



**Drexelbrook**  
Engineering Company

RF Level and  
Flow Controls

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# Installation & Operating Instructions

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**OPERATING INSTRUCTIONS**

**303-9000-104**

**CAR LOADING ON/OFF CONTROL SYSTEM**

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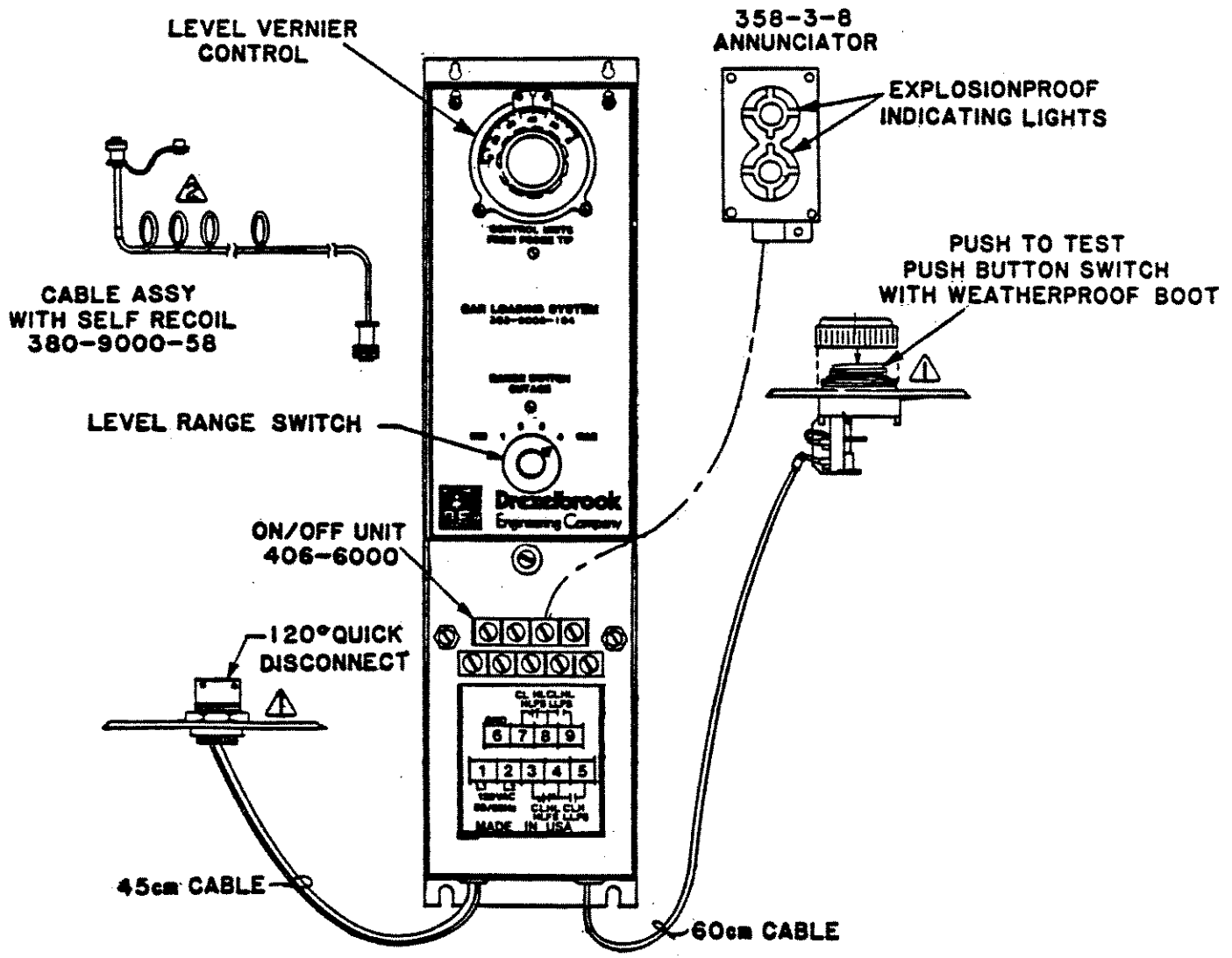


FIGURE 1. CAR LOADING ON/OFF SYSTEM

## 1.0 INTRODUCTION

### 1.1 Purpose and Use

The instructions in this manual pertain to the Drexelbrook 303-9000-104 On/Off Car Loading Level Control System.

Basically, this instrument is a precision electronic capacitance to relay operation transducer that normally is not affected by build up or coating of material on the sensing probe. The instrument will provide relay operation when the material within the tank reaches a pre-set point on the probe.

The required change of input capacitance is provided through the probe which is mounted in or near the material being measured. Drexelbrook 380 series cable transmits the change of capacity signal from the probe to the electronic unit. The Car Loading System seen in Figure 1 consists of an Electronic Unit, Explosion Proof Annunciator, Push to Test Switch, Sensor Cable and Sensor Cable Connector. The Sensors with their integrally mounted connectors are individually mounted on each Tank Car. Proper system operation relies on each Sensor of a Car Fleet being factory adjusted to a common empty (zero) condition.

The Electronic Unit combines a **DREXELBROOK 406-6000 ON/OFF** unit and the Vernier and Range Level Setting Controls. These controls allow the operator to conveniently move the System Trip Point up and down the length of the Sensor. The **ON/OFF** unit contains a DPDT relay which provides two sets of contacts; one set for the Annunciator and a second uncommitted set for customer use.

The Electronic Unit is designed to be mounted within the customer's weather proof housing. The Push to Test Switch and the Sensor Cable Connector are provided as flying components to be rear mounted on customer supplied panels.

The Push to Test Switch provides a self test function. Pushing the test button places a test condition on the probe. This condition simulates at the probe the effect of the material. For an operating system, pushing the test button causes the system to trip to its alarm state. For a properly calibrated system this test will operate satisfactorily only when the probe is connected. The test thus shows a probe fault as well as inoperative electronics.

### 1.2 Electrical Specifications

#### 1.2.1 **Power requirement**

120 VAC  $\pm$  25 VAC 50/60 HZ (6 watts)

#### 1.2.2 **Line Voltage Effect**

$\pm$  .05 pF for  $\pm$  20 VAC change

#### 1.2.3 **Ambient Temperature**

-40° to + 140° F recommended.

The system will operate above 140° F with reduced component life.

- 1.2.4 **Sensitivity**  
0.2 pF or less
- 1.2.5 **Stability**  
0.5 pF./6 mo. max.
- 1.2.6 **Output**  
Relay contact, DPDT 5A 120/230 VAC Non inductive.  
Annunciator - Green/Red Lamps
- 1.2.7 **Operating Time**  
Approximately .02 seconds
- 1.2.8 **Fail Safe**  
Field Switchable, either Low Level Fail Safe (LLFS) or High Level Fail Safe (HLFS).
- 1.2.9 **Measure Cable**  
3 terminal coaxial cable with Quick Disconnect connectors at each end. Standard length is 32 feet including a self recoil section.

## 2.0 **INSTALLATION**

### 2.1 **Unpacking**

Normally the instrument and cable are packed in the same shipping carton; the probe is packed separately.

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

### 2.2 **Location**

The instrument is designed for field mounting within a customer supplied enclosure. For long life and reliable operation it is advantageous that it be mounted in a location as free as possible from vibration, corrosive atmosphere, and any possibility of mechanical damage. Ambient temperatures should be between -40° F and 140° F. For convenience of operation and calibration it is important to locate the instrument at an easily accessed location.

### 2.3 **Mounting**

The electronic system may be mounted on any flat surface either vertically or horizontally. The unit sizes are shown on sheet 1 of drawing 303-9000-104CD1.

## 2.4 Wiring

All customer connections are made to the barrier strip located on the top surface of the 406-6000 On/Off unit. See drawing 303-9000-104-CD1 sheet 2. The barrier strip is accessed by unscrewing the barrier strip cover on the 406-6000 unit.

## 2.5 Cables

The radio frequency signal is carried from the Electronic Unit Box to the probe through a coaxial cable connected with 120° Quick Disconnect connectors. Only coaxial cables supplied by the **DREXELBROOK ENGINEERING COMPANY** should be used.

Care should be taken to avoid twisting the cable relative to the Quick Disconnect connectors. Only the collars on the connectors should be turned to make or break the cable connection.

## 3.0 OPERATION

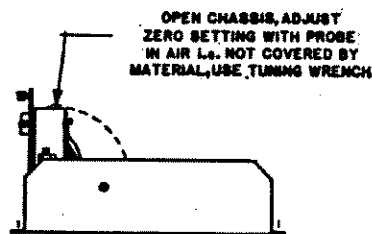
### 3.1 General

This section contains the calibration and operating information for the 303-9000-104 On/Off Car Loading, Level Control System.

### 3.2 Controls

#### 3.2.1 Zero Adjustment

Piston capacitor for Zero Adjustment is located within the 406-6000 unit. To access this control the hinged cover of the Electronic Unit must be raised, see 303-9000-104CD1. Turning the adjustment clockwise will raise the trip level and counterclockwise will lower the level relative to the probe tip, as shown in drawing below.



#### 3.2.2 Push To Test

The push to test push button switch should be mounted on an easily accessed panel. Depressing the switch has the effect of simulating approximately 1/2 inch of material on the probe (based on customer supplied information about material). When the

system is calibrated, if the probe is connected, pushing the switch causes the relay to switch; indicated by a change in the annunciator lights. If the probe is disconnected, the Push To Test Switch will not cause the relay to switch. The system can be checked in the absence of a probe by simulating the probe zero capacitance with a reference capacitor of 155 pF.

### 3.2.3 Level Range Switch

The Level Range Switch, seen in Figure 1, is located on the Electronic Unit below the Vernier Setter Control. It provides the coarse control for setting the relay set point relative to the car mounted sensor. The switch provides 4 overlapping control ranges. Position 4 represents the range of maximum outage providing a switching range (for the specified material) nearest the tip of the sensor. Similarly position 1 represents the range of minimum outage providing a switching range nearest the top of the car and the sensor mounting.

### 3.2.4 Level Vernier Control

The Level Vernier Control, seen in Figure 1, provides a fine vernier adjustment of the relay set point within the range set by the Range Switch (ref. 3.2.3). The Vernier Control is continuous providing essentially infinite resolution over its range. The vernier dial is marked in arbitrary units useful primarily as points of reference for resetting the vernier.

### 3.2.5 Sensor Trim

The car mounted probe has a zero level capacity trim adjustment located at the top of the probe head. This trim permits all probes of a fleet to have a common zero capacitance. For sensors having an integral concentric shield this adjustment is made at the factory.

#### Zero Capacity Standard

<u>Sensor</u>	<u>Length</u>	<u>Air Zero Capacity</u>
700-9000-293	Less than 4 ft.	155 pF
700-9000-293	4 ft. to 8 ft.	300 pF

### 3.2.6 Fail Safe Selector

The Fail Safe Switch determines whether the On/Off unit operates in the HL (High Level) or LL (Low Level) fail safe mode. The Switch is accessed through a hole in the side of the 406-6000 chassis.



### 3.3 Start Up

Before applying power to the instrument, be sure that the input power will be 115 VAC 50/60 Hz. Check all wiring connections.

### 3.4 Fail Safe

Fail Safe describes the condition under which the relay is de-energized.

High Level Fail Safe means the relay will de-energize under High Level conditions or upon loss of power.

Low Level Fail Safe means the relay will de-energize under Low Level conditions or upon loss of power.

### 3.5 Calibration

Refer to 406-6000 figures following. For proper calibration this procedure **must** be followed exactly; use the **Insulated Tool** supplied with the 406-6000 On/Off unit.

#### 3.5.1 **Preparation**

- a. Installation including wiring complete and probe connected.
- b. Material level well below probe tip, i.e., probe in air.
- c. Open Electronic Unit cover, ref. Figure 1, to access Zero Set Control on 406-6000 chassis.
- d. Turn on 115 VAC power to instrument.

#### 3.5.2 **Adjustment**

##### 3.5.2.1 **Zero Calibration**

3.5.2.1.1 If an empty car (material below the Sensor Tip) with mounted sensor is available connect the sensor cable to the sensor.

- a. Set variable setter vernier dial to zero.

Set range switch to maximum outage - position 4.

Using the **Insulated Tool** supplied with the 406-6000, turn the tuning adjustment (see drawing) to the full counterclockwise (CCW) position. Do not force. In this position the relay should be Off and the Green indicator on the 406-6000 chassis should be Off.

- b. Turn the tuning adjustment slowly clockwise (CW) until the Green chassis indicator just turns On (and the relay changes state). Turn the tuning adjustment an additional 1/2 turn clockwise (CW). The zero point is now calibrated. Close the hinged cover accessing the ON/OFF unit and retighten the cover fastener.

#### 3.5.2.1.2 The zero may be set using a reference C-box such as Drexelbrook 401-6-81.

- a. Connect the C-box cable to the sensor cable terminals of the 406-6000. (See Figure for terminal locations.) These connections should be in parallel with the connections normally on the 406-6000 in the 303-9000-104 car load system.
- b. Set the C-box to a reading of 137 pF. (18 pF standing capacity plus 137 pF equals the required zero capacity of 155 pF). (ref. 3.2.4)
- c. From the fully counterclockwise setting, rotate clockwise (CW) the tuning adjustment of the 406-6000 unit until the Green chassis indicator just turns On. Rotate an additional 1/2 turn clockwise (CW) from this point. The Zero point is now calibrated.

Disconnect the C-box at this time unless it is to be also used to set the level setpoint in the absence of material (See Section 3.5.2.2).

### 3.5.2.2 Set Point Calibration

#### 3.5.2.2.1 Calibration with Loaded Car (following zero calibration).

- a. Connect sensor cable to the sensor on a car loaded to the desired outage.
- b. With vernier dial set at zero advance outage range switch from position 4, the position of maximum outage, toward position 1. Advance the range switch step by step until the electronic unit relay changes state. At this point

back up the range switch one step. Now move the vernier dial from zero towards 100. Stop at the position where the relay switches. Calibration is now complete.

- c. It is recommended that a record be made showing materials, outage, and instrument settings of range position and vernier position. It is also desirable to record the corresponding capacitance obtained by a C-box substitution to produce the relay change at the calibrated setting. Refer to Sec. 3.8.2.

### 3.5.2.3 Calibration Without a Loaded Car

It is possible to calibrate the system set point using a C-box such as Drexelbrook 401-6-81 to provide a capacitance input to the system in place of the sensor and material. However, it is necessary then to know or calculate the capacity corresponding to the desired level and material. Information can be calculated at the Factory when the dielectric constant (K) and the conductivity (G) of the material is known.

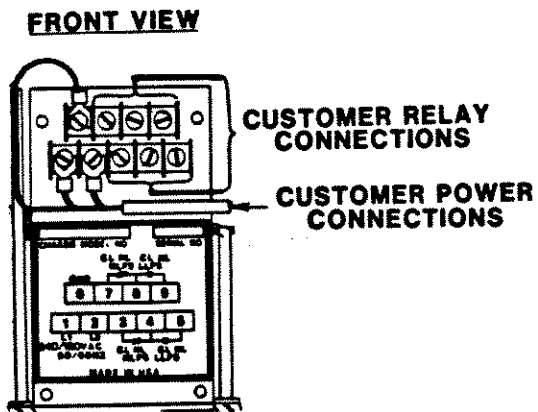
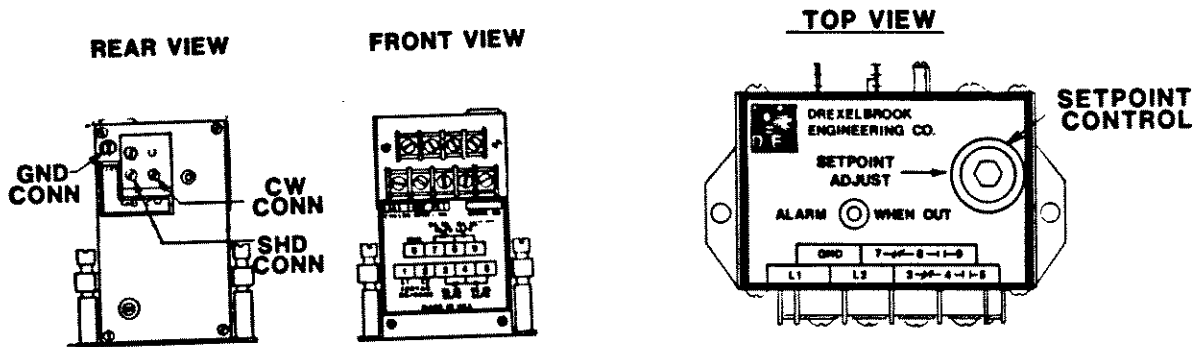


FIGURE 2. 406-6000 ON/OFF UNIT

## CALIBRATION IS NOW COMPLETE

### 3.6 Calibration of Time Delay Units

When instrument is equipped with Time Delay option, see drawing below for location of Time Delay Adjustment.

- 3.6.1 Turn Time Delay adjustment to extreme counterclockwise position (i.e., minimum time delay).
- 3.6.2 Proceed with normal calibration procedure. See Section 3.5.
- 3.6.3 After the instrument is adjusted to the desired operating point, turn the time delay adjustment clockwise until the required delay is achieved. For example, half rotation of the time delay is approximately 45 seconds. If the instrument is Low Level Fail Safe, the delay will be on increasing level. If the instrument is High Level Fail Safe, the delay will be on decreasing level.

Standard Time delay instruments are adjustable over the range of approximately 0-90 seconds delay. Time delay periods of 0-20 seconds and 0-10 minutes are also available.

### 3.7 Recalibration

If initial conditions are recorded at the time of calibration, recalibration or instrument replacement is simplified. For standard systems, the Zero capacity is known and no special measurements need be made to record its value.

#### 3.7.1 Zero Set Record

- a. Disconnect probe cable through quick disconnect at instrument.
- b. In place of the probe cable, connect the 401-6-81 capacitance calibration box.
- c. Adjust setting of the capacitance calibration box so that the On/Off unit just switches from Low to High level. **Note:** If system contains a Variable Setter the Dial must be set at Zero.
- d. Back off (reduce) setting of capacitance box by 1.5 pF (this is one and one half small divisions of the 401-6-8 dial).
- e. Record setting of the Capacitance Box. This value represents the zero capacitance of the system and can now be reconstituted at any time in the future for purposes of recalibration or instrument replacement.

### 3.7.2 Set Point Record

- a. Disconnect the probe cable through the Quick Disconnect connector at the instrument.
- b. Connect the 401-6-81 capacitance, calibration box to the 406-6000 unit.
- c. Adjust setting of the Capacitance calibration box so that the On/Off unit just switches from Low to High Level. Note that the Setter Dial must have been previously set to its required trip level per 3.5.2.2.
- d. Record the setting of the Capacitance Box. This value represents the span on the set back of the System to provide switching at arbitrary levels along the probe. This value can be reconstituted at any time in the future for purposes of recalibration or instrument replacement.

### 3.8 Maintenance

The 406-6000 Series instruments are designed to give years of unattended service. No periodic or scheduled maintenance is required.

There are no specific spare parts that we would recommend be stocked by the user. However, if the application is critical, it is best to have a spare chassis available in the event of a component failure. In most cases, the chassis should be returned to the factory for repair.

### 4.0 BACKUP SYSTEM - NOTICE -

*"Drexelbrook equipment is built with great care, and subjected to rigorous quality control. Even so, failures of any equipment can and do occur. Sound engineering practice demands that, whenever equipment failure may result in more than an inconvenience, a completely independent backup system be employed such that failure of either the unit or the backup unit will not permit a hazardous condition to occur."*