ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION
SERVICE DEPARTMENT

MAINTENANCE INSTRUCTION

TESTING OF LOAD INDICATING AMMETERS

INTRODUCTION

In order to control the movement of the train with maximum efficiency, the locomotive operator must have some means of accurately monitoring locomotive output. This is accomplished by a load indicating meter, Fig. 1, that is basic equipment on most locomotives. This meter is connected into the main electrical power circuit to read the current going to one traction motor. Since all motors receive the same amount of current, this reading reflects the total electrical load on the locomotive power system. The electrical loading at any given instant is a measure of locomotive pulling force. On locomotives equipped with dynamic brakes, this same meter indicates the braking current being generated.

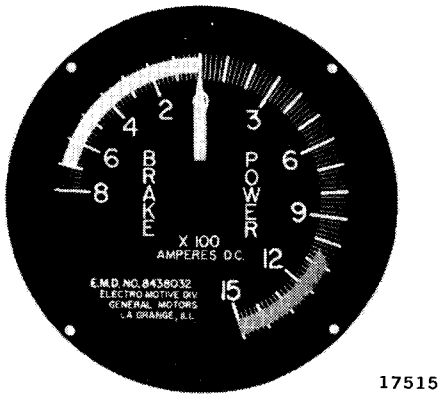

Fig. 1 -- Typical Load/Brake Current Indicating Meter

The accuracy and performance of this meter is quite important to the operation of the locomotive. It is therefore necessary that it be inspected and tested at regular intervals.

DESCRIPTION

LOCOMOTIVE LOAD METERS

Load indicating ammeters are actually millivolt meters calibrated to correspond to an amount of current (in amperes) through an external shunting resistance. These meters have 75 millivolt movements on the load power side and 40 millivolt movements on the brake side if equipped with dynamic brakes. Meters are set for a full scale deflection of either 750 or 1500 amperes load power (800 amperes on brake) depending on the rating of the locomotive traction motors. A total lead resistance of .051 ohm is used when the meters are initially calibrated. Load meters on domestic locomotives have a screwdriver adjust zero corrector on the back of the meter (on the front side of older units).

All load meters have a ruggedized magnetic core mechanism with spring backed jewels to withstand locomotive vibration. They are overdamped to provide at least 2.5 seconds response time -- time for the pointer to come to its final position after a change in current. The damping and friction inherent in this type of mechanism could cause an inaccurate meter indication if the meter is tested outside the locomotive operating environment. To overcome this friction when bench testing the meter, it should be tapped lightly as the pointer approaches its final position. Under normal operating conditions the locomotive vibration alone adds sufficient additional energy to the movement to overcome frictional losses and ensure accurate readings.

METER TESTER

Meter tester 8193976 is used to check the calibration of load indicating ammeters. This tester, shown in Fig. 2, is a 130 millivolt voltmeter with 1 per cent accuracy at full scale. It has a knife edged pointer on a mirrored scale calibrated to 130 millivolts. The instrument is powered by two internal 1-1/2 volt batteries which provide a variable voltage output. The output can be directed to either the tester's own meter or to the binding post terminals at the end of 17 foot cables attached to the tester. The meter tester is designed primarily to be a comparison device using a pushbutton switch to redirect power to the load meter being tested. A front panel

*This bulletin is revised and supersedes previous issues of this number.

Fig. 2 – Meter Tester Assembly

mounted toggle switch is used to turn the power on and off. When the cover is closed on the meter tester, it moves the power switch to the off position.

The meter tester should be periodically checked against a master meter to ensure that it is precisely calibrated and functioning correctly.

INSPECTION

All meters should be visually examined before testing. The following specific defect areas should be given special attention:

Cracks in case or glass.

Loose screws in meter case.

Loose glass on meter.

Defects of scale or pointer.

TESTING

To check the calibration of load indicating ammeters the following procedure should be observed.

POWER SIDE OF METER

1. Disconnect the leads from the load meter at the meter shunt. This shunt is usually located in the bottom part of the electrical control cabinet.

NOTE: If the meter to be tested is removed from the locomotive for bench testing, the meter should be tested in the same position as it is mounted in the locomotive.

2. Connect the shunt leads from the load meter (removed in Step 1) to the binding post terminals at the end of the long cable attached to the meter tester. Observe proper polarity as marked on the terminal block.

3. Rotate the voltage control knob until the pointer on the tester is at the selected value. Load meter calibration is checked by comparing the millivolt reading on the meter being tested to a reference or baseline voltage level set on the tester. Once the internal power source is set at a specific value on the tester, this amount of power is used as a reference for the meter being tested. The pushbutton switch on the panel of the tester controls the switching of the power source between meters.

   Meters should be checked at baseline settings of full scale deflection, center scale, and any other convenient marking on the scale. Some load meters have different colored zones marked on the face of the scale to indicate special operating conditions or limits. Meters should be checked at the breakpoints between zones. The extremes of each zone as well as other recommended check points for a particular meter application are given in the Service Data.

4. When the pointer of the meter tester is at the specified value, the pushbutton switch should be pressed down to apply the reference voltage to the load meter being tested.

NOTE: As the pointer of the meter being tested nears its final position, the meter should be tapped lightly with the fingers. This allows the blunt pivot to overcome friction and reach its true position. Tapping the meter simulates road operation by compensating for locomotive vibration. The procedure outlined assures that a meter calibrated on the bench will be accurate when put in road service.

5. Compare the reading on the load meter to the reference setting made on the tester. The difference between the two readings is the load meter error.

6. If the error read on the load meter being tested exceeds the maximum allowable error given in the Service Data, then the meter should be returned to Electro-Motive for re-calibration or repair. The calibration should be checked several times in a row to ensure that the readings are reproducible before the error is calculated. If after several trials it is found that the meter fails to return to the calibration reading within the allowable error limit, then the meter should be replaced.

BRAKE SIDE OF METER

The procedure outlined is also used to test the brake side of the load meter on units with dynamic brakes. The only difference is that the connection of the shunt leads from the load meter to the binding post terminals of the meter tester should be reversed (Step 2). This means connecting the positive load meter lead to the negative binding post and the negative lead to the positive post.

SERVICE DATA

ALL LOCOMOTIVE LOAD INDICATING AMMETERS:

1. Calibrated for .051 ohms total lead resistance.

2. Insulated for 1000 volts to ground (2400 volts Hi-Pot).

3. Overdamped for minimum response time of 2.5 seconds. Response time is time for pointer to reach its final position after a change in current has been made.

4. Spring backed jewel construction or some other damping characteristic that requires meter to be tapped or subject to locomotive vibration to reach its final position.

8438032, 8464206, 8481323, 9085182

Dual-range millivoltmeter; 40 - 0 - 75
Range; POWER; 0-1500 amperes (left to right)
BRAKE; 0-800 amperes (right to left)
Shunt; 1000 amp., 50 mv
Error Limit; ±25 amperes (±1.6 mv) at all scale deflections
Scale Assignment; BRAKE; 0-700 amperes (0-35 mv) DAY-GLO ARC YELLOW ZONE
700-800 amperes (35-40 mv) RED ZONE
POWER; 0-1050 amperes (0-52.5 mv) LIGHT GREEN ZONE
1050/1100 - 1500 amperes (52.5/55 - 75 mv) RED ZONE
1 HR. (60 min.) - - - 1075 amperes (53.75 mv)
1/2 HR. (30 min.) - - - 1100 amperes (55 mv)
1/4 HR. (15 min.) - - - 1150 amperes (57.5 mv)

8481324

Single-range millivoltmeter; 0-75
Range; POWER; 0-1500 amperes (left to right)
Shunt; 1000 amp., 50 mv.
Error Limit; ±25 amperes (±1.6 mv) at all scale deflections
Scale Assignment; POWER; 0-1050 amperes (0-52.5 mv) LIGHT GREEN ZONE
1050/1100 - 1500 amperes (52.5/55 - 75 mv) RED ZONE
1 HR. (60 min.) - - - 1075 amperes (53.75 mv)
1/2 HR. (30 min.) - - - 1100 amperes (55 mv)
1/4 HR. (15 min.) - - - 1150 amperes (57.5 mv)

8396908

Single-range millivoltmeter; 0-75
Range; POWER; 0-750 amperes (left to right)
Shunt; 500 amp., 50 mv
Error Limit; ±7.5 amperes (±.75 mv) from 450-550 amperes (45-55 mv)
±15 amperes (±1.5 mv) at other scale deflections

8375577

Single-range millivoltmeter; 0-75
Range; POWER; 0-750 amperes (left to right)
Shunt; 500 amp., 50 mv
Error Limit; ±7.5 amperes (±.75 mv) from 450-550 amperes (45-55 mv)
±15 amperes (±1.5 mv) at other scale deflections
Scale Assignment;

Top Band
0-450 amperes (0-45 mv) GREEN ZONE
450-750 amperes (45-75 mv) ORANGE ZONE

Scale Numbers
60 - - - 485 amperes (48.5 mv)
15 - - - 545 amperes (54.5 mv)
8 - - - 580 amperes (58 mv)

Lower Band
0-370 amperes (0-37 mv) GREEN ZONE
370-750 amperes (37-75 mv) RED ZONE

8380058, 8392129

Single-range millivoltmeter; 0-75
Range; POWER; 0-1500 amperes (left to right)
Shunt; 2000 amp., 50 mv
Error Limit; ±15 amperes (±.75 mv) from 900-1100 amperes (45-55 mv)
±30 amperes (±1.5 mv) at other scale deflections

8402916

Single-range millivoltmeter; 0-75
Range; POWER; 0-1500 amperes (left to right)
Shunt; 1000 amp., 50 mv
Error Limits; ±15 amperes (±.75 mv) from 900-1100 amperes (45-55 mv)
±30 amperes (±1.5 mv) at other scale deflections
Scale Assignment;
CONTINUOUS - - - 0-850 amperes (0-42.5 mv) ±15 amperes (±.75 mv)
1 HR. - - - 890 amperes (44.5 mv)
1/2 HR. - - - 965 amperes (48.25 mv)
1/4 HR. - - - 1065 amperes (53.25 mv)

8411333

Single-range millivoltmeter; 0-75
Range; POWER; 0-1500 amperes (left to right)
Shunt; 1000 amp., 50 mv
Error Limits; ±15 amperes (±.75 mv) from 900-1100 amperes (45-55 mv)
±30 amperes (±1.5 mv) at other scale deflections
Scale Assignment;
1050-1500 amperes (52.5-75 mv) RED ZONE

Litho in U.S.A.