Installation and Operating Instructions

Series 508-1X
Level Transmitter using 408-0200 Magi-Cal and 408-2200 Electronics
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Series 508-1X
Level Transmitter
using 408-0200 Magi-Cal
and 408-2200
Electronics

“When the measurement matters”
1.0 Introduction

The instructions in this manual are for the Drexelbrook 508-11,-12,-13, or -14-XX Series transmitter for level measurement in liquids, slurries, interfaces and granulars.

1.1 System Description

Each Drexelbrook 508-1X-XX transmitter consists of a 408-2200 Series two-wire electronic unit and a 700 Series sensing element (probe).

The transmitter model numbers indicate the application where they most often will be used:

508-11-X: For conducting liquids
508-12-X: For insulating liquids
508-13-X: For liquid/liquid interfaces
508-14-X: For granular solids

The final digits in the transmitter model number refer to the type of 700 Series sensing element used. A 508-11-1 transmitter uses a 700-1-22 type sensing element for measuring level in conducting liquids.

In the two-wire transmitter, the current supplied to the electronic unit from an external power supply is the same current used for the transmitter output signal.

1.2 Models Available

1.2.1 Electronic Chassis

The following is a partial list of the various 408-2200 Series chassis models available:

408-2200-1 - Basic electronic unit intended for use with insulating materials, interfaces, and conducting liquids that do not coat the sensing element.

408-0200-1 - Magi-Cal version of 408-2200 (listed above). This unit is intended for use with microprocessor receivers, such as the DE8000. The fine span and zero controls are eliminated and calibration is accomplished through the microprocessor. The microprocessor accepts currents other than exactly 4 and 20 mA and scales them for zero and 100%. For example, 5.6 mA to 14.3 mA may represent 0-100%. 
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1.2.2 Housings

The 408-2200 Series electronic units are available in a Nema 4 explosionproof housing. A "1" in the last position of the electronic unit number indicates chassis only, no housing. Example, 408-22XX-X1 means chassis only. The standard housing meets the following Nema classifications:

1 General Purpose
2 Drip Tight
3 Weather Resistant
4 Waterproof
7 Explosionproof
9 Dust/Ignitionproof
12 Industrial use: oil and dust tight

For typical dimensions of the standard housing, see Figure 1-2.

1.2.3 Sensing Elements

The following sensing elements are most often recommended with a 508-1X-XX transmitter according to the application requirements. See Section 2.2 for detailed specifications. This listing does not include all of the sensing elements available with the 508-1X-XX series transmitters. For identification, the last digits of the sensing element model number are stamped into the mounting gland. If you have additional questions about sensing elements, contact the factory or your local representative.

700-1-22 - Rigid sensing element for waterlike conducting liquids.
2.0 Technical Specifications

2.1 Electronic Unit

A. Power requirement: 11-30 VDC
   (For intrinsic safety, see "O" below).

B. Input range: 408-2200: 30-6600 pF. 408-0200: 170-6600 pF.

C. Output range: 4-20 mA

D. Linearity: ±0.5%.

E. Load resistance:
   \[ V_S - 11^* = \left( \text{i.e. max } 650 @ 24\text{VDC} \right) \times \frac{0.02}{10} \]
   *Where V_S = power supply voltage.

F. Temperature effect: ±65% per 30°F or ±0.15 pF whichever is larger.

G. Supply voltage effect: 0.5% max. per 10 volt change of dc power supply.

H. Effect of load resistance: 0.2% or less for full resistance range at 24 VDC supply.

I. Response to Step Change: 20 milliseconds std.; 0-20 seconds with time delay switch on.

J. Fail-Safe: Low-level Fail-Safe (LLFS) std. Also called direct acting because current increases as the level increases.

Note: THERE ARE NO DEVICES THAT ARE ABSOLUTELY "fail-safe". "Fail-safe" means that in the event of the most probable failures, the instruments will fail safely. "Most probable failures" means such things as loss of power and most transistor and component failures. If your application needs absolute fail-safe, a backup instrument should be installed.

K. Ambient temperature: -40° to 160°F (-40° to 70°C).

L. Calibration Adjustments:
   408-2200: Zero, Step Span, Fine Span. 408-0200: Step Span.

M. Lowest permitted resistance
   (sensing element to ground): 3K ohms.

N. Sensing Element coating effect:
   Max error for 2000 ohms-cm. product buildup of 1/16” thick on
   typical sensing element = 1.5”.

O. Intrinsic Safety: Sensing element and cable: Intrinsically safe for
   Class I Groups A, B, C and D; Class II Groups E, F and G (Div. 1 and 2).
   Electronics and signal wires: Intrinsically safe for Class I
   Groups C and D, Class II Groups E, F and G (Div. 1) when powered
   by an intrinsically safe power supply. Non-incendive for Class I
   Groups A, B C and D; Class II Groups E, F and G (Div. 2).

Warning: Explosion Hazard - Substitution of components may impair suitability for Class I, Division 2.

Advertissment: Risque d’explosion - La substitution de composites peut rendre ce matériel inacceptable pour les emplacements de Classe I, Division 2.

Warning: Explosion Hazard - Do not disconnect equipment unless power has been switched off, or the area is known to be non-hazardous.

Advertissment: Risque d’explosion - Avant de déconnecter l’équipement, couper le courant ou s’assurer que l’emplacement est désigné non dangereux.
2.2 Sensing Elements

<table>
<thead>
<tr>
<th>Model #</th>
<th>Process Wetted Parts</th>
<th>Sensing Element Dimensions</th>
<th>Temp. and Pressure</th>
<th>Max. Length</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>700-1-22</td>
<td>TFE covered rod</td>
<td>Rod 3/8&quot; OD 3/4&quot; NPT</td>
<td>100°F @ 1000 psi 300°F @ 500 psi</td>
<td>14 ft.</td>
<td>2-term. rigid</td>
</tr>
<tr>
<td>700-2-22</td>
<td>TFE covered rod</td>
<td>Rod 3/4&quot; OD 3/4&quot; NPT</td>
<td>100°F @ 1000 psi 300°F @ 500 psi</td>
<td>20 ft.</td>
<td>2-term. rigid</td>
</tr>
<tr>
<td>700-1-24</td>
<td>TFE covered rod w/CS concentric shield</td>
<td>1 1/2&quot; OD 1 1/2&quot; NPT</td>
<td>100°F @ 1000 psi 300°F @ 500 psi</td>
<td>20 ft.</td>
<td>2-term. rigid</td>
</tr>
<tr>
<td>700-5-44</td>
<td>Polypropylene covered cable</td>
<td>1/8&quot; OD 3/4&quot; NPT</td>
<td>200°F @ 50 psi</td>
<td>100 ft.</td>
<td>2-term. flexible cable</td>
</tr>
</tbody>
</table>

2.3 Three-Terminal Cable (When Used)

A. General Purpose 380-XXX-12: .51" OD at largest point, 160°F temp limit.

B. Composite Cable (first 10 ft. high temp) 380-XXX-18: .62" OD at largest point, 450°F temp limit for first 10 ft. 160°F temp limit for remainder.

C. High Temp. Cable 380-XXX-11: .51" OD at largest point, 450°F temp limit.

2.4 Hazardous Location Specifications

CAUTION
Substitution of components may impair intrinsic safety.

A. Installation of this equipment in an area where there may be hazardous materials, such as explosive gases, dusts, or fibers, must comply with one of the following in U.S. or Canada.

1. Article 500-504 of the National Electrical Code (NEC) NFPA 70 for U.S.

2. Section 18 of the Canadian Electrical Code, Part 1, C22.1 for Canada

B. Factory Mutual Approval (FM) for United States.

1. Model numbers and area classifications of FM approval are shown in control drawing 420-1-710-CD for model number 408-a200-b, Modif. 91-C.

2. For explosionproof and dust-ignition proof installations, transmitter chassis are approved only when mounted in 285-1-42 and 285-1-43 Series housings, options d = 4 or 9. See NEC requirements for conduit, seals, and drains.

3. For Class 1 intrinsically safe or Division 2 installations, the 408-a200-b chassis can be mounted in any NEMA type housing suitable for the area.

4. All 700 Series sensing elements and connecting 380 Series cable are intrinsically safe for Classes I, II, III, Groups A-G, so cable does not require conduit.
3.0 Installation

3.1 Unpacking

Carefully remove the contents of the carton and check each item against the packing list before destroying any packing material. If there is any shortage or damage, report it immediately to the factory.

3.2 Mounting the Electronics

The 408-2200 Series transmitter was designed for field mounting, but it should be mounted in a location as free as possible from vibration, corrosive atmospheres, and any possibility of mechanical damage. For convenience at start-up, mount the instrument in a reasonably accessible location. Ambient temperatures should be between -40°F and 160°F (-40° and 70°C). See Figure 3-1.

3.3 Mounting the Sensing Element

The mounting location for the sensing element (probe) is often determined by the placement of nozzles or openings in the vessel. The sensing element should not be placed in a fill stream. When there is no suitable location inside a vessel, an external side arm or float cage can be considered.

The following sensing element mounting and installation instructions should be followed so that the equipment will operate properly and accurately:

A. In applications requiring an insulated sensing element, use particular care during installation. There is always the danger of puncturing the insulating sheath, especially with the thin-walled, high capacitance probes.

B. Sensing elements should be mounted in such a manner that they are not in the direct stream of a filling nozzle or chute. If this is not possible, a deflecting baffle should be installed between the probe and the fill.

C. Do not take a sensing element apart or loosen the packing glands.

D. Tighten the sensing element with the wrench flats nearest the mounting threads.

E. If waves caused by agitation cause the output to be unsteady, consult the factory for the correct solution to the problem.
3.4 Wiring the Electronic Unit

The signal connections are made to the terminal strip(s) on the chassis. Due to the low power consumption of the instrument, the wiring need only be light gauge. See Figure 3-2 for proper connections.

![Fig. 3-2 Power Connections](image)

When used, the cable from the sensing element is also connected to the terminal strip on the instrument chassis. See Figure 3-3. The cable connections are probe (P), ground (G), and shield (SH).

Only coaxial cables supplied by Drexelbrook Engineering Company should be used to connect the transmitter to the sensing element. Use of other cables can result in unstable calibration.

**Caution:** Before using Intrinsic Safety Barriers, read the manufacturers instructions for barrier operation. Barriers supplied by Drexelbrook Engineering Company, and prewired to the power supply, have already been tested for proper operation. See Figure 3-4.

The 408-2200 has a built-in current limiter which holds the signal current to a maximum of 35 mA.
Check to make sure that the barriers being used will limit current to less than 35 mA. Make sure that the voltage applied will not exceed the barrier voltage rating.

3.5 Sensing Element Connections

The cable connections to the sensing element are shown in Figure 3-5. Do not connect the cable to the sensing element until after the sensor has been installed in the vessel and the conduit housing has been screwed on securely. Two-terminal probes do not have a shield connection. Be sure to clip and/or tape the shield wire at the probe end of the cable.

![Cable Connections to the Sensing Element](image)

**Fig. 3-5**
Cable Connections to the Sensing Element

If spark protection is supplied, use the following instructions for installing the spark protector in the sensing element conduit. See Figure 3-6.

A. Attach the mounting link on the spark protector to the probe center connection screw.

B. Connect the green wire from the spark protector to the ground screw.

C. Feed the cable into the conduit.

D. Connect the cable center wire (CW) to the spark protector and the ground wire (gnd) to the ground screw as shown.

E. Clip and tape the shield wire as shown in Figure 3-6.

![Spark Protection in Close-Coupled Installation](image)

**Fig. 3-6**
Spark Protection in Close-Coupled Installation
4.0 Calibration

4.1 Controls and Adjustments

4.1.1 Zero and Span Controls

The Zero and Fine Span controls are located on the chassis top panel, as shown in Figure 4-1.

![Zero and Fine Span Controls](image)

**Fig. 4-1**
Zero and Fine Span Controls (408-2200)

The Zero control provides continuous adjustment of the minimum current point.

**Note:** Under normal circumstances, the interaction between zero and fine span should be less than 1%. If this interaction becomes greater than 1%, consult factory for assistance. However, the zero setting is different depending on step span position (See calibration instructions).

The Step Span (Figure 4-2) and Fine Span controls also work together to provide continuous adjustment of the change in capacitance required to produce full scale current. Each Step Span position advances the range in inches or feet to approximately three times the previous setting. The Fine Span provides continuous adjustment between the Step Span positions.

4.1.2 Time Delay Control

Time delay damping is available on most Drexelbrook level transmitters. It is an RC time constant circuit that is switchable from 0 to 20 seconds. For most applications requiring damping, this is sufficient. Calibration of the transmitter is done with the time delay turned off.

The time delay switch control is located on the inside front circuit board, as shown in Figure 4-2. After calibration is complete, the time delay can be added, without affecting the calibration.

![Time Delay Switches](image)

**Fig. 4-2**
Step Span and Time Delay Switches
4.1.3 Fail Safe

The unit is supplied in Low-Level Fail-Safe, which is also called DIRECT ACTING. This is the most commonly used fail-safe position for continuous instruments. Output current increases as the level increases. In the event of most probable failures, the output current will drop and indicate low level.

4.2 Start-Up

Before applying power to the instrument, be sure that the input power will be from 11 to 30 VDC. Check all wiring connections, observing polarity of the output loop.

Caution: Explosionproof Units in Hazardous Areas: Before the explosionproof housing cover is removed to calibrate the instrument, the area must be checked and known to be nonhazardous. When calibration is complete, the housing cover must be replaced. Each lead from the explosionproof case must be equipped with an approved seal fitting.

4.3 Calibration Procedures for the 408-2200

Note: If your transmitter has been precalibrated at the factory, do not recalibrate.

The calibration instructions for the 408-2200 series transmitter are divided into two major application categories with different methods in each category.

The two calibration categories are immersion applications, and interface applications.

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Fig. 4-3
Immersion Application

4.3.1 Immersion Applications (See Figure 4-3 and 4-4)

Immersion - Low-Level Fail-Safe (Output rises as material rises)

Calibrating the instrument in an immersion application for low-level fail-safe is the most commonly used method.

a. Set Fine Span to extreme counterclockwise position. See Figure 4-4.
b. Refer to Chart in Figure 4-5 for the correct step span position for your application.

c. With the vessel empty (or probe uncovered), adjust the Zero control until the output is minimum (4 mA).

d. Fill the vessel (or raise the level as much as possible). Output current will rise with the level.

e. Turn the Fine Span control clockwise until the output is full scale (20 mA) or equal to the percentage equivalent of the actual level.

Calibration is now complete. Record the capacitance values that produce 4 mA and 20 mA outputs.

If you were unable to set the span correctly, adjust the Step Span control until the span is correct, and then repeat steps a through e.

CONTINUOUS

**Fig. 4-5 Step Span Chart**

<table>
<thead>
<tr>
<th>SYSTEM NUMBER</th>
<th>PROBE NO.</th>
<th>CALIBRATION RANGE IN FT. VS. STEP SPAN RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>508-11-9</td>
<td>700-1-22</td>
<td>0.2 1.25-6.5 4.21 OVER 12</td>
</tr>
<tr>
<td>508-12-6</td>
<td>700-1-24</td>
<td>1.25-6.5 4.0  OVER 12</td>
</tr>
<tr>
<td>508-11-8</td>
<td>700-5-44</td>
<td>6.35 18-105</td>
</tr>
<tr>
<td></td>
<td>700-5-48</td>
<td>4.5-25 13-75 OVER 27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OVER 30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SYSTEM NUMBER</th>
<th>PROBE NO.</th>
<th>CALIBRATION RANGE IN FT. VS. STEP SPAN RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>508-12-6</td>
<td>700-1-24</td>
<td>3-16  OVER 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.3-6.8 4-20 OVER 12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8-42 2.4-12 OVER 7.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6-3.1 1.8-9.4 OVER 5.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SYSTEM NUMBER</th>
<th>PROBE NO.</th>
<th>CALIBRATION RANGE IN FT. VS. STEP SPAN RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>508-12-45</td>
<td>700-1-24</td>
<td>11-60 OVER 60</td>
</tr>
<tr>
<td>12&quot; FROM WALL</td>
<td>K = 2</td>
<td>4-20 12-60 OVER 15</td>
</tr>
<tr>
<td></td>
<td>K = 4</td>
<td>2-8 5-25 OVER 15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SYSTEM NUMBER</th>
<th>PROBE NO.</th>
<th>CALIBRATION RANGE IN FT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>508-12-45</td>
<td>700-1-24</td>
<td>33-173</td>
</tr>
<tr>
<td>TYPICAL</td>
<td>TUNING</td>
<td>99-520</td>
</tr>
<tr>
<td>RATING</td>
<td>RANGE IN</td>
<td>310-1740</td>
</tr>
<tr>
<td>PF</td>
<td></td>
<td>940-5270</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1380-7760</td>
</tr>
</tbody>
</table>

*Step Span 5 is obtained by turning on all 5 Step Span switches.*
4.3.2 Interface Applications

All level control applications are actually interface measurements. The most common being the interface of air and product. The term interface generally refers to the interface of two immiscible liquids (liquids that don’t mix).

For the purpose of level control, two types of interface are considered. The first and more common is called normal interface. An interface is considered “normal” when the lower product has the higher conductivity (i.e. oil and water). The other type of interface is called inverted interface. In an inverted interface, the upper-phase product has the higher conductivity, indicating the insulating phase is heavier than water. Inverted interface can not be measured with this instrument, consult factory.

Normal Interface - (See Figure 4-6)

a. Set Fine Span to extreme counterclockwise position. See Figure 4-4.

b. Set Step Span using Chart in Figure 4-5 according to conductive materials and your probe type.

c. Lower the level until the probe is covered with only the upper phase insulating material. Set the Zero control until the output is minimum (4 mA).

d. Raise the interface until most of the lower, waterlike phase of material is covering the probe. Output current will now rise toward full scale.

e. Turn the Fine Span control clockwise until the output is equal to the actual interface level on the probe.

Calibration is now complete.

If you were unable to set the span current, adjust the Step Span control until the span is correct, then repeat steps a through e.

Fig. 4-6
Normal Interface Application
Calibration-Operation

4.4 Calibration Procedures for the 408-0200

Unlike the standard 408-2200 series, the 408-0200 Magi-Cal™ transmitter has only two controls and adjustments. They are the Step Span and Time Delay switches. The Fine Span and Zero adjustments have been eliminated, as these functions are handled by the microprocessor-based receiver that supplies the power to the transmitter.

To calibrate the 408-0200, follow the steps outlined in paragraph 4.3 -- Calibration Procedures for the 408-2200, specifically Figure 4-5 -- Step Span Chart. Also use the instructions outlined in the microprocessor receiver manual (e.g. DE8000 - Point Cal Method) to set the Zero and Fine Span controls.

Typically, once the step span switch is properly set for the application, two level values are entered into the microprocessor that correspond to the current coming from the 408-0200 transmitter. For example, with the level at 17%, the current may be 8.2 mA and later, with the level at 33%, the current may be 9.4 mA. When the level is at known points, the information is entered into the microprocessor, which then scales the reading for 0-100% or engineering units.

4.5 Secondary Calibration Standard

In some applications, it is difficult or even impossible to completely fill or empty a vessel. In such a case, it is desirable to have a secondary calibration standard such as the Drexelbrook Model 401-6-8 (which can be used to simulate the capacitance of an empty vessel). The following procedure permits recaliubration of an instrument without the necessity of emptying the vessel.

4.5.1 Recording Calibration Data

In order to establish the zero, or empty vessel calibration, start by setting up the instrument as described under Calibration. After initial calibration, do the following: (Also, see instruction manual for calibration standard.)

A. Disconnect the probe wire.

B. Connect the calibration standard to the instrument. See Figure 4-7.

C. Adjust the calibration standard until the instrument indicates minimum current (4 mA).

D. Record the value read on the calibration standard and its serial number for later use. Recording the value on the inside of the instrument door is also suggested.

E. Adjust the calibration standard until the instrument indicates maximum current (20 mA).
F. Record the capacitance value as in Step D.

G. Disconnect the calibration standard from the instrument terminals and reconnect the probe.

4.5.2 Recalibration

Whenever it is subsequently desired to check or reset the calibration, or replace the instrument, the calibration capacitor set to the value recorded above may be substituted for the probe. This is done as follows:

A. Disconnect the probe wire.

B. Connect the calibration standard to the instrument. See Figure 4-7.

C. Set the calibration standard to the recorded values.

D. If necessary, adjust the zero control for the minimum current calibration and the span control for the maximum current calibration.

E. Disconnect the calibration standard and reconnect the probe wire to probe.

Unit is again ready for operation.

When replacing a malfunctioning electronic unit, the replacement chassis can be calibrated on the bench by the preceding method and then installed in the field.
5.0 Accessories

The following Drexelbrook accessories are available for use with the 508-1X-XX Series transmitters.

5.1 RFI Filters

Radio Frequency Interference (RFI) filters are designed to protect Drexelbrook RF level transmitters from the interference of outside radio transmissions... mainly walkie-talkies. Without this protection, those interfering transmissions can cause the transmitter output to be in error. For complete protection up to 460 MHz, all electrical lines to and from the transmitter housing must be filtered. Each filter should be close-coupled to the housing, and the housing should be earth-grounded. See Figure 5-1. To be effective, the housing cover must be closed.

5.2 Setcon (TM)

Setcon is a Drexelbrook trade name for a current-operated setpoint relay. It is used with continuous instruments to provide an on/off output at a specific position along the transmitters 0-100% range. Setcons are available in double pole, double throw relay output models, field adjustable to either high- or low-level fail-safe. The relay contacts can be used to operate an alarm, solenoid valve, or other device.

The Setcon's standard differential, or deadband, is approximately 0.5% of the 0-100% setpoint range. There is an adjustable differential model with a deadband range of 0-100%, as well as a setpoint range of 0-100% of full scale.

Setcons are available in weatherproof and explosionproof housings or chassis only for mounting in various prewired case option packages. See Figure 5-2 and the Setcon instruction manual.

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**Fig. 5-1**
RFI Protection

**Fig. 5-2**
Setcon
5.3 Power Supplies

Drexelbrook power supplies are available in 24 VDC models. See Figure 5-3. The power supply takes a typical 115 VAC* input and converts it to the 24 VDC.

The Drexelbrook 24 VDC model has an auto-restart feature. The auto-restart power supply will shut itself off when an excessive current fault occurs. It then tries every few seconds to turn back on until the fault is cleared. This feature is particularly useful when feeding SCR-type intrinsic safety barriers.

The maximum current available with the Drexelbrook 24 VDC supply will power two transmitter loops.

Power supplies are available in weatherproof and explosionproof housings, chassis only, or included in line-powered transmitters.

*240 VAC power supplies are also available.

5.4 Meters

The standard Drexelbrook meter is a 5" horizontal, taut-band, analog type with 0-1 mA movement. See Figure 5-4. There is a 10 mA shunt on the back of the meter that can be changed to convert it to 0-50 mA input. In addition to the 4-20 mA scale is a 0-100% scale.

These meters can be purchased as meter only and in either weatherproof or explosionproof housings, or included in indicating transmitter housings.

Special linear, nonlinear, and vertical scales are also available in the analog meters.
Accessories

If preferred, digital meters can also be provided. See Figure 5-5.

The Drexelbrook digital loop meter chassis measures 2 1/2" by 4". It has a low voltage drop of 1.6 mA at 20 mA and has a built-in overrange protection of up to 1000 mA when connections are reversed. The meter can be field calibrated for percent, current or engineering units. Large LCD digits can easily be seen, even from longer distances.

Fig. 5-4
Analog Meter

Fig. 5-5
Digital Meter in Nema 4 Case
6.0 Troubleshooting

6.1 Introduction

The 408-2200 Series instruments are designed to give years of unattended service. No periodic or scheduled maintenance is required.

A spare chassis is recommended for every 10 units so that, in case of a failed unit, a critical application will not be held up while the unit is returned to the factory for repair.

If a difficulty occurs when operating your measurement system, mentally divide the system into its component parts and test each part individually for proper operation.

These troubleshooting procedures should be followed in checking out your system. If attempts to locate the difficulty fail, notify your local factory representative or call the factory direct and ask for the service department.

6.2 Testing the Electronic Unit

6.2.1 Operation Check

A. Remove the sensing element and signal wires from the transmitter.

B. Put the Step Span in Position #1 and the Fine Span (408-2200 only) in the full counterclockwise position. See Figure 6-1.

C. Observing polarities, connect a DC millimeter and DC power supply (13 to 30V) in series, and complete the loop by connecting to the (+) and (-) terminals.
Troubleshooting

D. Adjust the Zero (408-2200) until the meter reads 0% (4 mA).

E. Connect a 100 pF capacitor between terminals F and G, (probe and ground). The output should read between 40% and 70% (10-15 mA).

If so, the instrument is working correctly. Turning the Fine Span (408-2200 only) changes the input a known amount. This checks the operation and gain of the transmitter.

F. If the difficulty has not been located at this point, proceed to the output checkout procedure (Drift Check).

6.2.2 Drift Check

If the output of a transmitter seems to be drifting, it is important to determine whether the drift is in the transmitter or in the probe.

A. Remove the sensing element wire from the transmitter.

B. Without disturbing the calibration settings, connect a capacitance standard or an NPO capacitor* across the probe to ground input. Adjust the capacitance standard or select a capacitor value that will bring the unit on scale.

*The capacitor should remain stable with changes in temperature.

C. Observe the reading over a 24-hour period to see if it is stable.

D. If the reading is stable, the sensing element or the application must be the source of the drift. If the reading drifted, return the instrument for repair. Be sure to mark on the tag that the probe is drift. (List the capacitor size and mA deviation.)

6.3. Checking the Two-Wire System Loop. See Figure 6-3.

A. With probe already disconnected, disconnect the power from Terminals (+) and (-) and measure the open circuit voltage from the power supply. Voltage should be between 11 and 30.

B. Connect the signal wires to Terminals (+) and (-). Turn the Step Span to Position #1. Put Fine Span control completely

Fig. 6-3
Loop Check
clockwise and adjust the Zero until 20 mA flows.

C. Measure the voltage between Terminals (+) and (-). Voltage should be between 11 and 30 VDC. If there is less than the minimum 11 volts required, the loop has too much resistance or not enough power supply voltage.

D. If, in Step C above, the voltage is less than 11 VDC, disconnect the power supply and signal wires to the unit. Short the wires that were removed from the power supply (+) and (-) terminals.

E. Measure the resistance between the two wires that were just removed from Terminals (+) and (-) of the electronic unit. The graph below will tell you when the resistance is too large. See Figure 6-4.

![Graph showing Loop Resistance](image)

**Fig. 6-4**
Loop Resistance

6.4 Checking the Sensing Element

A. With an analog ohmmeter*, check the resistance of the probe-to-ground with level below the probe. See Figure 6-5.

Resistance should be infinite. Resistance less than 1 megohm indicates excessive leakage, probably due to product or condensation in the conduit, around the gland/packing nut area. (Consult factory.)

* A digital ohmmeter may produce erroneous readings.

![Diagram showing Testing Resistance with Level Below the Sensing Element](image)

**Fig. 6-5**
Testing Resistance with Level Below the Sensing Element
Troubleshooting

B. Check the resistance of the probe-to-ground with level above the probe. See Figure 6-6. Resistance readings less than 1 megohm indicate either defects in the probe insulation or, if a bare probe, that the material is conductive and an insulated probe may be required. (Consult factory.)

C. Coating error is characterized by high output with falling level, and a sharp drop to 0% when the material goes below the tip of the probe. To verify a coating problem, wipe the coating off the probe and recheck instrument operation. If the instrument reads correctly after cleaning, consult the factory for the best solution to the problem.

Fig. 6-6
Testing Resistance with Level Above the Sensing Element
6.5 Checking the Sensing Element Cable.

(Only supplied on some models)

1. Disconnect cable at both ends. Be sure all terminals are standing clear.

2. Measure resistance from center wire to COTE-shield. Resistance should be infinity (open circuit).

3. Short probe & ground terminals together at one end.

4. Measure resistance from probe to ground terminals at other end. Resistance should be near zero ohms (short circuit).

5. Repeat step 2 for COTE-shield and ground terminals.
6.6 List of Some Possible Problems and Causes

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>CHECKOUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Transmitter reads 20 mA or greater even when vessel is not full.</td>
<td>a. Transmitter malfunction.</td>
<td>a. Sec. 6.2.1</td>
</tr>
<tr>
<td></td>
<td>b. Water in probe conduit.</td>
<td>b. Sec. 6.4</td>
</tr>
<tr>
<td></td>
<td>c. Short in cable.</td>
<td>c. Sec. 6.5</td>
</tr>
<tr>
<td></td>
<td>d. Cut in probe insulation.</td>
<td>d. Sec. 6.4</td>
</tr>
<tr>
<td></td>
<td>e. Calibration is wrong.</td>
<td>e. Sec. 4.3</td>
</tr>
<tr>
<td>2. Transmitter never reaches 20 mA even though the vessel is full, or</td>
<td>a. Load resistance too high.</td>
<td>a. Sec. 6.3</td>
</tr>
<tr>
<td>the output reading is non-linear at the upper end of the scale.</td>
<td>b. Calibration is wrong.</td>
<td>b. Sec. 4.3</td>
</tr>
<tr>
<td></td>
<td>c. Transmitter malfunction.</td>
<td>c. Sec. 6.2.1</td>
</tr>
<tr>
<td>3. Transmitter is drifting.</td>
<td>a. Moisture in probe gland.</td>
<td>a. Sec. 6.4</td>
</tr>
<tr>
<td></td>
<td>b. Water in probe conduit.</td>
<td>b. Sec. 6.4</td>
</tr>
<tr>
<td></td>
<td>c. Transmitter malfunction.</td>
<td>c. Sec. 6.2.2</td>
</tr>
<tr>
<td></td>
<td>d. Water in cable.</td>
<td>d. Sec. 6.5</td>
</tr>
<tr>
<td></td>
<td>e. Cut in probe insulation.</td>
<td>e. Sec. 6.4</td>
</tr>
<tr>
<td></td>
<td>f. Calibration is wrong.</td>
<td>f. Sec. 4.3</td>
</tr>
<tr>
<td>100%.</td>
<td>b. Cut in probe insulation.</td>
<td>b. Sec. 6.4</td>
</tr>
<tr>
<td></td>
<td>c. Waves in liquid.</td>
<td>c. Sec. 4.1.2</td>
</tr>
<tr>
<td>5. Transmitter was shipped pre-calibrated, but is not reading correct</td>
<td>a. Wrong pre-calibration information was supplied to</td>
<td>a. Verify precal. info</td>
</tr>
<tr>
<td>level.</td>
<td>factory.</td>
<td>b. Need to include info on nozzle</td>
</tr>
<tr>
<td></td>
<td>b. Nozzle or pipe around probe is 6&quot; or less in diameter.</td>
<td>c. Note: The zero point is at end of probe; not</td>
</tr>
<tr>
<td></td>
<td>c. Accuracy being checked by measuring outage as a %</td>
<td>bottom of tank.</td>
</tr>
<tr>
<td></td>
<td>of full tank.</td>
<td></td>
</tr>
<tr>
<td>6. Probe installed in stilling well, and readings are incorrect.</td>
<td>a. Probe touching stilling well.</td>
<td>a. Adjust mounting.</td>
</tr>
<tr>
<td></td>
<td>b. Reading lower than actual level.</td>
<td>b. Put holes in stilling well to allow air to escape.</td>
</tr>
<tr>
<td></td>
<td>c. Calibration is wrong.</td>
<td>c. Sec. 4.3</td>
</tr>
<tr>
<td>7. Transmitter reading 5% to 10% or greater in error.</td>
<td>a. Conductive buildup on probe.</td>
<td>a. Sec. 6.4</td>
</tr>
<tr>
<td></td>
<td>b. Calibration is wrong.</td>
<td>b. Sec. 4.3</td>
</tr>
</tbody>
</table>
6.7 Factory and Field Service Assistance

6.7.1 Telephone Assistance

If you are having difficulty with your Drexelbrook equipment, and attempts to locate the problems have failed, notify your local Drexelbrook representative, or call the factory direct using the toll-free number 1-800-527-6297. Drexelbrook Engineering Company is located at 205 Keith Valley Road, Horsham, Pa. 19044. The telephone number is (215) 674-1234. To help us solve your problem quickly, please have as much of the following information as possible when you call:

Instrument Model# __________________
Probe Model# ___________________
P.O. # __________________________
Date _____________________________
Cable Length _____________________
Application _______________________
Material being measured __________
Temperature ______________________
Pressure __________________________
Agitation _________________________
Brief description of the problem ______

Checkout procedures that failed ______

6.7.2 Equipment Return

Do not return equipment without first contacting the factory for a return authorization number. Any equipment being returned must include the following information:

Reason for return __________________
Return Authorization# ______________
Original P.O.# ____________________

Drexelbrook order# ______________
Your company contact _____________
"Ship To" address ________________

To keep the paperwork in order, please include a purchase order with returned equipment even though it may be coming back for warranty repair. You will not be charged if covered under warranty. Please return your equipment with freight charges prepaid. We regret that we cannot accept collect shipments.

Drexelbrook usually has a stock of reconditioned exchange units available for faster turnaround of a repair order. If you prefer your own unit repaired rather than exchanged, please mark clearly on the return unit, "Do Not Exchange".

Spare instruments are generally in factory stock. If the application is critical, a spare chassis should be kept on hand.

6.7.3 Field Service

Trained field servicemen are available on a time-plus expense basis to assist in start-ups, diagnosing difficult application problems, or in-plant training of personnel.

Contact the service department for further details.

6.7.4 Customer Training

Periodically, Drexelbrook instrument training seminars for customers are held at the factory. These sessions are guided by Drexelbrook engineers and specialists, and provide detailed information on all aspects of level measurement including theory and instrument operation. For more information about these valuable workshops, write to Drexelbrook Engineering, Attention: Communications/Training Group; or call direct (215) 674-1234.