Installation and Operating Instructions

Series 401-18-20
Portable Calibration System
Including
401-6-8 Capacitance Box,
401-18-2 Meter Unit, and
401-18-7 Material Tester with Test Probes
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OPERATING INSTRUCTIONS
FOR
401-18-20 Series
PORTABLE CALIBRATION SYSTEM
INCLUDING
401-6-8 CAPACITANCE BOX
401-18-2 METER UNIT
401-18-7 MATERIAL TESTER W/TEST PROBES

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401-18-20 Series
Portable Calibration System

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1.0 Introduction

The instructions in this manual are for the Drexelbrook Portable Calibration System (PCS). It is a battery operated, easy to carry and use, testing system for troubleshooting and calibrating Drexelbrook level controls. It may also include a material tester for finding the conductivity and dielectric constant of a given material.

This system is available in several different model combinations of three major units; a capacitance reference standard (model #401-6-8), a meter calibration unit (model #401-18-2), and a material tester (model #401-18-7) including two hand held probes. The system combinations available in the PCS include:

(1) 401-18-20 = 401-6-8 Capacitance Unit and 401-18-2 Meter Unit
(2) 401-1821 = 401-6-8 Capacitance Unit, 401-18-2 Meter Unit, and 401-18-7 Material Tester
(3) 401-18-22 = 401-18-2 Meter Unit, and 401-18-7 Material Tester.
Section I

Although designed to use with the Portable Calibration Systems (PCS), each of these components can be bought separately.

The Drexelbrook Portable Calibration System (PGS) comes complete in a rugged field- carrying case with all the necessary test leads, battery, shoulder strap, instructions, and pocket for instruction manual. See Figure I-1.

2.0 #401-6-8 (401-6-81) Capacitance Reference Standard

This unit is used as a substitute sensing element for simulating level when calibrating or recalibrating a level transmitter. It can be used to check the instrument calibration without draining or filling the vessel. It has a standard range of 10-100,000 pF. For lower changes in capacitance, the 401-18-5 Attenuator is available to reduce the indicated capacitance reading by a factor of 100.

Operating instructions for the 401-6-8 unit are found in Section II.

3.0 #401-18-2 Meter Calibration Unit

This multi-function meter can be used to test the output of the level transmitter, continuity of the sensing element, and power supply voltage. It can also provide a signal current for loop checkout. The 401-18-2 consists of a dual range currentmeter, with an integral voltage source, an ohmmeter, a dc voltmeter, and a current generator. The operating instructions for this unit are found in Section III.

4.0 #401-18-7 K-G Material Tester with 2 Test Probes

The Material Tester makes it possible to test electrical characteristics of a process material under actual conditions in the field. It is valuable for testing materials that are too hazardous to ship to the Drexelbrook factory for testing. The 401-18-7 includes the tester unit (401-18-6) and two fixed length test probes for hand held use. Probe A (700-3-43) is used for dielectric constant (K) and low conductivity measurements. Probe B (700-3-44) is used for high conductivity measurements.

In addition, the Material Tester can be used to produce an output current proportional to capacitance up to 1000 pF.

The operating instructions for this unit are found in Section IV.
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INSTALLATION AND OPERATION INSTRUCTIONS
for
401-68
(401-6-81)
CAPACITANCE UNIT ("C" BOX)
Section II
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For 401-68 (401-681) Capacitance Unit ("C" Box)

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Capacitance Unit ("C" Box)
401-6-8 (401-6-81)

1.0 Introduction

1.1 Unit Description

The Drexelbrook 401-6-8 Capacitance Unit ("C" Box) is designed to provide a stable reference standard to use when calibrating Drexelbrook radio frequency instruments. It can be used in place of the sensing element to simulate level signals to the electronic unit. The "C" Box has three controls used to set the desired value of capacitance, and three terminals for connecting the "C" Box to the electronic instrument being calibrated. See Figure II-1.

![Diagram of Capacitance Unit](image)

1.2 Models Available

The "C" Box can be purchased as a chassis (401-6-8), in its own case (401-6-81), or as a component in the Portable Calibration System. See Section I.
1.3 Specifications

The 401-6-8 Capacitance Unit has a range of 10-100,000 pF. It has an intrinsic capacitance at the zero setting as follows:

3 terminal hook-up
- 10 pF (low range)
- 22 pF (normal range)

2 terminal hook-up
(Test cable capacitance included)
- 50 pF (low range)
- 60 pF (normal range)

2.0 Installation/Location

When used with the Drexelbrook 401-18-20 Series Portable Calibration System, the 401-6-8 Capacitance Unit is mounted in the left side position of the carrying case. There is nothing to install; the system is completely portable. See Figure II-2.
3.0 Operation

3.1 Controls and Adjustments

There are three controls used for setting the appropriate calibrating capacitance. They are the range switch, the vernier dial, and the thumbwheel switches. See Figure II-1.

3.1.1 Range Switch

The range switch makes it possible to have a large total range of capacitance. When the range toggle switch is thrown right to the LOW 100 pF max range, the standing capacity of the unit at a zero reading is 10 pF ± 0.5 pF. In this range, the capacitance value is determined solely by the vernier dial setting. See Section 3.1.2. (The thumbwheel switches have no effect.) When the range switch is thrown left to the NORM range, the standing capacity is approximately 22 pF. In all cases, the standing capacitance value must be added to the dial readings to obtain the actual absolute capacitance produced by the "C" Box. For applications in the range of .25 to 45 pF, see section 6.0 for use of the optional 401-18-5 plug-in Attenuator.

3.1.2 Vernier Dial

The vernier dial gives a continuously adjustable capacitance over the range of 0 to 100 pF. At a reading of 0, the unit will have a residual standing capacitance, and that value depends on the range selected by the range switch. (See range switch above. Section 3.1.1)

3.1.3 Thumbwheel Switches

The thumbwheel switches are used to select a capacitance over a range of 100 pF to 99.999 pF, and are only functional in the "normal range". The total capacitance set on the 401-6-8 unit is read as the sum of the values set on the thumbwheel switches, plus the value set on the vernier dial and the applicable standing capacitance. Thus, when the thumbwheel switches are set to a value of 205 and the vernier dial is set to a reading of 40, the total reference value is:

(Thumbwheel) 20500
(Vernier) 40
(Standing Capacity, Fig. 11-6) 18

20558 pF

See Section 3.3.

Note that the thumbwheel switch setting has no effect on the capacitance when the range switch is set to the LOW 100 pF range.
3.2 Cable Connections

Application Note

The 401-6-8 capacitance unit can be used with either two-terminal or three-terminal electronic units. However, the connections in these two cases differ slightly. Three-terminal transmitters take advantage of the internal shield built into the 401-6-8 in order to minimize the unit's standing capacity. Accordingly, a long, three-terminal calibration cable can be used in conjunction with a three-terminal transmitter, without significant error. With two-terminal transmitters, the connecting two-terminal cable's capacitance should be known and figured into the final value of capacitance.

3.2.1 Three-Terminal Connections

The three-terminal cable is used with the Drexelbrook transmitters that have three-terminal connections; center wire (CW), shield (SH), and ground (gnd). The exception is transmitter model #408-62XX-021. Consult the instrument instruction manual for specific instructions.

When using the 401-6-8 Capacitance Unit as a substitute for the sensing element, make the cable connections to the unit as shown in Figure II-3.

![Diagram of Capacitance Unit Connections]

When connecting the capacitance unit to the transmitter input, it is convenient to use the flexible six foot, 380-06-501, calibration cable supplied with the system. See Figure II-4. This cable has a dual banana plug connector which should be plugged into the SH and CW terminals on the capacitance unit. When making this connection, be sure to align the color marks on the connector with the terminals of corresponding color. Complete the connection by
plugging the ground wire into the ground terminal of the capacitance unit. The transmitter end of the calibration cable has spade lugs for its three connections and should be connected with the blue lug to CW, red lug to SH, and green lug to ground.

TO TRANSMITTER

Fig. 1C4
380-06-501 Cable Connections

3.2.2 Two-Terminal Connections

The two-terminal cable is used when the electronic unit being used has no provision for driving the shield.

With this cable, no connection is made to the 401-6-8 Shield (SH) terminal. The two-terminal hook-up should be used with the following Orexelbrook transmitters:

- 408-1000 Series
- 408-3000 Series
- 408-4000 Series
- 508-1100 Series

When using the capacitance unit to substitute for the sensing element, or connecting it directly to the transmitter input, make connections as shown in Figure II-5.

CAPACITANCE UNIT 401-6-8

2-Terminal Cable 380-02-503

Fig. II-5
380-02-503 Cable Connection8
In the two-terminal hook-up, the cable capacitance between center wire and ground will add to the capacitance produced by the "C" Box. When connecting the unit directly to a two-terminal transmitter, use the short 380-02-503 cable (supplied with the "C" Box) so that the cable capacitance is a small, known quantity.

3.3 Reading Error
The actual capacitance versus dial reading should be consistent between 401-6-8 units. However, the absolute value of capacitance, which exists between the CW and gnd terminals of the 401-6-8 units, differs from the reading value obtained from the vernier dial and the thumbwheel switches (thumbwheel switches are active only for NORM range). This is due to the existence of stray or standing capacitance associated with any physical structure, and to a lesser degree, the non-linearity associated with the vernier dial capacitor. These errors are virtually eliminated through the use of the correction charts given in Figure 11-6a and 11-6b. To find the absolute capacitance at the terminals of the 401-6-8, enter the chart on the left, at a point on the vertical axis corresponding to the vernier dial reading. From this point, move horizontally over to the place where this value intersects the correction curve corresponding to the range switch setting. From the point of this intersection, move directly down to the horizontal correction axis. This is the value of the reading correction. This correction value is added to the dial reading to produce the absolute value of capacitance seen at the 401-6-8 terminals.

In the LOW range, the zero reading standing capacity for the capacitance unit with the short 380-02-503 cable attached is 50 pF. In the NORM range, the zero reading standing capacity for the unit with the short cable attached is 60 pF. In both of these cases, the cable contributes 20 pF of the total standing capacity. See Section 1.3.

When using a three-terminal system with an active shield (SH), the cable length does not affect the standing capacity of the system.

Note: When the same "C" Box is always used, it is not necessary to add the standing capacitances, provided the values are consistently figured in the same way.

4.0 Calibration
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 or capacitance unit such as the Drexelbrook model 401-6-8, which can be used to simulate the capacitance of an empty vessel without having to empty the vessel.
Fig. II-6
Graph
4.1 Obtaining Recalibration Values

In order to establish the zero or empty vessel calibration, follow the calibration procedure in the instruction manual for the electronic unit. Repeat for the full scale point. After initial calibration, do the following:

A. Disconnect the coax center wire (CW) from the probe rod in the sensing element conduit. (Be sure that it does not short to anything).

B. Connect the 401-6-8 "C" Box and the electronic unit in parallel with the existing cable. See Figure II-7.

C. Adjust the 401-6-8 until the instrument being calibrated indicates the appropriate zero current. (i.e. 1 mA, 4 mA, or 10 mA, depending upon output current range).

D. Record the value read on the 401-6-8 together with its serial number for later use. We suggest recording the value also on the inside of the instrument door.

Fig. II-7 Capacitance Unit Connected in Parallel with Existing Cable
E. Adjust the 401-6-8 until the instrument indicates full scale current. (i.e. 5 mA, 20 mA, or 50 mA).

F. Record the capacitance value as in Step D.

G. Disconnect the “C” Box from the instrument terminals.

H. Reconnect sensing element.

4.2 Recalibration

Whenever it is desired to check or reset the calibration or replace the instrument, the 401-6-8 “C” Box, set to the value recorded above, may be substituted for the sensing element. This is done as follows:

A. Disconnect the coax center wire (CW) from the probe rod in the sensing element conduit.

B. Connect the 401-6-8 “C” Box in parallel with the existing cable. See Figure 11-7.

C. Set the 401-6-8 to the values recorded in Section 4.1.

D. Adjust the zero controls for the minimum current calibration, and the span controls for the maximum current calibration.

E. Disconnect the “C” Box.

F. Reconnect the coax center (CW) lead to the sensing element. The unit is again ready for operation.
## CALIBRATION REFERENCE LOG

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5.0 #401-18-5 "C" Box Attenuator (optional)

5.1 Introduction
The 401-18-5 "C" Box Attenuator is a plug-in option to the 401-6-8 Capacitance Unit ("C" Box). It is added to the 401-6-8 in order to lower the capacitance range by a factor of approx. 100.

With the attenuator in place, the effective range of the "C" Box is 0.25 pF to 45 pF. The attenuator is called for when either the zero capacity is very low, or the material being measured produces a very small change in capacitance. Usually the two effects occur together, as when the sensing element is very short. See Figure 11-8 in the center of this book following Section III for a graph of precise readings.

Note: The attenuator must only be used with the electronic units that provide Cote-Shield™ voltage for shielding the cable and the probe. Do not use with Drexelbrook electronic units 408-1000, 408-4000, EC-1000, EC-2000, EC-3000.

5.2 Installation
The Drexelbrook 408-18-5 "C" Box Attenuator plugs into the CW and SH terminals of the 401-6-8 Capacitance Unit as shown in Figure 11-9. The "C" Box CW and SH terminals must be tightly screwed in place before mounting the attenuator.

![Diagram of 401-18-5 Attenuator Attached to "C" Box](image-url)

Remove the attenuator cover shield to attach the coaxial cable center wire to the attenuator CW terminal. See Figure 11-10. Next, connect the cable ground wire (gnd) to the ground terminal on the "C" Box. See Figure 11-10. Finally, replace the cover shield and connect the coaxial cable shield wire to the screw on the top of the cover shield. Connect the other end of the coaxial cable to the appropriate CW, SH, and gnd terminals of the unit.
5.3 Operation

Now that the 401-18-5 "C" Box Attenuator is in place, the "C" Box is ready for measuring very low changes in capacitance.

The effect of the attenuator is to make the "C" Box slightly non-linear. To convert from a "C" Box setting to the effective capacitance value, use the graph in Figure II-8. (Center of this book following Section III.) Note that this graph has two curves. The dotted curve applies when the "C" Box range switch is in the LOW position. The solid curve applies when the range switch is in the NORM position. In the LOW range, the "C" Box setting is provided only by the vernier dial setting and the thumbwheel switches have no effect. In the NORM range, the "C" Box setting is provided by the sum of the vernier dial and the thumbwheel switch settings.

Refer to sections 3.0, 4.0 and 5.0 for operating and calibrating instructions for the 401-6-8 Capacitance Unit ("C" Box).
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INSTALLATION AND OPERATION INSTRUCTIONS
for
401-18-2
METER CALIBRATION UNIT
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401-18-2
Meter Calibration Unit

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   3.5 Volts function
   3.6 Current generator function
1.0 Introduction

1.1 Description

The 401-18-2 Meter Calibration Unit is a multifunction calibration aid specifically designed for the checkout and calibration of Drexelbrook RF transmitters. The battery powered unit provides 5 test functions, in addition to a battery self-test function. These capabilities make it easy and convenient to field check Drexelbrook and other process instrumentation loops.

Use of the 401-18-2 centers around the multi-scale meter. The specific function being used is selected by depressing one of the interlocked function selector buttons. See Figure III-1. The factor being tested is then read on the appropriate meter scale. The self contained batteries and fuse can be replaced by sliding off the bottom of the cover on the unit.
1.2 Specifications
A. Milliammeter only: dual range, 0-20 mA or 0-50 mA with 0-100% scale for instrument signal currents.
B. Battery power: 27 Volt, in series with the dual range meter.
C. Ohms: range 0-100,000Ω
D. Volts: 10-100 Vdc
E. Current Generator: dual range 0-20 mA and 0-50 mA delivered to a load having a maximum voltage drop of 18.5V.

2.0 Installation
When used with the Drexelbrook 401-18-20 Series Portable Calibration System, the Meter Calibration Unit is mounted in the right hand side of the carrying case. There is nothing to install, the system is completely portable. See Figure III-2.

Fig. III-2
Portable Calibration System with 401-18-2 Meter Unit
3.0 Operation

3.1 OFF Function

The OFF button opens the circuit to the unit output terminals. With the OFF button depressed, the internal battery can be checked by throwing the BATT TEST toggle switch either left or right. See Figure III-3. A satisfactory battery is indicated by the meter needle moving past the BATT GOOD line located above the 90% scale point. When the meter indication falls below this point, the batteries should be replaced. Always return the switch to the OFF position when not in use to avoid excessive battery drain.
3.2 METER ONLY Function

The METER ONLY button connects the meter directly to the output terminals. The full scale meter range of 0-20 mA or 0-50 mA is selected by the meter range switch, located directly above the BATT TEST switch. See Figure 111-4. For this function, the meter may be read on either the percent, 20 mA, or the 50 mA scale. The percent scale corresponds to the standard instrument output range (4-20 mA or 10-50 mA). In this function, the connections from the meter to the current loop must be made in series. Be sure to observe proper polarity.

Fig. III-4
3.3 BATTERY POWER Function

The BATT POWER button connects the meter, in series with the internal 27 volt battery, to the output terminals. The meter range is selected by the meter range switch (4-20 mA or 10-50 mA). This connection permits the Meter Unit to power an instrument and, at the same time, monitor the amount of current drawn by the instrument. See Figure 1115.

The BATT POWER mode is particularly useful for checking a two-wire transmitter. To do this, connect the meter in the field to the transmitter output terminals in place of the signal wires and power supply. This check will pinpoint a fault in the transmitter, or in the signal wire/power supply hook-up. Check with the instrument instruction manual for troubleshooting instructions.

![Fig. III-5]
3.4 OHMS Function

The OHMS function measures, on the Ω scale, the resistance in ohms between the terminals of the Meter Unit. See Figure 111-6.

The OHMS function must be zeroed by shorting together the (+) and (−) terminals and rotating the CURR GEN control to produce a zero ohms reading on the meter. With the OHMS function zeroed, remove the terminal short, and the meter is ready to read ohms. The range toggle switch has no effect on the ohms reading.

The OHMS function is useful in verifying the integrity of a sensing element. With the sensing element cable disconnected, measurements between the sensing element center wire (CW) terminal and either the ground (gnd) or shield (SH) terminal should provide resistance readings. Minimum tolerable resistance values are indicated in the instruction manual for the system being tested. Other uses include measuring loop resistances. See troubleshooting, Section V.
3.5 VOLTS Function
The VOLTS function provides a dc voltmeter with a full scale range of 100 volts. The volts reading is on the V scale. See Figure 111-7. The range toggle switch has no effect on the voltmeter reading.

The VOLTS function is useful, when checking out a transmitter system, for verifying that the dc voltage applied to the transmitter lies within acceptable limits. This function will not measure ac volts.

Fig. III-7
8.6 CURRENT GENERATOR Function

The CURR GEN function provides a constant current for a resistive load. This current may be adjusted over the range of 0 to 50 mA by the CURR GEN control knob. See Figure III-8. The generator will deliver a constant current into the attached load, as long as the resistance of the load is not too large. For a 20 mA loop, the resistance should not exceed 1,100 ohms. For a 50 mA loop, the resistance should not exceed 440 ohms.

The CURR GEN function is useful for calibrating indicators, or setting the relays on setpoint control units or other current alarms. The current generator is set to the desired current as indicated in the meter, and then the relay is adjusted to switch at that current.

Fig. III-8
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INSTALLATION AND OPERATION INSTRUCTIONS
FOR
401-18-7
K and G MATERIAL TESTER
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K and G Material Tester

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   3.1 Location
   3.2 Wiring/Connections

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1.0 Introduction

1.1 Description

The instructions in this section are for the Drexelbrook model 401-18-7 Material Tester.

The Material Tester was designed for use with the Drexelbrook Model 401-18-20 Series Portable Calibration System to provide a field useable material tester for dielectric constant (K) and/or conductivity (g). See Figure IV-1. The Material Tester allows a user to test the electrical characteristics of a material under actual process conditions.

The Material Tester comes with two test probes. The probes, or test cells, allow for measurements in several ranges of conductivity and dielectric constant. These probes are supplied with 5 foot long, three-terminal cables for connecting them to the unit.

In addition, the Material Tester can give an mA output proportional to any pure capacitance. It can be used to measure a probe’s gland capacitance or air capacitance in an empty vessel.

---

**Fig. IV-1**
401-18-6 “K and G” Material Tester
1.2 Models Available

Although designed for use with the Portable Calibration System, the Material Tester can be used by itself in conjunction with a 4-20 mA analog meter and a constant voltage dc power supply within the range of 23 to 50 Vdc.

The model number for the Material Tester electronic unit is 401-18-6. The model numbers of the testing systems available are as follows:

401-18-6: K & G Tester - basic electronics only
401-18-7: 401-18-6 with probes 700-3-43, 700-3-44
401-18-8: 401-18-6 in individual box
401-18-9: 401-18-7 in individual box
401-18-21: K & G Tester w/probes, meter, C-Box in case
401-18-22: K & G Tester w/probes, meter in case

1.3 Operating Conditions

1.3.1 Electrical

A. Operating Voltage Required: Min. 23 Vdc, Max 50 Vdc 
Nominal 24 Volts dc 25 mA required.
B. Effect of Supply Voltage Variation: 2.0% (0.32 mA) max within voltage limits
C. Output: 4-20 mA current from voltage source
D. Linearity: ±0.5% (.08 mA) over output current range
E. Maximum Output Loop Resistance: 550Ω total at 24 Vdc supply
F. Effect of Loop Resistance: 0.2% max for full resistance range
G. Response to Step Change: 20 milliseconds (to 90% of final value)

H. Range: K = 1-100, g = 1-100,000 μmhos, and capacitance = 0-1000 pF

1.3.2 Environmental

A. Storage Temperature: -40°F (-40°C) to 160°F (72°C)
B. Recommended Ambient Operating Temperature: 0°F (-18°C) to 140°F (60°C)
C. Effect of Temperature Variation: ±0.5% (.08 mA) per 30°F, over operating temp range

2.0 Theory of Operation

The Drexelbrook Dielectric Constant/Conductivity Tester (K and G Tester) operates at a frequency of 100KHz. It is designed to operate with two probes or test cells. When the cells (probes) are inserted into the test material, the K and G Tester will electronically analyze the material's
characteristics. The resulting output signal can be read on a 4-20 mA meter calibrated for 0-100.

No material is completely conductive or insulating. The Drexelbrook tester can measure both conductivity and dielectric constant separately. The K and G Tester can analyze any unknown material within its range, if the following conditions are met:

A) The test material must be compatible with the 316 stainless steel and teflon parts of the probe that will be in contact with the material.
B) No interface should occur within the probe cell. Each phase of an interface must be tested separately.
C) The viscosity of the material must allow an even flow into the probe. No granulars or thick slurries can be tested.

8.0 Installation

3.1 Location

When used with the Drexelbrook 401-18-20 Series Portable Calibration System, the Material Tester is mounted in the center compartment. See Figure IV-2.
3.2 Wiring/Connections

Refer to Figure IV-3 when using the Material Tester with the 401-18-20 Series Portable Calibration System. Using the cable supplied, connect the cable between the signal (+) and (-) terminals of the Material Tester, and the (+) and (-) terminals of the Meter Calibration Unit. See Meter Calibration Unit for “Batt. Power” and “4-20” range, Section III.

Fig. IV-3
Wiring Tester to Meter Unit

If using the Material Tester by itself, refer to Figure IV-4 for the proper wiring connections.
When measuring a material's dielectric constant or conductivity, the appropriate test probe will be connected to the center wire (CW), shield (SH), and ground (gnd) terminals as per Figure IV-5.
When measuring capacitance, the cable from the sensing element will be connected to the CW, SH and gnd terminals, with the 401-6-8 Capacitance Calibration Unit connected in parallel as shown in Figure IV-6.

Fig. IV-6
Sensing Element
Cable Connections
4.0 Operation

4.1 Initial Calibration

4.1.1 Electronics

Connect the tester to the meter and Probe A as shown in Figures IV-3 or IV-4, and IV-5, Section 3.2. Apply the required power to the tester at the signal terminals by switching the meter calibration unit to the "Batt Power" position. Turn the FUNCTION SELECT switch on the tester to the "Calib Test" position. See Figure IV-7. The meter reading should be 100%. If it reads between 95-105%, recalibrate by removing the "CALIB ADJ" cap plug and adjusting the potentiometer beneath it with a screwdriver until the output reads exactly 100%. See Figure IV-7. Replace the cap plug after this adjustment. If the meter is pinned (110%), shows no reading at all, or the adjustment of the "CALIB ADJ" potentiometer has no effect, recheck the wiring and power as described in Section 3.2. If the problem still persists, consult factory service department for assistance.

![Function Select Switch Diagram]

Fig. IV-7
Material Tester Contrac's
4.1.2 Probe A
After the 100% adjustment is complete, check Probe A air calibration by turning the FUNCTION SELECT switch to the 1-10 range for dielectric constant measurements. The meter should read 10% for a dielectric constant of “1” (air). If the meter indicates more than “1”, check to be sure there is no material in the probe and then proceed to adjust the probe as follows. Remove the cover on Probe A. This is done by loosening the two round head screws on top until the cover lifts off. See Figure IV-8.

**Fig. IV-8**
**700-3-43**
**Test Probe A**
(Note: Neither screw has to be removed completely from the cover to gain access.) With the tester still powered and Probe A connected, adjust the variable capacitor in the body of Probe A with a screwdriver until a reading of 10% is achieved. If the adjustment cannot be made, make sure that the probe is wired per Figure IV-8 and that the insertion end and body compartment are free from any foreign material. If the adjustment still cannot be made, consult factory for assistance.

After the 10% adjustment has been made, replace the cover on the body of Probe A and tighten the two hold-down screws. For proper weathertight fit, make sure the gasket is seated in between the cover and body all the way around.

**Caution:** The flat head screws on the bottom of the body should not be tampered with; nor should any probe fittings or parts be loosened except as provided for in the cleaning and maintenance section. Slight changes in positioning of these parts could affect the probe's accuracy.

Once these adjustments have been made, it is not normally necessary to readjust them unless prolonged storage is common, or different units and probe sets are interchanged. However, a calibration test is easy and should be done periodically. See Section 4.1.

The tester is now ready to use.

### 4.2 Testing the Unknown Material

**Note:** Be sure to follow all necessary safety precautions for handling each material being tested. Minimum protection for hazardous materials should include goggles and gloves. Other hazards such as toxic fumes and flammables should also be considered.

Obtain a sample of the material in question. Place the sample in a container with minimum dimensions of 5 inches high with a 1 inch diameter. The container's composition is not important as long as it does not affect the characteristics of the sample.

If the test material is probably highly conductive, over 100 \( \mu \text{mhos/cm} \), proceed to Section 4.2.2. If the conductivity of the material is less than 100 \( \mu \text{mhos/cm} \), or if there is any doubt of the material's characteristics, then proceed as follows. For best results, attempt to duplicate the actual process conditions (i.e., temperature and composition).

**Note:** Always thoroughly clean the test cell (probe) immediately after each test. Test cell contamination can seriously affect your next measurement. See Section 5.0.
4.2.1 Low Conductivity Measurements

Low conductivity measurements should always be made first. Use Probe A and the low conductivity (g) scale. See Figure IV-7. The tester should be connected to the power and meter per instructions in Section 3.2.

Connect Probe A to the tester terminal strip as in Figure IV-5. Check the calibration as required. Refer to Section 4.1. Set the FUNCTION SELECT switch to the 0-100 \( \mu \text{mho/cm} \) range. See figure IV-7. Put the insertion end of Probe A into the test material up to, but not over, the body fitting. See Figure IV-8.

If the reading is above 100% on the 0-100 range, disconnect Probe A from the tester. Connect the high conductivity Probe B to the tester, and proceed to Section 4.2.2.

If the reading is between 0-100%, the meter reading corresponds directly with conductivity. (Ex: Reading = 25% conductivity = 25 \( \mu \text{mho/cm} \).

If the reading is less than 10%, change the FUNCTION SELECT switch to the 0-10 \( \mu \text{mho/cm} \) range, leaving the probe connected to the tester and submerged in the sample material. If the reading is now between 0-100%, multiply this value by .10 to obtain the conductivity and record it on the material test sheet in Section 6.0. (Ex: Reading = 25%, conductivity = 25 \( \times .1 = 2.5 \mu \text{mho/cm} \)).

If the reading is still less than 10%, switch to the 0-1 \( \mu \text{mho/cm} \) range and multiply the reading by .01 to obtain the conductivity. (Ex: Reading = 25%, conductivity = 25 \( \times .01 = .25 \mu \text{mho/cm} \)).

Record this information on the material test log in Section 6.0. A material with a conductivity of less than 1.0 \( \mu \text{mho/cm} \) means that the conductance is small enough to make an accurate dielectric constant (K) measurement. If so, go to Section 4.2.3.

4.2.2 High Conductivity Measurements

High conductivity measurements should be made when either the material being tested is already known to have a conductivity greater than 100 \( \mu \text{mho/cm} \), or the first step in the low conductivity measurement (4.2.1) produced a reading above 100%. Use Probe B and the conductivity (g) scale. See Figure IV-7.

The tester should be connected to the power and meter per instructions in Section 3.2. (Power connections are the same as for low conductivity measurements). Connect Probe B to the tester terminal strip as in Figure IV-5. Check the calibration as required. Refer to Section 4.1.1.

Note: There is no internal adjustment in Probe B. The meter should read approximately 0% when the probe contains only air. The probe should be clean before use. Refer to Section 5.0.
Set the FUNCTION SELECT switch to the 0-1K range (max counterclockwise position). See Figure IV-7. Submerge the insertion end of Probe B into the test material up to, but not over, the body fitting. See Figure IV-9.

Unlike the gradual increase in reading when Probe A is used, it is normal for the reading to "jump" to a certain value and change very little with further insertion, when Probe B is used. If the reading is between 0-100%, multiply this value by 10 to obtain the conductivity. (Ex: Reading = 25%, then 25 x 10 = 250 μmho/cm).
4.2.3 Dielectric Constant Measurements

*Note:* Dielectric constant measurements can only be made on materials that have a conductivity of less than 1 $\mu$mho/cm, as tested in Section 4.2.1.

The tester should be connected to the power and the meter per instructions in Section 3.2. Use Probe A and the K scale. The power connections are the same as for low conductivity measurements. Connect Probe A to the tester as in Figure IV-5. Check the calibration as required. Refer to Section 4.1.1. Set the FUNCTION SELECT switch to 1-10 range. See Figure IV-7. The meter should read 10% in air since the dielectric constant of air = 1. Submerge the insertion end of Probe A into the test material up to, but not over, the body fittings. See Figure IV-8.

If the reading is between 10-100%, multiply this value by .1 to obtain the dielectric constant. (Ex: Reading = 25%, then 25 x .1 = "K" of 2.5; K = dielectric constant.) If the reading is greater than 100%, change the FUNCTION SELECT switch to the 10-100 range, leaving the probe connected to the tester and submerged in the sample material. If the reading is now between 10-100%, the meter reading corresponds directly to the dielectric constant of the material. (Ex: Reading = 25%, or K of 25).
4.3 **Capacitance Measurements**

As an added feature, the 401-18-6 tester electronics can be used to measure direct capacitance, such as the gland or air capacitance in Drexelbrook 700 Series sensing elements. Use the direct capacitance scale. See Figure IV-7.

Neither Probe A nor Probe B are used in making direct capacitance measurements, and neither should be connected to the tester’s terminal strip. A variable precision capacitor ("C" Box) is required to make a preliminary zero adjustment. The Drexelbrook 401-6-8 Capacitance Unit is recommended, but any "C" Box with a minimum capacity range of 30 pF to 50 pF is acceptable. When the 401-6-8 unit is available, the 3-terminal cable (P/N 380-06-501) supplied with it should be used. Refer to the wiring instructions, Section 3.2. The factory should be consulted if other than Drexelbrook 3-terminal cable is used.

Connect the tester to the power and meter per instructions in Section 3.2. Set the FUNCTION SELECT switch to the 0-100 pF range. The meter should indicate below 0%. Connect the tester to the "C" Box via the cable as shown in Figure IV-6. Adjust the "C" Box until the meter reads 0%.

Connect the cable from the sensing element, in parallel with the "C" Box cable, to the terminal strip of the tester. See Figure IV-6. The meter should always swing up scale. This reading corresponds directly to the capacitance. (Ex: Reading of 25% = 25 pF.)

If the meter reading is greater than 100%, change the position of the FUNCTION SELECT switch of the 0-1000 pF range. Rezeroing of the tester is not necessary. The test is now set up for 0-1000 pF indication. so the reading multiplied by 10 is the actual capacitance. (Ex: Reading of 25%, 25 x 10 = 250 pF).

If the meter reading is still greater than 100%, see the level transmitter instruction manual for proper sensing element/cable troubleshooting procedures.

Direct capacitance scales are intended for sensing element capacitance tests when there is no material on the sensing element. Due to the variety of probes (sensing elements) and electronics available, consult the factory before attempting to use the tester in any other fashion (i.e., with material on sensing element).

5.0 **Maintenance**

The only parts of the tester that normally require routine maintenance are the test probes. The bulk of this section refers to their inspection, cleaning, and testing. If splashing occurs and the tester electronics come in contact with the test material, clean it off immediately using soap or a solvent as required.
5.1 Cleaning Probe A

Probe A should be cleaned after each individual test. This prevents contamination of subsequent samples and provides for more accurate test results. The amount of cleaning required depends on the material being tested. Thin, waterlike materials usually require only a light cleaning, while thick viscous materials will require a thorough cleaning.

A light cleaning means simply dunking the insertion end of Probe A into a cleaning solvent until the inner cell is clean, and then shaking it dry. For a thorough cleaning, unscrew the outer shell from the insertion end of Probe A. See Figure IV-8. Using a cleaning solvent, run the 1/2" tube brush supplied (P/N 290-1-31) through the outer shell until it is clean. Bleed holes should be clear. Use a cloth to scrub the center rod and teflon plug at the base of the rod until clean. Reassemble, then check that the center rod is still in the center of the outer shell and flush with the end of that shell.

The body of Probe A should periodically be opened and checked for contaminants. See Figure IV-8. If necessary, use a solvent and stiff brush to clean the compartment. Let it dry thoroughly before closing the cover. For weatherproof protection, the gasket should fit between the cover and case lip all the way around.

5.2 Cleaning Probe B

Probe B should also be cleaned after each individual test. This prevents contamination of subsequent samples and provides for more accurate test results. As for Probe A, the amount of cleaning required for Probe B depends on the material being tested.

A light cleaning means simply dunking the insertion end of Probe B into cleaning solvent repeatedly until it appears clear, then shaking it dry. If a more thorough cleaning is required, run the 3/16" tube brush supplied (P/N 290-1-30) from the back end through the entire length of the probe and out the insertion end. See Figure IV-9. Repeat this until clean. Do not submerge the entire probe. Clean the outside with a cloth.

The body of Probe B should be periodically opened and checked for contaminants. See Figure IV-9. If necessary, use a solvent and stiff brush to clean the compartment. Let it dry thoroughly before closing the cover. Again, the gasket should fit between the cover and case lip all the way around.

5.3 Testing the Probes

Both Probe A and Probe B should be tested for accuracy on a periodic basis. The "Calib test" position checks the accuracy of the electronics only, not the probes. Probe accuracy may be affected by material residue inside the probe due to incomplete cleaning, or change in dimension(s) caused by jarring or dropping.
Prior to testing the probes, confirm that both probes are thoroughly clean both inside the insertion end and inside the body compartment, and that Probe A has been properly calibrated per Section 4.1.

Obtain small quantities of standard test liquids. For Probe A testing, carbon tetrachloride is recommended \( (K = 2.228) \). For Probe B testing, a standard solution with a known conductivity between 30-70 \( \mu \text{mhos} \) is recommended. With the tester calibrated, insert the probe into the testing liquid. Change the FUNCTION SELECT switch to the proper range and make a reading. Readings should be \( \pm 10\% \) of the liquid's value. Note: Other standard liquids can be substituted, provided their "K" or "g" values are known.

Each probe is tested prior to shipment. Contact the factory if probe(s) are out of tolerance.

5.4 Probe Cable Replacement

If either cable is found to be defective, the following instructions can be used for cable replacement.

A. First, unscrew the outer cable fitting completely. Slide the fitting down the cable along with the beveled washer and grommet. See Figures IV-8 and IV-9.
B. Remove the cover of the probe and unscrew the center wire (CW) and ground (gnd) connections inside the probe.
C. Pull the cable out of the probe body through the fitting.
D. Using the proper replacement cable (P/N 380-5-12), clip the shield (SH) wire off where it exits the blue heat shrink at the probe end only. The shield wire must be attached at the electronics end.
E. At the probe connection end, slide the outer cable fitting over the new cable together with the beveled washer and grommet.
F. Push the end of the cable through the probe body fitting connecting the CW and gnd wires as shown on Figures IV-8 and IV-9.
G. Slide the grommet, washer, and fitting up to the probe body making sure the grommet is seated in the body fitting.
H. Finally, tighten the outer fitting until it is secure, making sure that the cable wires in the probe do not twist.
I. Replace the probe cover.
6.0 Material Test Log

6.1 Introduction

The material test log sheet can be used for recording test material characteristics obtained by using the Drexelbrook 401-18-7 K and G Tester. The recorded results can be used to specify new equipment or evaluate calibration problems with existing equipment, should they occur.

The following table is a review of the correct multiples for each scale/reading. See Figure IV-10.

<table>
<thead>
<tr>
<th>SCALE</th>
<th>MULTIPLE x READING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1 umho/cm</td>
<td>.01 x %</td>
</tr>
<tr>
<td>0-10 umho/cm</td>
<td>.1 x %</td>
</tr>
<tr>
<td>0-100 umho/cm</td>
<td>1 x %</td>
</tr>
<tr>
<td>0-1K umho/cm</td>
<td>10 x %</td>
</tr>
<tr>
<td>0-10K umho/cm</td>
<td>100 x %</td>
</tr>
<tr>
<td>0-100K umho/cm</td>
<td>1000 x %</td>
</tr>
<tr>
<td>1-10 K</td>
<td>.1 x %</td>
</tr>
<tr>
<td>1-100 K</td>
<td>1 x %</td>
</tr>
<tr>
<td>0-100 pF</td>
<td>1 x %</td>
</tr>
<tr>
<td>0-1000 pF</td>
<td>10 x %</td>
</tr>
</tbody>
</table>

Fig. IV-10
Scale/Reading Multiples
Material Test Log

<table>
<thead>
<tr>
<th>TANK/BATCH</th>
<th>TEST PROBE (A OR B)</th>
<th>&quot;K&quot; OR &quot;G&quot; SCALE</th>
<th>&quot;K&quot; OR &quot;G&quot; READING</th>
<th>TESTER</th>
<th>MAT'L</th>
<th>TEMP</th>
<th>RESULT</th>
<th>MAT'L</th>
</tr>
</thead>
</table>

6.2 Log Sheet
When using the tester with an mA readout meter, see Figure IV-11 for conversion graph of 4-20 mA to percentage readings.

**Fig. IV-11**
Graph Conversion
4-20 mA dc to 0-100%
Section V

TYPICAL TROUBLESHOOTING PROCEDURES for DREXELBROOK LEVEL CONTROLS
Section V

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   2.3 Checking the Sensing Element
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5.0 Spare Parts
Troubleshooting Procedures

1.0 Introduction

The following procedures should make troubleshooting your Drexelbrook equipment as easy as possible, using a minimum of time and equipment. These procedures are typical and may vary slightly from the actual procedure recommended. For the exact troubleshooting methods for your system, consult the instrument instruction manual.

If there is a problem with your measurement system, divide the system into its component parts. Then, by using the appropriate instructions in this section, you can check each component individually for proper operation or function.

2.0 On/Off Troubleshooting

Note: These are examples of typical procedures. Consult the instruction manual for your instrument for exact procedure.

2.1 Testing the Electronics (ac powered)

A. Disconnect the connecting cable at the center wire (CW), Cote-Shield (SH), and ground (gnd) terminals as shown in Figure V-1. Leave the power connected.

![Fig. V-1: ac Powered Electronic Unit](image)
B. Starting with the adjustment in the extreme counterclockwise position, turn the insulated tuning wrench clockwise until the relay operates. (Adjust only with insulated tool supplied.) Note: Do not turn the adjustment past its stops. This can cause damage.

C. Rotate the adjustment back and forth about this point, observing the travel of the pointer between relay pull-in and relay drop-out. The pointer should travel less than 1/8 turn to operate the relay. If so, the instrument is working properly.

2.2 Two-Wire, Three-Terminal On/Off Electronics

Before testing a two-wire on/off system, mentally divide the system into two sections, transmitter electronics and receiver electronics. See Figure V-2.

![Figure V-2](image)

**Fig. V-2**

Two-Wire Point Level System
2.2.1 Two-Wire Transmitter

A. Remove the sensing element cable and the two signal wires.

B. Connect the power supply and meter or calibration system as shown in Figure V-3.

C. Starting from the full counterclockwise position of the operating point adjustment, start turning clockwise until the LED indicator changes state.

D. The meter should indicate 10 mA ± 1 mA with the LED unlit, and 20 mA ± 2 mA with the LED lit.

E. The rotation of the adjustment should be approximately \( \frac{1}{8} \) turn between LED ON and LED OFF.

If the above procedure checks okay, proceed to the receiver check.

Fig. V-3
Two-Wire Transmitter
2.2.2 Two-Wire Receiver System

A. With all loops connected normally, look at all the LED indicator lights on the receiver package. Status monitor LED, if present, should be in 'normal'. All receiver LEDs should indicate 'hi' or 'lo' with all 'status' LEDs extinguished. If LEDs are correct, go to Step B; if not, go to Step D.

B. Remove a (+) input wire from any input on the customer connection block. The 'status' LED for that unit should light. Also the status monitor LED should read 'fault'. If the 'status' LED and the 'fault' LED do not light, momentarily add a jumper from the yellow wire to the green wire on the status monitor unit. The 'fault' LED should light. If not, replace the status monitor. If the 'fault' LED lights, check for broken or disconnected yellow wires. If the yellow wires are okay, replace the receiver. Repeat Step B for all loops.

C. Connect a current source, or calibration system as shown in Figure V-4, in place of any transmitter. Adjust the current source from 0-20 mA while observing the meter. Check the LED indicator operation against the diagram in Figure V-5. If okay, check each remaining level alarm. If not okay, replace that level alarm module.

---

**Fig. V-4**

**Two-Wire Receiver**
D. Check the power supply. First, measure the voltage across the red to blue wires; it should be between 18 & 30 Vdc. Next, measure the voltage across the red to green wires; it should be between 22 & 26 Vdc. With the voltmeter across the red and green wires, there should be no change in voltage when any receiver input (+) terminal is shorted to ground (green wire).

This completes testing of the receiver system.
2.3 Checking the Sensing Element

USE ANALOG OHMMETER ONLY!

<table>
<thead>
<tr>
<th>MINIMUM RESISTANCE</th>
<th>406–6000</th>
<th>406–1000</th>
<th>407–1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROBE TO GROUND</td>
<td>1K</td>
<td></td>
<td>20K</td>
</tr>
<tr>
<td>PROBE TO SHIELD</td>
<td>600</td>
<td></td>
<td>12K</td>
</tr>
<tr>
<td>SHIELD TO GROUND</td>
<td>300</td>
<td></td>
<td>7K</td>
</tr>
</tbody>
</table>

NOTE: THESE ARE APPROXIMATE MINIMUM VALUES. CONSULT FACTORY SERVICE DEPARTMENT WITH THE ACTUAL VALUES YOU MEASURE.

Fig. V-6
2.4 Checking the Sensing Element Cable

1. DISCONNECT CABLE AT BOTH ENDS, BE SURE ALL TERMINALS ARE CLEAR.

2. MEASURE RESISTANCE FROM CENTER WIRE TO COTE-SHIELD. RESISTANCE SHOULD BE INFINITY (OPEN CIRCUIT).

3. SHORT PROBE AND COTE-SHIELD TERMINALS TOGETHER AT ONE END.

4. MEASURE RESISTANCE FROM PROBE TO COTE-SHIELD TERMINALS AT OTHER END. RESISTANCE SHOULD BE NEAR ZERO OHMS (SHORT CIRCUIT).

5. REPEAT STEP 2 FOR COTE-SHIELD AND GROUND TERMINALS

6. SHORT COTE-SHIELD AND GROUND TERMINALS AT ONE END.

Fig. V-7

REPEAT STEP 4 FOR COTE-SHIELD AND GROUND TERMINALS
2.5 **Testing the Relay Circuit**

The relay circuit consists of one set or more of single-pole, double-throw contacts brought out to a terminal strip. When the instrument is properly adjusted, one pair of contacts will be open with high or low level, and one pair closed with high or low level.

Relay operation may generally be heard as an audible click when the background noise is not too high. Relay operation may also be determined with one of the circuits shown. See Figure V-8.

**Fig. V-8**

Relay Circuit

Tune the instrument as described in the instrument checkout procedure. Use one of the methods shown to determine if relay contacts are switching. See Figure V-9.

Difficulty in calibration can often be traced to improper wiring of the relay terminals to an annunciator or other panel device. Check the wiring against the wiring diagram in the instruction manual.

BE SURE TO USE DIAGRAM FOR THE FAIL-SAFE IN WHICH THE INSTRUMENT IS CONNECTED.
3.0 Continuous **Troubleshooting**

*Note*: These are examples of typical procedures. Consult the instruction manual for your instrument for exact procedure.

3.1 Checking the **Electronics**

3.1.1 **Operation** Check

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

B. With pencil, mark the positions of all controls on the faceplate, in order to return to them. See Figure V-10.
Section V

C. Put the STEP SPAN in Position 1 and the FINE SPAN in the full clockwise position. Put the STEP ZERO in Position 1 (most sensitive position).

D. Observing polarities, connect a dc milliammeter and dc power supply (13 to 100 volts) in series to Terminals 1 & 2. See Figure V-11.

E. Adjust the FINE ZERO until the meter reads 0\% (4 mA).

F. Turn the FINE ZERO one clockwise turn further. The output should read between 40\% and 70\% (10-15 mA). If so, instrument is probably working correctly. (Each turn of the FINE ZERO changes the input a known amount.) This checks the operation and gain of the transmitter.

G. If the difficulty has not been located at this point, proceed to the output loop checkout procedure.

3.1.2 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 sensing element. (A properly connected cable never drifts.)
A. Remove the sensing element cable from the transmitter.

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

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 problem is drift.

3.2 Checking the Loop

A. With a capacitance standard, or by following the instrument checkout procedure, adjust the transmitter output until 20 mA flows. If it is not possible to get 20 mA, then measure the voltage across the transmitter output. If there is less than the minimum required (13 volts), the loop has too much resistance, or not enough power supply voltage. See Figure V-12 on the next page.

B. If, in Step A above, the voltage is not between 13 and 100 Vdc, disconnect the power supply leads at the power supply and at the unit. Next, short the wires that went to the power supply (+) and (-) terminals.

C. Measure the resistance between the two wires that were just connected to Terminals 1 and 2 of the transmitter. Figure V-13 illustrates when the resistance is too great.

**Fig. V-13**
Loop Resistance

<table>
<thead>
<tr>
<th>LOOP RESISTANCE IN OHMS</th>
<th>POWER SUPPLY VDC (OPEN LOOP VOLTAGE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>40</td>
<td>3</td>
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<td>50</td>
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<td>70</td>
<td>6</td>
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<tr>
<td>80</td>
<td>7</td>
</tr>
<tr>
<td>90</td>
<td>8</td>
</tr>
<tr>
<td>100</td>
<td>9</td>
</tr>
</tbody>
</table>

BAD (RESISTANCE TOO HIGH)
RESISTANCE LOW ENOUGH
Fig. V-12
Typical Loop

MAKE SURE THERE IS NO MORE THAN (1) GROUND PER LOOP

NONHAZARDOUS
HAZARDOUS
TYPICAL CIRCUIT
INTRINSIC
SAFETY BARRIERS
SETCON
METER
LOAD
POWER SUPPLY
3.3 Checking the Sensing Element

A. Check the resistance of the sensing element to ground with level below the probe (Figure V-14).

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

![Diagram of checking resistance](image)

**Fig. V-14**
**Level Below Probe**

B. Check the resistance of the sensing element to ground with level above the probe (Figure V-15). Resistance readings less than 1 megohm indicate either defects in the probe insulation or, if a bare rod, that the material is conductive and the operate point is at the tip of the sensing element.

C. If the instrument indicates high level all the time, even when level is below the probe, it may be due to a conductive coating on the sensing element. The application may require a Cote-Shield instrument and/or sensing element.
To verify the affect of the coating, wipe the coating off the sensing element and recheck the instrument operation. If the instrument reads low level after the cleaning, consult the factory for the best solution to the problem.
3.4 Checking the Sensing Element Cable

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.
4.0 Factory and Field Service Assistance

4.1 Telephone Assistance

If you are experiencing difficulty with your Drexelbrook equipment and attempts to solve that difficulty have failed, notify your local Drexelbrook representative or call the factory direct and ask for the service department. Drexelbrook Engineering Co. 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 __________________________

4.2 Equipment Return

Do not return equipment without first contacting the factory for a return authorization number. Any equipment being returned should include the following information in addition to that above:

Reason for return __________________________________________
Original P.O. # __________________________________________
Return Authorization # ______________________________________
Drexelbrook order # (if available) __________________________
Person to contact at your company __________________________
"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 the instrument is covered under warranty. Please return your equipment with freight charges prepaid. We regret that we cannot accept collect shipments.

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

4.3 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.

4.4 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 practice of instrument operation. For more information about these valuable workshops, write to Drexelbrook Engineering, attn: Communications/Training Group, or call direct (215) 674-1234.

5.0 Spare Parts
The following is a list of parts for the Drexelbrook 401-18-20 Series Portable Calibration System:

Case assembly: 401-18-3
Meter assembly: 401-18-4
"C" Box assembly: 401-6-10
K-G Material Tester Assembly: 401-18-6
Probe A/with cable: 700-3-43
Probe B/with cable: 700-3-44
Cable for Probe A or B: 380-5-12
2 foot signal cable: 380-02-502
2 foot calibration cable (2-terminal): 380-02-503
6 foot calibration cable (3-terminal): 380-06-501

For replacement of any parts not listed, contact Drexelbrook Service Department.