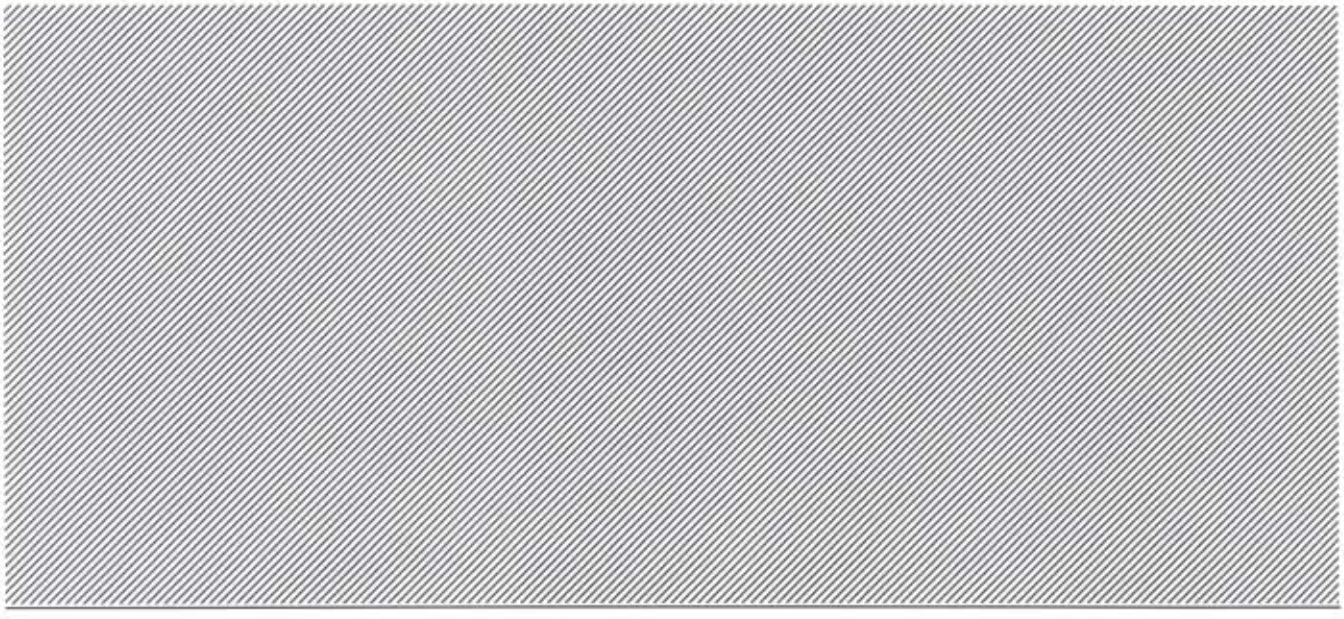
MOORE INDUSTRIES

USERS' MANUAL

DRT

Dual Resistance Transmitter



 127-701-00 (OBS)

SECTION 1
GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This document contains the operating and maintenance information for the Differential Resistance Transmitter, (DRT) manufactured by MOORE INDUSTRIES INC., Sepulveda, California.

The DRT is a resistance bulb transmitter that accepts inputs from two platinum R.T.D.'s, processes the signals and produces a corresponding voltage output.

1.2 UNIT PHYSICAL DESCRIPTION

The transmitter consists of a single printed circuit card that holds all of the electronic components, with the exception of the temperature sensing elements. The DRT is not enclosed in a housing, but model number as well as the customer stock code identification are indicated on the components side of the card.

1.3 MODEL NUMBER EXPLANATION

MOORE INDUSTRIES' model numbers describe an instrument's type, functional characteristics, operating parameter, and include option identification. If all accompanying documentation of a unit is missing, the model number may be used to obtain technical information on the unit by following the example of Table 1-2.

TABLE 1-1 MODEL NUMBER EXAMPLE

DRT/0-20ohm/.1-.9V/24VDC [PC]

Unit type
RTD, 0-20ohms
output
DC power input
Printed circuit

SECTION 2
CALIBRATION PROCEDURES

2.1 GENERAL INFORMATION

This section provides information about unit calibration. Units with standard input and output levels are normally calibrated at the factory. After the unit is unpacked, general operating level checks of units is recommended. Usually these checks, specified in this section under calibration procedures, require little or no adjustments. If units are ordered with factory calibration, an exact calibration is performed at the factory. Adjustments should not be made in the field on theses units unless a new range of input or output signal level is desired.

2.2 CONTROLS DESCRIPTION AND LOCATION

The controls consist of ZERO and SPAN adjustments, located on the unit. The controls are multiturn potentiometers that are adjusted with a blade screwdriver.

CAUTION

USE BLADE SCREWDRIVER NOT MORE THAN 0.1 INCH (2.54 mm) WIDE. USE OF A WIDER BLADE MAY PERMANENTLY DAMAGE THE POTENTIOMETER MOUNTING.

This type of potentiometer usually requires 20 turns of the shaft to move the wiper from one end of its range to the other. It is equipped with a slip clutch at either end of its travel to prevent damage if it is turned beyond the wiper stop. Usually a slight change in feel will be noticed when the clutch is slipping. However, if this change is not observed, either end

can be reached by turning the shaft 20 turns in the desired direction. Controls are connected, so turning the shaft clockwise increases the quantity or makes it more positive, and turning the shaft counterclockwise has the opposite effect.

2.3 TEST EQUIPMENT AND TOOLS REQUIRED

Test equipment and tools required for calibration of the unit are described in Table 2-1; they are not supplied and must be provided by the customer at the installation or test site.

2.4 TEST EQUIPMENT SETUPS

Off-line calibration for all units require the same test equipment setups regardless of option or physical configuration. The hookup requirements and physical preparations may vary on some units. The following paragraphs define the general test and setup and identify the units that require special attention for test preparation and connections.

2.5 GENERAL TEST EQUIPMENT SETUPS

The test equipment setup required for calibration of all units is identical, and Figure 2-1 shows the general test setup configuration for the types of RTD bulbs specified.

2.6 CALIBRATION OF UNITS

Units are calibrated and checked for proper performance at the factory before they are shipped. However, unless calibration was requested to a specific set of input-output values, the unit performance should be checked by the user before the unit is placed in service. Calibration consists of simulating the operating signal input and adjusting the unit to obtain the specified output.

SECTION 2
CALIBRATION PROCEDURES

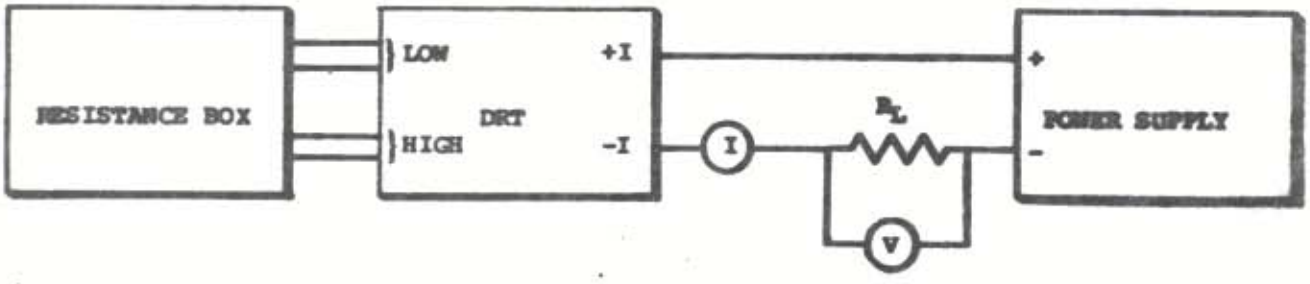
A precision decade resistance box and an output monitoring device are required for calibration. The resistance box and output monitoring device must have an accuracy within 0.05% or better. To calibrate a unit, proceed as follows:

a. Connect unit and test equipment as shown in Figure 2-1.
b. Apply power to the unit.
c. Adjust the resistance box to a value equal to the minimum resistance of the bulb to be used in actual operation.
d. Adjust the ZERO potentiometer to obtain 0% output with the minimum resistance connected to the input terminals.
e. Adjust the resistance box to a value equal to the maximum resistance of the bulb to be used in actual operation.
f. Adjust the SPAN potentiometer to obtain 100% output with the maximum resistance applied as in step (e).
g. Repeat steps (c) through (f) until no further adjustment of either the ZERO and SPAN potentiometer is required.
h. Subtract the minimum resistance used in step (c) from the maximum resistance used in step (e). Calculate 25%, 50% and 75% of this difference. Add these calculated percentages of resistance range to the input used in step (c). Adjust the resistance box to each of these values and check that the output is linearly proportional.
i. After step (h) has been successfully completed, turn off the power input to the unit and disconnect the test equipment.

TABLE 2-1. TEST EQUIPMENT AND TOOLS REQUIRED

EQUIPMENT OR TOOL	CHARACTERISTIC	PURPOSE
Screwdriver (blade)	Blade not wider than 0.1 inch (2.54 mm)	Front panel control adjustment
RTD or Resistance Box	Must be accurate to within ± 0.05% or better	Simulates resistance bulb input
DC Voltmeter	Must be accurate to within ± 0.05% or better	Output signal monitori and load resistor monitoring
DC Milliammeter	Must be accurate to with 0.05% or better	Output signal monitori and load resistor monitoring

Figure 2-1
Test Equipment Configuration



SECTION 3
INSTALLATION & OPERATION

3.1 ELECTRICAL CONNECTIONS

All electrical connections to standard units are made to the connector on the unit. Terminals used for standard units and their options are defined in the following paragraph.

3.2 GENERAL WIRING INFORMATION

No special wire or cable is required for signal connections to the unit. To avoid transients and stray pickups, it is recommended that twisted conductors be used where they are run close to other services (such as power wiring).

Wiring Information for Standard Units. Table 3-1 illustrates the connector pin locations and identification for the units.

3.3 OPERATION AND PERIODIC OBSERVATION

Once calibrated and installed, the unit may be operated unattended. The only controls on the unit are the SPAN and ZERO potentiometers, which, after initial adjustments, need no further attention. There are no indicators on the unit. Because the circuit uses highly reliable solidstate components with no moving parts, the unit should operate virtually maintenance-free for a long period of time. However, if a malfunction should occur, refer to Section 5 for maintenance information.

A periodic check of input and output connections is recommended every six months to ensure continued dependability of operation.

TABLE 3-1

TERMINAL POSITIONS

1. + OUT
2. + EXCITATION LOW RTD
3. + EXCITATION HIGH RTD
4. BLANK
5. - SENSE HIGH RTD
6. - I
7. + I
8. + I
9. - I
10. + SENSE HIGH RTD
11. - EXCITATION HIGH RTD
12. - EXCITATION LOW RTD
13. - SENSE LOW RTD
14. + SENSE LOW RTD

SECTION 4

THEORY OF OPERATION

4.1 INTRODUCTION

This section describes the unit operation. An overall view of the unit function based on the block diagram of Figure 4-1 introduces the user to the unit functional elements. This functional analysis is further detailed in the circuit description paragraphs that follow. These descriptions are based on the schematic diagram included in Section 6, Unit Documentation.

A rapid familiarization of the unit can be obtained by reading the general functional description. Circuit descriptions provide sufficient data so that troubleshooting, if required, can be performed intelligently and rapidly.

4.2 GENERAL FUNCTIONAL DESCRIPTION

The DRT is a device that converts differential resistive input from an RTD source into corresponding DC voltages. Figure 4-1 functionally illustrates the unit.

The input signal at $\pm$ I is processed by a constant current circuit that develops a constant load across the power supply during steady state condition. When the RTD increases in resistance, current drain from the power supply increases accordingly. The unit consists of constant current circuits, an input amplifier and output circuits.

SECTION 4
THEORY OF OPERATION

4.3 POWER SUPPLY

The power supply develops precise voltages using the output from two constant voltage sources. Transistor Q2 and the diode action of CR3 and CR4 provide one constant source, with zenor diode CR5 providing the second source. A regulated RTD excitation current is developed at the collector of Q2, and applied to the emitter circuit of Q1.

RTD excitation is generated by a dual tracking current source developed by the components IC1 and Q1. The voltage provided at the collector of Q2 is divided down by the dual resistance network of R3 and R4 where it is sensed at the non-inverting input of IC1.

With the output of IC1, Pin 6, connected to the base junctions of Q1, the resulting currents at the collector outputs of Q1 tend to track one another, and provide exitation to the high and low external RTD's.

4.4 INPUT CIRCUITS

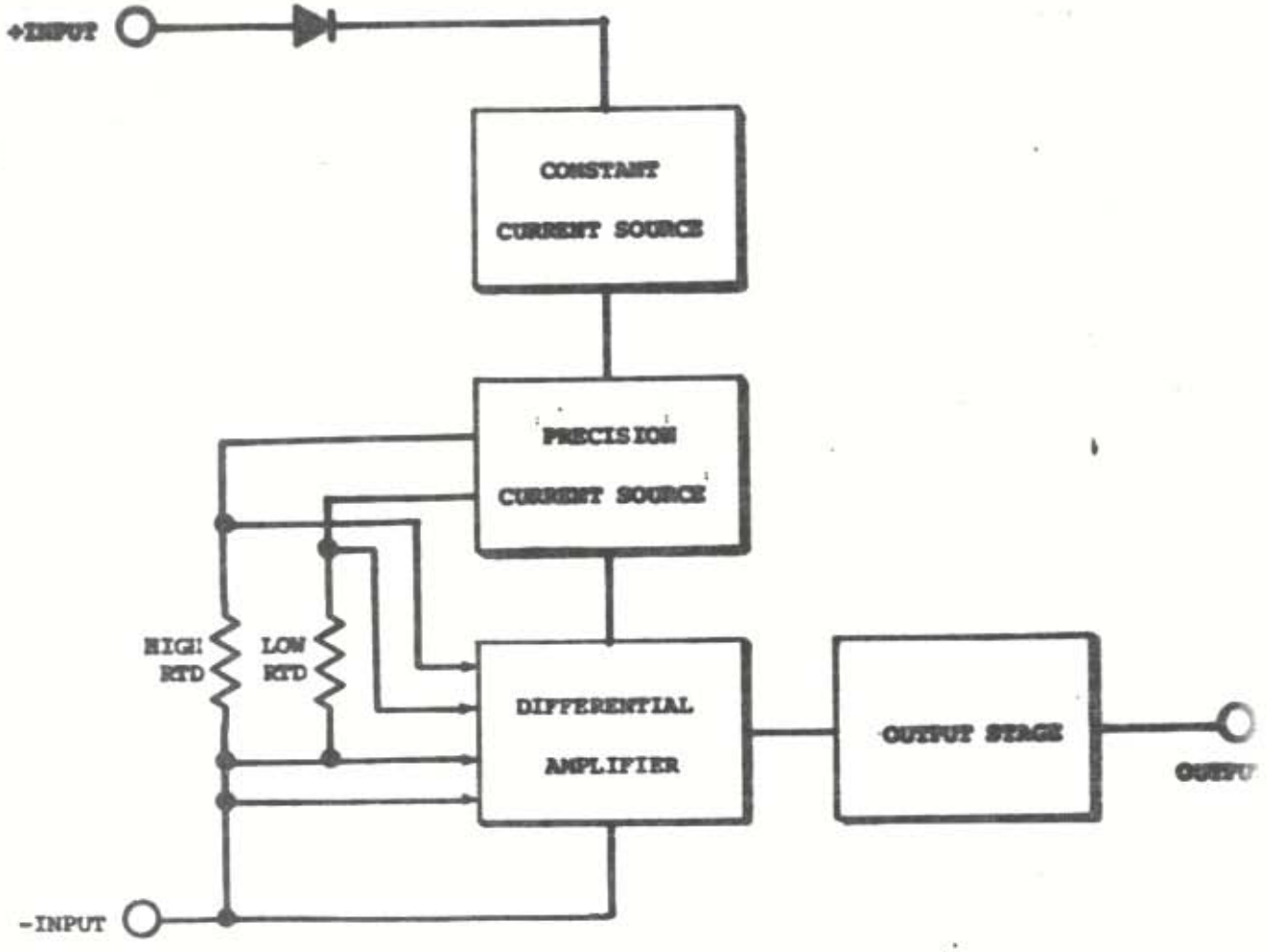
The high RTD and the low RTD provide the differential inputs to the unit using a bridge network and applying the input to IC2 Pins 2 and 3. The voltage developed at zenor diode CR5 provides the reference which activates the zero circuit.

Zenor diode CR5 provides operating voltage for amplifier IC2, in addition to the representative zero potentiometer voltage which is sensed at the non-inverting input, Pin 3 of IC2. This allows any variation of the two RTD resistance values to be sensed, and provide a corresponding variation at the output of IC2. When the high RTD value increases, the output of the transmitter will track the value and provide an increase in output. When the low RTD provides an increase in resistive value, the transmitter output will provide a decrease in output voltage.

4.5 OUTPUT CIRCUIT

The output voltage is developed at Pin 6 of IC2 and the associated components of the span adjust circuit to provide the output voltage range of 0.1 vdc to 0.9 vdc. A feedback signal is derived from the span circuitry, and applied to the inverting input to the operational amplifier which in turn controls the amplifier gain and affecting the range of the signal output.

Figure 4-1
Block Diagram



SECTION 5
MAINTENANCE & TROUBLESHOOTING

5.1 INTRODUCTION AND GENERAL INFORMATION

This section contains information to aid in the maintenance of the unit. This includes instructions for general troubleshooting, precautions, and special techniques required to replace components.

5.2 TROUBLESHOOTING

The schematic diagrams include flagged numbers at various points in the circuit, & Table 5-1 gives the voltages and waveforms at these points for specified input-signal conditions. The assembly drawing shows the physical locations of the parts on the circuit board. Bear in mind that the circuit board is protected with a moisture-resistant coating. Therefore, it may be necessary to use a needle-point probe and exert a fair amount of pressure to break through the coating when it is desired to observe the signal or voltage at a specific point. When connecting a probe to a component on the circuit board, exercise care to make sure the probe does not short-circuit to an adjacent component.

In general, troubleshooting is carried out by tracing the signal with an oscilloscope and referring to the schematic diagrams to determine what component might be causing an observed abnormal indication. If the original symptom was a complete failure of the unit to operate, the most logical components to suspect are those associated with the constant current supply in the unit (including any voltage regulators). If the unit is producing an incorrect (but not zero) output, check the outputs from the input circuit and trace the resulting signal through the unit.

5.3 PLUG-IN BOARD CONNECTOR CLEANING

Occasionally, modules which have been in service for a long period of time may develop resistive coatings on the gold-plated contacts of the plug-in board . This coating, if allowed to build up, may cause malfunctions by decreasing the noise margin of a circuit.

There are two types of foreign material coatings which can develop on the gold-plated contacts of a plug-in module. The first type is INORGANIC. This type of contamination results when copper "bleeds" through the gold plating and oxidizes. The second form of contamination involves ORGANIC substances, which usually are a result of careless handling, and are mainly made up of fingerprints, salts and oils deposited when the plug-in boards are handled by the gold-plated contacts. Contamination by organic substances can be greatly reduced by careful handling of the modules.

Although rack connectors are usually of the self-cleaning type, it may become necessary to clean the module fingers to ensure reliable connection. When module contacts are in need of cleaning, the following procedures are recommended:

Removal of Inorganic Contaminants

a. Immerse contacts of plug-in board in an ultrasonic bath of deionized water and a detergent such as Liquinyx, for at least 30 seconds.
b. Repeat step (a) with pure deionized water only.

CAUTION

REMOVE WATER IMMEDIATELY FROM CONTACTS. IF THIS IS NOT DONE QUICKLY, DAMAGE TO CONTACTS MAY RESULT.

c. Remove water by immersing contacts in an ethane or methanol bath to same depth used during the ultrasonic cleaning of step (a). Never wipe or use an abrasive cleaner on the contacts. If wiping is necessary, use K-Dry towels or equivalent.

Removal of Organic Contaminants

a. After inorganic contaminants and water have been removed, organic materials may be removed by immersion of contacts in trichloroethane for at least 30 seconds.

CAUTION

NEVER USE AN ERASER ON THE CONTACTS. THE USE OF ABRASIVE CLEANERS OR ERASERS ON PLUG-IN BOARD CONTACTS IS CONSIDERED A PHYSICAL ABUSE TO THE PLUG-IN UNIT.

b. Let contacts air dry or wipe with a very fine, nonabrasive material such as K-Dry towels or equivalent.

5.4 COMPONENT REPLACEMENT GENERAL INFORMATION

Replace all defective components with identical parts. Refer to Section 6 for a list of recommended replacement parts. The last row of numbers in the parts list is the number of spares recommended to be kept on hand for that part, per unit, for up to ten units of the same type. For more than ten units, a spares complement of 10% on the indicated parts should be used.

5.5 COMPONENT REPLACEMENT TECHNIQUES

Most parts used in the unit are quite small and are located in a confined area. Therefore, small hand tools are a necessity when servicing the unit. The following is a summary of the general techniques and precautions that should be observed to prevent damage to components in the unit:

a. Use a transformer-operated low-voltage soldering iron with a grounded tip and rated at not more than 50 watts. A temperature-controlled tip is desirable.

b. Use extreme care when unsoldering the leads to any component. Do not keep the soldering iron on a point for more than a few seconds at a time. Use a sunction-type solder-removing tool (solder sucker) as an aid in unsoldering transistors and integrated circuits. The protective coating on the unit may be removed with trichloroethane or equivalent. Be sure adequate ventilation is provided when using this or any other chemical.

c. Do not excessively bend or twist the leads of small components; they break easily.

d. Before removing a component, observe the lead dress. Be sure that the lead dress of the replacement is the same as that of the original.

e. Remove all flux from soldered joints with trichloroethane or equivalent.

f. Test the unit for proper operation and, if necessary, recalibrate by the procedure given in Section 2.

TABLE 5-1. WAVEFORMS OR VOLTAGES

Test Point	Wave Form or Voltages
1	12.6 vdc (Referenced to - PS)
2	6.2 vdc (Referenced to -PS)
3	COMMON (-PS)
4	0.1 to 0.9 vdc

PARTS LISTS

6.1 GENERAL

This section consists of a computer printout table that provides parts identification information for the unit. Wiring lists have been provided in this section as an aid to the maintenance personnel.

Parts information is grouped according to the number of assemblies. If the unit contains two PC boards, the table will be divided into two major sections: one section will contain information related to PC1 and the other section will list PC2 components information. Each major section in the table contains a complete parts list headed LIST OF MATERIALS specifying which PC board it is describing. This list is usually found at the end of the section. The list of materials consists of the following headings:

ITEM: A reference numeral used for data processing and not used by maintenance personnel.

NAME: Gives the nomenclature of the part.

DESCRIPTION: Identifies the component by manufacturer's part number, usually followed by component's parameters or value.

REF: Lists the reference designation for the component, referred to in Section 4, on the schematic and assembly drawings.

PART NUMBER: This column specifies the Moore Industries assigned part number. This is the part identification required when ordering parts from Moore Industries.

SPARE: The numeral in this column specifies the recommended number of component spares per unit type that should be kept on hand by maintenance personnel.

6.2 GLOSSARY OF ABBREVIATIONS

C	Capacitor	R	Resistor
CR	Diode — Zener included	T	Transformer
HW	Special hardware	IC	Integrated circuit
J	Connecting buss wire	Q	Transistor
L	Inductor	LED	Light emitting diode
LB	Label	TB	Terminal block
PC	Printed circuit board	VS	Voltage regulating varistor
		VR	Voltage regulator

RETURN PROCEDURES

To return equipment to Moore Industries for repair, follow these four steps:

1. Call Moore Industries and request a Returned Material Authorization (RMA) number.

   Warranty Repair –
   If you are unsure if your unit is still under warranty, we can use the unit's serial number to verify the warranty status for you over the phone. Be sure to include the RMA number on all documentation.

   Non-Warranty Repair –
   If your unit is out of warranty, be prepared to give us a Purchase Order number when you call. In most cases, we will be able to quote you the repair costs at that time. The repair price you are quoted will be a "Not To Exceed" price, which means that the actual repair costs may be less than the quote. Be sure to include the RMA number on all documentation.

2. Provide us with the following documentation:
   a) A note listing the symptoms that indicate the unit needs repair
   b) Complete shipping information for return of the equipment after repair
   c) The name and phone number of the person to contact if questions arise at the factory

3. Use sufficient packing material and carefully pack the equipment in a sturdy shipping container.

4. Ship the equipment to the Moore Industries location nearest you.

The returned equipment will be inspected and tested at the factory. A Moore Industries representative will contact the person designated on your documentation if more information is needed. The repaired equipment, or its replacement, will be returned to you in accordance with the shipping instructions furnished in your documentation.

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