calibration is checked at least every year, or in accordance with your industry regulations, to ensure maximum accuracy. *See "Calibrate Input" on page 38.*

Appendix A - Quality Approvals

CE Mark

The ***eZtrend V5*** is compliant with Low Voltage Directive 72/23/EEC and amended by 93/68/EEC, and the Electromagnetic Capability Directive 89/336/EEC and amended by 91/263/EEC, 92/31/EEC, 93/68/EEC and 93/97/EEC.

Appendix B - Battery Safety Data Sheet

Safety Guideline

Identification

Type	Inorganic Lithium Battery SL350PT
Typical Capacity (mAh)	1000 mAh
Weight (g)	9g
Chemical System	Li/SoCI2
Voltage	3.6V
Chemistry System	Litium thionyl chloride
Anode	Lithium metal
Cathode	Liquid, thionyl chloride

Composition/Information on Ingredients

NOTICE

Handling Precautions

The material in this section may only represent a hazard if the integrity of the battery is compromised, or if the battery is pysically or electrically abused

Substance	CAS No,	Approx. percent of total weight	Hazard symbol	R-phrases
Lithium metal	7439--93-2	2- 6	F, C	14/15-34
Thionyl Chloride	7719-09-7	18 - 47	C	14-34-37
Aluminium Chloride	7446-7--0	2 - 5		
Lithium Chloride	7447-41-8	1 - 2		
Carbon	7440-44-0	2 - 5		
Steel, Nickel plated	-	35 - 73		
Glass	-	0 - 2		
PVC	9002-86-2	0 - 1		
PMMA	9011-14-7	0 - 1		
PTFE	9002-84-0	0 - 1		

Hazard Identification

> **WARNING**
>
> **Fire, explosion and severe burn hazard**
>
> Do not recharge, disassemble, heat above 100° C, incinerate, or expose contents to water
>
> **Failure to comply with these instructions could result in death or serious injury.**

First Aid Measures

A) Electrolytic Contact

- Skin - Immediately wash with plenty of water for at least 15 minutes. If symptoms persist after washing, get medical attention.
- Eyes - Immediately flush with plenty of water for at least 15 minutes and get medical attention.
- Respiratory system: With large quantities and irritation of the respiratory tract medical surveillance for 48 hours. Immediately inhale Cortisone Spray.

B) Litium Metal Contact

- Skin Remove particles of lithium from the skin as rapidly as possible. Immediately wash with plenty of water for at lease 15 minutes and get medical attention.
- Eyes Immediately flush with plenty of water for at least 15 minutes and get medical attention.

Fire - fighting measures

A) Extinguishing Media

- Copious amounts of cold water is an effective extinguishing medium for lithium batteries. Do not use warm or hot water.
- Lith-X (Class D extinguishing media) is effective on fires envolving only a few lithium batteries.
- Do not use CO2 or Halon type extinguishers.
- Dry chemical type extinguishers have limited extinguishing potential.

B) Fire Fighting Procedure

- Use a positive self-contained breating apparatus if batteries are involved in a fire.
- Full protective clothing is necessary
- During water application caution must be advised as burning pieces of lithium may be ejected form the fire.

Accidental release measures

When the battery housing is damaged, small amounts of electrlyte may leak. Seal batteryair tight in a plastic bag, add some chalk (CaCO3) or lim3 (CaO) powder or Vermiculite. Electrolyte traces may be wiped off dryly using household paper. Rinse with water afterwards.

Handling and Storage

Do not allow terminals to short-circuit

Store preferably in a cool(below 21°C), dry area that is subject to little temperature change.

Do not place near heating equipment, nor expose to direct sunlight for long periods. Elevated temperatures can result in reduced battery life.

Stability and Reactivity

May rupture violently when heated above 145°C or when charged.

Ecological information

The batteries do not contain nercury, cadnium or other heavy metals.

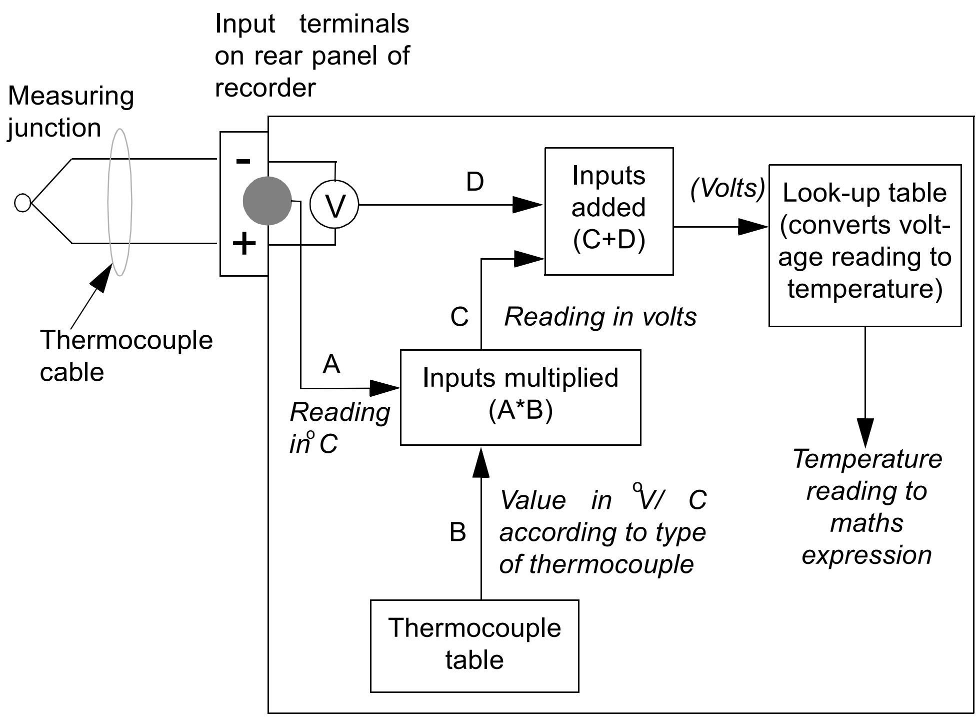
Disposal Considerations

- Dispose by incineration or burial at permitted waste treatment and/or disposal sites.
- Batteries do not contain hazerdous materials according to EC directives 91/157/EEC and 98/86/EEC.
- For large quantities a disposal service is offered upon request.

Appendix C -Thermocouple Connections

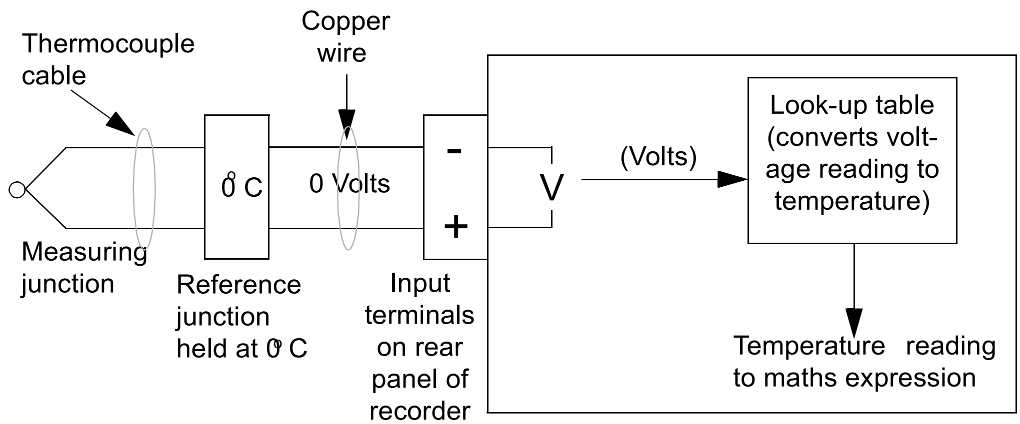
The different methods for connecting thermocouples according to the type of reference are shown below.

Internal Reference



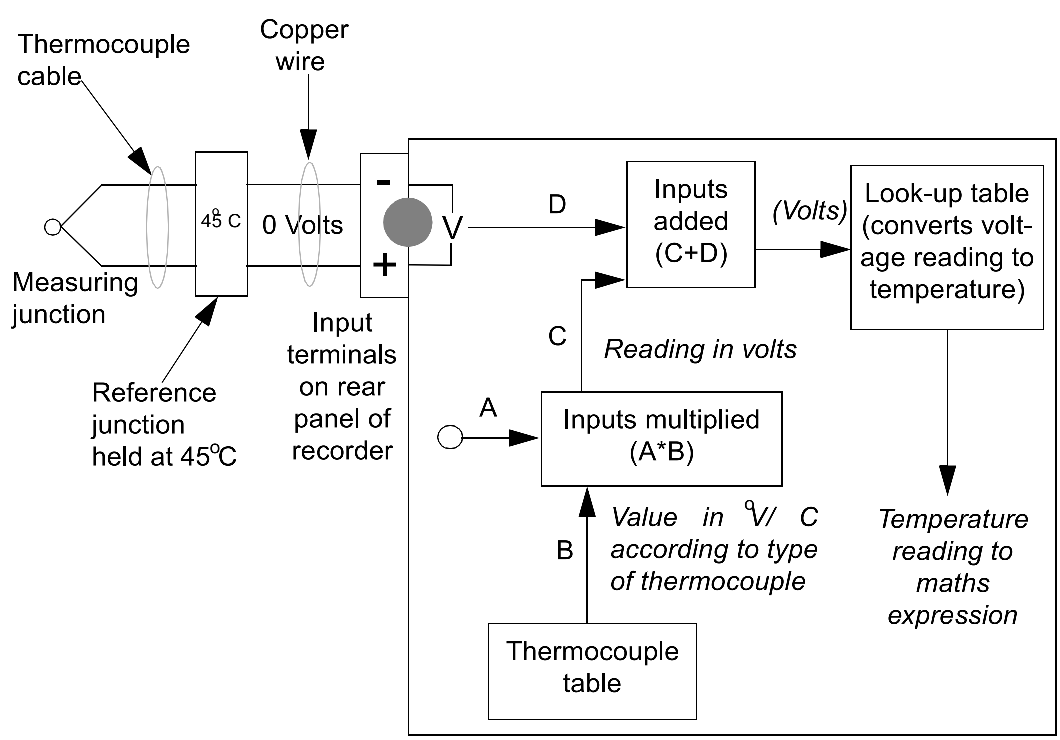
Internal Reference the reference junction is where the thermocouple is connected to the input terminals of the recorder, and the temperature at this junction is being measured by a temperature sensor on the rear panel of the recorder. The reading from this sensor is read off against a value taken from the thermocouple table, which corresponds to the type of thermocouple being used. The corresponding reading in volts for the temperature measured by the sensor is then used as a reference for the reading from the thermocouple.

External Reference @ 0°C



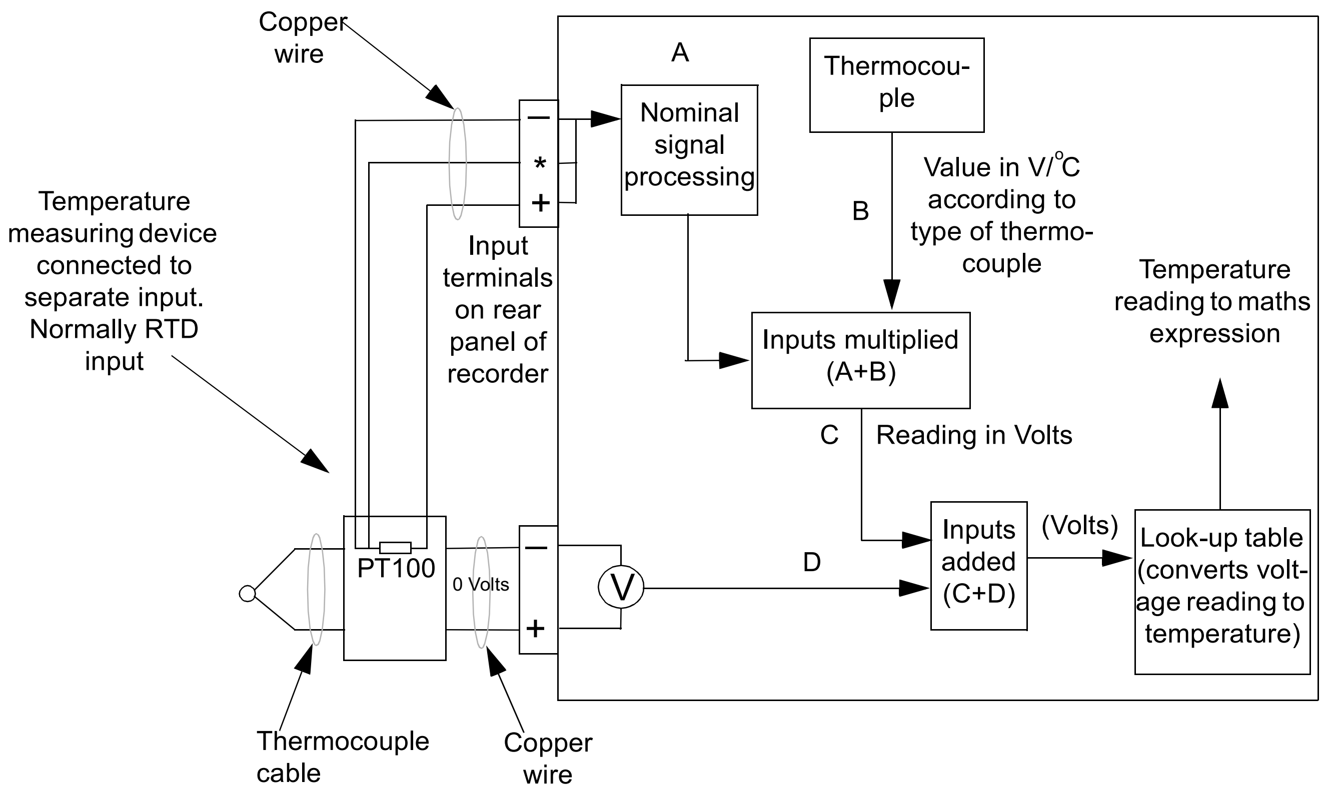
External Reference @ 0°C by keeping the reference junction at 0°C the negative input is acting as a 0 Volt reference so the voltage reading from the thermocouple can be passed directly to the polynomial where the corresponding temperature reading can be found.

External Reference @ Specified Temperature



External Reference @ specified temperature if the reference junction can be kept at a constant known temperature other than 0°C this temperature can be specified in the setup menus. This reference temperature is then used in the same way as the reading from the temperature sensor using the ***Internal Reference*** method.

External Input Reference



External Input Reference the reference temperature reading in this method is provided by a separate temperature measuring device connected to another input. This input is processed in the normal way and then passed back into the thermocouple signal processing system as a temperature reading.

Appendix D- Maths Expressions

A maths expression is made up of a number of terms. A term is the smallest valid component in a maths expression and can be a variable, operator or function.

An operand may be a constant (i.e. a fixed number) or a ***variable***. The variables that can be used are described below.

In the following examples P1 (Pen 1) equals the result of the maths expression shown in the shaded area. A pen number (P1) will be automatically entered when a pen is selected.

•***An*** - The letter 'A' followed by a number causes the reading taken from an analogue input (denoted by the number) to be inserted in the maths expression. In this example, the readings from Analogue Input 1 are being displayed on Pen 1.

P1= A1

•***In*** - The letter 'I' followed by a number causes the reading taken from a digital input (denoted by the number) to be inserted in the maths expression. In this example, the result of digital input 1 multiplied by digital input 2 is displayed on Pen 9. As digital inputs are read as either 1 or 0, the result of this maths expression will effectively be an AND function (i.e. digital inputs 1 and 2 must both be 1 for the value displayed on Pen 9 to be 1).

P1= I1*I2

•***On*** - The letter 'O' followed by a number causes the state of a Relay output (denoted by the number) to be inserted in the maths expression. A Relay output is read as 1 when active and 0 when inactive.

P1= O1

•These two features on the ***eZtrend V5*** are ***MU*** (Memory use) and ***DU*** (Disk use) gives a percentage reading of Memory space used or Disk space used.

P1= MU

NB. When entering the MU and DU feature using *Trend Manager Pro V5 Suite*, ensure the Complex Variables box is ticked.

The available functions and operators for maths expressions are described below. Where a function and operator have the same effect they are listed together. A ***U*** after the operator denotes a unary operator and a ***B*** denotes a binary operator.

+	**Add Operator + (B)**	**Analogue Input 1 added to Analogue Input 4 displayed on Pen 1**	P1 = A1+A4
-	**Subtract. Operator - (B)**	**Analogue Input 1 subtracted from Analogue 2 displayed on Pen 1**	P1 = A2-A1
*****	**Multiply. Operator * (B)**	**The value of Analogue Input 2 multiplied by two**	P1 = A2*2
/	**Divide. Operator: / (B)**	**Analogue Input 1 divided by Analogue Input 3**	P1 = A1/A3
T	**Assigns the Totalised value of a Pen**	**Pen 1 displays the Total of Pen 2 divided by 10 NB: Do not omit the divider (10), even if it is 1**	P1 = T[2,10]
A	**Indexed analogue**	**P1 is equal to the indexed analogue input 1+I1 (If I1 = 1, P1 = A2) (If I1= O, P1 = A1)**	P1 = A[1+I1]
I	**Indexed digital input**	**P1 is equal to the indexed digital input of 1 + O1 (If O1 is 1, P1 = I2)**	P1 = I[1+O1]
ABS	**Absolute. Function ABS Operator: & (U)**	**The result of Input 4 subtracted from Input 1 is always considered as positive. If A1 = 2, and A4 = 3.5, the value displayed on Pen 1 would be 1.5 not -1.5.**	P1 = ABS[A1-A4] or P1 = & A1-A4
O	**Indexed relay output**	**P1 is equal to the indexed relay output of 1-A1 (If A1 = O, P1 = O1)**	P1 = O[1-A1]
MODULUS	**Modulus Operator: % (B)**	**The value of Input 2 (A2) is divided by 20 and the remainder ONLY is displayed on Pen 1. The signal will be within 0-19.**	P1 = A2%2O
OVER	**Over**	**If the analogue input 'A1' is greater than '10' then P1 will return the value of A1.**	P1 = OVER[A1,10]

UNDER	**Under**	**If the analogue input 'A1' is less than '10' P1 will return the value of A1.**	P1 = UNDER[A1,10]
HI	**High value. Function: HI**	**Pen 1 displays the highest value out of Input 1 and Input 3.**	P1 = HI[A1,A3]
LO	**Low value. Function: LO**	**Pen 1 displays whichever is the lowest value out of Input 1 and Input 3. Note the inputs being compared are separated by a comma.**	P1 = LO[A1,A3]
CJC	**Cold Junction Compensator**	**P1 displays the value of the CJC 'x' is the board number from 1 to 4**	P1 = CJC[x]

Maths and Fail Safe

When using output relays in a maths expression be aware the maths is reporting the literal state of the relay.

If Pen 1 (P1) equals output channel 4 (O4) and fail safe is On with no alarm triggered, the relay will be energised and P1 will return 1.

P1= O4

Appendix E - Ethernet & E-mail

Ethernet

Ethernet is a local area network (LAN) technology that transmits information between computers and other devices, at speeds of 10 to 100 million bits per second (Mbps). Each Ethernet equipped device operates independently of all other devices on the network.
All devices attached to an Ethernet are connected to a shared signalling system. Ethernet signals are transmitted serially, one bit at a time, over the shared signal channel attached to each device.

It is up to the high-level protocol that is sending data over the network to make sure that the data is correctly received at the destination device.

Devices attached to an Ethernet can send application data to one another using high-level protocol software, such as TCP/IP protocol suite.

High-level protocols have their own system addresses, such as the 32-bit addresses used in the current version of IP. The high-level IP-based networking software in a device is aware of its own 32-bit IP address and can read the 48-bit Ethernet address of its own network interface, but it doesn't know the Ethernet addresses of the other devices on the network.

To discover the Ethernet addresses of other IP-based devices on the network another high-level protocol is used. For TCP/IP, this is done using a protocol called Address Resolution Protocol (ARP).

Example:

Device X has an IP address of 195.23.37.1 and sends data over the Ethernet channel to another IP-based device, Device Y with IP address 195.23.37.2. Device X sends the packets of information containing an ARP request. The ARP request is asking the device with the IP address of 195.23.37.2 to identify the address of the Ethernet Interface.

Only Device Y with the IP address of 195.23.37.2 will respond, sending a packet with the Ethernet address of device Y back to device X. Now device X and Y have each others Ethernet addresses to which data can be sent.

E-mail

General operation of the e-mail system

The recorder sends messages for distribution by an e-mail server. The e-mail server is located by its IP address as set-up in the communications set-up options. When the recorder sends an e-mail message, it locates the e-mail server and uses SMTP (Simple Message Transfer Protocol) to send the message to the e-mail server. SMTP allows the recorder to send messages to an e-mail server without having its own e-mail address; because of this the e-mail server will not be able to send any reply back to the recorder.

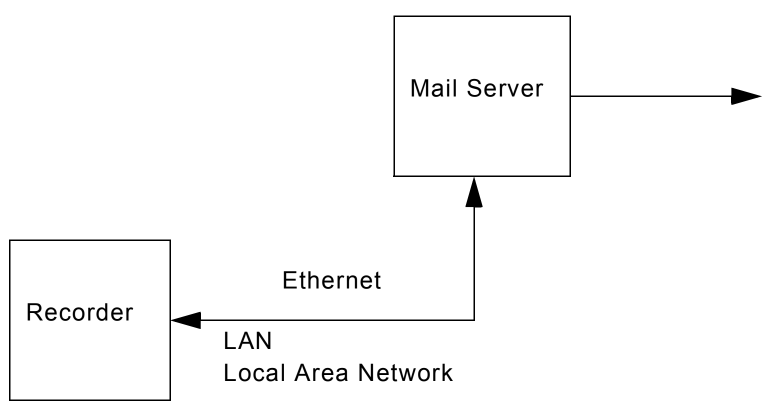
When setting-up the e-mail address list, it is important to include the e-mail administrator address. The Administrator e-mail address is the e-mail address to where the e-mail server will respond in the event of any problems with the delivery of e-mail messages. The Administrator will also appear to be the source of any e-mail messages sent by the recorder. Most e-mail systems require a 'Reply To' address as part of an e-mail message, since the recorder does not have its own e-mail address; it uses the e-mail administrator as the 'Reply To' address.

Any e-mail message will consist of a delivery list (recipients), a subject, and an optional message body. The message body may be omitted for very short messages, or where the message is to be sent to a paging system.

The e-mail subject may be either one of the existing event markers, or one of the two e-mail subjects. The e-mail message body may be either one of the existing event markers, or one of the two e-mail message blocks. Event markers are restricted to 80 characters each. The two e-mail message blocks are restricted to just over 1000 characters each. Both the message subject and body may contain embedded marker tags as used in the event markers.

When the recorder sends an e-mail message that includes a message body, the recorder name, recorder number and the time/date will be appended to the end of the message body text. This is to allow easy identification of when the message was send, and by which recorder.

Any e-mail message is sent as an action within the recorder events system, so anything that can be configured to act as an event cause, may be configured to send an e-mail message. Any e-mail message may be sent to up-to sixteen of the recipients. If the e-mail server supports named groups of e-mail addresses, an e-mail message may be sent to a combination of e-mail addresses and e-mail group.



Appendix F- Fuzzy Logging

What is Fuzzy Logging?

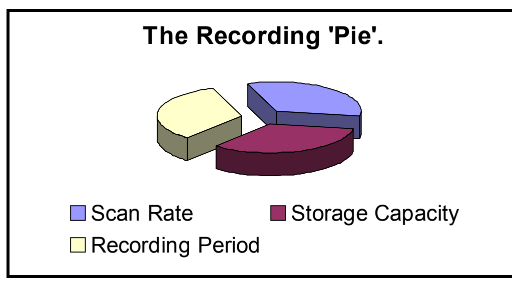
Fuzzy Logging is a real time Data Compression technique, *Patent-applied-for* and developed at **Honeywell** as an alternative to the more standard methods of recording data.

Paperless Recorders are primarily used for exception recording. They spend most of their life trending and recording straight lines. Fuzzy Logging has been developed to improve the efficiency of data storage, and is particularly effective in exception recording examples where normal operation consists of generally static inputs.

Fuzzy Logging looks for straight lines in the data stream, in real time, whether they are horizontal, climbing or descending. A straight line made up of say 10 points can be equally well represented by 2 points, one at either end, the other 8 points are redundant. Fuzzy logging works by creating straight lines in the data and discarding redundant points.

What's it for?

…… To help the user in the trade off between **Scan Rate**, **Disk capacity** and **Recording Time,** after all the 'Pie' is only so big.



Fuzzy Logging has been developed to help maximise all three sections, in effect increasing the size of the 'Pie'.

The result is a technique that delivers a host of real world benefits over the more traditional recording methods.

1. Disks take longer to fill – changed less frequently, less site visits.
2. Faster scan rates can be used for any given disk size – giving greater resolution on the process.
3. Recording time can be extended.
4. Less hard disk memory required for archiving on the PC.
5. Quicker graphing of data.
6. Smaller data files for remote collection.

OK. How does it work?

Fuzzy Logging does not log data points that form part of a straight line.

The technique is best illustrated by the diagram below:

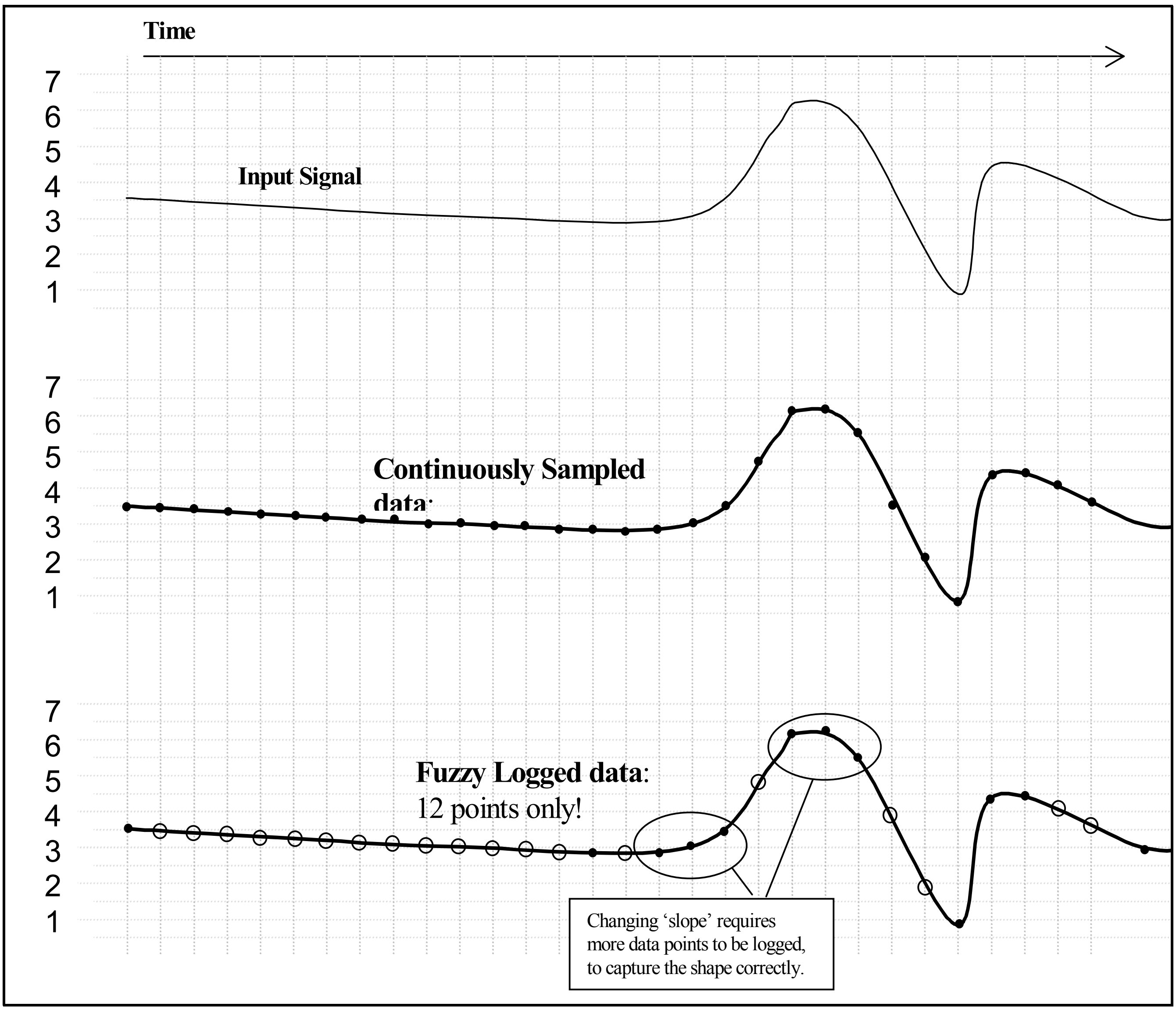


Diagram 1

Points marked: ○ are **NOT** logged, as they lie on an 'imaginary' straight line between points marked:

The graph of the Fuzzy Logged data, looks identical to the graph of the sampled data, but has taken ***less than half the points*** to build it.

Sounds Great! But what about ‘Spikes’ on my trend line? Won’t it miss them?

NO, you will not miss any ‘Spikes’, ‘Glitches’ or ‘Transients’ – these are what you need to see!

As Fuzzy Logging is an adaptive technique, it will log as fast as it needs to in order to capture everything.

Although not all points are logged, the base ‘Scan Rate’ of the input is the same as if you were using a standard logging technique.

OK, but what about slowly drifting inputs?

Again – **No Problem**. The algorithm is processed in ‘Real Time’, i.e. as the reading is taken. As it already knows the previous logged readings it can calculate where the next point should be (assuming it’s on a straight line) – if the measured value does not equal the predicted value, the point is logged as it no longer forms part of the straight line.

Fuzzy Logging, looks for straight lines – ***at any angle.*** Not just on the horizontal.

I’m convinced. Do you have any examples?

Example 1.) Flow & Pressure Measurement of Mains Water Pressure

A recorder was installed, to monitor the flow of a mains water supply. At peak demand the mains pressure had been subject to sharp drops in pressure and flow rate, and it was necessary to find the cause of the problem.

- The recorder had to have a fast scan rate, in order to capture the ‘glitches’.
- The recording period would be over many days if not weeks, so storage capacity was at a premium.

A fast scan rate using the standard sampling method would result in a disk life of about a day, which was not acceptable.

As this application consists of long periods of little activity (relatively constant flow rate), and short periods of high activity (rapidly changing flow rate), it is ideally suited to Fuzzy Logging.

During the hours of stable flow where the flow rate remained more or less constant, the Fuzzy Logging technique would give compression ratios up to 100 times. However, as soon as a glitch appeared the fast sampling rate was able to capture and store all the points.

Example 2.) Cold Storage Temperature Measurement

A recorder was required to help track random and rapid temperature changes within the cold storage rooms. Conventional sample recording had shown that temperature variations were present, but was not of high enough resolution to pinpoint the cause.

Again as in example 1), the measured inputs would show long periods of stable constant readings, interspersed with small sharp increases in temperature. In order to track the cause of these variations, it was necessary to maximise the time resolution of the data. This application was ideally suited to the Fuzzy Logging data storage technique, as the periods of inactivity would result in compression rates of over 50 times.

Example 3.) Logged Data Example

The diagram below is a sample of actual logged data in both the Fuzzy Logging method (top) and Sample Logging method (bottom), derived from the same analogue input.

It provides an excellent illustration of how less data points can be used to construct an identical trace.

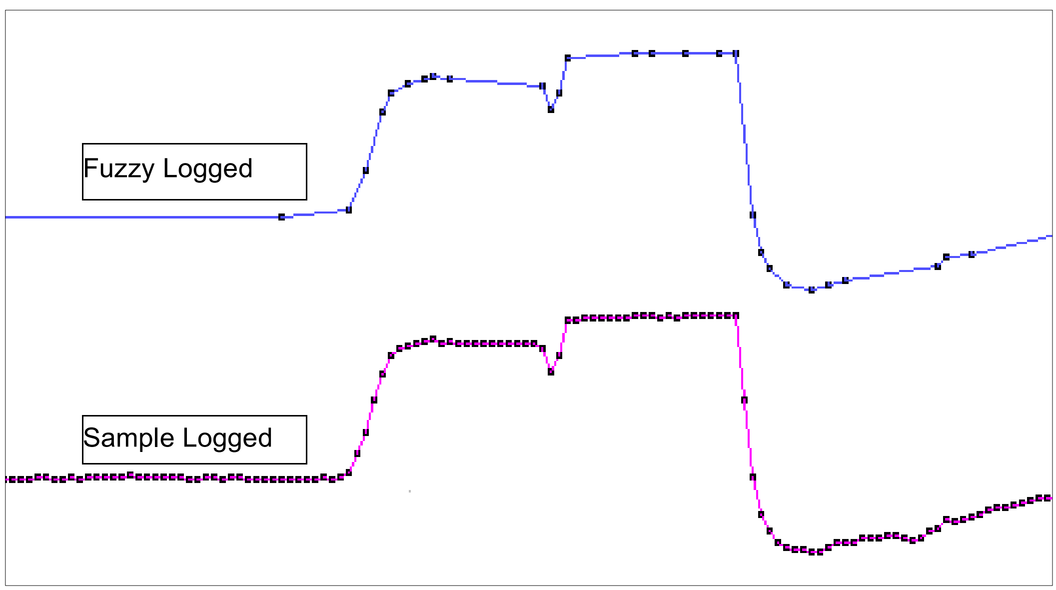


Diagram 2.

NB. This data extract was taken from a 56 hour temperature run, which resulted in approximately 1Mbyte of sample data, and approximately 40 Kbyte of Fuzzy Logged data.

A compression ratio of 25 times!!

Anything else it can do?

Yes! Fuzzy Logging can be used as a **'One Hit'** recording button.

In applications where the measured process is new or the ideal scan rate is unknown Fuzzy Logging is ideal, as it adapts the log rate to the input signal, and can therefore find the optimum logging rate for you.

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Please take a moment to complete this questionnaire

1 Reputation

How would you rate the reputation of **Honeywell**

Tick as appropriate

- A very reputable, successful company ☐
- A reputable company ☐
- A disreputable company ☐
- No views either way ☐

2 Service

How do you rate or perceive the following service levels provided by our sales staff?

Tick as appropriate	Excellent	Good	Fair
Response speed	☐	☐	☐
Quality of response	☐	☐	☐
Follow up response	☐	☐	☐
Overall level of service	☐	☐	☐

How do you rate or perceive the following service levels provided by our Technical Support Service?

Tick as appropriate	Excellent	Good	Fair
Response speed	☐	☐	☐
Quality of response	☐	☐	☐
Follow up response	☐	☐	☐
Overall level of service	☐	☐	☐

How could our service be improved upon

....

....

How many times do you receive a visit from one of our Sales representatives? Visits every:

1-3 months ☐ 3-6 months ☐ 6-12 months ☐

How does that compare to our competitors?

More ☐ Less ☐ The same ☐

Score on a level of 1-10, with 10 being the best

- Quality of manuals / sales literature ☐
- Administration / documentation and letters ☐
- Technical expertise of our sales staff ☐
- Sales staff ability to give informed advice ☐
- The quality of the **Honeywell** sales team. ☐
- Pricing ☐
- **Honeywell** understanding of your industry. ☐

3 Products

How do you perceive our range of products?

Tick as appropriate

- ☐ Products offered are **better** than those of competitors
- ☐ Products offered are **worse** than those of competitors
- ☐ Products offered are the **same** as those of competitors

Any other comments

....

....

....

Are there any products that we do not provide that you would like us to provide - or any we could improve on?

....

....

....

Improvements to existing products.........................

....

....

4 General

If you are an existing or new customer, what made you choose **Honeywell?**

- ☐ Only on price
- ☐ Price plus a combination of factors
- ☐ Prefer to deal with a reputable company
- ☐ **Honeywell** offers more than the competition in terms of 'added value' over and above the product itself

Thank you for completing this questionnaire.

Please fill out your name and address below.
Photo copy this form and Fax to us on

+1 (215) 641 4245

Name ....

Company name ....

Address ....

...

...

County................. Postcode..................

Tel:........................ Fax.........................

Company business ....

...

Warranty/Remedy

Honeywell warrants goods of its manufacture as being free of defective material and faulty workmanship. Contact your local sales office for warranty information. If warranted goods are returned to Honeywell during that period of coverage, Honeywell will repair or replace without charge those items it finds defective. The foregoing is Buyer's sole remedy and **is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose.**

While we provide application assistance, personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

Specifications may change at any time without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

Sales and Service

Honeywell serves its customers through a worldwide network of sales offices and distributors. For application assistance, current specifications, pricing or name of the nearest Authorised Distributor, contact your local sales office or:
INTERNET:www.honeywell.com/sensing

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43-TV-25-05 GLO Issue 3 09/01 UK

Series 7 Inline Flame Arrestor

Enardo Series 7 Inline Flame Arrestors are designed to stop the propagation of confined low pressure deflagrations. The Series 7 is typically used for end-of-line and near end of line applications when the system operating pressure is near atmospheric levels and when there is minimal probability of a flame stabilizing on the Flame Arrestor element for an extended period.

The Series 7 prevents flame propagation by absorbing and dissipating heat using spiral wound crimped ribbon flame cells. These cells allow maximum flow with maximum protection.

Designed with flanged connections, this arrestor allows removal of the flame cell element for easy cleaning and replacement without removing the arrestor body from the pipe connection. Standard housing construction is aluminum, carbon steel, and stainless steel. The element is available in aluminum or stainless steel. Special material and protective coatings are available on request.

EN 12874 Approved 2 in. (50 mm) - 12 in. (300 mm) IIA and IIB3
Factory Mutual Approved 2 in. (50 mm) - 12 in. (300 mm), IIA (D)

Features and Benefits

Enardo's large crimp opening provide:
- Maximum flow
- Less pressure Drop
- Easy Cleaning
- Less Clogging
- Less Maintenance

- Single Element Design.
- Fluoropolymer coated hardware provides outstanding corrosion and chemical resistance.
- Easily accessible and removable flame cell for easy inspection and service.
- Bi-directional design.
- Standard temperature probe on EN models.
- Available in ANSI, DIN and JIS flanges.

Flame Arrestor Specifications

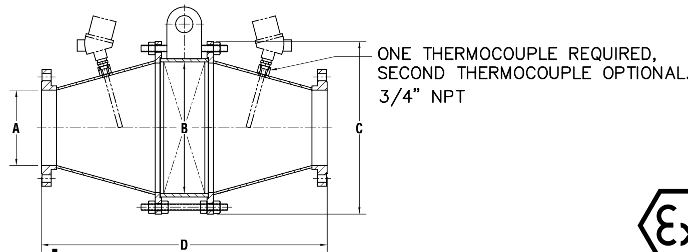
Model	Sizes Available
Series 7 Inline Flame Arrestor	1" (25 mm) through 48" (1220 mm)
EN Series 7-EN 12874 Approved	2" (50 mm) through 12" (300 mm)
Factory Mutual Approved	2" (50 mm) through 12" (300 mm)

Materials of Construction

Housing	Cell	Gas Group
Aluminum Carbon Steel 304 SS 316 SS Hastelloy	Aluminum 304 SS 316 SS Hastelloy	IIA (D) IIB 3 (C) IIC (B)

ENARDO
Flame Arrestors

Series 7 Inline Flame Arrestor
EN Certified Model



EN Model Series 7 Flame Arrestor Dimensions

Model	A Nominal Conn. Size In. (mm)	B Housing Size In. (mm)	C Outside Diameter In. (mm)	D Overall Length In. (mm)	Approximate Weight Lb. (Kg)
EN-70402	2 (50)	4 (100)	7.75 (197)	15.25 (387)	65 (29.5)
EN-70602	2 (50)	6 (150)	10.25 (260)	16 (406)	68 (31)
EN-70603	3 (75)	6 (150)	10.25 (260)	16 (406)	72 (32.5)
EN-70803	3 (75)	8 (200)	12 (305)	16 (406)	95 (43)
EN-70804	4 (100)	8 (200)	12 (305)	16 (406)	101 (46)
EN-71204	4 (100)	12 (300)	16 (406)	21 (533)	168 (76)
EN-71206	6 (150)	12 (300)	16 (406)	21 (533)	181 (82)
EN-71606	6 (150)	16 (400)	20 (508)	33 (838)	278 (126)
EN-71608	8 (200)	16 (400)	20 (508)	33 (838)	298 (135)
EN-72008	8 (200)	20 (500)	24 (610)	38 (965)	386 (175)
EN-72010	10 (250)	20 (500)	24 (610)	38 (965)	443 (201)
EN-72410	10 (250)	24 (600)	29 (737)	41 (1041)	622 (282)
EN-72412	12 (300)	24 (600)	29 (737)	41 (1041)	672 (305)

Dimensions may vary somewhat from those given above. Allow for a tolerance of ± 1.00" (25 mm). Specific dimensions available on request.

Key to Enardo EN Model Series 7 Flame Arrestor Model Number

EN [7] [ ][ ] [ ][ ] / [ ] — [ ] [ ] [ ] — [ ][2][ ]

Series
Series 7
Flame Arrestor
(Concentric)

E7 If Eccentric

Housing Size
04 = 4"
through
24 = 24"

Connection Size
02 = 2"
through
12 = 12"

IEC Gas Group
IIA (D)
IIB3 (C)

Housing Material
C. Carbon Steel
4. 304 S.S.
6. 316 S.S.
H. Hastelloy

Cell Material
4. 304 S.S.
6. 316 S.S.
H. Hastelloy

Connection Type
F. Flat Faced Flange
R. Raised Face Flange

Options
1. Drain Plugs
2. Temp. Probe (Std.)
3. Pressure Taps
4. Misc. Fittings
5. Protective Coatings
6. Special Features

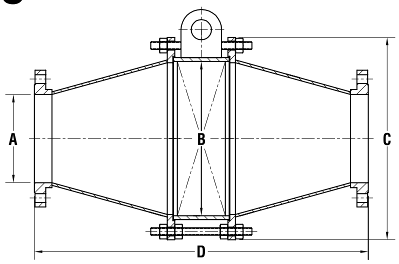
Example:

EN [7] [2][0] [1][0] / [IIA] — [C] [4] [R] — [1][2]

Indicates a 10" Concentric Series 7 Inline Flame Arrestor with a 20" carbon steel housing, ANSI 150 lb. raised faced flange connections and 304 stainless steel IEC Group “IIA” flame cell element. It also has additional options of drain plugs and stamdard temperature probe.

Series 7 Inline Flame Arrestor Carbon Steel and Stainless Steel Housings

ENARDO
Flame Arrestors



FM APPROVED *

Standard Model Series 7 Flame Arrestor Dimensions

Model	A Nominal Conn. Size In. (mm)	B Housing Size In. (mm)	C Outside Diameter In. (mm)	D Overall Length In. (mm)	Approximate Weight Lb. (Kg) Group D Models
70401	1 (25)	4 (100)	7.75 (197)	15.63 (397)	60 (27)
70402	2 (50)	4 (100)	7.75 (197)	15.25 (387)	63 (29)
70602	2 (50)	6 (150)	10.25 (260)	16 (406)	66 (30)
70802	2 (50)	8 (200)	12 (305)	16 (406)	85 (38.6)
70603	3 (75)	6 (150)	10.25 (260)	16 (406)	70 (31.8)
70803	3 (75)	8 (200)	12 (305)	16 (406)	90 (40.8)
70804	4 (100)	8 (200)	12 (305)	16 (406)	95 (43.1)
71006	6 (150)	10 (250)	14 (356)	21 (533)	135 (61.2)
71206	6 (150)	12 (300)	16 (406)	21 (533)	165 (74.8)
71408	8 (200)	14 (350)	18 (457)	25 (635)	225 (102.1)
71608	8 (200)	16 (400)	20 (508)	33 (838)	270 (122.5)
71810	10 (250)	18 (450)	22 (559)	30 (762)	335 (152.0)
72010	10 (250)	20 (500)	24 (610)	38 (965)	400 (181.4)
72212	12 (300)	22 (550)	26 (660)	34 (863)	477 (216)
72412	12 (300)	24 (600)	29 (737)	41 (1041)	590 (268)

14"-36" and over – dimensions available on request. Dimensions may vary somewhat from those given above. Allow for a tolerance of ± 1.00" (25 mm). Specific dimensions available on request.

*Not all models are available with FM approval. Consult Flame Arrestor Certifications page for more information.

Key to Enardo Standard Model Series 7 Flame Arrestor Model Number

7 | □□ | □□ / □ — □ | □ | □ — □□□

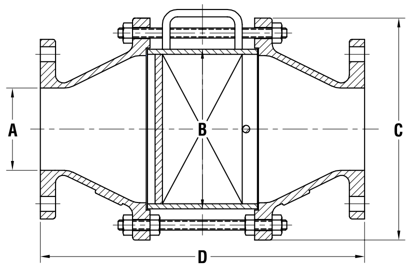
Series	Housing Size	Connection Size	NEC Gas Group	Housing Material	Cell Material	Connection Type	Options
Series 7 Flame Arrestor (Concentric) E7 If Eccentric	04 = 4" through 72 = 72"	01 = 1" through 48 = 48"	B. Group “B” (IIC) C. Group “C” (IIB3) D. Group “D” (IIA)	C. Carbon Steel 4. 304 S.S. 6. 316 S.S. H. Hastelloy	A. Aluminum 4. 304 S.S. 6. 316 S.S. H. Hastelloy	F. Flat Faced Flange R. Raised Face Flange	1. Drain Plugs 2. Temp. Probe Taps 3. Pressure Taps 4. Misc. Fittings 5. Protective Coatings 6. Special Features

Example:

7 | 2 0 | 1 0 / D — C | 4 | R — 1 2

Indicates a 10" Concentric Series 7 Inline Flame Arrestor with a 20" carbon steel housing, ANSI 150 lb. raised faced flange connections and 304 stainless steel NEC Group “D” flame cell element. It also has additional options of drain plugs and temperature probe taps.

Series 7 Inline Flame Arrestor Aluminum Housing



Cast Aluminum Model Series 7 Flame Arrestor Dimensions

Model	A Nominal Conn. Size In. (mm)	B Housing Size In. (mm)	C Outside Diameter In. (mm)	D Overall Length In. (mm)	Approx. Weight w/ Aluminum Cell Lb. (Kg) Group D Models	Approx. Weight w/ S.S. Cell Lb. (Kg) Group D Models
70802	2 (50)	8 (200)	11.13 (283)	16.50 (419)	24 (10.9)	33 (15.0)
70803	3 (75)	8 (200)	11.13 (283)	16.50 (419)	27 (12.2)	36 (16.3)
70804	4 (100)	8 (200)	11.13 (283)	16.50 (419)	31 (14.1)	40 (18.1)
71006	6 (150)	10 (250)	13.13 (334)	21.50 (546)	46 (20.9)	73 (33.1)
71206	6 (150)	12 (300)	15.13 (384)	21.50 (546)	60 (27.2)	85 (38.6)
71408	8 (200)	14 (350)	17.13 (435)	25.63 (651)	80 (36.3)	113 (51.3)
71608	8 (200)	16 (400)	19.13 (486)	25.50 (648)	95 (43.1)	138 (62.6)
72010	10 (250)	20 (500)	24.38 (619)	30.63 (778)	180 (81.6)	245 (111.1)
72212	12 (300)	22 (550)	26 (660)	34 (863)	190 (86)	255(116)
72412	12 (300)	24 (600)	29 (737)	41 (1041)	230 (104)	315 (143)

Dimensions may vary somewhat from those given above. Allow for a tollerance of ± 1.00" (25 mm). Specific dimensions available on request.

Key to Enardo Cast Aluminum Model Series 7 Flame Arrestor Model Number

7 ☐☐ ☐☐ / ☐ — ☐ ☐ ☐ — ☐☐☐

Series
Series 7 Flame Arrestor (Concentric)

E7 If Eccentric

Housing Size
08 = 8" through 24 = 24"

Connection Size
02 = 2" through 12 = 12"

NEC Gas Group
D. Group "D" (IIA)

Housing Material
A. Aluminum

Cell Material
A. Aluminum
4. 304 S.S.
6. 316 S.S.
H. Hastelloy

Connection Type
F. Flat Faced Flange
R. Raised Face Flange

Options
1. Drain Plugs
2. Temp. Probe Taps
3. Pressure Taps
4. Misc. Fittings
5. Protective Coatings
6. Special Features

Example:

7 2 0 1 0 / D — A 4 F — 1 2

Indicates a Concentric Series 7 Inline Flame Arrestor with a 20" aluminum housing, ANSI 10" flat faced flange connections and 304 stainless steel NEC Group "D" flame cell element. It also has additional options of drain plugs and temperature probe taps.

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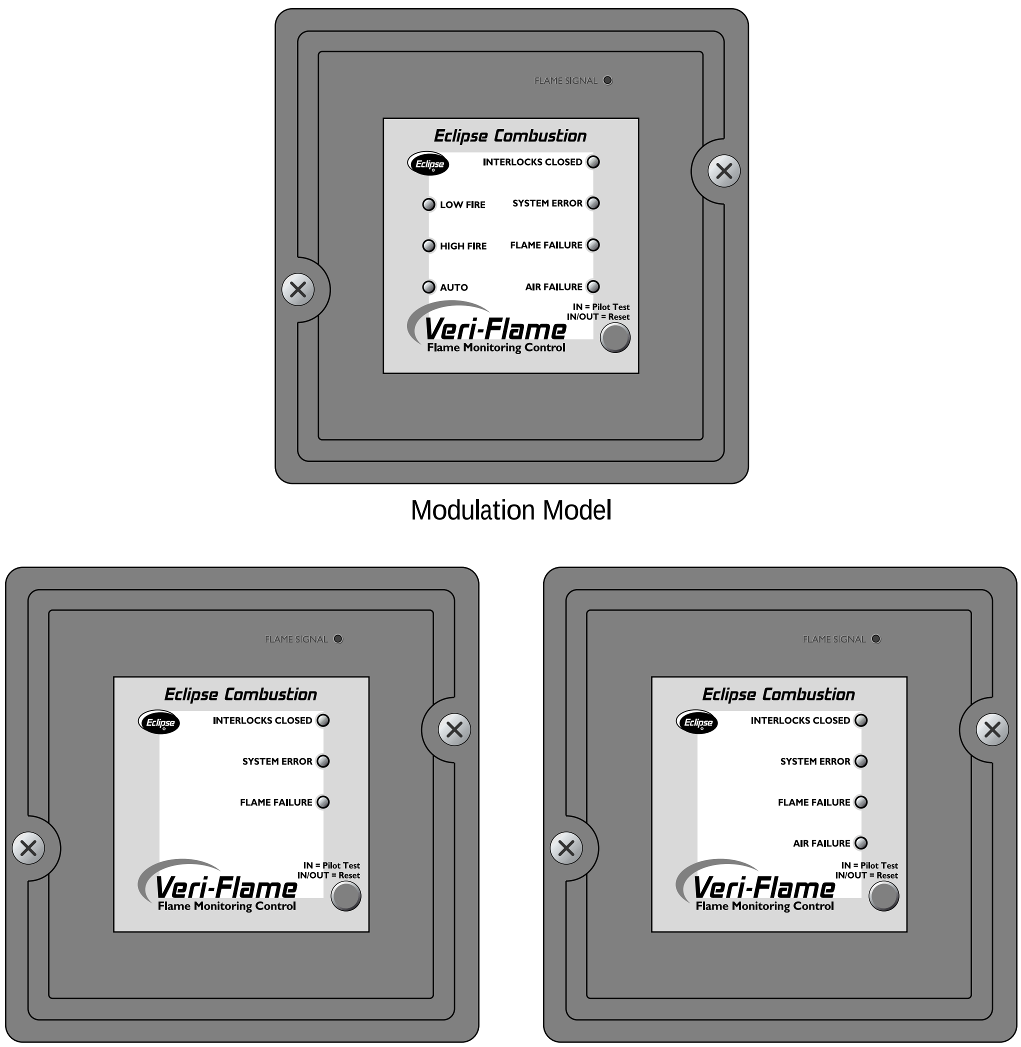
2/02

Eclipse
Combustion

VeriFlame Single Burner Monitoring System

Model 5600

Version 1.21



Modulation Model

No Purge Model

Purge Model

ECLIPSE™
Innovative Thermal Solutions

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DISCLAIMER NOTICE

In accordance with the manufacturer's policy of continual product improvement, the product presented in this brochure is subject to change without notice or obligation.

The material in this manual is believed adequate for the intended use of the product. If the product is used for purposes other than those specified herein, confirmation of validity and suitability must be obtained. Eclipse Combustion, Inc. warrants that the product itself does not infringe upon any United States patents. No further warranty is expressed or implied.

We have made every effort to make this manual as accurate and complete as possible. Should you find errors or omissions, please bring them to our attention so that we may correct them. In this way we hope to improve our product documentation for the benefit of our customers. Please send your corrections and comments to our Marketing Communications Manager.

LIABILITY AND WARRANTY

It must be understood that Eclipse Combustion's liability for its products, whether due to breach of warranty, negligence, strict liability, or otherwise, is limited to the furnishing of burner monitoring system replacement parts and Eclipse Combustion will not be liable for any other injury, loss, damage or expenses, whether direct or consequential, including but not limited to loss of use, income of, or damage to material arising in connection with the sale, installation, use of, inability to use or the repair or replacement of Eclipse Combustion's products.

Eclipse Combustion, Inc., for a period of one year from shipment, warrants each Veri-Flame burner monitoring system to the original purchaser to be free from defects in material and workmanship under normal use as defined hereafter. Any operation expressly prohibited in this Guide, any adjustment or assembly procedures not recommended or authorized in these instructions, shall void the warranty.

About this manual

Audience

This manual has been written for the people who select and install the product and the technicians who work on it. They are expected to have previous experience with this kind of equipment.

Scope

This manual contains essential information for the proper installation and operation of the Eclipse Veri-Flame Burner Monitoring System.

Following the instructions in this manual should assure trouble-free installation and operation of the monitoring system. Read this manual carefully. Make sure that you understand its structure and contents. Obey all the safety instructions.

Do not deviate from any instructions or application limits in this manual without written consent from Eclipse Combustion, Inc.

If you do not understand any part of the information in this manual, do not continue. Contact your Eclipse sales office or Eclipse Combustion, Inc., Rockford, Illinois.

Document Conventions

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows. Please read it thoroughly.

Danger:

Indicates hazards or unsafe practices which WILL result in severe personal injury or even death.
Only qualified and well trained personnel are allowed to carry out these instructions or procedures.
Act with great care and follow the instructions.

Warning:
Indicates hazards or unsafe practices which could result in severe personal injury or damage.
Act with great care and follow the instructions.

Caution:
Indicates hazards or unsafe practices which could result in damage to the machine or minor personal injury.
Act carefully.

Note:
Indicates an important part of the text.
Read the text thoroughly.

How to get help

If you need help, you can contact your local Eclipse Combustion sales office. You can also contact Eclipse Combustion, Inc. at:

1665 Elmwood Road
Rockford, Illinois 61103 USA

Phone: 815-877-3031
Fax: 815-877-3336

E-mail: eclipse@eclipsenet.com
http://www.eclipsenet.com

Table of Contents

Introduction

1

Product Description

The Eclipse Combustion Veri-Flame Single Burner Monitoring System controls the start-up sequence and monitors the flame of single gas, oil, or combination gas/oil burners. There are three different models to the Veri-Flame line: the no purge, the purge and the modulation models. Each model features field selectable trial for ignition (TFI). Each model is also available for use with four types of flame sensor: ultraviolet (UV), self-check UV, infrared (IR) and flame rod.

The **Veri-Flame No Purge** and **Purge** models are available in three different series—5602, 5603 and 5605. The 5602 Series is UL listed, CSA certified, FM approved and IRI acceptable; the 5605 Series is UL listed, FM approved and IRI acceptable. The 5603 Series is for 240VAC applications not requiring US or Canadian certifications.

The **Veri-Flame Modulation** model is available in two different series: 5602 and 5603. Both series are capable of modulation (high and low fire purging). The 5602 Series is UL listed, CSA certified, FM approved and IRI acceptable. The 5603 Series is for 240VAC applications not requiring US or Canadian certifications.

Figure 1.1 **Veri-Flame Single Burner Monitoring System** (Purge Unit Shown)

Specifications

2

Introduction

This section gives a detailed overview of Veri-Flame specifications and dimensions.

Specifications

Parameter	Description			
Supply	• Series 5602 & 5605: 120 VAC (+10%, -15%), 50/60 Hz standard. Series 5603: 240 VAC (+10%, -15%), 50/60 Hz standard. Internal power consumption: 12 VA (excluding external connected loads).			
Temperature Ranges	Unit	Model Nos.	Temperature Range	
	Veri-Flame	All Models	-40° to +60°C	(-40° to +140°F)
	90° U.V. Scanner	5600-90A	-20° to +60°C	(0° to 140°F)
	U.V. Scanner	5600-91	-20° to +125°C	(0° to +257°F)
	NEMA4 UV Scanner	5600-91N4	-20° to +125°C	(0° to +257°F)
	I.R. Scanner	5600-92B	-40° to +110°C	(-40° to +230°F)
	UV/IR Scanner	5600-92SC	-20° to +80°C	(0° to +176°F)
	Self-Check U.V.	5602-91	-20° to +60°C	(0° to +140°F)
	Remote Display	5602DB	0° to 50°C	(32° to 122°F)
	Remote Display	5602DBP	0° to 50°C	(32° to 122°F)
Flame Failure Response	3 seconds ±0.5 seconds.			
Trial For Ignition (TFI)	*No Purge & Purge Models:* Series 5602 & 5603: five or 10 seconds selectable. Series 5605: ten or 15 seconds selectable. Modulating Model: 5 or 10 seconds selectable			
Pilot Interrupt (if selected)	10 seconds.			
Purge Time	Selectable from 0-225 seconds in 15 second increments.			
Output Ratings for 120 VAC *(maximum total connected load not to exceed 15 amps)*	Function	Terminals	UL, CSA Inductive Load	Relay Contact Rating Resistive Load
	Gas Valve	3, 5	175VA, 1/10 HP	10 amps
	Ignition	4	375 VA	10 amps
	Motor or Contactor	8	470 VA, 1/2 HP	16 amps
	Control Signal	A, 10, 11, 12, 13	175VA	10 amps
Output Ratings for 240 VAC *(maximum total connected load not to exceed 15 amps)*	Function	Terminals	Relay Contact Rating Resistive Load	
	Valves, Ignition	3, 4, 5,	5 amps	
	Motors or Contactor	8	16 amps	
	Alarm	A	5 amps	
	Control	10, 11, 12, 13	5 amps	

(continued onto next page)

PARAMETER	DESCRIPTION
Approvals (See chart below.)	• *No Purge & Purge Models:* Series 5602: UL listed, CSA certified, FM approved and IRI acceptable. Series 5603: No approvals. Series 5605: UL listed, FM approved and IRI acceptable. • *Modulating Models:* Series 5602: UL recognized (must be mounted in panel), CSA certified, FM approved and IRI acceptable. Series 5603: No approvals.
Shipping Weight	• 1.4 kilograms (3 lbs.) for all Veri-Flame models. • 0.9 kilograms (2 lbs.) for Models 5602-10 & 5602-10-1 bases. • 1.2 kilograms (2.6 lbs.) for Model 5602-40 base.

Approval Information

UL Listed, Guide No. MCCZ, File MH12613

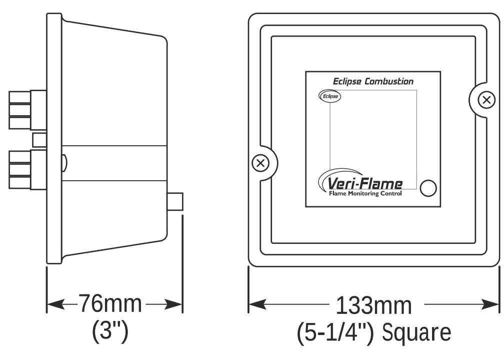
UL Recognized, Guide No. MCCZ2, File MH12613

CSA Certified, Class No. 2632 01, File 37456

FM Approved, Class No. 7610, Report 1Y2A4.AF

Dimensions

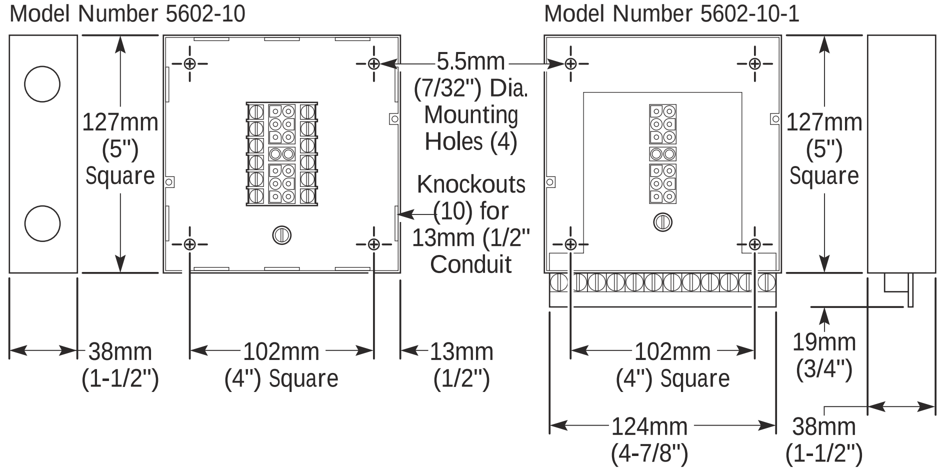
Veri-Flame Unit/All Models



Veri-Flame Bases/Purge & No Purge Models

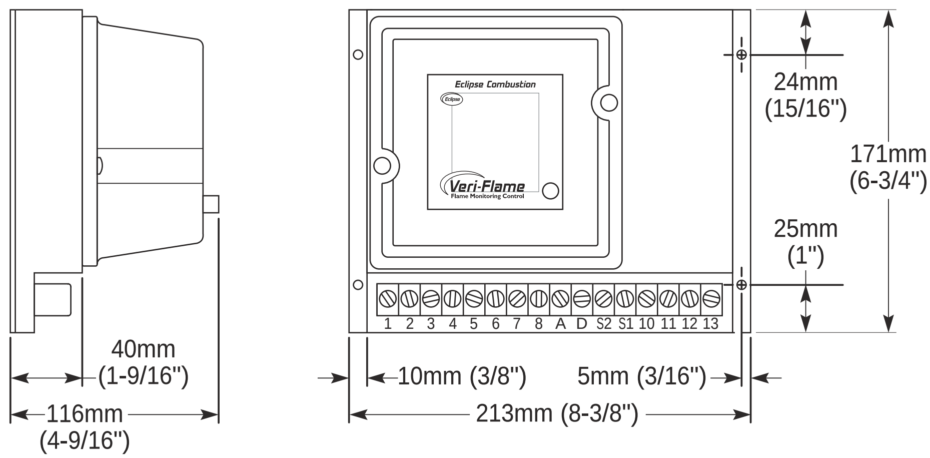
Model Number 5602-10

Model Number 5602-10-1

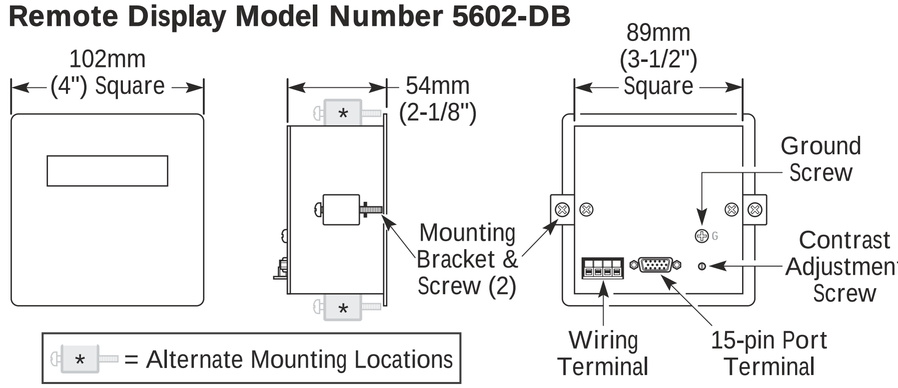


Dimensions *(continued)*

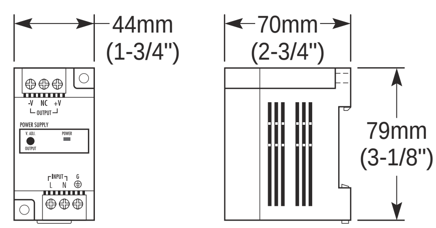
Veri-Flame/Modulating Model with Base Model Number 5602-40



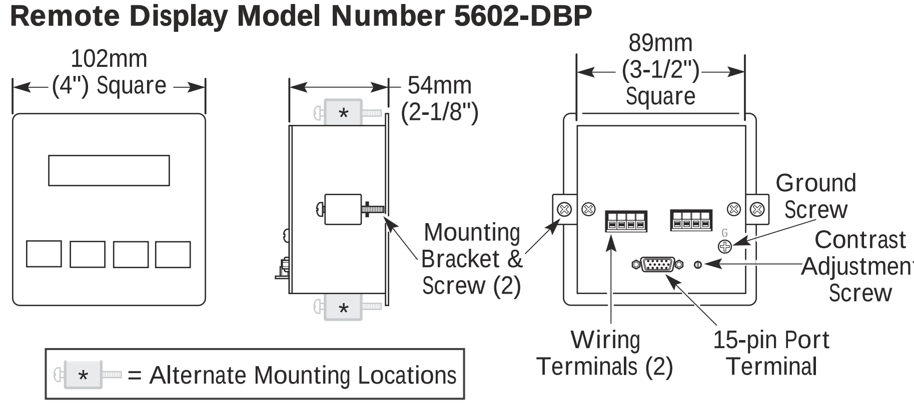
Remote Display Model Number 5602-DB



24VDC Power Supply for Remote Display 5602-DB



Remote Display Model Number 5602-DBP



DIP Switch Selection

3

INTRODUCTION

This section details the location, selection and description of the Veri-Flame DIP switches, which allow for sequence and timing functions as well as system configuration.

Caution
To avoid electric shock, shut off the power supply when installing or removing any control device. Flame monitoring systems must be installed by a qualified, licensed technician.

DIP Switch Location

All of the DIP switches are located in the back of each Veri-Flame unit (see Figure 3.1 on page 13, or the photograph on page 8).

DIP Switch Access

To gain access to the DIP switches, the Veri-Flame must be separated from the back box (for visual reference, please refer to "Dimensions" on page 10). This separation will expose the DIP switches on the back of the Veri-Flame unit.

No Purge DIP Switch Settings

No Purge models of the Veri-Flame only use three of the eight DIP switches, as shown in the labels in Figure 3.2 on page 13. They are as follows:

SW1: Recycling mode selection (On = Recycling; Off = Non-recycling)

SW2: Pilot selection (On = Intermittent, where pilot remains on during burner cycle; Off = Interrupted, where pilot valve closes after main burner is established).

SW3: Trial-for-ignition (TFI) range selection (For 5602/5603 units: On = 10 seconds; Off = 5 seconds. **For 5605 units**: On = 10 seconds; Off = 15 seconds).

Modulation & Purge DIP Switch Settings

Modulation and purge models of the Veri-Flame use all of the eight DIP switches, as illustrated in Figure 3.2 on page 13. They are as follows:

SW1: Recycling mode selection (On = Recycling; Off = Non-recycling)

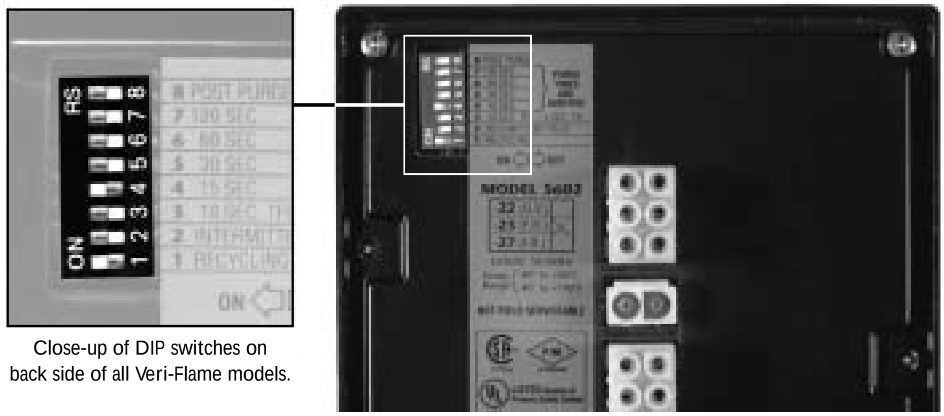
SW2: Pilot selection (On = Intermittent, where pilot remains on during burner cycle; Off = Interrupted, where pilot valve closes after main burner is established).

SW3: Trial-for-ignition (TFI) range selection (**For 5602/5603 units**: On = 10 seconds; Off = 5 seconds. **For 5605 units**: On = 10 seconds; Off = 15 seconds).

SW4 *through* 7: Purge time selection. Total purge time is the sum of each switch selected.

SW8: Post purge selection. (On=15 second post purge).

Figure 3.1 DIP Switch Location



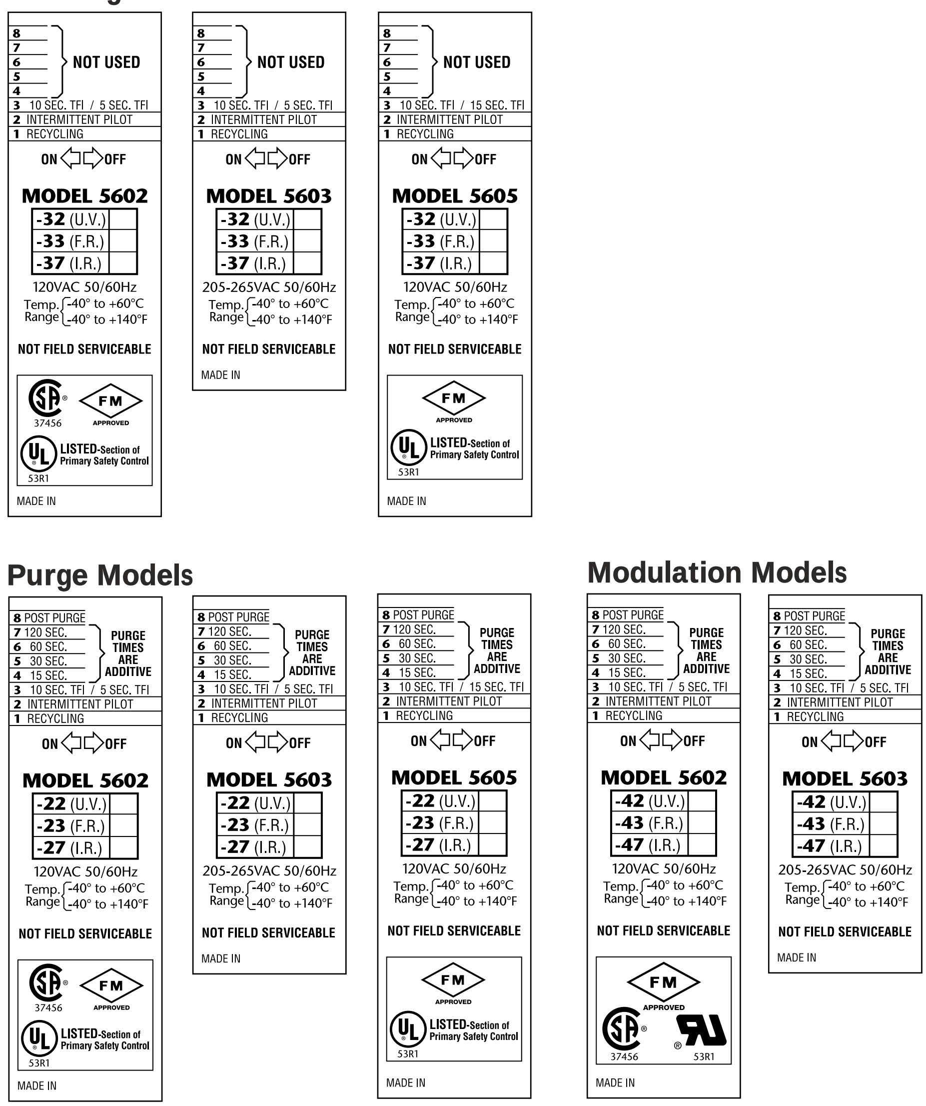
Close-up of DIP switches on back side of all Veri-Flame models.

Figure 3.2 DIP Switch Labels with Selections

No Purge Models

Purge Models

Modulation Models



Function Summary

4

Introduction

This section describes the features of the Veri-Flame. It is broken into three categories: Standard features, Optional features and the LED Indicator Lights on the front cover. Refer to Figure 5.5 for sequence diagrams.

Standard features

The following function features are standard on the Veri-Flame models as noted:

Interlocks and Limit Switch Input (Terminal 7)

This input is considered the normal operation control or run input to the Veri-Flame system. Interlocks are generally pressure or temperature switches which, when activated, start the burner. Limit switches are generally pressure, temperature and other switches which, when activated, stop the burner. The interlocks and limit switches are wired in series. A break in this circuit will shut the burner down, but will not produce an alarm.

Combustion Air Switch Input (Terminal 6)

For purge and modulation models: This input is for monitoring the combustion air switch separately from other interlocks and limits. The Veri-Flame checks the air flow switch input is open before start-up, closed during operation, and open again at burner shutdown, thus preventing operation with an air switch that is defective, maladjusted or jumped. This input has about a 2 second delay to filter out and ignore a momentary interruption.

The input will be proven open before start-up and after shutdown. If the input is improperly powered before the fan output is energized, the system error light will blink. The input must de-energize within 30 seconds or the Veri-Flame will lockout.

After the fan output has energized, the air switch input must be made within 10 seconds. If not proven, then the system will lockout, the alarm output and the air failure light will come on. However, if the unit has the optional air switch input hold feature, the sequence is held indefinitely without causing a lockout. When the air switch input is made, then the sequence continues.

If the air switch opens during the main firing cycle, the system will either lockout or recycle, depending on the DIP switch recycle selection.

Main Fuel Valve Closed Switch (Terminal V)

Purge and No-Purge models: the Veri-Flame can be interlocked with the main valve closed switch. This feature checks the switch position before start-up and after shutdown to insure proper valve operation when the jumper on the base is cut.

Low Fire Start

For modulation models: when wired, the system checks for the low fire start position prior to light-off.

Main Fuel Valve Closed/ High Fire Purge Check (Terminal D)

For modulation models: This feature is enabled when the jumper on the base is cut. The system checks that the high fire position switch and the main valve closed switch are both made at the end of the high fire purge.

Recycle Mode

For all models: when selected, the Veri-Flame will restart the sequence after flame or air failure. The recycle mode allows the system to re-initiate the start-up sequence automatically provided the main burner has been operating for at least 35 seconds. If the pilot flame fails to light during recycling, the system will lock out and annunciate a pilot flame fail. If the recycle is successful and the main burner is operational for at least 35 seconds, the system is ready for another recycle. At no time will the system recycle in the event of pilot flame fail.

Pilot Test Mode

Test Mode
(Button In)

Run Mode
(Button Out)

For all models: this mode is entered by depressing the TEST/RESET button on the front cover. In the pilot test mode, the Veri-Flame will hold the sequence once the pilot flame is established (i.e., the main valve is not energized). When in the pilot test mode, the green "Interlocks Closed" light **blinks**.

To exit the pilot test mode, simply push the TEST/RESET button again and the Veri-Flame will exit the pilot test mode (the green "Interlocks Closed" light **stops blinking but remains lit**) and restart the sequence.

Interrupted or Intermittent Pilot

For all models: pilot mode is selected using the DIP switch SW2. An interrupted pilot shuts off 10 seconds after the main valve opens. An intermittent pilot continues during the entire main flame firing cycle.

Post Purge

For purge and modulation models: post purge is enabled by DIP switch SW8. A post purge maintains the combustion air fan output for 15 seconds after the interlocks and limit switch input have opened.

Spark, Pilot Flame & Main Flame Separation

For all models: during the trial for ignition period (TFI), the pilot valve and ignition coil remains energized. At the end of the TFI, the pilot flame remains on and the ignition coil is de-energized. After a five second delay to prove the pilot flame, the main gas valve is energized.

System Errors & Lockout Conditions

A ***system error*** (illuminated by the red "System Error" LED on the front cover) prevents gas ignition. The unit will continue its sequence after the error is cleared. A ***lockout condition*** energizes the alarm output and de-energizes the gas valve and ignition outputs. The unit must be reset to clear the alarm and start the sequence. To reset, the button must be pressed twice so that the button is in the out position.

The following system errors result in immediate lockout conditions:

1) Wiring error which puts external voltage on the output terminals **(for all models)**.
2) Welded internal contacts or other malfunctions in the Veri-Flame **(for all models)**.
3) Main fuel valve **(for all models)**–open after cycle shutdown or before start-up. The system error light blinks twice and then remains on. The fan output terminal 8 will energize.

System Errors & Lockout Conditions (Continued)

4) Low fire fail **(for modulating model)**–low fire switch open prior to trial for ignition.
5) High fire fail **(for modulating model)**–high fire switch is not closed at the end of high fire purge.

The following situations will result in a lockout condition:

6) Air failure **(for purge and modulation models)** – loss of combustion air anytime during the operational cycle. The Air Failure LED will be on for this condition. (See "Recycle Mode").
7) Pilot flame fail **(for all models)** loss of flame during the trial for pilot ignition period. The Flame Failure LED will be on for this condition.
8) Main flame fail **(for all models)** loss of flame during the main burner trial for ignition or run period (recycling not selected). The Flame Failure LED will be on for this condition.

The following result in lockout conditions after 30 seconds, the system error light blinks about 14 times and then remains on:

9) If a flame is detected out of sequence, which may be caused by:
   a) a faulty scanner **(for all models)**;
   b) electrical interference on the sensor wiring **(for all models)**;
   c) a flame exists in the burner or in the line of sight of a scanner, due to a gas leak, product fire or other condition **(for all models)**.
10) Air flow switch closed before start-up **(for purge and modulation models)**.

High to Low Fire Purge Modulation Capability with High to Low Fire Position Switch Interlocks

For modulation models: the modulation feature incorporates a high fire purge time and a low fire purge time into the purge sequence. This feature allows the Veri-Flame to sequence internal dry contacts which can be used by the customer requiring a high fire purge of the combustion chamber before ignition.

The high fire and low fire purge times are selectable by means of DIP switches (see Section 3, "DIP Switch Settings" on page 12):

SW4 .... 15 seconds   SW6 .... 60 seconds
SW5 .... 30 seconds   SW7 .... 120 seconds

The selected times are additive and apply to both the high fire and low fire purge times (that is, high and low fire times are always identical).

The modulation terminals will sequence as follows:

Sequence Step	Internal Contact Connections	
Power Off	Terminal 10 (Common)	Terminal 11 (Auto)
Power On, Limits Open	Terminal 10 (Common)	Terminal 12 (Low Fire)
Purge To High Fire	Terminal 10 (Common)	Terminal 13 (High Fire)
Purge To Low Fire	Terminal 10 (Common)	Terminal 12 (Low Fire)
Automatic Modulation	Terminal 10 (Common)	Terminal 11 (Auto)
Alarm and Lockout	Terminal 10 (Common)	Terminal 12 (Low Fire)

The Automatic step occurs when the burners are operating and allows the burner firing rate to be controlled by an automatic temperature controller.

OPTIONAL FEATURES

The following features are available on select models, or when optional equipment is purchased.

Air Switch Input Hold

For purge/modulation models: holds the sequence indefinitely until air switch input is confirmed without affecting the air failure function and causing a lockout.

Remote Display & Power Supply

Two models of remote display are available. The model 5602DB operates on 24VDC and has no keypad. The model 5602DBP operates on 120VAC and has a keypad for reset function. The display is door panel mounted and features a liquid crystal display in a ¼ DIN housing. The unit connects to the Veri-Flame by a cable to the flame signal test jack, and receives a serial communication on each sequence state change. The display incorporates the following functions:

1) Provides status messages for the Veri-Flame sequence (see section 9).
2) Indicates lockout conditions when they occur, as well as the amount of time into the sequence when the lockout occurred (see section 9).
3) Provides continuous monitoring of the burner's flame signal strength and run time during main burner operation.

Manual Reset on Power Outage

This optional feature requires a reset on initial application of power or after an interuption of power. The system error light blinks rapidly (about 4 times per second) and a remote display will show "PUSH RESET TO START". The reset button must be pressed in and out to start

STATUS LIGHTS & PUSH-BUTTON

All of the status lights and the TEST/RESET push-button are located on the front cover of the Veri-Flame. This section describes their respective functions.

Interlocks Closed

For all models: this green LED illuminates when the operation limits are made. These limits are wired in series to terminal 7. This input becomes energized to begin the burner sequence. When in the test mode, this LED blinks (see "Pilot Test Mode" on page 15).

Air Failure

For purge and modulation models: this red LED illuminates whenever combustion air is lost during the operational cycle of the Veri-Flame.

System Error

For all models: this red LED illuminates when a system error is detected (see "System Errors & Lockout Conditions" on pages 15-16).

Flame Failure

For all models: this red LED illuminates when a pilot or main flame fails.

Low Fire

For modulation models: this yellow LED illuminates during the low fire period of the purge cycle.

High Fire

For modulation models: this red LED illuminates during the high fire period of the purge cycle.

Auto

For modulation models: this green LED illuminates during the automatic period which occurs 20 seconds after the main valve is energized.

Test/Reset

For all models: this push-button is used to activate the pilot test mode or to reset the Veri-Flame unit.

Flame Signal

For all models: this red LED is located behind the signal test port and illuminates when a flame signal is present.

System Installation

5

Introduction

In this section, the necessary procedures are detailed to integrate a Veri-Flame into a burner system; Figures 5.1 and 5.2 illustrate the various terminal strips mentioned.

Note:
Shut off the power supply before the Veri-Flame is removed or replaced from the base.

Caution:
Installation and maintenance must conform with the National Electrical Code and all other national and local codes and authorities having jurisdiction. Flame monitoring systems must be installed by a qualified, licensed technician.

Interlocks and Limit Switch Input

Wire external interlock, control, and limit switches in series to this input. Guard against induced voltage levels to wiring connected to this input. In some extreme wiring runs, reduction of induced voltages may require a load (relay or light) connected to terminal 7 to avoid system error lockouts. This input is the power source for the valve and ignition output terminals. Be sure all switches wired to this input can handle the current required by the total of all loads connected to terminals 3, 4,and 5.

Combustion Air Switch Input

For purge and modulation models: Wire any switches and contacts in series to this terminal for proving air flow function and relating to the air failure light. Power must not be immediately present at terminal 6 when power is first applied to terminals 1 or 7.

If this terminal is not used, place a jumper between the combustion blower output (terminal 8) and the air switch input (terminal 6).

If the combustion air blower is controlled outside of the Veri-Flame system, then a three way solenoid valve must be connected between the air switch port and the blower sensing port. The valve de-energized state should vent the switch to ambient pressure. The energized state then connects the air switch to the blower sensing port. Power the valve from the blower ouput terminal 8. If accepted by local codes, the air switch could be wired between the combustion blower output and the air switch input. Connecting the air switch in this manner will satisfy the open contact (air short) check on the switch.

Ignition Wiring

Route ignition wiring a sufficient distance from all sensors and other low voltage wiring to avoid electrical interference, which may cause erratic operation of the Veri-Flame system. Keep the high voltage wire run from the ignition transformer as short as possible. The best condition is to mount the ignition transformer close to the burner and keep a low impedance path from the burner ground to the case of the transformer. Make sure the high voltage lead and ground return paths do not create a loop antenna around the Veri-Flame and sensor wiring.

Low Fire Input

For modulation models: it is possible to wire the system for checking low fire start position prior to pilot ignition. To use this feature, the low fire start switch must be connected between terminal 3 and the pilot valve (see Figure 5.2). On direct spark burners, a by-pass contact must be wired around the low fire switch, see relay and contact CR in Figure 5.3.

Main Valve Closed Switch

The system can be wired to check for the main valve closed switch on the main gas valve prior to start-up and after the end of the burner cycle.

For purge and no purge models: the main valve closed switch must be connected to Terminal V and **the jumper in the base must be cut** (see Figure 5.4 on page 22).

For modulation models: the main valve closed switch must be wired in series between the air flow switch and the high purge damper switch (see Figure 5.1 on page 20). **To use this feature, the jumper in the base must be cut.**

High Purge Input

For modulation models: the system can be wired to check for high purge position during the high fire purge portion of the sequence. **To use this feature, the red jumper in the base must be cut** and the high purge position switch must be connected from terminal 6 to D. If this feature is not used, the jumper in the base remains intact or a jumper must be installed between terminals 1 and D. Please note that the yellow jumper on the base has no effect whether cut or intact.

Remote Reset

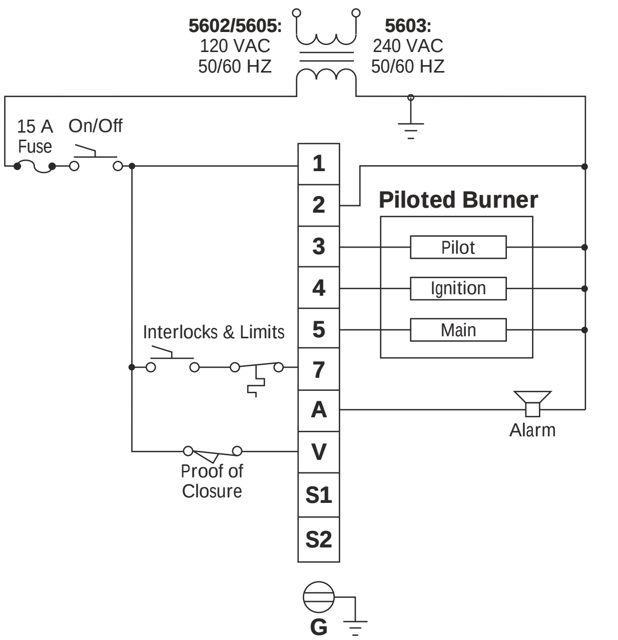
This feature permits remote mounting of a switch to reset the Veri-Flame. To use this feature, a normally closed remote reset switch must be wired so power is interrupted to terminal 1. When it is depressed or actuated, the connection to terminal 1 is momentarily interrupted and resets the Veri-Flame.

Remote Display & Power Supply

Identify the model of remote display (see page 11) and wire according to figure 5.3. Mount through a ¼ DIN cutout using the two supplied brackets in either the top and bottom or the side slots. Locate the display and wiring to minimize electrical interference. Applying and disconnecting the display power supply should coincide with power to terminal 1 of the Veri-Flame. Use the appropriate cable (Eclipse part #20318) to connect to the test jack and to the S2 terminal of the Veri-Flame wiring base. Do not attempt to parallel the test jack signal to other devices when using a remote display. The LCD display contrast can be adjusted on the back with a small blade screwdriver.

Figure 5.1 No Purge and Purge Wiring Diagrams

No Purge Models



Purge Models

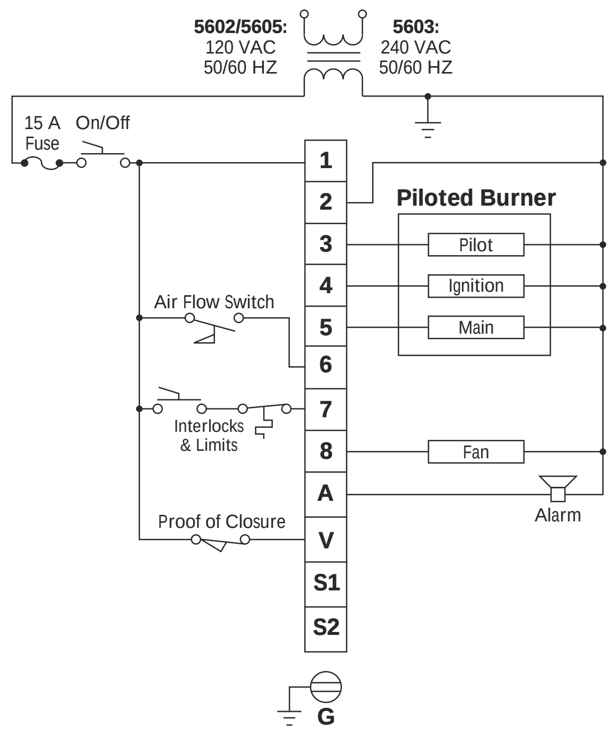


Figure 5.2 Modulation Wiring Diagram

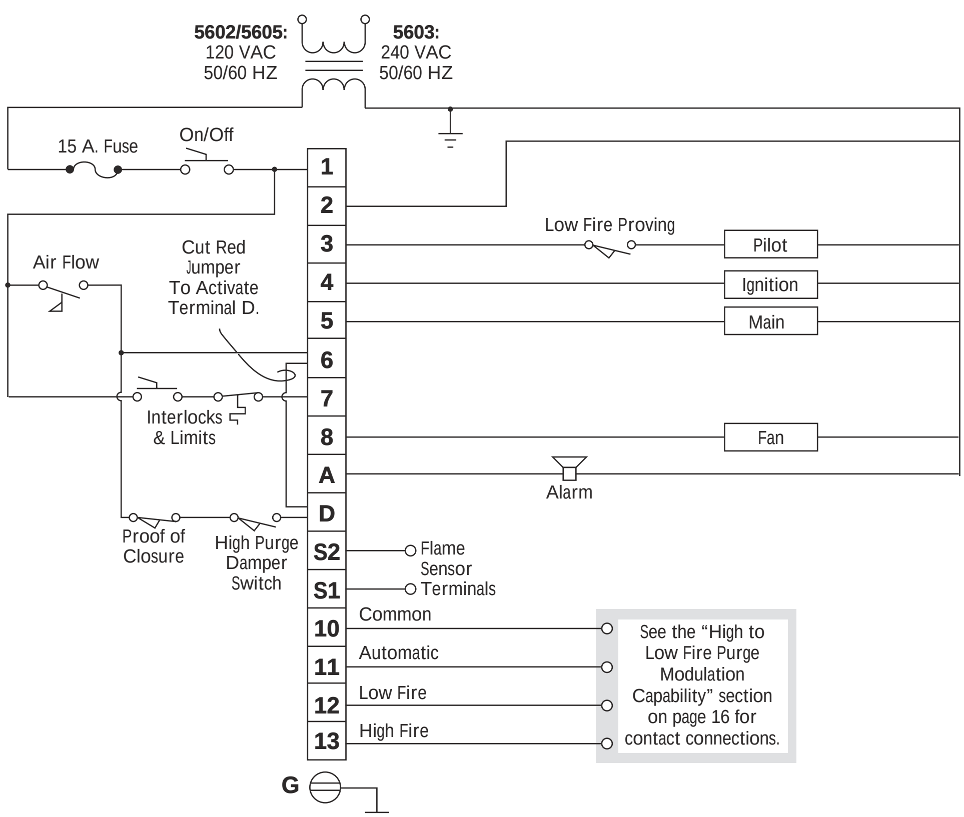
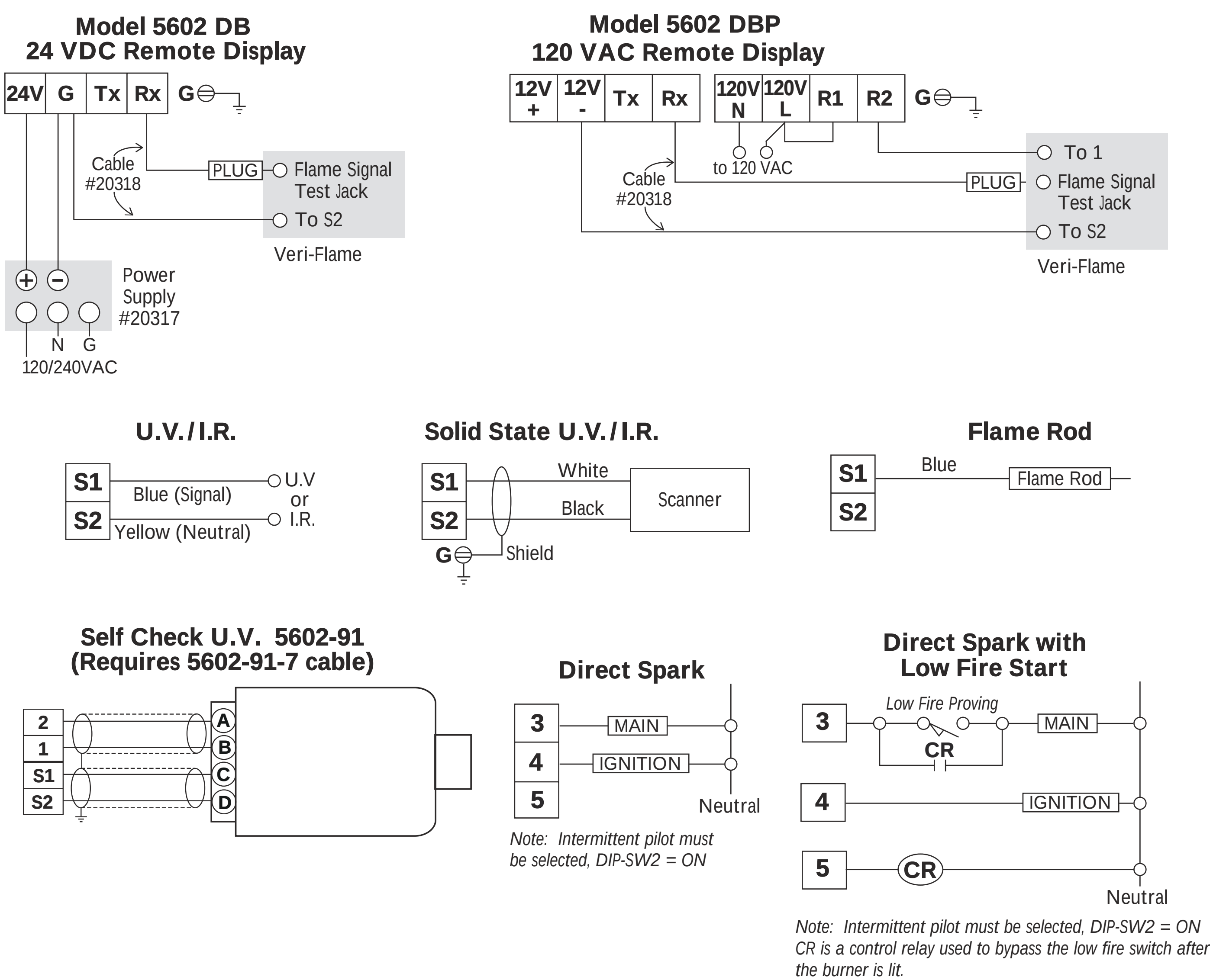


Figure 5.3 Typical Connections For All Models

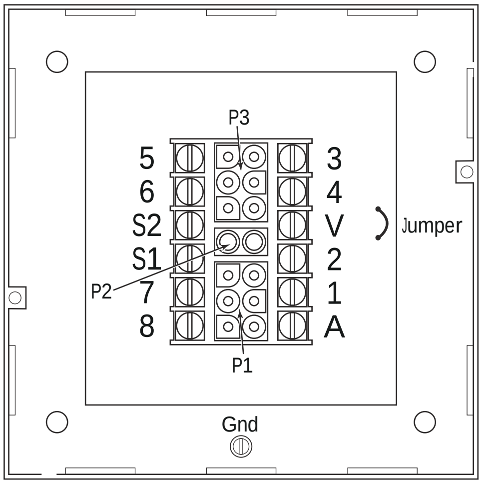


Notes for Figures 5.1, 5.2 & 5.3:

1. *Ground, shielding and conduit must not be connected to terminal S2.*
2. *Control circuit wires must meet 90°C (194°F) specification minimum and must be No. 16 AWG or larger and in accordance with all applicable codes.*
3. *Flame sensor wires must be individually run in their own separate conduit; flame sensor wires CANNOT be run together in a common conduit or wireway (See Section 6).*
4. *Flame signal should read between 4 and 10 VDC with a digital volt meter. Drop off is approximately 4.0 VDC. Positive test jack point is on the cover marked "Flame Signal" with negative point being the ground.*
5. *Purge time, TFI, intermittent/interrupted pilot, and recycle/non-recycle selections are made with a DIP switch located on the rear plate of the control unit.*
6. *Neutral must be grounded.*

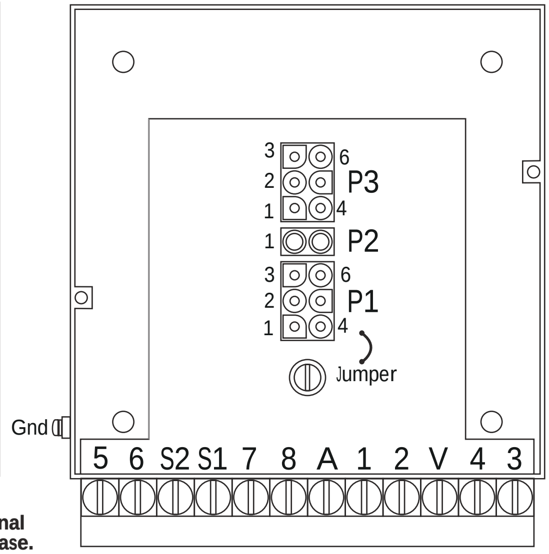
Figure 5.4 Purge and No Purge Bases

Model Number 5602-10

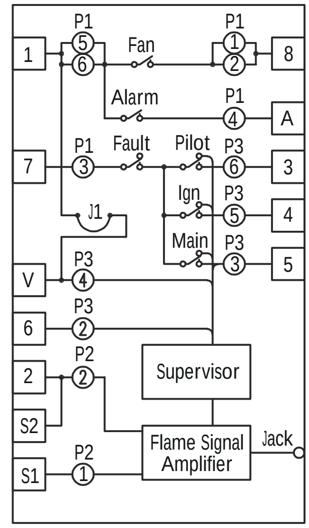


NOTE: **Ground Terminal not present in plastic base.**

Model Number 5602-10-1



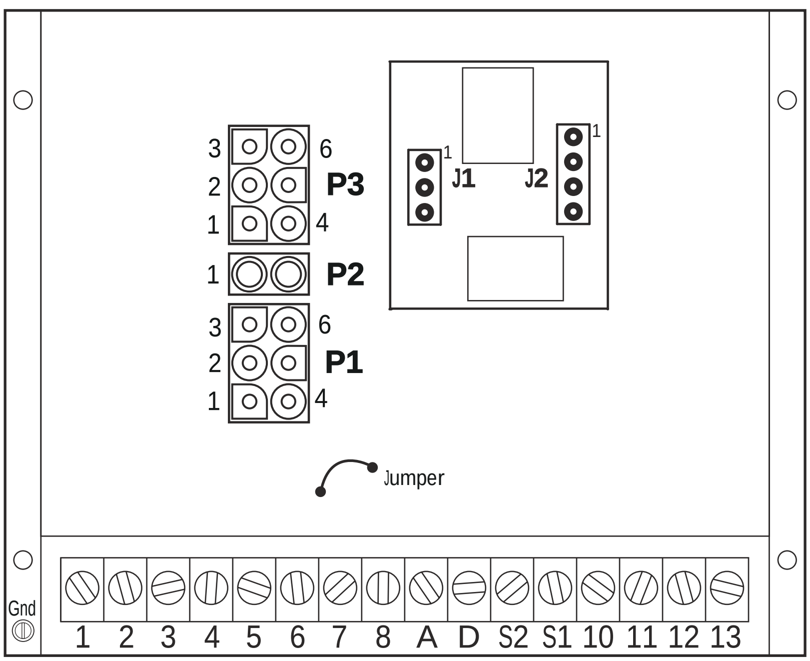
Internal Diagram Purge & No-purge



Note: No purge models do not use 6 & 8.

Modulating Base

Model Number 5602-40



Internal Diagram Modulation Model

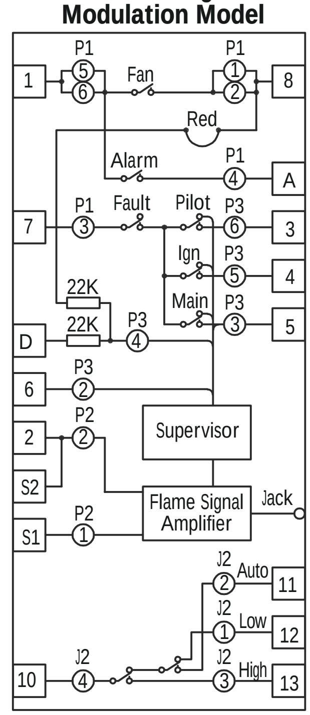
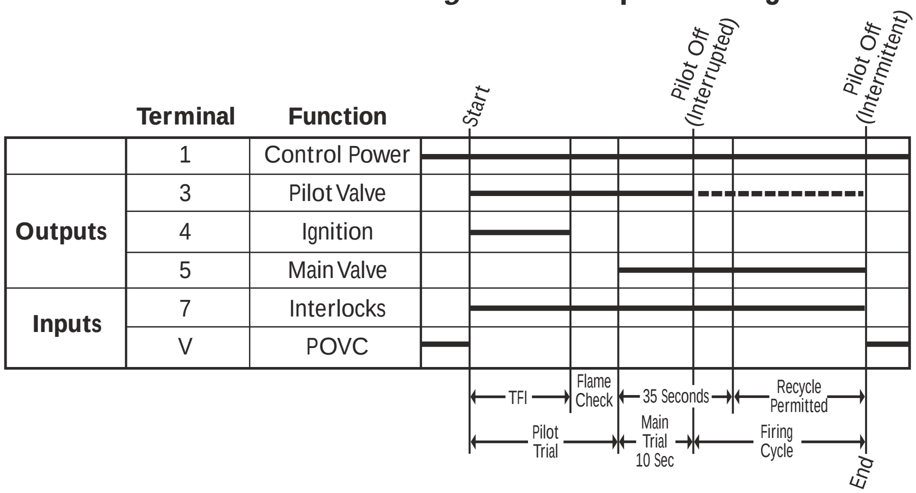
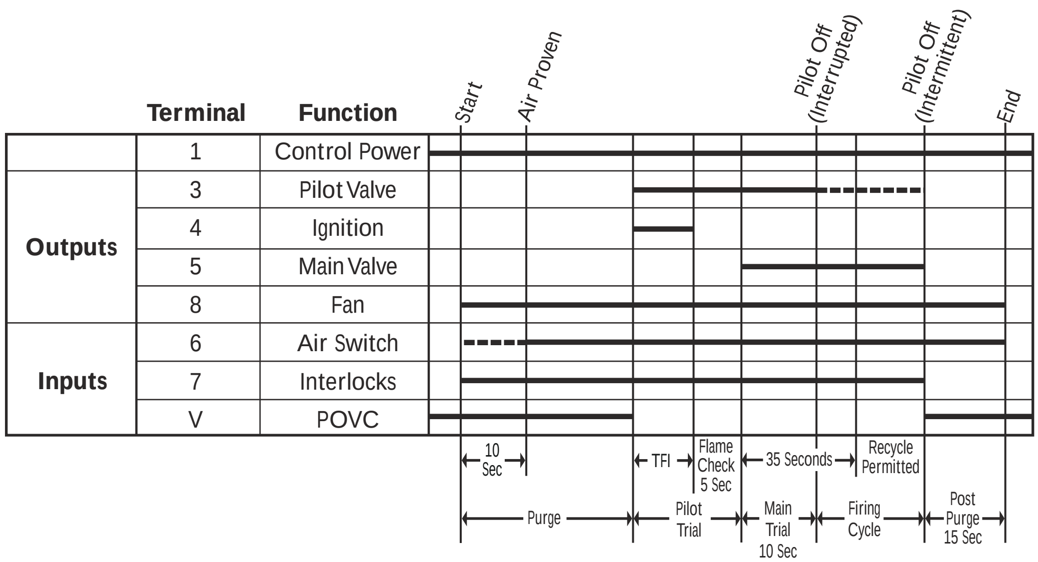
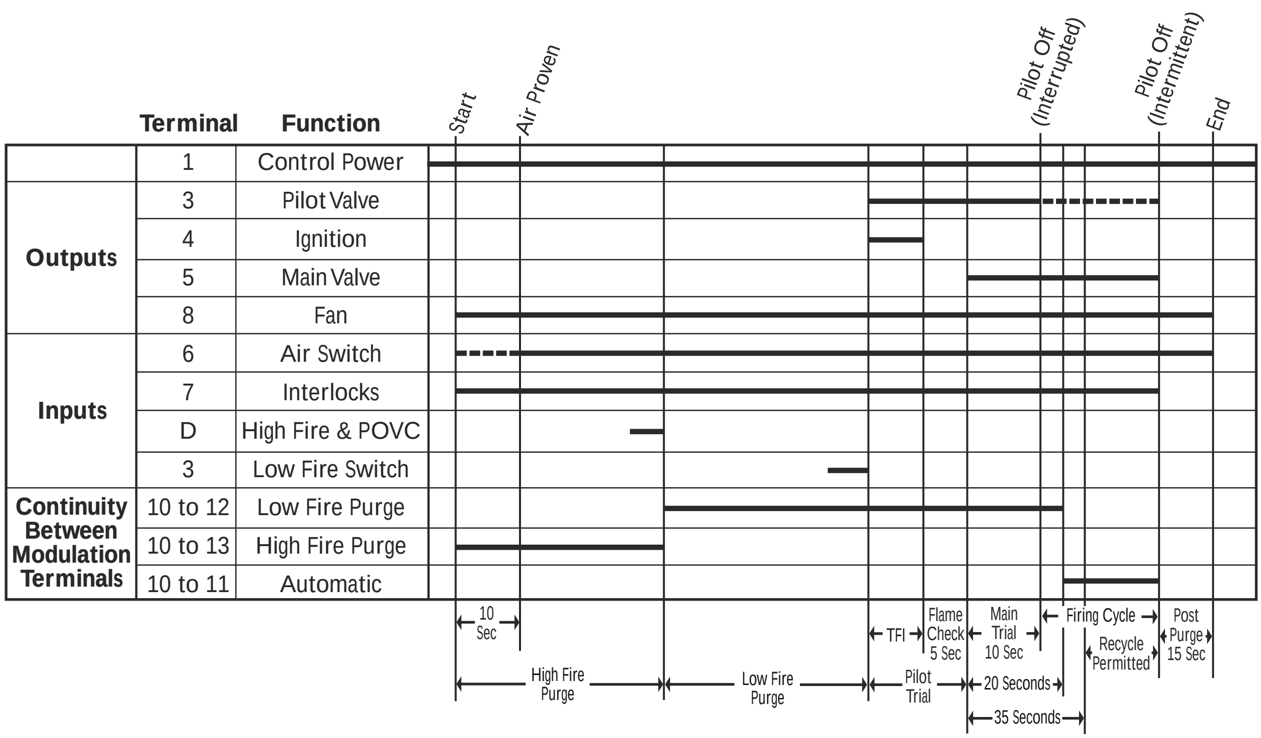


Figure 5.5 **Sequence Diagrams**







Sensor Installation

6

Introduction

This section describes the proper wiring, installation and sighting considerations for all sensors that can be used with a Veri-Flame.

Warning
Incorrect sensor installation may cause the sensor to generate a false flame signal, possibly resulting in the collection of unburned fuel in the combustion chamber. This unburned fuel creates the potential for explosions which can result in injuries, death and property damage. Be certain that the flame sensor detects acceptable pilot and main flames only.

Sensor Wiring

Route sensor wiring a sufficient distance from ignition and other high voltage or high current wiring to avoid electrical interference. Interference from ground currents, nearby conductors, radio-frequency emitters (wireless divices), and inverter drives can induce false flame signals. Shielded cables can help reduce interference with the shield connected to ground at the control end only. The wire type and its capacitance (picofarads or microfarads) to ground may cause low signal problems, so a grounded shield may decrease the signal due to the cable's internal capacitance. Multiple U.V. tube-type sensor leads run together without shielding may interfere or "cross talk", so the shield or flexible armor must be grounded to prevent this situation. For flame rod sensor runs approximately 100 feet (30 meters) or greater, use Eclipse part number 21741 coax cable. To achieve the maximum wiring distance, the shield should not be grounded (keep in mind that an ungrounded shield provides less protection against electrical interference).

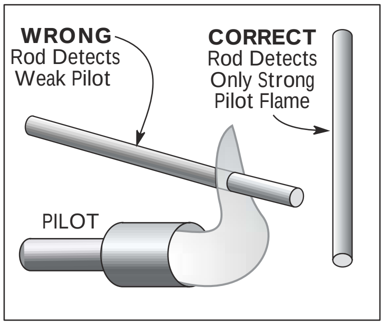
Note:
Unshielded sensor wiring must not be run in common with other wires; it must be run in separate conduit. Use #14 to #18 AWG wire suitable for 90°C (194°F) and 600 volt insulation. Multiple unshielded flame sensor wiring must not be run together in a common conduit or wireway. Multiple shielded flame sensor cables can be run in a common conduit.

Flame Rods

Flame rods should be used only on gas burners. They accumulate soot on oil burners, causing nuisance shutdowns and unsafe operating conditions.

See the burner manufacturer's literature for flame rod mounting location. When installing flame rods, please consider the following:

Figure 6.1 Flame Rod Position



1) Keep the flame rod as short as possible and at least 13 mm (1/2") away from any refractory.
2) Position the rod into the side of both the pilot and main flames, preferably at a descending angle to minimize drooping of the flame rod against burner parts, as shown in Figure 6.1. Flame rod position must adequately detect the pilot flame at all burner draft conditions. Extend the rod 13 mm (1/2") into nonluminous flames, such as blue flames from burning an air/gas mixture. For partially luminous flames, such as atmospheric air/gas mixtures, place the rod at the edge of the flame.
3) Provide a burner/flame grounding area that is at least four times greater than the flame rod area contacting the flame. The flame rod/burner ground ratio and position of the rod in the flame may need adjustment to yield maximum flame signal strength.
4) Ignition interference from the spark plug may increase or decrease the flame signal strength. Reversing the ignition transformer primary leads may reduce this effect. Changing the spark gap or adding grounding area between the flame rod and spark plug may eliminate the interference.

Scanners

Warning

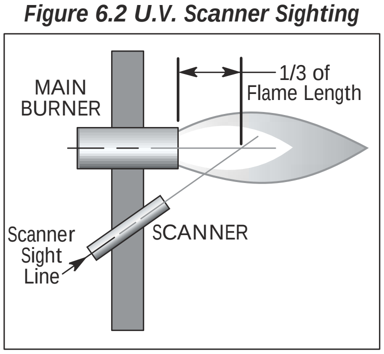
Use only Eclipse scanner models as listed in the Illustrated Parts List at the end of this document.

When installing scanners, please consider the following:

1) Position the scanner within 457 mm (18") of the flame. Consult factory for longer distances.
2) Bushing threads are 1/2 inch F.N.P.T. for all scanner models except 5602-91 which has 1 inch F.N.P.T. bushing threads.
3) The ambient temperature limits of each scanner varies; check the literature for the specific scanner model. For higher temperatures, use Eclipse heat block seal 23HBS for ½" N.P.T. scanners and if necessary, add cooling purge air.
4) An optional magnifying lens may also be used to increase the flame signal strength in difficult sighting situations.

Scanner Sighting Considerations

Figure 6.2 U.V. Scanner Sighting



Aim scanners at the third of the flame closest to the burner nozzle, as shown in Figure 6.2 (oil flames typically have less UV radiation in the outer flame). The scanner should view the intersection of the pilot and main flames. When sighting scanners, please consider the following:

1) Sight the scanner away from the ignition spark. Sighting the spark or its reflections from burner internals can cause nuisance shutdowns during burner ignition. If necessary, use a scanner orifice to reduce spark pickup.
2) Do not allow the scanner to detect a pilot flame that is too small to ignite the main burner.
3) Perform a minimum pilot test when installing or adjusting any pilot or main burner system; see "Minimum Pilot Test" on page 26.
4) I.R. scanner model 5600-92B is ideal for oil flame applications. When used, aim the I.R. scanner at the outer oil flame for flickering detection.

Test Procedures

7

INTRODUCTION

This section describes the test procedures that must be performed after installation to insure that the Veri-Flame is operating properly; these procedures are mandatory.

Flame Signal Strength

Insert the positive probe of a 0-15 VDC, digital volt meter into the test point on the front cover of the Veri-Flame; connect the negative probe to ground. A good flame signal strength will read between 6 and 11 VDC; anything below 4 VDC is inadequate. Also, the red LED inside the test point illuminates when a flame signal is indicated.

Minimum Pilot Test

Run the following test procedures to ensure that the sensor will not detect a pilot flame too small to reliably light the main flame:

1) Manually shut off the fuel supply to the burner, but not to the pilot.
2) Start the system normally.
3) To enter the pilot test mode, depress the test/reset button located in the lower right corner on the front cover.
4) The control will hold the operating sequence at the pilot flame step. Measure signal strength as described above.
5) Reduce pilot fuel until the flame relay drops out. Increase pilot fuel until the flame signal is greater than 4 VDC, and flame relay just manages to pull in. This is the minimum pilot. If you don't think this flame will be able to safely light the main burner, realign the sensor so that it requires a larger pilot flame and repeat steps 2 through 5.
6) Push the test/reset button located in the lower right corner on the front cover to exit the test mode (reset) and begin the normal start-up sequence again.
7) When the sequence reaches the main flame trial for ignition, smoothly restore the fuel supply to the burner. If the main burner does not light within five seconds, immediately shut off the burner supply to shut down the system. Realign the sensor so that it requires a larger pilot flame. Repeat steps 1 through 6 until the main burner lights off smoothly and reliably.

Pilot Flame Failure Test

1) Manually shut off the fuel supply to the pilot and the main burner.
2) Place system in pilot test mode (please refer to page 15).
3) Start the system normally. The controller should lock out*; if it doesn't, then the controller is detecting a false flame signal (see Section 6). Find the problem and correct it before resuming normal operation.

Main Flame Failure Test

(For Interrupted Pilot Systems)

1) Manually shut off the fuel supply to the main burner but not to the pilot.
2) Start the system normally. This should ignite the pilot and lock out* after pilot interruption. If the system does not lock out, the controller is detecting a false flame signal (see Section 6). Find the problem and correct it before resuming normal operation.

Spark Sighting Test

1) Manually shut off the fuel supply to the pilot and the main burner.
2) Start the system normally.
3) Measure the flame signal as described in "Flame Signal Strength" in this section.
4) If a flame signal greater than 4VDC is measured for more than three seconds during the trial for ignition, then the sensor is picking up a signal from the spark plug; see "Sensor Wiring" on page 24.

Limits & Interlock Tests

Periodically check all interlock and limit switches by manually tripping them during burner operation to make sure they cause the system to shut down.

Warning

Never operate a system that is improperly adjusted or has faulty interlocks or limit switches. Always replace faulty equipment with new equipment before resuming operation. Operating a system with defective safety equipment can cause explosions, injuries, and property damage.

* Indicated by the illuminated red "Flame Failure" LED on the Veri-Flame front cover.

Maintenance & Troubleshooting

8

Introduction

This section is divided into two parts:

- The first part describes the maintenance procedures.
- The second part describes troubleshooting procedures, from identifying problems to interpreting the operating conditions by the lit LEDs on the front cover.

Maintenance

Preventative maintenance is the key to a reliable, safe and efficient system. The core of any preventive maintenance program is a list of periodic tasks.

In the paragraphs that follow are suggestions for a monthly list and a yearly list.

<u>*Note:*</u>
The monthly list and the yearly list are an average interval. If your environment is dirty, then the intervals may be shorter.

<u>*Caution:*</u>
Turn off power before disconnecting or installing sensors, controls or modules.

Monthly Checklist

1. Inspect flame-sensing devices for good condition and cleanliness. Keep scanner lenses clean with a soft, damp cloth, since small amounts of dust will measurably reduce the flame signal strength. Wash the flame rod electrode and insulator with soap and water, then rinse and dry thoroughly.
2. Test all the alarm systems for proper signals.
3. Check ignition spark electrodes and check proper gap.
4. Test interlock sequence of all safety equipment as described on page 27: manually make each interlock fail, noting what related equipment closes or stops as specified by the manufacturer.

   Test flame safeguard by manually shutting off gas to the burner.

Yearly Checklist

1. Test (leak test) safety shut-off valves for tightness of closure.
2. Test pressure switch settings by checking switch movements against pressure setting and comparing with actual impulse pressure.
3. Visually check ignition cable and connectors.
4. Make sure that the following components are not damaged or distorted:
   - the burner nozzle
   - the spark plugs
   - the flame sensors
   - the flame tube or combustion block of the burner

TROUBLESHOOTING

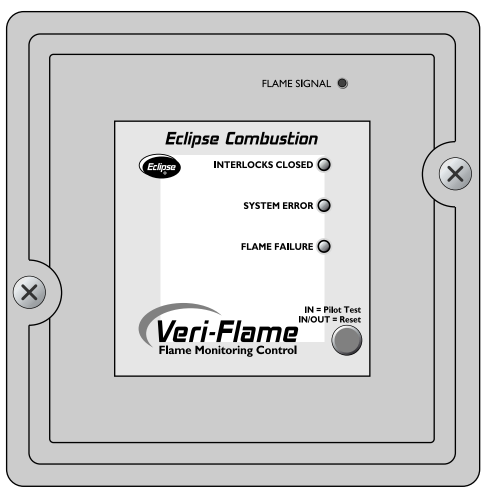
PROBLEM	POSSIBLE CAUSE	SOLUTION
Cannot initiate start sequence	Main valve is not closed.	Check main valve closed switch. No voltage on V (or D).
	Air pressure switch has not made contact.	Check air pressure switch adjustment. Check air filter. Check blower rotation. Check outlet pressure from blower. No voltage on 6 after 8 is on.
	High gas pressure switch has tripped.	Check incomming gas pressure; adjust gas pressure if necessary. Check pressure switch setting and operation. No voltage to 7.
	Low gas pressure switch has tripped.	Check incomming gas pressure; adjust gas pressure if necessary. Check pressure switch setting and operation. No voltage to 7.
	Malfunction of flame safeguard system such as a shorted-out flame sensor or electrical noise in the sensor line.	Have qualified electrician investigate and rectify.
	Purge cycle not completed.	Check switch settings. Check air switch.
	Main power is off.	Make sure power is on to control system.
	No power to control unit.	Call qualified electrician to investigate.
Scrambled messages on remote display.	Electrical interference.	Check grounding in system. Separate communication cable. Move ignition circuit.
"UNSAFE AIR SHORT" message appears on display.	Improperly adjusted air switch. Air switch either shorted or wired wrong.	Check air switch settings. Check wiring to air switch.
Burner flame fails but no flame failure indication occurs.	A faulty scanner.	Check scanner as explained in checklists in "Maintenance" portion of this Section.
	Improperly connected sensor wires.	Check wiring diagram on page 20 or 21 as well as appropriate sensor information in Section 6.
	Electrical interference from other current carrying wires.	Check Note information on page 24 regarding sensor wiring.
Voltage reading greater than 15VDC at "Test Point" on Veri-Flame faceplate.	Improper grounding.	Check grounding of neutral at control power transformer.

LED Status

This section describes the status of operating conditions based on the LED or combination of LEDs which are lit on the front cover of each Veri-Flame model.

Table 8.1 **LED Status & Conditions for Veri-Flame No Purge Models**

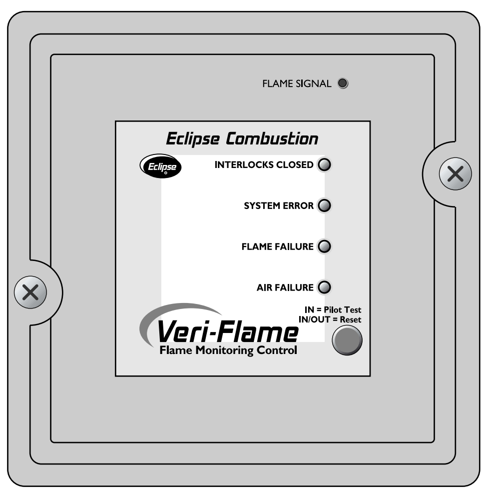
LED(s) Lit	Possible Causes
INTERLOCKS CLOSED	1) The interlocks are closed (normal operation), power on terminal 7.
SYSTEM ERROR	1) The flame detected is out of sequence, flame signal light is on. 2) The sensor is "runaway", flame signal light is on. 3) Inductance is detected on sensor wires, flame signal light is on. 4) Voltage wired into terminals 3, 4 or 5. 5) Internal relay contacts welded. 6) Internal controller failure. 7) Main valve closed switch defective, no power to V.
FLAME FAILURE	1) Pilot flame is not established in selected TFI. 2) Main flame is not established in selected TFI. 3) Main flame fails within 35 seconds of TFI. 4) Flame failed during operation in non-recycle mode. 5) Flame failed 35 seconds after TFI and was not established after try in recycle mode.



No Purge Model

Table 8.2 **LED Status & Conditions for Veri-Flame Purge Models**

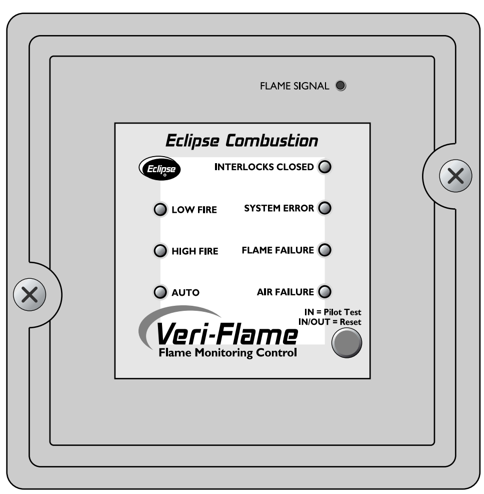
LED(S) LIT	POSSIBLE CAUSES
INTERLOCKS CLOSED	1) The interlocks are closed (normal operation), power on terminal 7.
SYSTEM ERROR	1) The flame detected is out of sequence, flame signal light is on. 2) The sensor is "runaway", flame signal light is on. 3) Inductance is detected on sensor wires, flame signal light is on. 4) Voltage wired into terminals 3, 4 or 5. 5) Internal relay contacts welded. 6) Internal controller failure. 7) Air flow switch closed before start-up. 8) Main fuel valve switch opens after shutdown or before start-up, no power to V.
FLAME FAILURE	1) Pilot flame is not established in selected TFI. 2) Main flame is not established in selected TFI. 3) Main flame fails within 35 seconds of TFI. 4) Flame failed during operation in non-recycle mode. 5) Flame failed 35 seconds after TFI and was not established after one try in recycle mode.
AIR FAILURE	1) Air flow switch not closed within ten seconds of start-up. 2) Air flow switch is open during timing cycle. 3) Air flow switch is open during firing cycle.



Purge Model

Table 8.3 **LED Status & Conditions for Veri-Flame Modulation Models**

LED(s) Lit	Possible Causes
INTERLOCKS CLOSED	1) The interlocks are closed (normal operation), power on terminal 7.
SYSTEM ERROR	1) The flame detected is out of sequence, flame signal light is on. 2) The sensor is "runaway", flame signal light is on. 3) Inductance is detected on sensor wires, flame signal light is on. 4) Voltage wired into terminals 3, 4 or 5. 5) Internal relay contacts welded. 6) Internal controller failure. 7) Air flow switch closed before start-up. 8) High purge damper switch and/or main fuel valve switch opens during start-up. 9) Low fire switch not made before TFI.
FLAME FAILURE	1) Pilot flame is not established in selected TFI. 2) Main flame is not established in selected TFI. 3) Main flame fails within 35 seconds of TFI. 4) Flame failed during operation in non-recycle mode. 5) Flame failed 35 seconds after TFI and was not established after try in recycle mode.
AIR FAILURE	1) Air flow switch not closed within ten seconds of start-up. 2) Air flow switch is open during timing cycle. 3) Air flow switch is open during firing cycle.
INTERLOCKS CLOSED and AUTO	1) Burner in run mode, firing rate determined by automatic controller (normal operation).
INTERLOCKS CLOSED and HIGH FIRE	1) Purge high sequence (normal operation).
INTERLOCKS CLOSED and LOW FIRE	1) Purge low sequence (normal operation).



Modulation Model

Remote Display Messages

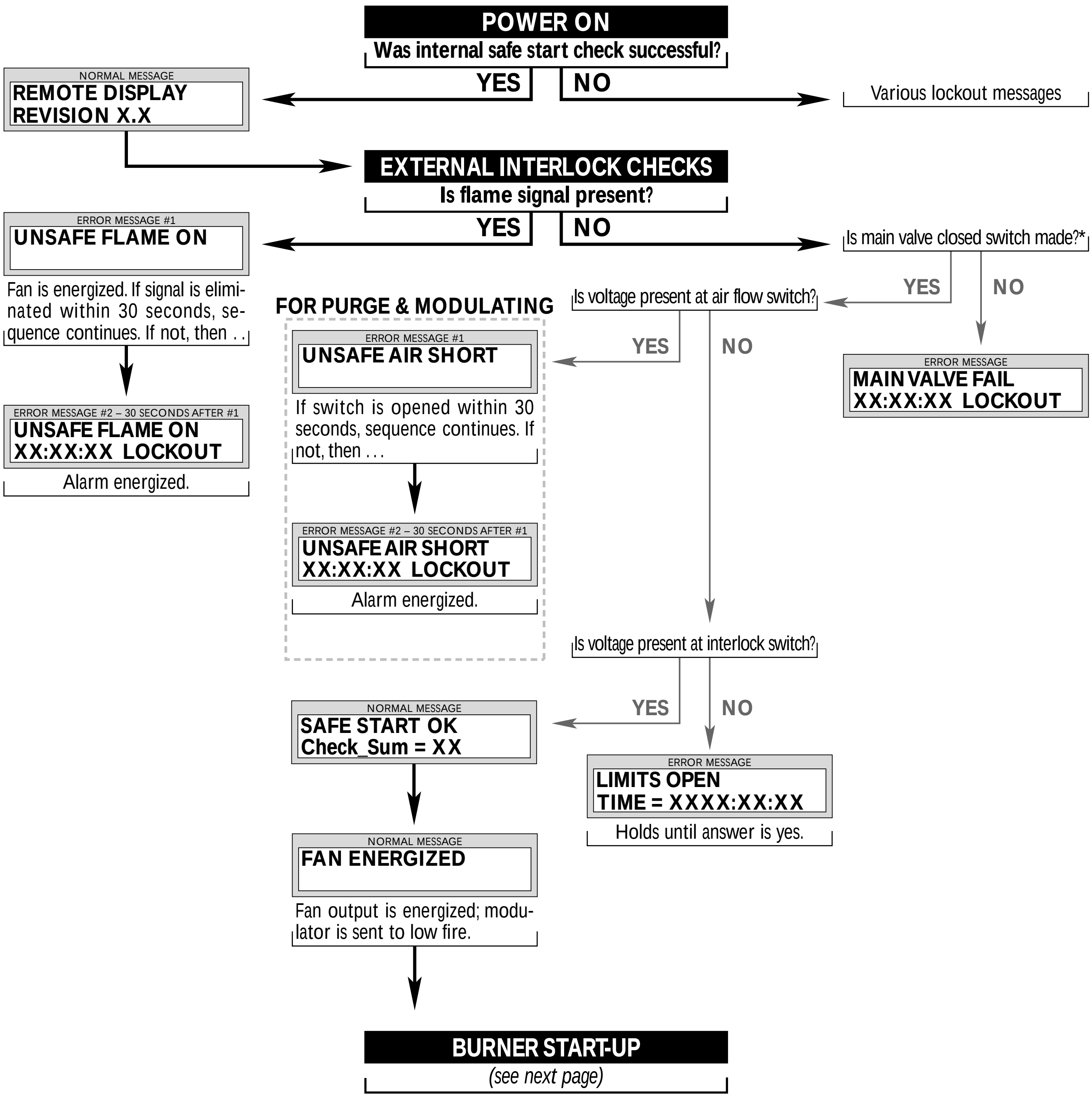
9

INTRODUCTION

This section covers how the optional remote display is used with the Veri-Flame. The remote display provides LCD messages which monitor the status of the Veri-Flame's functions as well as any lockout conditions. This section is divided into two parts or tables:

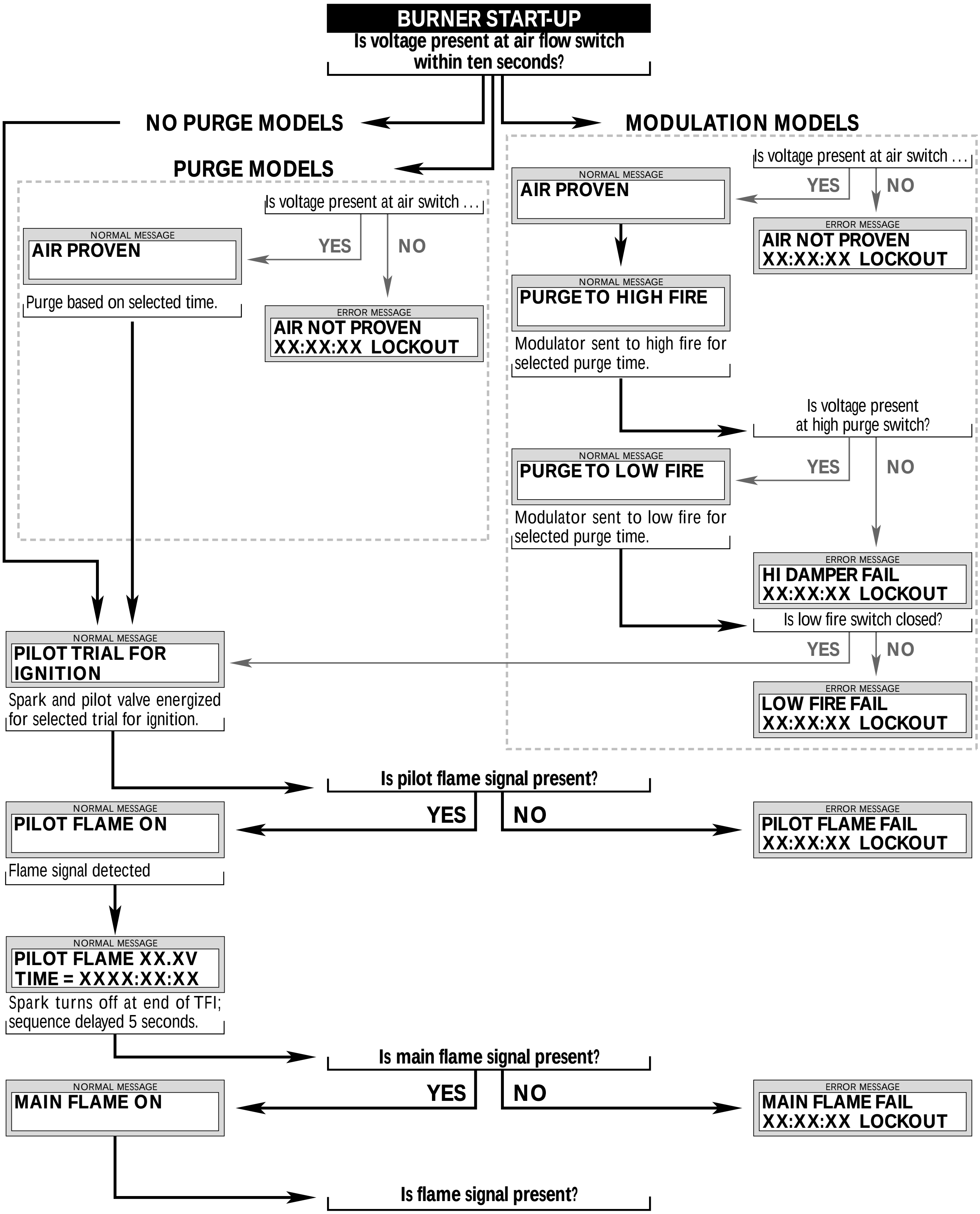
- The first table describes the start-up and shutdown monitoring sequences of the Veri-Flame and how the progress (or halt) of the sequence can be monitored by the messages on the remote display.
- The second table alphabetically lists and explains the diagnostic messages which can appear on the remote display.

Table 9.1 **Veri-Flame Operating Sequence**



* Applies to purge and no purge models only.

Table 9.1 **Veri-Flame Operating Sequence** (continued)



(see next page)

Table 9.1 **Veri-Flame Operating Sequence** (continued)

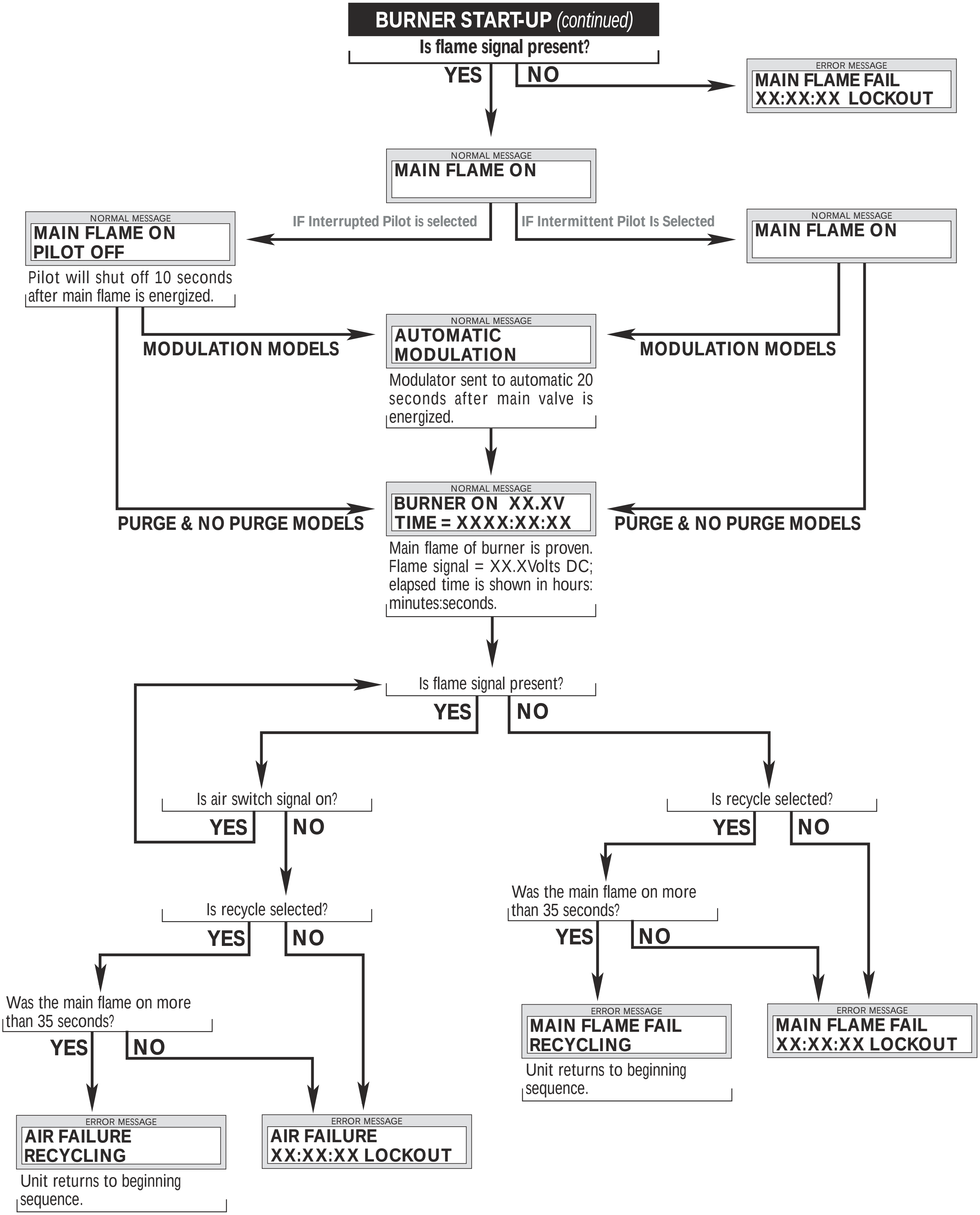
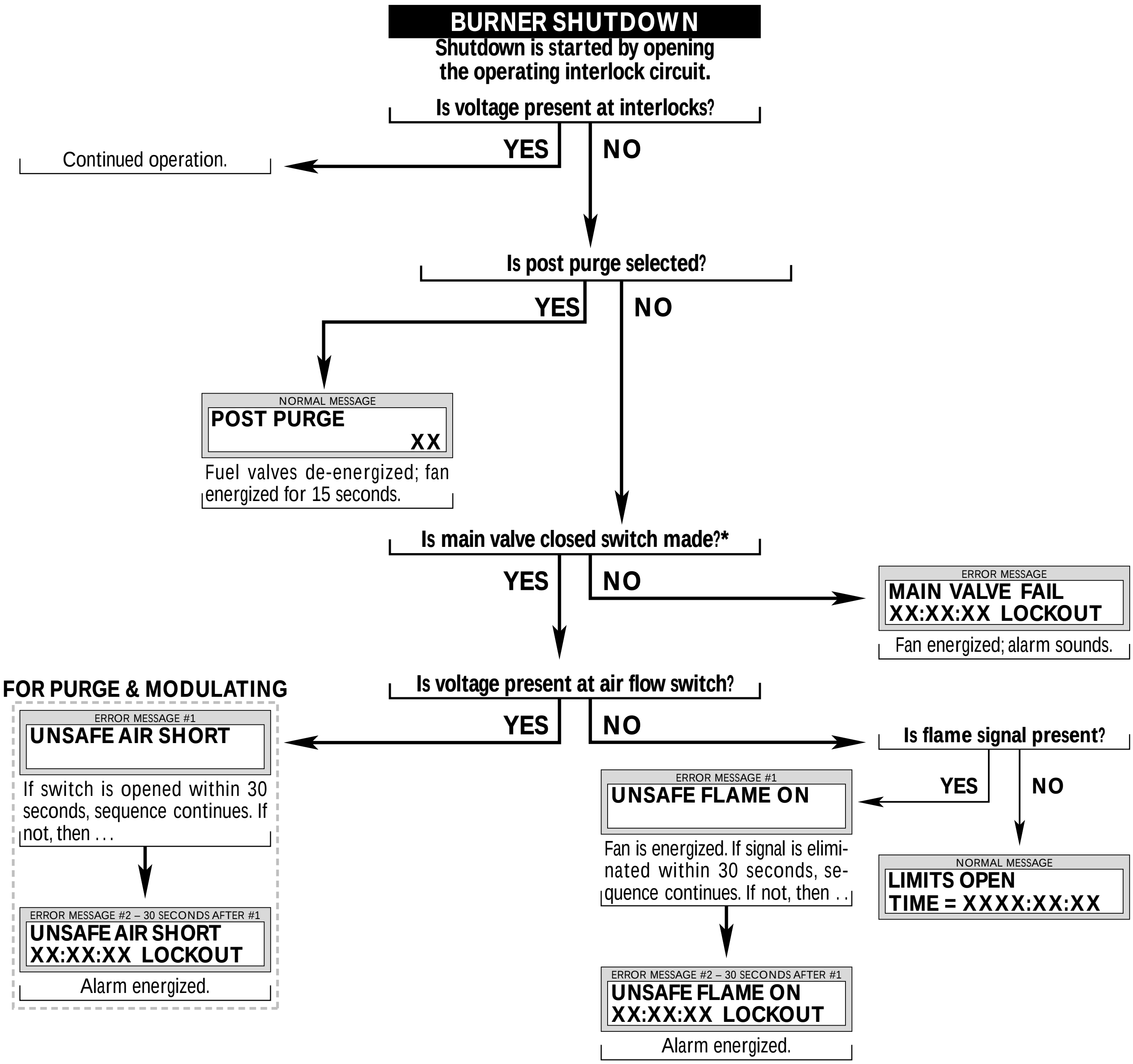


Table 9.1 **Veri-Flame Operating Sequence** (continued)



* Applies to purge and no purge models only.

Table 9.2 **Remote Display Diagnostic Messages (Listed Alphabetically)**

MESSAGE	TYPE	EXPLANATION
AIR FAILURE XX:XX:XX LOCKOUT	Lockout	**For purge & modulation models:** Combustion air flow limit switch opened for more than two seconds once initially proven.
AIR FAILURE RECYCLING	Status	**For purge & modulation models:** Combustion air flow limit switch opened; if "recycle" has been selected, the Veri-Flame will restart the sequence after air failure (see "Recycle Mode" on page 14).
AIR NOT PROVEN XX:XX:XX LOCKOUT	Lockout	**For purge & modulation models:** Combustion air flow limit switch did not make within ten seconds of fan being energized.
AIR PROVEN	Status	**For purge & modulation models:** Combustion air flow limit switch closed within ten seconds of fan being energized.
AUTOMATIC MODULATION	Status	**For modulation models only:** Modulating motor is sent to automatic operation.
BURNER ON XX.XV TIME=XXXX:XX:XX	Status	Main flame of burner is proven in the automatic modulation mode; flame strength is XX.XV (volts DC). Elapsed time is shown in hours:minutes:seconds.
D-INTERNAL FAIL XX:XX:XX:XX LOCKOUT	Lockout	**For modulation models only:** Internal control failure; replace controller.
FAN ENERGIZED	Status	**For purge & modulation models:** Blower motor is energized at the start of pre-purge.
FLAME FAILURE XX:XX:XX LOCKOUT	Lockout	Main flame lost during operation in the automatic modulation mode. Burner number (X) given of failed unit.
HI DAMPER/POVC XX:XX:XX LOCKOUT	Lockout	**For modulation models only:** High damper or high purge rate switch did not make at the end of pre-purge to high fire.
K-INTERNAL FAIL XX:XX:XX LOCKOUT	Lockout	Internal control failure; replace controller.
L-INTERNAL FAIL XX:XX:XX LOCKOUT	Lockout	Internal control failure; replace controller.
LIMITS OPEN TIME=XXXX:XX:XX	Status	The controller has completed its internal checks and is standing by for the interlocks to close.
LOW FIRE FAIL XX:XX:XX LOCKOUT	Lockout	**For modulation models only:** Low fire switch is open just prior to pilot trial for ignition.
MAIN FLAME FAIL XX:XX:XX LOCKOUT	Lockout	Main flame was not established during the main burner trial for ignition.
MAIN FLAME FAIL RECYCLING	Status	Main flame lost during automatic modulation; control will recycle once if "recycle" has been selected.

Table 9.2 **Remote Display Diagnostic Messages** (continued)

MESSAGE	TYPE	EXPLANATION
MAIN FLAME ON	Lockout	Main valve has been energized and main flame proven during trial for ignition.
MAIN FLAME ON PILOT OFF	Status	Pilot valve is de-energized and main flame is on.
MAIN VALVE FAIL XX:XX:XX LOCKOUT	Lockout	**For purge and no purge models:** Main valve closed switch is open before start-up or after burner shutdown.
NO PURGE SELECT XX:XX:XX LOCKOUT	Lockout	**For purge & modulation models:** No purge time was selected; lockout prior to purge to high fire.
PILOT FLAME FAIL XX:XX:XX LOCKOUT	Lockout	Pilot flame was not established during the pilot trial for ignition.
PILOT ON	Status	Pilot flame is proven; transformer is de-energized; remaining countdown for pilot trial for ignition is.
PILOT TRIAL FOR IGNITION	Status	Pilot valve and ignition transformer are energized; countdown for pilot trial for ignition begins.
POST PURGE	Status	**For purge & modulation models:** 15 second post purge is started on burner shutdown.
PROGM SWITCH ERR XX:XX:XX LOCKOUT	Lockout	DIP switch improperly set or changed during cycle.
PURGE TO HIGH FIRE	Status	**For modulation models only:** Modulating motor is sent to high fire.
PURGE TO LOW FIRE	Status	**For modulation models only:** Modulating motor is sent to low fire.
RELAY FAIL XX:XX:XX LOCKOUT	Lockout	Internal relay(s) fail initial check. Check ratings. If lockout still occurs after overload is eliminated, replace control.
SAFE START OK	Status	Control has completed internal safe-start check.
UNSAFE AIR SHORT	Status	**For purge & modulation models:** Combustion air switch is closed before start-up or after shutdown; control holds start-up until switch reopens; if interlocks close before switch opens, alarm is energized.
UNSAFE AIR SHORT XX:XX:XX LOCKOUT	Lockout	**For purge & modulation models:** Same conditions as above, except the interlocks close before the switch reopens, causing a lockout and the alarm being energized.

Table 9.2 **Remote Display Diagnostic Messages** (continued)

MESSAGE	TYPE	EXPLANATION
UNSAFE FLAME ON	Hold	Flame signal—actual, induced, or runaway scanner—is detected before start-up or after shutdown. The fan is energized. If the cause is corrected within 30 seconds, as in afterburn, the control will turn off the fan and continue the sequence.
UNSAFE FLAME ON XX:XX:XX LOCKOUT	Lockout	Same conditions as above, except the cause has not been corrected within 30 seconds, resulting in a lockout and the alarm being energized.
UNSAFE–FLM–PURGE	Hold	**For purge & modulation models:** Flame signal—actual, induced, or runaway scanner—is detected during the selected purge time period. The fan is energized. If the cause is corrected within 30 seconds, as in afterburn, the control will turn off the fan and continue the sequence.
UNSAFE–FLM–PURGE XX:XX:XX LOCKOUT	Lockout	**For purge & modulation models:** Same conditions as above, except the cause has not been corrected within 30 seconds, resulting in a lockout and the alarm being energized.
V–INTERNAL FAULT XX:XX:XX LOCKOUT	Lockout	Internal control failure; replace controller.
WATCHDOG FAIL XX:XX:XX LOCKOUT	Lockout	Internal control failure; replace controller.
XXXXXXX XXXXXTESTXX	Status	In combination with other messages, shows the control is in the minimum pilot test mode.

Appendix

Conversion Factors

Metric to English.

From	To	Multiply by
cubic meter (m^3)	cubic foot (ft^3)	35.31
cubic meter/hour (m^3/h)	cubic foot/hour (cfh)	35.31
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 1.8) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	Btu/hr	3414
meter (m)	foot (ft)	3.28
millibar (mbar)	inches water column ("wc)	0.401
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}

Metric to Metric.

From	To	Multiply by
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

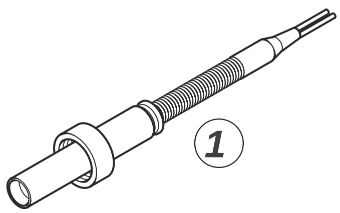
English to Metric.

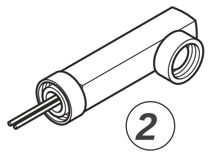
From	To	Multiply by
Btu/hr	kilowatt (kW)	0.293×10^{-3}
cubic foot (ft^3)	cubic meter (m^3)	2.832×10^{-2}
cubic foot/hour (cfh)	cubic meter/hour (m^3/h)	2.832×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F − 32) ÷ 1.8
foot (ft)	meter (m)	0.3048
inches (in)	millimeter (mm)	25.4
inches water column ("wc)	millibar (mbar)	2.49
pound (lb)	kilogram (kg)	0.454
pounds/sq in (psi)	millibar (mbar)	68.95

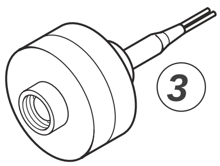
Illustrated Parts List

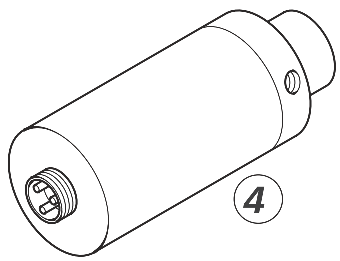
Category	Pos. No.	Description	Model Number	Part Number
Sensors	1	Straight U.V. scanner	5600-91	49600-91
	——	NEMA 4 U.V. scanner	5600-91N4	20898
	2	90˚ U.V. scanner	5600-90A	49600-90
	3	I.R. scanner	5600-92B	49600-92
	4	Self-check scanner	5602-91	49602-91
	5	Solid-state U.V./I.R. scanner	5600-92SC	21349
	——	10-foot cable for self-check scanner	5602-91-7	49602-91-7
	6	Scanner support (max. temp. 220˚F) (1)	5600-90A SS	20722
	6	Scanner support (max. temp. 475˚F) (1)	5600-90A SSH	20723
	7	Magnifying lens assembly	5600-98	49600-98
	——	Lens, magnifying		49600-99
	——	Lens, non-magnifying (2)		18165
	8	Insulated coupling	5600-99	49099
	——	Cable, coax, RG62A/U for flame rod		21741
Bases	9	Internal terminal base, metal	5602-10	49602-10
	10	Exposed terminal base, metal	5602-10-1	49602-10-1
	——	Internal terminal base, plastic	5602-10-P	22194
	——	Adapter Base RA890	5602-12	49602-12
	——	Adapter Base R4795	5602-14	49602-14
	11	Modulation base	5602-40	49602-40
	——	Screw, mounting to plastic base		22110
	——	Screw, mounting to metal base		22385
Test	——	Tester for Veri-Flame units	5602	49602
	——	Relay module (3)	5602-40-4	49240-2
Display	12	Remote display, 24V	5602 DB	20316
	——	Remote display, 120VAC with keypad	5602 DBP	20896
	——	Power supply, 24VDC (4)		20317
	——	Cable for remote display		20318

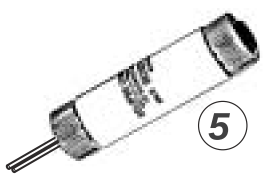
(1) For 90º U.V. scanner (Model No. 5600-90A), I.R. scanner (5600-92B), and solid state U.V./I.R. scanner (5600-92SC)
(2) For magnifying lens assembly (Model No. 5600-98), and self-check scanner (5602-91)
(3) Used to test modulation controls on tester (Model No. 5602) above.
(4) To be used with 20316 display only (not 20896).

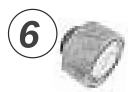


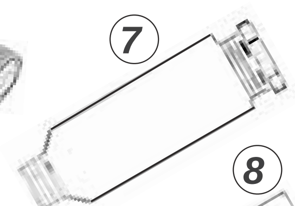


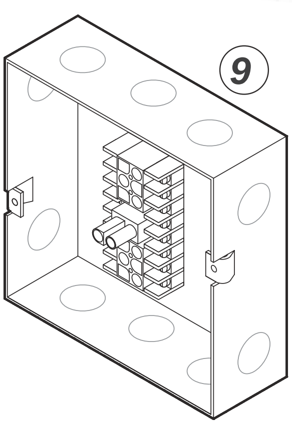


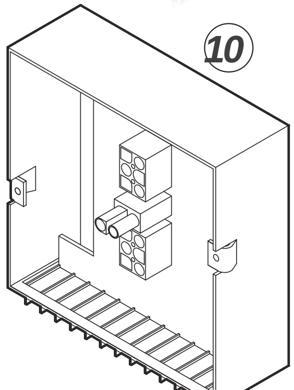


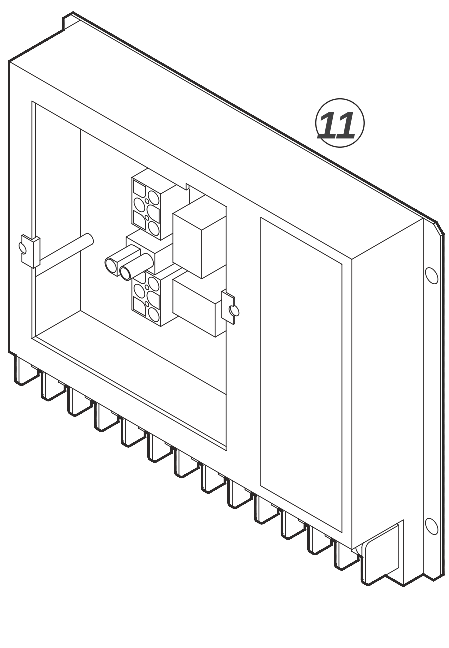


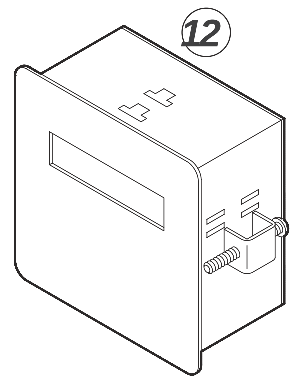












ECLIPSE™
Innovative Thermal Solutions
Eclipse Combustion
www.eclipsenet.com

GAO-A2-4
GMH-A2-4
GML-A2-4
Installation Instructions

DUNGS®

SPECIFICATIONS

High/low gas pressure switch (SPDT) with automatic or manual reset and with visual indication of switch position. Mounts directly to various ports on the DMV series valves and/or FRI series regulators.

Gases
Natural gas, Propane, Butane; Other Noncorrosive gases

Switch
SPDT

Switch action
GAO: high/low limit, NC breaks on rise, automatic reset
GMH: high limit, NC breaks on rise, manual reset
GML: low limit, NO breaks on fall, manual reset

Contact Rating
10 A res., 8 FLA, 48 LRA @120 Vac

Electrical Connection
1/2” NPT NPT 1/2” conduit connection

Enclosure
NEMA Type 4

Maximum Operating Pressure
7 PSI (500 mbar)

Ambient / Fluid Temperature
-40°F to +140°F; (-40°C to +60°C)

Materials in contact with Gas
Housing: Aluminum, Steel; **Seals**: NBR-based rubber

Approvals
UL Listed: File No. MH 16628, Guide No. MFHX
FM Approved: Report J.I. 1T7A8.AF and J.I. 1Y9A9.AF
CSA Certified: LR 73925

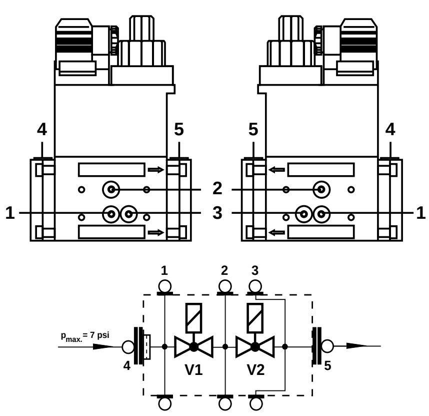
ATTENTION

- Read these instructions carefully.
- Failure to follow them and/or improper installation may cause explosion, property damage and injuries.
- Installation must be done with the supervision of a licensed burner technician.
- The system must meet all applicable national and local code requirements.
- Check the ratings in the specifications and on the switch to make sure that it is suitable for your application.
- Never perform work if gas pressure or power is applied, or in the presence of an open flame.
- Once installed, perform a complete checkout including leak testing.
- Label all wires prior to disconnection when servicing. Wiring errors can cause improper and dangerous operation
- Verify proper operation after servicing.

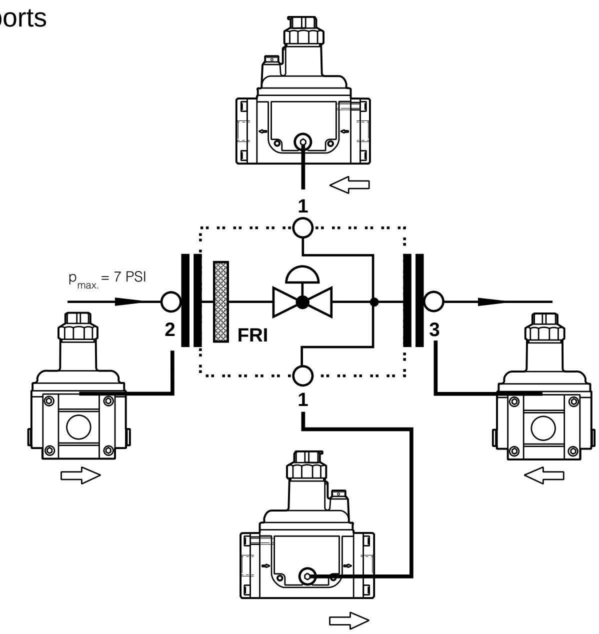
MOUNTING

Location
Model GAO-A2-4, GMH-A2-4, and GML-A2-4 can be mounted directly to various ports on the DMV system. The pressure switch should be mounted in locations meeting the requirements of the applicable code. Order mounting kit D214975 for DMV port 3 mount.

DMV ports



FRI ports



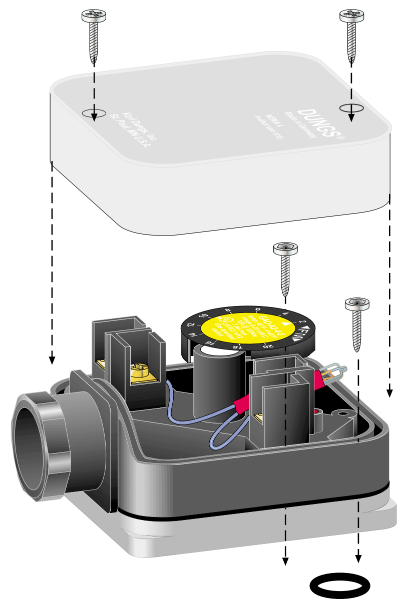
KARL DUNGS INC.
524 Apollo Drive,Suite 10 Lino Lakes, MN 55014 U.S.A.
Phone: (651) 792-8912 Fax: (651) 792-8919 E-mail: info@karldungsusa.com

MOUNTING

Recommended Mounting Procedure

- Remove the clear cover of the switch.
- Take out the self tapping socket head screws.
- Make sure the O-ring and the groove are clean and in good condition.
- Place the O-ring into the groove on the back of the pressure switch.
- Remove the G 1/8 plug from the port on the flange, the regulator, or the valve with a 3 mm hex key wrench.
- Mount the switch onto the port using the M 4 x 20 mm socket head screws.
- Make sure that the O-ring is located in the groove.
- Tighten the screws snugly, do not exceed 22 lb-in
- Perform a leak test to verify that no leakage occurs around the O-ring.

> ⚠ ATTENTION: Venting is NOT required. The switches have a built in restricting orifice.

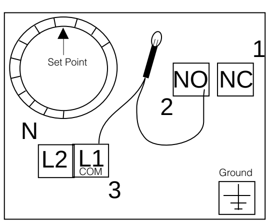


WIRING

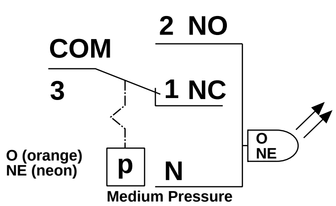
- Remove the clear cover from the switch.
- Use 14 or 16 AWG wire rated for at least 75°C
- Route the wires through the conduit connector
- Connect the wiring to the appropriate screw terminals on the terminal strip.

> ⚠ CAUTION: All wiring must comply with local electrical codes, ordinances and regulations.
>
> ⚠ CAUTION: Do not exceed the switch ratings given in the specifications and on the switch.

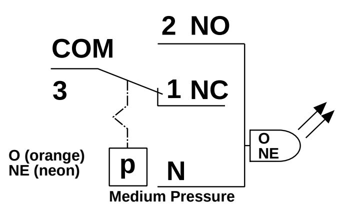
Wiring terminal illustration



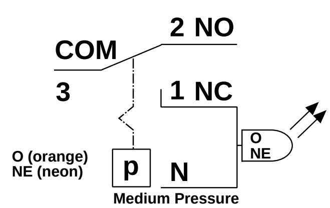
GAO switching function (upper)
As pressure rises:
1 NC opens, 2 NO closes
As pressure falls:
1 NC closes, 2 NO opens



GMH switching function
As pressure rises
2 NO closes, 1 NC opens
Neon light ON, tripped.



GML switching function shown in Operating state.
As pressure falls
2 NO opens, 1 NC closes
Neon light ON, tripped.



OPERATION

Set Point Calibration

The set point dial of the GAO and GMH is factory calibrated with increasing pressure (GML: decreasing pressure). Due to hysteresis the GAO switch will actuate at a slightly lower point when the pressure decreases.

Adjusting the Set Point

- Remove the clear cover from the switch.
- Adjust the set point to the desired set point pressure by turning the dial until the desired pressure is opposite the white arrow on the yellow dial face.
- After adjusting the set point for normal operation check to see that the gas pressure switch operates as intended.
- Use an accurate pressure gauge connected upstream from the switch to measure the actual pressure.
- Replace the clear cover.

Automatic Reset

The NC contact of the GAO-A2-4 breaks when pressure rises above the set point. It makes automatically when pressure falls below set point.

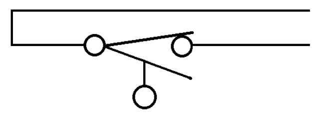
Manual Reset

The NC contact of the GMH-A2-4 breaks when pressure rises to the set point. The NO contact of the GML-A2-4 breaks when pressure falls to set point. Nether of the switches will return to their former position automatically. To reset one of these pressure switches, wait until the pressure falls (GML-A2-4: rises) below (GML-A2-4: above) the set point. Then press the clear cover over the red reset button in the center of the yellow dial face and release it.

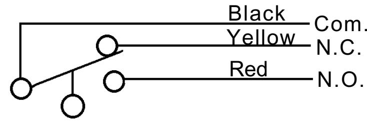
Electrical Data . . .

Standard snap-action switch is a 20VA, SPST, hermetically sealed,magnetically actuated, make-and-break type. Normally open or normally closed operation is selectable by inverting floats on unit stem. A level station with SPDT 3-wire switch is available as a separate component if required.

Typical Wiring Diagrams



SPST Switch N.O. or N.C. (Dry).
Selectable by Inverting Float.



SPDT Switch in N.C. (Dry) Position

Switch Ratings . . . Max. Resistive Load

VA	Volts	Amps AC	Amps DC
20	0-30	.4	.3
	120	.17	.13
	240	.08	.06

Important Points!

Product must be maintained and installed in strict accordance with the National Electrical Code and GEMS product catalog and instruction bulletin. Failure to observe this warning could result in serious injuries or damages.

An appropriate explosion-proof enclosure or intrinsically safe interface device must be used for hazardous area applications involving such things as *(but not limited to)* ignitable mixtures, combustible dust and flammable materials.

Pressure and temperature limitations shown on individual catalog pages and drawings for the specified level switches must not be exceeded. These pressures and temperatures take into consideration possible system surge pressures/temperatures and their frequencies.

Selection of materials for compatibility with the media is critical to the life and operation of GEMS level switches. Take care in the proper selection of materials of construction; particularly wetted materials.

Life expectancy of switch contacts varies with applications. Contact GEMS if life cycle testing is required.

Ambient temperature changes do affect switch set points, since the specific gravity of a liquid can vary with temperature.

Level switches have been designed to resist shock and vibration; however, shock and vibration should be minimized.

Liquid media containing particulate and/or debris should be filtered to ensure proper operation of GEMS products.

Electrical entries and mounting points may require liquid/vapor sealing if located in an enclosed tank.

Level switches must not be field repaired.

Physical damaged sustained by the product may render it unserviceable.

P/N 72946
Rev. L

Gems Sensors Inc.
One Cowles Road
Plainville, CT
06062.1198

tel 860.747.3000
fax 860.747.4244

Fabri-Level Switch Kit

Instruction Bulletin No. 72946

Fabri-Level Kits contain all components for complete assembly of a 1- or 2-station level switch unit for pipe-plug mounting in your tank. Each kit contains: 1 Tube Connector, 1 Mounting Plug, 2 Level Stations (Switch, Tube, Float), 2 Extension Tubes, 1 Tube End Fitting, 3 Tube Unions.

Specifications . . .

Conduit Thread: 1/2" NPT-F
Tube/Fitting Size: 1/2" O.D.
Max. No. Levels per Stem: 6
Mounting Attitude: Vertical ± 30°
Fitting Ferrule:
Buna N Floats: Nylon
Stainless Floats: 316 Stainless Steel

N.O. or N.C. operation of the SPST switch is selectable by inverting the float(s) on the unit stem. **Note: SPDT circuits must have "N.O." toward lead wires. SPDT floats are not reversible.** Two 10" lengths of tube are furnished to space level stations as desired.

Switch	Material	Oper. Temp. Water	Oper. Temp. Oil	Min. Sp. Gr.	Pres. (Max.PSI)	Mtg. NPT	Part Number
SPST 20 VA	Brass Fittings, Buna N Floats	To 180°F (82.2°C)	-40°F to +230°F	.55	150	2"	24576
				.75		1-1/4"	26128
	316 SS Fittings, Buna N Floats		(-40°C to +110°C)	.75		1-1/4"	26130
				55		2"	26675
	All 316 SS	-40°F to +275°F (-40°C to +135°C)		.80	750	2"	24577

CE This product is suitable for Class I and Class II applications only, per the requirements of standard EN60730 and any additional specific requirements for a particular application or medium being sensed. Class I compliance of metal bodied units requires a ground connection between the metal body and the earthing system of the installation. Class I compliance of plastic bodied units in contact with a conductive medium requires that the medium be effectively earthed so as to provide an earthed barrier between the unit and accessible areas. For Class III compliance, a supply at safety extra-low voltage (SELV) must be provided. Please consult the Factory for compliance information on specific part numbers.

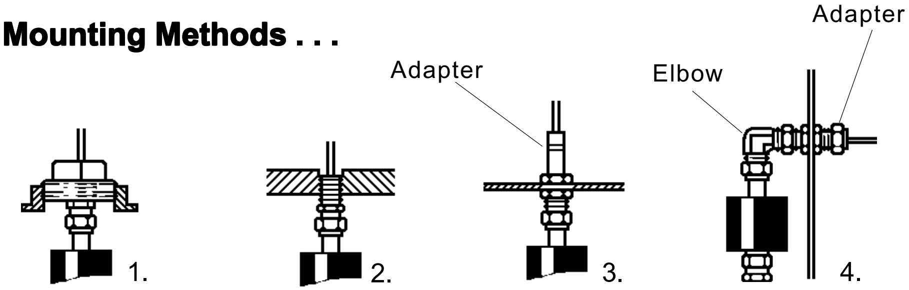
Installation and Maintenance . . .

Installation can be from top, bottom or side of tank, as shown below. Usually installed as nearly vertical as possible, units will operate reliably as much as 30o from the vertical. Only two wrenches are needed to assemble. From one to six level stations may be spaced as desired on a single unit. You merely follow **"Assembly Instructions"**, install in tank, connect electrical leads and your "tailor-made" unit is ready for use . . . in any media compatible with Brass and Buna N or 316 Stainless Steel - the two material options available.

Installation and Maintenance (Cont.)

Maintenance requirements are minimal and usually limited to occasional clean-up of scum or scale accumulation.

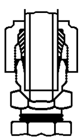
Mounting Methods . . .



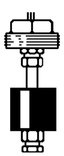
1. 1-1/4" or 2" NPT pipe plug. Top or bottom mount, boss or thickwall tank. Permits unit insertion from outside.

2. 3/8" NPT-M tube connector. Top or bottom mount from inside. Boss or thickwall tank.

3, 4. Top-mount through sheet metal cover, or with 90° elbow for mounting unit from inside of tank.



Pressure-type fittings form positive seal. Tube cannot turn, wires cannot twist during tightening. Nylon ferrule for brass units, SS ferrule for stainless units. 13/16" and 7/8" HEX fittings.



2" NPT mounting plug permits entire unit to be inserted in tank from outside. 1/2" NPT-F provides direct electrical conduit connection. A 1-1/4" NPT mounting plug is also available.

Assembly Instructions . . .

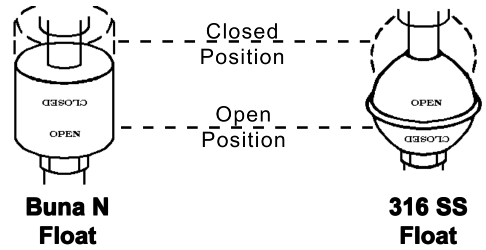
1. Assemble unit, observing the following sketches and information.

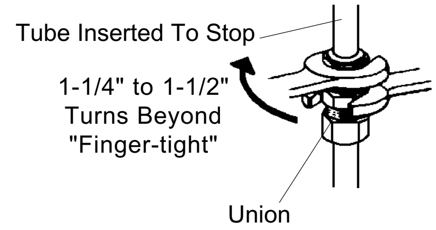
a/ Extension Tubes (When Required): Cut to proper length. Tubes 36" long are available as components, or use any 1/2" tubing of suitable non-magnetic material.

b/ Level Stations: Assemble floats on switch tubes for desired switch operation, as shown. Feed level station wires through switch tubes of each level station, toward mounting plug. **Note: Floats are shown in normally open (dry) position. To reverse operation, invert floats.** (See next page)

Note

SPDT circuits must have "N.O." towards lead wire end of switch tube. SPDT floats are not reversible.



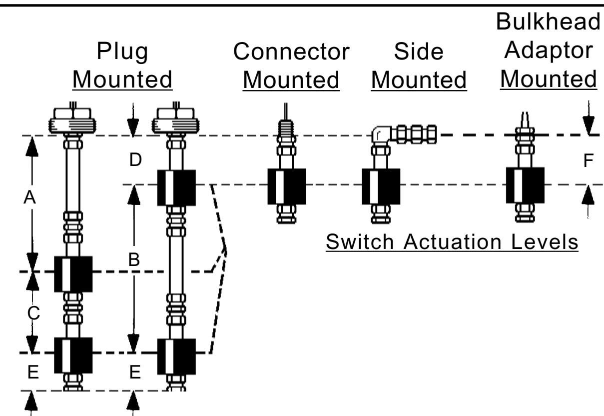


c/ **Coupling Components Together:** Insert tubes to limit in fittings and tighten “finger-tight”. After checking entire unit, wrench-tighten as illustrated. **Important: Always assemble entire unit “finger-tight” first, then check level locations and switch operation (N.O. or N.C.) before final tightening.**

2. **Install Unit in Tank:** Fabri-Level units with 1 1/4" or 2" NPT mounting plugs are installed through a boss or tapped hole from outside of tank. Units with alternate mountings are installed from the inside.

3. **Electrical Leads:** Leads are readily identified for connection; i.e., switch leads nearest mounting end of unit project the farthest, etc. **CAUTION: See “Switch Ratings” before connecting power to Fabri-Level unit.**

Actuation Level Dimensional Data . . .



Note: Buna N floats shown.

When two or more extension tubes are coupled together for greater length, assemble coupling unions before cutting to length per "A" or "B" (In illustration at left).

For Units with Buna N Floats . . .

A. Min. with tube extension: 4-3/4"
Cut tube to length: "A" minus 2-7/8"
B. Min. with tube extension: 6-5/16"
Cut tube to length: "B" minus 4-15/16"
C. 4-1/4": Closest that levels can be.
D. 2-5/8": Highest possible level.
E. 2-1/8": Lowest possible level.
F. 2-7/8": Minus tank wall thickness.

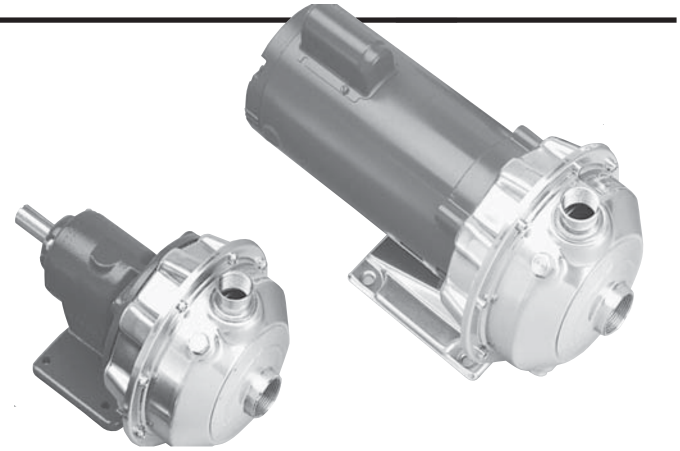
For Units with 316 Stainless Floats . . .

A. Min. with tube extension: 4-1/2"
Cut tube to length: "A" minus 2-5/8"
B. Min. with tube extension: 6-5/8"
Cut tube to length: "B" minus 4-11/16"
C. 4-1/2": Closest that levels can be.
D. 2-3/8": Highest possible level.
E. 2-5/8": Lowest possible level.
F. 2-5/8": Minus tank wall thickness.

G&L Pumps

Installation, Operation and Maintenance Instructions

Model NPE/ NPE-F



DESCRIPTION & SPECIFICATIONS:

The Models NPE (close-coupled) and NPE-F (frame-mounted) are end suction, single stage centrifugal pumps for general liquid transfer service, booster applications, etc. Liquid-end construction is all AISI Type 316 stainless steel, stamped and welded. Impellers are fully enclosed, non-trimable to intermediate diameters. Casings are fitted with a diffuser for efficiency and for negligible radial shaft loading.

Close-coupled units have NEMA 48J or 56J motors with C-face mounting and threaded shaft extension. Frame-mounted units can be coupled to motors through a spacer coupling, or belt driven.

1. Important:

1.1. Inspect unit for damage. Report any damage to carrier/dealer immediately.

1.2. Electrical supply must be a separate branch circuit with fuses or circuit breakers, wire sizes, etc., per National and Local electrical codes. Install an all-leg disconnect switch near pump.

CAUTION

Always disconnect electrical power when handling pump or controls.

1.3. Motors must be wired for proper voltage. Motor wiring diagram is on motor nameplate. Wire size must limit maximum voltage drop to 10% of nameplate voltage at motor terminals, or motor life and pump performance will be lowered.

1.4. Always use horsepower-rated switches, contactor and starters.

1.5. Motor Protection

1.5.1. Single-phase: Thermal protection for single-phase units is sometimes built in (check nameplate). If no built-in protection is provided, use a contactor with a proper overload. Fusing is permissible.

1.5.2. Three-phase: Provide three-leg protection with properly sized magnetic starter and thermal overloads.

1.6. Maximum Operating Limits:

Liquid Temperature:	212º F (100º C) with standard seal. 250º F (120º C) with optional high temp seal.
Pressure:	75 PSI.
Starts Per Hour:	20, evenly distributed.

1.7. Regular inspection and maintenance will increase service life. Base schedule on operating time. Refer to Section 8.

2. Installation:

2.1. General

2.1.1. Locate pump as near liquid source as possible (below level of liquid for automatic operation).

2.1.2. Protect from freezing or flooding.

2.1.3. Allow adequate space for servicing and ventilation.

2.1.4. All piping must be supported independently of the pump, and must "line-up" naturally.

CAUTION

Never draw piping into place by forcing the pump suction and discharge connections.

2.1.5. Avoid unnecessary fittings. Select sizes to keep friction losses to a minimum.

2.2. Close-Coupled Units:

2.2.1. Units may be installed horizontally, inclined or vertically.

CAUTION

Do not install with motor below pump. Any leakage or condensation will affect the motor.

2.2.2. Foundation must be flat and substantial to eliminate strain when tightening bolts. Use rubber mounts to minimize noise and vibration.

2.2.3. Tighten motor hold-down bolts before connecting piping to pump.

2.3. Frame-Mounted Units:

2.3.1. It is recommended that the bedplate be grouted to a foundation with solid footing. Refer to Fig.1.

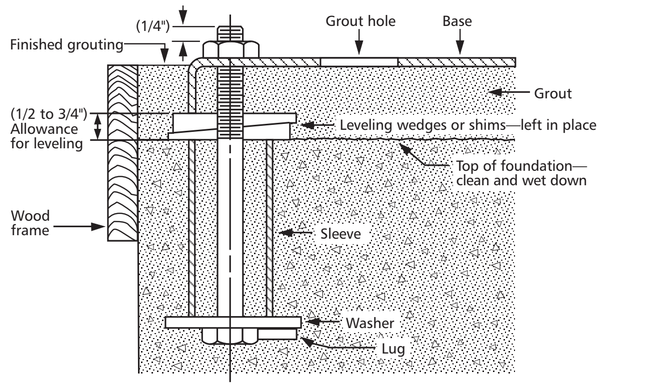


Figure 1

Goulds Pumps

ITT Industries

2.3.2. Place unit in position on wedges located at four points (two below approximate center of driver and two below approximate center of pump). Adjust wedges to level unit. Level or plumb suction and discharge flanges.

2.3.3. Make sure bedplate is not distorted and final coupling alignment can be made within the limits of movement of motor and by shimming, if necessary.

2.3.4. Tighten foundation bolts finger tight and build dam around foundation. Pour grout under bedplate making sure the areas under pump and motor feet are filled solid. Allow grout to harden 48 hours before fully tightening foundation bolts.

2.3.5. Tighten pump and motor hold-down bolts before connecting the piping to pump.

3. Suction Piping:

3.1. Low static suction lift and short, direct, suction piping is desired. For suction lift over 10 feet and liquid temperatures over 120 F, consult pump performance curve for Net Positive Suction Head Required.

3.2. Suction pipe must be at least as large as the suction connection of the pump. Smaller size will degrade performance.

3.3. If larger pipe is required, an eccentric pipe reducer (with straight side up) must be installed at the pump.

3.4. Installation with pump below source of supply:

3.4.1. Install full flow isolation valve in piping for inspection and maintenance.

CAUTION

Do not use suction isolation valve to throttle pump.

3.5. Installation with pump above source of supply:

3.5.1. Avoid air pockets. No part of piping should be higher than pump suction connection. Slope piping upward from liquid source.

3.5.2. All joints must be airtight.

3.5.3. Foot valve to be used only if necessary for priming, or to hold prime on intermittent service.

3.5.4. Suction strainer open area must be at least triple the pipe area.

3.6. Size of inlet from liquid source, and minimum submergence over inlet, must be sufficient to prevent air entering pump through vortexing. See Figs. 2-5

3.7. Use 3-4 wraps of Teflon tape to seal threaded connections.

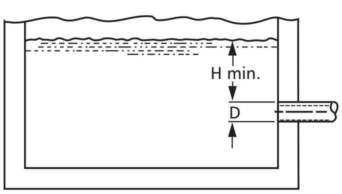


Figure 2

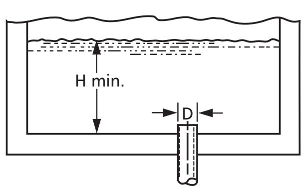


Figure 3

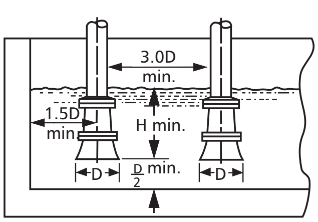


Figure 4

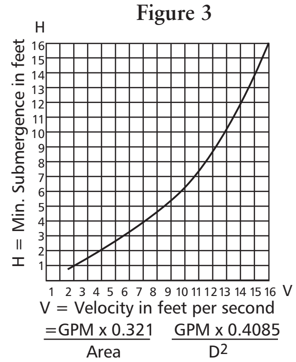


Figure 5

4. Discharge Piping:

4.1. Arrangement must include a check valve located between a gate valve and the pump. The gate valve is for regulation of capacity, or for inspection of the pump or check valve.

4.2. If an increaser is required, place between check valve and pump.

4.3. Use 3-4 wraps of Teflon tape to seal threaded connections.

5. Motor-To-Pump Shaft Alignment:

5.1. Close-Coupled Units:

5.1.1. No field alignment necessary.

5.2. Frame-Mounted Units:

5.2.1. Even though the pump-motor unit may have a factory alignment, this could be disturbed in transit and must be checked prior to running. See Fig. 6.

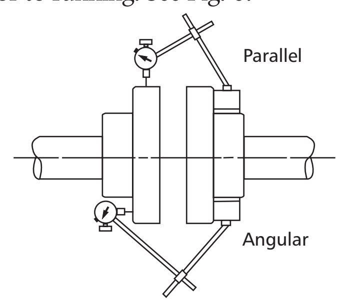


Figure 6

5.2.2. Tighten all hold-down bolts before checking the alignment.

5.2.3. If re-alignment is necessary, always move the motor. Shim as required.

5.2.4. Parallel misalignment - shafts with axis parallel but not concentric. Place dial indicator on one hub and rotate this hub 360 degrees while taking readings on the outside diameter of the other hub. Parallel alignment occurs when Total Indicator Reading is .005", or less.

5.2.5. Angular misalignment - shafts with axis concentric but not parallel. Place dial indicator on one hub and rotate this hub 360 degrees while taking readings on the face of the other hub. Angular alignment is achieved when Total Indicator Reading is .005", or less.

5.2.6. Final alignment is achieved when parallel and angular requirements are satisfied with motor hold-down bolts tight.

CAUTION

Always recheck both alignments after making any adjustment.

6. Rotation:

6.1. Correct rotation is right-hand (clockwise when viewed from the motor end). Switch power on and off quickly. Observe shaft rotation. To change rotation:

6.1.1. Single-phase motor: Non-reversible.

6.1.2. Three-phase motor: Interchange any two power supply leads.

7. Operation:

7.1. Before starting, pump must be primed (free of air and suction pipe full of liquid) and discharge valve partially open.

CAUTION

Pumped liquid provides lubrication. If pump is run dry,rotating parts will seize and mechanical seal will be damaged. Do not operate at or near zero flow. Energy imparted to the liquid is converted into heat. Liquid may flash to vapor. Rotating parts require liquid to prevent scoring or seizing.

7.2. Make complete check after unit is run under operating conditions and temperature has stabilized. Check for expansion of piping. On frame-mounted units coupling alignment may have changed due to the temperature differential between pump and motor. Recheck alignment.

8. Maintenance:

8.1. Close-Coupled Unit. Ball bearings are located in and are part of the motor. They are permanently lubricated. No greasing required.

8.2. Frame-Mounted Units:

8.2.1. Bearing frame should be regreased every 2,000 hours or 3 month interval, whichever occurs first. Use a #2 sodium or lithium based grease. Fill until grease comes out of relief fittings, or lip seals, then wipe off excess.

8.2.2. Follow motor and coupling manufacturers' lubrication instructions.

8.2.3. Alignment must be rechecked after any maintenance work involving any disturbance of the unit.

9. Disassembly:

Complete disassembly of the unit will be described. Proceed only as far as required to perform the maintenance work needed.

9.1. Turn off power.

9.2. Drain system. Flush if necessary.

9.3. Close-Coupled Units: Remove motor hold-down bolts.

Frame-Mounted Units: Remove coupling, spacer, coupling guard and frame hold-down bolts.

9.4. Disassembly of Liquid End:

9.4.1. Remove casing bolts (370).

9.4.2. Remove back pull-out assembly from casing (100).

9.4.3. Remove impeller locknut (304).

CAUTION

Do not insert screwdriver between impeller vanes to prevent rotation of close-coupled units. Remove cap at opposite end of motor. A screwdriver slot or a pair of flats will be exposed. Using them will prevent impeller damage.

9.4.4. Remove impeller (101) by turning counter-clockwise when looking at the front of the pump. Protect hand with rag or glove.

CAUTION

Failure to remove the impeller in a counter-clockwise direction may damage threading on the impeller, shaft or both.

9.4.5. With two pry bars 180 degrees apart and inserted between the seal housing (184) and the motor adapter (108), carefully separate the two parts. The mechanical seal rotary unit (383) should come off the shaft with the seal housing.

9.4.6. Push out the mechanical seal stationary seat from the motor side of the seal housing.

9.5. Disassembly of Bearing Frame:

9.5.1. Remove bearing cover (109).

9.5.2. Remove shaft assembly from frame (228).

9.5.3. Remove lip seals (138 & 139) from bearing frame and bearing cover if worn and are being replaced.

9.5.5. Use bearing puller or arbor press to remove ball bearings (112 & 168).

10. Reassembly:

10.1. All parts should be cleaned before assembly.

10.2. Refer to parts list to identify required replacement items. Specify pump index or catalog number when ordering parts.

10.3. Reassembly is the reverse of disassembly.

10.3.1. Impeller and impeller locknut assembled onto motor shaft with 10 ft-lbs of torque.

10.4. Observe the following when reassembling the bearing frame:

10.4.1. Replace lip seals if worn or damaged.

10.4.2. Replace ball bearings if loose, rough or noisy when rotated.

10.4.3. Check shaft for runout. Maximum permissible is .002" T.I.R.

10.5. Observe the following when reassembling the liquid-end:

10.5.1. All mechanical seal components must be in good condition or leakage may result. Replacement of complete seal assembly, whenever seal has been removed, is good standard practice.

It is permissible to use a light lubricant, such as glycerin, to facilitate assembly. Do not contaminate the mechanical seal faces with lubricant.

10.5.2. Inspect casing O-ring (513) and replace if damaged. This O-ring may be lubricated with petroleum jelly to ease assembly.

10.5.3. Inspect guidevane O-ring (349) and replace if worn.

CAUTION

Do not lubricate guidevane O-ring (349). Insure it is not pinched by the impeller on reassembly.

10.6. Check reassembled unit for binding. Correct as required.

10.7. Tighten casing bolts in a star pattern to prevent O-ring binding.

11. Trouble Shooting Chart:

MOTOR NOT RUNNING
(See causes 1 thru 6)

LITTLE OR NO LIQUID DELIVERED:
(See causes 7 thru 17)

POWER CONSUMPTION TOO HIGH:
(See causes 4, 17, 18, 19, 22)

EXCESSIVE NOISE AND VIBRATION:
(See causes 4, 6, 9, 13, 15, 16, 18, 20, 21, 22)

PROBABLE CAUSE:

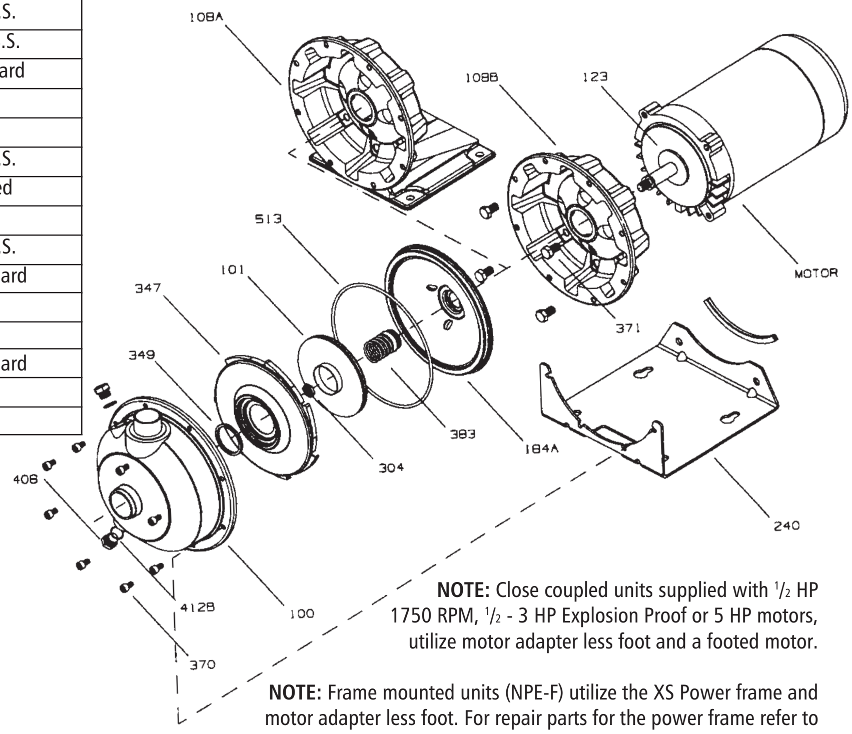
1. Tripped thermal protector
2. Open circuit breaker
3. Blown fuse
4. Rotating parts binding
5. Motor wired improperly
6. Defective motor
7. Not primed
8. Discharge plugged or valve closed
9. Incorrect rotation
10. Foot valve too small, suction not submerged, inlet screen plugged.
11. Low voltage
12. Phase loss (3-phase only)
13. Air or gasses in liquid
14. System head too high
15. NPSHA too low:
    Suction lift too high or suction losses excessive. Check with vacuum gauge.
16. Impeller worn or plugged
17. Incorrect impeller diameter
18. Head too low causing excessive flow rate
19. Viscosity or specific gravity too high
20. Worn bearings
21. Pump or piping loose
22. Pump and motor misaligned

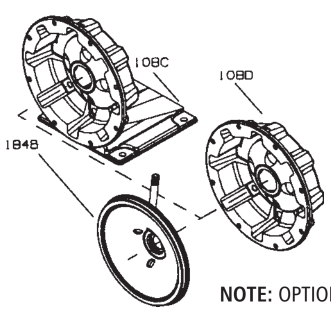
G&L Pumps

NPE Standard Repair Parts List

Item No.	Description	Materials of Construction
100	Casing	AISI 316L Stainless Steel
101	Impeller	
108A	Motor adapter with foot	
108B	Motor adapter less foot	
108C	Motor adapter with foot and Flush	
108D	Motor adapter less foot with Flush	
123	Deflector	BUNA-N
184A	Seal housing std.	AISI 316L S.S.
184B	Seal housing with seal flush	
240	Motor support	300 S.S.
	Rubber channel	Rubber
304	Impeller locknut	AISI 316 S.S.
347	Guidevane	AISI 316L S.S.
349	Seal-Ring, guidevane	Viton Standard
		EPR
		BUNA
370	Socket head screw, casing	AISI 410 S.S.
371	Bolts, motor	Steel/plated
383	Mechanical seal	
408	Drain and vent plug, casing	AISI 316 S.S.
412B	O-Ring, drain plugs	Viton, standard
		EPR
		BUNA
513	O-Ring, casing	Viton, standard
		EPR
		BUNA

Item 383 Mechanical Seal (⅝" seal)				
Rotary	Stationary	Elastomers	Metal Parts	Part No.
Carbon	Sil-Carbide	EPR	316SS	10K18
		Viton		10K55
Sil-Carbide		EPR		10K81
		Viton		10K62





NOTE: OPTIONAL SEAL FLUSH COMPONENTS

NOTE: Close coupled units supplied with ½ HP 1750 RPM, ½ - 3 HP Explosion Proof or 5 HP motors, utilize motor adapter less foot and a footed motor.

NOTE: Frame mounted units (NPE-F) utilize the XS Power frame and motor adapter less foot. For repair parts for the power frame refer to the XS-Power frame repair parts page in the parts section of your catalog. To order the power frame complete order item 14L61

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.

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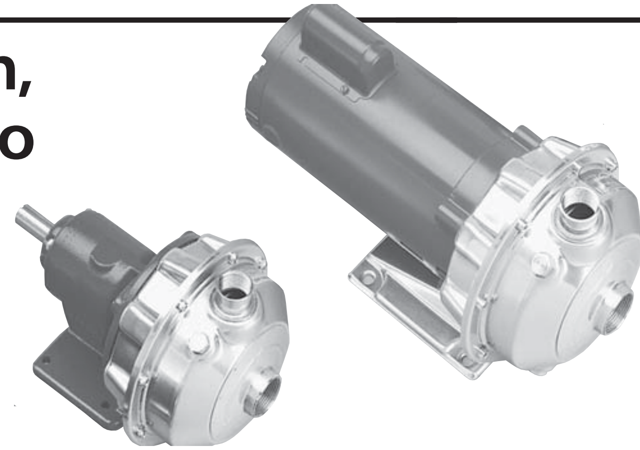
Instrucciones De Instalación, Operación Y Mantenimiento

Modelo NPE/NPE-F



DESCRIPCIÓN Y ESPECIFICACIONES:

Los modelos NPE (compacto) y NPE-F (montado en marco) son bombas centrífugas de una etapa, de succión axial para el servicio de transferencia de líquidos en general, aplicaciones de refuerzo de presión, etc. La construcción del extremo sumergido es toda de AISI (Instituto Norteamericano del Hierro y el Acero) de acero inoxidable Tipo 316, estampada y soldada. Los impulsores son totalmente cerrados, y no se pueden recortar a diámatros intermedios. Las carcasas están equipadas con un difusor para eficiencia y que las cargas radiales sean negligibles en el eje.

Las unidades compactas tienen motores NEMA 48J o 561, con montaje de cara C y extensión roscada del eje. Las unidades montadas en marco se pueden acoplar a los motores a través de un espaciador de acoplamiento, o ser accionadas por correa.

1. Importante:

1.1. Inspeccione si la unidad tiene daños. Informe inmediatamente de cualquier daño al transportista o al agente.

1.2. La alimentación eléctrica debe ser un circuito separado con los fusibles o interruptores automáticos, tamaños de alambres, etc., de acuerdo con los Códigos Eléctricos Nacional y Local. Instale un interruptor de desconexión en todos los alambres cerca de la bomba.

PRECAUCIÓN

Siempre desconecte la corriente eléctrica cuando maneje la bomba o los controles.

1.3. El cableado de los motores debe ser adecuado para la tensión. El diagrama del cableado del motor está en la placa del fabricante del motor. El tamaño del los alambres debe limitar la máxima caída de tensión al 10% de la tensión de la placa del fabricante en los terminales del motor, o la vida del motor y el rendimiento de la bomba se disminuirán.

1.4. Siempre use interruptores, contactores y arrancadores con clasificación de potencia nominal.

1.5. Protección del motor

1.5.1. Monofásico: La protección térmica en las unidades monofásicas a veces está incorporada (verifique la placa del fabricante). Si no se provee protección incorporada, use un contactor con la sobrecarga apropiada. Se permite usar fusible.

1.5.2. Trifásico: proporcione protección en los tres alambres con arrancador magnético de tamaño apropiado y sobrecargas térmicas.

1.6. Límites máximos de operción:

Temperatura del líquido:	212º F (100º C) con sello estándar.
	250º F (120º C) con sello de alta temperatura opcional.
Presión:	75 lib/pulg^2.
Arranques por hora:	20, distribuidos uniformemente.

1.7. La inspección y el mantenimiento regular aumentarán la vida de servicio. Establezca el programa de acuerdo al tiempo de funcionamiento. Refiérase a la Sección 8.

2. Instalación:

2.1. Generalidades

2.1.1. Coloque la bomba tan cerca de la fuente del líquido como sea posible (debajo del nivel del líquido para operación automática).

2.1.2. Proteja de la congelación o inundación.

2.1.3. Deje espacio libre adecuado para el servicio y la ventilación.

2.1.4. Toda la tubería debe estar soportada independientemente de la bomba, y debe "estar alineada" naturalmente.

PRECAUCIÓN

Nunca estire la tubería en el lugar forzando las conexiones de la succión y descarga de la bomba.

2.1.5. Evite los accesorios innecesarios. Seleccione los tamaños para mantener las pérdidas de fricción al mínimo.

2.2. Unidades compactas:

2.2.1. Estas unidades pueden instalarse horizontalmente, inclinadas o verticalmente.

PRECAUCIÓN

No instale con el motor debajo de la bomba. Cualquier fuga o condensación afectará al motor.

2.2.2. La cimentación debe ser plana y substancial para eliminar las deformaciones cuando se aprieten los pernos. Use montajes de goma para minimizar el ruido y las vibraciones.

2.2.3. Apriete los pernos de sujeción del motor antes de conectar la tubería a la bomba.

2.3. Unidades montadas en marco:

2.3.1. Se recomienda enlechar la plancha de asiento a un cimiento con zapata sólida. Vea la Fig. 1.

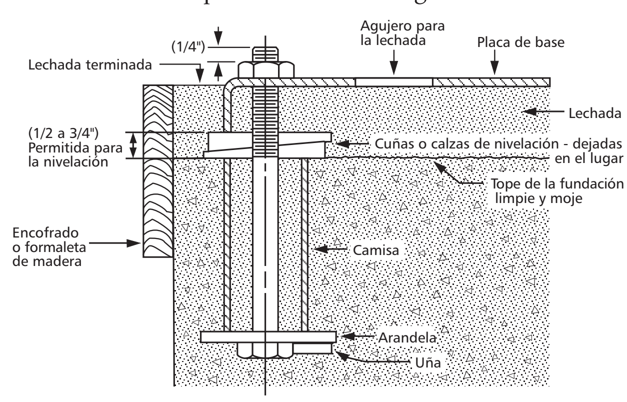


Figura 1

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2.3.2. Coloque la unidad en posición sobre las cuñas ubicadas en cuatro puntos, (dos aproximadamente debajo del centro del motor y dos aproximadamente debajo del centro de la bomba). Ajuste las cuñas para nivelar la unidad. Nivele o ponga vertical las bridas de succión y de descarga.

2.3.3. Asegúrese de que la placa de base no esté distorsionada y se pueda hacer la alineación final del acoplamiento dentro de los límites del movimiento del motor y poniendo calzas, si fuera necesario.

2.3.4. Apriete con los dedos los pernos de la cimentación y construya la presa alrededor de la cimentación. Vierta la lechada debajo de la placa de base asegurándose de que las áreas debajo de la bomba y de la pata del motor estén bien rellenas. Deje que la lechada fragüe por 48 horas antes de apretar totalmente los pernos de la cimentación.

2.3.5. Apriete los pernos de sujeción de la bomba y del motor antes de conectar la tubería a la bomba.

3. Tubería de succión:

3.1. Es deseable tener una tubería de succión directa, corta y una altura de aspiración estática baja. Para alturas de succión superiores a 10 pies y temperaturas del líquido superiores a 120º F, consulte la curva de rendimiento de la bomba para ver la Altura de Succión Positiva Neta requerida.

3.2. La tubería de succión debe ser por lo menos tan grande como la conexión de succión a la bomba. Un tamaño más pequeño disminuirá el rendimiento.

3.3. Si se requiere una tubería más grande, se debe instalar una reducción excéntrica (con el lado recto hacia arriba), en la bomba.

3.4. Instalación con la bomba abajo de la fuente de alimentación:

3.4.1. Instale en la tubería una válvula de aislación de todo el caudal para la inspección y mantenimiento.

PRECAUCIÓN

No use la válvula de aislación de succión para estrangular la bomba.

3.5. Instalación con la bomba arriba de la fuente de alimentación:

3.5.1. Evite las bolsas de aire. Ninguna de las partes de la tubería debe ser más alta que la conexión de succión de la bomba. Incline la tubería hacia arriba, partiendo de la fuente del líquido.

3.5.2. Todas las juntas deben ser estancas.

3.5.3. La válvula de pie debe usarse solamente si es necesario para el cebado o para mantener el cebado durante el servicio intermitente.

3.5.4. El área abierta del colador de succión debe ser por lo menos el triple del área de la tubería.

3.6. El tamaño de la entrada de la fuente del líquido, y la inmersión mínima sobre la succión, deben ser suficientes para impedir la entrada de aire a la bomba a través de vórtices. Vea las Figuras 2 a 5.

3.7. Use 3 a 4 vueltas de cinta de Teflon para sellar las conexiones roscadas.

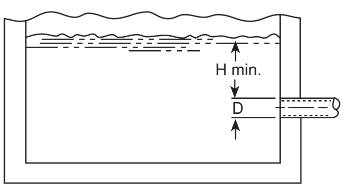


Figura 2

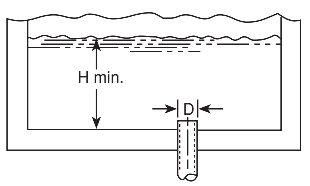


Figura 3

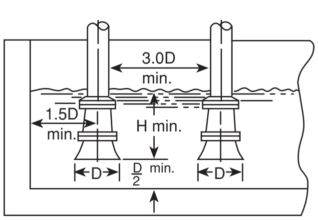


Figura 4

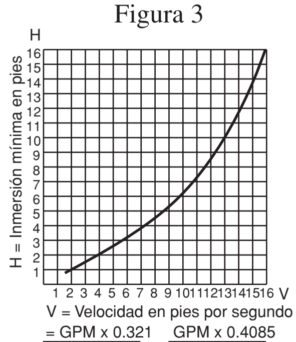


Figura 5

4. Tubería de descarga:

4.1. La disposición debe incluir una válvula de retensión ubicada entre una válvula de compuerta y la bomba. La válvula de compuerta es para la regulación de la capacidad o para la inspección de la bomba o de la válvula de retención.

4.2. Si se requiere un aumentador, instale entre la válvula de retención y la bomba.

4.3. Use 3 a 4 vueltas de cinta de Teflón para sellar las conexiones roscadas.

5. Alineación del eje del motor al de la bomba:

5.1. Unidades compactas:

5.1.1. No se necesita alinear en el campo.

5.2. Unidades montadas en marco:

5.2.1. Aunque la unidad del motor y bomba pueda tener una alineación de fábrica, ésta pudo haberse alterado en tránsito y debe verificarse antes de hacer funcionar. Vea la Figura 6.

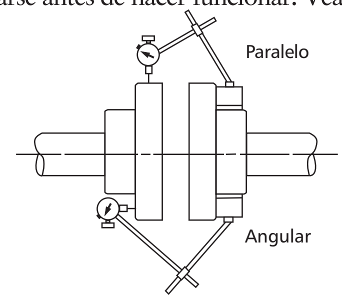


Figura 6

5.2.2. Apriete todos los pernos de sujeción antes de verificar la alineación.

5.2.3. Si es necesario realinear, siempre mueva el motor. Ponga calzas según se requiera.

5.2.4. Mala alineación paralela (ejes con ejes paralelos pero no concéntricos). Ponga el indicador de cuadrante en un cubo y gire este cubo 360º mientras hace lecturas en el diámetro exterior del otro cubo. La alineación paralela se obtiene cuando la lectura indicada total es de 0,005" (0,127 mm) o menos.

5.2.5. Mala alineación angular (ejes con ejes concéntricos pero no paralelos). Ponga el indicador de cuadrante en un cubo y gire este cubo 360º mientras hace lecturas en la cara del otro cubo. La alineación angular se obtiene cuando la lectura indicada total es de 0,005" (0,127 mm) o menos.

5.2.6. La alineación final se obtiene cuando se satisfacen los requerimientos de alineación paralela y angular, con los pernos de sujeción del motor apretados.

PRECAUCIÓN

Siempre vuelva a verificar ambas alineaciones después de hacer cualquier ajuste.

6. Rotación:

6.1. La rotación correcta es a la derecha (en sentido dextrorso cuando se mira desde el extremo del motor). Encienda y apague la corriente rápidamente. Observe la rotación del eje. Para cambiar la rotación:

6.1.1. Motores monofásicos: No reversibles.

6.1.2. Motores trifásicos: Intercambie dos cualesquiera de los conductores de alimentación de potencia.

7. Operación:

7.1. Antes de arrancar, se debe cebar la bomba (la tubería de succión llena de líquido y sin aire), y abrir parcialmente la válvula de descarga.

PRECAUCIÓN

El líquido bombeado proporciona lubricación. Si se hace funcionar la bomba en seco, las partes que giran se agarrotarán y se dañará el sello mecánico. No haga funcionar con caudal muy bajo o cerca de cero. La energía impartida al líquido se convierte en calor y el líquido puede convertirse en vapor. Las partes giratorias requieren líquido para impedir la formación de estrías o el agarrotamiento.

7.2. Haga una verificación completa después de que haya funcionado la unidad bajo condiciones de operación y se haya estabilizado la temperatura. Verifique la expansión de la tubería. En las unidades montadas en marco la alineación del acoplamiento pudo haber cambiado debido a la diferencial de temperatura entre el motor y la bomba. Vuelva a verificar la alineación.

8. Mantenimiento:

8.1. Unidad compacta. Los cojinetes de bolas están colocados adentro y son parte del motor. Están lubricados permanentemente y no requieren engrase.

8.2. Unidades montadas en marco:

8.2.1. El marco del cojinete se debe volver a engrasar cada 2.000 horas o a intervalos de 3 meses, el que ocurra primero. Use una grasa #2 con base de sodio o litio. Llene hasta que la grasa salga de las graseras o de los sellos de reborde, luego limpie el exceso.

8.2.2. Siga las instrucciones de lubricación del fabricante del motor y del acoplamiento.

8.2.3. La alineación se debe volver a verificar después de cualquier trabajo de mantenimiento que implique alguna alteración de la unidad.

9. Desmontaje:

Se describirá el desmontaje completo de la unidad. Prosiga solamente hasta donde se requiera para realizar el trabajo de mantenimiento necesario.

9.1. Apague la alimentación eléctrica.

9.2. Drene el sistema. Lave con chorro, si es necesario.

9.3. Unidades compactas: Quite los pernos de sujeción del motor.

Unidades montadas en marco: Quite el acoplamiento, el espaciador, el resguardo del acoplamiento y los pernos de sujeción del marco.

9.4. Desmontaje del extremo sumergido:

9.4.1. Quite los pernos (370) de la carcasa.

9.4.2. Quite el conjunto de desmontaje de la caja de rodamientos de la carcasa (100).

9.4.3. Quite la tuerca de seguridad (304) del impulsor.

PRECAUCIÓN

No inserte un destornillador entre los álabes del impulsor para impedir la rotación de las unidades compactas. Quite la tapa en el lado opuesto del motor. Se expondrá una ranura del destornillador o un par de filos normales al eje. Usándolos impedirá daños al impulsor.

9.4.4. Quite el impulsor (101) girando en sentido sinistrorso mirando al frente de la bomba. Protéjase las manos con telas o guantes.

PRECAUCIÓN

No quitar el impulsor en sentido sinistrorso puede dañar las roscas en el impulsor, el eje o en ambos.

9.4.5. Con dos barras de hacer palanca separadas en 180 grados e insertadas entre el alojamiento del sello (184) y el adaptador del motor (108), cuidadosamente separe las dos partes. La unidad giratoria del sello mecánico (383) debe salir del eje con el alojamiento del sello.

9.4.6. Empuje afuera el asiento estacionario del sello mecánico, del lado del motor del alojamiento del sello.

9.5. Desmontaje del marco del cojinete:

9.5.1. Quite la tapa (109) del cojinete.

9.5.2. Quite el conjunto del eje del marco (228).

9.5.3. Quite los sellos de reborde (138 y 139) del marco del cojinete y de la tapa del cojinete si están desgastados y se están cambiando.

9.5.5. Use un extractor de cojinetes o prensa de eje para quitar los cojinetes de bolas (112 y 168).

10. Reensamble:

10.1. Todas las piezas deben limpiarse antes del montaje.

10.2. Consulte la lista de piezas para identificar las piezas necesarias para la reparación. Especifique la bomba o el número de catálogo cuando pida las piezas.

10.3. Reensamblar o volver a montar es lo contrario de desmontar.

10.3.1. El impulsor y la contratuerca del impulsor se instalan en el eje del motor con una torsión de 10 pie-lbs.

10.4. Observe lo siguiente cuando vuelva a montar el marco del cojinete:

10.4.1. Cambie los sellos de reborde si están desgastados o dañados.

10.4.2. Cambie los cojinetes de bolas si están flojos, ásperos o ruidosos al girarlos.

10.4.3. Verifique si el eje está descentrado. El máximo permisible es una lectura de indicador total de 0,002".

10.5. Observe lo siguiente cuando vuelva a montar el extremo sumergido:

10.5.1. Todos los componentes del sello mecánico deben estar en buenas condiciones o pueden haber fugas. Es buena práctica estándar cambiar todo el conjunto del sello en cualquier momento en que se haya quitado el sello.
Se permite usar un lubricante ligero, tal como glicerina, para facilitar el montaje. No contamine las caras del sello mecánico con lubricante.

10.5.2. Inspeccione el anillo en O (513) de-la carcasa y cámbielo si está dañado. Este anillo en O puede lubricarse con vaselina para facilitar el montaje.

10.5.3. Inspeccione el anillo en O (349) del álabe director y cámbielo si está desgastado.

PRECAUCIÓN

No lubrique el anillo en O (349) del álabe director. Asegúrese de que no esté pellizcado por el impulsor al volver a montar.

10.6. Verifique la unidad que volvió a montarse viendo si está agarrotada. Corrija según se requiera.

10.7. Apriete los pernos de la carcasa en un patrón de estrella para impedir que se trabe el anillo en O.

11. Investigación de averías:

MOTOR NO FUNCIONA:
(Vea las causas 1 a 6)

ENTREGA POCO O NADA DE LÍQUIDO:
(Vea las causas 7 a 17)

CONSUMO MUY ALTO DE CORRIENTE:
(Vea las causas 4, 17, 18, 19, 22)

EXCESIVO RUIDO Y VIBRACIONES:
(Vea las causas 4, 6, 9, 13, 15, 16, 18, 20, 21, 22)

CAUSA PROBABLE:

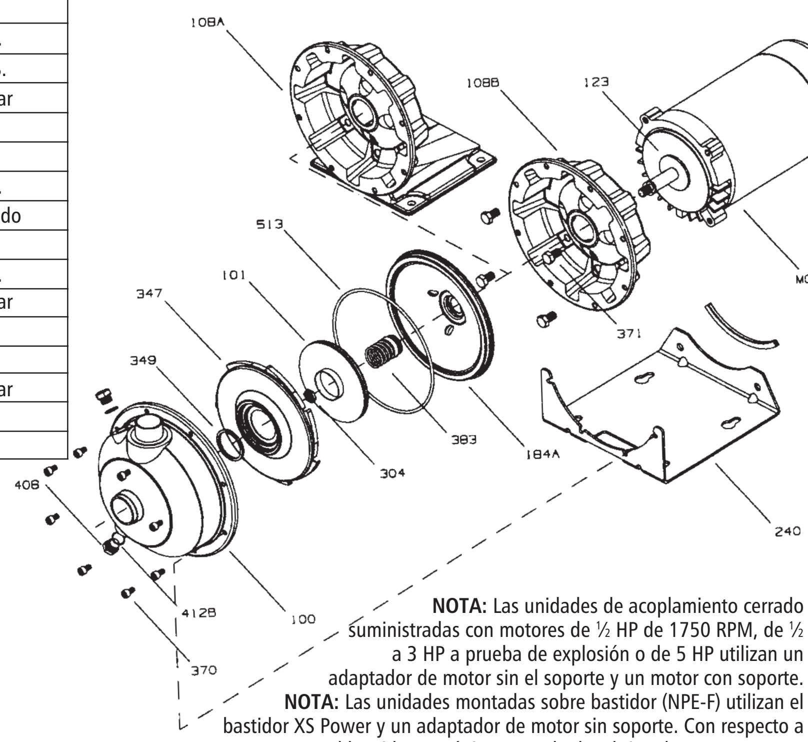
1. Protector térmico del motor disparado
2. Interruptor automático abierto
3. Fusible quemado
4. Partes giratorias agarrotadas
5. Motor mal conectado
6. Motor defectuoso
7. Bomba no cebada
8. Taponada la descarga o cerrada la válvula
9. Rotación incorrecta
10. Válvula de pie demasiado pequeña, succión no sumergida, taponada la malla de entrada.
11. Tensión baja
12. Pérdida de fase (trifásico solamente)
13. Aire o gases en el líquido
14. Demasiado alta la altura o carga del sistema
15. Demasiado baja la ASPN$_D$; (altura de succión positiva neta disponible);
    Demasiado alta la altura de aspiración o excesivas las pérdidas. Verifique con un calibrador de vacío.
16. Impulsor desgastado o taponado
17. Incorrecto el diámetro del impulsor
18. Demasiado baja la altura de descarga causando caudal excesivo
19. Demasiado alta la viscosidad o gravedad específica
20. Cojinetes desgastados
21. Bomba o tubería flojas
22. Bomba y motor mal alineados

G&L Pumps

Lista de repuestos estándar NPE

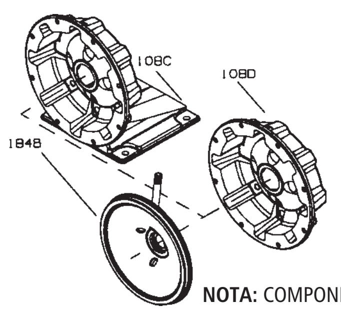
Pieza No.	Descripción	Materiales de Construcción
100	Carcasa	Acero inoxidable AISI 3161
101	Impulsor	
108A	Adaptador del motor con soporte	
108B	Adaptador del motor sin soporte	
108C	Adaptador del motor con soporte y a ras	
108D	Adaptador del motor sin soporte a ras	
123	Deflector	BUNA-N
184A	Caja del sello, estándar	AISI 316L S.S.
184B	Caja del sello con sello a ras	
240	Apoyo para el motor	300 S.S.
	Canal de caucho	Caucho
304	Contratuerca del impulsor	AISI 316 S.S.
347	Álabe de guía	AISI 316L S.S.
349	Anillo de sellado, álabe de guía	Viton, estándar
		EPR
		BUNA
370	Tornillo de cabeza hueca, carcasa	AISI 410 S.S.
371	Pernos, del motor	Acero/enchapado
383	Sello mecánico	
408	Tapón de drenaje y venteo, carcasa	AISI 316 S.S.
412B	Anillo en O, tapón de drenaje	Viton, estándar
		EPR
		BUNA
513	Anillo en O, carcasa	Viton, estándar
		EPR
		BUNA

Art. 383 Sellos mecánicos (sello de ⅝")				
Giratorio	Estacionario	Elastómeros	Partes Metálicas	Pieza No.
Carbono	Carbono de silicio	EPR	316SS	10K18
		Viton		10K55
Carbono de silicio		EPR		10K81
		Viton		10K62



NOTA: Las unidades de acoplamiento cerrado suministradas con motores de ½ HP de 1750 RPM, de ½ a 3 HP a prueba de explosión o de 5 HP utilizan un adaptador de motor sin el soporte y un motor con soporte.

NOTA: Las unidades montadas sobre bastidor (NPE-F) utilizan el bastidor XS Power y un adaptador de motor sin soporte. Con respecto a repuestos para el bastidor mecánico, consulte la página de repuestos para bastidor XS-Power en la sección de partes de su catálogo. Para ordenar el bastidor mecánico completo, pida el artículo 14L61.



NOTA: COMPONENTES OPCIONALES DEL SELLO A RAS

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 resulten 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 entidad jurídica que opera 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 entidad jurídica que 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, una sociedad, una corporación, una sociedad de responsabilidad limitada, una asociación o cualquier otra entidad jurídica con actividades en cualquier tipo de negocios.

LA PRESENTE GARANTÍA SE EXTIENDE AL COMERCIANTE ÚNICAMENTE

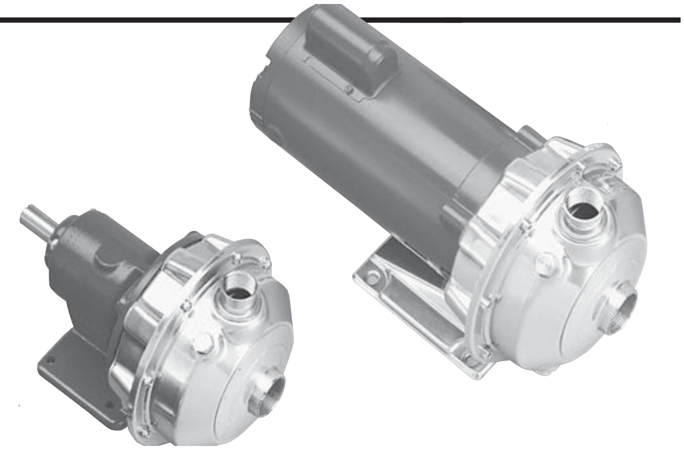
Goulds Pumps

ITT Industries

G&L Pumps

Directives d'installation, d'utilisation et d'entretien

Modèles NPE et NPE-F



DESCRIPTION ET CARACTÉRISTIQUES

Les pompes modèles NPE monobloc (sur moteur) et NPE-F (sur palier) sont des pompes centrifuges à un étage et à orifice d'aspiration en bout, utilisées pour le transfert général de liquides, l'augmentation de pression, etc. La tête de pompage est tout en inox AISI du type 316 estampé ou soudé. La roue, fermée, ne peut être réduite à un diamètre moindre par usinage. Le corps de pompe est muni d'un diffuseur pour en améliorer le rendement et diminuer la charge radiale de l'arbre.

Les NPE sont montées sur des moteurs NEMA 48J ou 56J à bride de fixation en C et à bout d'arbre fileté. Les pompes montées sur palier peuvent être entraînées par accouplement ou par courroie.

1. Informations importantes

1.1. Inspecter l'appareil et signaler immédiatement tout dommage au transporteur ou au détaillant.

1.2. L'alimentation en électricité doit être assurée par un circuit de dérivation distinct dont les fusibles ou les disjoncteurs, le calibre des fils, etc. sont conformes aux prescriptions du code provincial ou national de l'électricité. Poser un sectionneur tout conducteur prés de la pompe.

ATTENTION

On doit toujours couper le courant lorsque l'on effectue quelque travail que ce soit sur la pompe ou les commandes.

1.3. Le câblage d'alimentation du moteur doit convenir à la tension de fonctionnement. Le schéma de câblage se trouve sur la plaque signalétique du moteur. Les fils doivent avoir un calibre limitant la chute de tension maximale, aux bornes du moteur, à 10 % de la valeur de tension indiquée sur la plaque signalétique, sinon la durée de vie du moteur et les performances de la pompe diminueront.

1.4. Il faut toujours employer des contacteurs et des démarreurs conçus pour les puissances nominales en horse-power (hp).

1.5. Protection du moteur

1.5.1. Moteurs monophasés — Ces moteurs sont parfois munis d'une protection thermique intégrée (consulter la plaque signalétique). Dans le cas contraire, utiliser un contacteur à protection appropriée contre les surcharges. Les dispositifs fusibles sont permis.

1.5.2. Moteurs triphasés — Employer une protection trois conducteurs appropriée contre les surcharges thermiques ainsi qu'un démarreur magnétique convenant à la charge électrique.

1.6. Limites d'utilisation maximales :

Température du liquide :	100 ºC (212 ºF), avec joint standard ; 120 ºC (250 ºF), avec joint pour hautes températures en option.
Pression :	517 kPa (75 lb/po^2).
Démarrages par heure :	20, répartis uniformément.

1.7. Une inspection et un entretien réguliers augmenteront la durée de vie de l'appareil. Établir un programme d'entretien et d'inspection basé sur le temps de fonctionnement. Voir la section 8.

2. Installation

2.1. Généralités

2.1.1. Placer la pompe aussi prés de la source de liquide que possible, mais plus bas pour assurer l'amorçage automatique.

2.1.2. Protéger l'appareil contre les inondations et le gel.

2.1.3. Laisser assez d'espace pour l'entretien et l'aération.

2.1.4. La tuyauterie doit posséder ses propres supports et « s'aligner » correctement sur la pompe.

ATTENTION

Poser la tuyauterie de façon à n'appliquer aucune contrainte sur les raccords d'aspiration et de refoulement de la pompe.

2.1.5. Ne poser aucun accessoire ni raccord de tuyauterie superflu. Choisir le calibre qui réduit les pertes de charge par frottement au minimum.

2.2. Pompes montées sur moteur :

2.2.1. Les pompes peuvent être installées sur une surface horizontale, inclinée ou verticale.

ATTENTION

Ne pas placer le moteur plus bas que la pompe afin de le protéger contre les fuites et l'eau de condensation.

2.2.2. L'assise doit être plane et solide pour empêcher que le serrage des boulons ne cause de contraintes. Monter l'appareil sur cautchouc pour réduire le bruit et les vibrations au minimum.

2.2.3. Serrer les boulons de fixation du moteur avant de raccorder la tuyauterie à la pompe.

2.3. Pompes montées sur palier :

2.3.1. Il est recommandé de remplir de coulis le vide entre la plaque de base et la dalle reposant sur une semelle de fondations solide (v. fig. 1).

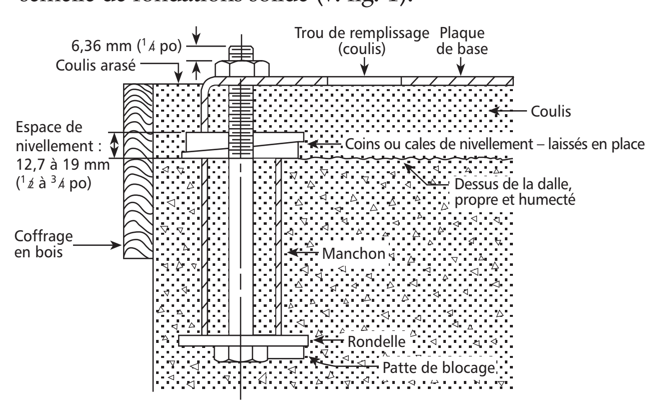


Figure 1

Goulds Pumps

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2.3.2. Placer l'appareil sur des coins de nivellement situés en quatre points distincts : deux sous le centre approximatif du moteur et deux sous celui de la pompe. Régler la position de l'appareil de manière à ce que la bride des raccords d'aspiration et de refoulement soit de niveau (avec un fil à plomb ou un niveau).
2.3.3. S'assurer que la plaque de base n'est pas déformée et que l'alignement final de l'accouplement est possible dans les limites de déplacement ou de calage du moteur.
2.3.4. Serrer les boulons d'ancrage à la main et construire un coffrage autour de la plaque de base. Verser du coulis sous la plaque et s'assurer qu'il n'y a aucun creux sous la plaque-support de la pompe et du moteur. Laisser le coulis durcir pendant 48 heures avant de serrer les boulons d'ancrage à fond.
2.3.5. Serrer les boulons de fixation de la pompe et du moteur avant de raccorder les tuyaux à la pompe.

3. Tuyauterie d'aspiration

3.1. Une hauteur géométrique d'aspiration réduite et une tuyauterie directe et courte sont souhaitables. Si la hauteur d'aspiration dépasse 3 m (10 pi), et la température du liquide, 49 °C (120 °F), consulter la courbe de débit de la pompe pour obtenir la hauteur nette d'aspiration requise (NPSHR).
3.2. Le calibre du tuyau d'aspiration doit être au moins égal à celui du raccord d'aspiration de la pompe pour éviter une perte de performances.
3.3. S'il faut un tuyau plus gros, on doit installer prés de la pompe un raccord excentré (le côté non oblique en haut).
3.4. Pompe placée plus bas que la source de liquide :
3.4.1. Poser un robinet d'isolement à passage intégral sur le tuyau d'aspiration pour l'inspection et l'entretien.

ATTENTION

Ne pas employer le robinet d'isolement pour réduire la section de passage vers la pompe.

3.5. Pompe placée plus haut que la source de liquide :
3.5.1. Afin de prévenir les poches d'air, aucun élément de la tuyauterie d'aspiration ne devrait être plus haut que le raccord d'aspiration de la pompe. Incliner la tuyauterie vers le haut à partir de la source de liquide.
3.5.2. Chaque joint doit être étanche.
3.5.3. N'employer un clapet de pied que s'il est nécessaire pour amorcer la pompe ou la maintenir amorcée durant les arrêts.
3.5.4. La section de passage de la crépine du tuyau d'aspiration doit être au moins le triple de celle du tuyau.
3.6. Le diamètre (*d*) et la hauteur d'immersion minimale (*h* min.) de l'entrée du tuyau d'aspiration doivent être suffisants pour empêcher l'aspiration d'air par vortex (v. fig. 2 à 5).
3.7. Enrouler les filets des raccords de 3 ou 4 couches de ruban de téflon pour les étancher.

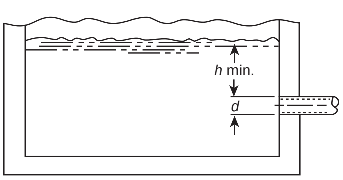
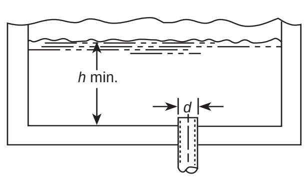


Figure 2



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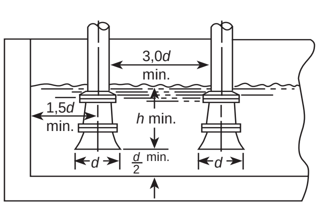


Figure 4

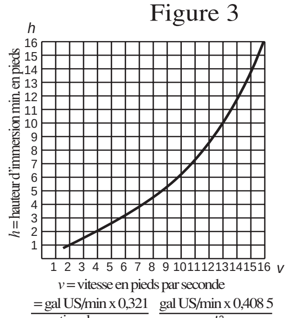


Figure 5

4. Tuyauterie de refoulement

4.1. L'installation doit comporter un robinet-vanne, ainsi qu'un clapet de non-retour placé entre le robinet-vanne el la pompe. Le robinet-vanne sert à la régularisation du débit et à l'inspection de la pompe et du clapet de non-retour.
4.2. Si un raccord agrandisseur est nécessaire, le poser entre le clapet de non-retour et la pompe.
4.3. Enrouler les filets des raccords de 3 ou 4 couches de ruban de téflon pour les étancher.

5. Alignement des arbres — moteur et pompe

5.1. Pompes montées sur moteur :
5.1.1. Aucun alignement sur place n'est requis.
5.2. Pompes montées sur palier :
5.2.1. Les arbres ont été alignés en usine, mais le transport peut parfois les désaligner. On doit donc vérifier l'alignement avant la mise en service de la pompe (v. fig. 6).

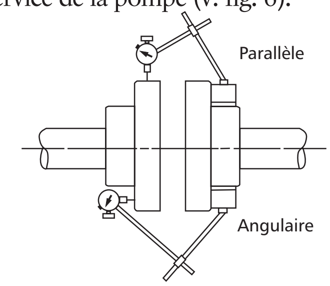


Figure 6

5.2.2. Serrer tous les boulons de fixation avant de vérifier l'alignement.
5.2.3. Si un alignement est nécessaire, on ne doit déplacer que le moteur. Employer des cales au besoin.
5.2.4. Désalignement parallèle (arbres parallèles mais non concentriques) — Fixer sur un moyeu un comparateur à cadran que l'on tourne de 360° le long de la périphérie de l'autre moyeu tout en notant l'amplitude de déplacement de l'aiguille. L'alignement est correct si le faux-rond total est de 0,127 mm (0,005 po) ou moins.
5.2.5. Désalignement angulaire (arbres concentriques mais non parallèles) — Fixer sur un moyeu un comparateur à cadran que l'on tourne de 360° le long du plateau de l'autre moyeu tout en notant l'amplitude de déplacement de l'aiguille. L'alignement est correct si le faux-rond total est de 0,127 mm (0,005 po) ou moins.
5.2.6. L'alignement final convient lorsqu'il satisfait aux exigences relatives à l'alignement parallèle et angulaire (après le serrage à fond des boulons de fixation du moteur).

ATTENTION

On doit toujours vérifier les deux types d'alignement après chaque réglage.

6. Rotation

6.1. La rotation appropriée s'effectue en sens horaire (vers la droite, vue de l'extrémité du moteur). Couper et rétablir le courant rapidement pour observer le sens de rotation de l'arbre. Changer le sens de rotation comme suit.
6.1.1. Moteur monophasé : irréversible.
6.1.2. Moteur triphasé : intervertir deux des conducteurs du moteur.

7. Utilisation

7.1. Avant la mise en service, on doit amorcer la pompe (pour en faire sortir l'air), remplir de liquide le tuyau d'aspiration et entrouvrir le robinet de refoulement.

ATTENTION

Les liquides pompés servent de lubrifiant. Si la pompe tournait à sec, les pièces mobiles gripperaient, et la garniture mécanique se détériorerait. Ne pas faire marcher la pompe quand le débit est nul ou presque, car le liquide absorberait la chaleur produite par frottement et pourrait se changer rapidement en vapeur. Les pièces mobiles doivent être lubrifiées par le liquide pour ne pas se détériorer ni gripper.

7.2. Faire fonctionner l'appareil dans des conditions de service normales jusqu'à ce que sa température se soit stabilisée, puis vérifier tout le système. Vérifier également si la tuyauterie se dilate. Dans le cas des pompes sur palier, la différence de température entre le moteur et la pompe peut causer le désalignement de l'accouplement. Vérifier l'alignement de nouveau.

8. Entretien

8.1. Dans le cas des pompes montées sur moteur, les roulements sont situés à l'intérieur du moteur et sont lubrifiés à vie. Aucun graissage n'est requis.

8.2. Pompes montées sur palier :

8.2.1. Les roulements de palier devraient être graissés toutes les 2 000 heures ou tous les trois mois, soit la période prenant fin la première. Employer une graisse au lithium ou au sodium n° 2. Remplir le roulement jusqu'à ce que la graisse sorte par les garnitures ou par les joints à lèvres, puis essuyer le surplus.

8.2.2. Suivre les directives de lubrification du fabricant du moteur et de l'accouplement.

8.2.3. Vérifier l'alignement de nouveau après tout travail d'entretien nécessitant le déplacement de l'appareil.

9. Démontage

Le démontage complet de la pompe est décrit ci-dessous. Ne démonter que ce qui permet d'effectuer l'entretien nécessaire.

9.1. Couper le courant.

9.2. Vidanger le système. Le rincer au besoin.

9.3. Dans le cas des pompes montées sur moteur, enlever les boulons de fixation de ce dernier. Quant aux pompes montées sur palier, enlever la bague et le carter d'accouplement ainsi que les boulons de fixation du palier.

9.4. Démontage de la tête de pompage :

9.4.1. Enlever les vis de fixation (370) du corps de pompe.

9.4.2. Écarter l'ensemble d'entraînement de la roue d'avec le corps de pompe (100).

9.4.3. Enlever l'écrou autofreiné (304) de la roue.

ATTENTION

Ne pas insérer de tournevis entre les aubes de la roue pour l'empêcher de tourner : enlever le couvercle d'extrémité du moteur et utiliser la fente ou les méplats de blocage de l'arbre ; on préviendra ainsi l'endommagement de la roue.

9.4.4. Dévisser la roue (101) dans le sens antihoraire (vu du devant de la pompe). Se protéger les mains avec un linge ou des gants.

ATTENTION

Toute tentative de dévissage dans le sens horaire peut endommager les filets de la roue ou de l'arbre, ou des deux.

9.4.5. Retirer le logement de garniture (184) avec soin au moyen de deux leviers placés dans un angle de 180° entre le logement et l'adaptateur de moteur (108). L'élément mobile de la garniture mécanique (383) devrait sortir de l'arbre avec le logement.

9.4.6. Pousser l'élément fixe de la garniture mécanique hors du logement.

9.5. Démontage du palier :

9.5.1. Enlever le couvercle de palier (109).

9.5.2. Sortir l'arbre (122) du palier (228).

9.5.3. Si les joints à lèvres (138 et 139) sont usés et doivent être remplacés, les retirer du palier et du couvercle de palier.

9.5.5. À l'aide d'un arrache-roulement ou d'une presse à mandriner, extraire les roulements (112 et 168).

10. Remontage

10.1. Chaque pièce devrait être nettoyée avant le remontage.

10.2. Voir la liste de pièces pour déterminer celles qui sont requises. Préciser le numéro de pièce ou de catalogue de la pompe lorsque l'on commande des pièces.

10.3. Le remontage se fait dans l'ordre inverse du démontage.

10.3.1. Visser la roue et son écrou autofreiné sur l'arbre de moteur. Les serrer à 10 lbf·pi.

10.4. Observer les directives suivantes pendant le remontage du palier :

10.4.1. Remplacer les joints à lèvres s'ils sont usés ou endommagés.

10.4.2. Remplacer les roulements à billes s'ils ont du jeu, s'ils ne tournent pas rond ou s'ils sont bruyants.

10.4.3. Vérifier si l'arbre comporte des faux-ronds : le faux-rond maximal admissible est de 0,051 mm (0,002 po).

10.5. Observer les directives suivantes pendant le remontage de la tête de pompage :

10.5.1. Tous les éléments de la garniture mécanique doivent être en bon état pour empêcher les fuites. Le remplacement de la garniture en entier est une pratique courante appropriée chaque fois que la garniture est enlevée. On peut utiliser de la glycérine ou un autre lubrifiant léger pour faciliter la pose de la garniture, dont on ne doit pas contaminer la surface avec le lubrifiant.

10.5.2. Inspecter le joint torique (513) du corps de pompe et le remplacer s'il est endommagé. On peut employer du pétrolatum (vaseline) pour en faciliter la pose.

10.5.3. Inspecter le joint torique (349) du diffuseur et le remplacer s'il est endommagé.

ATTENTION

Ne pas lubrifier le joint torique (349) du diffuseur. S'assurer que le joint n'est pas pincé par la roue au cours du remontage.

10.6. Une fois la pompe remontée, vérifier s'il y a grippage. Apporter les corrections nécessaires.

10.7. Serrer les vis de fixation du corps de pompe en étoile pour prévenir le coincement du joint torique.

11. Diagnostic des anomalies

NON-FONCTIONNEMENT DU MOTEUR
(V. causes probables 1 à 6)

DÉBIT DE LIQUIDE FAIBLE OU NUL
(V. causes probables 7 à 17)

CONSOMMATION D'ÉNERGIE EXCESSIVE
(V. causes probables 4, 17, 18, 19 et 22)

VIBRATION ET BRUIT EXCESSIFS
(V. causes probables 4, 6, 9, 13, 15, 16, 18, 20, 21 et 22)

CAUSES PROBABLES :

1. Protecteur thermique déclenché
2. Disjoncteur ouvert
3. Fusible sauté
4. Pièces mobiles grippées
5. Moteur mal connecté
6. Moteur défectueux
7. Pompe non amorcée
8. Tuyau de refoulement obstrué ou robinet fermé
9. Mauvais sens de rotation
10. Clapet de pied trop petit, entrée de tuyau d'aspiration non immergée, crépine de tuyau d'aspiration obstruée.
11. Basse tension électrique
12. Perte de phase (moteurs triphasés seulement)
13. Présence d'air ou de gaz dans le liquide
14. Hauteur de charge trop élevée du système
15. Hauteur nette d'aspiration disponible (NPSHA) trop faible — hauteur ou perte d'aspiration excessives — à vérifier avec un vacuomètre
16. Roue usée ou engorgée
17. Diamètre de roue inapproprié
18. Hauteur de charge trop faible : débit excessif
19. Viscosité ou densité trop élevées
20. Roulements usés
21. Pompe ou tuyauterie mal assujetties
22. Pompe et moteur désalignés

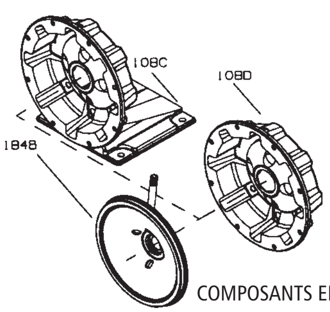
G&L Pumps

Liste de pièces de rechange de la NPE standard

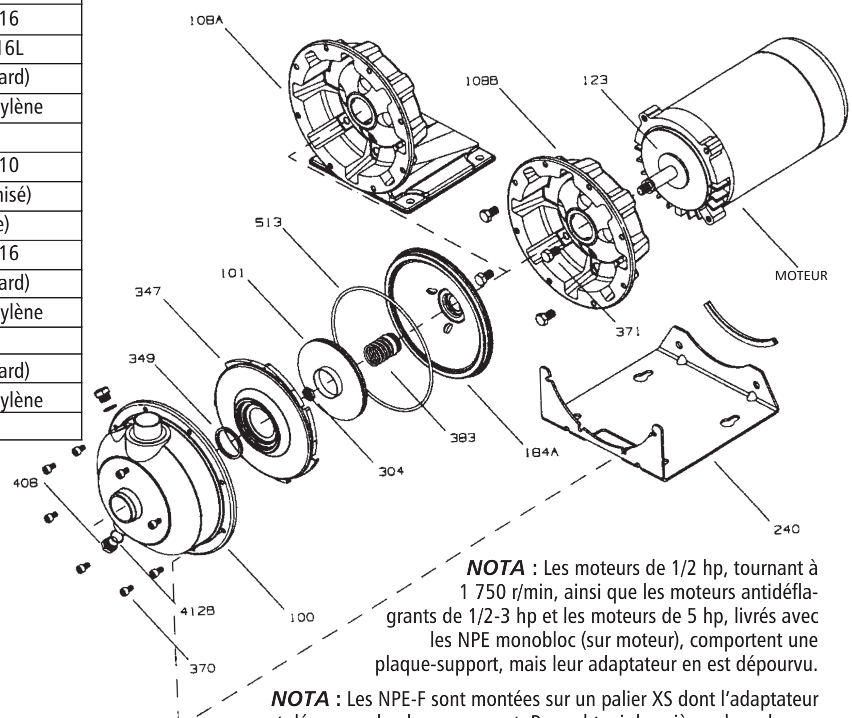
Nº d'article	Description	Matériau
100	Corps de pompe	Inox AISI 316L
101	Roue	
108A	Adaptateur de moteur et plaque-support	
108B	Adaptateur de moteur sans plaque-support	
108C	Adaptateur de mot., plaque-supp. et rinceur	
108D	Adaptateur de moteur et rinceur sans plaque-supp.	
123	Déflecteur	Buna-N
184A	Logement de garniture standard	Inox AISI 316L
184B	Logement de garniture et rinceur	
240	Plaque-support (moteur)	Inox 300
	Profilé en U	Caoutchouc
304	Écrou autofreiné (roue)	Inox AISI 316
347	Diffuseur	Inox AISI 316L
349	Joint d'étanchéité (diffuseur)	Viton (standard)
		Éthylène-propylène
		Buna
370	Vis à pans creux (corps de pompe)	Inox AISI 410
371	Vis (moteur)	Acier (galvanisé)
383	Garniture mécanique	(Voir table)
408	Bouchons — vidange et MAL (corps de pompe)	Inox AISI 316
412B	Joints toriques (bouchons)	Viton (standard)
		Éthylène-propylène
		Buna
513	Joint torique (corps de pompe)	Viton (standard)
		Éthylène-propylène
		Buna

MAL = mise à l'air libre

Garnitures mécaniques (⅝ po) — article nº 383				
Élément mobile	Élément fixe	Élastomère	Métal	Nº de pièce
Carbone	Carbure de silicium	Éthyl.-propyl.	Inox 316	10K18
		Viton		10K55
Carbure de silicium		Éthyl.-propyl.		10K81
		Viton		10K62



COMPOSANTS EN OPTION AVEC RINCEUR DE GARNITURE



NOTA : Les moteurs de 1/2 hp, tournant à 1 750 r/min, ainsi que les moteurs antidéflagrants de 1/2-3 hp et les moteurs de 5 hp, livrés avec les NPE monobloc (sur moteur), comportent une plaque-support, mais leur adaptateur en est dépourvu.

NOTA : Les NPE-F sont montées sur un palier XS dont l'adaptateur est dépourvu de plaque-support. Pour obtenir les pièces de rechange du palier XS, voir la page pertinente dans le catalogue des pièces. Le numéro d'article pour commander le palier complet est le 14L61.

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 ou 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. Un « 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 <u>SEULEMENT</u>.

Visitez notre site (www.goulds.com).

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Goulds Pumps

ITT Industries

TRAVAINI PUMPS USA

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  Fax: 706-367-2770
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TRAVAINI PUMPS USA

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TRAVAINI PUMPS USA

Liquid Ring & Rotary Vane Vacuum Pumps and Systems

DynaSeal™ Liquid Ring Vacuum Systems

www.travaini.com

DynaSeal™

The versatile, reliable vacuum pump system designed with the customer in mind.

Travaini Pumps, USA, is one of the world's leading manufacturers of liquid ring vacuum pumps and systems. The simplicity in design offers excellent reliability and low maintenance. Environmental laws and severe restrictions on water usage together with the ever-increasing costs of disposal created the need for a closed loop system. Travaini answers this need with the **DynaSeal**™ system offering years of experience and know-how in the application of different sealing fluids other than water to achieve solutions for a broad variety of harsh environments.

Twenty (20) years ago, our engineers realized the need for environmentally friendly, waterless systems when they developed the first air-cooled, closed loop, liquid ring vacuum pump system using oil as the sealing liquid.

Today, thousands of our vacuum pumps installed in those first systems are still operating after thousands of hours of trouble-free operation. – "A Proven Design".

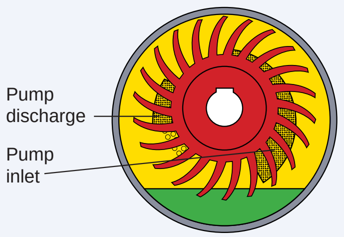
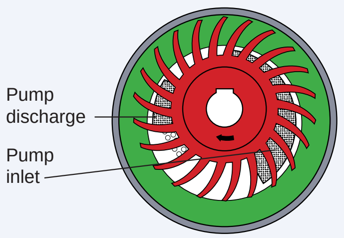


Figure 1



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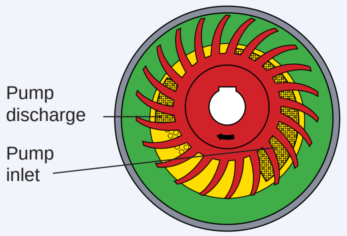


Figure 3

Principle of Operation

A multi-bladed impeller mounted on a shaft is positioned eccentrically in a cylindrical housing, partially filled with liquid. Portplates with inlet and discharge openings are positioned on each side of the impeller (Figure 1). As the impeller rotates, centrifugal force pushes the liquid outward, forming a liquid ring (Figure 2). Looking at the YELLOW area of the impeller chambers (Figure 3), we see that on the right hand side, from the top down, the chamber volume increases as the liquid ring moves outward, creating a vacuum in the impeller chamber. on the left hand side, the volume decreases as the liquid moves inward, increasing the pressure in the chambers until the discharge takes place through the discharge opening. A continuous flow of fresh sealing liquid is supplied to the pump.

Seal Fluid Technology

In our ongoing search for better solutions, we can offer alternative sealing fluids that are environmentally friendly. Unlike other types of vacuum pumps, our liquid ring design requires no internal lubrication because there is no metal to metal contact between rotating and stationary parts and the bearings are located external to the pumping chamber. This allows for more diversity when choosing the sealing fluid because the lubricating properties of the fluid are not critical.

The Travaini **DynaSeal**™ system offers a simple, low maintenance design with low noise and vibration levels, as well as reduced operating costs.

Count on Travaini for in-depth experience, technology and innovation. Our extensive inventory of pumps and replacement parts can, in most instances, be shipped the same day. Superior service is our #1 goal.

DynaSeal™, you can't beat the system.

DynaSeal™ Benefits

DynaSeal™ Standard Specifications:

≥ 15" Hg Vacuum; 60-120° F Ambient Temperatures; 180° F Inlet Gas Temperature Max; 180° F Discharge Gas/Oil Temperature; If conditions differ, consult factory for recommended design modifications.

200° F Inlet Gas – Consult factory.

Capacity Range Standards

15-1000 ACFM. Larger systems available **upon request**.

Low Noise Level.

Unlike rotary screw vacuum pumps, which run at rotor speeds as high as 9000-rpm, **DynaSeal**™ systems operate at conservative speeds (1750-rpm) resulting in low noise levels (75-80 dBA at 3-ft.) acceptable to the environment without the need for sound enclosures.

Minimal Maintenance.

DynaSeal™ systems typically only require an oil change and replacement of discharge filter every 10,000 hours under normal operating conditions. No other maintenance is required except for periodic greasing of bearings.

Not affected by carry-over of soft solids or liquids.

DynaSeal™ systems can handle carry-over of soft solids and liquids without damage to the system components. We do however recommend to install an inlet filter/strainer or knock-out pot in those applications where a high carry-over of either solids or liquids is expected.

Designed for continuous operation.

DynaSeal™ systems are designed for continuous operation over the full vacuum range without overheating.

Automatic Temperature Control.

Prevents low temperature operation, reduces accumulation of water and other liquids in the reservoir and decreases the risk of bacteria growth. This optional feature is very important in hospital and other intermittent duty applications.

Low Vibration.

DynaSeal™ systems require no special foundations or anti-vibration mountings as a standard.

High-Quality Manufacturing Standards.

Travaini pumps are manufactured under ISO 9001 quality control standards.

Quality Control

DynaSeal™ systems are a "proven design". Combine this with our inline quality procedures and outgoing inspection, this provides you with the leading quality in the industry.

Custom Solutions

DynaSeal™ systems can be provided in single or multiple system configurations with programmable controllers to meet your specific requirements. Explosion proof designs for those stringent environments. Wide range of materials including stainless steel, copper, etc.

DynaSeal™

Air-cooled Liquid Ring Vacuum Systems

Made in the USA. DynaSeal™ systems are designed, built, and tested at our facility in Yorktown, Virginia.

Typical System Features & Options

1 ADVANCED LIQUID RING VACUUM PUMP DESIGN Offers high efficiency, reliability and minimum maintenance. External bearings and ample clearance between rotating parts eliminate the need for internal lubrication.

2 ELECTRIC CONTROL PANEL Each system includes a NEMA 12 electrical control panel complete with magnetic starter and overload protection, 110-volt control circuit and hour meter as standard. Wiring to motor and control switches is completed at the factory.

3 HIGH TEMPERATURE SWITCH Shuts unit down at 225˚F in case oil flow to unit is interrupted.

4 BACK PRESSURE GAUGE Shows condition of demister element and if element requires service. It also indicates back pressure from piping system.

5 AIR/OIL SEPARATOR Includes a highly efficient demister element to remove oil mist from discharge air. Exhaust is 99.9% oil-free.

6 OIL RESERVOIR Mounted overhead for positive oil flow pressure and sized for adequate oil capacity, cooling and efficient separation by internal baffles. A sight gauge complete with temperature gauge is included.

7 INLET CHECK VALVE Properly sized and suitable for vacuum.

8 HIGH EFFICIENCY AIR-COOLED HEAT EXCHANGER Allows system to operate at moderate temperatures with ambient temperatures as high as 110˚. Water-cooled units are available.

9 PUMP OR MOTOR-MOUNTED COOLING FAN Provides high air flow for maximum cooling without the need for a separate fan motor, except for units of 50-hp and larger which have electric-drive fan units.

10 SOLENOID VALVE Shuts down oil flow to pump when unit is stopped.

11 MONOBLOCK MOTOR MOUNTING DESIGN Standard up to 25-hp, eliminates misalignment problems by flange mounting to a standard NEMA C-face motor. (TEFC motors with a 1.15 service factor are standard) a heavy-duty flexible coupling ensures trouble-free service.

12 MANUAL UNLOADER VALVE WITH FILTER SILENCER Aids in vacuum unloading and/or relief of the pump prior to start-up and shutdown. (Electric unloading–optional)

13 VACUUM RELIEF VALVE WITH SILENCER (OPTIONAL) Field adjustable to control maximum vacuum level.

14 TEMPERATURE CONTROL VALVE (OPTIONAL) Allowing the system to reach operating temperature very quickly which is important especially for outdoor installations and intermittent duties.

15 HIGH AND LOW OIL LEVEL SWITCH (OPTIONAL) To protect pump from loss of oil.

EXPLOSION PROOF DESIGN
(Optional)

DynaSeal™ Systems are used extensively in industries such as:

- Hospitals, healthcare and pharmaceutical
- Solvent and vapor recovery
- Soil remediation
- Wood working and wood impregnation
- Electronics and semi-conductors
- Printing and paper converting
- Food and meat processing
- Plastics, automotive and aircraft
- Sterilization and impregnation
- Plus numerous others

The "Mini" Series

Models – TRO-075VM, TRO-110VM AND TRO-160VM

Latest concept of our patented DynaSeal™ System

Features:

- Space Saving
- Vastly Improved Mist Elimination
- Cost Savings
- 3 Models Available

1 Using our 3 monoblock vari-ported pump designs, models TRM 40-110, 40-150, and 40-200, we offer these three systems, 5, 7.5, and 10 hp, configured to incorporate the above features.

2 The traditional oil sealed systems has a footprint almost twice the length and 50% wider than the "MINI" Series. By incorporating the monoblock pump design, we have developed the "MINI" package to fit within equipment or locations that require economies of space.

3 Traditional oil-sealed packages have been designed to handle vacuums beyond 15" HgV, as the majority of applications require. Below 15" HgV, the coalescing filters are not designed to fully handle the oil mist. The new "MINI" Series was designed to coalesce from 0-30" Hg vacuum through our unique filter element and specially formulated synthetic oil.

4 The simplicity of the "MINI" design has resulted in reduced costs which allow us to pass the savings on to you, our customers. Cost is always a priority without sacrificing the quality you've come to expect from Travaini products.

Standard DynaSeal™ Models

System Model	Nominal Capacity ACFM	Motor HP	Maximum End Vacuum in. Hg	Approximate Dimensions (in) L x W x H	Approximate Weight (Lbs)
TRO015H	15	2	29	38 x 17 x 40	340
TRO015S	15	1.5	26	38 x 17 x 40	340
TRO035S	35	3	26	38 x 17 x 40	340
TRO035H	35	3	29	38 x 17 x 40	340
TRO050H	50	5	29.5	38 x 17 x 40	435
TRO075S	75	5	27	43 x 17 x 40	530
TRO075-VM**	75	5	29	32 X 25 X 43	500
TRO110V	110	7.5	29.5	55 x 25 x 51	920
TRO110-VM**	110	7.5	29	32 X 25 X 43	540
TRO140H	140	10	29.5	55 x 25 x 51	1005
TRO160V	160	10	29.5	65 x 26 x 51	1070
TRO160-VM**	160	10	29	32 X 25 X 43	570
TRO200V	200	15	29.5	65 x 26 x 56	1300
TRO200H	200	15	29.5	65 x 26 x 56	1325
TRO250H	250	20	29.5	65 x 26 x 56	1350
TRO300V	300	20	29.5	65 x 26 x 56	1355
TRO300H	300	25	29.5	65 x 26 x 56	1430
TRO400S	380	25	28	83 x 35 x 64	1900
TRO425H	425	40	29.5	83 x 35 X 64	2250
TRO500S	500	40	28	83 x 35 x 64	2150
TRO700S*	700	50	26	80 X 63 X 58	3550
TRO750H*	750	50	29.5	80 X 63 X 58	3750
TRO900S*	900	60	26	80 X 63 X 58	3650
TRO950H*	950	60	29.5	80 X 63 X 58	4016
TRO1000S*	1000	75	26	80 X 63 X 58	3750
TRO1000H*	1050	100	29.5	80 X 63 X 58	4302

**VM = Mini Series
*PUMPS ARE V-belt driven.

DynaSeal™ Standard Specifications:

≥ 15" Hg Vacuum; 60-120° F Ambient Temperatures; 180° F Inlet Gas Temperature Max; 180° F Discharge Gas/Oil Temperature; If conditions differ, consult factory for recommended design modifications.

- Explosion proof designs are available upon request.
- **Larger capacity systems are available upon request.**
- **DynaSeal™** systems are available in multiple pump configurations with a wide range of optional accessories.
- **DynaSeal™** systems can be customized per O.E.M. specification and for special applications.
- **DynaSeal™** systems are sold and serviced through a nation-wide distributor network.

DMV-D(LE)/604 (NEMA Type 4x)
Installation Instructions

DUNGS®

SPECIFICATIONS

DMV-D/604 Two normally closed safety shutoff valves in one housing. V1 and V2 are fast opening, fast closing. Two stage and adjustable max. flow on V2. NEMA Type 4x.

DMV-DLE/604 Two normally closed safety shutoff valves in one housing. V1 fast opening, fast closing. V2 is a slow opening, fast closing valve. Adjustable max. flow and adjustable initial lift with V2. NEMA Type 4x.

Body size	**Flange Size**	
DMV-D(LE) 702/604	1" - 2"	NPT
DMV-D(LE) 703/604	1" - 2"	NPT

Gases
Natural gas, Propane, Butane; Other Noncorrosive gases

Maximum Operating Pressure
7 PSI (500 mbar)UL, FM
5 PSI (350 mbar) CSA

Ambient / Fluid Temperature
-20°F to +150°F; (-30°C to +65°C)

Electrical Ratings
120 Vac 60 Hz

Power Consumption with all coils energized
DMV-D(LE) 702: 120 VA
DMV-D(LE) 703: 135 VA

Electrical Connection
Terminal boxes with NPT 1/2” conduit connections

Enclosure Rating
NEMA Type 4x

Operating Time
100 % duty cycle

Classification of Valve V1 and V2
Safety Shut Off Valve:
UL 429
ANSI Z21.21 • CGA 6.5 C/I Valves
FM 7400

Closing Time (Valve 1 & Valve 2)
< 1 second

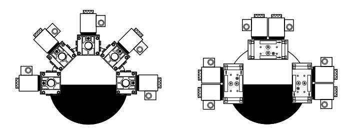
Opening Time
DMV-D/604: V1 &V2 < 1 sec.
DMV-DLE/604: V1 < 1 sec.; V2 10 to 20 sec. (70 °F)

Main Flow Setting (DMV-D/604 & DMV-DLE/604)
Adjustable on V2: <10 to 100% of total flow

Initial Lift Adjustment (DMV-DLE/604)
Adjustable on V2: 0 to 70 % of totai flow

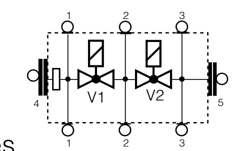
Materials in contact with Gas
Housing: Aluminum, Steel
Sealings on valve seats: NBR-based rubber

Mounting Position
Solenoid upright vertical
to solenoid horizontal



Strainer
23 Mesh, installed in the housing upstream V1

Test Ports
G 1/8 ISO 228 taps available
on both sides upstream of
V1, between V1 and V2 and
downstream of V2, and on both flanges



Position Indication (optional)
Visual Indicator
CPI 400 w/ visual indication and electrical switch (SPDT),

Approvals
UL: Listed File No. MH16727
CSA: Certified File No. 1010989
FM Approved: Report J.1.1Z6A0.AF

ATTENTION

- Read these instructions carefully.
- Failure to follow them and/or improper installation may cause explosion, property damage and injuries.
- Installation must be done with the supervision of a licensed burner technician.
- The system must meet all applicable national and local code requirements.
- Check the ratings in the specifications to make sure that it is suitable for your application.
- Never perform work if gas pressure or power is applied, or in the presence of an open flame.
- Once installed, perform a complete checkout including leak testing.
- Label all wires prior to disconnection when servicing. Wiring errors can cause improper and dangerous operation
- Verify proper operation after servicing.

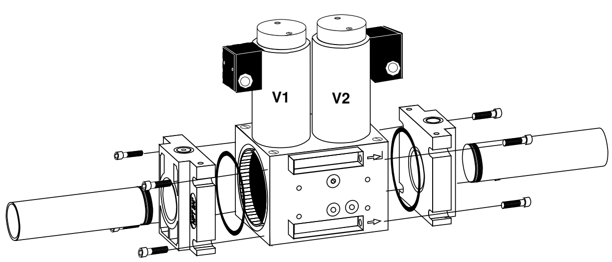
KARL DUNGS INC.
524 Apollo Drive,Suite 10 Lino Lakes, MN 55014 U.S.A.
Phone: (651) 792-8912 Fax: (651) 792-8919 E-mail: info@karldungsusa.com

MOUNTING

Recommended Preparation
- Examine the valve for shipping damage.
- The main gas supply must be shut off before starting the installation.
- The inside of the DMV-D(LE)/604, the flanges, and piping must be clean and free of dirt, remove all dirt and debris before installing the DMV-D(LE)/604. Failure to remove dirt/ debris could result in valve damage or improper performance.

Recommended Procedure to Mount the Flanges
- Unpack the valve and remove the 8 socket cap head screws using a 6 mm Allen wrench.
- Remove the two white protective plastic covers from the valve body.
- Make sure the O-rings and the grooves in the valve are clean and in good condition.
- Clean the mounting surface of the flanges that comes into contact with the o-ring seal.
- Attach the flanges to the valve body using the M8 socket cap screws supplied. Install the flanges so that the test port on the flange is accessable from the top of the valve.
- Tighten the screws in a crisscross pattern following the recommended torque table below.

Recommended Torque	M8	Screw Size
	134	[lb-in]



⚠ CAUTION: If the flow is not in the same direction of the arrows the valve body or the valve will not operate properly.

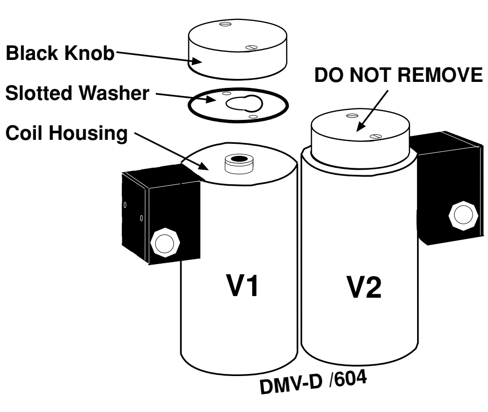
Recommended Piping Procedure
- Use new, properly reamed and threaded pipe.
- Apply good quality pipe sealant, putting a moderate amount on the male threads only. If pipe sealant lodges on the valve seat, it will prevent proper operation. If using LP gas, use pipe sealant rated for use with LP gas.
- Install the DMV-D(LE)/604 with the gas flow matching the direction indicated by the arrows on the casting.
- Do not thread pipe too far. Valve distortion and/or malfunction may result from excess pipe in the valve body.
- Apply counter pressure with a parallel jaw wrench only to the flats on the flange when screwing the pipe into the flanges.
- Do not overtighten the pipe. Follow the maximum torque values listed below.

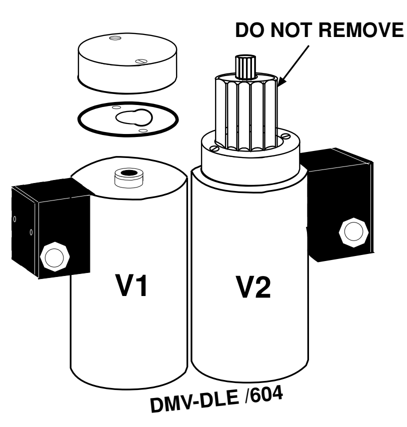
Recommended Torque for Piping

1"	1-1/4"	1-1/2"	2"	NPT pipe
750	875	940	1190	[lb-in]

- After installation is complete, perform a complete leak test.

Positioning junction boxes
- Locate the black knob on top of **Valve** 1. There are two screws, the holding screw is recessed and has a blue sealing compound on it, while the pan head screw protrudes from the cap.
- Remove both screws, remove the black knob, remove the slotted washer.
- Remove the coil assembly **Valve 1 ONLY** .
- Locate the black knob on top of **Valve 2**. There are two screws, the holding screw is recessed and has a blue sealing compound on it, while the pan head screw protrudes from the cap.
- Loosen the pan head screw until you can freely rotate the coil assembly. Position the coil so that the junction box is in an accessable location to connect to conduit.
- Replace the coil from **Valve 1**. Position the coil so that the junction box is in an accessable location to connect to conduit.
- Re-install the washer, black cap, and the screws.





⚠ CAUTION: Do not adjust or remove any screws or bolts which are sealed with a red colored compound. Doing so will void all approvals and warranties.

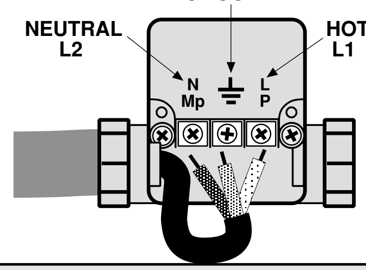
⚠ WARNING: DO NOT remove the adjustment cap from valve 2. If the adjustment cap is removed, perform the valve leakage test on page 3 - with special attention to the area under the adjustment cap.

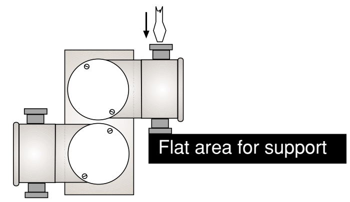
WIRING

NOTE: Use 14 or 16 guage wire rated for 95˚C(200˚F).

- Remove the wiring box cover and knock out only one of the conduit connections on the side of the terminal box you wish to make your conduit connection to.
- Make electrical connections to the valve, replace cover.

⚠ CAUTION: All wiring must comply with local electrical codes, ordinances and regulations.





VALVE ADJUSTMENT

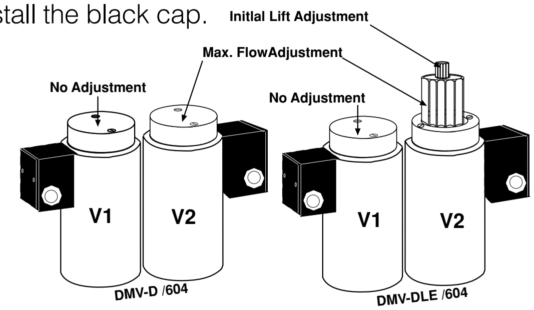
Flow Setting

- The valves are factory set with the flow adjustment fully open.
- CAUTION: Make sure the flow of gas does not create a hazard.
- Locate the black knob on top of **Valve 2**. There are two screws, the holding screw is recessed and has a blue sealing compound on it, while the pan head screw protrudes from the cap.
- Loosen the pan head screw until you can freely rotate the flow adjustment.
- Turn clockwise for less gas or counterclockwise for more gas.
- Check the flow at the burner with an orifice or flow meter.
- Tighten the pan head screw on the adjustment cap.

Initial Lift Adjustment (DMV-DLE/604 only)

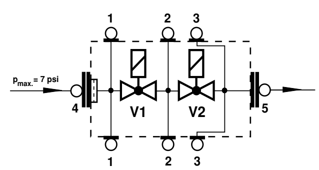
The initial lift adjustment varies the initial gas flow through the valve as the valve seat begins to open. This adjustment can vary the initial flow between 0 % and 70% of the total gas flow; 0 to 25% of stroke. All DMV-DLE/604 valves are factory set with no initial lift. To adjust the lift proceed as follows:

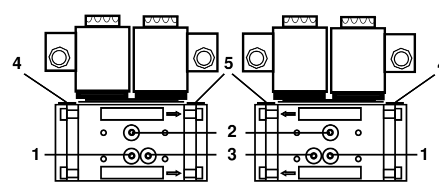
- Unscrew the small black cap on top of the flow adjustment cap to expose the initial lift adjustment knob.
- The black cap also serves as tool; turn the cap over and insert it on the slot on the adjustment knob.
- Turn the knob clockwise for a min. initial lift or counterclockwise for a max. initial lift.
- Once the desired initial fast lift has been achieved, reinstall the black cap.



Test Ports

The G 1/8 ISO 228 taps are available on both sides upstream V1, between V1 and V2, downstream V2, and on both flanges. The G 1/8 test nipple (# D219 008) can be screwed in any of these pressure tap ports.





VALVE LEAKAGE TEST

This test checks the sealing capabilities of the DMV-D(LE)/604 automatic shutoff valves. This test requires test nipples installed in the downstream accessory port of both automatic shutoff valves to make the required hose connection. (Port 2 and 3) Only qualified personnel should perform this test at the initial burner system startup, and annually or more depending on the application, environmental parameters, and the requirements of the authority having jurisdiction.

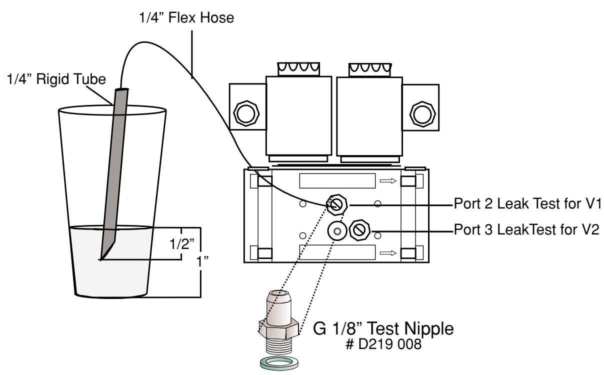
It is recommended that this test be included in scheduled inspection and maintenance procedures.

Use the illustration on page 4 below as a reference.

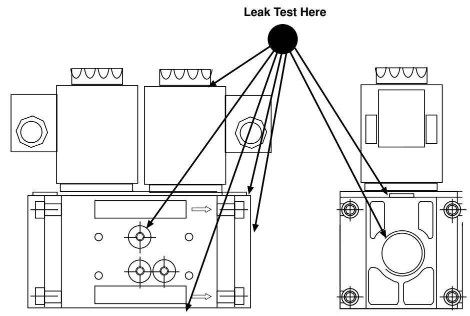
1) Externally leak test the valve. DUNGS recommends using an all purpose liquid leak detector solution (Snoop™ or a soapy water solution). Apply the liquid leak detector solution to the areas indicated. The presence of bubbles indicate a leak. Be sure to test any accessories mounted to the Valve.
2) De-energize valve # 1 and #2.
3) Close the upstream manual ball valve, and close the downstream manual ball valve.
4) Be sure that both test nipples are properly installed in port 2 and 3 and are leak tight.
5) Fill a glass of water at least 1 inch from the bottom, Connect a 1/4” flexible hose to a rigid tube. The rigid tube shall be 1/4 in. diameter and have a 45˚ cut at the end that is not connected to the flexible hose. The rigid tube can be made from either aluminum, copper or plastic.
6) Using a screwdriver, slowly open the V1 test nipple (port 2) by turning it counter clockwise to depressurize the volume between the two valves.
7) Connect the 1/4” flexible hose to test nipple.
8) Open the upstream manual ball valve.
9) Immerse the 1/4 in. tube vertically 1/2 in. (12.7 mm) into the glass of water.

10) If bubbles emerge from the rigid tube, let the rate stabilize and count the number of bubbles appearing during a 10 second period. (See chart below for leakage rates.)
11) Repeat the same procedure for valve V2 (port 3), except that valve #1 needs to be opened at step 7 above. (Energize only terminal 2 on the DIN connector).

After completing the above tests:



12) Close the upstream and downstream manual ball valves. De-energize the safety shutoff valves.
13) Remove the flexible hose, and close the test nipples.
14) Open the upstream manual ball valve, and energize both valves.
15) Use soapy water to leak test all test nipples to ensure that there are no leaks.
16) De-energize the safety shutoff valves.
17) Open the downstream manual ball valve.



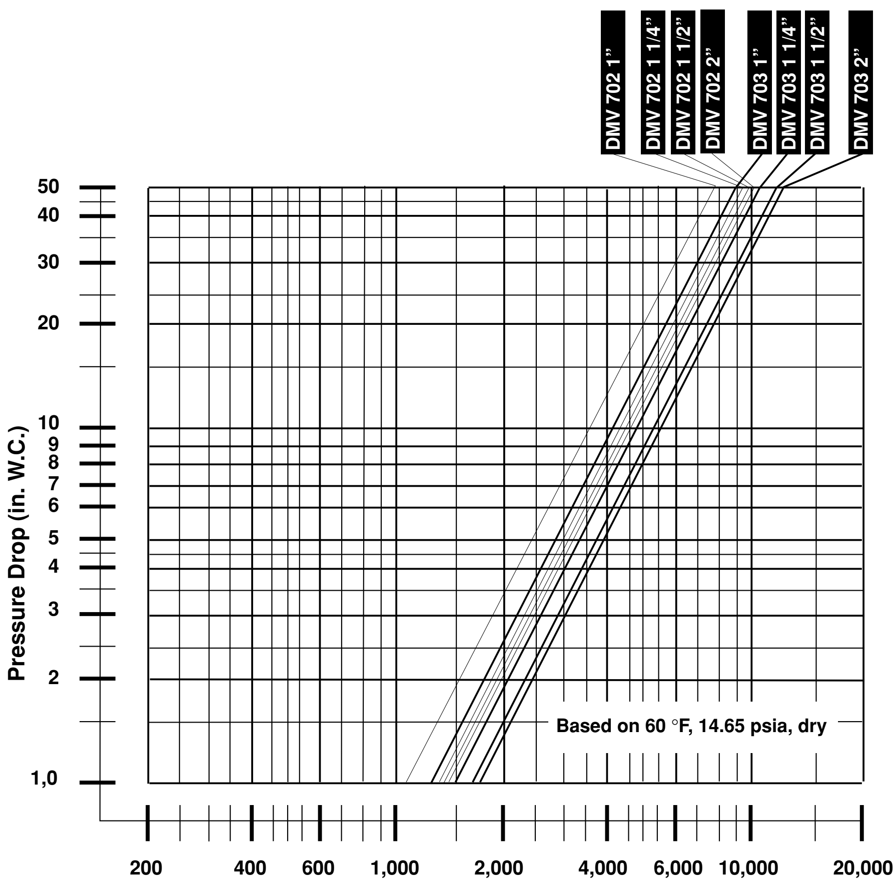
WARNING: If leakage values are exceeded, replace valve immediately.

Allowable Valve Seat Leakage*

Model	Allowable Leakage*	# of Bubbles in 10 sec AIR	Natural Gas	LP
DMV D(LE) 702/604	494 cc/hr	9	11	7
DMV D(LE) 703/604	494 cc/hr	9	11	7

*Based on air, and test conditions per UL 429 Section 29. (Air or inert gas at a pressure of 1/4 psig and also at a pressure of one and one-half times maximum operating pressure differential, but not less than 1/2 psig. This test shall be applied with the valve installed in its intended position.) Volume of bubble defined in Table 2 of FCI 70-2-1998.

FLOW CURVE



Flow (CFH) of natural gas s.g. 0.65 at 60 °F
20 in W.C Inlet

BLOWERS EXHAUSTERS COMPRESSORS

ROOTS™

US $3.00, Canada $4.50

UNIVERSAL RAI® & RAM™ SERIES

CONTENTS

DO THESE THINGS TO GET THE MOST FROM YOUR ROOTS™ BLOWER

- ❏ Check shipment for damage. If found, file claim with carrier and notify ROOTS.
- ❏ Unpack shipment carefully, and check contents against Packing List. Notify ROOTS if a shortage appears.
- ❏ Store in a clean, dry location until ready for installation. Lift by methods discussed under INSTALLATION to avoid straining or distorting the equipment. Keep covers on all openings. Protect against weather and corrosion if outdoor storage is necessary.
- ❏ Read OPERATING LIMITATIONS and INSTALLATION sections in this manual and plan the complete installation.
- ❏ Provide for adequate safeguards against accidents to persons working on or near the equipment during both installation and operation. See SAFETY PRECAUTIONS.
- ❏ Install all equipment correctly. Foundation design must be adequate and piping carefully done. Use recommended accessories for operating protection.
- ❏ Make sure both driving and driven equipment is correctly lubricated before start-up. See LUBRICATION.
- ❏ Read starting check points under OPERATION. Run equipment briefly to check for installation errors and make corrections. Follow with a trial run under normal operating conditions.
- ❏ In event of trouble during installation or operation, do not attempt repairs of ROOTS furnished equipment. Notify ROOTS, giving all nameplate information plus an outline of operating conditions and a description of the trouble. Unauthorized attempts at equipment repair may void ROOTS warranty.
- ❏ Units out of warranty may be repaired or adjusted by the owner. It is recommended that such work be limited to the operations described in this manual, using ROOTS™ parts. Good inspection and maintenance practices should reduce the need for repairs.

NOTE: Information in this manual is correct as of the date of publication. ROOTS reserves the right to make design or material changes without notice, and without obligation to make similar changes on equipment of prior manufacture.

For your nearest ROOTS Office, dial our Customer Service Hot Line toll free; 1 877 363 ROOT(S) (7668) or direct 281-966-4700.

DRESSER® Roots

IRB-180-102
Rev. 12/02

ROOTS™ products are sold subject to the current General terms of Sale, GTS-5001 and Warranty Policy WP-5020. Copies are available upon request.
Contact your local ROOTS Office or ROOTS Customer Service Hot Line 1.877.363.ROOT(S) (7668).

Safety Precautions

It is important that all personnel observe safety precautions to minimize the chances of injury. Among many considerations, the following should be particularly noted:

- Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
- Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting. Protect external moving parts with adequate guards.
- Disconnect power before doing any work, and avoid bypassing or rendering inoperative any safety or protective devices.
- If blower is operated with piping disconnected, place a strong coarse screen over the inlet and avoid standing in the discharge air stream. **CAUTION: Never cover the blower inlet with your hand or other part of body.**
- Stay clear of open inlet piping (suction area) of pressure blowers, and the open discharge blast from vacuum blowers.
- Stay clear of the blast from pressure relief valves and the suction area of vacuum relief valves.
- Use proper care and good procedures in handling, lifting, installing, operating and maintaining the equipment.
- Casing pressure must not exceed 25 PSI (1725 mbar) gauge. Do not pressurize vented cavities from an external source, nor restrict the vents without first consulting ROOTS.
- Do not use air blowers on explosive or hazardous gases.
- Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be trained to exercise adequate general safety precautions.

Operating Limitations

A ROOTS™ blower or exhauster must be operated within certain approved limiting conditions to enable continued satisfactory performance. Warranty is contingent on such operation.

Maximum limits for pressure, temperature and speed are specified in TABLE 1 for various models & sizes of blowers & exhausters. These limits apply to all units of normal construction, when operated under standard atmospheric conditions. Be sure to arrange connections or taps for thermometers and pressure or vacuum gauges at or near the inlet and discharge connections of the unit. These, along with a good tachometer, will enable periodic checks of operating conditions.

PRESSURE – The pressure rise, between inlet and discharge, must not exceed the figure listed for the specific unit frame size concerned. Also, in any system where the unit inlet is at a positive pressure above atmosphere a maximum case rating of 25 PSI gauge (1725 mbar) should not be exceeded without first consulting the ROOTS. Never should the maximum allowable differential pressure be exceeded.

On vacuum service, with the discharge to atmospheric pressure, the inlet suction or vacuum must not be greater than values listed for the specific frame size.

TEMPERATURE – Blower & exhauster frame sizes are approved only for installations where the following temperature limitations can be maintained in service:

- Measured temperature rise must not exceed listed values when the inlet is at ambient temperature. Ambient is considered as the general temperature of the space around the unit. This is not outdoor temperature unless the unit is installed outdoors.
- If inlet temperature is higher than ambient, the listed allowable temperature rise values must be **reduced** by 2/3 of the difference between the actual measured inlet temperature and the ambient temperature.
- The average of the inlet and discharge temperature must not exceed 250°F. (121°C).

SPEED – These blowers & exhausters may be operated at speeds up to the maximum listed for the various frame sizes. They may be direct coupled to suitable constant speed drivers if pressure/temperature conditions are also within limits. At low speeds, excessive temperature rise may be a limiting factor.

Special Note: The listed maximum allowable temperature rise for any particular blower & exhauster may occur well before its maximum pressure or vacuum rating is reached. This may occur at high altitude, low vacuum or at very low speed. The units' operating limit is always determined by the maximum rating reached first. It can be any one of the three: Pressure, Temperature or Speed.

INSTALLATION

ROOTS™ blowers & exhausters are treated after factory assembly to protect against normal atmospheric corrosion. The maximum period of internal protection is considered to be one year under average conditions, if shipping plugs & seals are not removed. Protection against chemical or salt water atmosphere is not provided. Avoid opening the unit until ready to start installation, as corrosion protection will be quickly lost due to evaporation.

If there is to be an extended period between installation and start up, the following steps should be taken to ensure corrosion protection.

- ❑ Coat internals of cylinder, gearbox and drive end bearing reservoir with Nox-Rust VCI-10 or equivalent. Repeat once a year or as conditions may require. Nox-Rust VCI-10 is petroleum soluble and does not have to be removed before lubricating. It may be obtained from Daubert Chemical Co., 2000 Spring Rd., Oak Brook, Ill. 60521.
- ❑ Paint shaft extension, inlet and discharge flanges, and all other exposed surfaces with Nox-Rust X-110 or equivalent.
- ❑ Seal inlet, discharge, and vent openings. It is not recommended that the unit be set in place, piped to the system, and allowed to remain idle for extended periods. If any part is left open to the atmosphere, the Nox-Rust VCI-10 vapor will escape and lose its effectiveness.
- ❑ Protect units from excessive vibration during storage.
- ❑ Rotate shaft three or four revolutions every two weeks.
- ❑ Prior to start up, remove flange covers on both inlet and discharge and inspect internals to insure absence of rust. Check all internal clearances. Also, at this time, remove gearbox and drive end bearing cover and inspect gear teeth and bearings for rust.

Because of the completely enclosed unit design, location of the installation is generally not a critical matter. A clean, dry and protected indoor location is preferred. However, an outdoor location will normally give satisfactory service. Important requirements are that the correct grade of lubricating oil be provided for expected operating temperatures, and that the unit be located so that routine checking and servicing can be performed conveniently. Proper care in locating driver and accessory equipment must also be considered.

Supervision of the installation by a ROOTS Service Engineer is not usually required for these units. Workmen with experience in installing light to medium weight machinery should be able to produce satisfactory results. Handling of the equipment needs to be accomplished with care, and in compliance with safe practices. Unit mounting must be solid, without strain or twist, and air piping must be clean, accurately aligned and properly connected.

Bare-shaft Units: Two methods are used to handle a unit without base. One is to use lifting lugs bolted into the top of the unit headplates. Test them first for tightness and fractures by tapping with a hammer. In lifting, keep the direction of cable pull on these bolts as nearly vertical as possible. If lifting lugs are not available, lifting slings may be passed under the cylinder adjacent to the headplates. Either method prevents strain on the extended drive shaft.

Packaged Units: When the unit is furnished mounted on a baseplate, with or without a driver, use of lifting slings passing under the base flanges is required. Arrange these slings so that no strains are placed on the unit casing or mounting feet, or on any mounted accessory equipment. **DO NOT** use the lifting lugs in the top of the unit headplates.

Before starting the installation, remove plugs, covers or seals from unit inlet and discharge connections and inspect the interior completely for foreign material. If cleaning is required, finish by washing the cylinder, headplates and impeller thoroughly with a petroleum solvent. Turn the drive shaft by hand to make sure that the impellers turn freely at all points. Anti-rust compound on the connection flanges and drive shaft extension may also be removed at this time with the same solvent. Cover the flanges until ready to connect piping.

Mounting

Care will pay dividends when arranging the unit mounting. This is especially true when the unit is a “bare-shaft” unit furnished without a baseplate. The convenient procedure may be to mount such a unit directly on a floor or small concrete pad, but this generally produces the least satisfactory results. It definitely causes the most problems in leveling and alignment and may result in a “Soft Foot” condition. Correct soft foot before operation to avoid unnecessary loading on the casing and bearings. Direct use of building structural framing members is not recommended.

For blowers without a base, it is recommended that a well anchored and carefully leveled steel or cast iron mounting plate be provided. The plate should be at least 1 inch (25 mm) thick, with its top surface machined flat, and large enough to provide leveling areas at one side and one end after the unit is mounted. It should have properly sized studs or tapped holes located to match the unit foot drilling. Proper use of a high quality machinist's level is necessary for adequate installation.

With the mounting plate in place and leveled, set the unit on it without bolting and check for rocking. If it is not solid, determine the total thickness of shims required under one foot to stop rocking. Place half of this under each of the diagonally-opposite short feet, and tighten the mounting studs or screws. Rotate the drive shaft to make sure the impellers turn freely. If the unit is to be direct coupled to a driving motor, consider the height of the motor shaft and the necessity for it to be aligned very accurately with the unit shaft. Best unit arrangement is directly bolted to the mounting plate while the driver is on shims of at least 1/8 inch (3mm) thickness. This allows adjustment of motor position in final shaft alignment by varying the shim thickness.

Aligning

When unit and driver are factory mounted on a common baseplate, the assembly will have been properly aligned and is to be treated as a unit for leveling purposes. Satisfactory installation can be obtained by setting the baseplate on a concrete slab that is rigid and free of vibration, and leveling the top of the base carefully in two directions so that it is free of twist. The slab must be provided with suitable anchor bolts. The use of grouting under and partly inside the leveled and shimmed base is recommended.

It is possible for a base-mounted assembly to become twisted during shipment, thus disturbing the original alignment. For this reason, make the following checks after the base has been leveled and bolted down. Disconnect the drive and rotate the unit shaft by hand. It should turn freely at all points. Loosen the unit foot hold-down screws and determine whether all feet are evenly in contact with the base. If not, insert shims as required and again check for free impeller rotation. Finally, if unit is direct coupled to the driver, check shaft and coupling alignment carefully and make any necessary corrections.

In planning the installation, and before setting the unit, consider how piping arrangements are dictated by the unit design and assembly. Drive shaft rotation must be established accordingly and is indicated by an arrow near the shaft.

Typical arrangement on vertical units has the drive shaft at the top with counterclockwise rotation and discharge to the left. Horizontal units are typically arranged with the drive shaft at the left with counter-clockwise rotation and discharge down. See Figure 3 and 4 for other various unit arrangements and possible conversions.

When a unit is DIRECT COUPLED to its driver, the driver RPM must be selected or governed so as not to exceed the maximum speed rating of the unit. Refer to Table 1 for allowable speeds of various unit sizes. A flexible type coupling should always be used to connect the driver and unit shafts.

Coupling halves must be accurately aligned, and a sufficient gap between shaft ends provided so that side strains and end thrust on either shaft are avoided or minimized. This will require considerable care in the mounting of the driver. The two shafts must be in as near perfect alignment in all directions as possible, and the gap must be established with the motor armature on its electrical center if end-play exists.

The following requirements of a good installation are recommended. Coupling halves must be fitted to the two shafts with a line to line thru .001" interference fit. Coupling halves must be warmed up, so that only light tapping is required to install them. Maximum deviation in offset alignment of the shafts should not exceed .005" (.13 mm) total indicator reading, taken on the two coupling hubs. Maximum deviation from parallel of the inside coupling faces should not exceed .001" (.03 mm) when checked at six points around the coupling.

When a unit is BELT DRIVEN, the proper selection of sheave diameters will result in the required unit speed. This flexibility can lead to operating temperature problems caused by unit speed being too low. Make sure the drive speed selected is within the allowable range for the specific unit size, as specified under Table 1.

Belt drive arrangements usually employ two or more V-belts running in grooved sheaves. Installation of the driver is less critical than for direct coupling, but its shaft must be level and parallel with the unit shaft. **The driver should be mounted on the inlet side of a vertical unit (horizontal piping) and on the side nearest to the shaft on a horizontal unit.** The driver must also be mounted on an adjustable base to permit installing, adjusting and removing the V-belts. To position the driver correctly, both sheaves need to be mounted on their shafts and the nominal shaft center distance known for the belt lengths to be used.

Install the unit sheave so that its inner hub face is not more than 1/8 inch (3mm) from the drive end cover. See page 18 for minimum sheave diameter and maximum sheave width. The shaft fit should be such that the sheave can be worked into place by hand or by very light tapping. A tight or driving fit can damage a bearing, and may cause internal unit damage by forcing the impeller out of its normal operating position. A loose fit or wobbly sheave will cause vibration, and may result in shaft breakage.

CAUTION: Couplings as well as sheave bushings must have a slight slide fit with the unit shaft such that they can be installed in place by hand. Any force used to install them could change unit end clearance resulting in unit damage. If interference fit is desired for the coupling, the coupling hub should be heated and shrunk on the shaft. For engine drives, use "locktite" between the coupling hubs and the shafts and on the threads of the coupling set screws.

The driver sheave should also be mounted as close to its bearing as possible, and again should fit the shaft correctly. Position the driver on its adjustable base so that 2/3 of the total movement is available in the direction away from the unit, and mount the assembly so that the face of the sheave is accurately in line with the unit sheave. This position minimizes belt wear, and allows sufficient adjustment for both installing and tightening the belts. After belts are installed, adjust their tension in accordance with the manufacturer's instructions. However, only enough tension should be applied to prevent slippage when the unit is operating under load. Excessive tightening can lead to early bearing failures or shaft breakage.

Before operating the drive under power to check initial belt tension, first remove covers from the unit connections. Make sure the interior is still clean, then rotate the shaft by hand. Place a coarse screen over the inlet connection to prevent anything being drawn into the unit while it is operating, and avoid standing in line with the discharge opening. Put oil in the sumps per instructions under **LUBRICATION.**

Piping

Before connecting piping, remove any remaining anti-rust compound from Unit connections. Clean pipe should be no smaller than unit connections. In addition, make sure it is free of scale, cuttings, weld beads, or foreign material of any kind. To further guard against damage to the unit, especially when an inlet filter is not used, install a substantial screen of 16 mesh backed with hardware cloth at or near the inlet connections. Make provisions to clean this screen of collected debris after a few hours of operation. It should be removed when its usefulness has ended, as the wire will eventually deteriorate and small pieces going into the unit may cause serious damage.

Pipe flanges or male threads must meet the unit connections accurately and squarely. DO NOT attempt to correct misalignment by springing or cramping the pipe. In most cases this will distort the unit casing and cause impeller rubbing. In severe cases it can prevent operation or result in a broken drive shaft. For similar reasons, piping should be supported near the unit to eliminate dead weight strains. Also, if pipe expansion is likely to occur from temperature change, installation of flexible connectors or expansion joints is advisable.

Figure 2 represents an installation with all accessory items that might be required under various operating conditions. Inlet piping should be completely free of valves or other restrictions. When a shut-off valve can not be avoided, make sure a full size vacuum relief is installed nearest the unit inlet. This will protect against unit overload caused by accidental closing of the shut-off valve.

Need for an inlet silencer will depend on unit speed and pressure, as well as sound-level requirements in the general surroundings. An inlet filter is recommended, especially in dusty or sandy locations. A discharge silencer is also normally suggested, even though Whispair units operate at generally lower noise levels than conventional rotary blowers. Specific recommendations on silencing can be obtained from ROOTS.

Discharge piping requires a pressure relief valve, and should include a manual unloading valve to permit starting the unit under no-load conditions. Reliable pressure/vacuum gauges and good thermometers at both inlet and discharge are recommended to allow making the important checks on unit operating conditions. The back-pressure regulator shown in Figure 2 is useful mainly when volume demands vary while the unit operates at constant output. If demand is constant, but somewhat lower than the unit output, excess may be blown off through the manual unloading valve.

In multiple unit installations where two or more units operate with a common header, use of check valves is mandatory. These should be of a direct acting or free swinging type, with one valve located in each line between the unit and header. Properly installed, they will protect against damage from reverse rotation caused by air and material back-flow through an idle unit.

After piping is completed, and before applying power, rotate the drive shaft by hand again. If it does not move with uniform freedom, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment.

DO NOT operate the unit at this time unless it has been lubricated per instructions.

LUBRICATION

LUBRICATION: For Units with a Grease Lubricated Drive End

A simple but very effective lubrication system is employed on the drive shaft end bearings. Hydraulic pressure relief fittings are provided to vent any excess grease, preventing pressure build-up on the seals. A restriction plug and metering orifice prevent loss of lubricant from initial surges in lubricant pressure but permit venting excess lubricant under steadily rising pressures.

When servicing drive end bearings, use a NLGI #2 premium grade grease with 300°F (149°C) service temperature and moisture resistance and good mechanical stability. Using a pressure gun, slowly force new lubricant into each drive end bearing housing until traces of clean grease comes out of the relief fitting.

After a long shutdown, it is recommended that the grease fittings be removed, the old grease flushed out with kerosene or #10 lubricating oil, drained thoroughly, and bearings refilled with new grease. Be sure grease relief fittings are reinstalled. Grease should be added using a hand operated grease gun to the drive end bearings at varying time intervals depending on duty cycle and RPM. Table 4 has been prepared as a general greasing schedule guide based on average operating conditions. More frequent intervals may be necessary depending on the grease operating temperature and unusual circumstances. ROOTS™ synthetic grease (ROOTS P/N T20019-) is highly recommended.

LUBRICATION: For Units with Splash Lubrication on Both Ends

Bearings and oil seals are lubricated by the action of the timing gears or oil slingers which dip into the main oil sumps causing oil to splash directly on gears and into bearings and seals. A drain port is provided below each bearing to prevent an excessive amount of oil in the bearings. Seals located inboard of the bearings in each headplate effectively retain oil within the sumps. Any small leakage that may occur should the seals wear passes into a cavity in each vented headplate and is drained downward.

Oil sumps on each end of the blower are filled by removing top vent plugs, Item (21), and filling until oil reaches the middle of the oil level sight gauge, Item (37), or the overflow plug.

Initial filling of the sumps should be accomplished with the blower not operating, in order to obtain the correct oil level. Approximate oil quantities required for blowers of the various models and configurations are listed in Table 3. Use a good grade of industrial type non-detergent, rust inhibiting, anti-foaming oil and of correct viscosity per Table 2. ROOTS™ synthetic oil (ROOTS P/N 813-106-) is highly recommended.

The oil level should not fall below the middle of the site gauge when the blower is idle. It may rise on the gauge during operation, to an extent depending somewhat on oil temperature and blower speed.

Proper lubrication is usually the most important single consideration in obtaining maximum service life and satisfactory operation from the unit. Unless operating conditions are quite severe, a weekly check of oil level and necessary addition of lubricant should be sufficient. During the first week of operation, check the oil levels in the oil sumps about once a day, and watch for leaks. Replenish as necessary. Thereafter, an occasional check should be sufficient. It is recommended that the oil be changed after initial 100 hours of operation. Frequent oil changing is not necessary unless the-blower is operated in a very dusty location. Normal life expectancy of petroleum based oils is about 2000 hours with an oil temperature of about 200°F (93°C). As the oil temperature increases by increments of 15-18°F (8°C - 10°C), the life is reduced by half. Example: Oil temperatures of 230-236°F (110°C - 113°C) will produce life expectancy of 1/4 or 500 hours. Therefore, it is considered normal to have oil change periods of 500 hours with petroleum based oils.

OPERATION

Before operating a blower under power for the first time, recheck the unit and the installation thoroughly to reduce the likelihood of avoidable troubles. Use the following procedure check list as a guide, but consider any other special conditions in the installation.

- ❑ Be certain that no bolts, tools, rags, or debris have been left in the blower air chamber or piping.
- ❑ If an outdoor intake without filter is used, be sure the opening is located so it cannot pick up dirt and is protected by a strong screen or grille. Use of the temporary protective screen as described under INSTALLATION is strongly recommended.
- ❑ Recheck blower leveling, drive alignment and tightness of all mounting bolts if installation is not recent. If belt drive is used, adjust belt tension correctly.
- ❑ Turn drive shaft by hand to make sure impellers still rotate without bumping or rubbing at any point.
- ❑ Make sure oil levels in the main oil sumps are correct.
- ❑ Check lubrication of driver. If it is an electric motor, be sure that power is available and that electrical overload devices are installed and workable.
- ❑ Open the manual unloading valve in the discharge air line. If a valve is in the inlet piping, be sure it is open.
- ❑ Bump blower a few revolutions with driver to check that direction of rotation agrees with arrow near blower shaft, and that both coast freely to a stop.

After the preceding points are cleared, blower is ready for trial operation under "no-load" conditions. The following procedure is suggested to cover this initial operation test period.

a. Start blower, let it accelerate to full speed, then shut off. Listen for knocking sounds, both with power on and as speed slows down.

b. Repeat above, but let blower run 2 or 3 minutes. Check for noises, such as knocking sounds.

c. Operate blower for about 10 minutes unloaded. Check oil levels. Observe cylinder and headplate surfaces for development of hot spots such as burned paint, indicating impeller rubs. Be aware of any noticeable increase in vibration.

Assuming that all trials have been satisfactory, or that necessary corrections have been made, the blower should now have a final check run of at least one hour under normal operating conditions. After blower is restarted, gradually close the discharge unloading valve to apply working pressure. At this point it is recommended that a good pressure gauge or manometer be connected into the discharge line if not already provided, and that thermometers be in both inlet and discharge lines. Readings from these instruments will show whether pressure or temperature ratings of the blower are being exceeded.

During the final run, check operating conditions frequently and observe the oil levels at reasonable intervals. If excessive noise or local heating develops, shut down immediately and determine the cause. If either pressure rise or temperature rise across the blower exceeds the limit specified in this manual, shut down and investigate conditions in the piping system. Refer to the **TROUBLESHOOTING CHECKLIST** for suggestions on various problems that may appear.

The blower should now be ready for continuous duty operation at full load. During the first few days make periodic checks to determine whether all conditions remain steady, or at least acceptable. This may be particularly important if the blower is supplying air to a process system where conditions can vary. At the first opportunity, stop the blower and clean the temporary inlet protective screen. If no appreciable amount of debris has collected, the screen may be removed. See comments under **INSTALLATION**. At this same time, verify leveling, coupling alignment or belt tension, and mounting bolt tightness.

Should operating experience prove that blower capacity is a little too high for the actual air requirements, a small excess may be blown off continuously through the manual unloading or vent valve. Never rely on the pressure relief valve as an automatic vent. Such use may cause the discharge pressure to become excessive, and can also result in failure of the valve itself. If blower capacity appears to be too low, refer to the **TROUBLESHOOTING CHECKLIST**.

Vibration Assessment Criteria

With measurements taken at the bearing locations on the housings, see chart below for an appropriate assessment guide for rotary lobe blowers rigidly mounted on stiff foundations.

In general, blower vibration levels should be monitored on a regular basis and the vibration trend observed for progressive or sudden change in level. If such a change occurs, the cause should be determined through spectral analysis.

As shown on the chart below, the level of all pass vibration will determine the need to measure discrete frequency vibration levels and the action required.

All Pass Vibration (in/sec)	Discrete Frequency Vibration (in/sec)	Action
0.45 or less	N/R	Approved
Greater than 0.45 but 1.0 or less	0.45 or less @ any frequency	Approved
	Greater than 0.45 @ any frequency	ROOTS™ Approval Required
Greater than 1.0	Less than 1.0	ROOTS™ Approval Required
	Greater than 1.0	ROOTS™ Approval Required

Operating Characteristics

ROOTS™ rotary blowers and exhausters, as covered in this manual, are available in basic frame sizes ranging from 2 inch to 7 inch gear diameter. Various models, within this gear diameter range, are available with different case lengths to produce reasonable steps in flow capacity. The shorter case lengths have lower volumetric capacities, but are capable of operating against higher pressures. All models are available for air service and there are specifically designed models for gas service.

The basic ROOTS™ rotary lobe blower is a positive displacement type unit. Flow capacity is determined by frame size, operating speed and pressure conditions. It employs two impellers mounted on parallel shafts rotating in opposite directions within a cylinder closed at the ends by head-plates. As the impellers rotate, gas is drawn into one side of the cylinder and forced out the opposite side. The pressure or vacuum developed depends on the resistance of the piping and process system.

The unit is a precision engineered product with very fine clearances between the rotating impellers and stationary case. Since there is no actual contact between these surfaces, internal lubrication is not required. Clearances are maintained by a pair of accurately machined timing gears, mounted on the two shafts extended outside the blower casing.

Operation of the familiar basic rotary lobe blower is illustrated in FIGURE 1, where air flow is left to right from inlet to discharge with the top impeller rotating clockwise. In Position 1 it is delivering a known volume (B) to the discharge, while space (A) between the lower impeller and cylinder wall is being filled. Counterclockwise rotation of this impeller then traps equal volume (A) in Position 2, and further rotation delivers it to the discharge in Position 3.

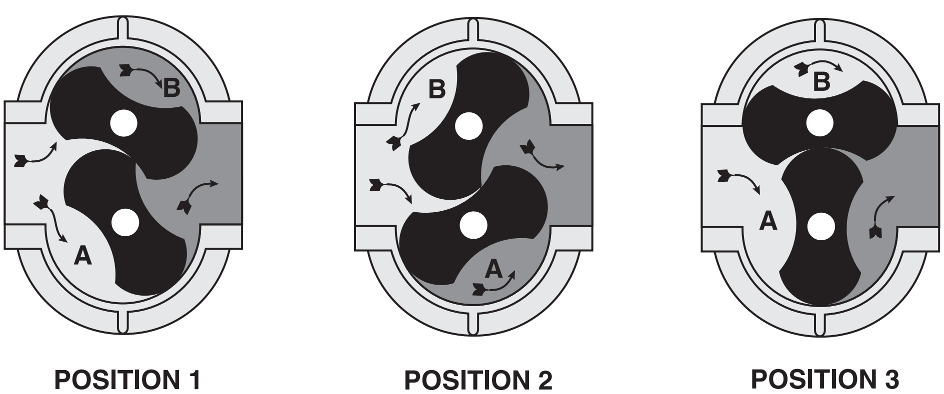
One complete revolution of the driving shaft alternately traps four fixed and equal volumes of air (two by each impeller) and pushes them through to the discharge. The volume capacity of a lobe blower operating at a constant speed therefore remains relatively independent of reasonable inlet of discharge pressure variations. To change capacity, it is necessary either to change speed of rotation or blow off some of the discharge air.

No attempt should ever be made to control capacity by means of a throttle valve in the intake or discharge piping. This will not only increase the power load on the driver, but can also overload and seriously damage the blower. If a possibility does exist that flow to the blower inlet may be cut off during normal operation of a process, then an adequate vacuum relief valve must be installed near the blower. A pressure type relief valve in the discharge line near the blower is required for protection against cut-off or blocking in this line. Refer to FIGURE 3 for a complete piping schematic.

When a belt drive is installed, blower speed can usually be adjusted to obtain desired capacity by changing the diameter of one or both sheaves. In a direct coupled arrangement a variable speed motor or transmission is required, or excess air may be blown off through a manually controlled unloading valve and silencer. If returned to the blower inlet, the air must be cooled to 100°F (38°C) through a by-pass arrangement to maintain acceptable blower temperatures.

Before making any change in blower capacity, or operating conditions, contact ROOTS for specific information applying to your particular blower. In all cases, operating conditions must be maintained within the approved range of pressures, temperatures and speeds as stated under **LIMITATIONS.** The air blower must not be used to handle liquids or solids as serious damage to the rotating parts may result.

Figure 1 – Flow Through a Basic Rotary Lobe Blower



TROUBLESHOOTING

Trouble	Item	Possible Cause	Remedy
No flow	1	Speed too low	Check by tachometer and compare with published performance
	2	Wrong rotation	Compare actual rotation with Figure 1 or 2 Change driver if wrong
	3	Obstruction in piping	Check piping, valves, silencer to assure open flow path
Low capacity	4	Speed too low	See item 1, If belt drive, check for slippage and readjust tension
	5	Excessive pressure rise	Check inlet vacuum and discharge pressure and compare with Published performance
	6	Obstruction in piping	See item 3
	7	Excessive slip	Check inside of casing for worn or eroded surfaces causing excessive clearances
Excessive power	8	Speed too high	Check speed and compare with published performance
	9	Excessive pressure rise	See Item 5
	10	Impeller rubbing	Inspect outside of cylinder for high temperature areas, then check for impeller contact at these points. Correct blower mounting, drive alignment
	11	Scale, sludge, rust or product build up	Clean blower appropriately
Overheating of	12	Inadequate lubrication	Check oil sump levels in gear and drive end headplates
bearing or gears	13	Excessive lubrication	Check oil levels. If correct, drain and refill with clean oil of recommended grade
	14	Excessive pressure rise	See Item 5
	15	Coupling misalignment	Check carefully. Realign if questionable
	16	Excessive belt tension	Readjust for correct tension
Vibration	17	Misalignment	See Item 15
	18	Impellers rubbing	See Item 10
	19	Worn bearings/gears	Check gear backlash and condition of bearings, and replace as indicated
	20	Unbalanced or rubbing impeller	Scale or process material may build up on casing and impellers, or inside impellers. Remove build-up to restore original clearances and impeller balance
	21	Driver or blower loose	Tighten mounting bolts securely
	22	Piping resonances	Determine whether standing wave pressure pulsations are present in the piping
	23	Scale/sludge build-ups	Clean out interior of impeller lobes to restore dynamic balance
	24	Casing strain	re-work piping alignment to remove excess strain
Driver stops, or will not start	25	Impeller stuck	Check for excessive hot spot on headplate or cylinder. See item 10. Look for defective shaft bearing and/or gear teeth
	26	Scale, sludge, rust or product build-up	Clean blower appropriately
Excessive breather	27	Broken seal	Replace seals
Blow-by or excessive oil leakage to vent area	28	Defective O-ring	Replace seals and O-ring

MAINTENANCE & REPLACEMENTS: UNIVERSAL RAI® SERIES BLOWERS

A good program of consistent inspection and maintenance is the most reliable method of minimizing repairs to a blower. A simple record of services and dates will help keep this work on a regular schedule. Basic service needs are:

- Lubrication
- Checking for hot spots
- Checking for increases or changes in vibration and noise
- Recording of operating pressures and temperatures

Above all, a blower must be operated within its specified rating limits, to obtain satisfactory service life.

A newly installed blower should be checked often during the first month of full-time operation. Attention thereafter may be less frequent assuming satisfactory performance. Lubrication is normally the most important consideration and weekly checks of lubricant levels in the gearbox and bearing reservoirs should be customary. Complete oil change schedules are discussed under **LUBRICATION**.

Driver lubrication practices should be in accordance with the manufacturer's instructions. If direct connected to the blower through a lubricated type coupling, the coupling should be checked and greased each time blower oil is changed. This will help reduce wear and prevent unnecessary vibration. In a belted drive system, check belt tension periodically and inspect for frayed or cracked belts.

In a new, and properly installed, unit there is no contact between the two impellers, or between the impellers and cylinder or headplates. Wear is confined to the bearings (which support and locate the shafts) the oil seals, and the timing gears. All are lubricated and wear should be minimal if clean oil of the correct grade is always used. Seals are subject to deterioration as well as wear, and may require replacement at varying periods.

Shaft bearings are designed for optimum life under average conditions with proper lubrication and are critical to the service life of the blower. Gradual bearing wear may allow a shaft position to change slightly, until rubbing develops between impeller and casing. This will cause spot heating, which can be detected by observing these surfaces. Sudden bearing failure is usually more serious. Since the shaft and impeller are no longer supported and properly located, extensive general damage to the blower casing and gears is likely to occur.

Oil seals should be considered expendable items, to be replaced whenever drainage from the headplate vent cavity becomes excessive or when the blower is disassembled for any reason. Sealing effectiveness can vary considerably from seal to seal and is also affected to surprising degree by shaft finish under the seal lip. Because of these normal variables, minor seal leakage should not be considered as indicating seal replacement.

Timing gear wear, when correct lubrication is maintained, should be negligible over a period of years. Gear teeth are cut to provide the correct amount of backlash, and gears correctly mounted on the shafts will accommodate a normal amount of tooth wear without permitting contact between lobes of the two impellers. However, too high an oil level will cause churning and excessive heating. This is indicated by unusually high temperature at the bottom of the gear housing. Consequent heating of the gears will result in loss of tooth-clearance , backlash and rapid wear of the gear teeth usually will develop. Continuation of this tooth wear will eventually produce impeller contacts (knocking), and from this point serious damage will be unavoidable if blower operation is continued. A similar situation can be produced suddenly by gear tooth fracture, which is usually brought on by sustained overloading or momentary shock loads.

Problems may also develop from causes other than internal parts failure. Operating clearances within a blower are only a few thousandths of an inch. This makes it possible for impeller interference or casing rubs to result from shifts in the blower mounting, or from changes in piping support. If this type of trouble is experienced, and the blower is found to be clean, try removing mounting strains. Loosen blower mounting bolts and reset the leveling and drive alignment. Then tighten mounting again, and make sure that all piping meets blower connections accurately and squarely Foreign materials in the blower will also cause trouble, which can only be cured by disconnecting the piping and thoroughly cleaning the blower interior.

A wide range of causes & solutions for operating troubles are covered in the **TROUBLE SHOOTING CHECKLIST**. The remedies suggested should be performed by qualified mechanics with a good background, using procedures detailed in this manual. Major repairs generally are to be considered beyond the scope of maintenance, and should be referred to ROOTS.

Warranty failures should not be repaired at all, unless specific approval has been obtained through ROOTS before starting work. Unauthorized disassembly within the warranty period will void the warranty.

It is recommended that major repairs be performed at an authorized ROOTS facility. However, it is recognized that this may not always be practical. If a blower is out of warranty, mechanical adjustments and parts replacement may be undertaken locally at the owner's option and risk. It is recommended that ROOTS™ parts be used to insure fit and suitability. The maintenance of a small stock of on-hand spare parts can eliminate possible delays. When ordering parts give item numbers and their word descriptions from the appropriate sectional drawings. Also specify quantities required and the blower model and serial number from the nameplate.

Repairs or adjustments are best performed by personnel with good mechanical experience and the ability to follow the instructions in this manual. Some operations involve extra care, patience, and a degree of precision work. This is especially true in timing impellers and in handling bearings. Experience indicates that high percentages of bearing failures are caused by dirt contamination before or during assembly. Therefore, the work area should be cleaned before starting disassembly, and new or re-usable parts protected during progress of the work.

In the following repair procedures, numbers shown in brackets ( ) correspond to the item numbers used in sectional drawings. It is recommended that the procedures be studied carefully and completely, with frequent reference to the drawings, before starting work. This will produce better efficiency through an understanding of what work is to be done, and the order of doing it. Before disassembly, mark all parts so that they may be returned to original locations or relative positions.

Requirements for special tools will depend on the work to be done. If impeller clearances and float are to be checked or re-set, a dial indicator and a set of long feeler gauges will be needed. Work involving removal of the timing gears cannot be accomplished without a suitable puller.

Design of ROOTS™ blower is simple, and most repair operations are straightforward. For this reason, the following procedures are intended mainly to indicate a preferred work order and to call out points to be observed. Where special operations are required, detailed coverage is given.

A – Replacing Timing Gears

1. Drain all oil from the gearhouse by removing drain plug (21) in the bottom. Remove gearhouse by taking out all cap screws (23) in its flange. It may be necessary to bump the sides with a wood block or mallet to break the flange joint.
2. Reach through one of the blower pipe connections and place a chalk mark on the strip of one impeller and the mating waist of the other, so that they may easily be returned to their original relative positions.
3. **GEAR REMOVAL:** CAUTION: Do not remove gear nuts (17) completely before the gears are unseated from the taper fits or damage/injury may result. For this operation, the impellers should be wedged, as shown in Table 5. Back off gear clamping nuts (17) about 1/4". Use a suitable puller or wedge. As the puller set screw is torqued, the puller will have a tendency to turn and contact teeth of the other gear. To prevent this contact, hold the puller corner nut with a wrench while torquing the set screw. Once the gear is unseated, remove the puller. Remove gear nuts (17) and the gear.
4. **GEAR INSTALLATION:** Place impellers in correct position as previously marked. Be sure shafts and gear bores are clean, oil free and free of scratches. Clean the shaft tapered fits. Place hardwood wedges as shown in Table 5. Install drive gear (4) and gear nut (17). Tighten the drive gear nut to the torque given below. Blower assembly must be fastened down for torquing operation.
5. Installing driven gear (4) – Insert a long, metal feeler gauge between the impellers' lobes at the fronts or backs as shown below. Feeler gauge thickness to be a middle value from Table 5 for fronts and backs. Install nut (17). Tighten lightly with a small wrench, then check front and back clearances against Table 5 for each 45° position. Both fronts and backs should be about the same and within the specified range in Table 5. Adjust gear position, if necessary, then insert the corrected feeler gauge and wedges and use a torque wrench to tighten the gear nut to the torque specified in below. Remove wedges and rotate the drive shaft by hand to make sure there are no gear tight spots or impeller contacts. **CAUTION**! *Keep fingers away from impellers and gears.*

UNIVERAL RAI® SERIES BLOWER GEAR NUT TORQUE

Frame Size	Torque lb.-ft.	Torque (kg-m)
22, 24,	60	(8.3)
32, 33, 36	110	(15.2)
42, 45, 47	190	(26.3)
53, 56, 59	250	(34.6)
65, 68, 615	400	(55.3)
76, 711, 718	550	(76.1)

6. Check the end clearances between impellers and headplates. Adjust clearances per B-15 below.
7. When clearances are correct, clean and re-install the gearhouse. Check condition of flange gasket (7) and replace if questionable. Fill gearhouse to correct level with proper grade oil.

B – Replacing Shaft Bearings and Impellers

Remove coupling or sheave from the drive shaft. Drain and remove gearhouse, and pull the timing gears. If gears are to be re-used, mark them so they may be returned to the same shafts.

1. Break corners and deburr the keyway. Remove bearing end cover at the drive end. Remove bearing clamp plates (34).
2. Make single and double identifying punch marks on the mating edges of headplate and cylinder flanges at the two ends of the blower.
3. At the drive end, drive out the two dowel pins and remove all capscrews holding headplate to cylinder. By inserting jacking screws into the two threaded flange holed, and turning them in evenly, the headplate will be separated from the cylinder. As the headplate comes off the shafts it will bring bearings with it. 2-1/2" and 3-1/2" gear diameter units do not have tapped holes for jack screws in the drive end headplates. Remove dowel pins and all capscrews holding headplate to cylinder and foot on the drive end. Support unit under gear end cylinder flange with the shafts vertical. Using soft metal block against gear end shafts, push them out of gear end headplate.
4. For 2-1/2" and 3-1/2" gear diameter units, support the drive end headplate on the underside, and using soft metal block against drive end shafts, push them out of drive end headplate.

   For 4", 6" & 7" gear diameter units, from the gear end, using a wood or soft metal block against the ends of the shafts, drive them out of the head plate. If they are to be reused, protect them from damage in this operation.
5. If blower interior surfaces need cleaning, it may be advisable to separate the gear end headplate from the cylinder. Use the same general procedure as employed at the drive end.
6. Working from the back (flat) face of each head plate, push or tap out the bearings and seals. Use a round bar or tube that will pass through the shaft clearance holes in the headplates. All lip seals will be damaged during removal and must be replaced.
7. Clean bearing and seal pockets in headplates and remove burrs or rough edges. (Apply a thin coating of sealant on seal O.D.) Press new seals (27) into gear end headplate using a round tube or bar with recessed end that will bear on the outer metal edge of seal enclosure. Seal lip should point toward the driving tool. Seals to be flush without board bore face. Apply a light coat of oil or grease to the seal lips. In a similar fashion, install lip seals into the drive end headplate.
8. Place cylinder on a flat surface. Assemble gear end headplate to cylinder after checking flange punch marks. Drive in the two locating dowel pins before tightening flange screws. Also install gear end foot using the same longer cap screws (32) and washers (41). (On 6" & 7" UNIVERSAL RAI® blower install both gear end feet.)
9. Place the assembly horizontally on steel blocks with gear end headplate on bottom. The height of the blocks should be sufficient to clear gear end shaft extensions. Assemble impellers into the cylinder with the drive shaft (longer shaft) in same location as in original assembly. Before starting the shafts through the headplate holes, make sure shaft ends have no sharp or rough edges to damage seal lips. Position impellers at 90° to each other in the cylinder, using lobe-and-waist match marks if original impellers are being re-installed. Install drive end headplate and feet in same manner as gear end.
10. It is recommended that new bearings be used for rebuild. Apply thin film of machine oil on the shaft bearing fit, bearing I.D., and headplate bearing bore. Install drive end bearings into headplate. Use a tube with flanged end that will contact both bearing faces simultaneously. Refer to Assembly Drawing for proper bearing depths.
    NOTE: *Cylindrical drive bearing should be installed with inner race large shoulder facing outboard.*
11. Place blower on its feet on a flat surface. Loosen feet capscrews (32) and square up unit. Re-tighten capscrews (32). Clamp unit down to a solid base for further assembly.
12. Oil the gear end bearing fits as described previously. Install 2-1/2" thru 5" blower gear end bearings flush with the headplate bearing shoulders using proper drivers. On 6" & 7" gear diameter units, install thrust washer (29) in bearing bores then install gear end bearings so they protrude 1/16" (1.6mm) above headplate surface.
13. Install bearing clamp plates (34). On 6" & 7" gear diameter units, blower impeller end clearances are also to be set during this step. Install clamp plates (34) with capscrews (31) making sure that the gap between the clamp plates and the headplate is even all around. At the same time, set end clearances per Table 5.
14. Install gears and time impellers as in (A).

15. For setting end clearances on 2-1/2” thru 5” gear diameter units, special tools, thrust adjuster fork and thrust adjuster saddle are required. Refer to Table 5 for installation of tools. The flat side of the saddle rests against the bearing inner race and the flat side of the fork rests against the back side of the gear. Install a shim, with thickness equal to gear end clearance (Table 5), between the impeller and the gear end headplates. Tap on top of the fork until the shim becomes snug. Remove the shim and check end clearances. To increase gear end clearance, tap on the end of the gear end shaft with a soft metal mallet. Set end clearances for 6” & 7” by turning capscrews (31) evenly in or out.
16. Install drive end cover (5) after packing bearing cavities with suitable grease. Replace drive shaft seal. Lip must point toward (33) the bearing. Exercise care not to damage the lip as it passes over shaft keyway.
17. Install gasket item (7). Install the gear house after cleaning out the inside. Tighten gear box cap screws (23) evenly. Fill with correct grade of oil until oil flows out through oil level hole. Grease drive and bearings. (See Lubrication.)
18. Reinstall coupling or belt sheave making sure that they have a slight slide fit with the shaft and could be installed by hand.

Technical Supplement

for 32, 33, 36, 42, 45, 47, 53, 56, 59, 65, 68, 615 Univeral RAI®-G blowers

ROOTS™ Universal RAI™-G rotary positive gas blowers are a design extension of the basic Universal RAI™ blower model. URAI™-G blower uses (4) mechanical seals in place of the standard in board lip seals to minimize gas leakage into the atmosphere. The seal vent chambers are plugged. These units are intended for gases which are compatible with cast iron case material, steel shafts, 300/400 series stainless steel and carbon seal components, viton o-rings and the oil/grease lubricants. If there are any questions regarding application or operation of this gas blower, please contact factory.

Precaution: ***URAI™-G blowers: Care must be used when opening the head plate seal vent chamber plugs (43) as some gas will escape–if it is a pressure system, or the atmospheric air will leak in-if the system is under vacuum. There is a possibility of some gas leakage through the mechanical seals. This leakage on the gear end will escape through the gear box vent, and on the drive end, through the grease release fittings. If the gas leakage is undesirable, each seal chamber must be purged with an inert gas through one purge gas hole (43) per seal . There are two plugged purge gas holes(1/8 NPT) provided per seal. The purge gas pressure must be maintained one psi above the discharge gas pressure. Also, there exists a possibility of gear end oil and drive end grease leakage into the gas stream.***

The lubricants selected must be compatible with the gas. Mechanical Seal Replacement: Disassemble the blower. During disassembly, damage to mechanical seals is very likely. During rebuild, always use new mechanical seals. Prior to any assembly, make sure that all parts are completely clean and free from nicks and scratches.

(1) Place head plate on an assembly table with seal bores pointing up. Coat the OD of the stationary seal element and install it with carbon facing up in the seal bore with a seal driver that is guided by the bearing bore. Drive the seal flush with front face of the seal bore. Repeat this procedure for all four seals. Apply a light coating of lubricating oil on the sealing surface. Protect sealing faces during assembly from any damage.

(2) Apply teflon based sealant on the cylinder flanges before installing head plates. Continue the assembly procedure as outlined up to bearing installation. Before installation of the bearings, the seal mating rings need to be installed. Apply light film of lubricating oil on mating ring o-rings and sealing faces. Slide mating rings on the shaft and up to carbon faces making sure that no damage to the o-rings occur during installation (break sharp shaft corners to avoid damage to the o-rings during initial preparation). Install bearings all the way against the back bearing bore shoulders.

(3) Complete the rest of the assembly.Make sure all plugged holes are sealed with teflon thread liquid sealant.

Note: On 6” gear diameter units, shims (44) are used between the bearing clamp plates and the head plate on the gear end.

Also, on size 32 and 42, washers with embedded o-rings are used on the center head plate to cylinder bolts.

After the assembly is completed, plug the blower inlet and discharge connections and run static soap bubble. Leak test to assure leak free assembly.

For satisfactory operation of mechanical seals, synthetic lubricants are recommended (Check suitability to gases before using.)

Oils:

(1) ROOTS™ GT Synthetic Lubricant ROOTS P/N 13-106-001 (1) one quart ISO-220

(2) Mobil SHC 600 Series Lubricating Oils

Grease:

ROOTS™ Synthetic Grease – NLGI # 2
ROOTS P/N T20-019-001 (1) one 14 oz tube

MAINTENANCE & REPLACEMENTS: RAM™ SERIES BLOWERS

A good program of consistent inspection and maintenance is the most reliable method of minimizing repairs to a blower. A simple record of services and dates will help keep this work on a regular schedule. Basic service needs are:

- Lubrication
- Checking for hot spots
- Checking for increases or changes in vibration and noise
- Recording of operating pressures and temperatures

Above all, a blower must be operated within its specified rating limits, to obtain satisfactory service life.

A newly installed blower should be checked often during the first month of full-time operation. Attention thereafter may be less frequent assuming satisfactory performance. Lubrication is normally the most important consideration and weekly checks of lubricant levels in the gearbox and bearing reservoirs should be customary. Complete oil change schedules are discussed under **LUBRICATION**.

Driver lubrication practices should be in accordance with the manufacturer's instructions. If direct connected to the blower through a lubricated type coupling, the coupling should be checked and greased each time blower oil is changed. This will help reduce wear and prevent unnecessary vibration. In a belted drive system, check belt tension periodically and inspect for frayed or cracked belts.

In a new, and properly installed, unit there is no contact between the two impellers, or between the impellers and cylinder or headplates. Wear is confined to the bearings (which support and locate the shafts) the oil seals, and the timing gears. All are lubricated and wear should be minimal if clean oil of the correct grade is always used. Seals are subject to deterioration and wear, and may require replacement at varying periods.

Piston ring seals (28) are designed to operate without rubbing contact, once temperature and thermal growth have stabilized. The stationary rings will rub the rotating sleeve (38) briefly as a result of temperature cycles that occur during the startup and shutdown of the unit. The sleeves are hardened and the rings are coated with dry lubricant that provides for temporary break in wear. Replace piston ring seals if they become excessively worn or inspection shows more than .010" (.25mm) axial clearance between ring and groove.

Shaft bearings are designed for optimum life under average conditions with proper lubrication and are critical to the service life of the blower. Gradual bearing wear may allow a shaft position to change slightly, until rubbing develops between impeller and casing. This will cause spot heating, which can be detected by observing these surfaces. Sudden bearing failure is usually more serious. Since the shaft and impeller are no longer supported and properly located, extensive general damage to the blower casing and gears is likely to occur.

Oil seals should be considered expendable items, to be replaced whenever drainage from the headplate vent cavity becomes excessive or when the blower is disassembled for any reason. Sealing effectiveness can vary considerably from seal to seal and is also affected to surprising degree by shaft finish under the seal lip. Because of these normal variables, minor seal leakage should not be considered as indicating seal replacement.

Timing gear wear, when correct lubrication is maintained, should be negligible over a period of years. Gear teeth are cut to provide the correct amount of backlash, and gears correctly mounted on the shafts will accommodate a normal amount of tooth wear without permitting contact between lobes of the two impellers. However, too high an oil level will cause churning and excessive heating. This is indicated by unusually high temperature at the bottom of the gear housing. Consequent heating of the gears will result in loss of tooth-clearance , backlash and rapid wear of the gear teeth usually will develop. Continuation of this tooth wear will eventually produce impeller contacts (knocking), and from this point serious damage will be unavoidable if blower operation is continued. A similar situation can be produced suddenly by gear tooth fracture, which is usually brought on by sustained overloading or momentary shock loads.

Problems may also develop from causes other than internal parts failure. Operating clearances within a blower are only a few thousandths of an inch. This makes it possible for impeller interferences or casing rubs to result from shifts in the blower mounting, or from changes in piping support. If this type of trouble is experienced, and the blower is found to be clean, try removing mounting strains. Loosen blower mounting bolts and reset the leveling and drive alignment. Then tighten mounting again, and make sure that all piping meets blower connections accurately and squarely Foreign materials sucked into the blower will also cause trouble, which can only be cured by disconnecting the piping and thoroughly cleaning the blower interior.

A wide range of causes & solutions for operating troubles are covered in the **TROUBLE SHOOTING CHECKLIST**. The remedies suggested should be performed by qualified mechanics with a good background, using procedures detailed in this manual. Major repairs generally are to be considered beyond the scope of maintenance, and should be referred to ROOTS.

Warranty failures should not be repaired at all, unless specific approval has been obtained through a Sales Office or the factory before starting work. Unauthorized disassembly within the warranty period will void the warranty.

It is recommended that major repairs be performed at an authorized ROOTS facility. However, it is recognized that this may not always be practical. If a blower is out of warranty, mechanical adjustments and parts replacement may be undertaken locally at the owner's option and risk. It is recommended that ROOTS™ parts be used to insure fit and suitability. The maintenance of a small stock of on-hand spare parts can eliminate possible delays. When ordering parts give Item numbers and their word descriptions from sectional drawings and parts lists. Also specify quantities wanted and the blower size and serial number from the nameplate.

Repairs or adjustments are best performed by personnel with good mechanical experience and the ability to follow the instructions in this manual. Some operations involve extra care, patience, and a degree of precision work. This is especially true in timing impellers and in handling bearings. Experience indicates that high percentages of bearing failures are caused by dirt contamination before or during assembly. Therefore, the work area should be cleaned before starting disassembly, and new or re-usable parts protected during progress of the work.

In the following repair procedures, numbers shown in brackets ( ) correspond to the Item numbers used in assembly drawings, and parts lists. It is recommended that the procedures be studied carefully and completely, with frequent reference to the drawings, before starting work. This will produce better efficiency through an understanding of what work is to be done, and the order of doing it. Before disassembly, mark all parts so that they may be returned to original locations or relative positions.

Requirements for special tools will depend on the work to be done. If impeller clearances and float are to be checked or re-set, a dial indicator and a set of long feeler gauges will be needed. Work involving removal of the timing gears cannot be accomplished without a puller suitable. Heat must be used during bearing and sleeve installation.

Design of ROOTS™ blower is simple, and most repair operations are straightforward. For this reason, the following procedures are intended mainly to indicate a preferred work order and to call out points to be observed. Where special operations are required, detailed coverage is given.

DISASSEMBLY OF DRIVE END

1. Remove the sheave or coupling and key from the drive shaft. File off any burrs or sharp edges along the keyway.
2. Drain oil by removing drain plug (22).
3. Remove the flange screws (75). Tap the drive end cover to loosen it, then slide it along the shaft care fully to avoid damaging the lip seal (33) on the drive shaft keyway. Remove the gasket (7). Remove oil slinger (40) and cap screw (60).
4. Remove bearing clamp plates (34) by unscrewing capscrews (32) and removing lock washers (35). Keep shim halves (10) together exactly as removed by tagging them with each clamping plate.
5. Remove the headplate – remove all capscrews (23) holding headplate to the cylinder. Insert jacking screws into the four threaded flange holes and turn them in evenly. The headplate will separate from the cylinder. The lip seals (27), and bearing outer race and rollers, are removed with the headplate and can be pressed out later.
6. Remove the bearing inner race and sleeve (38) from the shaft with aid of a bearing puller by inserting the puller jaws in the groove in the sleeve and applying the jacking screw against the end of the shaft. Protect the threaded hole and the end of the shaft with a small, flat spacer between the shaft and the puller.

DISASSEMBLY OF GEAR END

1. Drain oil completely from the gearbox sump by removing plugs (22) in bottom of the headplate (1).
2. Loosen all flange screws (75) in the gearbox and remove all but two upper screws. Bump the gear box to break the joint if it cannot be pulled free by hand, then remove the last two screws and lift off the gearbox. Remove gasket (7).
3. Removing gears: CAUTION**:** Do not remove gear nuts (31) completely before the gears are unseated from the taper fits or damage/injury may result. Be sure that each gear is marked for return to the same shaft in the same angular position and that the gears have match marks for the teeth. For this operation, the impellers should be wedged as shown in Figure 8. Back off nuts (31) and slinger (46). The timing gears (4) have two 1/2" – 13 holes for pulling purposes. Use a suitable puller.
4. Remove bearing clamp plates (54) by unscrewing capscrews (32) and removing lock washers. Group the shims (10), the wavy spring washers (29) with each clamp plate and tag for ease of reassembly.
5. Remove the headplate – remove all capscrews 23) holding the headplate to the cylinder. Insert jacking screws into the four (4) threaded flange holes and turn them in evenly. They headplate will separate from the cylinder. The lip seals (27), and bearing outer race and rollers, are removed with the headplate and can be pressed out later.

   For RAM™-J WHISPAIR™ gas pump units: The gear end headplate which is removed next requires a different approach from the drive end. On this end, the shafts are forced from the bearing bore by using a bar across the end of the shaft with threaded rods to the headplate. Once the headplates are removed from the assembly, the seal housings can be pressed or driven from the headplate bores. Generally, new seals will be required prior to reassembly.

6. Remove the bearing inner race and sleeve (38) from the shaft with the aid of a bearing puller by inserting the puller jaws in the groove in the sleeve and applying the jacking screw against the end of the shaft. Protect the threaded hole and the end of the shaft with a small, flat spacer between the shaft and the puller.

ASSEMBLY

Prior to any assembly operation, it is essential that all parts are completely clean and free from nicks and scratches.

Prior to assembly, lightly coat the groove in the sleave with slip plate. ROOTS P/N813-314-000.

1. Assembly of Piston ring seals (28) – To avoid scratching the lip seal surface, install the Piston ring seals (28) in the sleeves (38) from the end nearest the groove before assembling the sleeve on the shaft.

   Unhook the gap joint and expand the ring while sliding it to the groove, then compress it so one end of the hook joint slides over the other. Move the ring in the groove to be sure it is free.

   NOTE: *Care must be taken not to scratch or dent the sleeve surface since it is the sealing surface for the lip seal.*

2. Installation of sleeves (38) – heat the sleeve to 300° F. (149°C) then quickly slide it on the shaft tightly against the impeller. If the sleeve hangs up during assembly, it can be pressed into place using a tubular pressing tool with square, clean ends.

3. Assembly of seals (27) in headplate (1) – Place headplate flat with seal bores up. Be sure the pressing tool face is clean and square and there is a smooth, clean entering bevel in the headplate. Lubricate the seal lips. Place seal over the bore with lip facing up, then press the seal evenly until it is flush with bore face.

   For Gas Sealed Units: Assemble mechanical seals (27) in headplate – (**CAUTION:** *Care must be used to avoid damaging the carbon face. Before proceeding with this step, you should have a piloted seal driver which is designed to clear the carbon face.*) with headplate positioned horizontally with seal bores up. Be sure the pressing tool face is clean and square and there is a smooth, clean entering bevel in the headplate. Place the seal over the bore with carbon facing up. Then press the seal evenly on its steel shell using the piloted seal driver until the driver seats against the stop.

4. Assembly of impellers (12 and 13) to headplate (1) – Place gear end headplate flat on 3 in. (76 mm) blocks with the smallest bores facing up. Inspect entering bevels to be sure they are smooth and clean. Locate the drive impeller correctly (top for vertical units and toward the driver for horizontal units). Place the seal ring gaps toward the inlet for pressure applications and towards dis charge for vacuum applications. Insert the impeller shafts in the headplate so the impellers rest on the headplate. Use care to avoid damaging the lip seals.

5. Assembly of cylinder (11) to gear end headplate (1) – Install dowel pins (16) and secure cylinder to headplate with capscrews (23). Torque to 35 ft.-lbs (4.5 Kg-m). Then, install drive end headplate (1) and dowel pins (16) and secure with capscrews (23). Install feet (76) & 77) to both headplates and secure with capscrews (66). Torque to 35 ft.-lbs. (4.5 kg-m).

   For Gas Sealed Units: Use a Teflon sealant between headplate and cylinder joint. Assemble rotating seal – apply a light coating of oil to the O-ring and seal face. Then with flute side out install the rotating seat tight to the shaft sleeve. Check and record seal compression – With the seal body in place and the impeller against the opposite headplate, check that seal compression is adequate. This can be checked using a depth gauge or dial indicator from the face of the head plate to the face of the mating ring. First, measure this distance while the carbon is out at its full length. Then, push the mating ring back against its stop and measure it again. The difference between these measurements is the compression. This can be done easily with finger pressure as the spring force is only 10 lbs. The correct travel is given below (record actual compression on clearance sheets).

SEAL COMPRESSION

Frame	Minimum	Maximum
400	.047”	.097”
600	.108”	.151”

* Prior to to assembly, lightly coat the groove in the sleave(38) with slip plate. ROOTS™ P/N 813-314-000

6. Installation of bearings (14) – Heat bearing inner race to 300°F (149°C) in an oven or hot oil; then slide it onto the shaft so the bearing shoulder is snugly against the sleeve. Note: Be sure to install the shaft shim (70) behind the shaft sleeve before installing the drive end drive bearing inner race. This is required to compensate for the oil leader for shimming. Insert the bearing outer race and rollers in each bore and tap lightly in place. Spray bearings with lubricant.

7. Measure and record the end clearances between the impellers and drive headplate using long feeler gauges. Then, subtract the allowed average drive end clearance. See Table 6. The result is the space required between clamping plates (34) and bearing outer race. Place shims (10) as required to get this clearance. Then, fasten the clamping

plates to the headplate with capscrews (32) and lock washers (35).

8. Installation of gear end bearings (14) – Turn the blower so that the gear end headplates is up. Heat bearing inner race to 300°F (149°C) in an oven or hot oil; then slide it onto the shaft so that the bearing shoulder is snugly against the sleeve. Insert the bearing outer race and rollers in each bore and tap lightly into place.

9. Measure and record the end clearance between the impellers and gear end headplate, then subtract the allowed average gear end clearance. See Table 6. The result is the space required between clamping plate (54) and bearing outer race. Place shims (10) as required to get this clearance. Then fasten the clamping plates (54) to the headplate using capscrews (32) and lock washers (35). Do not install wavy-spring washers (29) at this time, as a final check of clearances is required first.

10. Final check of end clearances and float – Using long feeler gauges, check the clearance between the impellers and drive end headplate. See Table 6. Place the blower assembly on its feet and correct shimming as required. Then, force the impellers as close to the gear end headplate as possible, and check the clearance between impellers and gear end headplate for agreement with Table 6. Adjust shimming on the gear end as required. With unit securely fastened down, use a dial indicator to measure the impeller float. Again push the impeller to one end of the cylinder. With indicator firmly mounted, place contact point on the end of the shaft just pushed and set dial on zero. Force the impeller to the opposite end (toward indicator). Indicator reading will be a measurement of the impeller float. Repeat process on second impeller and compare float to Table 6. Adjust shimming at bearing clamp plates to obtain both float and end clearances specified in Table 6.

    Finally, after clearances and float have been corrected and checked, remove the gear end clamping places (54) and install wavy-spring washers (29) and reinstall shims (10) and clamping plates (54). Be sure oil feed grooves are up and toward bearings.

11. Installing drive gear (4) – Be sure shafts and gear bores are clean and free of scratches. Oil gear nut threads lightly. Place hardwood wedges as shown in Figure 8. Install gear (4) and nut (31) so match mark at the tooth is at the line of engagement. Tighten the drive gear to the torque given below. Blower assembly must be fastened down for torquing operation.

12. **Left side discharge machine**
    Installing driven gear (14) – Insert a long metal feeler gauge between the impellers' lobes at the fronts as shown in Table 6. Feeler gauge thickness to be a middle value from Table 6 for fronts.

13. **Right side discharge machine**
    Installing driven gear (4) – Insert a long metal feeler gauge between the impellers' lobes at the backs. Feeler gauge thickness to be minimum value from Table 6 for backs.

RAM™ SERIES BLOWER GEAR NUT TORQUE

Frame Size	Torque	
	lb.-ft.	(kg-m)
404, 406, 409, 412, 418	400	(56)
616, 624	630	(88)

RAM™ SERIES BLOWER OIL SLINGER SCREW TORQUE

Frame Size	Torque	
	lb.-ft.	(kg-m)
404, 406, 409, 412, 418	75	(10)
616, 624	140	(19)

Align the gear so the tooth match marks agree with the drive gear, then install slinger (46) and nuts (31). Tighten lightly with a small wrench, then check front and back clearances against Table 6 for each 45° position. Both fronts should be about the same and backs should about equal and be within the specified range in Table 6. Adjust gear position if necessary, then insert the corrected feeler gauge and wedges and use a torque wrench to tighten the gear nut to the torque specified above. Remove wedges and rotate the drive shaft by hand to make sure there are no gear tight spots or impeller contacts. **CAUTION: Keep fingers away from impeller end gears.**

Install gearbox (3) with gasket (7) and tighten the capscrews (75) evenly to 10 ft.-lbs. (1.3 kg-m).

Install drive end oil slinger (40) and capscrew (60), apply Locktite to threads and torque to value specified above.

Install drive end cover (5) and gasket (7) with drive lock pins (17) in place, being careful not to dent or scratch drive shaft lip seal surface. Tighten capscrews (75) evenly. Check seal bore for concentricity with shaft using an indicator; reposition drive lock pins, if necessary. Install seal (33) with lip facing inward, using care to avoid tearing or scratching seal on shaft keyway. Use a pressing tool with clean, square ends to insure correct positioning of the seal. For hydrodynamic style seals, the shaft rotation is critical for correct installation and proper sealing. Match the directional arrow shown on the seal faces with the required shaft rotation. An installation protective sleeve is required to protect seal lip during installation.

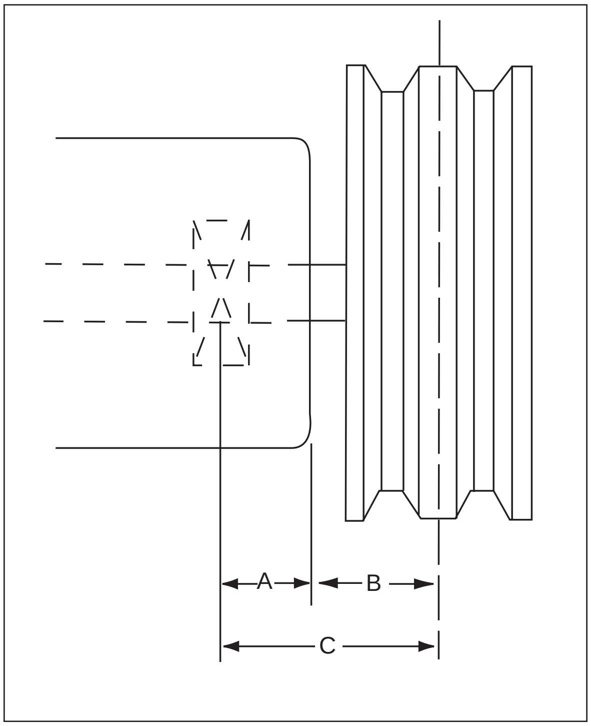
Install vent plug (21) in each headplate.

Replace oil drain plugs (22) and refill drive end and gear sumps with proper grade of oil as discussed under **LUBRICATION**.

Install drive sheave or coupling half and install blower, refer to **INSTALLATION instructions**.

FIGURE 2

ALLOWABLE OVERHUNG LOADS FOR V-BELT DRIVES UNIVERSAL RAI®/URAI™-J UNITS



$$\text{Belt Pull lbs} = \frac{252100 \cdot \text{Motor HP}}{\text{Blower RPM} \cdot \text{Sheave Diameter}}$$

C = Distance between drive bearing center line and sheave center line (A+B)

$$B = (1/8" + \frac{\text{Sheave Width}}{2})$$

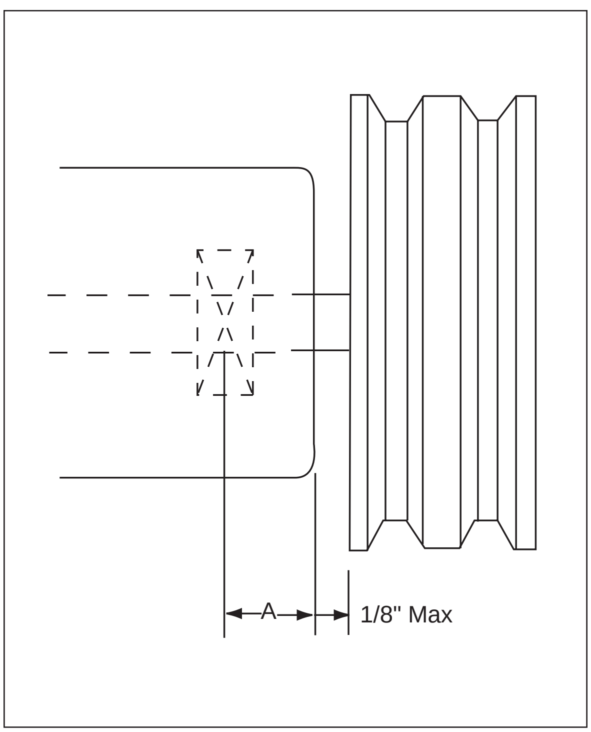
Shaft Load (lb.in) = Belt Pull • C

Frame Size	Dimension "A"	Max Allowable Shaft Load (lb-in.)
22, 24	0.61	80
32, 33, 36	0.80	300
42, 45, 47	1.02	640
53, 56, 59	1.13	1,110
65, 68, 615	1.36	1,550
76, 711, 718	1.16	2,300

NOTE: Arc of sheave belt contact on the smaller sheave not to be less than 170°

Driver to be installed on the inlet side for vertical units, and on the drive shaft side for horizontal units.

ALLOWABLE OVERHUNG LOADS FOR V-BELT DRIVES 400 - 600 RAM™ UNITS



$$\text{Belt Pull lbs} = \frac{27500 \cdot \text{Motor HP}}{\text{Blower RPM} \cdot \text{Sheave Diameter}}$$

$$\text{Shaft Load (lb.in)} = \text{Belt Pull} \cdot (A + 1/8" + \frac{\text{Sheve Width}}{2})$$

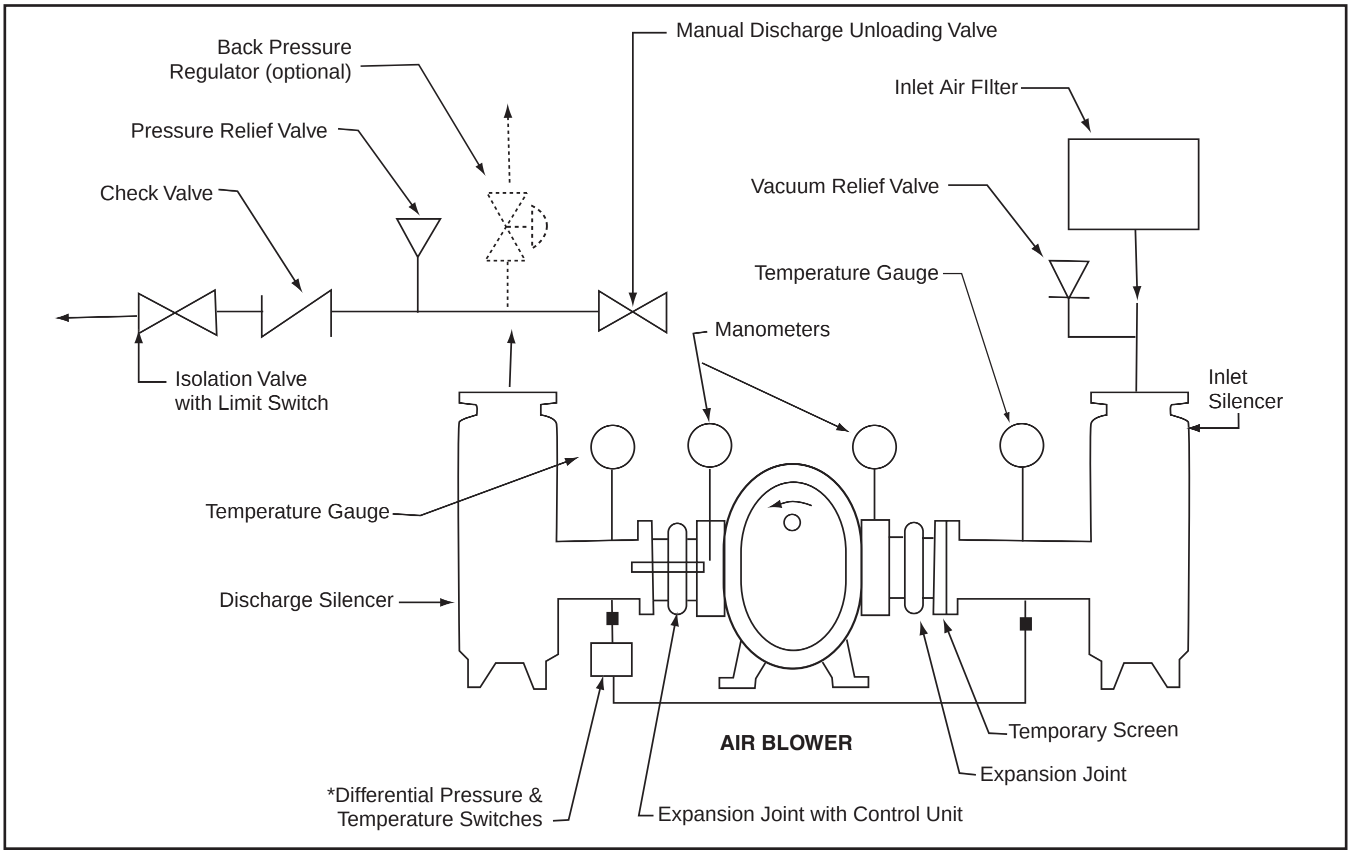
	Dimension "A"		
Frame Size	Standard Unit	Bottom Drive or Double Shaft Seal	Max Allowable Shaft Load (lb-in.)
404, 406	1.90	2.11	3,200
409, 412, 418	1.90	2.11	3,200
616, 624	2.11	2.67	7,975

NOTE: Arc of sheave belt contact on the smaller sheave not to be less than 170°

Driver to be installed on the inlet side for vertical units, and on the drive shaft side for horizontal units.

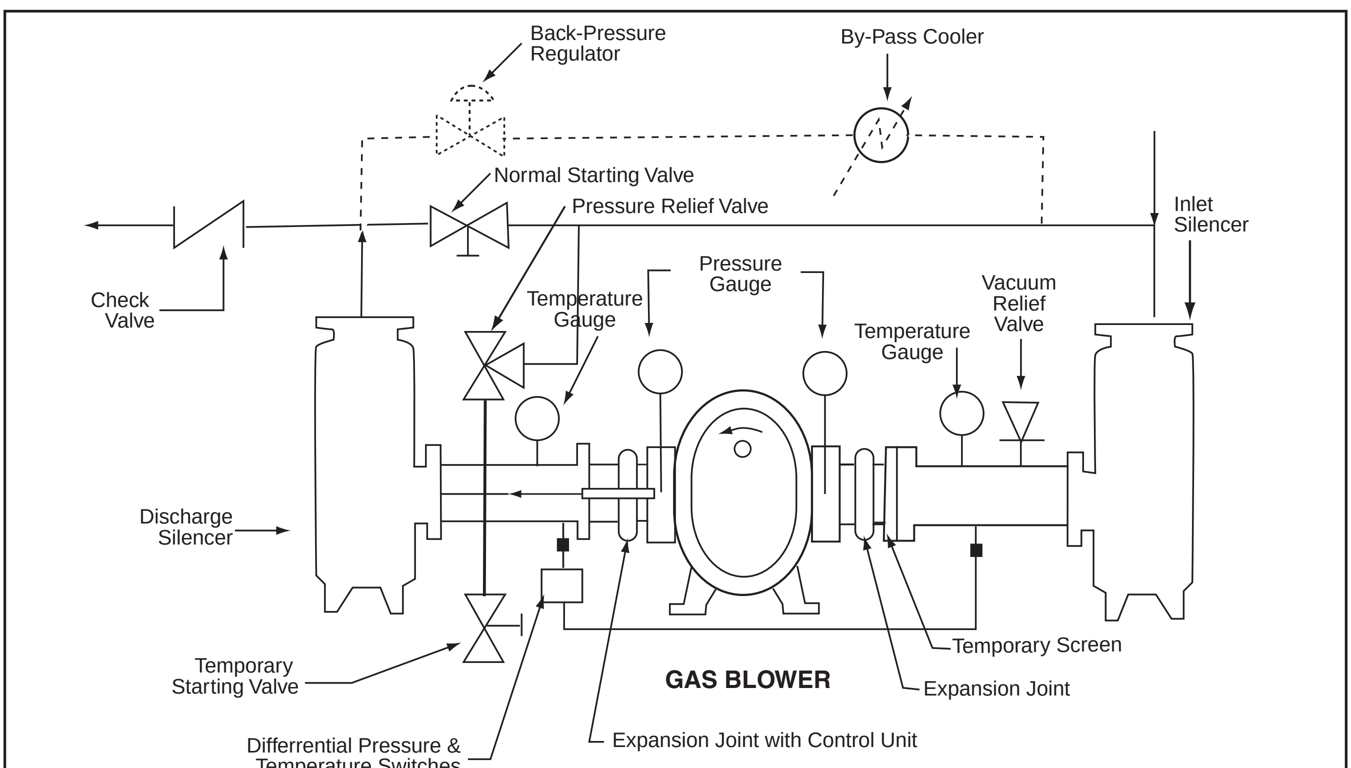
Figure 3

Air Blower Installation with Accessories



Above are suggested locations for available accessories.

Gas Blower Installation with Accessories



Above are suggested locations for available accessories.

Figure 4

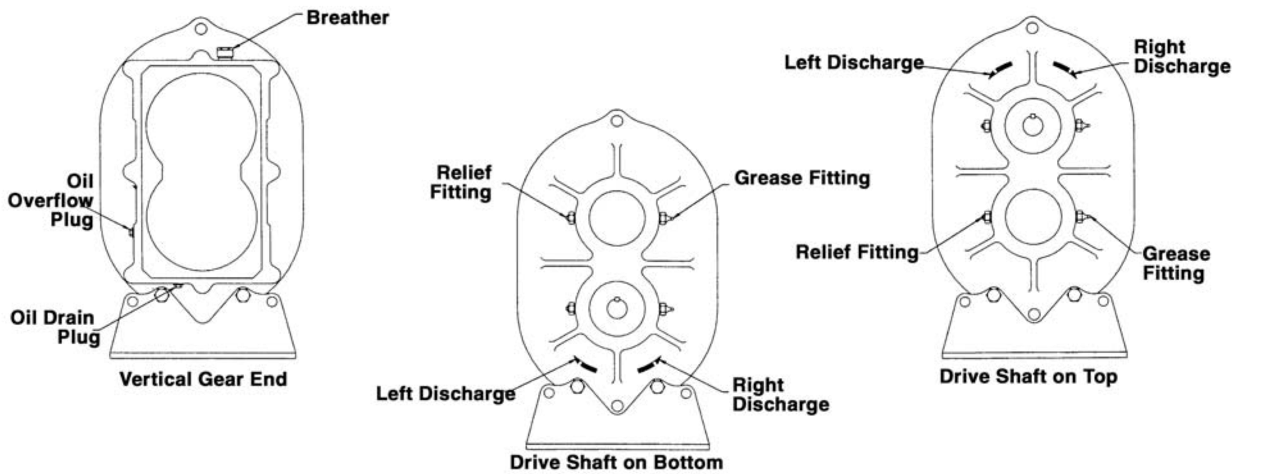
Blower Orientation Conversion

Model	Reversible Rotation	Whispair Design
Universal RAI	yes	no
URAI-J	no	yes
URAI-G	yes	no
RAM	yes	no
RAM-J	no	yes
RAM-GJ	no	yes

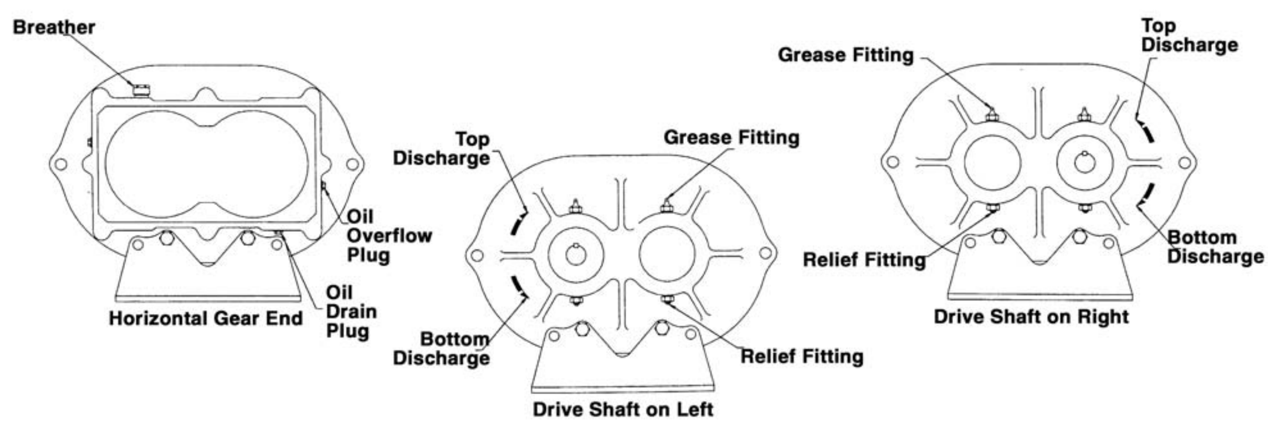
Special Note: WHISPAIR™ models are designed to operate with only one shaft rotation direction to take full advantage of the Whispair feature. Therefore, a WHISPAIR™ blower should be operated in the following combinations only.

- **CCW Rotation:** Bottom Shaft; Right side discharge or a Left Shaft; Bottom discharge
- **CCW Rotation:** Top Shaft; Left side discharge or a Right Shaft; Top discharge
- **CW Rotation:** Bottom Shaft; Left side discharge or a Right Shaft Bottom discharge
- **CW Rotation:** Top Shaft; Right side discharge or a Left Shaft Top discharge

Blower Orientation and Lubrication Points: Universal RAI® & URAI™-G gas blowers



Vertical Mounting

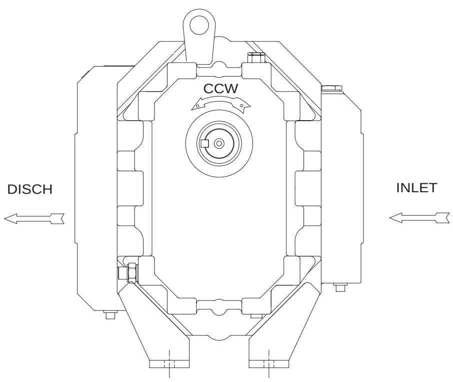


Horizontal Mounting

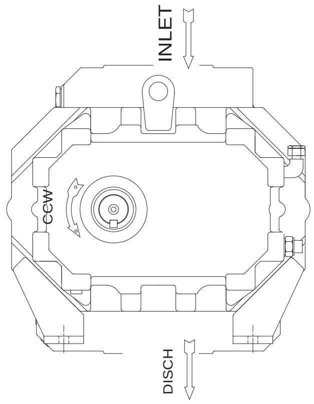
FIGURE 5

BLOWER ORIENTATION CONVERSION - WHISPAIR™ UNITS

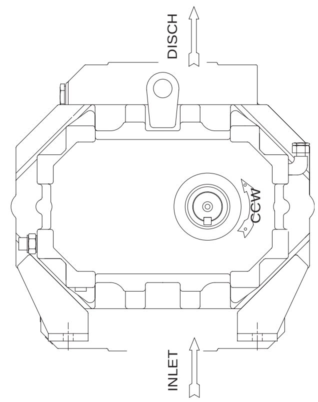
1. STANDARD ARRANGEMENT (3-WAY UNIVERSAL)
   EXTERNAL SIGHT GLASSES (37) & BREATHERS (21) MUST BE RELOCATED AS SHOWN.
   FEET (76&77) & LIFTING LUGS (63) MUST BE RELOCATED AS SHOWN.



TOP DRV, L.S. DISCH

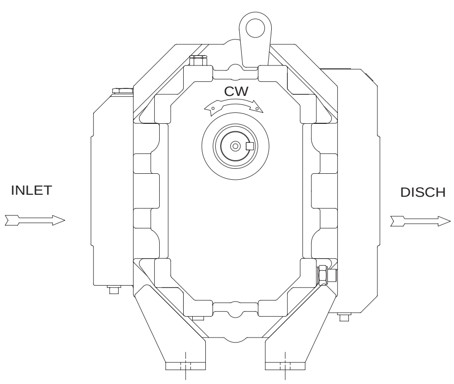


L.H. DRV, BTM DISCH

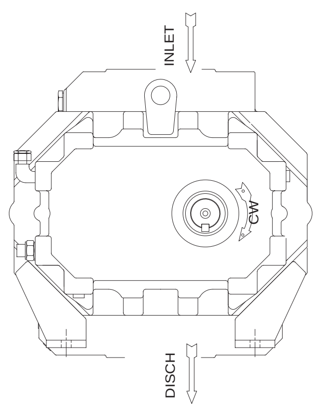


R.H. DRV, TOP DISCH

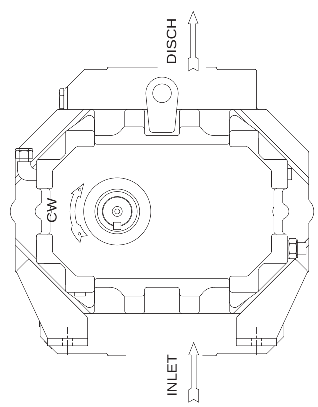
2. NON-STANDARD ARRANGEMENT (3-WAY UNIVERSAL)
   CYLINDER (11) MUST BE UNBOLTED FROM HEADPLATES (1) AND DISCHARGE
   RELOCATED AS SHOWN. **MUST HAVE AUTHORIZATION FOR CONVERSION SO NOT TO VOID WARRANTY.**
   EXTERNAL SIGHT GLASSES (37) & BREATHERS (21) MUST BE RELOCATED ALSO.
   FEET (76&77) & LIFTING LUGS (63) MUST BE RELOCATED AS SHOWN



TOP DRV, R.S. DISCH

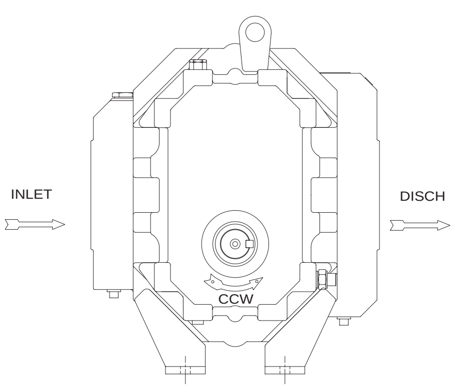


R.H. DRV, BTM DISCH

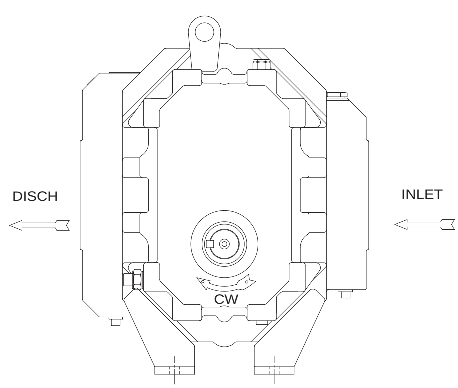


L.H. DRV, TOP DISCH

3. BOTTOM DRIVE SHAFT ARRANGEMENT "SPECIAL ORDER" (3-WAY UNIVERSAL)
   SPECIAL OGE OIL SLINGER REQUIRED FOR ASSEMBLY.
   MAY BE CONVERTED TO HORIZONTAL CONFIGURATION AS PREVIOUSLY SHOWN.



BTM DRV, R.S. DISCH



BTM DRV, L.S. DISCH

Table 1 -

URAI™-J WHISPAIR™ & URAI™-G gas blower, Maximum Allowable Operating Conditions

Frame Size	Gear Diameter (Inch)	Speed RPM	Temp. Rise F° (C°)	Delta Pressure PSI (mbar)	Inlet Vacuum INHG (mbar)
22	2.5	5275	225 (125)	12 (227)	15 (500)
24	2.5	5275	210 (117)	7 (483)	15 (500)
32	3.5	3600	240 (133)	15 1034	16 (539)
33	3.5	3600	225 (125)	12 (827)	15 (500)
36	3.5	3600	225 (125)	7 (483)	15 (500)
42	4.0	3600	240 (133)	15 (1034)	16 (539)
45	4.0	3600	225 (125)	10 (690)	16 (539)
47	4.0	3600	225 (125)	7 (483)	15 (500)
53	5.0	2850	225 (125)	15 (1034)	16 (539)
56	5.0	2850	225 (125)	13 (896)	16 (539)
59	5.0	2850	225 (125)	7 (483)	15 (500)
65	6.0	2350	250 (130)	15 (1034)	16 (539)
68	6.0	2350	240 (133)	14 (965)	16 (539)
615	6.0	2350	130 (72)	7 (483)	12 (405)
76	7.0	2050	250 (139)	15 (1034)	16 (539)
711	7.0	2050	225 (125)	10 (690)	16 (539)
718	7.0	2050	130 (72)	6 (414)	12 (405)

RAM™, RAM™-J WHISPAIR™ blower, RAM™-GJ gas blower
Maximum Allowable Operating Conditions

Frame Size	Gear Diameter (Inch)	Speed RPM	Temp. Rise F° (C°)	Delta Pressure PSI (mbar)	Inlet Vacuum INHG (mbar)
404	4.5	4000	240 (133)	18 (1241)	16 (539)
406	4.5	4000	240 (133)	18 (1241)	16 (539)
409	4.5	4000	240 (133)	18 (1241)	16 (539)
412	4.5	4000	240 (133)	15 (1034)	16 (539)
418	4.5	4000	240 (133)	10 (690)	16 (539)
616	6.0	3000	230 (128)	15 (1034)	16 (539)
624	6.0	3000	230 (128)	10 (690)	16 (539)

Table 3

Recommended Oil Grades

Ambient Temperature °F (°C)	Viscosity Range SSU at 100°F	ISO No.	Approximate SAE No.
Above 90° (32°)	1000-1200	320	60
32° to 90° (0° to 32°)	700-1000	220	50
0° to 32° (-18° to 0°)	500-700	150	40
Below 0° (-18°)	300-500	100	30

UNIVERSAL RAI®, URAI™-J, URAI™-G Oil Sump Capacities

Frame Size	Capacity Fl. Oz. (Liters)	
	Vertical	Horizontal
22	3.4 (.1)	6.1 (.18)
24	3.4 (.1)	6.1 (.18)
32	8.5 (.25)	16.0 (.47)
33	8.5 (.25)	16.0 (.47)
36	8.5 (.25)	16.0 (.47)
42	12.7 (.37)	22.8 (.67)
45	12.7 (.37)	22.8 (.67)
47	12.7 (.37)	22.8 (.67)
53	16.0 (.47)	27.6 (.82)
56	16.0 (.47)	27.6 (.82)
59	16.0 (.47)	27.6 (.82)
65	28.3 (.84)	52.1 (1.54)
68	28.3 (.84)	52.1 (1.54)
615	28.3 (.84)	52.1 (1.54)
76	32.3 (.96)	59.5 (1.76)
711	32.3 (.96)	59.5 (1.76)
718	32.3 (.96)	59.5 (1.76)

RAM™, RAM™-J & RAM™-GJ Oil Sump Capacities

Orientation	Gearbox		Drive End	
	Fl. Oz.	(Liters)	Fl. Oz.	(Liters)
400 (Horizontal)	36	1.06	19	.56
400 (Vertical)	18	.52	9	.27
600 (Horizontal)	95	2.81	50	1.48
600 (Vertical)	55	1.63	28	0.83

Table 4

Suggested Bearing Greasing Intervals

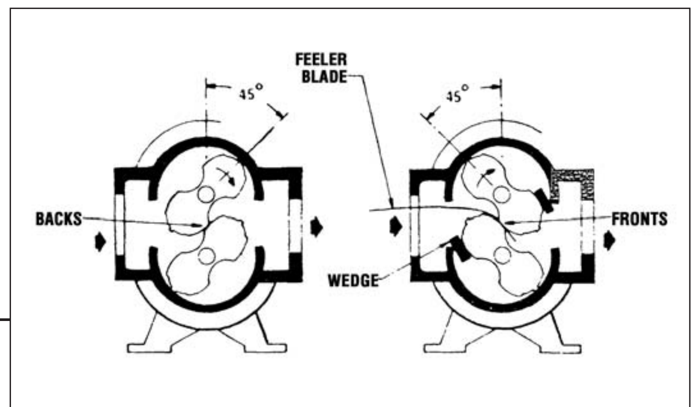
Speed In RPM	Operating Hours Per Day		
	8	16	24
	Greasing Intervals in Weeks		
750-1000	7	4	2
1000-1500	5	2	1
1500-2000	4	2	1
2000-2500	3	1	1
2500-3000	2	1	1
3000 and up	1	1	1

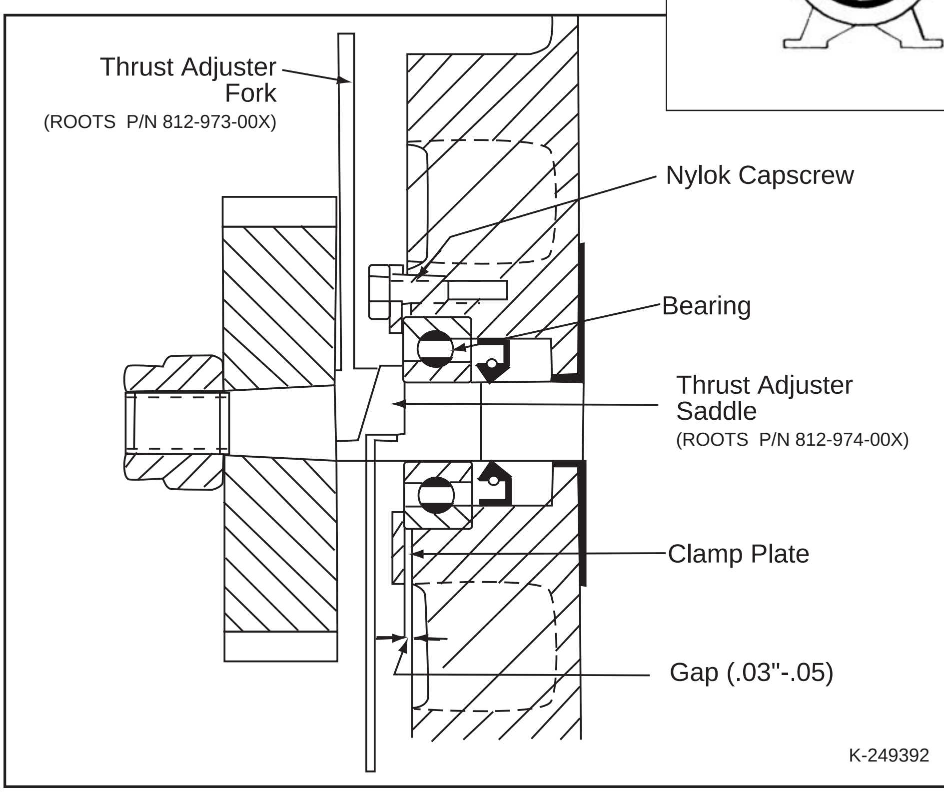
Table 5

Normal Clearances for Universal RAI® and URAI™-J, URAI™-G blowers - Inches (mm)

	Impeller Ends			Cylinder		Impeller
Frame Size	Total	Drive End Minimum	Gear End Minimum	Inlet & Discharge	Center Center	* Fronts/Backs
22	.006/.010 (.15-.25)	.003 (.08)	.003 (.08)	.004/.005 (.10-.13)	.002/.003 (.05-.08)	.007/.01 (.18-.25)
24	.006/.010 (.15-.25)	.003 (.08)	.003 (.08)	.004/.006 (.10-.15)	.002/.003 (.05-.08)	.007/.01 (.18-.25)
32	.006/.011 (.15-.28)	.003 (.08)	.003 (.08)	.004/.006 (.10-.15)	.002/.003 (.05-.08)	.01/.012 (.25-.30)
33	.006/.011 (.15-.28)	.003 (.08)	.003 (.08)	.004/.006 (.10-.15)	.002/.003 (.05-.08)	.01/.012 (.25-.30)
36	.006/.011 (.15-.28)	.003 (.08)	.003 (.08)	.004/.006 (.10-.15)	.002/.003 (.05-.08)	.01/.012 (.25-.30)
42	.008/.011 (.20-.28)	.004 (.10)	.004 (.10)	.005/.007 (.13-.18)	.003/.004 (.08-.10)	.009/.012 (.23-.30)
45	.008/.013 (.20-.33)	.004 (.10)	.004 (.10)	.005/.007 (.13-.18)	.003/.004 (.08-.10)	.012/.015 (.30-.38)
47	.008/.013 (.20-.33)	.004 (.10)	.004 (.10)	.005/.007 (.13-.18)	.003/.004 (.08-.10)	.012/.015 (.30-.38)
53	.008/.011 (.20-.28)	.004 (.10)	.004 (.10)	.005/.008 (.13-.20)	.003/.004 (.08-.10)	.011/.013 (.28-.33)
56	.008/.013 (.20-.33)	.004 (.10)	.004 (.10)	.005/.008 (.13-.20)	.003/.004 (.08-.10)	.015/.017 (.38-.43)
59	.008/.013 (.20-.33)	.004 (.10)	.004 (.10)	.005/.008 (.13-.20)	.003/.004 (.08-.10)	.015/.017 (.38-.43)
65	.012/.016 (.30-.40)	.008 (.20)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.010/.014 (.25-.36)
68	.014/.018 (.36-.46)	.010 (.25)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.010/.014 (.25-.36)
615	.014/.018 (.36-.46)	.010 (.25)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.010/.014 (.25-.36)
76	.012/.016 (.30-.40)	.008 (.13)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.013/.015 (.33-.38)
711	.014/.018 (.36-.46)	.010 (.25)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.013/.015 (.33-.38)
718	.014/.018 (.36-.46)	.010 (.25)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.013/.015 (.33-.38)

*** Impeller Timing for Standard Rotation Viewed from Gear End**





Thrust Setting, 2-1/2" thru 5" UNIVERSAL RAI® blowers

TABLE 6

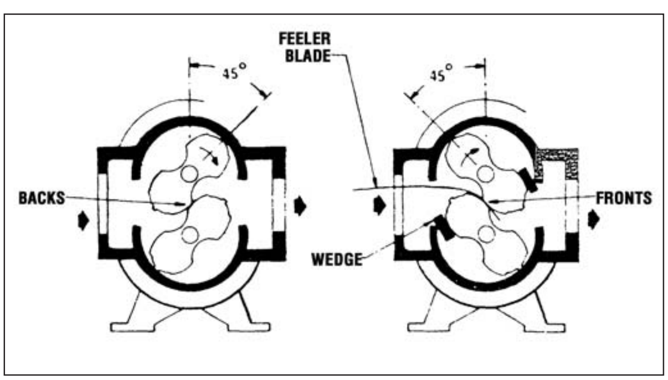
NORMAL CLEARANCES FOR RAM™-J & RAM™-GJ WHISPAIR™ BLOWERS - INCHES (MM)

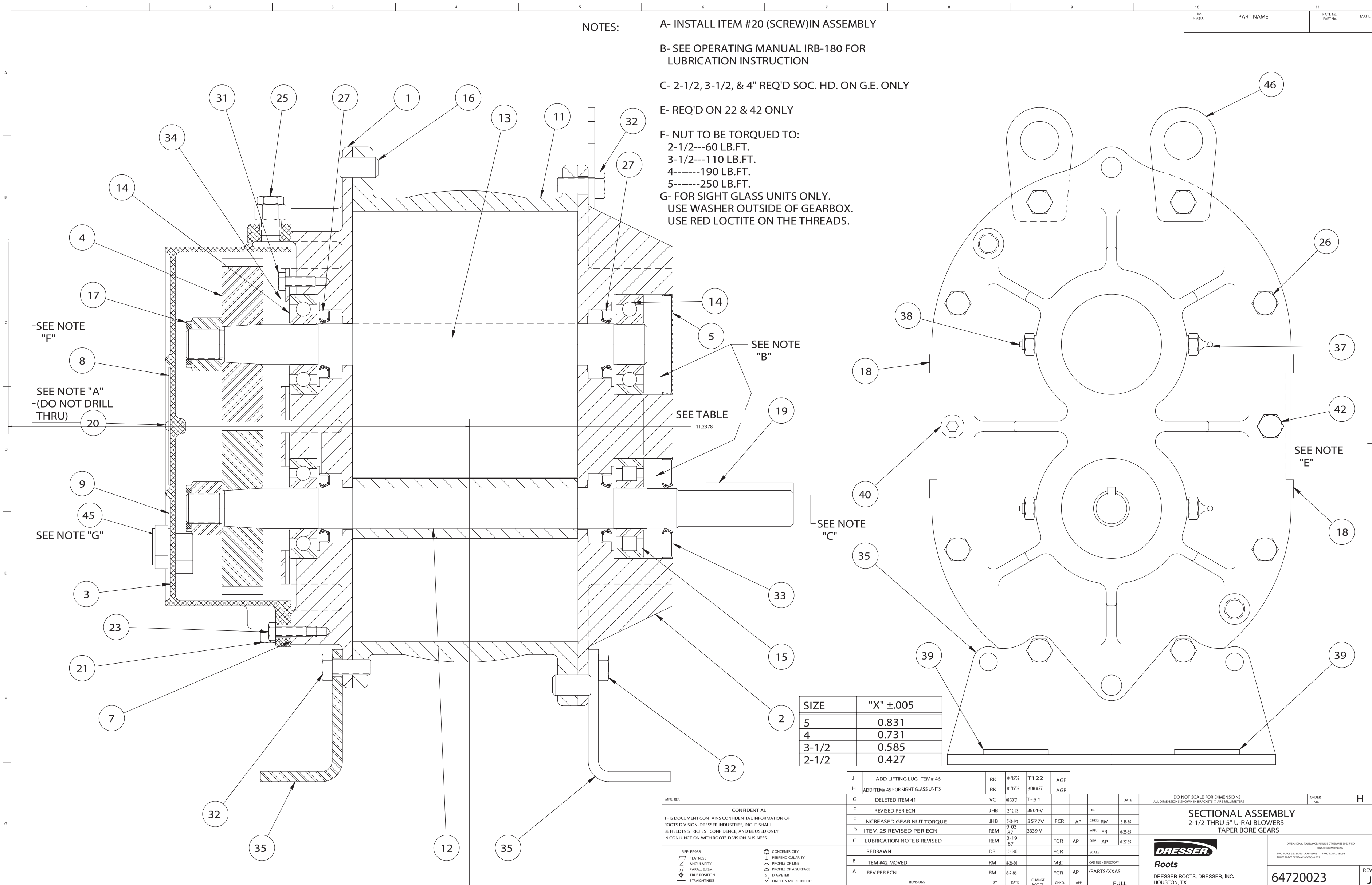
Blower Frame Size	* Impeller Lobes at 45°		End Clearance			Impeller Tips to Cylinders		
	Fronts	Backs	Each End Without Wavy Spring	Gear End Without Spring Installed	Required End Float	Inlet	Center	Discharge
	Min-Max	Min-Max	Min-Max	Min-Max	Minimum	Min-Max	Min-Max	Min-Max
404	.012-.014	.006-.009	.003-.005	.003-.008	.003	.004-.006	.002-.004	.002-.004
	(.31-.36)	(.15-.23)	(.08-.13)	(.10-.15)	(.08-.20)	(.08)	(.05-.10)	(.05-.10)
406	.012-.014	.006-.009	.003-.005	.007-.012	.006	.005-.007	.003-.005	.002-.004
	(.31-.36)	(.15-.23)	(.08-.13)	(.15-.30)	(.13)	(.13-.18)	(.08-.13)	(.05-.10)
409	.013-.015	.006-.009	.003-.005	.013-.018	.008	.005-.007	.003-.005	.002-.004
	(.33-.38)	(.15-.23)	(.08-.13)	(.31-.43)	(.17)	(.13-.18)	(.08-.13)	(.05-.10)
412	.013-.015	.006-.009	.003-.005	.016-.021	.011	.006-.008	.004-.006	.004-.006
	(.33-.38)	(.15-.23)	(.08-.13)	(.36-.48)	(.28)	(.15-.20)	(.10-.15)	(.10-.15)
418	.013-.015	.006-.009	.003-.005	.022-.027	.017	.008-.010	.004-.006	.004-.006
	(.33-.38)	(.15-.23)	(.08-.13)	(.51-.64)	(.38)	(.20-.25)	(.10-.15)	(.10-.15)
616	.012-.014	.006-.008	.004-.006	.017-.022	.011	.009-.011	.004-.006	.002-.005
	(.31-.36)	(.15-.20)	(.10-.15)	(.38-.51)	(.28)	(.23-.28)	(.10-.15)	(.05-.13)
624	.012-.015	.006-.009	.004-.006	.024-.029	.018	.013-.015	.005-.007	.002-.005
	(.31-.36)	(.15-.23)	(.10-.15)	(.61-.74)	(.46)	(.33-.38)	(.13-.18)	(.05-.13)

NORMAL CLEARANCES FOR RAM™ BLOWERS - INCHES (MM)

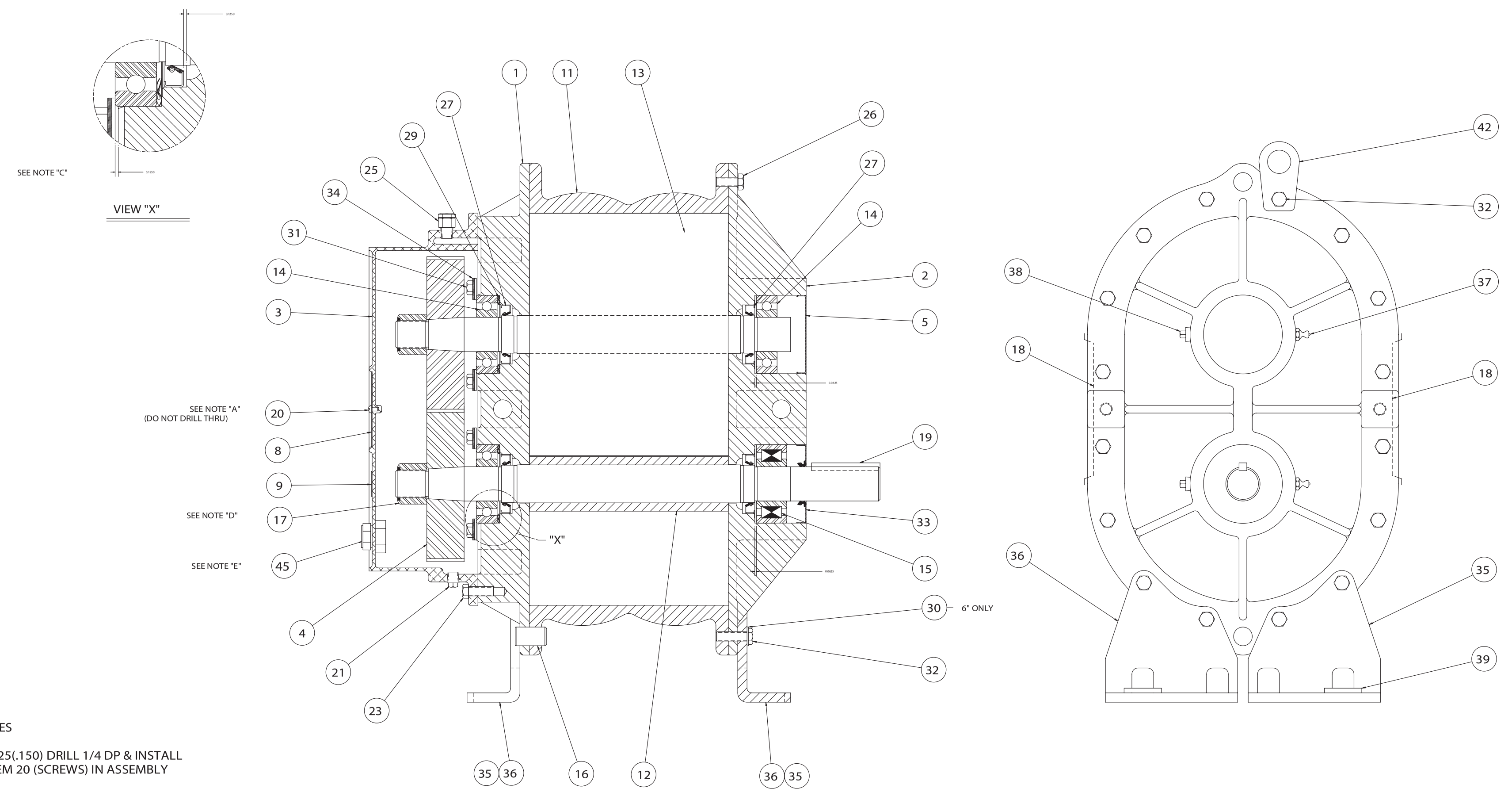
Blower Frame Size	* Impeller Lobes at 45°		End Clearance			Impeller Tips to Cylinders		
	Fronts	Backs	Each End Without Wavy Spring	Gear End Without Spring Installed	Required End Float	Inlet	Center	Discharge
	Min-Max	Min-Max	Min-Max	Min-Max	Minimum	Min-Max	Min-Max	Min-Max
404	.009-.013	.009-.013	.003-.005	.003-.008	.003	.004-.006	.002-.004	.004-.006
	(.23-.33)	(.23-.33)	(.08-.13)	(.08-.20)	(.08)	(.10-.15)	(.05-.10)	(.10-.15)
406	.009-.013	.000-.013	.003-.005	.007-.012	.006	.005-.007	.003-.005	.005-.007
	(.23-.33)	(.23-.33)	(.08-.13)	(.15-.30)	(.13)	(.13-.18)	(.08-.13)	(.13-.18)
409	.010-.014	.010-.014	.003-.005	.013-.018	.008	.005-.007	.003-.005	.005-.007
	(.25-.36)	(.25-.36)	(.08-.13)	(.31-.43)	(.17)	(.13-.18)	(.08-.13)	(.13-.18)
412	.010-.014	.010-.014	.003-.005	.016-.021	.011	.006-.008	.004-.006	.006-.008
	(.25-.36)	(.25-.36)	(.08-.13)	(.36-.48)	(.28)	(.15-.20)	(.10-.15)	(.15-.20)
418	.010-.014	.010-.014	.003-.005	.022-.027	.017	.008-.010	.004-.006	.008-.010
	(.25-.36)	(.25-.36)	(.08-.13)	(.51-.64)	(.38)	(.20-.25)	(.10-.15)	(.20-.25)
616	.011-.013	.011-.013	.004-.006	.017-.022	.011	.009-.011	.004-.006	.009-.011
	(.28-.33)	(.28-.33)	(.10-.15)	(.38-.51)	(.28)	(.23-.28)	(.10-.15)	(.23-.28)
624	.011-.013	.011-.013	.004-.006	.024-.029	.018	.013-.015	.005-.007	.013-.015
	(.28-.33)	(.28-.33)	(.10-.15)	(.61-.74)	(.46)	(.33-.38)	(.13-.18)	(.33-.38)

* IMPELLER TIMING FOR STANDARD ROTATION VIEWED FROM GEAR END





ASSEMBLY OF UNIVERSAL RAI® SERIES, AIR BLOWERS, 2-1/2" THRU 5" GEAR DIAMETER



NOTES

A #25(.150) DRILL 1/4 DP & INSTALL ITEM 20 (SCREWS) IN ASSEMBLY

B SEE OPERATING MANUAL IRB-180 FOR LUBRICATION INSTRUCTION

C INSTALL BEARINGS AS SHOWN BEFORE SETTING END CLEARANCE

D NUT TO BE TORQUED TO:
6"---400 LB. FT.
7"---550 LB. FT.

E FOR SIGHT GLASS UNITS ONLY.
USE WASHER OUTSIDE OF GEARBOX.
USE RED LOCTITE ON THE THREADS.

REF. 862-600-023

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	REVISIONS	BY	CHANGE NOTICE	CHKD.	APP
	ORIGINAL LOST/REDRAWN ON CAD	DAC			
E	INCREASED GEAR NUT TORQUE	REM	3577-V	FCR	AGP
D	REMOVED ITEM #43	REM	3389-V		
C	ITEM 25 REVISED	REM	3339-V		AGP
B	ADDED ITEM #43	REM			
A	ADDED 7"	REM			
	REDRAWN	DB			

DO NOT SCALE FOR DIMENSIONS

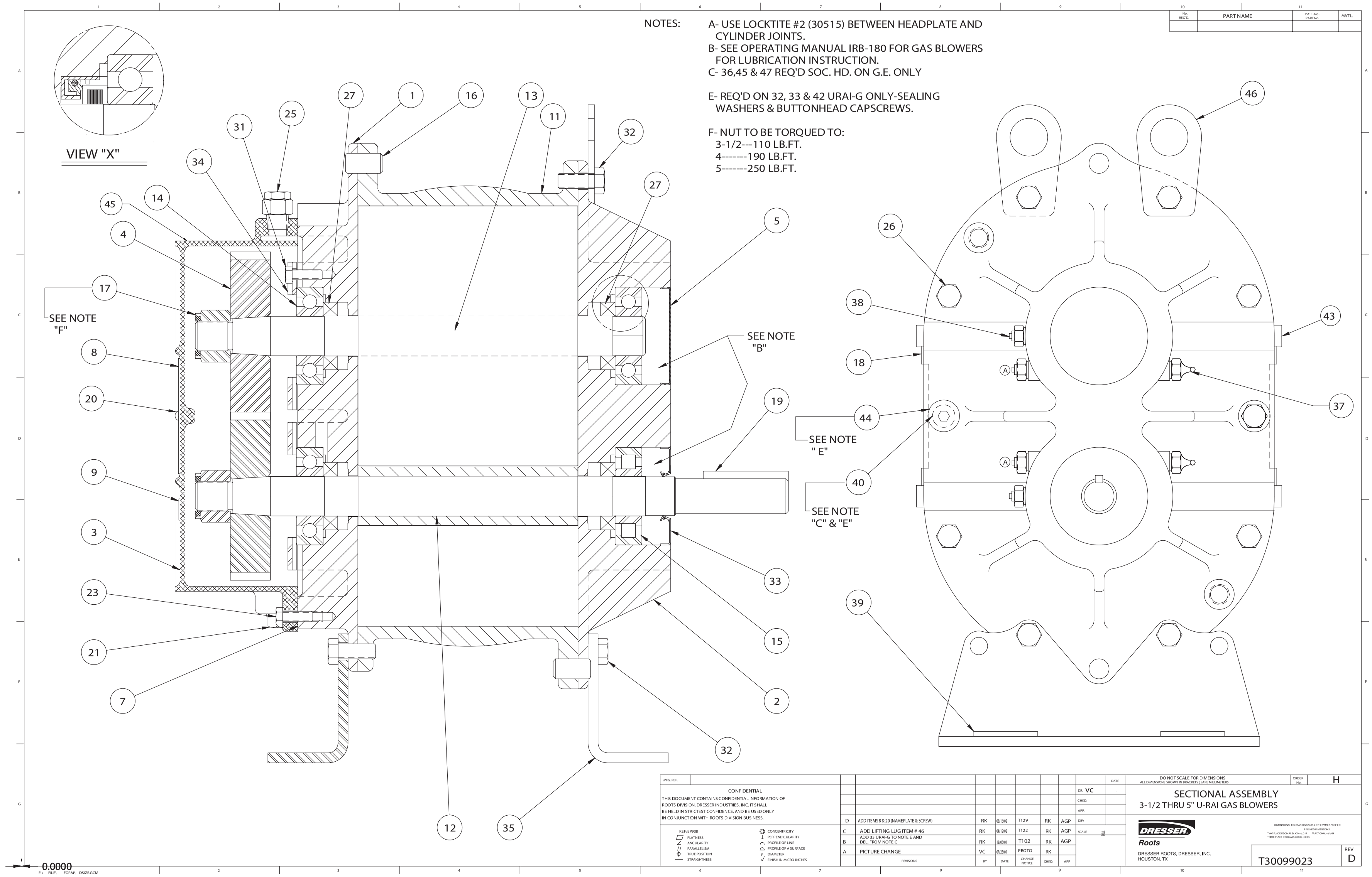
55-1242-2

SECTIONAL ASSEMBLY
FOR 6" & 7" U-RAI BLOWER
WITH TAPER GEAR FIT

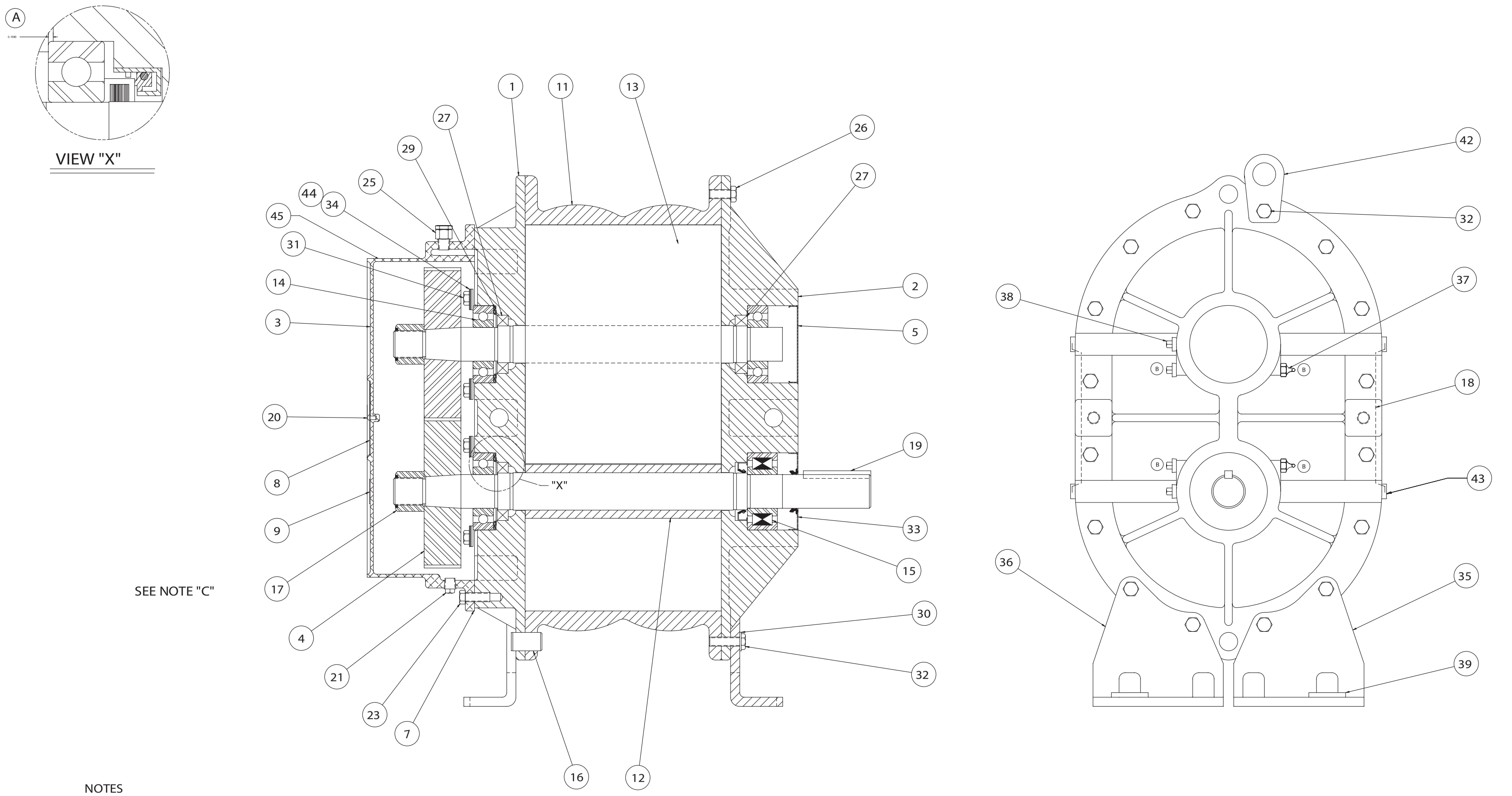
DRESSER Roots
DRESSER ROOTS, DRESSER, INC.
HOUSTON, TX

DR. CHKD. REM APP. FCR DRV AP
/PARTS/XXAS
NTS
64792023
REV F

ASSEMBLY OF UNIVERSAL RAI® BLOWERS, 6" AND 7" DIAMETER



ASSEMBLY OF UNIVERSAL RAI™-G SERIES GAS BLOWERS, 3-1/2" THRU 5" GEAR DIAMETER



SEE NOTE "C"

NOTES

A USE LOCKTITE #2 (30515) BETWEEN HEADPLATE AND CYLINDER JOINTS.

B SEE OPERATING MANUAL IRB-180 FOR LUBRICATION INSTRUCTION

C NUT TO BE TORQUED TO: 6"---400 LB. FT.

REF. 64792023

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C	ADD ITEMS # 8 & 20 (NAMEPLATE & SCREW)	RK	08/16/02	T129	RK	
B	PICTURE CHANGE	VC	07/25/01	PROTO	RK	
A	ADDED DIMENSION .066	VC	06/26/01	PROTO	RK	
	REVISIONS	BY	DATE	CHANGE NOTICE	CHKD.	APP.

DO NOT SCALE FOR DIMENSIONS

SECTIONAL ASSEMBLY
FOR 6" U-RAI GAS BLOWERS

DR. VC 01/12/01

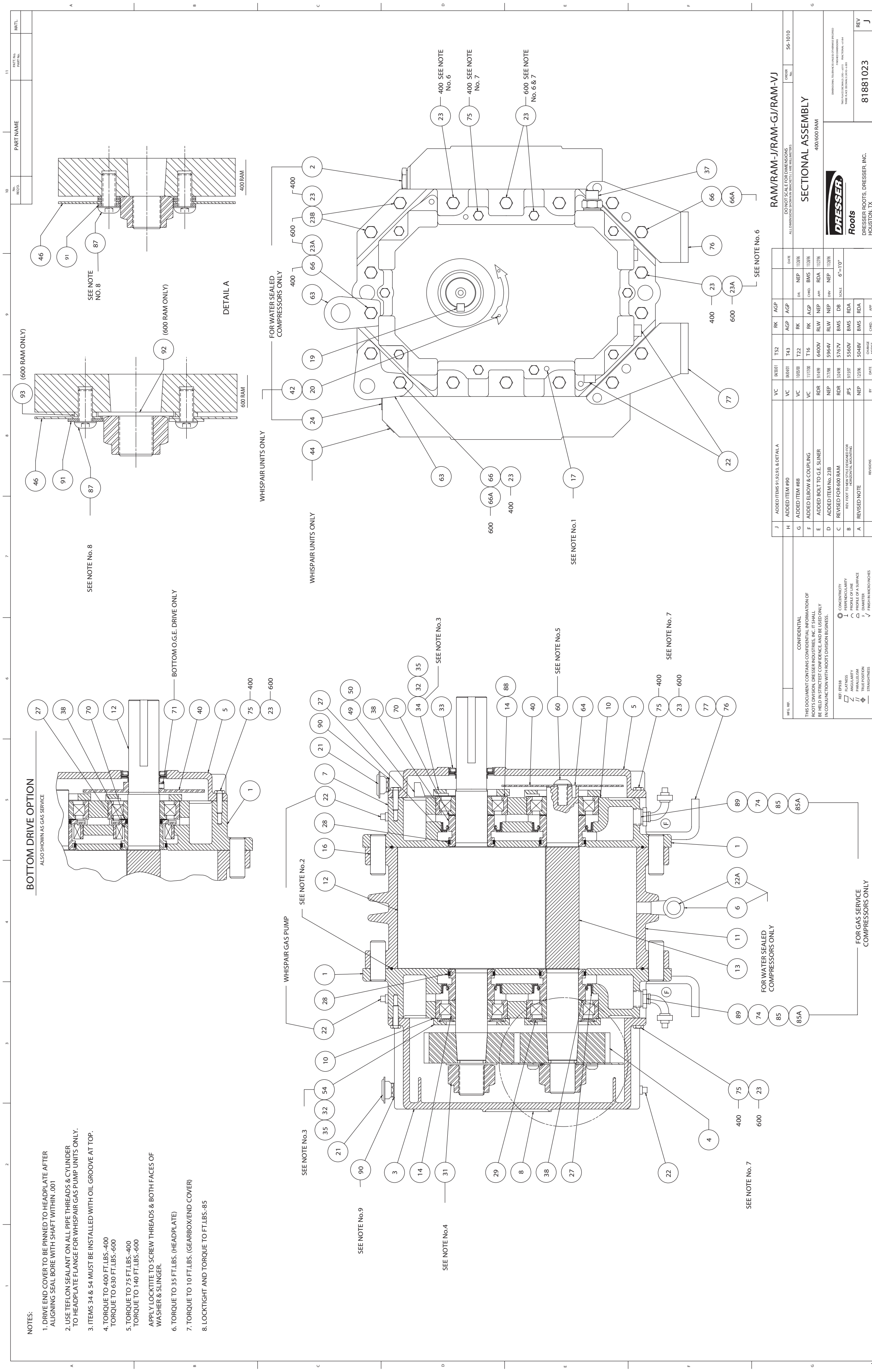
SCALE NTS

DRESSER Roots

DRESSER ROOTS, DRESSER, INC.
HOUSTON, TX

T30110023 REV B

ASSEMBLY OF UNIVERSAL RAI® SERIES GAS BLOWERS, 6" GEAR DIAMETER



ASSEMBLY OF RAM™ SERIES AIR & GAS BLOWERS

UNIVERSAL RAI® SERIES BLOWERS PARTS LIST

Item No.	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Gears	1
5	Cover-Blind (Plug Opening)	1
7	Gasket	1
9	Nameplate Lube	1
14	Bearing G.E., - Driven	3
15	Bearing Drive D.E., - Drive	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
20	Screw, Self Tap	1
21	Plug, Pipe	3
23	Screw Hex	6
25	Breather (Plug Vent)	1
26	Screw, Hex	14
27	Seal	4
29	Washer - wavy Spring	2
30	Washer	8
31	Screw, Hex	4
32	Screw, Hex	4
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
36	Foot	2
37	Fitting, Grease	2
38	Fitting, Relief	2
39	Washer Flat	4
40	Screw Socket	2
40*	Screw, Button Hd.	4
42	Screw Hex	2
43	Plug	8
44*	Washer	4

*For 32 and 42 URAI-G only.

RAM™ SERIES PARTS LIST

Item No.	Part Name	Qty.
01	Headplate	2
03	Gearbox	1
04	Gear, Assembly	1
05	End Cover	1
07	Gasket – Gearbox/Cover	2
09	Installation Tag	2
10	Shims-(.010)	Lot
14	Bearing Roller	4
16	Pin, Dowel (Pull Out)	4
17	Pin, Dowel	2
19	Key Square	1
20	Screw, Drive - Rd. Hd.	4
21	Breather	2
22	Plug, Pipe	12
23	Screw, Cap Hex Hd.	24
27	Seal, (Viton)	4
28	Piston, Ring-Seal	4
29	Washer, Wavy Spring	2
31	Nut, Hex ESNA	2
32	Scr, Cap Hex Hd.	16
33	Seal, Lip	1
34	Brg. Clamp Plate - D. E.	2
35	Lock Washer - Spring	16
37	Sight Plug - Oil Level	2
38	Sleeve - GE & DE	4
38	Sleeve - Piston Ring	4
40	Slinger - D.E. (Top Drive)	1
40	Slinger - D. E. (Bottom Drive)	1
42	Rotation Arrow	1
44	Label	1
46	Slinger - G.E.	1
49	Oil Leader L/S	1
50	Oil, Leader-R/S	1
54	Brg Clamp Plate - G. E.	2
60	Screw, Cap Butt. HD.	1
63	Lifting Lug	2
64	Pin, Spring	1
66	Screw, Cap Hex HD.	12
66.1	Whispair, Spring Lock 3/8M	12
70	Shims D.E. Brg.	1
75	Screw, Cap - Hex HD.	20
76	Blower Foot - RH	2
77	Blower Foot - LH	2
85	Elb, Pipe-Black	2
85.1	Plug, Pipe	2
87	Scr, Cap BH	2
88	Ball Spherical	4
90	BSHG-RDCG	2
91	Washer, Plain Flat	2
92	Washer, Plain Flat	2
93	Washer	2

NOTES

CONTACT LIST

CUSTOMER SERVICE

Dresser ROOTS
2135 Hwy 6 South
Houston, TX 77077
Toll Free Hot Line: 1-877-363-ROOT(S) (7668)
Toll Free Fax: 1-877-357-7238
Local Fax: 281-966-4309

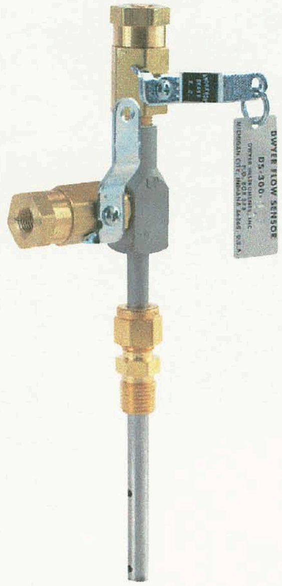
ROOTS Factory Service & Repair Center
11611B Tanner RD
Houston, TX 77041
Toll Free: 1-800-866-6182
Local Phone: 713-896-4810
Local Fax: 713-896-4927

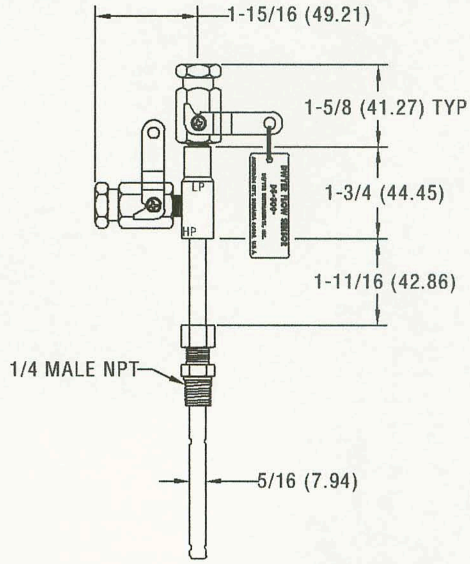
Service & Warranty
Toll Free: 1-800-866-6182
Local Phone: 832-467-4614
Local Fax: 713-896-4927

Bulletin F-50

Series DS-300 Flow Sensors

Installation and Operating Instructions Flow Calculations





Series DS-300 Flow Sensors are averaging pitot tubes that provide accurate, convenient flow rate sensing. When purchased with a Dwyer Capsuhelic® for liquid flow or Magnehelic® for air flow, differential pressure gage of appropriate range, the result is a flow-indicating system delivered off the shelf at an economical price. Series DS-300 Flow Sensors are designed to be inserted in the pipeline through a compression fitting and are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8″ female NPT connections. Accessories include adapters with 1/4″ SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® kit. Standard valves are rated at 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 Flow Sensors are available for pipe sizes from 1″ to 10″.

INSPECTION

Inspect sensor upon receipt of shipment to be certain it is as ordered and not damaged. If damaged, contact carrier.

INSTALLATION

General - The sensing ports of the flow sensor must be correctly positioned for measurement accuracy. The instrument connections on the sensor indicate correct positioning. The side connection is for total or high pressure and should be pointed upstream. The top connection is for static or low pressure.

Location - The sensor should be installed in the flowing line with as much straight run of pipe upstream as possible. A rule of thumb is to allow 10 - 15 pipe diameters upstream and 5 downstream. The table below lists recommended up and down piping.

PRESSURE AND TEMPERATURE

Maximum: 200 psig (13.78 bar) at 200°F (93.3°C).

Upstream and Downstream Dimensions in Terms of Internal Diameter of Pipe*

Upstream Condition	Minimum Diameter of Straight Pipe		
	Upstream		Downstream
	In-Plane	Out of Plane	
One Elbow or Tee	7	9	5
Two 90° Bends in Same Plane	8	12	5
Two 90° Bends in Different Plane	18	24	5
Reducers or Expanders	8	8	5
All Valves**	24	24	5

* Values shown are recommended spacing, in terms of internal diameter for normal industrial metering requirements. For laboratory or high accuracy work, add 25% to values.

** Includes gate, globe, plug and other throttling valves that are only partially opened. If valve is to be fully open, use values for pipe size change. **CONTROL VALVES SHOULD BE LOCATED AFTER THE FLOW SENSOR.**

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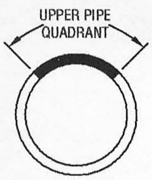
POSITION

Be certain there is sufficient clearance between the mounting position and other pipes, walls, structures, etc, so that the sensor can be inserted through the mounting unit once the mounting unit has been installed onto the pipe.

Flow sensors should be positioned to keep air out of the instrument connecting lines on liquid flows and condensate out of the lines on gas flows. The easiest way to assure this is to install the sensor into the pipe so that air will bleed into, or condensate will drain back to, the pipe.

For Air or Gas Flow

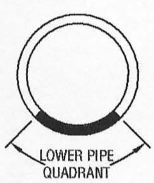
Install in upper quadrant of pipe



Condensate drains back to pipe

For Liquid or Steam Flow

Install in lower quadrant of pipe



Air bleeds back to pipe

INSTALLATION

1. When using an A-160 thred-o-let, weld it to the pipe wall. If replacing a DS-200 unit, an A-161 bushing (1/4″ x 3/8″) will be needed.

2. Drill through center of the thred-o-let into the pipe with a drill that is slightly larger than the flow sensor diameter.

3. Install the packing gland using proper pipe sealant. If the packing gland is disassembled, note that the tapered end of the ferrule goes into the fitting body.

4. Insert sensor until it bottoms against opposite wall of the pipe, then withdraw 1/16″ to allow for thermal expansion.

5. Tighten packing gland nut finger tight. Then tighten nut with a wrench an additional 1-1/4 turns. Be sure to hold the sensor body with a second wrench to prevent the sensor from turning.

INSTRUMENT CONNECTION

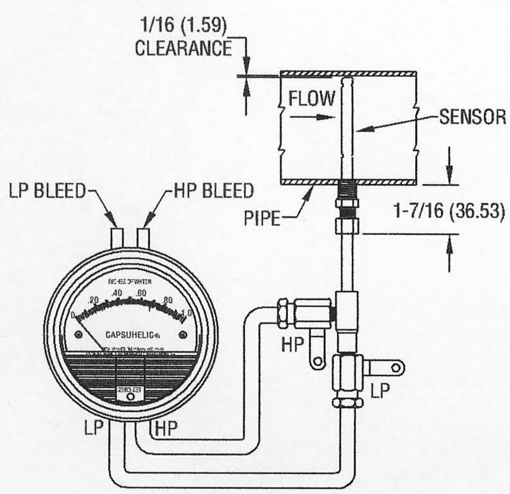
Connect the slide pressure tap to the high pressure port of the Magnehelic® (air only) or Capsuhelic® gage or transmitting instrument and the top connection to the low pressure port.

See the connection schematics below.

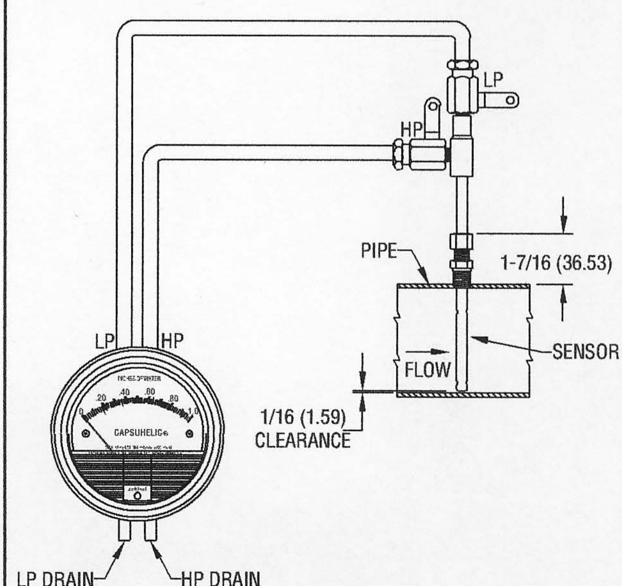
Bleed air from instrument piping on liquid flows. Drain any condensate from the instrument piping on air and gas flows.

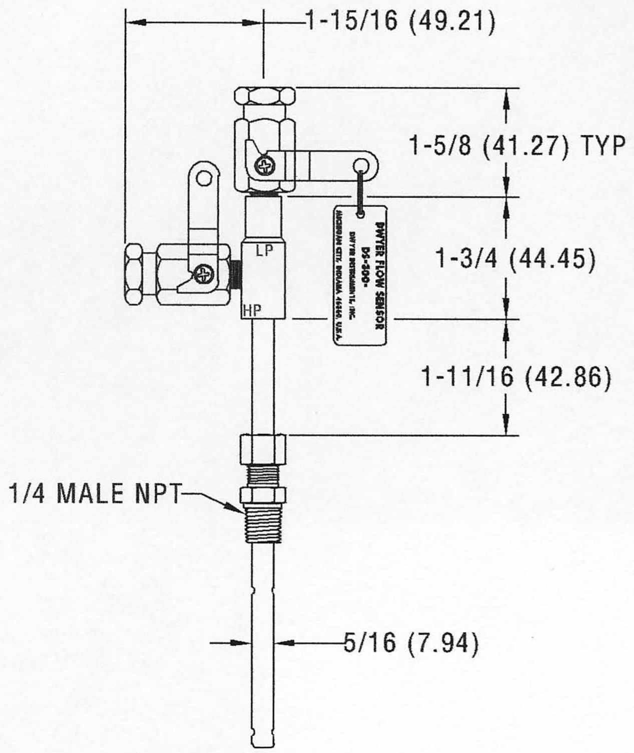
Open valves to instrument to place flow meter into service. For permanent installations, a 3-valve manifold is recommended to allow the gage to be zero checked without interrupting the flow. The Dwyer A-471 Portable Test Kit includes such a device.

Water Flow



Air or Gas Flow





Flow Calculations and Charts

The following information contains tables and equations for determining the differential pressure developed by the DS-300 Flow Sensor for various flow rates of water, steam, air or other gases in different pipe sizes.

This information can be used to prepare conversion charts to translate the differential pressure readings being sensed into the equivalent flow rate. When direct readout of flow is required, use this information to calculate the full flow differential pressure in order to specify the exact range of Dwyer Magnehelic® or Capsuhelic® gage required. Special ranges and calculations are available for these gages at minimal extra cost. See bulletins A-30 and F-41 for additional information on Magnehelic® and Capsuhelic® gages and DS-300 flow sensors.

For additional useful information on making flow calculations, the following service is recommended: Crane Valve Co. Technical Paper No. 410 "Flow of Fluids Through Valves, Fittings and Pipe." It is available from Crane Valve Company, www.cranevalve.com.

Using the appropriate differential pressure equation from Page 4 of this bulletin,calculate the differential pressure generated by the sensor under normal operating conditions of the system. Check the chart below to determine if this value is within the recommended operating range for the sensor. Note that the data in this chart is limited to standard conditions of air at 60°F (15.6°C) and 14.7 psia static line pressure or water at 70°F (21.1°C). To determine recommended operating ranges of other gases, liquids an/or operating conditions, consult factory.

Note: the column on the right side of the chart which defines velocity ranges to avoid. Continuous operation within these ranges can result in damage to the flow sensor caused by excess vibration.

Pipe Size (Schedule 40)	Flow Coefficient "K"	Operating Ranges Air @ 60°F & 14.7 psia (D/P in. W.C.)	Operating Ranges Air @ 60°F & 14.7 psia (D/P in. W.C.)	Velocity Ranges Not Recommended (Feet per Second)
1	0.52	1.10 to 186	4.00 to 675	146 to 220
1-1/4	0.58	1.15 to 157	4.18 to 568	113 to 170
1-1/2	0.58	0.38 to 115	1.36 to 417	96 to 144
2	0.64	0.75 to 75	2.72 to 271	71 to 108
2-1/2	0.62	1.72 to 53	6.22 to 193	56 to 85
3	0.67	0.39 to 35	1.43 to 127	42 to 64
4	0.67	0.28 to 34	1.02 to 123	28 to 43
6	0.71	0.64 to 11	2.31 to 40	15 to 23
8	0.67	0.10 to 10	0.37 to 37	9.5 to 15
10	0.70	0.17 to 22	0.60 to 79	6.4 to 10

FLOW EQUATIONS

1. Any Liquid

$$Q\ (GPM) = 5.668 \times K \times D^2 \times \sqrt{\Delta P / S_f}$$

2. Steam or Any Gas

$$Q\ (lb/Hr) = 359.1 \times K \times D^2 \times \sqrt{p \times \Delta P}$$

3. Any Gas

$$Q\ (SCFM) = 128.8 \times K \times D^2 \times \sqrt{\frac{P \times \Delta P}{(T + 460) \times S_s}}$$

DIFFERENTIAL PRESSURE EQUATIONS

1. Any Liquid

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_f}{K^2 \times D^4 \times 32.14}$$

2. Steam or Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2}{K^2 \times D^4 \times p \times 128{,}900}$$

3. Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_s \times (T + 460)}{K^2 \times D^4 \times P \times 16{,}590}$$

Technical Notations

The following notations apply:

ΔP = Differential pressure expressed in inches of water column
Q = Flow expressed in GPM, SCFM, or PPH as shown in equation
K = Flow coefficient— See values tabulated on Pg. 3.
D = Inside diameter of line size expressed in inches.

For square or rectangular ducts, use: $D = \sqrt{\frac{4 \times \text{Height} \times \text{Width}}{\pi}}$

P = Static Line pressure (psia)
T = Temperature in degrees Fahrenheit (plus 460 = °Rankine)
p = Density of medium in pounds per square foot
S_f = Sp Gr at flowing conditions
S_s = Sp Gr at 60°F (15.6°C)

SCFM TO ACFM EQUATION

$$\text{SCFM} = \text{ACFM} \times \left(\frac{14.7 + \text{PSIG}}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

$$\text{ACFM} = \text{SCFM} \times \left(\frac{14.7}{14.7 + \text{PSIG}}\right) \left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT STD.} = \text{POUNDS PER CUBIC FOOT ACT.} \times \left(\frac{14.7}{14.7 + \text{PSIG}}\right) \left(\frac{460 + °F}{520^*}\right)$$

$$\text{POUNDS PER CUBIC FOOT ACT.} = \text{POUNDS PER CUBIC FOOT STD.} \times \left(\frac{14.7 + \text{PSIG}}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

1 Cubic foot of air = 0.076 pounds per cubic foot at 60° F (15.6°C) and 14.7 psia.
* (520°= 460 + 60°) Std. Temp. Rankine

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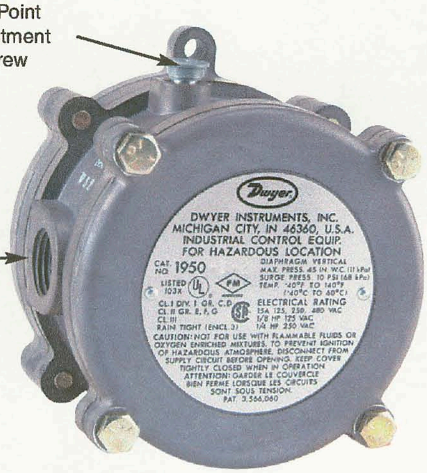
Series 1950 – Explosion-Proof Differential Pressure Switches

Specifications - Installation and Operating Instructions



Series 1950 Explosion-Proof Differential Pressure Switches combine the best features of the Dwyer Series 1900 Pressure Switch with an integral explosion-proof and weather-proof housing. Each unit is UL & CSA listed; FM approved for use in Class I, Groups C & D; Class II, Groups E, F, & G; and Class III atmospheres (NEMA 7 & 9). They are totally rain-tight for outdoor installations. Twelve models allow set-points from .03 to 20 inches w.c. and from .5 to 50 psi (3.4 to 345 kPa).

Easy access to the SPDT switch for electrical hook-up is provided by removing the top plate of the three-part aluminum housing. Adjustment to the set point of the switch can be made without disassembling the housing. The unit is very compact, about half the weight and bulk of equivalent conventional explosion-proof switches.

CAUTION
For use only with air or compatible gases. Use of the Model 1950 switch with explosive media connected to the Low pressure port (including differential pressure applications in such media) is not recommended. Switch contact arcing can cause an explosion inside the switch housing which, while contained, may render the switch inoperative. If switch is being used to sense a single positive pressure relative to atmosphere, run a line from the low pressure port to a non-hazardous area free of combustible gases. This may increase response time on -0 and -00 models.

NOTE: The last number-letter combination in the model number identifies the switch's electrical rating (number) and diaphragm material (letter). The 2F combination is standard as described in the physical data above. In case of special models, a number 1 rating is the same as 2; a number 3 or 4 rating is 10A 125, 250, 480 VAC; 1/8 H.P. 125 VAC; 1/4 H.P. 250 VAC; a number 5 or 6 rating is 1A 125 VAC. Letter B indicates a Buna-N diaphragm; N = Neoprene; S = Silicone; and V = Viton®.

UL and CSA Listed, FM Approved For
CL. I GR. C, D - CL. II GR. E, F, G - CL. III

Series 1950 Switches
Operating ranges and deadbands

To order specify Model Number	Operating Range: Inches, W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
1950-02	0.03 to 0.10	0.025	0.05
1950-00	0.07 to 0.15	0.04	0.05
1950-0	0.15 to 0.5	0.10	0.15
1950-1	0.4 to 1.6	0.15	0.20
1950-5	1.4 to 5.5	0.3	0.4
1950-10	3.0 to 11.0	0.4	0.5
1950-20	4.0 to 20.0	0.4	0.6
Model Number	**Operating Range: PSI**	**Approximate Dead Band**	
		Min. Set Point	Max. Set Point
1950P-2	0.5 to 2.0	0.3 PSI	0.3 PSI
1950P-8	1.5 to 8.0	1.0 PSI	1.0 PSI
1950P-15	3.0 to 15.0	0.9 PSI	0.9 PSI
1950P-25	4.0 to 25.0	0.7 PSI	0.7 PSI
1950P-50	15.0 to 50	1.0 PSI	1.5 PSI

PHYSICAL DATA

Temperature Limits: -40° to 140°F (-40° to 60°C); 1950P-8, -15, -25, -50: 0° to 140°F (-17.8° to 60°C); 1950-02: - 30° to 130°F (-34.4° to 54.4°C).
Rated Pressure: 1950: 45 in. w.c. (0.1 bar); 1950P: 35 psi (2.4 bar); 1950P-50 only: 70 psi (4.8 bar).
Maximum Surge Pressure: 1950: 10 psi (0.7 bar); 1950P: 50 psi (3.4 bar); 1950P-50 only: 90 psi (6.2 bar).
Pressure Connections: 1/8″ NPT(F).
Electrical Rating: 15A, 125, 250, 480 volts, 60 Hz. AC Resistive 1/8 H.P. @ 125 volts, 1/4 H.P. @ 250 volts, 60 Hz. AC.
Wiring Connections: 3-screw type; common, normally open and normally closed.
Conduit Connections: 1/2″ NPT(F).
Set point adjustment: Screw type on top of housing, field adjustable.
Housing: Anodized cast aluminum.
Diaphragm: Molded fluorosilicone rubber, 02 model: silicone on Nylon.
Calibration Spring: Stainless Steel
Installation: Mount with diaphragm in vertical position.
Weight: 3 1/4 lbs (1.5 kg), 02 model; 4 lbs, 7 oz. (2 kg).

RESPONSE TIME: Because of restrictive effect of flame arrestors, switch response time may be as much as 10-25 seconds where applied pressures are near set point.

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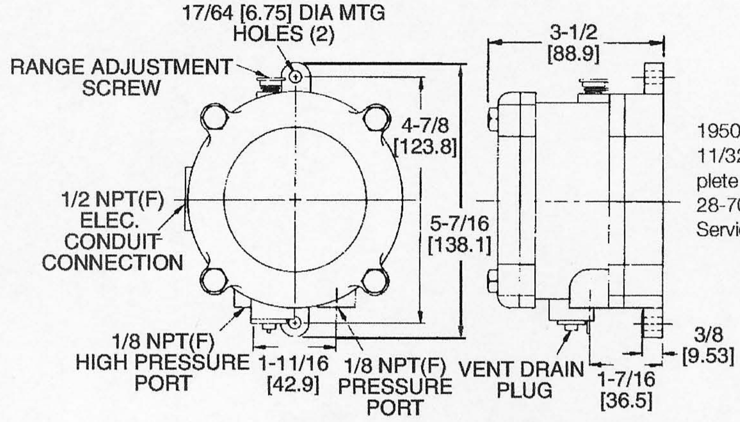
Series 1950 – Explosion-Proof Differential Pressure Switches

Specifications - Installation and Operating Instructions



1950-02: 7-3/4″ (196.9) dia. x 4-11/32″ (110.3) depth. For complete dimensions request drawing 28-700175-00 from our Customer Service Department

1950 Switch Outline Dimensions

INSTALLATION

1. Select a location free from excess vibration and corrosive atmospheres where temperatures will be within the limits noted under Physical Data on page 1. Switch may be installed outdoors or in areas where the hazard of explosion exists. See page 1 for specific types of hazardous service.

2. Mount standard switches with the diaphragm in a vertical plane and with switch lettering and Dwyer nameplate in an upright position. Some switches are position sensitive and may not reset properly unless they are mounted with the diaphragm vertical.

3. Connect switch to source of pressure, vacuum or differential pressure. Metal tubing with 1/4″ O.D. is recommended, but any tubing which will not restrict the air flow can be used. Connect to the two 1/8″ NPT(F) pressure ports as noted below:

   A. Differential pressures - connect pipes or tubes from source of greater pressure to high pressure port marked HIGH PRESS, and from source of lower pressure to low pressure port marked LOW PRESS.

   B. Pressure only (above atmospheric pressure) - connect tube from source of pressure to high pressure port. The low pressure port is left open to atmosphere.

   C. Vacuum only (below atmospheric pressure) - connect tube from source of vacuum to low pressure port. The high pressure port is left open to atmosphere.

4. To make electrical connections, remove the three hex head screws from the cover and after loosening the fourth captive screw, swing the cover aside. Electrical connections to the standard single pole, double throw snap switch are provided by means of terminals marked "COM" (common), "NO" (norm open), "NC" (norm closed). The normally open contacts close and the normally closed contacts open when pressure increases beyond the set point. Switch loads for standard models should not exceed the maximum specified current rating of 15 amps resistive. Switch capabilities decrease with an increase in ambient temperature, load inductance, or cycling rate. Whenever an application involves one or more of these factors, the user may find it desirable to limit the switched current to 10 amps or less in the interest of prolonging switch life.

ADJUSTMENT: To Change the Set point

1. Remove the plastic cap and turn the slotted Adjust-ment Screw at the top of the housing clockwise to raise the set point pressure and counter-clockwise to lower the set point. After calibration, replace the plastic cap and re-check the set point.

2. The recommended procedure for calibrating or checking calibration is to use a "T" assembly with three rubber tubing leads, all as short as possible and the entire assembly offering minimum flow restriction. Run one lead to the pressure switch, another to a manometer of known accuracy and appropriate range, and apply pressure through the third tube. Make final approach to the set point very slowly. Note that manometer and pressure switch will have different response times due to different internal volumes, lengths of tubing, fluid drainage, etc. Be certain the switch is checked in the position it will assume in use, i.e. with diaphragm in a vertical plane and switch lettering and Dwyer nameplate in an upright position.

3. For highly critical applications check the set point adjustment and if necessary, reset it as noted in step A.

MAINTENANCE

The moving parts of these switches need no maintenance or lubrication. The only adjustment is that of the set point. Care should be taken to keep the switch reasonably clean. Periodically the vent drain plug should be rotated, then returned to its original position. This will dislodge deposits which could accumulate in applications where there is excessive condensation within the switch.

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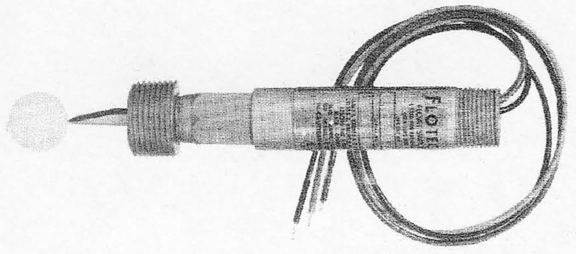
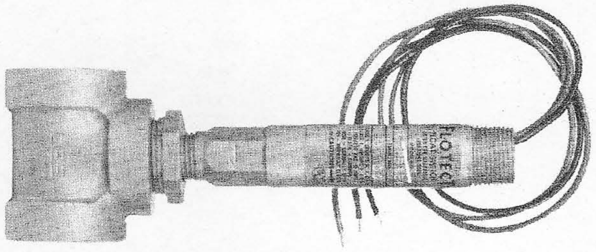
W.E. Anderson

FLOTECT™ MODEL L-6 FLOAT SWITCH

Installation and Operating Instructions





Explosion-Proof; U.L. and C.S.A. Listed -
Class I, Groups *A, B, C & D
Class II, Groups E, F & G
CENELEC: EExd IIC T6 (T amb=75°C)
*(Group A, stainless steel body only)

PHYSICAL DATA

Temperature Limit: 220°F (105°C) maximum
Maximum Pressure: See chart below
Switches: One or two SPDT snap switches
Electrical Rating: **U.L.:** 5A @ 125/250 VAC.
C.S.A. and CENELEC: 5A @ 125/250 VAC, 5A resistive, 3A inductive @ 30 VDC.
Optional ratings: MV option—Gold contacts for dry circuits. Rated 0.1A @ 125 VAC MT option: 400°F (205°C) 5A @ 125/250 VAC (not listed).
Wiring Connections: 3-18" (460mm) wire leads, 18 ga.
CENELEC models only: push-in type terminal blocks
Black = common, blue = N.O., red = N.C.
Minimum Specific Gravity:
Polypropylene float - 0.9
Round SS float - 0.7
Cylindrical SS float - 0.5
Switch Body: Brass 3/4" NPT conduit connection.
For SS switch body, change model no. to L6EPS.
Piping/Mounting Connection: 1" NPT
Installation: Horizontal, index arrow pointing down.
Weight: 1 lb. (.5 KG); w/external chamber 1-3/4 lb. (.8 KG)

WETTED MATERIALS CHART

Model	Brass	Bronze	Ceramic	Polypropylene	301SS	303SS	304SS
B-S-3-A	X		X		X		X
B-S-3-B	X	X	X	X	X		
B-S-3-C	X		X		X		X
B-S-3-H	X	X	X		X		X
B-S-3-O	X		X	X	X		
S-S-3-A			X	X	X		X
S-S-3-C			X		X	X	X
S-S-3-L			X		X	X	X
S-S-3-O			X	X	X	X	
S-S-3-S			X	X	X	X	

MAXIMUM PRESSURE CHART

Model Number	Float	Pressure Rating PSIG (KG/CM²)
L6EPB-B-S-3-A	Cylindrical SS	200 (14)
L6EPB-B-S-3-B	Polypropylene	250 (18)
L6EPB-B-S-3-C	Round SS	350 (25)
L6EPB-B-S-3-H	Round SS	250 (18)
L6EPB-B-S-3-O	Polypropylene	1000 (70)
L6EPB-S-S-3-A	Cylindrical SS	200 (14)
L6EPB-S-S-3-C	Round SS	350 (25)
L6EPB-S-S-3-L	Round SS	350 (25)
L6EPB-S-S-3-O	Polypropylene	2000 (140)
L6EPB-S-S-3-S	Polypropylene	2000 (140)

INSTALLATION:

Unpack switch and remove any packing material found inside lower housing or float chamber.

Switch must be installed with body in a horizontal plane and arrow on side pointing down.

If switch has an external float chamber (tee), connect it to vertical sections of 1" NPT pipe installed outside vessel walls at appropriate levels. If unit has no external float chamber, it must be mounted in a 1" NPT half coupling welded to the vessel wall. The coupling must extend through the wall.

Inspect and clean wetted parts at regular intervals.

ELECTRICAL CONNECTIONS:

Connect wire leads in accordance with local electrical codes and switch action required. N.O. contacts will close and N.C. contacts will open when liquid level causes float to rise. They will return to "normal" condition on decreasing liquid level. Black = common, Blue = N.O. and Red = N.C.

For units supplied with both internal and external grounds, the ground screw inside the housing must be used to ground the control. The external ground screw is for supplementary bonding when allowed or required by local code. Some CSA listed models are furnished with a separate green ground wire. Such units must be equipped with a junction box, not supplied but available on special order.

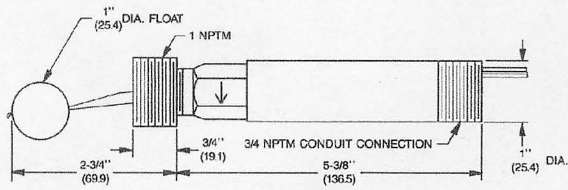
CENELEC certified models include a junction box. Cable should enter enclosure through an approved EX cable gland, not supplied. Push stripped and tinned leads into appropriate openings in terminal block(s). To connect fine stranded leads or to remove any wire, depress spring release with small screwdriver first.

All wiring, conduit and enclosures must meet applicable codes for hazardous areas. Conduits and enclosures must be properly sealed. For outdoor or other locations where temperatures vary widely, precautions should be taken to prevent condensation inside switch or enclosure. Electrical components must be kept dry at all times. **CAUTION:** To prevent ignition of hazardous atmospheres, disconnect the device from the supply circuit before opening. Keep assembly tightly closed when in use.

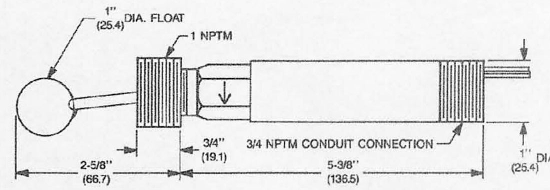
Dimensions on reverse

W.E. ANDERSON DIV., DWYER INSTRUMENTS, INC.
P. O. BOX 358 • MICHIGAN CITY, INDIANA 46360, U.S.A.
Telephone 219/879-8000
Fax 219/872-9057

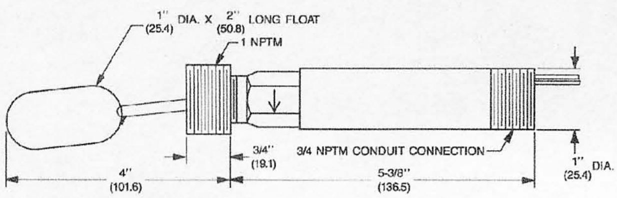
FLOTECT™ MODEL L-6 FLOAT SWITCH — DIMENSION DRAWINGS



Polypropylene Float

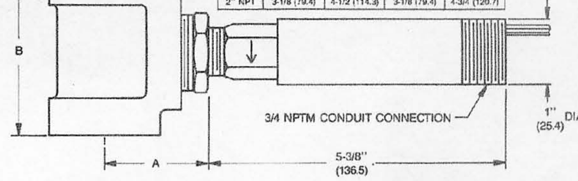


Round Stainless Steel Float

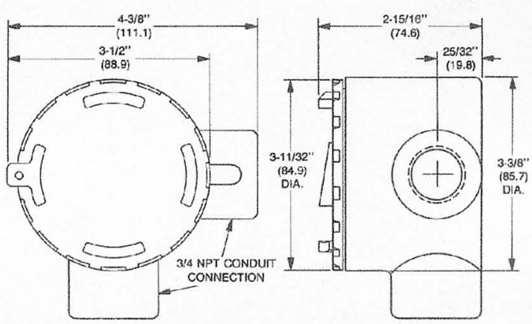


Cylindrical Stainless Steel Float

Pipe Size	Brass Dimension A	Brass Dimension B	Stainless Steel Dimension A	Stainless Steel Dimension B
1" NPT	2-1/8 (54)	3 (76.2)	2-1/8 (54)	3 (76.2)
2" NPT	3-1/8 (79.4)	4-1/2 (114.3)	3-1/8 (79.4)	4-3/4 (120.7)



With External Float Chamber (Tee)



CSA, CENELEC Conduit Enclosure

Limited Warranty: The Seller warrants all Dwyer instruments and equipment to be free from defects in workmanship or material under normal use and service for a period of one year from date of shipment. Liability under this warranty is limited to repair or replacement F.O.B. factory of any parts which prove to be defective within that time or repayment of the purchase price at the Seller's option provided the instruments have been returned, transportation prepaid, within one year from the date of purchase. All technical advice, recommendations and services are based on technical data and information which the Seller believes to be reliable and are intended for use by persons having skill and knowledge of the business, at their own discretion. In no case is Seller liable beyond replacement of equipment F.O.B. factory or the full purchase price. This warranty does not apply if the maximum ratings label is removed or if the instrument or equipment is abused, altered, used at ratings above the maximum specified, or otherwise misused in any way.

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HONEYWELL UDC1200 MICRO-PRO
Universal Digital Controller
Start-Up Guide

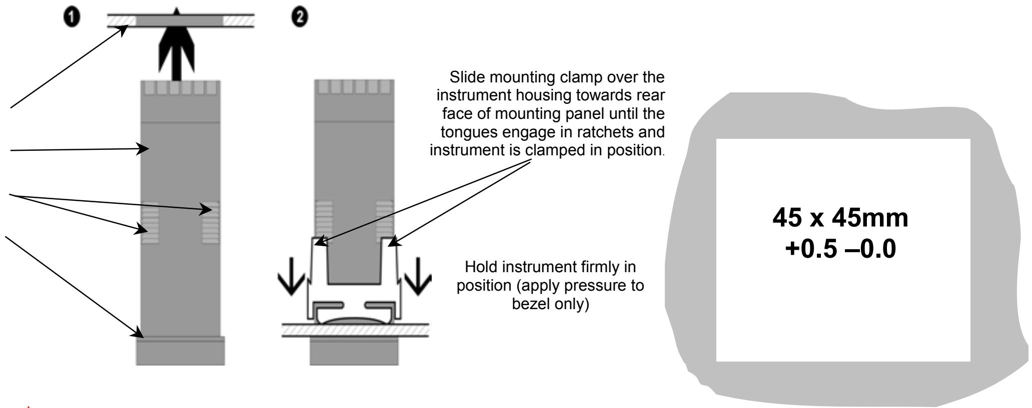
The full users manual can be downloaded from Honeywell IMC Web page
http://content.honeywell.com/imc/

HONEYWELL UDC1200 MICRO-PRO
Universal Digital Controller

CAUTION: Installation and configuration should be performed only by personnel who are technically competent to do so. Local Regulations regarding electrical installation & safety must be observed.

Panel-Mounting

The mounting panel must be rigid and may be up to 6.0mm (0.25 inches) thick. The cut-out required for the instrument is shown on the right. Instruments may be mounted side-by-side in a multiple installation for which the cut-out width (for *n* instruments) is (48*n*-4)mm or (1.89*n*-0.16)inches.



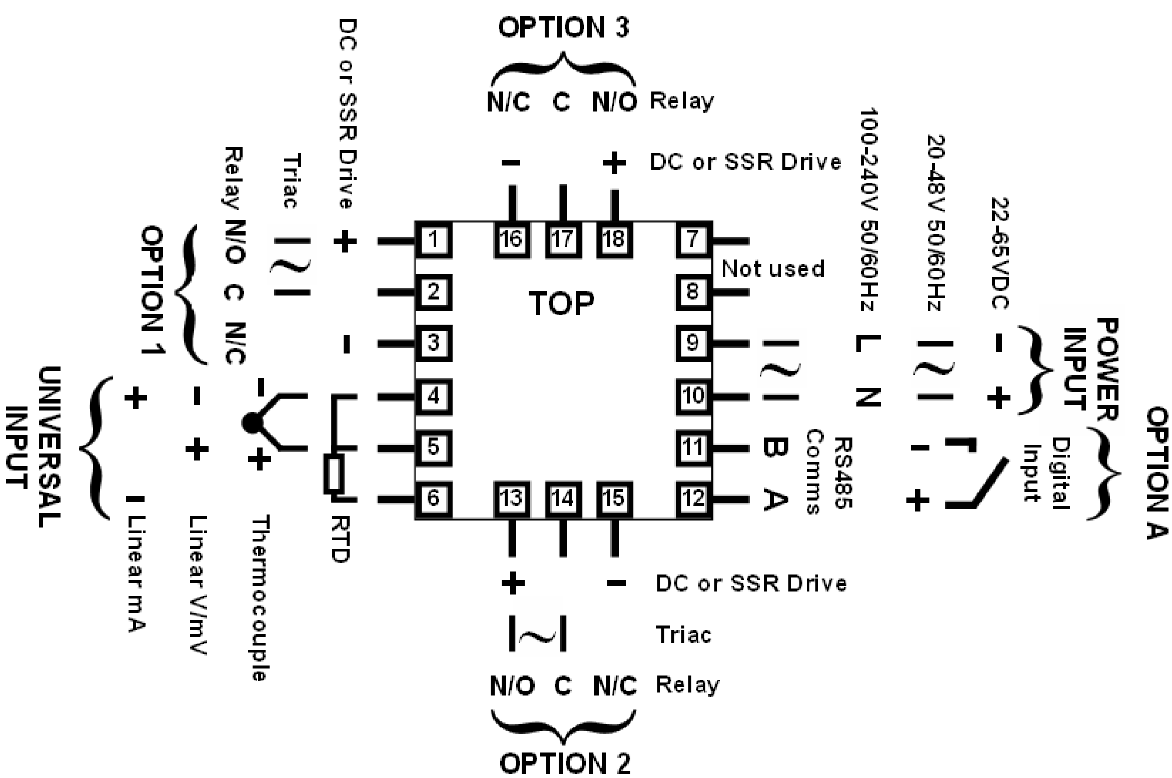
CAUTION: Do not remove the panel gasket; it is a seal against dust and moisture.

2. WIRING

Rear Terminal Wiring

USE COPPER CONDUCTORS
(EXCEPT FOR T/C INPUT)
Single Strand wire gauge:
Max 1.2mm (18SWG)

CAUTION: Check information label on housing for correct operating voltage before connecting supply to Power Input
Fuse: 100 – 240V ac – 1amp anti-surge
24/48V ac/dc – 315mA anti-surge



3. SELECT MODE

Select mode is used to access the configuration and operation menu functions.
It can be accessed at any time by holding down SETUP and pressing ▲.

Once in select mode, press ▲ or ▼ to select the required mode. An unlock code is required to prevent unauthorised entry to Configuration, Setup & Automatic Tuning modes.

Press ▲ or ▼ to enter the correct code number, then press SETUP to proceed.

Mode	Upper Display	Lower Display	Description	Default Unlock Codes
Operator	Optr	SLCt	Normal instrument operation.	None
Set Up	SetP	SLCT	Tailor settings to the application.	10
Configuration	Conf	SLCT	Configures the instrument for use.	20
Product Info	Info	SLCT	Check manufacturing information.	None
Auto-Tuning	Atun	SLCT	Invoke Pre-Tune or Self-Tune.	0

Note: The instrument will always return automatically to Operator mode if there is no key activity for 2 minutes.

4. CONFIGURATION MODE

First select Configuration mode from Select mode *(refer to section 3).*

Press SETUP to scroll through the parameters, then press ▲ or ▼ to set the required value.
To accept a change Man Auto must be pressed, otherwise parameter will revert to previous value.
To exit from Configuration mode, hold down SETUP and press ▲, to return to Select mode.
Note: Parameters displayed depends on how instrument has been configured.

Parameters marked * are repeated in Setup Mode.

Parameter	Lower Display	Upper Display	Adjustment range	Default
Input Range/Type	inPt		*See following table for possible codes*	J T/C

Code	Input Type & Range	Code	Input Type & Range	Code	Input Type & Range
bC	B: 100 – 1824 °C	L.C	L: 0.0 – 537.7 °C	P24F	PtRh20% vs 40%: 32 – 3362 °F
bF	B: 211 – 3315 °F	L.F	L: 32.0 – 999.9 °F		
CC	C: 0 – 2320 °C	NC	N: 0 – 1399 °C	PTC	Pt100: -199 – 800 °C
CF	C: 32 – 4208 °F	NF	N: 32 – 2551 °F	PtF	Pt100: -328 – 1472 °F
JC	J: -200 – 1200 °C	rC	R: 0 – 1759 °C	Pt.C	Pt100: -128.8 – 537.7 °C
JF	J: -328 – 2192 °F	rF	R: 32 – 3198 °F	Pt.F	Pt100: -199.9 – 999.9 °F
j.C	J: -128.8 – 537.7 °C	SC	S: 0 – 1762 °C	0_20	0 – 20 mA DC
j.F	J: -199.9 – 999.9 °F	SF	S: 32 – 3204 °F	4_20	4 – 20 mA DC
KC	K: -240 – 1373 °C	tC	T: -240 – 400 °C	0_50	0 – 50 mV DC
KF	K: -400 – 2503 °F	tF	T: -400 – 752 °F	1050	10 – 50 mV DC
k.C	K: -128.8 – 537.7 °C	t.C	T: -128.8 – 400.0 °C	0_5	0 – 5 V DC
K.F	K: -199.9 – 999.9 °F	t.F	T: -199.9 – 752.0 °F	1_5	1 – 5 V DC
LC	L: 0 – 762 °C	P24C	PtRh20% vs 40%: 0 – 1850 °C	0_10	0 – 10 V DC
LF	L: 32 – 1403 °F			2_10	2 – 10 V DC

Parameter	Lower Display	Upper Display	Adjustment range	Default
Scale Range Upper Limit	ruL		Scale Range Lower Limit +100 to Range Max	Range max (Lin=1000)
Scale Range Lower Limit	rLL		Range Min. to Scale Range Upper Limit -100	Range min (Linear=0)
Decimal point position	dPoS		0=**XXXX**, 1=**XXX.X**, 2=**XX.XX**, 3=**X.XXX** (non-temperature ranges only)	1
Control Type	CtYP	SnGL	Primary (heat) only	SnGL
		duAL	Primary & Secondary (heat/cool)	

Parameter	Lower Display	Upper Display	Adjustment range	Default
Primary Output Control Action	CtrL	rEu	Reverse Acting	rEu
		d ir	Direct Acting	
Alarm 1Type	ALA 1	P_H i	Process High Alarm	P_H i
		P_Lo	Process Low Alarm	
		dE	Deviation Alarm	
		bAnd	Band Alarm	
		nonE	No alarm	
High Alm 1 value*	PhA 1		Range Min. to Range Max in display units	Range Max.
Low Alm 1 value*	PLA 1			Range Min.
Band Alm 1 value*	bAL 1		1 LSD to span from setpoint in display units	5
Dev. Alm 1 value*	dAL 1		+/- Span from setpoint in display units	5
Alm 1 Hysteresis*	AHY 1		1 LSD to full span in display units	1
Alarm 2 Type*	ALA2		Options as for alarm 1	P_Lo
High Alm 2 value*	PhA2			Range Max.
Low Alm 2 value*	PLA2			Range Min.
Band Alm 2 value*	bAL2			5
Dev. Alm 2 Value*	dAL2			5
Alm 2 Hysteresis*	AHY2			1
Loop Alarm	LAEn		d iSA(disabled) or EnAb (enabled)	d iSA
Loop Alarm Time*	LAt i		1 sec to 99 mins. 59secs (only applies if primary proportional band = 0)	99.59
Alarm Inhibit	Inh i	nonE	No alarms Inhibited	nonE
		ALA 1	Alarm 1 inhibited	
		ALA2	Alarm 2 inhibited	
		both	Alarm 1 and alarm 2 inhibited	
Output 1 Usage	USE 1	Pr i	Primary (Heat) Power	Pr i
		SEc	Secondary (Cool) Power	
		A 1_d	Alarm 1, Direct	
		A 1_r	Alarm 1, Reverse	
		A2_d	Alarm 2, Direct	
		A2_r	Alarm 2, Reverse	
		LP_d	Loop Alarm, Direct	
		LP_r	Loop Alarm, Reverse	
		Or_d	Logical Alarm 1 OR 2, Direct	
		Or_r	Logical Alarm 1 OR 2, Reverse	
		Ad_d	Logical Alarm 1 AND 2, Direct	
		Ad_r	Logical Alarm 1 AND 2, Reverse	
		rEtS	Retransmit SP Output	
		rEtP	Retransmit PV Output	
Linear Output 1 Range	tYP 1	0_5	0 – 5 V DC output 1	0_ 10
		0_ 10	0 – 10 V DC output	
		2_ 10	2 – 10 V DC output	
		0_20	0 – 20 mA DC output	
		4_20	4 – 20 mA DC output	

Parameter	Lower Display	Upper Display	Adjustment range	Default
Retransmit Output 1 Scale maximum	ro1H		-1999 to 9999 (display value at which output will be maximum)	Range max
Retransmit Output 1 Scale minimum	ro1L		-1999 to 9999 (display value at which output will be minimum)	Range min
Output 2 Usage	USE2		As for output 1	Sec or AI2
Lin. O/P 2 Range	tYP2		As for output 1	0_10
Retransmit Output 2 Scale maximum	ro2H		-1999 to 9999 (display value at which output will be maximum)	Range max
Retransmit Output 2 Scale minimum	ro2L		-1999 to 9999 (display value at which output will be minimum)	Range min
Output 3 Usage	USE3		As for output 1	A1_d
Linear Output 3 Range	tYP3		As for output 1	0_10
Retransmit Output 3 Scale maximum	ro3H		-1999 to 9999 (display value at which output will be maximum)	Range max
Retransmit Output 3 Scale minimum	ro3L		-1999 to 9999 (display value at which output will be minimum)	Range min
Display Strategy	disP		1, 2, 3, 4, 5 or 6 (*refer to section 7*)	1
Comms Protocol	Prot	ASC1	ASCII	Mmbn
		Mmbn	Modbus with no parity	
		MmbE	Modbus with Even Parity	
		Mmbo	Modbus with Odd Parity	
Bit rate	bAud	1.2	1.2 kbps	4.8
		2.4	2.4 kbps	
		4.8	4.8 kbps	
		9.6	9.6 kbps	
		19.2	19.2 kbps	
Comms Address	Addr	1	1 –255 (Modbus), 1-99 (ASCII)	1
Comms Write	CoEn		Read only or read/write	r_ Ww
Digital Input Usage	diGi	diS1	Setpoint 1 / Setpoint 2 select	diS1
		diAS	Automatic / Manual select	
Config Lock Code	CLoc		0 to 9999	20

*** Refer to the full user guide for further details on these parameters.**

5. SETUP MODE

Note: Configuration must be completed before adjusting Setup parameters.

First select Setup mode from Select mode *(refer to section 3).* While in Setup Mode MAN is lit.
Press SETUP to scroll through the parameters, then press or to set the required value.
To exit from Setup mode, hold down SETUP and press , to return to Select mode.
Note: Parameters displayed depends on how instrument has been configured.

Parameter	Lower Display	Upper Display Adjustment Range	Default
Input Filter Time constant	FiLt	OFF or 0.5 to 100.0 secs	2.0
Process Variable Offset	OFFS	+/- Span of controller	0
Primary (Heat) power	PPWw	Current power levels *(read only)*	N/A
Secondary (Cool) power	SPWw		
Primary Proportional Band	Pb_P	0.0% (ON/OFF) and 0.5% to 999.9% of input span.	10.0
Secondary Proportional Band	Pb_S		
Automatic Reset (Integral Time)	ArSt	1 sec to 99 mins 59 secs and OFF	5.00
Rate (Derivative Time)	rAtE	00 secs to 99 mins 59 secs	1.15
Overlap/Deadband	OL	-20 to +20% of Primary and Secondary Proportional Band	0
Manual Reset (Bias)	biAS	0%*(-100% if dual control)* to 100%	25
Primary ON/OFF Differential	diFP	0.1% to 10.0% of input span centered about the setpoint	0.5
Secondary ON/OFF Diff.	diFS		
Prim. & Sec. ON/OFF Diff.	diFF		
Setpoint Upper Limit	SPuL	Current Setpoint to Range max	R/max
Setpoint Lower limit	SPLL	Range min to Current Setpoint	R/min
Primary Output Power Limit	OPuL	0% to 100% of full power.	100
Output 1 Cycle Time	Ct1	0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256 or 512 secs.	32
Output 2 Cycle Time	Ct2		
Output 3 Cycle Time	Ct3		
High Alarm 1 value	PhA1	Range Min. to Range Max.	R/max
Low Alarm 1 value	PLA1		R/min
Deviation Alarm 1 Value	dAL1	+/- Span from SP in display units	5
Band Alarm 1 value	bAL1	1 LSD to span from setpoint	5
Alarm 1 Hysteresis	AHY1	1 LSD to full span in display units	1
High Alarm 2 value	PhA2	Range Min. to Range Max.	R/max
Low Alarm 2 value	PLA2		R/min
Deviation Alarm 2 Value	dAL2	+/- Span from SP in display units	5
Band Alarm 2 value	bAL2	1 LSD to span from setpoint	5
Alarm 2 Hysteresis	AHY1	1 LSD to full span in display units	1
Loop Alarm Time	LAti	1 sec to 99 mins. 59secs.	99.59
Auto Pre-tune	APt	diSA disabled or EnAb enabled	diSA
Auto/manual Control selection	PoEn		
Setpoint ramping	SPr		
SP Ramp Rate Value	rP	1 to 9999 units/hour or Off (blank)	Off
SP Value	SP	Scale range upper to lower limits	Scale Range min
SP1 Value	_ SP1	Scale range upper to lower limits "_"" indicates currently active SP.	
SP2 Value	_ SP2		
Setup Lock Code	SLoc	0 to 9999	10

6. OPERATOR MODE

This mode is entered at power on. It can also be accessed from Select mode (*see section 3*).
Note: All configuration mode and Setup mode parameters must be set as required before starting normal operations.

Press to scroll through the parameters, then press or to set the required value.
Note: All parameters in Display strategy 6 are read only, and can only be adjusted via Setup mode.

Upper Display	Lower Display	Display Strategy When Visible	Description
PV Value	Active SP Value	1 & 2 (initial screen)	PV and target value of selected SP *SP adjustable in Strategy 2*
PV Value	Actual SP Value	3 & 6 (initial screen)	PV and actual value of selected SP (e.g. ramping SP value). ***Read only***
PV Value	*(Blank)*	4 (initial screen)	Process variable only. ***Read only***
Active SP Value	*(Blank)*	5 (initial screen)	Target value of selected setpoint only. ***Read only***
SP Value	**SP**	1, 3, 4, 5 & 6 if digital input is not diS1	***Target value of SP*** *Adjustable except in Strategy 6*
SP1 Value	**_ SP1**	"_ "lit if dig I/P = diS1 and active SP is SP1	Target value of SP1 *Adjustable except in Strategy 6*
SP2 Value	**_ SP2**	"_ "lit if dig I/P = diS1 and active SP is SP2	Target value of SP2 *Adjustable except in Strategy 6*
Actual SP Value	**SPrP**	SPr enabled and **rP** is not zero	Actual (ramping) value of selected SP *Read only*
Ramp Rate	**rP**	SPr enabled in Setup mode	SP ramping rate, in units per hour. *Adjustable except in Strategy 6*
Active Alarms	**ALSt**	When one or more alarms are active. **ALM** indicator will also flash	**L21** Alarm 2 active Alarm 1 active Loop Alarm active

Manual Control

If PoEn is set to EnAb in Setup mode, manual control can be selected/de-selected by pressing the key while in Operator mode, or by changing the status of the digital input if diGi has been configured for diAS in Configuration mode. The indicator will flash while in Manual Control mode and the lower display will show Pxxx (where xxx is the current manual power level). Switching to/from manual mode is via Bumpless Transfer.
Press or to set the required output power.
Caution: Not restricted by OPuL limit.

7. AUTOMATIC TUNING MODE

First select Automatic tuning mode from Select mode (*refer to section 3*).

Press SETUP to scroll through the modes, then press ▲ or ▼ to set the required value.
To exit from Automatic tuning mode, hold down SETUP and press ▲ to return to Select mode.
Pre-tune is a single-shot routine and is thus self-disengaging when complete.
If **APt** in Setup mode = **EnAb**, Pre-tune will attempt to run at every power up*.
Refer to the full user guide (available from your supplier) for details on controller tuning.

Parameter	Lower Display	Upper Display Adjustment Range	Default
Pre-Tune	PtUn	**On** or **Off**. Indication remains **OFF** if automatic tuning cannot be used at this time*.	Off
Self-Tune	StUn		
Tune Lock	tLoc	0 to 9999	0

**** Note: Automatic tuning will not engage if either proportional band = 0. Also, Pre-tune will not engage if setpoint is ramping, or the PV is within 5% of span of the setpoint.***

8. PRODUCT INFORMATION MODE

First select Product information mode from Select mode (*refer to section 3*).

Press SETUP to view each parameter.
To exit from Product Information mode, hold down SETUP and press ▲ to return to Select mode.
Note: These parameters are all read only.

Parameter	Lower Display	Upper Display	Description
Input type	In_1	Uni	Universal input only
Option 1 module type fitted	OPn1	nonE	No option fitted.
		rLY	Relay
		SSr	SSR drive
		tri	Triac
		Lin	Linear voltage / Current output
Option 2 type fitted	OPn2	As Option 1.	
Option 3 type fitted	OPn3		
Auxiliary Option module type fitted	OPnA	nonE	No option fitted
		r485	RS485 comms
		diGi	Digital Input
Firmware type	FW	Value displayed is firmware type number	
Firmware issue	ISS	Value displayed is firmware issue number	
Product Revision Level	PrL	Value displayed is Product Revision level.	
Date of manufacture	dOMm	Manufacturing date code (mmyy)	
Serial number 1	Sn1	First four digits of serial number	
Serial number 2	Sn2	Middle four digits of serial number	
Serial number 3	Sn3	Last four digits of serial number	

9. Installing Option Modules

CAUTION: Turn off all power. Remove instrument by gripping the sides of the front panel and pulling the instrument out of its housing. ***Note its orientation.***

To access modules 1 or A, first detach the PSU and CPU boards from the front moulding by lifting first the upper, and then lower mounting struts. Gently separate the boards.

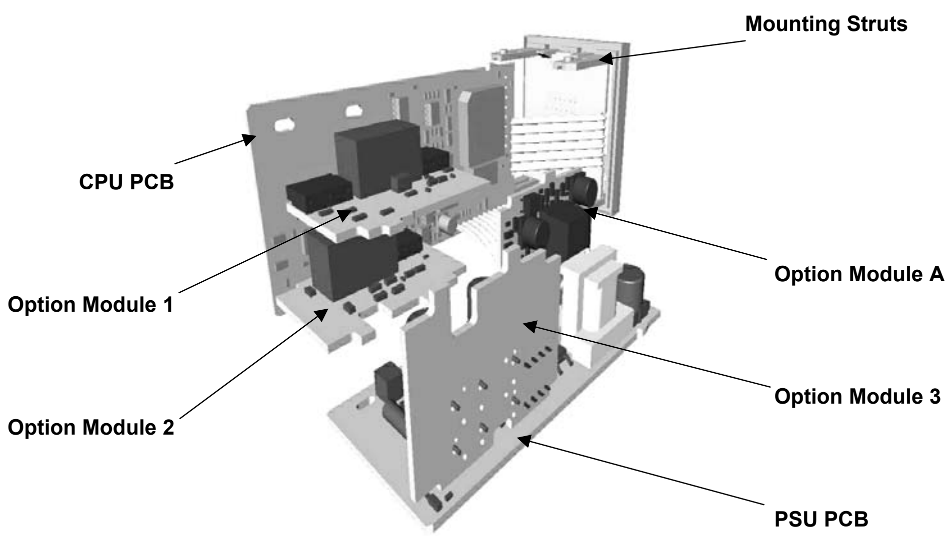
a). Plug the required option modules into the correct connectors, as shown below.

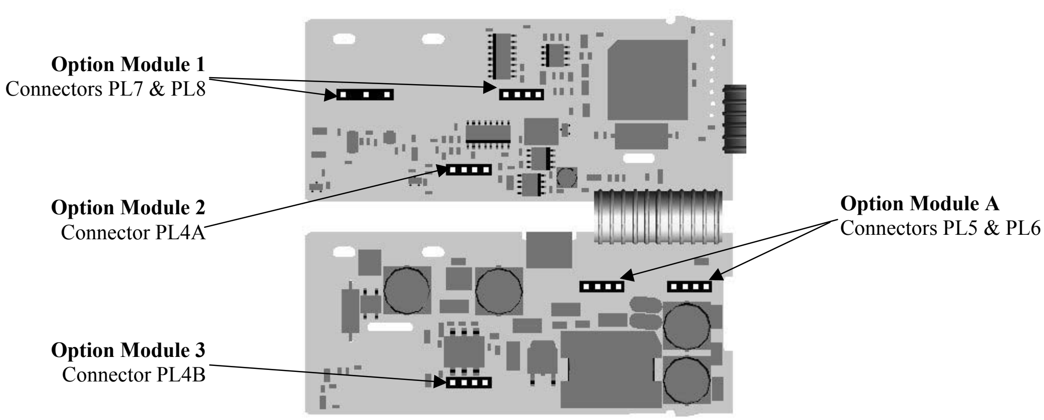
b). Locate the tongues on each module into the corresponding slot in the board opposite.

c). Hold the main boards together while relocating them back on the mounting struts.

d). Replace the instrument by aligning the CPU and PSU boards with their guides in the housing, then slowly push the instrument back into position.

Note: The instrument will automatically detect which option modules have been fitted.





10. ERROR/FAULT INDICATIONS

Parameter	Upper Display	Lower Display	Description
Instrument parameters are in default conditions	Goto	ConF	Configuration & Setup required. Seen at first turn on or if hardware configuration changed. Press SETUP to enter the Configuration Mode, next press ▲ or ▼ to enter the unlock code number, then press SETUP to proceed.
Over Range	[HH]	Normal	Input > 5% over-range
Under Range	[LL]	Normal	Input > 5% under-range
Sensor Break	OPEN	Normal	Break in input sensor or wiring
Option 1 Error	Err	OPn 1	Option 1 module fault
Option 2 Error		OPn2	Option 2 module fault
Option 3 Error		OPn3	Option 3 module fault
Option A Error		OPnA	Auxiliary Option module fault

Eclipse Combustion

ThermAir Burners

Model TA075

Version 1.10

Main Specification – TA075

PARAMETER	BLOWER SIZE								
		3"w.c. Packaged				6"w.c. Packaged			
Maximum input (Btu/hr) *(To maintain 15% excess air with standard air orifice and standard combustion air blower)*	Frequency	Capacity at Chamber Pressure				Capacity at Chamber Pressure			
		BTU/hr	"w.c.	kW	mbar	BTU/hr	"w.c.	kW	mbar
	60 Hz Packaged Blower	805,000	-1.0	236	-2,5	814,000	-1.0	238	-2,5
		750,000	0.0	220	0,0	750,000	0.0	220	0,0
		691,000	1.0	202	2,5	705,000	1.0	206	2,5
	50 Hz Packaged Blower	Not Available				822,000	-1.0	241	-2,5
						771,000	0.0	226	0,0
						716,000	1.0	210	2,5

Parameter		3"w.c. Packaged		6"w.c. Packaged	
Minimum input		BTU/hr	kW	BTU/hr	kW
	Natural gas	14,000	4,1	25,000	7,3
	Propane	18,000	5,3	25,000	7,3
	Butane	23,000	6,7	25,000	7,3
Main Gas Inlet Pressure • *Fuel pressure at gas inlet (Tap "B")*		" w.c.	mbar	" w.c.	mbar
	Natural gas	6.6	16,4	6.5	16
	Propane	7.2	17,9	6.8	17
	Butane	8.0	19,9	6.9	17
High Fire Flame Length • *Measured from the outlet end of combustor*		inches	mm	inches	mm
	Natural gas	39	990	30	762
	Propane	43	1092	32	813
	Butane	43	1092	32	813

Parameter		ºF	ºC
Maximum Chamber Temperature	Alloy Tube	1500	820
	SIC Tube	1900	1038
Flame Detection		Flame rod or UV scanner	
Fuel		Natural gas, Propane, or Butane. *For any other mixed gas, contact Eclipse Combustion for orifice sizing*	

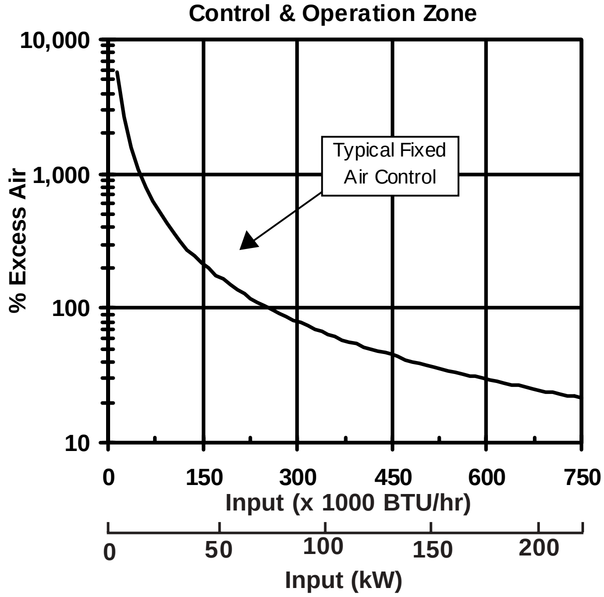
- All information is based on laboratory testing in neutral (0.0"w.c.) chamber with standard combustor design. Different chamber conditions and/or combustor design will affect the data.
- Maximum inputs are given for the standard combustion air blower without an air filter.
- All inputs based upon gross calorific values and standard conditions: 1 atmosphere, 70º F (21ºC).
- Blower motor service factors greater than 1.0 may be required when firing into negative chamber pressure applications. For specific application questions, contact your Eclipse Combustion representative.
- Eclipse reserves the right to change the construction and/or configuration of our products at any time without being obliged to adjust earlier supplies accordingly.

ECLIPSE™ Innovative Thermal Solutions

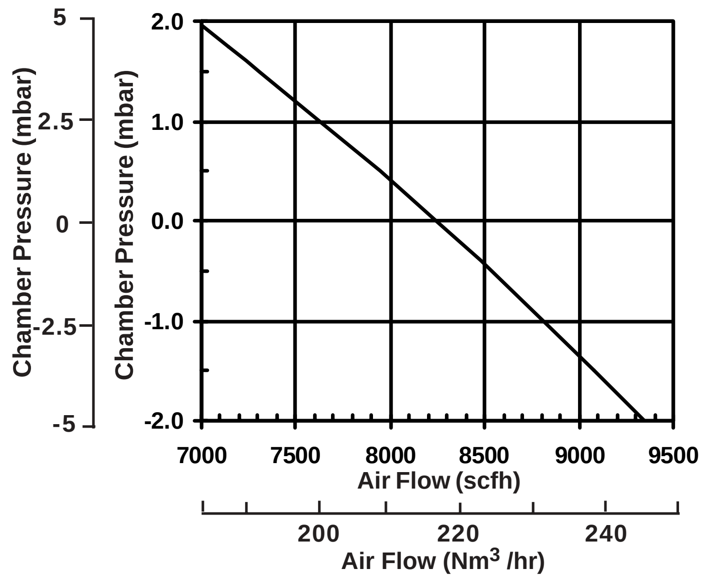
Performance Graphs

ThermAir TA075

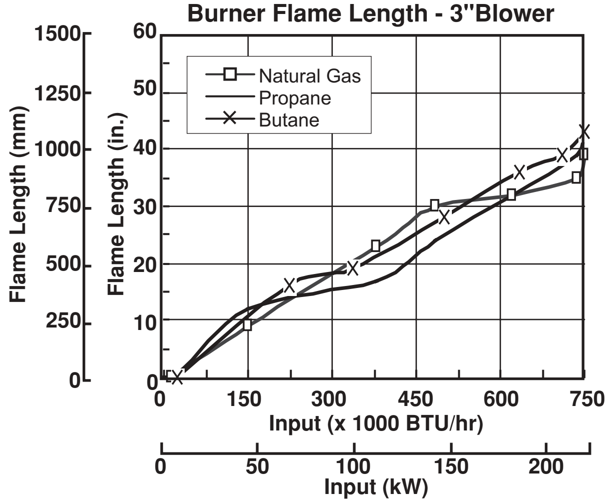
Control & Operation Zone



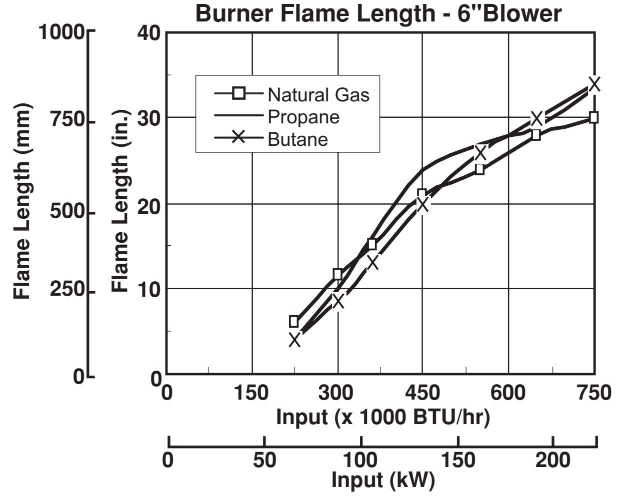
Air Flow vs. Chamber Pressure



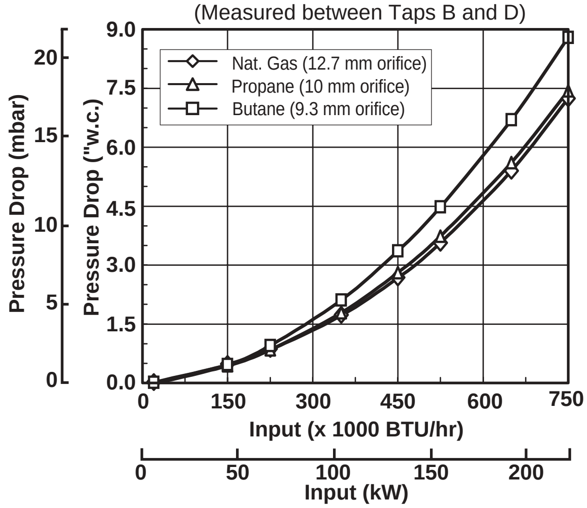
Burner Flame Length - 3"Blower



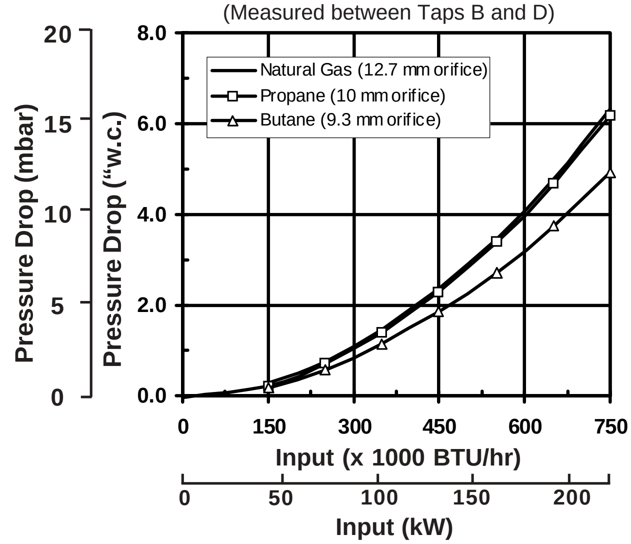
Burner Flame Length - 6"Blower



Fuel Orifice ΔP vs. Input - 3" Blower
(Measured between Taps B and D)



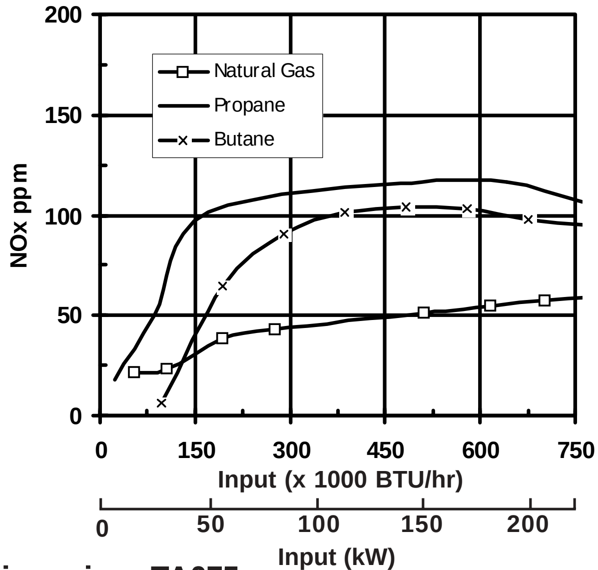
Fuel Orifice ΔP vs. Input - 6" Blower
(Measured between Taps B and D)



Performance Graphs (Continued)

ThermAir TA075

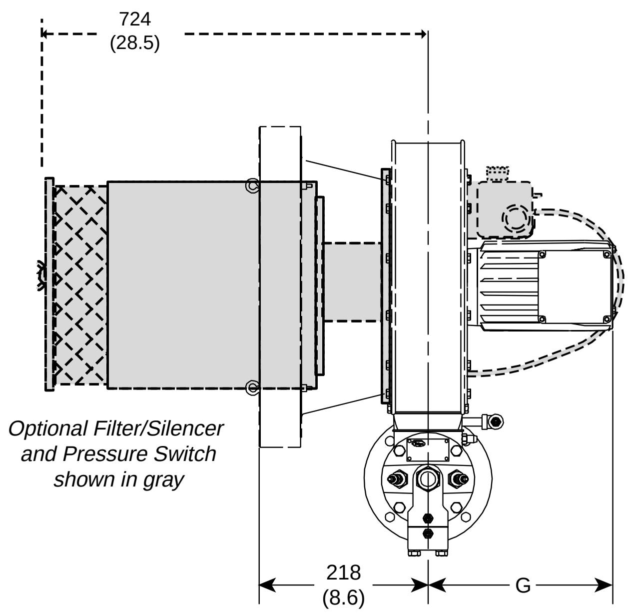
NOx Emission Data

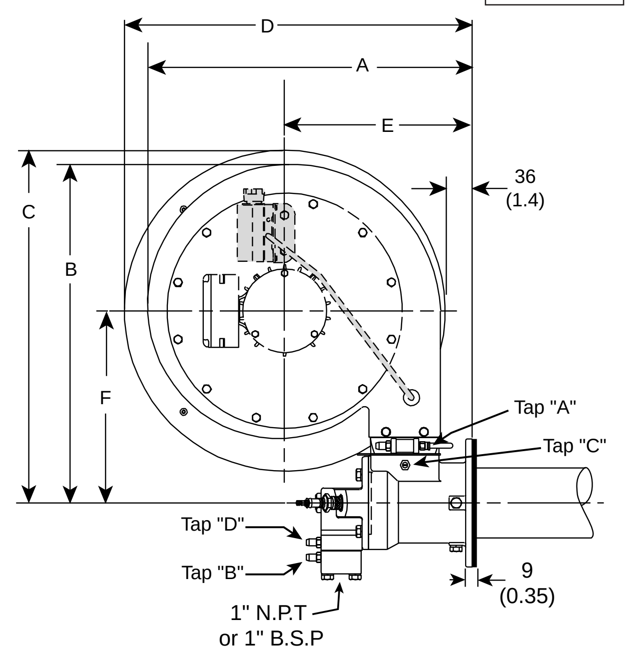


Notes on emission data
NOx emission data is given for: • Ambient combustion air ~70° F (20° C) • Minimal process air velocity • ppm volume dry at 3% O_2 • Neutral chamber pressure **Emissions are influenced by:** • Chamber conditions • Fuel type • Firing rate • Combustion air temperature
CO emission is largely influenced by chamber conditions. Contact your local Eclipse Combustion representative for an estimate of CO emission on your application.

Dimensions-TA075

mm (in)

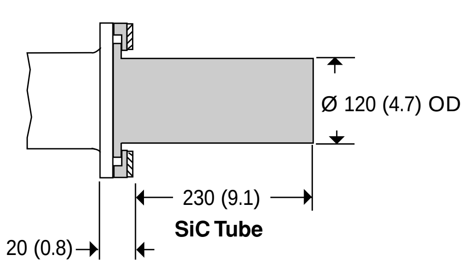




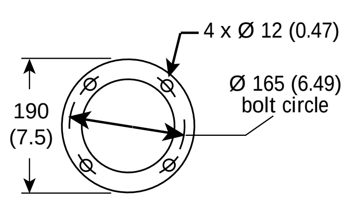
Port Connection	
Sparkplug	14mm
Flamerod or scanner	0.5" N.P.T.
Peepsight	0.75" N.P.T.

Weights	lb	kg
Burner, w/ blower	78	35
Burner, less blower	31	14
Filter/Silencer	41	19

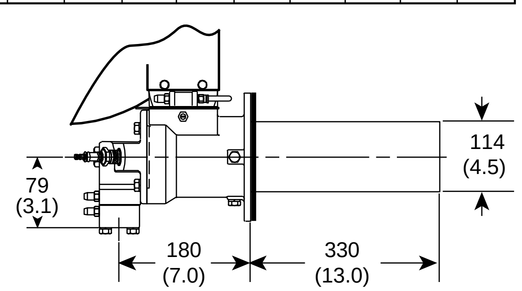
Blower 6" w.c.														
	A		B		C		D		E		F		G	
Hz	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
50	484	19.0	532	20.9	N/A	N/A	N/A	N/A	272	10.7	309	12.2	291	11.5
60	424	16.7	473	18.6	482	19.0	447	17.6	243	9.5	279	11.0	291	11.5
Blower 3" w.c.														
60	338	13.3	393	15.5	N/A	N/A	N/A	N/A	202	7.9	234	9.2	192	7.6



SiC Tube



Mounting Pattern



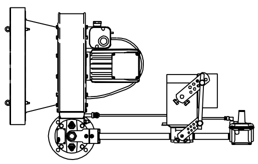
310 Stainless Steel Alloy Tube

Piping

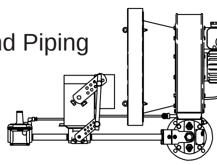
Orientation

Upright

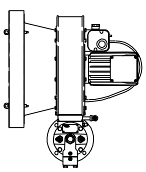
Right Hand Piping



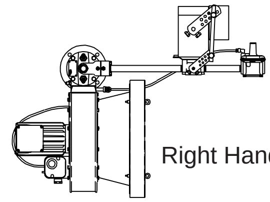
LeftHand Piping



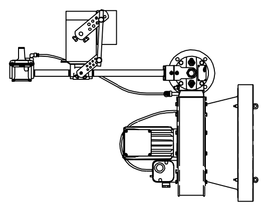
No Piping



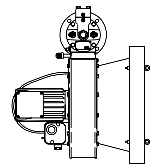
Inverted



Right Hand Piping



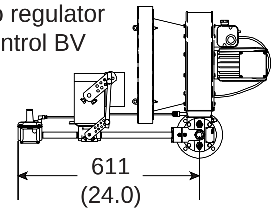
Left Hand Piping



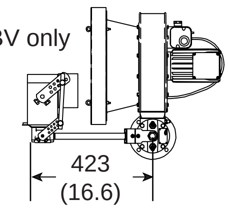
No Piping

Piping Options

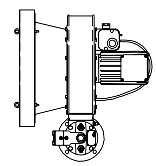
With ratio regulator and control BV



With control BV only



Less ratio regulator and control BV



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