SOUTHERN RAILWAY SYSTEM

MECHANICAL DEPARTMENT

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ASSISTANT VICE-PRESIDENT
PREFACE

This manual has been designed and prepared for use by Southern Railway diesel electricians, mechanics and supervision. Many of the procedures and tests outlined herein are in use only by Southern Railway. The contents of this manual reflect time tested procedures for performing the work in a safe, correct and efficient manner.

This book has been provided you by Southern to aid you in performing your job. From time to time there will be additions, deletions and changes as our locomotive fleet changes, and different and more complex equipment is added.

To make the best use of this manual refer to it when a question arises as to how a particular job should be done.

J. B. Waddle

Editor – J. P. Hoffman
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GENERAL

ELECTRICAL SECTION
SANDING ANALYZER

FOR TESTING CONTINUITY OF SANDING EQUIPMENT ON DIESEL ELECTRIC LOCOMOTIVES

THE REVERSE SWITCH OF THE ANALYZER IS WIRED FOR FRONT END APPLICATION. IF USED ON REAR END, REVERSER POSITIONS WILL BE OPPOSITE
OPERATION No. 909 SANDING ANALYZER

The AAR Specifications for sanding trainline wires are – SC-23 and ES-5. **BE SURE TO CHECK YOUR ELECTRICAL PRINTS TO VERIFY WIRES USED.** If they are not the same, these two connectors will have to be rewired.

<table>
<thead>
<tr>
<th>Connector No.</th>
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<td>SC-23</td>
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<td>Man. Sand. Trainline</td>
<td>Reverser – Forward</td>
</tr>
<tr>
<td>EC-5</td>
<td>4</td>
</tr>
<tr>
<td>Emerg. Sand. Trainline</td>
<td>System Negative</td>
</tr>
<tr>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Positive Power</td>
<td>Gen. Field Circuit</td>
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<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Reverser – Reverse</td>
<td></td>
</tr>
</tbody>
</table>

Place all switches in **OFF** Position.

1. Apply 909 Analyzer in 27 point receptacle front end of locomotive as reverse switch is wired for front end application. If used on rear end, reverser positions will be opposite.

2. If RED light turns on when Analyzer is placed in receptacle, turn off GENERATOR FIELD CIRCUIT before proceeding with any further testing!!

3. Push test light switch up to assure all bulbs light and power is available for Analyzer. Replace any defective bulbs – Salem No. 3617 or Sylvania No. MB120/6.

4. Turn power switch ON. GREEN light will light. You are now ready to start analyzing continuity or sanding system.

5. Place reverser switch in forward or reverse direction – depending upon which sanders you desire to check.

**IMPORTANT** Check your electrical prints to assure proper numbered diodes. The numbers in this write-up are for only latest locomotives.

6. Turn on manual sanding switch. Only the sanders should be running in direction the reverser is set. Again, depending upon which direction the reverser is set, if the WHITE light comes on, it indicates bad diode – usually CR35A on EMD locomotives and RT12 on
GE locomotives block forward sanding circuitry—CR35B and RT13 block reverse sanding circuitry.

**IMPORTANT** Return Manual Sand Switch to OFF before resuming test.

(7) Turn on emergency sand switch. If equipment is functioning properly, both the forward and reverse sanders should be ON on all units. If YELLOW light comes on, it indicates bad diode—usually CR32B or CR13 on EMD locomotives or RT11 or RT15 on GE locomotives. Return emergency sand switch to OFF.

Early locomotives did not have CR13. If this diode is not in the circuitry, the YELLOW light will always light up.

**CHECK YOUR ELECTRICAL PRINTS FOR CORRECT NUMBERS.**

If WHITE or YELLOW lights do not come on, and sanders do not operate, check the pneumatic portion of the sanding equipment.
FALSE WHEEL SLIP

When locomotive wheels slip, voltage and current unbalances in the motor circuits occur. Electro-Motive employs these unbalances to signal the wheel slip control system and correct the slip. The control system is designed to tolerate a normal degree of unbalance without corrective response. However, various deviations from mechanical or electrical design specifications, conditions of excess wear or other forms of deterioration, abnormal differences between paired components, or momentary operating transients can add to the normal unbalances and bring about corrective response that is not the result of actual wheel slip.

Considerable time can be spent by railroad maintenance personnel checking locomotives due to road reports of “excessive or continuous wheel slip.” Usually, the “continuous wheel slip” and frequently the “excessive slip” are false indications — the wheels are not actually slipping. Road crews sometimes use the traction motor cut out feature (if so equipped) in an attempt to eliminate the wheel slip indication. The use of motor cut out for this purpose makes the maintenance personnel’s determination of the real problem more difficult.

Generally, an investigation of the locomotive with a “wheel slip” report could be better organized with a reduction of locomotive out-of-service time. The following paragraphs list some of the more common causes for false wheel slip signals and provide procedures for checking a locomotive. These are given in order of the most common causes and simplest procedures and progress to more involved ones in order to keep trouble-shooting time to a minimum.

1. WHEEL SIZE VARIATION

Unloading and wheel slip indications can be expected if locomotives are operated with wheel size variation in excess of 1 - 1/4”.

Wheel size recommendations are based on maintaining uniform sizes that —

a. Will result in acceptable axle loading variation.

b. Will NOT result in false wheel slip signals.
Recommendations for maximum allowable wheel size variation are as follows:

<table>
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<th>Recommendations</th>
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<tr>
<td>a. On same axle</td>
<td>2 tapes</td>
</tr>
<tr>
<td>b. Within a GP truck</td>
<td>19 tapes (approximately 3/4” in diameter)</td>
</tr>
<tr>
<td>c. Within an SD or DD truck</td>
<td>12 tapes (approximately 1/2” in diameter)</td>
</tr>
<tr>
<td>d. On one truck compared to another truck on the same locomotive (GP, SD).</td>
<td>30 tapes (approximately 1-14” in diameter)</td>
</tr>
</tbody>
</table>

No restrictions on DD.

Note that wheel rim thickness **CANNOT** be used as a reliable gage of wheel diameter. Such measurements can result in readings that are in error by up to 1” on the diameter.

2. SANDING SYSTEM

Check to be sure the sanding system is functioning properly in both forward and reverse directions.

3. TRACTION MOTORS

All motors must meet EMD specifications for speed-current characteristics.

When motors that do not conform are mixed with motors that do, there may be enough difference in speed-current characteristics at a given speed to result in false wheel slip signals due to current differentials. The load saturation characteristics are of significance here. The no-load saturation curve cannot be used to judge whether the motor is within tolerance.

All traction motor pinion gears and axle gears on a locomotive must be of the same ratio. Traction motors with different gear ratios will have different armature speeds (rpm), and consequently different armature currents for identical wheel speeds. This differential will cause false wheel slip signals.
All traction motors on the unit reported with wheel slip problems should be inspected for the following:

a. Short, binding or broken brushes or broken brush shunts.

b. Loose cable connections to brushholders and for any cable irregularities at "glad hands."

c. Excessive wear of motor pinion, signs of overheating, and lack of lubrication which can lead to a slipping pinion condition.

4. CONTACTORS AND CABLES

Open and high resistance circuits cause current unbalance and false wheel slip signals. Contactors and cable connections are frequently the source of these problems and should be inspected as follows:

a. Inspect the main contacts of all power contactors, reversers and brake transfer (when equipped) switchgear, and shunting contactors. Contacts that do not meet the recommendations for service made in the 9/22/65 Pointers and the applicable section of the Locomotive Service Manual must be replaced.

b. Inspect pivot area of movable main contact on all power contactors and reverser brake transfer switchgear for signs of burning, arcing, or overheated shunts (on power contactors). Replace contactors with failed pivot areas.

c. On shunting contactors, upon energizing, make sure ALL main contacts close properly.

d. Inspect cable and bus bar connections for being loose or discolored.

5. TRANSITION

During transition, overlapping pickup and dropout of "S," "SP," or "P" power contactors causes unequal current in the various traction motor circuits for a very short time. Wheel slip transducers sense the unbalance and signal a wheel slip, either due to the rate at which current changed, or due to the level of current differential between motor circuits. Since locomotive power is already temporarily reduced at the time of transition, this false wheel slip response is of little significance aside from a small expenditure of sand. An incomplete transition sequence, on the other hand, results in a steady wheel slip indication.
Sequence the transition system – check that all shunting steps and transition into series-parallel (where applicable) and/or parallel (where applicable) is normal and that the sequence does not “hang up” (stop before completion of normal sequence). On SD’s check that contactors in No. 2 electrical cabinet (if equipped) are operating satisfactorily during sequencing.

6. WHEEL SLIP CIRCUIT

Incorrectly set or defective wheel slip devices will obviously result in false signals.

The following checks should be made:

a. Check WS and WCR circuitry and settings. Use blocked power contactor for checking settings.

b. Check IDAC with push button test. Also check IDAC operation with blocked power contactor test.

c. Check WS bridge relay circuitry and resistors.

7. TRACTION MOTOR CUT OUT CIRCUIT

Problems in the traction motor cut out circuitry can be reflected as a steady wheel slip indication.

a. Check traction motor cut out micro-switches for high resistance contacts.

b. Check that ONLY one (on GP’s) or two (on SD’s) motors can be cut out at any given time and that NO motors are cut out with cut out selector in "normal" or "all cut in" position.

8. MOTOR FIELD SHUNTING RESISTANCE

During power operation, traction motor armatures are connected in series with their fields. When a resistor is connected in parallel with a motor field, part of the motor field current is shunted through the resistor. This has the effect of weakening the motor field and reducing the back EMF, with the resultant lowering of system voltage to keep it within the limitations of the main generator. Since motor circuits are balanced before the shunting resistance is applied, equal external circuit resistances are necessary to maintain the balance and
prevent false wheel slip signals. The motor field shunting resistor and the traction motor field should be checked as follows:

a. Visually inspect all shunting resistors for broken or cracked ribbons or for loose cable connections.

b. Check that cable connections to resistors are correct according to wiring schematic and that resistors have correct part number.

On units equipped with dynamic brake a simple test can be made to determine whether a faulty shunting resistor and/or open or shorted traction motor field exists. The procedure is as follows (it is assumed that the dynamic brake system operates normally):

**To check shunting resistors**

- a. With engine running set up unit for dynamic brake — do **NOT** advance throttle.

- b. Jumper in one FS contactor for test (on SD’s jumper in FS-A and B contactors at same time).

- c. Advance throttle to Run 3.

- d. Measure voltage drop from F to FF cables at each reverser with DC voltmeter. Voltages measured should all be about equal. Any voltage that is higher than the others, indicates an open shunting resistor. The particular resistor and its connections should then be visually inspected very closely.

- e. Repeat for each other FS contactor(s).

**To check traction motor fields**

- a. With engine running and locomotive positioned over a pit, slide the rubber boots over F and FF cable “glad hands” back far enough to allow voltmeter to be touched across the two connectors — do this on all motors. Set up the unit for dynamic brake and advance throttle to Run 8 position. After allowing time for the motor fields to heat up, measure voltage drops across the F and FF “glad hands” on each motor. Any motor reading that is consistently higher or lower than the other motors indicates internal motor field problems.
9. WHEEL SLIP TRANSDUCTORS

Transductors that do not meet the specifications given in Electro-Motive Service Manuals are a possible source of false wheel slip signals.

If Steps 1 thru 8 do not reveal the cause for the false wheel slip indication, track test the locomotive and measure voltage drop across each traction motor ARMATURE. A motor reading that is consistently higher or lower than the rest indicates a faulty motor or motor circuit.

An alternate method of pinpointing an offending motor on a road test is to compare individual transductor outputs by disconnecting all but one transducer at a time. Transductor output can easily be determined by measuring the voltage across the transductor summing resistance. It should be emphasized, however, that, when a motor is connected in series with another motor, an imbalance in some cases will energize the bridge connected relays without causing a significant transductor output.
INSTRUCTION FOR USE OF BIRD No. 43 WATTMETER

<table>
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<th>TYPE RADIO</th>
<th>RADIATED POWER</th>
<th>REFLECTED POWER</th>
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<td>MOTRAN</td>
<td>20 W (Min.)</td>
<td>2 W (Max.)</td>
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<tr>
<td>MOTRAC</td>
<td>15 W (Min.)</td>
<td>2 W (Max.)</td>
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</tbody>
</table>

(1) If radiated power is less than 20 Watts for MOTRAN AND/OR less than 15 Watts for MOTRAC indication is that radio is defective and needs replacing.

(2) Reflected power more than 2 Watts indicates that the antenna, coax, or connections are defective.

NOTE: Use center scale on meter.

Record radio readings on bottom of E 5 Electrical Maintenance Sheet.
TRANSMITTER & ANTENNA TEST

Fig. 1

TRANSMITTER UNIT REMOVED

Fig. 2

RADIO RACK

SIDE VIEW

EXTENSION TEST CABLE
ENCLOSED INTERLOCK CROSS REFERENCE
( = OVERLAPPING CONTACT)

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</tbody>
</table>

1. Used on left side FSBs on SD-24.
2. Used on power contactors F-7. When used on M contactor change A-B from NC to NO contacts and remove MK number.
3. Used on power contactors and reversers, F-7. Part No. 8204206 for reversers.
4. Used on right side of FSBs on SD-24, but not used electrically.
5. Used on power contactors, BKBs, BKP's and MF on SD-24.
6. Not used on our locos. Same as 515 except has centering springs.
7. Used on right side of FSAs on SD-24.
8. Used on left side of FSAs on SD-24, N-P and QR are overlapping contacts. On pickup NP closes before QR opens and on drop out QR closes before NP opens. No centering springs.
9. Used on RVR and RVF on SD-24, EF and GH close very close behing opening of AB and CD. Top centering pin is longer than bottom pin and holds plunger flush at top of box.
11. Replaced by 8192151.

NOTE: Don't trust the MK number, always ring out interlocks to be sure. When reassembling enclosed interlock block, not that square plunger is keyed and will fit only one way without binding.
BRIGHT ADJUSTMENT B1, B2, FOR 32 VOLT

DIM ADJUSTMENT D1, D2, FOR 20 VOLT

NECESSARY TO ADD ADJUSTING TAPS TO ALL RESISTORS FOR B1, B2, D1, D2.
POLARITY CHECK AND ARC CHUTES
FOR 8200710 AND 8251126 SH CONTACTORS
AND 8200709 BF CONTACTORS

1. All "U" connected SH contactors shall be converted to the "Z" connection as outlined in Pointers November 4, 1958.

   A. Remove copper strap between front main contacts.
   
   B. Remove the wire from the right rear main contact and place it on the right front main contact.
   
   C. Connect a No. 12 wire jumper from the left front main contact to the right rear main contact.
   
   You now have a "Z" connected SH Contactor.

2. To check the polarity; connect a 1000 V DC meter positive to left rear contact negative to right front contact. With the engine off the line and the BF fuse in, lift the BF contactor by hand. Note that when the BF contactor is RELEASED the voltmeter will read up scale if the polarity is correct. Reverse the main leads on SH contactor if voltmeter reads backwards.

3. The arc chutes of the "U" and the "Z" connected SH contactors are NOT interchangeable since the magnets cast in the covers are not of the same polarity arrangement. (See Figure 1.) The arc will blow down and burn contactor if cover or polarity is wrong.

4. The long cover 8208920 will work on a "U" connected contactor but tends to arc over between (+) and (-) at the back of contactor.

5. BF contactors of this type (8200709) use the short cover 8208933 since the contacts are paralleled current will be in the same direction in both contacts just like the "Z" connected SH contactor.

6. To check the polarity of the BF contactor, with engine off the line, connect a 74V DC meter to the BF main terminals, positive to positive and negative to negative. Voltmeter should read approximately 74 V up scale. Reverse main leads if meter reads backwards.

7. Caution: No attempt should be made to saw off the back of the long cover (8208920) to make it fit a BF contactor or a "Z" connected SH contactor.
Top View

Note how much longer back is

N S S N Magnets cast in cover

"U" Connected

ARC CHUTE 8208920

Side View

Front

Top View

"Z" Connected

N S S N Magnets cast in cover

Back

ARC CHUTE 8208933

Side View

Front

Short Back

-E7.1-
SUBJECT: Smoother Application of Dynamic Brake

UNITS: F7A and GP7 units with dynamic brake

When dynamic brake was applied at high speeds, the first few steps of resistance cut out by the dynamic brake controller were too large, causing brake to apply too heavy with very little movement of the brake lever.

By relocating certain resistors in the brake controller circuit so as to put the smaller steps of resistance at the start and the larger at the end this has been eliminated.

It is important to recognize this change when replacing bad order resistors. The table below lists the correct order of the resistors from top to bottom on the panel located to left of engineer's heater on F-7's and in short hood on GP-7's.

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Clams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td></td>
</tr>
<tr>
<td>8065946</td>
<td>.75</td>
</tr>
<tr>
<td>8065947</td>
<td>.93</td>
</tr>
<tr>
<td>8065949</td>
<td>6.60</td>
</tr>
<tr>
<td>8065948</td>
<td>4.20</td>
</tr>
<tr>
<td>8005144</td>
<td>3.06</td>
</tr>
<tr>
<td>8005143</td>
<td>2.19</td>
</tr>
<tr>
<td>8005142</td>
<td>1.62</td>
</tr>
<tr>
<td>8005141</td>
<td>1.20</td>
</tr>
<tr>
<td>8065950</td>
<td>10.80</td>
</tr>
<tr>
<td>8065951</td>
<td>20.10</td>
</tr>
<tr>
<td>Bottom</td>
<td></td>
</tr>
<tr>
<td>8065952</td>
<td>1.20</td>
</tr>
<tr>
<td>8065952</td>
<td>1.20</td>
</tr>
</tbody>
</table>
1. Single Range Switch:
   a. Set cut in pressure at 130 lbs. by turning pressure adjusting nut to left to raise pressure, to right to lower pressure. This nut changes cut in and cut out pressures equally, do not attempt to set cutout pressure with this nut.
   b. Set the cutout pressure at 140 lbs. by adjusting the differential screw. Clockwise to raise cutout pressure, counter-clockwise to lower pressure. The differential screw changes only the cutout pressure.

2. Dual Range Switch:
   a. 130 lb. and 140 lb. settings on this switch are set the same as on the single range switch.
   b. To check the 145 lb. second range cut out pressure connect a jumper between the 16 and 22 pins on one of the control receptacles, the compressor should then pump to 145 - 148 lbs. and cut out. There is no adjustment for this second range cut out, if it is not within the above limits and the 130 - 140 range is set correctly, change the switch.

NOTE: A sticking magnet valve will make these switches seem to be out of adjustment, tap the compressor magnet valve to see if it is stuck. A test light across the magnet valve coil will also indicate a sticking magnet valve; if the compressor does not cut in below 130 lbs. and the test light does not light, it indicates a stuck magnet valve, change it out.
BIRD THRULINE WATTMETER MODEL 43

CAUTION — The meter element in the model 43 wattmeter is a very delicate mechanism and can be severely damaged if dropped or subjected to hard blows!

1. Theory of Operation:
   A. The model 43 wattmeter is installed at any point in a coaxial cable between the transmitter and the antenna. When the arrow on the front of the instrument is turned so that it points toward the antenna, the wattmeter shows the radio frequency power, measured in watts, generated by the transmitter and being radiated by the antenna. When the arrow is turned so that it points toward the transmitter, the wattmeter shows the amount of power being returned from the antenna.

2. Installation of Wattmeter:
   A. The wattmeter can be installed at any point in a coaxial cable such as between the cable and the antenna, between the cable and radio unit, between the cable and radio rack or between a plug-in transmitter and the rack by using the adapter cable furnished.

3. Operation of the Wattmeter:
   A. Place the wattmeter in series with the coaxial cable at some point in the line where there are connectors.
   B. Turn the arrow on the meter so that it points toward the antenna and then key the transmitter on the air with the handset.
   C. Read the power, in watts, going to the antenna on the top scale of the meter. The reading for a normal transmitter will be between 20 and 25 watts. If the reading is below 15 watts the transmitter should be changed out.
   D. To check the power being reflected by the antenna turn the arrow on the meter so that it points toward the radio unit. Again key the transmitter on the air and read the reflected power on the top scale of the meter.
   E. The reflected power reading must not exceed 5 watts. If it does exceed 5 watts, it is an indication that trouble exists somewhere in the antenna system. The trouble can be due to a defective transmitter, a defective coaxial cable or connectors or to a defective antenna.
### Interlock Data

**Type Unit:** GP7  
**Print No.:** 10013  
**With Dynamic Brake**

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>S14</td>
<td>507</td>
<td>NC</td>
<td>NO</td>
<td>8192151</td>
<td>8192153</td>
<td></td>
</tr>
<tr>
<td>S23</td>
<td>507</td>
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<td>&quot;</td>
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<tr>
<td>P1</td>
<td>507</td>
<td>NC</td>
<td>NC</td>
<td>&quot;</td>
<td>&quot;</td>
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<tr>
<td>P2</td>
<td>507</td>
<td>NC</td>
<td>NC</td>
<td>&quot;</td>
<td>&quot;</td>
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<tr>
<td>P3</td>
<td>507</td>
<td>NC</td>
<td>NO</td>
<td>&quot;</td>
<td>&quot;</td>
<td></td>
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<tr>
<td>P4</td>
<td>507</td>
<td>NC</td>
<td>NC</td>
<td>&quot;</td>
<td>&quot;</td>
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<tr>
<td>REV</td>
<td>507</td>
<td>NC</td>
<td>NO</td>
<td>8204206</td>
<td>8204231 ARM</td>
<td></td>
</tr>
</tbody>
</table>

**Contactor Layout**

- P4 S14 P1
- P3 S23 P2

### Spool No.

<table>
<thead>
<tr>
<th>Spool No.</th>
<th>Dim. &quot;A&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>8192153</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>8260395</td>
<td>7/16&quot;</td>
</tr>
<tr>
<td>8279976</td>
<td>1/4&quot;</td>
</tr>
</tbody>
</table>

(Ring out interlocks to be sure)

---

- E11 -
MARK III CALIBRATION INSTRUCTIONS

1. Calibrator Connection:
   (a) Connect one test cable from the calibrator to the speed recorder, and the other from the calibrator to the speed recorder cable.

2. Wheel Size Calibration
   (a) Set “Standard Variable” switch to “Standard”. Recorder should read 17.
   (b) Turn “wheel size adjust” pot in speed recorder using a small screwdriver to obtain an indicator reading of 17 or equal to three times the wheel diameter in inches.

   Example: 39” wheel times 3 = 117

3. Overspeed Calibration
   (a) Set “Standard Variable” switch to “Variable.”
   (b) Set calibrator frequency for desired speed (overspeed setting 65 MPH) which is displayed on indicator. This is done with the “high—low” switch (set on high) and the “variable frequency control” pot.
   (c) Turn overspeed adjust pot in speed recorder, using a small screwdriver, until “overspeed” lamp just goes off.

4. Axle Generator Test
   (a) Connect ohmeter to the two “axle generator” jacks and check for reading of 1,000 ohms ± 10%.
   (b) Connect ohmeter from “shield” jack to each of the “axle generator” jacks in turn, and check for a reading of infinite resistance.

5. Unloading Speed Recorder — Tape Recorder
   (a) Loosen upper right hand screw on first panel.
   (b) Pull out chassis carefully to stop before wires are pulled loose.
   (c) Push both retaining dips toward housing.
   (d) Lift up used roll of tape.
   (e) Remove take-up spindle.
   (f) Remove feed spindle.

6. Loading Speed Recorder — Tape Recorder
   (a) Lower front panel by loosening upper left hand screw.
   (b) Open chassis latch on right side. (CAUTION: Do Not Damage Needle On Inside of Front Panel.)
   (c) Insert feet spindle into new roll of tape.
6. Loading Speed Recorder — Tape Recorder (Cont’d)
   (d) Place supply roll in recorder notches with black side up with about 1½ foot hanging loose.
   (e) Feed tape through recorder and fold edge of tape and insert into grooves in take-up spindle.
   (f) Wrap tape around the take-up spindle until tape is snug, with chart side up.
   (g) Place take-up spindle in slots.
   (h) Push retaining clips forward to lock in place.
   (i) Snap chassis latch back in place.
   (j) Take up slack in tape, by pushing forward on lever on left hand front of recorder.
   (k) Make sure sprocket is engaged in paper.
   (l) Close face — careful not to damage needle — tighten upper left hand screw.
   (m) Slide chassis back into recorder housing and tighten upper right hand screw.

7. Calibrate Recorder
   (a) Set indicator in cab on 40 MPH and recorder should read 40 MPH on tape. If not, go to Step (b).
   (b) Adjust pot on chassis latch on right side of chassis.
<table>
<thead>
<tr>
<th>COLOR</th>
<th>TYPE AXLE DRIVE</th>
<th>TYPE PANEL (RES. BOX)</th>
<th>TYPE METER</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED</td>
<td>17MM24F1</td>
<td>17FM192A8</td>
<td>80 M.P.H.: 1 M.A. FULL SCALE</td>
</tr>
<tr>
<td>YELLOW</td>
<td>17MM24F1</td>
<td>17FM192A2</td>
<td>100 M.P.H.: 1 M.A. FULL SCALE</td>
</tr>
<tr>
<td>WHITE</td>
<td>17MM24F1</td>
<td>17FM192A4</td>
<td>100 M.P.H.: 1 M.A. FULL SCALE</td>
</tr>
<tr>
<td>GREEN</td>
<td>17MM24F1</td>
<td>17FM192-A1S1</td>
<td>0 – 10 0 – 80 1 M.A. FULL SCALE</td>
</tr>
<tr>
<td>BLUE</td>
<td>5GYAA17A2 (LARGE TYPE)</td>
<td>8901923G6</td>
<td>80 M.P.H.: 1.84 VOLTS FULL SCALE</td>
</tr>
</tbody>
</table>
# COLOR CODED SYSTEM FOR G. E. SPEED INDICATING EQUIPMENT

<table>
<thead>
<tr>
<th>MODEL LOCOMOTIVE</th>
<th>MAXIMUM RANGE</th>
<th>COLOR – BOX/METER</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP38</td>
<td>80 M.P.H.</td>
<td>RED</td>
</tr>
<tr>
<td>GP38</td>
<td>100 M.P.H.</td>
<td>YELLOW</td>
</tr>
<tr>
<td>FP7 6130 – 6149</td>
<td>100 M.P.H.</td>
<td>YELLOW</td>
</tr>
<tr>
<td>U23B 3900 – 39XX</td>
<td>100 M.P.H.</td>
<td>YELLOW</td>
</tr>
<tr>
<td>U30C 3800 – 3804</td>
<td>100 M.P.H.</td>
<td>WHITE</td>
</tr>
<tr>
<td>U33C 3805 – 3814</td>
<td>100 M.P.H.</td>
<td>WHITE</td>
</tr>
<tr>
<td>E8 6900 – 6916</td>
<td>100 M.P.H.</td>
<td>WHITE</td>
</tr>
<tr>
<td>HUMP SW1500 2300 – 2348</td>
<td>0 – 10 M.P.H., 0 – 80 M.P.H.</td>
<td>GREEN</td>
</tr>
<tr>
<td>F7 ALCO</td>
<td>80 M.P.H.</td>
<td>BLUE</td>
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</table>

- E13.1 -
### TYPES OF G.E. SPEED INDICATORS

<table>
<thead>
<tr>
<th>MPH</th>
<th>WHEEL SIZE</th>
<th>TYPE RES. BOX</th>
<th>TYPE G.E. W.S. PANEL</th>
<th>TYPE IND. METER</th>
<th>TYPE O – S</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP38 80</td>
<td>40”</td>
<td>17FM192A8</td>
<td>NONE</td>
<td>A706AC</td>
<td>17FL9CIA</td>
</tr>
<tr>
<td>GP38 100</td>
<td>40”</td>
<td>17FM192A2</td>
<td>NONE</td>
<td>A706AC</td>
<td>17FL9CIA</td>
</tr>
<tr>
<td>E8 100</td>
<td>36”</td>
<td>17FM192A4</td>
<td>17FL8A3</td>
<td>A706AC</td>
<td>17FL9CIA</td>
</tr>
<tr>
<td>GE 6 AXLE 100</td>
<td>40”</td>
<td>17FM192A4</td>
<td>17FL8A3</td>
<td>A706AC</td>
<td>17FL9CIA</td>
</tr>
<tr>
<td>GE 4 AXLE 100</td>
<td>40”</td>
<td>17FM192A4</td>
<td>17FL7A3</td>
<td>A706AC</td>
<td>17FL9CIA</td>
</tr>
<tr>
<td>ITEM</td>
<td>UNIT SWITCH</td>
<td>SERIES FORESTALLING SWITCH</td>
<td>BOOSTER SWITCH</td>
<td>HUMP CONT.</td>
<td>LOAD INC./DEC. SWITCH</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td>----------------------------</td>
<td>----------------</td>
<td>------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>1</td>
<td>LEAD UNIT (2-UNIT OPER) WITH BOOSTER</td>
<td>TWO UNIT</td>
<td>SERIES FORESTALLING</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>TRAIL UNIT (2-UNIT OPER) WITH BOOSTER</td>
<td>TWO UNIT or ONE UNIT</td>
<td>SERIES FORESTALLING</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>3</td>
<td>SINGLE UNIT (WITH BOOSTER)</td>
<td>ONE UNIT</td>
<td>SERIES FORESTALLING</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>4</td>
<td>SINGLE OR MULTIPLE (NORMAL SWITCHER)</td>
<td>ONE UNIT</td>
<td>AS REQUIRED</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>

Items (1) and (2) normal two unit hump operation with booster.

**NOTE:**

(1) To resume two unit multiple operation with booster between, shut throttle to idle, center reverser, turn booster switch to **OFF**, place unit switch in **ONE UNIT** position.

(2) When operating booster with one switch engine (item 3 above) place M.U. headlight switch on booster to **SINGLE UNIT**.
ON-BOARD TEST AND CALIBRATION FOR BARCO TAPE RECORDER & INTERFACE OPERATING WITH G.E. INDICATOR
SOUTHERN RAILWAY*

This procedure is to be used on systems already in service. For calibration on newly installed equipment or where a component of the system has been replaced, see the detailed Calibration and Troubleshooting Procedure.

1. Check for 74 volt power to recorder by opening recorder door, pull out plunger on door switch and depress rapid rewind button. Close recorder door and latch to engage door switch.

2. Connect oscillator to terminals in G. E. resistor box as outlined in G. E. indicator calibration procedure. (Test kit 17MM37A1.)

3. Adjust oscillator for 168.0 cycles. If recorder speed stylus does not match the indicated speed of the G.E. meter, adjust the wheel diameter potentiometer located within the Barco interface module.

4. Reset oscillator so that speed stylus is on the 40 mph line. Begin a timing check of tape travel between two vertical lines. These vertical lines are spaced one-quarter (¼) inch apart and represent one (1) mile of tape travel. At 40 mph, time of travel between two lines should be ninety (90) seconds. A check of ten (10) miles is recommended for greater accuracy. Adjustment for tape travel is made with the blue/white color coded potentiometer on the chart drive board in the interface module. A ten (10) mile time interval will be (at 40 mph) fifteen (15) minutes and the tape should advance ten (10) one-quarter (¼) inch vertical lines on tape.

*These instruments are to be used for recorder check only after the speed indicator is properly set.

— E15 —
**G E SPEEDOMETERS**

<table>
<thead>
<tr>
<th>Res. Box</th>
<th>Meter</th>
<th>Max Range</th>
<th>Test Kit To Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 17FM192A8</td>
<td>- A706BC</td>
<td>80 MPH—GP</td>
<td>17MM26K1</td>
</tr>
<tr>
<td></td>
<td>- A706AC</td>
<td>100 MPH E—8 G.E.</td>
<td>17MM37A1</td>
</tr>
<tr>
<td></td>
<td>- A702BK</td>
<td>100 MPH F—7, ALCO</td>
<td>ALCO Transition Rig</td>
</tr>
<tr>
<td></td>
<td>- A702HR</td>
<td>80 MPH F—7, ALCO</td>
<td>ALCO Transition Rig</td>
</tr>
<tr>
<td>(2) - 8DB17SYU419</td>
<td>- 8DB17SYU419</td>
<td>65 MPH Dual</td>
<td>Change out all 3 items if defective (Do not set)</td>
</tr>
</tbody>
</table>

**VAPOR SPEEDOMETERS**

- **Mark III Locos (2746-2752)**
  - 0 — 100 MPH
  - Mark III Tester
  - Red Box

- **Mark II**
  - 0 — 100 MPH
  - Mark II Tester
  - Blue Box

- **All Mechanical (CP)**
  - 0 — 75 MPH
  - Gear Box
  - 0 — 120 MPH
  - To Nearest MPH

**BARCO SPEEDOMETERS**

- **SIS 400**
  - 0 — 100 MPH
  - SIS 400 Tester
  - Purple Box
GENERAL

MECHANICAL SECTION
POP TESTING CYLINDERS ON
EMD ENGINES FOR CRACKED
PISTONS OR BLOWBY

1. With engine shut down remove hair pins from one linkage pin of each injector,
   leave linkage pin in place.

2. a. Pull out low oil button on governor to keep engine from starting.
   b. Leave engine run switch off to keep alarm bell from ringing.
   c. Turn fuel pump on.
   d. All test cocks must be closed.

3. Connect remote start button cable as shown in Fig. 1.

4. Remove crankcase covers from left side of engine only, all cylinders can be
   checked from this side and oil does not splash out as badly as on right side.

5. Remove linkage pin from one injector at a time and open injector to full load.

6. Man doing inspecting will operate push button and rotate engine 3 or 4
   revolutions for each cylinder tested.

7. A defective cylinder will be indicated by an unusual amount of stroke coming
   into the crankcase from cylinder under test.

   NOTE: A distinct thump or stack noise will be heard if the cylinder under
   test is firing, if not check for a bad injector or hole in piston. If the
   cylinder is not firing this test probably will not show up a cracked
   piston or blowby.

8. Repeat Steps 5 and 6 for each cylinder and replace pin after each cylinder is
   tested.

9. On completion replace hair pins on all injector linkage pins.

10. If this test does not show up a defective cylinder, check other possible
    causes of smoke in top deck and crankcase listed below:
    a. Oil separator stopped up.
    b. Bolt missing between crankcase and air box.
    c. Crack in drain pipe between top deck and crankcase.
    d. Loose injector.

— M1 —
REMOTE PUSHBUTTON HOOKUP
FOR POP TESTING EMD ENGINES
M.B. 9525

Isolation Switch Panel

Start Contactors
Note: If breaker trips or contactors do not pick up, try hooking to coil terminals.

Start Contactors
(Top View)

Start Contactors
(Top View)

- M1.1 -
SPEED SETTINGS ON SW 1500

1. Place throttle in No. 6 Position and bring to specified speeds by adjusting Fulcrum Nut. (735–743 RPM’s)

2. Move throttle to No. 8 Position and set speeds by adjusting the “D” Solenoid. (900–908 RPM’s)

3. With the throttle in No. 7 Position adjust the “A” Solenoid to set speeds. (817–825 RPM’s)

4. With the throttle in No. 4 Position, adjust the “B” Solenoid to set speeds. (571–579 RPM’s)

5. With the throttle in No. 2 Position, adjust the “C” Solenoid to set speeds. (396–426 RPM’s)

6. Check Idle Speed setting. If Idle Speed is high, lower speed by adjusting the “A” Solenoid (325–333 RPM’s). This adjustment will cause others to be off slightly.

SPEED SETTINGS ON GP 38

1. Place throttle in No. 6 Position and bring to specified speeds by adjusting Fulcrum Not. (730–738 RPM’s)

2. Move throttle to No. 8 Position and set speeds by adjusting the “D” Solenoid. (900–908 RPM’s)

3. With the throttle in No. 5 Position, adjust the “A” Solenoid to set speeds. (645–653 RPM’s)

4. With the throttle in No. 4 Position, adjust the “B” Solenoid to set speeds. (475–483 RPM’s)

5. With the throttle in No. 2 Position, adjust the “C” Solenoid to set speeds. (390–398 RPM’s)

6. Check Idle Speed Setting. If Idle Speed is high, lower speed by adjusting the “A” Solenoid (307–323 RPM’s). This adjustment will cause others to be off slightly.

PILOT VALVE SETTING ON BOTH GP – 38 AND SW 1500

Pilot Valve should be set at .83 Rack in 8th Notch.

Pilot Valve should be set at 1.75 Rack in Idle Position.
PROCEDURE FOR CHECKING INJECTORS WHILE STILL INSTALLED IN AN ENGINE USING INJECTOR POPPING TOOL

1. Start fuel pump – be sure there is fuel in 5 pounds sight glass.

2. Position layshaft lever to full fuel position.

3. Bar engine over and apply test to injectors which are at, or near, the top of their stroke. The top of the injector rocker arm roller must be below the tops of the exhaust valve rocker arm rollers on camshaft.

4. Install Injector Popping Tool astride the injector rocker arm, and position the two legs against the rocker arm shaft bearing portion of the rocker arm.

5. Use a \( \frac{3}{4} \)" drive torque wrench with an audible sound or "click" signal. Set torque wrench at 75 foot pounds and pull the injector rocker arm down.

   If the injector travels all the way down before the 75 foot pounds of torque is reached, the injector is defective and must be replaced.

   If torque wrench "clicks" or otherwise indicates 75 foot pounds before the injector moved down, the injector is OK and should not be forced down.

6. After testing is finished, release layshaft and turn off fuel pump.
THE FOLLOWING INDEPENDENT BRAKE PRESSURES ARE TO BE ADHERED TO:

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<td>FP7</td>
<td>COMPOSITION</td>
<td>32#</td>
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</table>
SETTING GOVERNOR ON PG AND SI ELECTROHYDRAULIC

1. Any excessive lateral in governor linkage should be replaced before starting. You cannot set speeds without unbalancing pilot valve. Pilot valve will have to be rechecked any time speeds are set.

2. Removed 5/16 stop block (on A, B, BC engines) and apply 7/16" end of governor block part No. 8122072 between bottom of governor and top of clevis on governor power piston. Remove cover from governor and use clevis to pull up lay shaft to make tight on block. NOTE: If C governor set pointer on governor quadrant to 1" using tail rod jack to keep in place.

3. Set all injectors to 1.00" with gage part No. 8339610. Remove tail rod jack.

4. Start engine, governor should be warm, if new power jack has been applied to governor make preliminary adjustments as follows: A, B, C, — Down All Way and screw out 3 turns. D — Screw down all way and back out out 2 turns. 0” — screw down all way and back out 2 1/2 turns.

5. (a) Put engine in 6th throttle position adjust fulcrum not to give 650 R.P.M. (b) Advance to No. 8 throttle and set 800 R.P.M. with "D" Solenoid. (c) Reduce throttle to 7 and set 725 R.P.M. with "A" Solenoid. (d) Reduce throttle to 4 and set 500 R.P.M. with "B" Solenoid. (e) Reduce to idle and set "C" Solenoid to 275 R.P.M. NOTE: Recheck these speeds to see that they are accurate. If not, reduce starting at Step 5-(a).

SETTING PILOT VALVE

1. After speeds are set, put engine in idle and set idle speed pointer on speed scale. It will probably be necessary to loosen screw and slide scale to set.

2. Advance to No. 8 throttle and make mark on scale for No. 8 speed. (NOTE: These two marks will be used for pilot valve setting — make sure they are correct.)

3. With engine still running, pull B.F. fuse set up for load and (make sure governor stays full of oil) advance to No. 3 throttle and lift load control pilot valve either with special jack or with screw driver to check position of pilot valve indicator at "0" or balance. Stop load regulator movement at 12:00 and check pointer it should be at "0" on scale, if not adjust. (If special jack is used power piston tail road pin will have to be removed to lift linkage.)

4. Stop engine. (Apply power piston tail road pin if removed.) Remove cotter key from floating linkage — don’t forget to remove 5/16" stop block.
5. Apply 1 1/32" end of block PT. No. 8122072, to power piston extension put speed jack knurled knob with female threads on speed jack stud and set speeder scale on idle which was set in Step 1. Set pilot valve indicator pointer on maximum field start mark plus and additional .015. Put .015 feeler gage between heel of pilot valve indicator arm and top of pilot valve and adjust to maximum field start by moving eccentric.

6. Apply 11/32" end of gage P.T. No. 8122072 to power piston and run speed jack to No. 8 position on speeder scale set in Step No. 2. Put .020 feeler on top of 11/32" block under power piston and adjust floating linkage to obtain zero ("0") on pilot valve pointer. If you find point on Steps 5 and 6 way out of adjustment—split difference each time setting is made. Each setting of pointer, Steps 5 and 6, will have to be CORRECT — apply cotter pin to adjusting floating linkage, remove speed jack. Apply cover to governor and seal, apply 5/16 block to power piston.

NOTE: If governor is "0" type with quadrant instead of power piston extension extension — setting is exactly same to Steps 5 & 6 in which case do the following:

(A) Set idle to 1.79 instead of using 1 1/32 block.
(B) Set full speed No. 8 to .87 instead of 11/32 + .020— scale on "C" type governor give full load setting of governor always check.
OPERATION OF THE SPEED LOG CALIBRATOR AND TESTER

(Refer to the attached sketch for clarification)

1. Apply power to the Calibrator. If 115 VAC is used, plug into wall outlet and turn on switch marked AC on. The red pilot lamp will light. For operation on 74 VDC, attach leads at an appropriate point, being careful to observe proper polarity. The amber light will light.

2. Attach cable from Calibrator output to Speed Log input (marked "pickup").

3. Set range switch to "1000". Speed Log should indicate the speed shown on chart "A" with wheel size set as shown on the chart. Additional checks can be made at the various settings of the wheel size potentiometer with the clock type face, located on the front board of the Speed Log.

4. Set range switch to "500". Speed Log should indicate the speed shown on chart "B" with wheel size set as shown on the chart. Additional checks can be made as in Step 3 using chart "B".

5. Set range switch to "250". Speed Log should indicate the speed shown on chart "C" with wheel size set as shown on the chart. Additional checks can be made as in Step 3 using chart "C".

After the above tests have been made, the following step can be made giving an indirect comparison between the Calibrator and the 60 cycle line voltage signal. This test is only possible with the calibrator operating from 115 VAC, as the signal used is obtained directly from the 60 cycle line voltage. With the range switch set at "60", and the wheel size set at 810, an indication of 06 MPH should be obtained.

6. With the range switch set at "Variable", a test can be made of both overall Speed Log operation and the operation of all indicator lamps.

With the "Hi-Lo" switch set to "Lo", speed indication up to approximately 30 MPH can be observed. With the switch set to "Hi", speed indication to over 100 MPH can be observed.

If the calibration is found to be within ± 1 MPH, this is acceptable. Any error greater than this can be corrected by slight adjustment of P1, located on the control board.

The calibrator has two fail-safe features. One protects the unit from accidental reversal of the 74 VDC leads. The calibrator will not operate and no damage will be done.

The other feature prevents the simultaneous application of both 115 VAC and 74 VDC power at the same time from damaging the unit; if both types of voltage are applied, normal operation continues from the 74 VDC.

JGJ/pm
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<td>116 (&quot;16&quot;)</td>
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**CHART “B” (RANGE SWITCH ON 500)**

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**CHART “C” (RANGE SWITCH ON 250)**

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SPEED LOG CALIBRATOR TESTER

CALIBRATOR OUTPUT

SPEED LOG (FRONT VIEW)

- M8.2 -
The 700—1 gauge tester is an entirely hand-operated, self-contained portable tester, mounted on a companion holster using CO₂ as its testing medium.

To charge tester remove from holster.

1. Refer to photograph of tester. **NOTE:** Safety relief and manual vent valve back side of tester. Depress valve to assure that all pressure is released before removing knurled chamber cap.

2. Refer to parts list and cut open view of tester. Remove knurled chamber piercing cap (Item No. 21) which should be screwed out with fingers only—**USE NO TOOLS**!

3. Remove spent CO₂ cartridge. (Item No. 27)

4. Refer to picture side of brochure. Before inserting new CO₂ cartridges be sure that needle valve “A” is closed.

5. Insert new CO₂ cartridge in handle chamber.

6. Before replacing chamber piercing cap, examine and be sure piercer (Item No. 22) is backed out against shoulder. Turn roll pin handle (Item No. 20) counter clockwise to accomplish this.

7. Replace chamber piercing cap. **USE NO TOOLS – SCREW IN FINGER TIGHT.**

8. Again check to make sure that needle valve “A” is closed. If it is not, air will escape out the safety relief and manual vent valve.

9. Turn roll pin handle (Item No. 20) clockwise all the way in to pierce the CO₂ cartridge and back it out against the shoulder. (Counter clockwise) This now charges the tester with CO₂.

10. Replace tester on holster. Tester is now charged and ready to test gauges or pressure switches.

11. Open needle valve “A” very slowly as you are releasing 900 lbs. pressure. If opened too quickly, pressure will build up of 185 psi and vent out the safety relief and manual vent valve. This, of course, protects damaging the gauge.

12. When desired pressure is reached, **GENTLY CLOSE** needle valve “A”. Pressure will be manually reduced by pressing (Item No. 1) safety relief and manual vent valve.
13. For fine VERNIER adjustment use displacement valve “B”. This can be used for one or more lbs. adjustment throughout the entire 200 lb. range.

14. If you have no leaks in the gauge complex, one cartridge should test 30 to 50 gauges.

**TESTING GAUGES**

1. See Illustration No. 3 of Report R60. **NOTE:** When the probe plug is removed, the air shuttle automatically seals off pressure to the gauges or pressure switches, therefore, you do not have to blow down the air pressure when using Salem test fittings.

2. Screw tester probe in fitting, finger tight. (No. 701–16–1 on Salem fittings and No. 701–14–1 if Prime fitting) **USE FINGERS ONLY – NO TOOLS ARE NECESSARY.**

3. Connect female hose connector (Item No. 37) by pushing on nut (Item No. 39) on probe sharply until it snaps. This charges the gauge or pressure switch. If more pressure is desired, turn displacement valve “B” clockwise. If less pressure is desired, turn displacement valve “B” counter clockwise. If it is desired to reduce pressure quickly, press gently on the safety relief and manual vent valve.

4. After gauge being tested is found to be correct, disconnect female connector (Item No. 37) by pushing **FORWARD ON OUTER RING** with knurled rings.

5. Replace probe plug.

**TESTING PRESSURE SWITCHES**

1. If pressure switch is equipped with test fitting, remove probe plug. **NOTE:** If pressure switch is equipped with Salem fitting, use test probe 701–16–1 and if equipped with Prime fitting, use probe 701–14–1. If no fitting is on pressure switch, use pressure switch coupling (Item No. 3499). Screw in either of these **finger tight.** Connect female connector to the probe or the pressure switch coupling by pushing in on Item No. 39 until it snaps. This will allow the CO₂ to charge the pressure switch.

2. Use displacement valve “B” for raising or lowering pressure on the pressure switch. By this you can determine the drop in or drop out of the pressure switch. This may be repeated several times while making adjustment.
TESTING PRESSURE SWITCHES (Cont'd)

3. After setting pressure switch, remove female connector (Item No. 37) by pushing forward on outer ring with knurled rings.

4. Replace probe plug. If bench testing, remove pressure switch coupling from pressure switch.

THIS ENTIRE OPERATION SHOULD BE PERFORMED WITHOUT THE USE OF ANY TOOLS!
SETTING ENGINE SPEEDS ON SWITCHER WITH AIR GOVERNOR

1. With the engine dead and main reservoir charged connect an air gage in the 
   \( \frac{3}{4}'' \) air line at back of the governor.

   (a) Pressure should be 14 lbs. with throttle in idle position. Adjust the
       eccentric on the transmitter in control stand to obtain this pressure.

   (b) Pressure should be 29 lbs. or over in full throttle. If not, check for air
       leaks in line or at receiver in governor. **NOTE:** If "O" ring 8223696
       between the receiver air port in the power pack and the governor is
       missing, air pressure will be low. Remove power pack to check.

       **CAUTION:** There is another "O" ring beneath the "D" valve oil
       port, do not misplace it.

       Change transmitter if above does not help.

2. The "O" valve and the "D" valve will have to be checked before speeds are set.

3. With the engine shut down and governor plug pulled out.

   (a) "O" Valve:
       Loosen the lock nut on the "O" valve, bottom the adjusting screw,
       then back out two turns and lock.

       **NOTE:** This adjustment is necessary, even if the "O" valve is not active.

   (b) "D" Valve:
       There are two styles of "D" valve plungers, loosen the lock nut and
       remove the adjusting screw to identify plunger.

       1. The new style has a 1/4 x 28 hole in the top of plunger and has
          a set screw with a locking screw on top of it in the bottom of the
          hole.

       2. The old style does not have this hole in top of the plunger.

   (c) To adjust the old style "D" valve, bottom the adjusting screw, then
       back out two turns and lock.

   (d) To adjust the new style "D" valve, remove the adjusting screw and lock
       nut. Using a small steel rule, note the dimension from the top of
       the plunger to the top of the solenoid case. Using the rule, push the plunger
       down as far as it will go and note the amount of travel. It should be
       1/16". If the travel is correct, bottom the adjusting screw, then back
       out 2½ turns and lock.
1. If the travel is not correct, remove the plunger, using a 1/4 x 28 bolt as a lifter. Remove the upper locking screw from the plunger (See Fig. 11-12), then adjust the lower set screw for 1/16” plunger travel. Screw in for more travel, screw out for less travel. Replace locking screw after correct travel is obtained. Repeat Step 3-D.

4. Setting the speeds:
   (a) Start the engine and with throttle in idle and 14 lbs. of air on gage at governor, adjust the fulcrum nut for 275 RPM’s in idle. See Item 1, Fig. 11–15.
   (b) With the throttle in No. 8 and over 28 lbs. on gage, set the high speed stop screw for 800 RPM’s. See Item 2, Fig. 11–15.

   Check speed again after lock nut is tightened.

   NOTE: If 800 RPM’s cannot be reached with 29 lbs. air pressure, refer to 567-B engine manual, 3rd Edition, Page 1133, Step 8, or change governor.

5. If engine speeds are changed, pilot valve will have to be checked.
### FIRING ORDER AND TOP DEAD CENTER
12 CYLINDER 567–A AND 567–B ENGINES

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FIRING ORDER AND TOP DEAD CENTER
6 CYLINDER 567-A – 567-B ENGINES

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# FIRING ORDER AND TOP DEAD CENTER

16 CYLINDER 567-8 AND 567-C ENGINES

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<td>B-85</td>
<td>Traction motor blower, 660 HP Switcher</td>
<td>2</td>
</tr>
<tr>
<td>C-112</td>
<td>Exciter, passenger, 1000 HP &amp; 660 HP Switcher</td>
<td>2</td>
</tr>
<tr>
<td>B-75</td>
<td>Traction motor blower, passenger</td>
<td>3</td>
</tr>
<tr>
<td>C-180</td>
<td>Radiator fan drive, passenger</td>
<td>6</td>
</tr>
<tr>
<td>C-120</td>
<td>ALCO 1500 HP generator belts, road engine</td>
<td>7</td>
</tr>
</tbody>
</table>
### DIESEL LOCOMOTIVE V BELT DATA (Cont'd)

<table>
<thead>
<tr>
<th>Dayton Number</th>
<th>Application</th>
<th>Belts Per Set</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BALDWIN Diesels</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-128</td>
<td>Auxiliary generator drive, 1000 HP &amp; 660 HP Switcher</td>
<td>5</td>
</tr>
<tr>
<td>A-35</td>
<td>Traction motor blower drive, 1000 HP &amp; 660 HP Switcher</td>
<td>3</td>
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<tr>
<td>C-105</td>
<td>Radiator fan drive, 660 HP Switcher</td>
<td>4</td>
</tr>
<tr>
<td>C-105</td>
<td>Radiator fan drive, 1000 HP Switcher</td>
<td>7</td>
</tr>
<tr>
<td><strong>GENERAL ELECTRIC DIESELS, 44-Ton</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-128</td>
<td>Compressor and exciter drive</td>
<td>3</td>
</tr>
<tr>
<td>C-75</td>
<td>Fan drive</td>
<td>2</td>
</tr>
<tr>
<td><strong>GENERAL ELECTRIC DIESELS, 70-Ton</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-75</td>
<td>Cooling fan</td>
<td>3</td>
</tr>
<tr>
<td>C-105</td>
<td>Air compressor Auxiliary generator</td>
<td>4</td>
</tr>
<tr>
<td>B-112</td>
<td>Traction Motor blower</td>
<td>3</td>
</tr>
<tr>
<td><strong>Steam Generators, 4625</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-38</td>
<td>Steam generator motor to pump</td>
<td>2</td>
</tr>
<tr>
<td>B-64</td>
<td>Steam generator motor to blower</td>
<td>2</td>
</tr>
<tr>
<td>B-80</td>
<td>Main generator to traction motor, 1500 HP ALCO</td>
<td>4</td>
</tr>
<tr>
<td><strong>FAIRBANKS MORSE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CX 120</td>
<td>2100 Class — auxiliary generator and exciter</td>
<td>4</td>
</tr>
<tr>
<td>CX 196</td>
<td>6500 Class — auxiliary generator and exciter</td>
<td>5</td>
</tr>
<tr>
<td>CX 136</td>
<td>6300 Class — auxiliary generator and exciter</td>
<td>8 &amp; 3</td>
</tr>
</tbody>
</table>
As part of Electro-Motive's continuing effort to improve engine performance, the depth of the lead-in overlay on engine main bearings has been increased approximately 55%. The thicker layer of material provides improved formability of the bearing to the crankshaft - which will improve the bearing life.

Effective immediately all new and remanufactured engines will be equipped with the new main bearings. The new bearings are fully interchangeable and can be mixed in an engine with the former bearings, however, it is recommended that only the new bearings be used in turbocharged 645 engines and they should be installed according to the latest torque specifications. This latest design bearing is available - AT NO INCREASE IN PRICE!

ORDERING REFERENCE - MAIN BEARINGS - 567 AND 645

<table>
<thead>
<tr>
<th>NEW PART NO.</th>
<th>REPLACES SIZE ENGINE</th>
<th>NBR. REQ'D PER ENGINE</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6  8 12 16 20</td>
<td></td>
</tr>
</tbody>
</table>

**NEW PART NO. **| **REPLACES SIZE ENGINE** | **NBR. REQ'D PER ENGINE** |  **PRICE** 
| 845866 813816 | Std. | 3 4 5 7 9 | $16.40 |
| 813863 813765 | 1/32 US | 3 4 5 7 9 | 21.65 |
| 813504 813766 | 1/16 US | 3 4 5 7 9 | 30.70 |
| 845865 813767 | 3/32 US | 3 4 5 7 9 | 31.30 |
| 845868 813768 | 1/8 US | 3 4 5 7 9 | 31.30 |

<table>
<thead>
<tr>
<th>NEW PART NO.</th>
<th>REPLACES SIZE ENGINE</th>
<th>NBR. REQ'D PER ENGINE</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6  8 12 16 20</td>
<td></td>
</tr>
</tbody>
</table>

**NEW PART NO. **| **REPLACES SIZE ENGINE** | **NBR. REQ'D PER ENGINE** |  **PRICE** 
| 845596 807781 | Std. | 3 4 5 7 9 | $15.90 |
| 809740 809746 | 1/32 US | 3 4 5 7 9 | 20.25 |
| 809747 809748 | 1/16 US | 3 4 5 7 9 | 29.90 |
| 809749 809750 | 3/32 US | 3 4 5 7 9 | 31.30 |
| 809740 809748 | 1/8 US | 3 4 5 7 9 | 31.30 |

**NEW PART NO. **| **REPLACES SIZE ENGINE** | **NBR. REQ'D PER ENGINE** |  **PRICE** 
| 845585 813818 | Std. | 3 4 5 7 9 | $19.75 |
| 813851 813903 | 1/32 US | 3 4 5 7 9 | 35.00 |
| 813502 813904 | 1/16 US | 3 4 5 7 9 | 48.00 |
| 813503 813905 | 3/32 US | 3 4 5 7 9 | 36.00 |
| 813502 813906 | 1/8 US | 3 4 5 7 9 | 37.05 |

**NEW PART NO. **| **REPLACES SIZE ENGINE** | **NBR. REQ'D PER ENGINE** |  **PRICE** 
| 845567 807782 | Std. | 3 4 5 7 9 | $17.90 |
| 809740 809746 | 1/32 US | 3 4 5 7 9 | 23.40 |
| 809747 809751 | 1/16 US | 3 4 5 7 9 | 34.45 |
| 809749 809750 | 3/32 US | 3 4 5 7 9 | 31.30 |
| 809740 809748 | 1/8 US | 3 4 5 7 9 | 36.40 |

*567A, B, BC, C & D2 Engines only.*
<table>
<thead>
<tr>
<th>Type Power</th>
<th>Type Brakes</th>
<th>Type Relay</th>
<th>Type Shoes</th>
<th>Brake Cylinder Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>F &amp; Alco</td>
<td>2r RL</td>
<td>B3</td>
<td>Cast Iron</td>
<td>45 PSI</td>
</tr>
<tr>
<td>GP-7 &amp; 9's</td>
<td>24 RL</td>
<td>B3</td>
<td>Cast Iron</td>
<td>45</td>
</tr>
<tr>
<td>GP-38's</td>
<td>24 RL</td>
<td>J46B &amp; J64</td>
<td>Composition</td>
<td>32</td>
</tr>
<tr>
<td>GP-18</td>
<td>26L</td>
<td>J1</td>
<td>Cast Iron</td>
<td>45</td>
</tr>
<tr>
<td>GP-18</td>
<td>26L</td>
<td>J64</td>
<td>Composition</td>
<td>32</td>
</tr>
<tr>
<td>GP-38's(2716-2879)</td>
<td>26L</td>
<td>J64</td>
<td>Composition</td>
<td>32</td>
</tr>
<tr>
<td>GP-38's(5000-5138)</td>
<td>26L</td>
<td>J16-16</td>
<td>Composition</td>
<td>72</td>
</tr>
<tr>
<td>GP-30 &amp; 35's</td>
<td>26L</td>
<td>J46B</td>
<td>Composition</td>
<td>32</td>
</tr>
<tr>
<td>SD-24's</td>
<td>26L</td>
<td>J14-14</td>
<td>Composition</td>
<td>63</td>
</tr>
<tr>
<td>SD-35's</td>
<td>26L</td>
<td>J14-14</td>
<td>Composition</td>
<td>63</td>
</tr>
<tr>
<td>U-30-C's (3800-3804)</td>
<td>26L</td>
<td>J14-14</td>
<td>Composition</td>
<td>63</td>
</tr>
<tr>
<td>SD-45's(3105-3119)</td>
<td>26L</td>
<td>J14-14</td>
<td>Composition</td>
<td>63</td>
</tr>
<tr>
<td>SD-45's(3100-3104)</td>
<td>26L</td>
<td>J16-16</td>
<td>Composition</td>
<td>72</td>
</tr>
<tr>
<td>SD-45's(3120)</td>
<td>26L</td>
<td>J16-16</td>
<td>Composition</td>
<td>72</td>
</tr>
<tr>
<td>SD-45's(3160-3169)</td>
<td>26L</td>
<td>J16-16</td>
<td>Composition</td>
<td>72</td>
</tr>
<tr>
<td>U-33-C's (3805-3814)</td>
<td>26L</td>
<td>J64B</td>
<td>Composition</td>
<td>32</td>
</tr>
<tr>
<td>U-23-B's (3900-3934)</td>
<td>26L</td>
<td>J64B</td>
<td>Composition</td>
<td>32</td>
</tr>
</tbody>
</table>

As information, the E-8 locomotives with the cast iron shoes presently carry 26 p.s.i. brake cylinder pressure. During the year all of the E-8 units will be converted to composition shoes and will have a pressure of 32 p.s.i.
INJECTOR IDENTIFICATION MARKS

VIEW OF FRONT BODY FACE

567 B INJECTOR
FOR ALL SWITCHES EXCEPT CW 1500
P-7 GT-7 2-8

567 C INJECTOR
FOR GT-9 SD-9 GF-13

567 D INJECTOR
(USE EITHER TYPE IN ANY SD-24, SD-35, GP-30, AND GF-35)

645 BI-PIN TYPE
FOR CW 1500 GT-33

- M17 -
# INJECTOR PART NUMBERS AND TIMING REFERENCE

**Rev. 2-12-73**

| SW1  | 600 HP | 5228565 | 8276707 | 8477972 | 4° BTDC |
| SW8  | 800 HP | 5228565 | 8276707 | 8477972 | 4° BTDC |
| NW2  | 1000 HP | 5228565 | 8276707 | 8477972 | 4° BTDC |
| NW5  | 1000 HP | 5228565 | 8276707 | 8477972 | 4° BTDC |
| TR2  | 1000 HP | 5228565 | 8276707 | 8477972 | 4° BTDC |
| TR2B | 1000 HP | 5228565 | 8276707 | 8477972 | 4° BTDC |
| SW7  | 1200 HP | 5228565 | 8276707 | 8477972 | 4° BTDC |
| SW9  | 1200 HP | 5228565 | 8276707 | 8477972 | 4° BTDC |
| SW15 | 1500 HP (645) | 5228830 | 5229200 | 8369058 | 8478045 | 4° BTDC |

**GENERAL PURPOSE:**

| GP7  | 5228565 | 8276707 | 8477972 | 4° BTDC |
| GP9  | 5228540 | 8276708 | 8477971 | 4° BTDC |
| GP18 | 5228540 | 8276708 | 8477971 | 4° BTDC |
| GP30 | 5228750 | 5229285 | 8296452 | 8478047 | 0° BTDC |
| GP35 | 5228750 | 5229285 | 8296452 | 8478047 | 0° BTDC |
| GP38 (645) | 5228830 | 5229200 | 8369058 | 8478045 | 4° BTDC |

**SPECIAL DUTY:**

| SD7  | 5228565 | 8276707 | 8477972 | 4° BTDC |
| SD9  | 5228540 | 8276708 | 8477971 | 4° BTDC |
| SD24 | 5228750 | 5229285 | 8296452 | 8478047 | 0° BTDC |
| SD35 | 5228750 | 5229285 | 8296452 | 8478047 | 0° BTDC |
| SD40 | 5228995 | 5229250 | 8369044 | 8478046 | 0° BTDC |
| SD45 | 5228995 | 5229250 | 8369044 | 8478046 | 0° BTDC |

**PASSENGER:**

| 5228565 | 8276707 | 8477972 | 4° BTDC |

**FREIGHT:**

| F7 - FP7 | 5228565 | 8276707 | 8477972 | 4° BTDC |

All locomotives Atlanta Shop EXCEPT GP-38's, SW-1500's (645 engines) use one of the following injections: **5228565, 8276707-8477972**.

All 645 engines use **5228830, 5229200, 8369058 or 8478045**.
# G E Speedometers

<table>
<thead>
<tr>
<th>Res. Box</th>
<th>Meter</th>
<th>Max Range</th>
<th>Test Kit to Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>17FM192A8</td>
<td>A706BC - 1 M.A. Full Scale</td>
<td>80 MPH — GP Small Gen.</td>
<td>17MM26K1</td>
</tr>
<tr>
<td>17FM192A4</td>
<td>A706AC - 1 M.A. Full Scale</td>
<td>100 MPH E—8 G.E. Small Gen.</td>
<td>17MM37A1</td>
</tr>
<tr>
<td>8DB17SYU4Z</td>
<td>A702BK - F-7, ALCO Large Gen.</td>
<td>100 MPH</td>
<td>ALCO Transition Rig</td>
</tr>
<tr>
<td>8DB17SYU423</td>
<td>A702HR - F-7, ALCO Large Gen.</td>
<td>80 MPH</td>
<td>ALCO Transition Rig</td>
</tr>
<tr>
<td>8DB17SYU419</td>
<td>8DB17SYU419 - 10 MPH Scale (Hump Only)</td>
<td>65 MPH Dual</td>
<td>Change out all 3 items if defective (Do not set)</td>
</tr>
</tbody>
</table>

## Vapor Speedometers

- **Mark III Locos (2746-2752)** 0 — 100 MPH Mark III Tester Red Box
- **Mark II** 0 — 100 MPH Mark II Tester Blue Box
- **All Mechanical (CP)** 0 — 75 MPH Gear Box 0 — 120 MPH To Nearest MPH

## Barco Speedometers

- **SIS 400** 0 — 100 MPH SIS 400 Tester Purple Box
### LOCOMOTIVE ADAPTER SIZES AND VENT TUBE LENGTHS

<table>
<thead>
<tr>
<th>LOCOMOTIVE TYPE</th>
<th>VENT TUBE LENGTH (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMD</td>
<td></td>
</tr>
<tr>
<td>E8</td>
<td>18”</td>
</tr>
<tr>
<td>F7 - FP7</td>
<td>10”</td>
</tr>
<tr>
<td>GP 7</td>
<td>22”</td>
</tr>
<tr>
<td>GP 9</td>
<td>22”</td>
</tr>
<tr>
<td>GP 18</td>
<td>22”</td>
</tr>
<tr>
<td>GP 30</td>
<td>22”</td>
</tr>
<tr>
<td>GP 35 (EMD Trucks)</td>
<td>22”</td>
</tr>
<tr>
<td>GP 35 (Alco Trucks)</td>
<td>19”</td>
</tr>
<tr>
<td>GP 38 (1700 &amp; 2600 Gal.)</td>
<td>13”</td>
</tr>
<tr>
<td>SD 7</td>
<td>10”</td>
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<tr>
<td>SD 9</td>
<td>10”</td>
</tr>
<tr>
<td>SD 24</td>
<td>20”</td>
</tr>
<tr>
<td>SD 35</td>
<td>* See Note</td>
</tr>
<tr>
<td>SD 45</td>
<td>16”</td>
</tr>
<tr>
<td>NW 2</td>
<td>13”</td>
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<tr>
<td>NW 5</td>
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</tr>
<tr>
<td>SW 1</td>
<td>13”</td>
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<td>SW 7</td>
<td>13”</td>
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<td>SW 8</td>
<td>13”</td>
</tr>
<tr>
<td>SW 1500</td>
<td>3”</td>
</tr>
<tr>
<td>ALCO</td>
<td></td>
</tr>
<tr>
<td>RS 3 (800 Gal. Tank)</td>
<td>-</td>
</tr>
<tr>
<td>RS 3 (1200 Gal. Tank)</td>
<td>10”</td>
</tr>
<tr>
<td>RS 3 (1400 Gal. Tank)</td>
<td>24”</td>
</tr>
<tr>
<td>RS 3 (1600 Gal. Tank)</td>
<td>-</td>
</tr>
<tr>
<td>RS 11</td>
<td>11”</td>
</tr>
<tr>
<td>GE</td>
<td>9”</td>
</tr>
<tr>
<td>U30C</td>
<td></td>
</tr>
<tr>
<td>U33C</td>
<td>9”</td>
</tr>
</tbody>
</table>

* There are two lengths of cut off tubes on the SD-35’s; the filler neck that protrudes out beyond the side of unit is 17½” and the filler neck that is recessed or even with the side of the unit is 13½” long.
PROCEDURE NO. 1
INSTALLATION, TIME AND RACK SETTING
OF INJECTORS – BLOWER ENGINES

INSTALLATION

1. When installing an injector in an engine, make sure it is the correct injector for the engine in which it is to be applied.

   NOTE: Attached is a copy of INJECTOR PART NUMBERS AND TIMING REFERENCE chart.

2. See that injector body and tapered hole in cylinder head are clean.

3. Install injector and apply injector holdown crab, spherical washer and nut. Torque nut to 50 ft-lbs.

4. Connect injector rack to lever assemble.

5. Install and tighten fuel supply and return lines to injector and engine fuel manifold.

6. Install rocker arm shaft and rocker arms. Loosen injector rocker arm locknut and back off on adjusting screw before tightening rocker arm shaft nuts. Injector is now ready for timing.

TIMING

1. Set the flywheel at 4° before top dead center of the cylinder being timed.

2. Insert injector timing guage into the hole provided for it in the injector body.

3. Loosen locknut and turn the rocker arm adjusting screw until the shoulder of the gauge just passes over the injector follower guide.

   NOTE: Injectors cannot be timed if the overspeed has been tripped. It must first be reset and the engine crankshaft barred over at least one revolution.

4. Tighten adjusting screw locknut, holding adjusting screw in position with a screwdriver.

5. Recheck setting.
SETTING INJECTOR RACKS

Injector racks should be set with the engine at operating temperature. If racks are set when engine is not at operating temperature, the setting should be rechecked when operating temperature is reached. As engine temperature increases right bank rack length shortens and the left bank rack length increases. The change on the left bank is insignificant, but the change on right bank may shorten the racks beyond the minus $1/64''$ tolerance.

NOTE: Every time a governor is installed on an engine the injector rack setting must be checked.

Set the injector rack on the engine as follows:

1. Position the injector control lever so that the pointer on the governor aligns with the governor terminal shaft scale at approximately the $1.00''$ position.

2. Place one hook of the governor jack around the lever on the governor terminal shaft. Place the other hook on the bearing brackets forward of the injector control lever. Adjust the turnbuckle on the governor jack until the governor pointer aligns within $\pm 1/64''$ of the $1.00''$ position on the scale.

3. After the injector control lever has been properly positioned, the injector rack is set, using a rack gauge, Part No. 8339610. The rack setting gauges are 8 to 1 multiplying gauges which indicate the plus or minus $1/64''$ rack setting tolerance by means of marks $1/8''$ each side of the center mark on the gauge scale.

4. It is important that the proper rack gauge be used, as previous model rack gauges will measure the rack length from the body of the injector instead of the face of the calibrating slide. The correct gauge for setting injectors with calibrating slides can be readily identified by the red plastic handle. This gauge can be used for all injectors.

5. Place the gauge over the injector rack and hold the gauge firmly against the face of the adjustable calibrating slide on the injector, and check the gauge pointer. If the pointer is to the short ("S") end of gauge scale center mark, the rack is not extending out far enough from the injector. Loosen the lock-nut on the adjusting link and turn adjusting nut on link until pointer is at long ("L") end of the scale; then reverse pointer travel until it aligns within $\pm 1/64''$ of the scale center mark. Hold adjusting nut and tighten locknut. The reason for exceeding the scale center mark when making adjustment is so that, in setting all of the racks, the backlash will be taken up in the same direction.

When pointer is at long ("L") end of scale, set pointer within $\pm 1/64''$ of the center mark. The accuracy of the injector rack gauge can be checked by inserting the master block in the gauge body. Pointer should align with center mark on the scale.

— M21.1 —
REPORT OF MECHANICAL SPEED RECORDER TEST

The speed recorder on Unit __________ has been serviced and maintained on this date.

1. Date of last overhaul ______________________________
   (If speed recorder is more than one (1) year old renew.)
   SIGNATURE

2. Was speed recorder renewed? ________________________

3. Speed recorder filled with red oil.

4. Applied grease to angle drive and cable.

5. Check condition of drive cable and hose, correct any defects noted.

6. Check angle drive for proper operation.

7. Check light and correct any defects.

8. Rim thickness of drive wheel. ________________________

9. When making adjustments in order to get speed recorder to register correctly, always turn adjusting screw counter-clockwise and bring up to correct setting by turning adjustment screw clockwise. If the point is passed, turn the adjustment screw counter-clockwise again and make correct setting by turning the adjustment screw clockwise to correct setting.

<table>
<thead>
<tr>
<th>Wheel Rim Thickness (Nearest Whole No.)</th>
<th>Set Speed Recorder Tester to run as Follows:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8 MPH</td>
</tr>
<tr>
<td></td>
<td>Set Speed Recorder A +</td>
</tr>
<tr>
<td>1&quot;</td>
<td>7.5 MPH</td>
</tr>
<tr>
<td>1-¼&quot;</td>
<td>7.5 MPH</td>
</tr>
<tr>
<td>2&quot;</td>
<td>8 MPH</td>
</tr>
<tr>
<td>2-½&quot;</td>
<td>8 MPH</td>
</tr>
<tr>
<td>3&quot;</td>
<td>8 MPH</td>
</tr>
</tbody>
</table>

Locomotive Overspeed

Record of Sp. Rec. readings as found.

Record of Sp. Rec. reading as left.
<table>
<thead>
<tr>
<th>ITEM</th>
<th>FT. LBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYLINDER HEAD CRAB NUTS</td>
<td>1800</td>
</tr>
<tr>
<td>CYLINDER HEAD-TO-LINER NUTS</td>
<td>200</td>
</tr>
<tr>
<td>ROCKER ARM SHAFT NUTS</td>
<td>300</td>
</tr>
<tr>
<td>EXHAUST STACKS</td>
<td>130</td>
</tr>
<tr>
<td>TOP DECK FRAME BOLTS</td>
<td>30</td>
</tr>
<tr>
<td>INJECTOR CRAB NUTS</td>
<td>50</td>
</tr>
<tr>
<td>INJECTOR FUEL LINES</td>
<td>40</td>
</tr>
<tr>
<td>ACCESSORY DRIVE COVER</td>
<td>65</td>
</tr>
<tr>
<td>OVERSPEED TRIP HOUSING</td>
<td>65</td>
</tr>
<tr>
<td>WATER PUMP MOUNTING BOLTS</td>
<td>65</td>
</tr>
<tr>
<td>WATER PUMP ELBOWS</td>
<td>65</td>
</tr>
<tr>
<td>SCAVENGING &amp; LUBE OIL PUMPS</td>
<td>65</td>
</tr>
<tr>
<td>SCAVENGING &amp; LUBE PUMP ELBOWS</td>
<td>65</td>
</tr>
<tr>
<td>GOVERNOR DRIVE MOUNTING BOLTS</td>
<td>65</td>
</tr>
<tr>
<td>OIL STRAINER HOUSING &amp; ELBOWS</td>
<td>65</td>
</tr>
<tr>
<td>ENGINE BLOWER SUPPORTS</td>
<td>65</td>
</tr>
<tr>
<td>BLOWER TO SUPPORT</td>
<td>65</td>
</tr>
<tr>
<td>BLOWER DRAIN LINES</td>
<td>65</td>
</tr>
<tr>
<td>AUXILIARY DRIVE HOUSING TO ENGINE</td>
<td>175</td>
</tr>
<tr>
<td>BLOWER END HOUSING COVER TO CRANKCASE</td>
<td>65</td>
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<tr>
<td>*CRANKCASE TO OIL PAN</td>
<td>*450</td>
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<tr>
<td>WATER JUMPER TO LINER</td>
<td>30</td>
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<tr>
<td>BASKET TO CON. ROD (SERRATED)</td>
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<tr>
<td>SPLIT BASKET 1/2 – 20 BOTTOM BOLTS</td>
<td>75</td>
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<tr>
<td>MAIN BEARING</td>
<td>800</td>
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*USE 36" WRENCH AND APP. 150 LBS. PULL TO OBTAIN THIS VALVE.
## G. E. Diesel Engine Torque Chart

<table>
<thead>
<tr>
<th>CYLINDER ASSEMBLY</th>
<th>FT. LB.</th>
<th>PREFERRED GE TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYLINDER HOLDDOWN BOLTS</td>
<td>1300 - 1400</td>
<td><strong>147X1568</strong> SET AIR REGULATOR AT 43 PSI MOTOR RUNNING</td>
</tr>
<tr>
<td>CAUTION:</td>
<td></td>
<td>UNLOADED</td>
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<tr>
<td>CYLINDER HOLDDOWN MOUNTING INSERTS</td>
<td>375 - 400</td>
<td><strong>147X1823</strong> TORQUE WRENCH</td>
</tr>
<tr>
<td>INSECTION PUMP MOUNTING BOLTS</td>
<td>45 - 50</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
</tr>
<tr>
<td>FUEL NOZZLE BUSHING (2 PC. CYLINDERS)</td>
<td>200 - 220</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
</tr>
<tr>
<td>FUEL NOZZLE STUD</td>
<td>55 - 60</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
</tr>
<tr>
<td>FUEL NOZZLE MOUNTING NUTS</td>
<td>30 - 35</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
</tr>
<tr>
<td>TAPPET SCREW LOCKNUTS</td>
<td>50 - 55</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
</tr>
<tr>
<td>HIGH PRESSURE FUEL LINE NUTS (SMALL SYSTEM)</td>
<td>65 - 70</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
</tr>
<tr>
<td>HIGH PRESSURE FUEL LINE NUTS (LARGE SYSTEM)</td>
<td>140 - 150</td>
<td><strong>147X1592</strong> TORQUE KIT WITH</td>
</tr>
<tr>
<td>COMPRESSION RELIEF ADAPTOR</td>
<td>60 - 65</td>
<td><strong>147X1879</strong> ADAPTOR</td>
</tr>
<tr>
<td>COMPRESSION RELIEF PLUG</td>
<td>30 - 35</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
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### Intake and Exhaust

<table>
<thead>
<tr>
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<th>FT. LB.</th>
<th>PREFERRED GE TOOLS</th>
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</thead>
<tbody>
<tr>
<td>EXHAUST STACK CLAMPING BOLTS</td>
<td>55 - 60</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
</tr>
<tr>
<td>EXHAUST MANIFOLD TO CYLINDER BOLTS</td>
<td>105 - 115</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
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<tr>
<td>INTAKE MANIFOLD TO CYLINDER BOLTS</td>
<td>55 - 60</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
</tr>
<tr>
<td>TURBOCHARGER INLET BOLTS</td>
<td>70 - 75</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
</tr>
<tr>
<td>MAIN PIPE CLAMPING BOLTS (SINGLE PIPE)</td>
<td>70 - 75</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
</tr>
<tr>
<td>Elbow CLAMPING BOLTS (SINGLE PIPE)</td>
<td>18 - 20</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
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<tr>
<td>EXHAUST MANIFOLD MOUNTING BOLTS (SINGLE PIPE)</td>
<td>50 - 55</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
</tr>
<tr>
<td>EXHAUST MANIFOLD SECTION TO TURBO BOLTS</td>
<td>70 - 75</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
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<tr>
<td>EXHAUST PIPE TO TURBOCHARGER CLAMP BOLTS</td>
<td>90 - 100</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
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</table>

### Connecting Rod

<table>
<thead>
<tr>
<th>CYLINDER ASSEMBLY</th>
<th>FT. LB.</th>
<th>PREFERRED GE TOOLS</th>
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<tbody>
<tr>
<td>MASTER ROD CAP STUD (ROD WITH STUDS)</td>
<td>200</td>
<td><strong>147X1823</strong> TORQUE WRENCH</td>
</tr>
<tr>
<td>MASTER ROD CAP NUTS (RODS WITH STUDS)</td>
<td>450 - 470</td>
<td><strong>147X1823</strong> TORQUE WRENCH</td>
</tr>
<tr>
<td>MASTER ROD CAP BOLTS</td>
<td>600 - 420</td>
<td><strong>147X1823</strong> TORQUE WRENCH</td>
</tr>
<tr>
<td>ART ROD PIN BUSHING CLAMPING BOLTS</td>
<td>35 - 40</td>
<td><strong>147X1592</strong> TORQUE KIT</td>
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<tr>
<td>ART ROD PIN BOLTS</td>
<td>375</td>
<td><strong>147X1823</strong> TORQUE WRENCH</td>
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<tr>
<td>PISTON PIN BOLTS</td>
<td>250</td>
<td><strong>147X1823</strong> TORQUE WRENCH</td>
</tr>
<tr>
<td>LOCKING PLATE LOCKNUTS (EARLIER STYLE ART</td>
<td>30 - 35</td>
<td><strong>147X1822</strong> TORQUE WRENCH</td>
</tr>
<tr>
<td>ROD &amp; PISTON PIN BOLTS</td>
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**- M24 -**
<table>
<thead>
<tr>
<th>MAIN BEARINGS</th>
<th>FT. LB.</th>
<th>PREPARED GE TOOLS</th>
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</thead>
<tbody>
<tr>
<td>BEARING CAP SIDE BOLTS</td>
<td>265 - 275</td>
<td>147X1823 TORQUE WRENCH</td>
</tr>
<tr>
<td>MAIN BEARING STUDS (STRETCH PREFERRED)</td>
<td>.027&quot; - .033&quot;</td>
<td>147X1860 STRETCH GAGE</td>
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<tr>
<td>MAIN BEARING CAP NUTS</td>
<td>1400 - 1500</td>
<td>(REFER TO OPERATING INSTRUCTIONS PROVIDED WITH WRENCH USED.)</td>
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<table>
<thead>
<tr>
<th>TURBOCHARGER</th>
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</thead>
<tbody>
<tr>
<td>TURBOCHARGER MOUNTING BOLTS</td>
<td>150 - 165</td>
<td>147X1592 TORQUE KIT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>147X1637 WRENCH ADAPTOR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(SET TORQUE WRENCH FOR 115 LB. FT.)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>ENGINE AND GENERATOR MOUNTING BOLTS</th>
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</thead>
<tbody>
<tr>
<td>REAR PEDESTAL MOUNTING BOLTS (GEN. END)</td>
<td>600 - 650</td>
<td>147X1825 TORQUE WRENCH</td>
</tr>
<tr>
<td>FRONT PEDESTAL MOUNTING BOLTS (FREE END)</td>
<td>125</td>
<td>147X1823 TORQUE WRENCH</td>
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<tr>
<td>ENGINE FRAME TO PEDESTAL (HORIZONTAL STRETCH BOLT)</td>
<td>.055&quot;</td>
<td>147X1860 STRETCH GAGE</td>
</tr>
<tr>
<td>GEN/ALT FRAME TO ENGINE FRAME BOLTS</td>
<td>625 - 675</td>
<td>147X1825 TORQUE WRENCH</td>
</tr>
<tr>
<td>CRANKSHAFT TO GEN/ALT ROTOR BOLTS (WITH WASHERS)</td>
<td>1040 - 1160</td>
<td>147X1825 TORQUE WRENCH WITH ITS EXTENSION</td>
</tr>
<tr>
<td></td>
<td></td>
<td>147X1730 WRENCH</td>
</tr>
<tr>
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<td></td>
<td>147X1731 SOCKET</td>
</tr>
<tr>
<td>CRANKSHAFT TO GEN/ALT ROTOR BOLTS (WITHOUT WASHERS)</td>
<td>975 - 1025</td>
<td>147X1825 TORQUE WRENCH WITH ITS EXTENSION</td>
</tr>
<tr>
<td></td>
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<td>147X1730 WRENCH</td>
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<tr>
<td></td>
<td></td>
<td>147X1731 SOCKET</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(READ 650-685 LB. FT. ON TORQUE WRENCH)</td>
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<table>
<thead>
<tr>
<th>CAMSHAFT</th>
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<tbody>
<tr>
<td>CAMSHAFT STUD NUTS</td>
<td>80 - 90</td>
<td>147X1592 TORQUE KIT</td>
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<tr>
<td>THRUST BEARING BOLTS</td>
<td>25 - 30</td>
<td>147X1592 TORQUE KIT</td>
</tr>
<tr>
<td>DRIVE GEAR BOLTS</td>
<td>25 - 30</td>
<td>147X1592 TORQUE KIT</td>
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<tr>
<td>BEARING MOUNTING BOLTS</td>
<td>70 - 75</td>
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<tr>
<td>BEARING ASSEMBLY BOLTS</td>
<td>40 - 45</td>
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</tr>
<tr>
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<td>35 - 40</td>
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-- M24.1 --
<table>
<thead>
<tr>
<th>Type Power</th>
<th>Type Brakes</th>
<th>Type Relay</th>
<th>Type Shoes</th>
<th>Brake Cylinder Pressure</th>
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<tbody>
<tr>
<td>F &amp; Alco</td>
<td>2r RL</td>
<td>B3</td>
<td>Cast Iron</td>
<td>45 PSI</td>
</tr>
<tr>
<td>GP-7 &amp; 9’s</td>
<td>24 RL</td>
<td>B3</td>
<td>Cast Iron</td>
<td>45</td>
</tr>
<tr>
<td>GP-8 &amp; 9’s</td>
<td>24 RL</td>
<td>J46B &amp; J64</td>
<td>Composition</td>
<td>32</td>
</tr>
<tr>
<td>GP-18</td>
<td>26L</td>
<td>J1</td>
<td>Cast Iron</td>
<td>45</td>
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<td>GP-18</td>
<td>26L</td>
<td>J64</td>
<td>Composition</td>
<td>32</td>
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<tr>
<td>GP-38’s(2716–2879)</td>
<td>26L</td>
<td>J64</td>
<td>Composition</td>
<td>32</td>
</tr>
<tr>
<td>GP-38’s(5000–5138)</td>
<td>26L</td>
<td>J16–16</td>
<td>Composition</td>
<td>72</td>
</tr>
<tr>
<td>GP-30 &amp; 35’s</td>
<td>26L</td>
<td>J46B</td>
<td>Composition</td>
<td>32</td>
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<tr>
<td>SD-24’s</td>
<td>26L</td>
<td>J46B</td>
<td>Composition</td>
<td>32</td>
</tr>
<tr>
<td>SD-35’s</td>
<td>26L</td>
<td>J14–14</td>
<td>Composition</td>
<td>63</td>
</tr>
<tr>
<td>U-30-C’s</td>
<td>26L</td>
<td>J16–16</td>
<td>Composition</td>
<td>72</td>
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<tr>
<td>U-30-C’s</td>
<td>26L</td>
<td>J14–14</td>
<td>Composition</td>
<td>63</td>
</tr>
<tr>
<td>U-23-B’s</td>
<td>26L</td>
<td>J64B</td>
<td>Composition</td>
<td>32</td>
</tr>
</tbody>
</table>

As information, the E-8 locomotives with the cast iron shoes presently carry 26 p.s.i. brake cylinder pressure. During the year all of the E-8 units will be converted to composition shoes and will have a pressure of 32 p.s.i.
SECTION 100
EMD SWITCH
SETTING TRANSITION ON SW-7, 1200 HP SWITCHERS
WITH D15 MAIN GENERATOR
REFER TO MI 6825
(Use only an approved Voltmeter)

1. Remove the wire from F2 coil terminal of V1 transition relay. (Top right terminal.

2. Connect the negative motor generator output and the negative lead of the 100 V voltmeter to the F2 coil terminal on the V1 relay.

3. Connect the positive motor generator output and the positive lead of the voltmeter to the movable contact of the P2 contactor (Right power contactor).

4. Connect the input of the motor generator to the battery switch, observe polarity.

5. Raise the motor generator voltage to approximately 900 V and let relay and resistor warm up for 3 or 4 minutes. After warmup period, raise the voltage to 940V and V1 relay should pick up. Adjust the 9000 ohm adjustable resistor in the bottom of the high voltage cabinet below the voltage regulator.

6. To check the drop out reduce the voltage to 610 to 650 V and V1 should drop out. The only drop out adjustment is in the springs of the two top contacts and how far the contacts let the plunger enter the coul.

7. Inspect contacts, springs and shunts.
   Contact air gap - - - - - - - - - - - - - - - - - - - - - 1/4"
   Contact lift - - - - - - - - - - - - - - - - - - - - - - - - - - - - 1/8”

8. Remove motor generator and voltmeter. Replace wire on F2 coil terminal of V1 relay. See that band is tight on 9000 ohm resistor and seal screw.

LOAD TEST SW. ENG. (LOAD BOX) EMD 1000 OR 1200 HP

1. Load box pos. leads to bottom P2 power sw.
2. Load box neg. leads to meter shunt panel.
3. Block wheel slip relay if through cable type.
4. Block rev. in center.
5. Jump out interlock on rev.
6. Cut out control air.
7. On completion repeat steps 1–2–3–4–5–6 in reverse.
### LOCOMOTIVE TEMPERATURE SWITCHES

Revised 6-18-74

**GP38**

<table>
<thead>
<tr>
<th>TA</th>
<th>TB</th>
<th>ETS</th>
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</thead>
<tbody>
<tr>
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<td>8409069</td>
<td>8379564</td>
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<tr>
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<td>8409072</td>
<td>8379942</td>
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2716 - 2822

**GP38**

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<thead>
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<tbody>
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<td>8314889</td>
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<td>8323990</td>
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2880 - 2886

**GP38**

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<tr>
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<td>8425575</td>
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<td>8424293</td>
<td>8424295</td>
<td>8425023</td>
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2823 - 2878

5000 - 5138

**SW1500**

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<tr>
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2300 - 2329

**SW1500**

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2300 - 2347

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<thead>
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<th>LOCATION</th>
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</tr>
<tr>
<td></td>
<td>HES for 2330 – 2347</td>
</tr>
<tr>
<td>8379942</td>
<td>ETS for 2716 – 2822</td>
</tr>
<tr>
<td></td>
<td>HES for 2330 – 2347</td>
</tr>
<tr>
<td>8409067</td>
<td>TA for 2716 – 2822</td>
</tr>
<tr>
<td>8409069</td>
<td>TB for 2716 – 2822</td>
</tr>
<tr>
<td></td>
<td>ETS for 2300 – 2329</td>
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<tr>
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<td>TA for 2716 – 2822</td>
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<tr>
<td>8409072</td>
<td>TB for 2716 – 2822</td>
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<td></td>
<td>ETS for 2300 – 2329</td>
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<tr>
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<td>ETS for 2330 – 2347</td>
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<tr>
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PEGRAM DIESEL SHOP
ALCO - GE - 1600 HP R. S.

LOCOMOTIVE NO. OPERATORS DATE

ENGINE SERIAL NO.

<table>
<thead>
<tr>
<th>ITEM TO BE CHECKED</th>
<th>REMARKS</th>
<th>READING</th>
</tr>
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<tbody>
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<td>Outside Air temperature</td>
<td>When checking H. P.</td>
<td></td>
</tr>
<tr>
<td>Governor Oil pressure</td>
<td>During pre-run</td>
<td></td>
</tr>
<tr>
<td>Shutters open</td>
<td>When loading</td>
<td></td>
</tr>
<tr>
<td>Shutters closed</td>
<td>When loading</td>
<td></td>
</tr>
<tr>
<td>Turbo air pressure</td>
<td>When checking HP 8th notch</td>
<td></td>
</tr>
<tr>
<td>Engine overspeed tripped</td>
<td>During break-in</td>
<td></td>
</tr>
<tr>
<td>Fuel oil pressure</td>
<td>During break-in</td>
<td></td>
</tr>
<tr>
<td>Fuel limit pilot current</td>
<td>During break-in</td>
<td>D. C.</td>
</tr>
<tr>
<td>Speed pilot valve current</td>
<td>During break-in</td>
<td>A. C.</td>
</tr>
<tr>
<td>M. G. 400 Cycle set voltage</td>
<td>When checking H. P.</td>
<td>A. C.</td>
</tr>
<tr>
<td>Tach. Gen. out-put voltage</td>
<td>During break-in</td>
<td>A. C.</td>
</tr>
<tr>
<td>Percent overtravel-load control</td>
<td>When checking H. P.</td>
<td>%</td>
</tr>
<tr>
<td>Field current limit volts</td>
<td>During load test</td>
<td>D. C.</td>
</tr>
<tr>
<td>1st notch current limit</td>
<td>During load test</td>
<td>D. C.</td>
</tr>
<tr>
<td>8th notch parallel current limit</td>
<td>During load test</td>
<td>D. C.</td>
</tr>
<tr>
<td>8th notch ser. parallel current</td>
<td>During load test</td>
<td>D. C.</td>
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"Dry Run"

Rack Readings

Lube Oil Pressure

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<tr>
<td>8th Notch Load</td>
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<td>3</td>
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Water Tem. (During Load)

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<tr>
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Firing Pressures (Full Load Full Th.)

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Compression Pressure (80% Load)

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H. P. ______ (8th notch-Step 5 Load Box) (During Load)
H. P. ______ Notch_______ Load
H. P. ______ Notch_______ Load

REMARKS —
INSTRUCTIONS FOR LOAD TESTING
ALCO – GE – 1600 HP R.S.

I – INSPECTION AND PRE-RUN PROCEDURE

1. Fill engine with water – check for leaks.
2. Check oil level in engine, air compressor, governor, fan gear box and generator gear box.
3. If available, apply break-in filters to bearings, turbo, and valve rocker and camshaft lines. Circulate oil by portable pump for 10 minutes.
4. Engage turning device and jack engine over to insure against possible obstructions.
5. Check fuel pump timing and valve lever clearances. 18° timing BTC, .012 valve clearance.
6. Disengage turning device.
7. If available, apply adaptors for cylinder pressure tests.
8. Check Governor oil pressure – 135 lbs.
9. Obtain control air pressure with shop air.
10. Check all safety devices. (See TP-500, Page 1214.)
11. Set up “Dry Run” – Check fuel pump rack travel using rack gauge. (See TP-500, Page 1218) Readings should be - 23.5 MM – Full
   - 14 MM – Idle
   - 3.5 MM – Off
12. Check Governor brush arm positioning except fuel limit valves 3-7. (See attached instructions.)
13. Remove blocks and prepare engine for cranking.

II – BREAK IN PROCEDURE

1. Crank engine and run at no load following “break-in schedule”. (See TP-500 Manual, page 1207.)
2. Next 30 minutes raise speed by steps to 8th notch. Use No. 132H rheostat in 8th notch to check overspeed trip, should trip 1100-1120 RPM.
3. Adjust engine speeds as follows:
   Adjust No. 132H to set intermediate speed band – 2-7 Notches, at 5th notch valve of 765 RPM. This must be done first. Adjust No. 132 50 set idle speed at 350 RPM.
Adjust No. 132G to set 8th notch speed – 100 RPM’s. Intermediate speeds should be within plus or minus – 2-RPM’s.

**NOTE:** On old style engine panels with rheostat for each notch (See TP–400, Page 817).

4. With engine running, check Governor Fuel limit brush arm positioning in No. 3, No. 5, and No. 8 throttle. Notches-in No. 3 throttle brush arm should be at 7 o’clock. Make adjustment at rheostat on fuel limit panel in No. 3 throttle notch and No. 5 and No. 8 should be correct.

### III – LOAD TEST PROCEDURE

**NOTE:** Using GE load resistor box equipped with 4000 amp, 50 MV shunt, 1000 volt meter. Specified portable instruments may also be used if desired. (See attached list.)

1. Apply load to engine in step 1 or 2 of loading resistor, holding 5 minutes or more in each throttle notch.

   **Observe** — Cooling water temperature
   Proper sequence of cooling fan and shutter operation
   Exhaust manifold at top vent and elbows
   Sound of turbo
   Color of exhaust

2. Check compression and firing pressures (see Limits).

3. Check for full rack under load — 23.5 MM.

4. Check Turbo air pressure at full load 15-18 lbs.

5. Check Governor Load Control
   Overtravel should be 40% - 60% (Will be in overtravel notches 3-8 only).

6. Remove break-in filters, prepare engine for service.
INSTRUCTIONS FOR LOAD TESTING
ALCO – GE – 1600 HP R.S.

I – INSPECTION AND PRE-RUN PROCEDURE

1. Megger all circuits for insulation faults.
2. Hi-pot main power and auxiliary wiring and control circuits (See TP–500, Page 1208).
3. Check alarm system and contactor sequence. (See TP–500, Page 1210.)
4. Remove bus connection at left side of main generator and connect load box negative to generator GAA. Remove lower left panel in rear of control compartment and connect load box positive to GA terminal plate.
5. The 36 wire must be left on negative terminal of main generator.
6. Connect a 100 amp shunt with MV (50 AMP’s or more 0:K) in the A1 circuit at amplidyne terminal box.
7. Connect 1 or 1.5 amp meter in 42C circuit at terminal board for amplidyne F1 – F2 control field current.

II – BREAK IN PROCEDURE

1. Control voltage must be 74 volts. Adjust as required.
2. With one amp meter and test harness, adjust Governor Speed Pilot valve current. Engine must be running even speed any notch. Should be 475 MA. (See attached instructions for adjustment.)
3. With same meter and harness as used in (2), check fuel limit pilot valve current in the 5th notch. Should be 475 MA – 480 MA.
4. Check Tach Generator AC volts at 1000 RPM’s between phases T1 and TB2 terminal strip. Should be 103 - 113 volts.

III – LOAD TEST PROCEDURE

1. Setting Field Current Limit – (Primarily interested in only voltage reading). See step one on resistor at 8th notch load adjust No. 154. Pheostat in 17FM105 panel to obtain
   Generator volts at 850-856
   Generator amps should be 850-950
   Generator field amps should not exceed 50
III - LOAD TEST PROCEDURE (Cont'd)

Generator amps at 355-395
Generator volts should be 55-65 volts
F1-F2 amps 0.2–0.4. If not, apply brush seater lightly to amplidyne brushes.

3. Setting 8th notch parallel current limit.

Set step six on resistor at 8th notch load in No. 3 transition (Interlock 32-32T on P21 open) adjust No. 156-A theostat to set.
Generator amps at 2240-2260
Generator volts at 420-460
F1-F2 amps should be 0.10–0.25.


Set step eight on resistor at 8th notch load in No. 1 transition (Interlock 32-32T on P-21 closed). Adjust 156 to set
Generator amps at 3065-3085
Generator volts at 150-170
F1-F2 amps should be .03–0.12.

5. Check horsepower

Short circuit CVS left hand contact 50K-50L with clip lead. Put fan on manual control and air compressor unloaded. Use step five on load box at 8th notch load.

\[
\text{H.P.} = \frac{\text{Volts} \times \text{amps}}{700}
\]

H.P. – should equal 1600

6. Check H. P. in other notches 3-8.

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<thead>
<tr>
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<th>Fuel Rack Setting</th>
<th>Horsepower (Approx)</th>
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<td>4</td>
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<td>18.0</td>
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<td>6</td>
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<td>8</td>
<td>24.5</td>
<td>1600</td>
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7. Check voltage output of 400 cycle MG set at 8th notch full load. Adjust Resistor 122 if not 115 volts plus or minus 5 volts. Check at wire 57 on EF relay and wire 56 on TB1 terminal strip.
SETTING AUTO TRANSITION ON ALCO RS

1. Remove small end plate from axle Gen.
2. Remove Spline Shaft.
4. Connect clip leads of test set to Battery switch.
5. Plug in frequency tachometer to test receptacle in Cab.
6. Eng. can be either running or shut down – Leave 430 cycle MG switch off – Must have 90 lbs. Control air.
7. Close GF switch and place throttle in No. 1 – S1 & S21 should pick up.
8. Increase drive Gen. slowly and at 17GPS, GBE should pick up and the four “M” contactors should close.
9. Increase drive Gen. Speed more and at 23 CPS, CR2 should pick up and drop “S” & “M” contactors and pick up the four “P” contactors.
10. Increase drive Gen. Speed more and at 48 CPS, CR3 should pick up and the four “M” contactors should close.
11. Decrease speed of Gen. and note that the drop out of CR3, CR2, and CR1 are 1.5 and not over 2 CP3 of the pick up valve. To change setting of drop out adjust variable resistor at right of the relay.
12. If an adjustment has to be made on the pick up of CR1, CRw2, CR3 relay, drive the axle Gen. at speed the relay is supposed to pick up. Loosen button head lock screw and turn reactor adjustment counter clockwise to a lower setting, then turn adjustment clockwise until Relay picks up. Tighten Button head lock screw.
13. Before removing test kit turn Rheostat to off position.
14. Be sure to replace spline Shaft and end cap.
REVERSER 1600 HP ACLO

TO M4 RES

TO M2 RES

TO M3 RES

TO M1 RES

#4 TM

#2 TM

#3 TM

#1 TM

BUS

TOP TO P22 & S21

BUS TO TOP OF S1

TOP TO P2

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## Panels for ALCO - Locomotives

<table>
<thead>
<tr>
<th>LOCOMOTIVE NUMBERS</th>
<th>PANELS OR SUBSTITUTES TO USE</th>
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<tbody>
<tr>
<td>2025 - 2047</td>
<td>D2 - Speed Panel</td>
</tr>
<tr>
<td></td>
<td>B4 - Excitation Panel</td>
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<td>(No Substitute on these locomotives)</td>
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<tr>
<td>6208 - 6239</td>
<td>D2 - Speed Panel</td>
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<td>2048 - 2062</td>
<td>D2 - Speed Panel</td>
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<tr>
<td>133 - 159</td>
<td>C1 - Excitation Panel</td>
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<td>(You can substitute a B4 Excitation panel in place of C1 provided you use the D2-Speed Panel with Br)</td>
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<tr>
<td>111 - 119</td>
<td>D2 - Speed Panel</td>
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<td>B4 - Excitation Panel</td>
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<td>(No substitute on these locomotives)</td>
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<tr>
<td>2135 - 2145</td>
<td>D1 - Speed Panel</td>
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<tr>
<td></td>
<td>B1 - Excitation Panel</td>
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<tr>
<td></td>
<td>(D1 - Speed and B1 - Excitation Panels must be paired together - however, you may substitute as a pair a D2 - Speed Panel and a B4 - Excitation Panel in place of a (D1 and B1) pair.</td>
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<tr>
<td>INT 30 - 39</td>
<td>D2 - Speed Panel</td>
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<tr>
<td></td>
<td>C1 - Excitation Panel</td>
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<td>(Use a YELLOW BASE C1 - Excitation Panel, OR use a C1 - Excitation Panel without jumpers in left bottom base plug. You CANNOT substitute any Panels of these units.)</td>
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## Setting Voltage Limits on Alcos

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<td>150–170</td>
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</table>

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SETTING 1100 OHM SERIES TYPE ALLIS CHALMERS
DYNAMIC BRAKE REGULATOR ON GP7 WITH 600A GRIDS
(Refer to M.I. 2049)

NOTE: If unit is equipped with a 176 ohm potentiometer type regulator, part No. 8172120, it should be replaced with an 1100 ohm series type regulator, part No. 8182999, and then set according to these instructions. Replacement procedure is outlined in M.B. 4555 in GP-7 section of Shop Manual.

1. With unit dead and controls out remove BB86 wire from the 400 ohm adjustable resistor near the regulator. Replace nut so remaining wire will be tight.

2. Connect MG input to 74 V DC, observe polarity.

3. Connect the negative output of the MG set to the D contact of the SFT relay.

4. Connect the positive output of the MG set and the positive lead of a 1000 V voltmeter to the terminal on the resistor where BB86 wire was removed.

5. Check the continuity of the 13B wire and the resistors in the regulator by connecting the negative lead of the voltmeter to the A contact of the SFT relay. Increase the MG set voltage, if the voltmeter reads, continuity is good. Reduce voltage and connect negative voltmeter lead to the BB86 wire removed in Step 1.

6. Increase MG set voltage slowly and note voltage at which the regulator sector arm first starts to move along commutator, it should start to move at 240 volts. Move band on 400 ohm adjustable resistor to adjust. Let sector arm go its full travel to be sure there is no mechanical binding or broken springs. If voltmeter does not read or regulator does not move, check for open circuit in regulator or locomotive wiring.

7. a. Remove test equipment
   b. Replace BB86 wire
   c. Be sure adjusting band is tight
   d. Examine beaded shunt on front of regulator
   e. Apply date decal to regulator cover

M.B. 4555 1/31/65

- 301 -
1. Remove old regulator (8172120).
2. Apply new regulator (8182999).
3. Connect No. 13 wire to terminal 13 on regulator.
4. Connect BR86 wire to terminal 6 on regulator.
5. Connect all wire from 400 ohm adjusting resistors to terminal 11 on regulator.
6. Tape No. 12 wire. It will not be used.
7. Remove No. 12 wire from SFT relay “D” interlock and tape. **CAUTION:** Do not remove the 12 G wire which is also on the “D” interlock. The No. 12 wire comes from the 8 amp fuse mounted on wall to right of regulator ring it out to be sure.
8. Check the setting of the new regulator as outlined in Shop Manual.
TO CHECK POLARITY AND CONTINUITY OF WIRING TO REHOHM DBR

1. Disconnect the BRN wire from the lower right stationary contact on cam switch.

2. Remove operator from Regohm.

3. Start engine and put a 150V voltmeter across the stationary contacts of starting contactors. Positive on left, negative on right.

4. Run a jumper from the batter switch negative to the BRN wire which was removed in step one.

5. Put the unit in full braking, the voltmeter should read between 25 and 50 volts. If meter reads backwards the generator polarity is reversed.

6. Connect a jumper from battery switch positive to the lower right stationary contact on cam switch where the BRN wire was removed. The reading on the voltmeter should drop approximately 5 volts if polarity is correct. If the voltage increases the polarity of the bucking voltage is reversed. If no change takes place there is an open in the bucking voltage circuit.

7. Remove meter and replace BRN wire.
SETTING WHEEL SLIP RELAYS ON GP-7 UNITS
WITH DYNAMIC BRAKE
(Refer to MI 5353 and DLW 10013)

1. With engine dead, controls in, isolation switch in start, transition lever in No. 1, toggle switch on control stand in ROAD SERVICE and cam switch in MOT, connect a jumper from positive side (left) of control knife switch to the A terminal of the ground relay. SH and BF contactors should pick up.

2. The wheel slip relays are located just below the power contactors, WSR1 is the left relay. Connect the leads of the wheel slip test box to the coil terminals of WSR1. Turn the knob on the test box to increase the current until the relay picks up. Note that BF drops out, WSA picks up and the wheel slip light comes on. Reduce the current from the test box 'til WSR1 drops out but do not reduce any further. Increase the current again and when the relay picks up, note the reading on the milliammeter. This is the pick up value. Adjust the spring tension nut (Fig. 2, Item A) for 17 to 19 MA pick up.

3. With the pick up value set correctly, reduce the current until the relay drops out. Adjust the closed air gap screw (Fig. 2, Item B) for 10 to 19 MA dropout.

4. The relay should snap in and out, there should not be any partial movement or hesitation. If there is, increase the spring tension. This will change the pick up and drop out values but this can be corrected by adjusting the pick up air gap screw (Fig. 2, Item C) and the dropout adjusting screw (Fig. 2, Item B). Contact wipe plays an important part in the drop out value. Too much wipe will cause an early dropout or partial movement. Set contact air gap as in Fig. 1. Tight or loose armature pivot pins can cause erratic action. Be sure contacts have enough wipe so there is no arcing.

5. To check the continuity of WSR1 circuit, pick up the relay with the test box, then pick up S14 contactor manually and the reading on milliammeter should rise a little.

6. Repeat Steps 1 thru 4 for WSR2. Step 5 is the same except S23 is used instead of S14.

7. These units are equipped with two thru cable wheels slip relays WSB1 and WSB2 for wheel slip protection in dynamic brake. They are located on the grid leads to the left of the reverser under the running board.

8. Repeat Steps 1 thru 4 for WSB1 and WSB2. There is no continuity check.

9. Make visual inspection of all contacts to see if they have proper wipe. See that all adjusting screws are tight. Remove jumper and test equipment.
1. With engine dead, controls in, isolation switch in start, transition lever in No. 1 and toggle switch on control stand in road service, connect a jumper from the positive side (left) of the control knife switch to the A terminal of the ground relay. SH and BF contactors should pick up.

2. The WSR is located on the buss below the power contactors. Connect the leads of the wheel slip test box to the coil terminals of the WSR. Turn the knob on the test box to increase the current until WSR picks up. Note that SH and BF drop out and WS light comes on. Reduce the current from the test box 'til WSR drops out but do not reduce any further. Increase the current again and when the relay picks up, note the reading on the milliammeter. This is the pick up value. Adjust the spring tension nut (Fig. 2, Item A) for 17 to 19 MA pick up.

3. With the pick up value set correctly, reduce the current until the relay drops out. Adjust the closed air gap screw (Fig. 2, Item B) for 10 to 12 MA dropout.

4. The relay should snap in and out. There should not be any partial movement or hesitation. If there is, increase the spring tension. This will also change the pick up and drop out values but this can be corrected by adjusting the pick up air gap screw (Fig. 2, Item C) and the dropout adjusting screw (Fig. 2 Item B). Contact wire relays an important part in the dropout value. Too much wipe will cause an early dropout or partial movement. Set contactor air gap as in Fig. 1. Tight or loose armature pivot pins can cause erratic action. Be sure contacts have enough wipe so there is no arcing.

5. There is no continuity check on this wheel slip relay.

6. Make visual inspection of all contacts to see if they have proper wipe. See that all adjusting screws are tight. Remove jumper and test equipment.
SETTING WHEEL SLIP RELAYS ON GP-7
(NON-DYNAMIC UNITS WITH TWO WSR RELAYS)
(Refer to MI 5353)

1. With engine dead, controls in, isolation switch in start, transition lever in No. 1 and toggle switch on control stand in ROAD SERVICE, connect a jumper from positive side (left) of control knife switch to the A terminal of the ground relay. SH and BF contactors should pick up.

2. The wheel slip relays are located just below the power contactors, WSR1 is the left relay. Connect the leads of the wheel slip test box to the coil terminals of WSR1. Turn the knob on the test box to increase the current until the relay picks up. Note that BF drops out, WSA picks up and the wheel slip light comes on. Reduce the current from the test box 'til WSR1 drops out but do not reduce any further. Increase the current again and when the relay picks up, note the reading on the milliammeter. This is the pick up value. Adjust the spring tension nut (Fig. 2, Item A) for 17 to 19 MA pick up.

3. With the pick up value set correctly, reduce the current until the relay drops out. Adjust the closed air gap screw (Fig. 2, Item B) for 10 to 12 MA dropout.

4. The relay should snap in and out, there should not be any partial movement or hesitation. If there is increase the spring tension. This will change the pick up and drop out values but this can be corrected by adjusting the pick up air gap screw (Fig. 2, Item C) and the dropout adjusting screw (Fig. 2, Item B). Contact wipe plays an important part in the drop out value. Too much wipe will cause an early dropout or partial movement. Set contact air gap as in Fig. 1. Tight or loose armature pivot pins can cause erratic action. Be sure contacts have enough wipe so there is not arcing.

5. To check the continuity of WSR1 circuit, pick up the relay with the test box, then pick up S14 contactor manually and the reading on milliammeter should rise a little.

6. Repeat Steps 1 thru 4 for WSR2. Step 5 is the same except S23 is used instead of S14.

7. Make visual inspection of all contacts to see if they have proper wipe. See that all adjusting screws are tight. Remove jumpers and test equipment.
SETTING TRANSITION ON GP-7 WITH FTR RELAY
(Use only an approved voltmeter)
Refer to print 8163004

1. With engine dead, set up controls in forward position loading.
2. Remove the GN7 wire from the top left coil terminal of the FTR relay.
3. Connect the negative of a 1000V voltmeter and the negative output of a motor generator to the top left stud of FTR relay where GN7 was removed.
4. Connect the positive of the voltmeter and the motor generator output to the GS7 wire on the 10,000 ohm resistor.
5. Connect the input of the motor generator to 74V DC, observe polarity.
6. Increase the output of the motor generator to 900V and let resistors and relay warm up a minute or so. Then raise voltage to 950 V, FTR should pickup and unit should make transition. Adjust band on 10,000 ohm resistor on door post to right of relay at floor level to correct pickup value.

**NOTE:** Series — automatic switch on instrument panel must be in automatic position.

7. Check and set the VT time delay relay for (1) second delay, seal adjusting unit.
8. Check dropout of FTR relay. Should be between 620-650V. Adjust air gap screw to correct. Check contacts for proper wipe. Replace cover and seal.
9. Replace GN7 wire on FTR relay.
10. Make sure band is tight on 10,000 ohm resistor and apply paint to locking screw or nut.

```
+  MG
  +
  +
VM

GS7  10K  10K  GS  FTR

950 V P.U.
```
**INTERLOCK DATA**

**TYPE UNIT** GP7

**PRINT NO.** 10013

**WITH DYNAMIC BRAKE**

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<th>C-D</th>
<th>E-F</th>
<th>G-H</th>
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**Contactor Layout**

- P4 S14 P1
- P3 S23 P2

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(RING OUT INTERLOCKS TO BE SURE)
SECTION 400

EMD GP-9 ROAD SWITCH
SETTING TRANSITION ON SOUTHERN GP-9
(Refer to MI 2207 & 6825)

1. Remove GS3 wire from bottom of left back transition resistor, replace nut so remaining wire will be tight.

2. Connect positive of 10000V voltmeter and MG set to terminal where GS3 was removed. Connect negative of voltmeter and MG set to GN wire at top of FTR, left relay. Connect input of MG set to 74 V DC, observe polarity.

3. Set time delay relays and seal adjusting nuts:
   TDB . . . . 90 Seconds   FSD . . . . 10 Seconds

4. With unit shut down and BF fuse removed, load in forward.

5. Set FSR pickup 1–2 and 3–4 at 965 V, move top band on left front resistor to adjust. If there are three bands on front resistor adjust middle band.

6. Set FSR dropout 4–3 at 655 V, unit must be in No. 4 transition for this check. Adjust air gap screw in relay to correct. Advance unit to No. 4 transition with MG set, then reduce voltage to 655 V, FSR should out. This setting must be correct before going any further. Check for proper wipe on relay contacts on completion.

7. Set FSR dropout 2–1 at 725 V, move lower band on left front resistor to adjust. Keep FSR picked up for 10 to 12 seconds until FSD—"B" opens before checking 2–1 dropout.

8. To check the 1000 V pickup fo the FTR relay FSD—"A" must be open. To prevent pickup of FSD either block the pneumatic device down or put a piece of paper between the AB contacts of FSR relay. Raise the voltage to 965 V, FSR should pick up, then raise to 1000 V and FTR should pick up. Move bottom band on right front resistor to adjust. Remove FSD blocking.

9. To check FTR pickup voltage 2–3 raise voltage to 965 V to pick up FSR relay, then reduce quickly to 800 V and hold until FSD—"A" closes. Increase to 965 V again and FTR should pick up. Move top band on right front resistor to adjust.

10. To check FTR dropout voltage block FSD as in Step 8. Raise voltage to 1000V and pick up FTR then reduce voltage to between 620–690V and FTR should drop out. Adjust air gap screw in relay to bring in range. Check for proper contact wipe on completion. Remove FSD blocking.
SETTING TRANSITION ON SOUTHERN GP-9 (Cont'd)

11. To check FSR dropout voltage 2–3, increase MG set voltage until FSR and FTR pick up, then slowly reduce voltage. At 515 V FSR should drop out and change power contactors to parallel. Move band on left back resistor to adjust. If there are three bands on front resistor, adjust top band.

12. a. Remove test equipment.  
b. Replace GS3 wire.  
b. Seal relay covers.  
d. Apply date decal.

13. Backward transition (Load meter amps X 4)
   a. BTR pickup TDB—"A" open  
      2225–2275 amps  
b. BTR pickup TDB—"A" closed (90 sec.)  
      2400–2500 amps  
   Adjust 1000 ohm resistor above FTR resistors to change setting in 13b.
TRANSITION SOUTHERN GP 9

1. Pickup 1-2, 965V
2. Dropout 2-1, 725V (FSD-B)
3. Pickup 2-3, 515V
4. Pickup 2-4, 1000V with FSD "A" Open

74V DC LOW VOLTAGE CIRCUIT

FSD "A" Opens 10 Sec. After FSD Picks Up

Rev. 11-64
SETTING EI TRANSITION ON CENTRAL OF GEORGIA
GP-9 UNITS 160–170
(Zero Current)

NOTE: All settings must be made with engine running and auxiliary generator voltage 74 volts.

1. Remove GS3 wire from bottom of back 20,000 ohm FSR resistor on panel in back of HV cabinet, engineer's side. Replace nut so remaining wire will be tight.

2. Connect positive of a 1000 V voltmeter and MG set to bottom of front 7500 ohm PTR resistor. (See sketch)
   Connect negative of voltmeter and MG set to buss at bottom of two center wheel slip resistors.
   Connect input of MG set to 74 volts DC.
   CAUTION: Correct polarity must be observed.

3. Lock reverser in neutral and jumper C–D reverser interlocks. Remove BF fuse and load engine in forward, make sure power contactors BF and SF pick up. See that auxiliary generator is 74 V.

4. FSR PICKUP & DROPOUT
   a. Set FSR pickup 1–2 and 3–4 at 363 V, move FRJ2 slider on front 10,000 ohm FSR resistor to adjust.
   NOTE: You will notice MG set voltage fall back as soon as FSR and FS pick up, this is normal and is partly due to the 1000 MFD capacitor across PTR coils charging since A–B interlocks on FS are now open. (See sketch.)
   PTR should not pick up at this time, if it does, the capacitor is open or PTR is set too low.

   b. Set FSR dropout 2–1 at 165 V, move P4H1 slider on back 20,000 ohm FSR resistor to adjust.

5. PTR PICKUP & DROPOUT
   a. Set PTR pickup 2–3 at 363 V, move PRJ4 slider on back 15,000 ohm PTR resistor to adjust. Power contactors will change to parallel as soon as PTR picks up. (Transfer voltage will be set later in Step 6.)
   NOTE: If 1000 MFD capacitor across PTR coils is shorted, the PTR relay will not pick up. Capacitor is on front of panel.
PTR PICKUP & DROPOUT (Cont’d)
b. Set PTR relay dropout 3–1 at 110 V, move PGE slider on front 7500 ohm PTR resistor to adjust.

6. FSR TRANSFER VOLTAGE
Set FSR dropout 2–3 at 380 V. Run MG set quickly to 500 V and hold, SF and BF should drop out indicating that FSR and PTR have picked up. Slowly reduce voltage until power contactors change to parallel at 380 V. Adjust band on small 500 ohm resistor above PTR resistors right side of panel, repeat until correct. Start from series each time.

7. FSR DROPOUT 4–3
Set FSR dropout 4–3 at 135 V. Run MG set voltage to a little over 363 V and hold at this voltage until unit changes to No. 4 transition. Reduce voltage until FSR relay falls out at 135 V, move P4G slider on back 20,000 ohm FSR resistor to adjust. Unit must be in No. 4 transition to check this dropout.

8. a. Replace GS3 wire removed in Step 1.
   b. Unblock reverser.
   c. Remove jumper from C–D reverser interlocks.
   d. Remove test equipment.
   e. Apply date decal to resistor panel.
   f. On completion see that engine loads in forward and reverse.

9. Relay part numbers.
   FSR & PTR............................................. 8235328
   TR.................................................. 8216610
   160–165 Wiring Diagram....................... 8243919
   166–170 Wiring Diagram....................... 8248723

NOTE: Sketch with these instructions has revisions to PTR and TR relay interlocks not shown on wiring diagrams above. Use sketch until wiring diagram is revised.
SETTING DBR ON GP-9

1. Remove BR21 wire from right terminal of front 10,000 ohm resistor above brake warning resistors on back of dynamic brake panel at bottom. See sketch, page 2. Replace nut so two remaining wires will be tight.

2. Connect a 150V voltmeter positive to B terminal of Regohm negative to A terminal of Regohm.

3. Connect a 1000V voltmeter positive to the BB45 terminal right side of front BWR resistor just below the two DBR resistors. See sketch, page 2. Negative to the terminal on the front DBR resistor where BR21 was removed.

4. Connect the output of a motor generator, positive to the A interlock of the BF contactor, negative to the B interlock of BF contactor.

5. Connect the input of the motor generator to 74V DC, observe polarity.

6. Increase output of motor generator to 980-990 volts and reading on 150V meter should gradually rise to between 30-90V. If 150V meter begins to read too soon or too late, move the bands on the 10,000 ohm resistors to correct. Try to keep bands even.

7. If 150V meter does not read or if movement is erratic, change operator and repeat step 6.
SETTING LFR GP-9

BACK OF BRAKING FIELD

- 403.1 -
TO SET BWR ON GP-9
(Use only an approved voltmeter)

1. Remove BR21 and BR25 wires from top left coil terminal of BWR.

2. Connect negative of a 1500 V voltmeter and the negative output of a motor generator to top left stud of BWR where above wires were removed.

3. Connect the positive of the voltmeter and the motor generator to the BB45 terminal of the front 10,000 ohm resistor on back of dynamic brake panel. (The front resistor of the two mounted horizontally at the bottom of the panel.)

4. Connect the input of the motor generator to 74 volts DC, observe polarity.

5. Increase the output of the motor generator to 1000V and let the relay and resistors warm up for a minute or so. Then raise the voltage to 1050 V and BWR should pick up. Move band on front resistor to adjust.

6. Reduce voltage to 970V and BWR should drop out. Adjust air gap to correct.

7. Check contact wipe and be sure BW light comes on and ORS is energized when BWR is picked up in braking. Inspect grid protection rectifiers mounted near BWR.

8. Replace relay cover and seal. Remove meter and motor generator.

9. Replace BP21 and BR25 wires on top left coil terminal of BWR.

10. Be sure band is tight on resistor and put paint on locking screw.
SETTING WHEEL SLIP RELAYS ON GP-9
REFER TO M1 5353 & WIRING DIAGRAMS WS 11323—WS 11324

1. With engine dead, controls in and reverser handle in neutral, connect a jumper from any positive to C interlock of SF contactor. SF contactor should pick up. Connect another jumper from the C to the A interlock of the SF contactor, BF contactor should pick up.

2. WS13 is located below the reverser, left relay. Connect the leads of the wheel slip test box to the coil terminals of WS13. Turn the knob on the test box to increase the current until WS13 picks up. Note that SF and BF drop out. TDS picks up and WS light comes on. Reduce the current from the test box 'till WS13 drops out but do not reduce any further. Increase the current again and when the relay picks up, note the reading on the milliammeter. This is the pick up value. Adjust the spring tension nut (Fig. 2, Item A) for 17 to 19 MA pick up.

3. With the pick up value set correctly, reduce the current until the relay drops out. Adjust the closed air gap screw (Fig. 2, Item B) for 10 to 12 MA dropout.

4. The relay should snap in and out, there should not be any partial movement or hesitation. If there is, increase the spring tension. This will also change the pick up and drop out values but this can be corrected by adjusting the pick up air gap screw (Fig. 2, Item C) and the drop out air gap screw (Fig. 2, Item B). Contact wipe plays an important part in the drop out value. Too much wipe will cause an early drop out or partial movement. Set contact air gap as in Fig. 1. Tight or loose armature pivot pins can cause erratic action. Be sure contacts have enough wipe so there is no arcing.

5. To check the WS13 circuit for continuity, pick up the relay with the test box, then pick up S13 manually and the reading on the milliammeter should increase a little.

6. Repeat Steps 1 thru 4 for WS24. Step 5 is the same except S24 is used instead of S13. WS24 is located to right of WS13.

7. The WSS relay is located below BKP1 contactor, right relay. Repeat Steps 1 thru 4 for the WSS relay, continuity check is not necessary. Note that only BF drops when WSS picks up.

8. The WCR relay is located to left of WSS relay. Repeat Steps 1 thru 4 but values are different. WCR should pick at at 13.5 to 15.5 MA and drop out at 8 to 10 MA. WCR picks up TDS only. Continuity check not necessary.

9. Make visual inspection of all contacts to see if they have proper wipe. See that all adjusting screws are tight. Remove jumpers and test equipment.
SECTION 500

EMD GP-18 ROAD SWITCH
SETTING EI TRANSITION ON CENTRAL OF GEORGIA
GP-18 UNITS 171–178
(Zero Current)

NOTE: All settings except Step 7 are made with engine shut down. For Step 7 auxiliary generator voltage must be 74 volts.

1. Set delay on FSO relay so “A” contacts close 3 seconds after coil is picked up, seal nut.

2. Remove GS5 wire from top of front RF2 resistor on panel in back of HV cabinet engineer’s side. Replace nut so remaining wire will be tight.

3. Connect positive of a 1000 V voltmeter and MG set to the top of front 2000 ohm RE2 resistor where GS5 was removed.
   Connect negative of voltmeter and MG set to bottom of 10 ohm RE5 resistor at upper right corner of panel.
   Connect input of MG set to 74 volts DC.
   CAUTION: Correct polarity must be observed.

4. With engine shut down and BF fuse pulled load unit in forward. See that power contactors SF and BF pick up.

5. FSR1 PICKUP & DROPOUT
   a. Set FSR1 pickup 1–2 and +–4 at 360 V, move J35 slider on back RE3 resistor to adjust. FSR1 picks up FSD which picks up FS1 after a 3 second delay.

   NOTE: You will notice MG set voltage fall back as soon as FSR1 and FS1 pick up, this is normal and is partly due to the 1000 MFD capacitor CA1 across PTR coils charging since A–B interlocks on FS1 are now open. PTR should not pick up at this time, if it does, the capacitor is open, or PTR is set too low.

   b. Set FSR1 dropout 2–1 and 4–3 at 160 V, move FSD slider on back RE3 resistor to adjust.

6. PTR PICKUP & DROPOUT
   a. Set PTR pickup 2–3 at 360 V, move J32 slider on back RE2 resistor to adjust. Power contactors will change to parallel as soon as PTR picks up.
      (Transfer voltage will be set in Step 7.)

   NOTE: If 1000 MFD capacitor CA1 across PTR coils is shorted the PTR relay will not pick up.
PTR PICKUP & DROPOUT (Cont'd)

b. Set PTR relay dropout 3–1 at 110 V, move PTB slider on middle RE2 resistor to adjust.

7. FSR1 TRANSFER VOLTAGE

Start engine and load in forward being sure BF fuse is out and auxiliary generator is charging at 74 volts. Check FSR1 dropout 2–3, should be between 365–410 volts. Run MG set voltage quickly to 500 volts and hold, SF and BF should drop out indicating that FSR1 and PTR have picked up. Slowly reduce voltage until power contactors change to parallel and note voltage. There is no adjustment for this setting, if out of limits check auxiliary generator voltage, CR3, RE6 and interlocks shown in sketch.

8. a. Replace GS5 wire removed in Step 2.
   b. Remove test equipment.
   c. Apply date decal to resistor panel.
   d. On completion see that engine loads in forward and reverse.

9. Relay part numbers —

   FSR1 & PTR................................................. 8245903
   TR ...................................................... 8190872
   FSD.................................................... 8272600
   CAL 1000 MFD – 150 V ......................... 8225149
   Wiring Diagram...................................... 8291114
TRANSITION - GP18
(C of Ga 171 - 178)

LOW VOLTAGE CIRCUIT
LOAD TEST PROCEDURE
Norfolk Southern GP-18
(1 - 17) or (180 - 196)

*1. Remove 89J wire from B interlock on GS contactor.

2. Connect NEG. load test cable to test lug marked (1) on RVR4.

3. Connect NEG. load test cable to test lug marked (3) on RVR3.

4. Connect POS. load test cable to test lug marked (3) on RVR2.

5. Connect POS. load test cable to test lug marked (1) on RVR1.

*6. Remove PTA3 wire from interlock on PTR relay.

7. Start unit put on line. Leave throttle in idle.

*8. Run jumper from G interlock on S13 to H on S24.

9. Turn on GF breaker and load to notch one. Observe if GF, SF contactors pick up and load regulator moves.

10. Full load horsepower is .96 governor rack.

* ON COMPLETION DO THE FOLLOWING:

(1) APPLY 89J wire removed in Step 1.

(2) APPLY PTA3 wire removed in Step 6.

(3) REMOVE jumper from G on S13 to H on S24, which was applied in Step 8.

(4) Remove all (4) load box cables.

(5) Load unit from throttle — see if loading normal when above step completed.
SECTION 600

EMD GP-30 ROAD SWITCH
DBR AND BWR ON GP-30.

OUTSIDE SECTION
R2 GRID

BB42 or 41

SEMISTATIC DBR

FRONT
PLC-6

WHEN USED

PLC; 8

MA

-601-
SETTINGS AND COMPATIBILITY TEST OF DBR AND BWR ON GP-30

1. Remove BB42 wire from left contact of BKP2. This wire may be labeled BB41.

2. Connect positive output of M.G. set and positive lead of a 1000 V voltmeter to the BB42 wire removed in Step 1.

3. Connect negative of M.G. set and voltmeter to stud where BB42 was removed in Step 1. (NOTE: Polarity of test leads, Steps 2 & 3, must be correct, recheck.)

4. Connect 150V voltmeter to back of test jacks, positive on left, negative on right. This meter will read main generator voltage in dynamic brake.

5. Connect input of M.G. set to battery switch, observe polarity. Increase M.G. set output to 300 V and warm up circuit for 10 minutes.

6. After warmup period reduce voltage to zero and remove wire from “C” terminal of DBR to isolate DBR while setting BWR.

7. SETTING BWR
   With unit in full dynamic brake, increase MG set output to 335 V and BWR should pick up. Note that main generator voltage on 150 V meter is knocked down and BWR light comes on. BWR should pick up and drop out in a slow telegraphing manner. Adjust the pickup at 335 V with the band on RE27. Adjust the dropout at 332V with band on front RE26 resistor. Be sure the 10 MFD capacitor is connected to J and K of BWR.

8. SETTING DBR
   Reconnect wire removed in Step 6 to C of DBR. Remove M.G. set input leads from battery switch and connect positive lead to positive contact of P4 contactor, negative lead to negative contact of P2 contactor. Turn M.G. set rheostat full on.

9. PLS or PLR operation must be checked before DBR can be set. With unit in full dynamic brake, note reading on 150 V meter, normally it will be between 20 and 30 V. Turn MG set switch off, if reading on 150 V meter increases, turn switch on again and go to Step 10. If voltage does not increase, it means PLS or PLR is controlling main generator voltage, you will have to nullify PLS or PLR before going to Step 10.

10. With unit in full dynamic brake adjust rheostat on front of DBR to read 310 V on 1000 V meter. Loosen locknut on rheostat before adjusting and tighten on completion.
11. COMPATIBILITY TEST
This test is to see that DBR does not overshoot and pick up BWR. Bring unit to full dynamic, then move throttle quickly to No. 1 and back to No. 8. The DBR should not let voltage on 1000 V meter swing over 320 V, if it does and if pickup or steady voltage is correct, replace DBR and reset.

12. ON COMPLETION:
   a. Remove test equipment
   b. Replace BB42 wire on BKP2, Step 1.
   c. Remove jumper across PLS or PLR if used in Step 9.
   d. Apply date decal to front of DBR and BWR.
BALANCE TEST ON GP-30 TRACTION MOTOR
FIELDS & MOTOR SHUNTING CIRCUIT
(Unit Must Be Over a Pit)

A. Voltage Drop Comparison Test of Motor Field Coils.
1. Put unit in dynamic brake and read the output of the main generator with a DC voltmeter connected to GS and GN. Connect voltmeter positive to left lug back of P3 contactor, negative to right lug back of P1 contactor.
2. Increase the braking until the voltmeter reads 32 V. Read and record the voltage drop across each field at the F and FF leads of each motor. This can be done by sticking knives in the F and FF leads at the motor and connecting a voltmeter to the blades. The voltage should average about 8 volts. A difference of 15% or 1 volt condemns the motor that is out.
3. Return unit to idle.

B. Checking Field Shunting Circuit:
1. Connect a test light or jumper from battery switch positive to the left terminals of third from top micro switch on program switch. This will pick up FS 1.
2. Put unit in full dynamic brake and read and record voltage drop at F and FF leads of each motor. This reading will be less than 1/2 volt, a low scale meter is necessary. Any difference here will probably be caused by a dirty contact or loose connection in FS 1 circuit of motor that is out. Return unit to idle.
3. Repeat Steps B1 and B2, moving jumper to fourth from top micro switch to pick up FS 2. Any difference here will be in FS 2 circuit of motor that is out.
4. Repeat Steps B1 and B2, moving jumper to fifth from top micro switch to pick up FS 3. Any difference here will be in FS 3 circuit of motor that is out.
5. Return unit to idle and remove jumper.

GP–30 Elec.
7/63
INSTRUCTIONS FOR CHECKING OPERATION OF
TRANSDUCTOR WHEEL SLIP SETTINGS
ON GP-30 LOCOMOTIVES

1. Be sure brake is cut in and engine brake is on.
2. Turn automatic sand switch off.
3. Start engine and "Put on line."
5. Insulate main contact tips of S-13.
6. With engine on line, battery field fuses in, generator field switch on, locomotive in forward, open throttle to number two.
7. The locomotive should "unload" due to W. S. action before load meter reads 400 amps. If engine loads to 400 amps, check CR1 and CR2 with ohmmeter per instructions at bottom.
8. Return throttle to idle.
10. Repeat Step 6; however, load meter will not show load but engine should unload due to W.S.
12. Reapply both arc chutes.
13. Turn automatic sand back on.

OHMMETER CHECK FOR CR-1, CR-2

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TESTING AND ADJUSTING GP-30 CONTROL SYSTEMS
Refer to MI 6844A

NOTE: Settings must be made in the following sequence:

1. Start engine, remove main generator buss.

2. Set auxiliary generator voltage at 74 volts in number eight throttle, check reference voltage, it should be 72 volts.

3. Remove: POZ wire from CR19
   PSR2 wire from CR5
   LCXX wire from RH4
   LCZ wire from CR8
   One wire from TPS motor

4. Insulate GH & LM contacts of SFT relay to open shunt field circuit.

5. Connect a motor generator set and 1500 V voltmeter to two 7/32” rods plugged into test jacks, observe polarity.

6. Connect a 250V AC voltmeter across the bottom of the BFA fuses. This meter will read alternator voltage and also verify that fuses are good.

7. Block in one cooling fan with a jumper from right coil terminal of AC1 to a POA wire. NOTE: AC voltage may be controlled with a carbon pile in series with alternator field fuse or by blocking fans in or out.

8. Increase voltage on M.G. set to 1000 V. Load unit in run 8 for 10 minutes to warm up circuits. After warmup, reduce to idle.

9. RH1 MINIMUM BATTERY FIELD CURRENT
   Disconnect POH wire from terminal 8 of FM1. Connect a 300 MA meter, positive to POH wire, negative to 8 of FM1. CAUTION: Do not open circuit to this meter while loading or meter in Step 11 will be damaged.

10. Disconnect LCC wire from terminal 11 of FM1 to prevent feedback.

11. Remove BFP wires from red terminal of CR20. Connect a 0–10 amp DC ampmeter, positive to red terminal of CR20, negative to the BFP wires. CAUTION: Do not open circuit to this meter while loading or Cr21 will be damaged.
12. Load in run 8, adjust AC voltage to 185-195 volts. Turn RH1 to increase milliamps in 8-7 winding to 200 MA. Slowly reduce milliamps with RH1 until BF current on 10 amp meter just begins to rise, lock RH1. BF current must be below 2 amps, milliamps in 8-7 windings must be below 180 MA. Return to idle.


14. **RH2 MAXIMUM BATTERY FIELD VOLTAGE**
Connect 150V DC voltmeter across CR20; positive to BFP (Red), negative to BFN (Black). Load unit in run 8, adjust AC voltage to 185-195 volts. Check AC voltage and adjust BF voltage with RH2 to value opposite AC voltage in table below. Lock RH2 and return to idle.

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15. Remove 150 V meter, remove insulation from SFT relay. Replace LCXX wire on RH4.

16. **PERFORMANCE CONTROL**
Short circuit main generator by placing a 2000 amp 50 MV shunt across GP and GN in bottom of HV cabinet. Connect a 150 MV meter to shunt. Energize FSA relay with a jumper.

17. The next four adjustments must be made quickly, generator must not operate at 2900 amps for over 30 seconds. Loosen locknuts on RH 4, 5, 6, 7, 11, 12 & 21. NOTE: Millivolt values given in the following steps apply only when using a 2000 amp 50 MV shunt.

18. **RH7 - 76 MV - 200 V FSA UP**
Adjust MG set to 200 volts. Load unit in run 8, adjust RH7 to 76 MV (3040 amps) and lock.

19. **RH6 - 66MV - 200V - FSA DOWN**
Deenergize FSA adjust RH6 to 66 MV (2640 amps) and lock.
20. **RH4 - 40 MV - 1000V - FSA DOWN**  
Increase MG set voltage to 1000 V adjust RH4 to 40 MV (1600 amps) and lock.

21. **RH5 - 41 MV - 1000 V - FSA UP**  
Energize FSA, adjust RH5 to 41 MV (1640 MV) and lock. **IMPORTANT:** If RH4 or RH5 were adjusted, you must repeat Steps 18, 19, 20 & 21 until no change is necessary. Return to idle. Remove FSA jumper.

22. **RH21 MOTOR CUTOUT POWER LIMIT**  
Cut out a traction motor. Adjust MG set to 200 volts. Load unit in run 8 and adjust RH21 to 65 MV (2600 amps) and lock. Return to idle and cut motor in.

23. **RH 11 - RH 12 2000 HP ADJUSTMENT**  
Reconnect LCZ wire to CR8. Turn RH12 fully toward the POA terminal (generally CCW), center RH 11. Adjust M.G. set to 720 V, load in run 8, current should regulate to 49.25 MV (1970 amps). Adjust RH 12 until there is a definite rise in current, lock RH 12. If current does not regulate between 48.75 and 49.75 MV, recheck Steps 18 and 19.

24. Reduce M.G. set to 640 V, current should regulate at 56.25 MV (2250 amps), adjust RH 11 and lock. If RH 11 was adjusted, check Steps 23 & 24 again until no change is necessary. Return to idle. If 56.25 MV cannot be obtained, recheck RH 12, it was probably not turned far enough for a definite rise in current or check CR8.

25. Remove MG set and rods from test jacks.  
**APPLY:** POZ wire to CR19  
PSR2 wire to CR5  
Wire to TPS motor.

26. **RH3 DYNAMIC BRAKE ADJUSTMENT**  
Move test shunt from GP & GN place from GP to GS, connect 150 MV meter to shunt. Keep number one fan energized. Connect a 150 V DC voltmeter from 24T wire in control stand to negative.

27. Place unit in minimum dynamic brake, 24T wire voltage should be zero. Place unit in full dynamic brake, voltage should be 70 volts, align rheostat if necessary.

28. Place unit in minimum brake, main generator current should be .5 to 1 MV, (20-40 amps). Adjust JT slider on RE13 to obtain.

29. Increase dynamic brake to 68V at 24T wire. Adjust RH3 to 22.5 MV (900 amps) and lock. Return to idle.
30. Remove test shunt and apply buss. Remove jumper at AC1. Seal flaps over rheostats. Remove all test equipment and see that all wires removed in Step 3 are replaced.

31. Make sequence test, check loading and braking.
SECTION 700

EMD GP-38 ROAD SWITCH
SETTING DBR & BWA ON GP38 UNITS

1. TEST EQUIPMENT REQUIRED:
   A. Motor Generator Set
   B. 1500 Volt Voltmeter
   C. 12 Volt Voltmeter

2. Remove BKF10 wire from TB63A2. Connect Positive of MG set and 1500 V voltmeter to BKF10 wire. Connect negatives to TB63A2. Connect MG set input to battery switch, observe polarity.

3. Connect 12V voltmeter to RCP panel, positive on No. 4, negative on No. 6.

4. With engine shut down set up unit in minimum dynamic brake be sure GF contactor has picked up. NOTE: DBR may also be checked with engine running, see Step 8.

5. TIMING CAPACITOR CIRCUIT CHECK:
   Increase MG set voltage to approximately 100 volts and note that the 12V voltmeter will read 2 or 3 volts while the voltage is rising, the 12V voltmeter should return to zero when the MG set voltage levels off. If the 12V voltmeter stills read 2 or 3 volts after the MG set voltage is steady one of the timing capacitors (CALL 61, 62, 63, 64 or 65) may be shorted. If the 12V voltmeter does not read 2 or 3 volts while the MG set voltage is rising the timing capacitor circuit may be open or the DBR Relay BO.

6. CHECKING DBR PICKUP:
   Remove BKT wire from TB62A3 to nullify timing capacitors. Increase MG set voltage slowly, at 250 volts the 12V voltmeter should read 2 or 3 volts indicating that the DBR 8-2 contacts have opened. Adjust RH 10 to correct.

7. CHECKING BWA PICKUP:
   Increase MG set voltage to 260 volts, the GF contactor should dropout and the brake warning light should light. Adjust RH 11 to correct.

8. ALTERNATE DBR CHECK WITH ENGINE RUNNING:
   Use test setup as in Step 2 except MG set input leads are connected to the TEST JACKS, observe polarity. Turn MG set rheostat full on; Do not connect 12V voltmeter to RCP. NOTE: Keep engine brake applied to prevent BPS movement.
9. Put unit in maximum dynamic brake and note that voltage rises slowly on 1500V voltmeter and stops at 250 volts. Adjust RH 10 to correct. It should take approximately 15 seconds to reach 250 volts, this is a check of the timing capacitors.

10. **REMOVE TEST EQUIPMENT:**
   A. Replace BKT wire on TB62A3
   B. Replace BKF10 wire on TB63A2
   C. Check loading and braking.
OPERATION OF THE 169X0394 SPEED LOG CALIBRATOR AND TESTER

(Refer to the attached sketches for clarification)

The calibrator has two fail-safe features. One protects the unit from accidental reversal of the 74 VDC leads. The calibrator will not operate and no damage will be done.

The other feature prevents the simultaneous application of both 115 VAC and 74 VDC power at the same time from damaging the unit; if both types of voltage are applied, normal operation continues from the 74 VDC.

A. USE WITH MARK II

1) Apply power to the calibrator. If 115 VAC is used, plug cable No. 1 into wall outlet and calibrator and turn on switch marked AC, on. The red pilot lamp will light. For operation on 74 VDC, attach leads from cable No. 2 at an appropriate point, being careful to observe proper polarity. The amber light will light.

2) Attach cable from calibrator output to Speed Log input (marked “pick-up”).

3) Set range switch to “1000”. Speed Log should indicate the speed shown on chart “A” with wheel size set as shown on the chart. Additional checks can be made at the various settings of the wheel size potentiometer with the clock type face, located on the front board of the Speed Log.

4) Set range switch to “500”. Speed Log should indicate the speed shown on chart “B” with wheel size set as shown on the chart. Additional checks can be made as in step No. 3 using chart “B”.

5) Set range switch to “250”. Speed Log should indicate the speed shown on chart “C” with wheel size set as shown on the chart. Additional checks can be made as in step No. 3 using chart “C”.

After the above tests have been made, the following step can be made giving an indirect comparison between the calibrator and the 60 cycle line voltage signal. This test is only possible with the calibrator operating from 115 VAC, as the signal used is obtained directly from the 60 cycle line voltage. With the range switch set at “60”, and the wheel size set at 810, an indication of 06 should be obtained.

6) With the range switch set at “Variable”, a test can be made of both overall Speed Log operation and the operation of all indicator lamps.

- 702 -
With the "Hi-Lo" switch set to "Lo", speed indication up to approximately 30 mph can be observed. With the switch set to "Hi", speed indication to over 100 mph can be observed, and the overspeed setting can be tested.

If the calibration is found to be within ±1 mph, this is acceptable. Any error greater than this can be corrected by slight adjustment of P1, located on the control board.

B. USE WITH MARK III

The procedures outlined herein will enable you to properly install and calibrate the new Mark III Speed Logs. A cable is provided for this: this cable has an octal plug on one end, and a male connector "A" and a female "B" connector for the Mark III Speed Log.

Calibration of the Mark III Speed Log requires the use of the 169X0394 calibrator. The procedure is easily done as follows:

1) Turn off power to the Speed Log and remove the cable.

2) Remove only the center rear screws from both sides of the back plate and slide the chassis out from the rear to the point where the two access holes on the front shield cover, marked "Wheel Size" and "Overspeed", are visible.

3) Attach the cables from the calibrator. The male connector attaches to the Speed Log cable, and the female connector is attached to the Speed Log.

4) Turn on power to the Speed Log.

WHEEL SIZE CALIBRATION

1) Set the range switch on the calibrator to the "1000" position. (Position of "High-Low" switch not important.)

2) Check wheel size and then refer to the attached charts for the proper indicator reading for the wheel size used.

3) CAREFULLY insert either an alignment tool or a SMALL BLADED screwdriver into the "Wheel Size" hole on the front shield cover and adjust the potentiometer for the proper indicator reading as determined in 2. Adjusting the potentiometer in a clockwise direction will raise the number; counterclockwise will lower the number. Further tests can be made as in Steps 4 and 5 of the Mark II procedure using charts A, B and C. The readings will be the same as for a Mark II Speed Log.
OVERSPEED CALIBRATION

This must be set AFTER the wheel size calibration has been completed each time.

1) Set the range switch on the calibrator to the "Variable" position.
2) Set switch marked "High-Low" on the calibrator to the "High" position.
3) Adjust the calibrator frequency for the overspeed reading required.
4) Using the alignment tool or screwdriver mentioned earlier, CAREFULLY adjust the "Overspeed" potentiometer until the lamp on the calibrator just turns off. If the lamp was off, adjust the potentiometer until it goes on, then adjust until the lamp just turns off. Adjusting in a clockwise direction will raise the overspeed pickup point; counterclockwise will lower it. Check adjustment by setting the variable frequency oscillator to a point below the overspeed point and slowly increase the frequency through the desired overspeed point and observe that the lamp turns off at the desired overspeed setting.

TEST PROCEDURE

This operational test of the Mark III Speed Log is performed using the No. 169X0394 calibrator and a 20,000 ohm/volt multimeter, such as a Simpson 270.

1) Turn off power to the Speed Log and remove the cable. Attach the cables from the calibrator. The male connector attaches to the Speed Log cable and the female connector is attached to the Speed Log.
2) Turn on power to the Speed Log.
3) Set range switch on the calibrator to the "Variable" position and the "High-Low" switch on the calibrator to the "Low" position.
   If the unit is not equipped with automatic range change (decimal point), proceed to Step 5.
4) Using the "Variable" knob, slowly increase the speed reading. The decimal point should turn off from between 12 and 16 mph. This is not critical providing that it does turn off below 20 mph.
5) Set the "High-Low" switch to "High" and slowly increase speed reading up to 100. This demonstrates that all digits are operating. If the independent brakes are released, the overspeed can be checked, and a suitable alarm or brake application will be evident. Also, the lamp marked "Mark III Overspeed" will go out.
6) Turn off the power and disconnect the calibrator and reconnect the cable to the Speed Log.

7) An additional check should be made while moving the locomotive to make sure that the complete system is operational and indicating speed.
MARK IV SPEED LOG

CASE MOUNTING SCREWS

OVERSPEED RELAY

OVERSPEED CALIBRATION POTENTIOMETER

WHEEL SIZE

UNSCREW TO REMOVE CONNECTOR

NOTE: DO NOT USE A SCREWDRIVER

USE FINGERS ONLY AS EXCESSIVE

TORQUE WILL DAMAGE THE JACKSCREWS.

CUSTOMER INPUT CABLE J

CONNECTOR (FEMALE)

INPUT CONNECTOR
(MALE CONNECTOR)

REMOVE THESE SCREWS AND SLIDE CHASSIS OUT.
## CHART "A" (RANGE SWITCH ON 1000)

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<tr>
<th>SPEED</th>
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<tr>
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<td>622</td>
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<tr>
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<td>606</td>
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<tr>
<td>96</td>
<td>575</td>
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<tr>
<td>94</td>
<td>558</td>
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<tr>
<td>116 (&quot;16&quot;)</td>
<td>810</td>
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<tr>
<td>112 (&quot;12&quot;)</td>
<td>750</td>
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## CHART "B" (RANGE SWITCH ON 500)

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<td>58</td>
<td>810</td>
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## CHART "C" (RANGE SWITCH ON 250)

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<tr>
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<td>29</td>
<td>810</td>
</tr>
<tr>
<td>28</td>
<td>750</td>
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</tbody>
</table>
SETTING DBR AND BWA ON GP-38
2823 - 2878

Test Equipment Needed: (a) Motor Generator Set.
(b) 1500 Volt - Voltmeter.
(c) 12 Volt - Voltmeter.

SETTING DBR:
1. Remove BB12 wire from 62A1. Connect negative of M.G. Set & 1500 V. Voltmeter to BB12 wire. Connect positive to 62 A1 terminal where wire was removed. Connect M.G. set to input to battery switch, observe polarity.
2. Connect 12 V. Voltmeter to RCP panel, positive on No. 4 and negative on No. 6.
3. With engine shut down, set up unit in minimum Dynamic Brake be sure G.F. contactor has picked up. Increase M.G. set voltage slowly, at 250 volts the 12 V. voltmeter should read approx. 8 volts indicating that the DBR 8-2 contacts have opened. Adjust RH 10 to correct.
4. Replace BB12 wire on terminal 62A1 and remove M.G. set and 1500 volt0 meter & 12 V. voltmeter from 4 & 6 terminal on R.C.P.

SETTING OF BWA:
1. Remove BKF10 from Terminal Board 63A2.
2. Connect positive of M.G. set & 1500 V. Voltmeter, to BKF10 wire that was removed.
3. Connect Negative of M.G. set & 1500 V. Voltmeter to terminal board 63A2.
4. Increase M.G. voltage set to 260 volts, the G.F. contactor should dropout and the brake warning light should come on. Adjust RH11 to correct.

REMOVE TEST EQUIPMENT:
A. Replace BB12 wires on TB 62A1
B. Replace BKF10 wire on TB63A2
C. Check loading & braking.
1. REMOVE STARTING FUSE AND THE GENERATOR FIELD FUSES.
2. CONNECT NEG LEADS OF LOAD BOX TO BUS AT BOTTOM OF HIGH VOLTAGE CABINET.
3. REPLACE STARTING FUSE AND CRANK ENGINE.
4. CONNECT POS LEADS OF LOAD BOX TO BUS AT BOTTOM OF HIGH VOLTAGE CABINET.
5. DISCONNECT ME9 WIRE FROM THE FONT B TERMINAL OF G.S. CONTACTOR, GENERATOR START CONTACTOR.
6. CONNECT A JUMPER WIRE FROM THE RIGHT SIDE OF A 6B-5 TERMINAL 65-4 WIRE TO THE RIGHT SIDE OF "B" TERMINAL 6F-6F-6 WIRE OF TIME DELAY RELAY ELD.
7. PLACE THE TRANSITION SEQUENCE TEST PANEL IN MANUAL SEQUENCE TEST POSITION.
8. JUMPER F1–F2 ON S24A RELAY.
9. DISCONNECT THE ALGX9 & ALGX WIRES FROM THE WSC TERMINAL NO. 1 ON IDAC PANEL.
10. CONNECT 2000 OHM 10 WATT RESISTOR (WHEEL SLIP RESISTOR) FROM RCP TERMINAL NO. 2 TO TERMINAL NO. 8.
11. SET LOAD BOX SWITCHES UP FOR 5–6–7–8 (REPLACE GENERATOR FLD FUSES).
12. MAKE SURE VOLTS NOT OVER 1000 & AMPS NOT OVER 2300.
   RECORD THE FOLLOWING BALANCE POINT OF GOV IN 8TH THROTTLE LOADED.
   VOLTS ____________________
   AMPS ____________________
   H.P. ____________________
13. REPLACE WIRES IN STEP 5 & 8.
14. REMOVE JUMPER APPLIED IN STEP 6.
15. RETURN TRANSITION SEQUENCE SWITCH TO THE NORMAL POSITION.
*17. REMOVE JUMPER ON S24A RELAY F1-F2 CONTACT.

* ITEM 8 & 17 OMITTED ON LOCOMOTIVES WITH D-32 GEN & SINGLE SHUNT CONTACTOR.
TO CHECK SBP OR SENSOR BYPASS PANEL
1. With unit in Notch 1
2. Pos: LR & Neg to 5 of Rep - about 5 Volts
3. Pos, FB & Neg to 5 of Rep - about 4.5 Volts
4. FB should always be lower than LR

TO CHECK SBP–SCR– & FIELD OF D32E1 GENERATOR
1. Remove 19 & 20 wires from Sensor
2. Pos of 1.5V battery put on Terminal 20
3. Neg of 1.5V battery just touch Terminal 19
4. Units hes to be in Notch 1
5. Unit should load 1200, 1500a

TO CHECK SCR OR SILICON CONTROLLED RECTIFIER
1. Remove 18–14–16 wires from Sensor
2. Put throttle in No. 1
3. Touch 18 to Sensor should lead about 300A
4. Do 14 & 16 the same way, just put one wire at a time

GP-38 PRINT IS DIVIDED UP THIS WAY:

```
High Voltage   Local Control   Battery   13T   Charts
142            210           244         500    610   752
```

- 705 -
To Check RP or Throttle Response Panel:
1. Remove generator field fuses.
2. Pos. to 2 of RCP Should get line.
3. Neg. to 5 of RCP Increase in volt.

1. 9.5 to 15.5.
2. 27.5 to 27.0.
3. 42.5 to 43.5.
4. 56.5 to 58.
5. 61.5 to 62.5.
6. 65 to 66.5.
7. 69.5 to 71.
8. 71.5 to 73.5.

Pos. 71V Reference Voltage
Check RCP or Rate Control Panel:
1. Remove generator field fuses.
2. Positive to 3 of RCP.
3. Negative to 5 of RCP.
4. Put in #3 throttle.
5. Should be 49 - 50 volts & get top voltage in 14 - 19 seconds.
ON GP-38 LOCOMOTIVES MONTHLY INSPECTION WITH IDAC WHEEL SLIP CONTROL, THE FOLLOWING PROCEDURES TO BE OBSERVED TO CHECK OUT PROPER FUNCTIONING OF WHEEL SLIP UNLOADING SYSTEM:

1. START ENGINE, PUT ON LINE GENERATOR FIELD FUSES IN.
2. APPLY INDEPENDENT BRAKES, MAKE SURE NOT CUT OUT AT TRUCKS.
4. BLOCK S-13 & S-24 ONE AT TIME WITH PIECE PAPER & LOAD UNIT TO NO. 1 NOTCH.
5. AT APPROXIMATELY 150–200 AMP THE WHEEL SLIP LIGHT SHOULD LIGHT, SAME LIGHT COME ON, SAND START RUNNING AND LOAD ON METER SHOULD FLUCTUATE APPROXIMATELY 50–75 AMPS.
6. IF ITEM 5 IS OPERATIVE ADVANCE TO THROTTLE NO. 2 AND LOAD SHOULD INCREASE TO APPROXIMATELY 300 AMP WITH 50–100 AMP FLUCTUATION.
7. DO NOT ADVANCE THROTTLE BEYOND NO. 2 UNLESS SUPERVISOR IS PRESENT.
8. IF ABOVE DOES NOT OCCUR AND CURRENT CONTINUES TO BUILD UP, REPLACE IDAC PANEL & REPEAT.
9. REMOVE PAPERS & PROPERLY APPLY ARC CHUTES.
GP-38 CHECKS AND QUALIFICATIONS

Checking Reference Voltage Input:

1. Remove both Generator Field fuses — open Throttle in Steps from Idle to No. 8. (To check T.R.P.)
   
   (A) Voltmeter should be at RCP-2 (Pos.) & RCP-5 (Neg.) should increase in steps. Zero at Idle and above 68 volts in 8 if less than 65 to 68 volts bad T.R.P.

   Throttle Response Voltages:
   
   1. 9.5 to 15.5
   2. 27.5 to 29.0
   3. 42.0 to 43.5
   4. 56.5 to 58.0
   5. 61.0 to 62.5
   6. 65.0 to 66.5
   7. 69.5 to 71.0
   8. 71.5 to 72.5

   (B) Put Voltmeter at SBP–LR (Pos.) & RCP-5 (Neg.) - Pull Throttle to No. 8 quickly voltage should increase to 48 volts in about 14 - 18 seconds – if not in required time check (CA 29–CA 31) — this checks rate control.

   (C) With the Throttle in No. 8 and Voltmeter SBP–EZ (Pos.) to BN. If less than 69 volts failed Voltage Regulator.

   (D) To check RCP put Voltmeter at No. 3 of RCP (Pos.) and No. 5 of RCP (Neg.) – Voltage should climb to 48 - 50 volts.

To check Sensor — SCR and Field of D32 E–1 Generator

1. Remove 19 & 20 wires from Sensor.
2. Put (Pos.) of 1.5 V Battery put on Terminal 20.
3. Put (Neg.) of 1.5 V Battery just touch Terminal 19.
4. Units has to be in Notch 1.
5. Unit should load 1200 – 1500 Amps.

(E) To check for SBP failure: Throttle in No. 1 position with brakes on and Generator Field fuses in. Remove wire from SBP–LR Terminal and measure voltage from SBP–20 (Pos) to SBP–FB (Neg.) with wires removed, loading should go to zero and voltmeter should read more than 50 volts. If unit still loads and SBP voltage is less than 25 volts replace SBP.
2. Unit not loading:
   
   (a) Check for blown Generator Field Fuses. Replace fuses and if fuses blown again SCR is bad.

   (b) With throttle in No. 1 check to see if all relays and contactors have picked up — GFR — GFD — S-13; S-24 —G.F; Forward or Reverse: MIZ; S24A.

   (C) Remove Generator Field Fuses; disconnect the wire from Terminal of LR of SBP. Connect a Voltmeter Pos. lead to the wire and connect negative lead to BN. Put throttle in Run 8 position.

   (1) If voltage is about 50 V.D.C. do the following:

      Replace wire at L.R.

      (a) Brakes set up and Throttle in No. 1 and Power set up.

      (1) Check Voltage SBP—EZ to SBP—19 if more than 10 volts failed SBP. Remove Generator Field Fuses and place throttle in Run 8 position, if not between 15 & 30 volts, replace SBP.

      (2) Check Voltage PCP Terminal 4 to NA. If more than 55 volts, failed PCP.

      (3) Return Throttle to Idle and replace Generator Field Fuses — Advance Throttle to Run 1 and check equal Voltage at Sensor Terminals 18 to 24; 18 to 16; 16 to 14, should be about 75 volts D.C.

   (D) Remove Generator Field Fuses; disconnect the wire from Terminal at LR of SBP. Connect a Voltmeter Pos. lead to the wire and connect negative lead to BN. Put Throttle in Run 8 position if voltage is much less 50 volts do the following:

      Replace wire at L.R.

      (1) With Generator Field Fuses removed place Throttle in No. 8 — Put Voltmeter RCP—3 (Pos.) & RCP—5 (Neg.) if less than 40 volts D.C. — Do.

         (a) Remove wire from WSC—10 if Voltage increases failed WSC Panel.

         (b) Check continuity RCP—6 & RCP—4 to negative.
If Steps A & B Prove satisfactory, check RCP.

(c) WSC-10 to BN if less than 40 Volts D.C.
   (1) Open load Regulator (should read 1500 - 150 ohms)
   (2) Bad load Regulator brushes.
   (3) Jammed Load Regulator.
   (4) WSC-10 to WSC-11, if more than 10 V D.C. failed WSC.

(3) Unit Overloading:
   (a) Unit overloads Throttle No. 1 position – Remove No. 4 wire from RCP Load Meter should go to zero. (Check RCP).
   (b) Unit overloads throttle No. 1 position. Remove wires from Sensor No. 19 current should go to zero. If not, disconnect wire from Sensor Terminals 14, 16, 18 if current still don’t go to zero the SCR is faulty. If current goes to zero with wires removed from 14, 16, 18 but does not go to zero when wire removed from Terminal 19 the Sensor is faulty.

(C) To check Sensor on Unit:
   Unit shut down and Leads disconnected from Sensor Terminals 4, 8, 12, resistance with Ohmeter (RX100 scale) should read infinite between any of input terminals 4, 8, 12 to any of Terminals 14, 16, 18 of Sensor.

(D) With engine running, throttle in idle check AC voltage (0-5VAC) from Sensor Terminal 13 to 14, 16, 18. No Voltage should appear at any Terminal.

(E) Unit Idling and Brakes set Throttle in Position 1 – Measure AC Voltage (0-10 VAC range) from Terminal 13 to 14, 16 and 18. Voltage at all three terminals should be within 1 volt of each other. Disconnect wires from 14, 16, 18 for this test.

(4) Unit Hunting Under load - check:
   (a) Check for Shorted GVT & GCT turns by reading AC Voltage drop across Transducers – A shorted turn will show a low reading at all Windys.
   (b) Check T3 & T4 Transformers – can be checked in identical method as in (A).
(c) With Generator Field Fuses removed and rectifiers in PCP isolated from loading coils. Check blocking and forward resistance with an ohmmeter.

(d) Faulty signal from PCP Panel.
**GP-38 – DIODES (AR10E)**

<table>
<thead>
<tr>
<th>ORIGINAL PART NO.</th>
<th>REPLACEMENT PART NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8364554 – 2 (POS)</td>
<td>8368466— *Type - 2</td>
</tr>
<tr>
<td>8364554 – 3 (POS)</td>
<td>8368467— Type - 3</td>
</tr>
<tr>
<td>8364555 – 2 (NEG)</td>
<td>8368468— Type - 2</td>
</tr>
<tr>
<td>8364555 – 3 (NEG)</td>
<td>8368469— Type - 3</td>
</tr>
</tbody>
</table>

ORIGINAL EQUIPMENT NO's ARE NOT FURNISHED AS REPLACEMENT DIODES. WHEN RENEWING DIODES USE PART NO. OPPOSITE ORIGINAL EQUIPMENT NUMBER. LOOK AT FUSES TO SEE IF DIODES ARE BAD. BLOWN FUSE INDICATOR PIN WILL BE PROTUDING FARTHER OUT THAN NORMAL. THIS INDICATES BLOWN FUSE. FUSE WILL NEED TO BE REPLACED ALSO AND YOU WILL HAVE TO CHECK TO SEE WHICH DIODE IS BLOWN SINCE ONE (1) FUSE PROTECTS TWO DIODES (USE OHMMETER). APPLY **ONLY** 35 LB. TORQUE ON APPLICATION. USE SPECIAL DIODE APPLICATOR AND APPLY IT ONLY ON BASE THAT CONTACTS HEAD SINK. **DO NOT APPLY** ON THREADS. MAKE SURE BASE OF DIODE AND HEAT SINK ARE CLEAN.

* (TYPE IS STAMPED ON END OF DIODE THREADS).
LOAD TESTING – GP-38-AC ON BOARD

PROVISION IS MADE TO LOAD TEST LOCOMOTIVE THROUGH OVER GRIDS WITHOUT MAKING ANY EXTERNAL CONNECTIONS.

1. START AND PUT ON LINE.

2. APPLY BRAKES MAKE SURE CUT IN PUT GF BREAKER IN.

3. CK. G. RELAY CUT OUT SEE IF ON.

4. PUT REVERSER IN REVERSE DIRECTION (SHORT HOOD) LOAD UNIT 100 AMP OR SO SEE THAT CIRCUITS ARE OK.

5. RETURN REVERSER HANDLE TO NEUTRAL.

6. THROW SWITCH ON LOAD TEST PANEL TO GRID LOADING POSITION. NOTE LIGHT ON PANEL COMES ON. IF NOT, CHECK LAMP.

7. CONNECT VOLT METER TO TERMINALS ON PANEL FOR VOLTAGE, AND USE MILIVOLT METER ON M.G. CURRENT TERMINALS IF A CURRENT READING IS NEEDED. (ENG. GOV WILL BE .83 FULL LOAD.)

8. LOAD UNIT TO NO. 2 NOTCH SEE IF GRID BLOWER IS TURNING. IF SO, CONTINUE LOAD TEST.

9. WHEN FINISHED RETURN S.W. TO NORMAL ON TEST PANEL (DO NOT DISTRUB UNDER LOAD.)

10. TEST SEE IF UNIT LOADS.

HORSE POWER – IV – 80X MILIVOLT X ALT VOLT.

700 700
GROUND RELAY CHECK ON GP-38-AC & 38-2 UNITS
Locomotives 2823 – 2878, 5000 - 5054

Prior to Load Testing, follow this Procedure:

1. Attach jumper (No. 16 wire) from GP test jack to ground.

2. Attach 0 - 150 volt D.C. Meter across GP and GN test jacks.

3. Place test panel switch on load test position.

4. Set unit up for load testing and place throttle in No. 1 notch.

5. Observe meter reading, ground relay should pick up between 75 and 125 volts. **DO NOT ALLOW VOLTAGE TO INCREASE ABOVE 130 VOLTS** if ground relay fails to trip.

   If pick up is above 125 volts or ground relay fails to trip, renew ground relay and recheck.

6. Remove jumper and continue with load test procedure after ground relay check.
Megger Test — 1,000 Volt Megger

1. Isolate and stop engine.
2. Open main battery switch and ground relay switch.
3. Apply jumper across GP and GN (main gen. volts) on test panel. (Use bare copper or 3 point jack wire, 1 point to attach megger.)
4. Jump out AR10 and D-14 slip rings. (short cut)
5. Pull out all module cards approximately three inches from mounting receptacles or contact pins.
6. Place all circuit breakers in ON position EXCEPT BREAKERS MARKED ELECTRONIC DEVICES AND RADIO. Leave these breakers in OFF position.
7. Attach megger — one side to jumper across GP and GN, the other lead to carbody frame or other suitable ground.
8. “Meg” unit approximately one minute and record reading on maintenance chart.
9. Reverse procedure to replace unit back in service. NOTE: Make sure all jumpers are removed before placing battery switch and ground relay switch in. SEAL GROUND RELAY SWITCH.
10. Crank unit and check for loading in forward and reverse.

* Item 5 does not apply for Locomotives 2823 — 2878.
HYPOTING PROCEDURE FOR GP-38-AC
UNITS 2823 – 2878 WITH AR10 ALTERNATORS

(Electrician must sign for jumpers applied and removed)
Shut unit down and pull battery switch.

1. Remove fiberglass covers from both sets of buses on AR10. Short cut positive and negative buses on each side, also short both sets of buses together.

   Jumper applied ___________ Jumper removed, covers replaced ___________

2. Short out AR10 and D-14 slip rings.

   Jumper applied ___________ Jumper removed, cover replaced ___________

3. Short cut AR10 field with a jumper between ARP wire on TB33L9 and ARN wire on TB33L-10.

   Jumper applied ___________ Jumper removed, cover replaced ___________

4. Short out Z1. Apply jumper between TB62A-2 (wires BKD and BKD10) to No. 5 on DBR. (wire BKU1 and BKU2)

   Jumper applied ___________ Jumper removed ___________

5. Short out Z3 apply jumper between TB 63A-2 (wires BKF and BKF10) to No. 5 on BWA. (wire BKM1)

   Jumper applied ___________ Jumper removed ___________

6. Open ground relay switch and connect hypot leads to AR10 buses and locomotive frame. Hypot for 1 minute at 1050 volts.

   Open ground switch _______ Close ground switch & seal ___________
HYPOTING PROCEDURE FOR GP-38-2
UNITS 500–5054

(Electrician must sign for jumpers applied and removed)
Shut unit down and pull battery switch

1. Remove fiberglass covers from both sets of buses on AR10. Short out positive and negative buses on each side, also short both sets of buses together.

Jumpers applied _______ Jumpers removed, covers replaced _______

2. Short out AR-10 and D-14 slip rings.

Jumpers applied _______ Jumper removed, cover replaced _______

3. Short out AR-10 field with a jumper between ARP wire on TB33L9 and ARN wire on TB33L10.

Jumper applied _______ Jumper removed, cover replaced _______

4. Pull all module cards approximately (3) three inches from mounting receptacles or contact pins.

Cards removed _______ Cards replaced __________________________

5. Open ground relay switch and connect hypot leads to AR-10 buses and locomotives frame – hypot for 1 minute 15 1050 volts.

Open ground switch_______ Close ground switch ____________________
1. Apply No. 16 wire jumper from top right H.V. lead on B-24 contactor to suitable ground.

2. Remove arc chutes from S24 and S13 contactors and block contacts on both.

3. Apply 150 volt meter — positive on wire jumper to ground and negative on bottom lead on P-2 contactor.

4. Put unit in 2nd notch and observe volt meter. Ground relay should trip between 75 and 125 volts.

5. Do not exceed 130 volts. If does not trip, renew ground relay and check operation by repeating above.

6. Reset ground relay, also GDL. Remove blocking and wire jumper. Replace arc chutes and check for loading in forward and reverse.
# Locomotive Temperature Switches

Revised 6-18-74

<table>
<thead>
<tr>
<th>Train Type</th>
<th>TA Numbers</th>
<th>TB Numbers</th>
<th>ETS Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP38</td>
<td>8409067, 8409070</td>
<td>8409069, 8409072</td>
<td>8379564, 8379942</td>
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<tr>
<td>GP38</td>
<td>8314889, 8334771</td>
<td>8314887, 8334773</td>
<td>8323990, 8334774</td>
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<td>GP38</td>
<td>8424290, 8424293</td>
<td>8424292, 8424295</td>
<td>8425575, 8425023</td>
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<tr>
<td>SW1500</td>
<td>8409069, 8409072</td>
<td>8418385</td>
<td>8379564, 8379942</td>
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- 715 -
<table>
<thead>
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<tbody>
<tr>
<td>8379564</td>
<td>ETS for 2716 – 2822</td>
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<td>HES for 2330 – 2347</td>
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<td>8379942</td>
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<td>HES for 2330 – 2347</td>
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<td>ETS for 2300 – 2329</td>
</tr>
<tr>
<td>8409070</td>
<td>TA for 2716 – 2822</td>
</tr>
<tr>
<td>8409072</td>
<td>TB for 2716 – 2822</td>
</tr>
<tr>
<td></td>
<td>ETS for 2300 – 2329</td>
</tr>
<tr>
<td>8418385</td>
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</tr>
<tr>
<td>8424293, 8424290</td>
<td>TA for 2823 – 2878</td>
</tr>
<tr>
<td></td>
<td>5000 – 5138</td>
</tr>
<tr>
<td>8424295, 8424292</td>
<td>TB for 2823 – 2878</td>
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<td></td>
<td>5000 – 5138</td>
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<td>8314887, 8334773</td>
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</tr>
<tr>
<td>8323900, 8334774</td>
<td>ETS for 2880 – 2886</td>
</tr>
</tbody>
</table>
LOAD TEST PROCEDURE
Norfolk Southern GP-38
(2001 - 2006) or (2880 - 2886)

1. Connect two (2) positive load test cables to main generator positive buss bar (GS1, 2, 3, 4, 5).

2. Connect two (2) negative load test cables to main generator negative buss (GN4, 5, 6, 7, 8, 9, 10).

*3. Place manual transition switch in test position.

*4. Remove MJ wire from interlock of starting contactor.

5. Start locomotive and put on line.

*6. Run jumper from E to F interlock on S24 power contactor.

7. Place GF breaker in ON position and load to No. 1 (1) throttle. Observe that BF and SF pick up and load regulator moves.

8. Full load is .96 governor rack.

* ON COMPLETION DO THE FOLLOWING:

(1) Place manual transition switch in NORMAL position which was moved in Step 3.

(2) Apply MJ wire to GS interlock which was removed in Step 4.

(3) Remove jumper from E to F on S24 power contactor which was applied in Step 6.

(4) Remove all (4) load test cables and tighten bolts.

(5) Load from throttle - see if loading normal when above step is completed.
SETTING OVERSPEED ON MARK IV SPEED INDICATOR

1. Remove the three screws in back of cover. Remove housing from indicator.

2. Remove the three screws in the front cover. Remove front cover.

3. Locate switch block numbered from 1 thru 8 on face of board. The switches when turned on represent the following MPH:

<table>
<thead>
<tr>
<th>SWITCHES</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBERS</td>
<td>80</td>
<td>40</td>
<td>20</td>
<td>10</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Thus for 65 miles/hr. overspeed depress nos. 2, 3, 6, and 8 switches which will add to 65 (40 + 20 + 4 + 1).

4. The switches have either on/off markings or a white dot for the ON side.

5. You CANNOT use the following combinations for setting of overspeed:

   Numbers 1 and 2 switches
   " 8 and 3 "
   " 5 and 6 "
   " 5 and 7 "

6. Any overspeed setting from 1 – 99 MPH can be obtained without using a combination of switches in Step No. 5.
SETTING OF PERFORMANCE CONTROL PANEL  
(PCP-Part No. 8411758 Two Stage Shunting)  
Unit No's 2716-2888

NOTE: Make all settings in order as they appear. This is a must as other settings depend on the other.

1. Preliminary Procedure - Turn the PCP rheostats to the center of travel and place RE27 slider to obtain 6200 to 6240 ohm's from the base of the resistor to the slider, or across terminals two (2) and twelve (12) of PCP panel.

2. Stop diesel engine
   A. Put reverse lever in neutral position
   B. Isolation switch in start position
   C. Remove Gen. Fld. Fuses
   D. Place the Gen. Fld. and engine run switch in the OFF position.

3. Disconnect the main generator shunt panel bus (8390746).

4. Insert 7/32" rods into the test jacks. Connect M.G. set output leads and a 1500 D.C. Voltmeter to the test jacks - DON't connect the M.G. set input heads.

5. Start Engine - Set the handbrake and airbrake (Remove starting fuse). The engine must be started before generator is short circuited.

6. Connect jumper wire from GP to GN. (To prevent sparking)

7. At brackets next to bus panel, connect a 2000 ampere 50 millivolt meter shunt to short circuit the main gun.


9. Connect the M.G. set input leads to the Battery SW. and place the transition sequence switch in the manual sequence test position.

10. Disconnect the wire (GVT) from the No. 1 Terminal of the GVT, and connect the GVT wire to the positive terminal of a 0–300 D.C. milliammeter. Connect the negative lead of the milliammeter to the No. 1 terminal of GVT.
1. **Voltage Feedback Settings** — Adjust RE-18 (Set between 90 and 110 milliamperes).
   
   A. Apply 1000 volts and let resistors warm up for 10 minutes. The milliammeter should read between 90 and 110 milliamperes if not return M.G. set to zero and make adjustments with the slider on RE18 resistor on resistor panel in back of electrical panel.
   
   B. Return M.G. set to zero and reconnect the GVT and disconnect milliammeter.

2. **Excitation Control Parallel** — Adjust RH7 (Set between 4000 and 4200 amperes).
   
   A. Disconnect wire 38 from terminal "B" of CR41A in PCP panel.
   
   B. Connect jumper wire from No. 5 (GLF wire) to terminal No. 18 GLG wire on PCP terminal- in PCP panel.
   
   C. With zero volts from M.G. set, put throttle in No. 8 position. Generator current should regulate between 4000 and 4200 amperes, if doesn’t, regulate adjust RH7.
   
   D. Do not allow current to go over 4200 amps — always turn RH7 full clockwise, brush arm at 32 wire—this allows you to build the current up from lower level (lock RH7 when completed).
   
   E. Keep high levels of current for as short as time as possible.
   
   F. Disconnect the jumper wire from No. 5 and 18 terminals.

3. **Excitation Control Service Parallel** — Adjust RH6 (Set between 2050 and 2150 amps).
   
   A. Apply jumper wire on terminal No. 17 and No. 20 of PCP panel.
   
   B. Apply 680 volts with M.G. set, then place throttle in run 5 position. Main generator current should regulate between 2050 and 2150 amps if not adjust RH6. Lock RH6 when adjustment is completed.

4. **Excitation Control Series Parallel** — Adjust RH4 (Set between 1805 and 1895 amps).
   
   A. Apply jumper wire on Terminal No. 17 and No. 20 of PCP panel.
   
   B. Apply 1000 volts with M.G. set. Place throttle in No. 5 position. Generator current should regulate between 1805 and 1895 amps, if not, adjust RH4.
   
   C. Reduce M.G. set voltage to 680 volts, then place throttle in No. 5 position if necessary readjust RH6 to obtain correct amperes (2050 to 2150 amps).
D. Increase M.G. set voltage to 1000 volts and place throttle in No. 5 position, if necessary readjust RH4 to obtain correct amperes (1805-1895 amps).

E. Repeat Steps C & D until correct settings is obtained. Lock RH4 and RH6 in place.

F. Connect No. 38 wire to the "B" terminal of CR41A.

G. Center the brush arm of RH11 and turn the brush arm of RH12 fully to the No. 11 wire of terminal of RH12.

5. **Performance Control** – Adjust RH12 (To increase 20 to 40 amps).
   A. Apply jumper wire on terminal No. 17 and No. 20 of PCP panel.
   B. Apply 680 volts with M.G. set, then place throttle in Run 5 position. Should regulate between 2050 and 2150 amps.
   C. Turn the brush arm of RH12 to obtain an increase of from 20 to 40 amps over the value obtained in Step A. Lock RH12.

6. **Performance Control** – Adjust RH11 (Set between 2700 and 2900 amperes).
   A. Apply jumper wire on terminal No. 17 and No. 20 of PCP panel.
   B. Apply 490 volts with M.G. set. Place throttle in No. 5 position and current should regulate between 2700 and 2900 amperes, if not adjust RH11. Lock RH11.

7. **Excitation Control Panel** – Adjust RH5 (Set between 1680 and 1850 amps).
   A. Remove jumper from No. 17 and No. 20 terminal of PCP panel.
   B. Disconnect the No. 17 wires from (GLX) from terminal 17 of PCP panel.
   C. Connect jumper wire from No. 5 to No. 18 on PCP panel.
   D. Apply 1000 volts with M.G. set and then place throttle in No. 5 position. Current should regulate between 1680 and 1850 amps. If necessary, adjust RH5. Lock RH5.
   E. Reconnect No. 17 wire GLX on PCP panel.
   F. Remove jumper wire from No. 5 and No. 18 terminal on PCP panel.
8. **MCO Power** — Adjust RH8 (Set between 1730 and 1830 amps).
   A. Cut out traction motor.
   B. Remove wires off terminal No. 17 of PCP panel.
   C. Remove wires off Cor-H1 (EHX and EHX1 wires).
   D. Apply jumper to No. 5 and No. 18 terminal of PCP panel.
   E. Reconnect No. 17 wire (GLX) on PCP panel.
   F. Remove jumper wire from No. 5 and No. 18 terminal on PCP panel.

   A. Connect 0–75 D.C. voltmeter positive lead to terminal No. 1 of RCP panel.
   B. Connect the negative lead of voltmeter to a "N" wire.
   C. Be sure dynamic brake cut out switch is on.
   D. Set up locomotive controls for operation in dynamic braking.
   E. Advance throttle to maximum braking position and observe voltage.
   F. Generator current should regulate between the following:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Current Range</th>
<th>Voltage</th>
<th>Current Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>65V</td>
<td>770–830 AMPS</td>
<td>71V</td>
<td>890–940 AMPS</td>
</tr>
<tr>
<td>66V</td>
<td>800–860 AMPS</td>
<td>72V</td>
<td>920–970 AMPS</td>
</tr>
<tr>
<td>67V</td>
<td>820–865 AMPS</td>
<td>73V</td>
<td>940–980 AMPS</td>
</tr>
<tr>
<td>68V</td>
<td>840–890 AMPS</td>
<td>74V</td>
<td>950–1000 AMPS</td>
</tr>
<tr>
<td>69V</td>
<td>860–910 AMPS</td>
<td>75V</td>
<td>980–1030 AMPS</td>
</tr>
<tr>
<td>70V</td>
<td>800–930 AMPS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   G. If generator current doesn’t regulate, adjust RH3 rheostat.

10. Throttle in No. 1 and locomotive brakes applied, current should read 500 to 700 amps.

11. Check and make sure all wires are on tight and jumpers are removed that was applied on PCP.

12. When unit is removed from the short circuit — main generator shunt applied—load engine and engine should load about 300 amps in notch 1.

13. **ELR Calibration** — Adjust RH27 (56 amperes or 56 millivolts). Don’t have to be short circuited.
   A. Stop engine.

   - 718.3 -
B. Disconnect the FS1 and FP cables from the GFD contactor.
   FS2    FP2
C. Bolt the cables to a 50 amperes 50 millivolt shunt.
D. Connect a 0 - 75 D.C. millivolt meter to the shunt.
E. Disconnect the EW wire from the No. 1 terminal of TRP panel,
   relay "A" connect 100 ohm 100 watt test rheostat as follows:
   1. Connect lead top of the rheostat to a negative (turn arm of
      rheostat to the "N" terminal).
   2. Connect the other end top to a No. 6 wire terminal that will
      be energized when throttle is moved (F of B24-GS1 wire)
   3. Connect center top to the No. 1 terminal of TRP panel.
F. Disconnect the positive side of the coil of the ELD (6VX6 wire).
G. Connect test light to negative and the other end of light to the
   wire removed from the ELD (6VX6).
H. Center the reverser handle and remove it. Set brakes, hand brakes
   and engine air brakes.
I. Connect jumper from positive coil terminal of G.F. contactor to a
   No. 6 wire that is energized when throttle is moved out of idle
   (F of B24-GS1 wire).
J. Start engine and make sure reverser is removed from controller.
K. Put throttle in No. 7 position.
L. Advance test rheostat slowly and test lamp should come on at 56
   millivolts, if not adjust RH27. This setting picks up ELR.
M. Drop out of ELR was adjusted by RE27 earlier by adjusting to
   6200 or 6240 ohms at terminal No. 2 and No. 12 of PCP panel.
   Lock RH27.
N. Return circuits to normal operating conditions.

Material Needed

1. M.G. Set
2. 0 - 1500 D.C. Voltmeter
3. 2000 AMP 50 Millivolt Meter Shunt
4. 0 - 300 D.C. Milliameter
5. Test Light
6. 0 - 75 D.C. Voltmeter
7. 50 Amp- 50 Millivolt shunt 8042781

- 718.4
Troubleshooting the Locked Wheel Detection System — GP-38

The test switch on the module provides a functional test of the module and the locked wheel indication circuitry. Test 1 should duplicate operation with all axles above 4 MPH, i.e., light B on and no locked wheel indication. Test 2 should duplicate operation with 5 axles above 4 MPH and 1 axle locked and a locked wheel indication should be provided. Voltage from each of the individual motor jacks to jack 13 (common) can be checked during these tests to qualify the module.

A movement check is required to qualify the entire system. While moving, read the voltage from the individual motor jacks to 13. The DC voltage output from the frequency converters should be 0.4 volt maximum at standstill and should increase to about 32 volts at 8 MPH and above. If the absence of a signal is detected and the previous module tests were OK, the trouble is probably in the magnetic pickup or cables. This is assuming all axles have been checked for actual rotation.

The magnetic pickups connect to the cable color coded wire as follows:

<table>
<thead>
<tr>
<th>Point</th>
<th>Color</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Blue</td>
<td>Power Supply +</td>
</tr>
<tr>
<td>B</td>
<td>Green</td>
<td>Output Signal (Squarewave)</td>
</tr>
<tr>
<td>C</td>
<td>Orange</td>
<td>Common</td>
</tr>
</tbody>
</table>

The power supply to the magnetic pickups is about 10 volts DC, blue to orange. The output signal from the magnetic pickup (green to orange), will be 0.2 volt (DC scale) or less at standstill and will increase to approximately 3-5 volts when moving. If no increase in this signal is detected with locomotive movement, trace this problem to a cable or magnetic pickup as follows: At the LW terminal board in the inertial filter compartment, disconnect the blue, green and orange wires of the individual motor cable and check continuity green-blue, blue-orange and orange-green. Use an ohmeter on the 10X scale. Disregard the exact ohmic value or non-repetitive readings but check circuit continuity only. Also, do not use a megger, bell righer, etc., as the magnetic pickup contains solid state circuitry. In the case of no continuity, disconnect the cable at the magnetic pickup and plug into a spare pickup and read continuity again. If a cable problem, check all connector pins and straighten if necessary.

In the case of unusual locked wheel system problems, we suggest looking for grounds. Pull the LW module and check for grounds using an ohmeter at the LW terminal board. All wires should be clear of ground.
Also suggested is checking various signals at standstill. Check for proper value
the signal at the TM1–6 jacks to jack 13 and also check the magnetic pickup
output signal. This can be read (DC scale) at the LW terminal board or by
reaching behind the LW module and checking from pins 3–8 to jack 13. This
should be 0.2 maximum (DC scale). NOTE: Jack 13 is 6.2 volts + in respect
to BN.

In some cases, shorted pickups have reduced the power supply voltage. To
determine if a low power supply voltage is a fault of the pickups or module,
disconnect the blue (power supply) wires at the LW terminal board.

To change the magnetic pickup, take care not to allow dirt to enter the CE
bearing through the opening. Also, do not allow dirt to enter either connector
as this can lead to grounds, low output signals or connector deterioration. The
pickup must be torqued to 15 ft. lbs. Make sure the connector properly locks
on the pickup. A 6” channel-lock pliers is a handy tool for disconnecting the
connector from the pickup.
DI-MAG
DIGITAL MAGNETIC PICKUP
MODEL 58404

GENERAL:
The Model 58404 pickup provides a digital pulse output whenever there is an abrupt change from non-magnetic to magnetic material moving past the pole piece. The rise-fall times and amplitude of the output pulse are independent of the characteristics and speed of the magnetic discontinuity. The maximum rise time is 1 microsecond; the maximum fall time is 500 nanoseconds.

MOUNTING:
The pickups are designed to mount in a 5/8” – 18 threaded hole and are provided with a jam nut for securing.

ADJUSTMENT:
The gap between the actuator and the Di-Mag pole piece should be adjusted so that the operating point is established above the sensitivity curves shown on the reverse side. As an example, with a 20 pitch gear, if the surface speed is 100 ips any gap from 0” to .80” will provide full pulse amplitude under the worst-case operating conditions. For more detailed sensitivity information, refer to the specification sheet.

CONNECTIONS:
Red (Power Input) — The red lead should be connected to the positive terminal of the d-c power source. And d-c voltage from +4.0 to 15.0 volts d.c. may be used. Black (Common) — The black lead is common to the low side of the signal and the negative side of the power source. Green (Signal Out) — The green lead is the signal output.

CAUTION: OBSERVE POLARITY WHEN CONNECTING—MOMENTARY REVERSAL WILL DAMAGE THE UNIT.

OUTPUT CHARACTERISTICS:
With no discontinuity moving in front of the pole piece, the output voltage will be less than +0.150 volts. For each discontinuity passing the pole piece, a positive pulse will be produced. To calculate the output pulse amplitude for various loads the following relationship may be used:

\[ V_O = \frac{V_s \cdot R}{R + 5000} \]

Where:
- \( V_O \): Amplitude of output pulse (volts)
- \( V_s \): Supply voltage (volts, d-c)
- \( R \): Load impedance (ohms)
- 5,000: Approximate output impedance (ohms)

**TEST CIRCUIT**

- Supply Voltage "A"
- 24" Leads
- 10K, 10pf
- Common "C"
- 750 Nanoseconds Max.
- 1 Microsecond Max.
- 90% 80%
- 500 Nanoseconds Max.

**OUTPUT PULSE**
## THROTTLE RESPONSE PANELS GP-38

<table>
<thead>
<tr>
<th>LOCO NO.</th>
<th>TRIP PART NO.</th>
</tr>
</thead>
<tbody>
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<td>1. 2716 – 2777</td>
<td>8366931</td>
</tr>
<tr>
<td>2. 2778 – 2822</td>
<td>8409702</td>
</tr>
<tr>
<td>3. 2823 – 2878</td>
<td>8365431</td>
</tr>
</tbody>
</table>

TRP Panel 8481556 replaces above 3 panels. However, if 8481556 is not available, the above will have to be replaced with the original.
CALIBRATION OF SPEEDOMETER AND OVERSPEED ON FP-7, GP-38 AND SD TYPE WITH GE TEST KIT MODEL 17MM26K1

<table>
<thead>
<tr>
<th>RIM THICKNESS</th>
<th>WHEEL SIZE</th>
<th>RPM ON METER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20 MPH</td>
</tr>
<tr>
<td>1&quot;</td>
<td>37&quot;</td>
<td>181</td>
</tr>
<tr>
<td>1½&quot;</td>
<td>38&quot;</td>
<td>177</td>
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<tr>
<td>2&quot;</td>
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<td>172</td>
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<tr>
<td>2½&quot;</td>
<td>40&quot;</td>
<td>168</td>
</tr>
<tr>
<td>3&quot;</td>
<td>41&quot;</td>
<td>163</td>
</tr>
</tbody>
</table>

INSTRUCTIONS

1. Use columns A, B, C, D, E, F on 58/19 gear ratio.
3. Use 17MM26K1 test kit. – Connect power cable to locomotive battery. (Observe polarity.)
4. Turn RPM dial to X1, power dial to 75 volts, frequency controls FINE and COARSE to OFF position.
5. Remove cover from resistor box on throttle stand, remove SPW wire and connect to leads marked panel to resistor box A and B terminals (two left hand terminals).
6. Select rim thickness of speed recorder wheel from chart above and move horizontally across chart for 20, 40, 60 and 80 MPH.
7. Adjust dial in resistor box to obtain correct setting at 60 MPH, (80 MPH for 19 Tooth). If more than 2–4 MPH off at 40 and 20 MPH setting, 40 and 60 for 19 tooth. Renew meter first, (Use one with IMA full scale) and re-check before renewing resistor-transformer box.
8. Check overspeed by increasing RPM until overspeed whistle blows. (Be sure to have overspeed cut in and an on unit.) Adjust overspeed rheostat on 357 card on panel in short to 65 MPH for all 62/15 gear ratios. (Adjust overspeed to 83 MPH for 58/19 gear ratio.)
9. Measure ohm value of axle generator from SPX and SPW wire on resistor box – should be approximately 70 ohms.
10. Reconnect wire and seal resistor box.

*Revised 9/26/73 to include FP-7 locomotives 6130–6149 and GP-38-2 with 100 MPH speed indicators.
BARCO SIS 400 CALIBRATION PROCEDURE

A - Indicator Calibration

(1) With electronic device switch off, check for mechanical zero on meter. Adjust by turning screw in the center rear of the meter located within the control indicator housing.

(2) Reapply power and check for electrical zero mph indication. Adjust with yellow/violet color coded potentiometer on the amplifier board.

(3) Insert verifier test cable into test jack at the base of the control-indicator housing. Turn verifier on and set selector switch to 80 mph. Adjust yellow/orange color coded potentiometer if needed.

(4) Turn selector switch to 40 mph and adjust yellow/green color coded potentiometer if needed.

(5) Recheck zero and 80 mph and adjust as necessary.

(6) Overspeed
   a. Turn verifier selector switch to VH.
   b. Adjust VAR-HI potentiometer slowly to 65 mph, overspeed relay should activate at 65 mph. If overspeed relay is out of calibration adjust the red/grey color coded potentiometer with indicator at 65 mph.

B - Recorder Calibration

NOTE: When calibrating the recorder, it is necessary to close the door fully after each adjustment since the door switch disconnects power to the recorder each time the door is opened. Tape must also be in the unit since the recorder is equipped with an end of tape sensor which shuts off the recorder when the tape supply is exhausted.

(1) With verifier cable inserted in test jack at control indicator, set selector switch to 80 mph. Adjust the potentiometer marked Hi-STYLUS within the recorder as needed.

(2) Turn verifier switch off. If the stylus settles at a position other than zero mph, physically turn the black servo pot mounted on the plate to the left of the tape deck. This is accomplished by first loosening the 1/2" lock nut on the other side of the plate. Retighten the nut without allowing the pot to turn.

(3) Recheck settings and adjust as needed.

(4) To calibrate tape advance, turn verifier selector switch to 40 mph. When the stylus is at the 40 mph line record the elapsed time that the stylus takes to travel between two vertical lines. At 40 mph the time of travel should be 90 seconds, or adjust the potentiometer marked TAPE ADVANCE. (1/4" equals one mile of tape travel.) For accuracy a check of ten miles should be made.
Wheel diameter compensator within control indicator presumed at 40" (or use correction chart on verifier).

1. With electronic device switch off, indicator hand and stylus should be on zero.
2. Turn on electronic device switch.
3. Insert verifier test cable in test jack at base of S.I.S. 400 control indicator.
4. Turn verifier on and set selector switch to 80 mph. Recorder speed stylus and indicator pointer should rise to 80 mph.
5. Turn verifier off; indicator pointer and speed stylus should be positioned on zero.
6. Turn verifier on, set selector switch to 40 mph.
7. With recorder speed stylus on the 40 mph line, the speed stylus should travel between two vertical lines (1/4" = one mile to travel) in 90 seconds.
8. Turn verifier selector switch to VH and adjust VAR-HIGH potentiometer so that indicator reads 65 mph. At this value the overspeed relay will activate.

<table>
<thead>
<tr>
<th>WHEEL DIAMETER SETTING</th>
<th>VERIFIER SIGNAL IN</th>
<th>OVERSPEED SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOUND LEFT</td>
<td>0</td>
<td>40</td>
</tr>
</tbody>
</table>

Engine #
Date
Electrician
Supervisor

NOTE: If indicator or recorder is not within desired values see Calibration Procedure.
SECTION 800

EMD F-7 FREIGHT
SETTING TRANSITION ON F-7
(Use only an approved voltmeter)
(Refer to MI 6825 A)

1. Remove GS & GN wires from GS & GN studs on panel, replace nut and tighten so two remaining relay wires will be secure.
2. Put negative motor generator output and negative voltmeter leads on GN stud.
3. Put positive motor generator output and positive voltmeter leads on GS stud.
4. Connect motor generator input to 74 V, observe polarity.
5. With engine dead, set up controls in forward motor position.
6. Raise motor generator output voltage to about 850 V and let relays and resistors heat up for 2 or 3 minutes.
7. Set FSR pickup (1 to 2 & 3 to 4) at 910 V. Adjust bottom band on left front resistor. NOTE: If unit is equipped with FSTD relay, there should be a 4.3 sec. delay from time FSR picks up until FS contactor picks up. Replace FSTD if otherwise.
8. Set FSR dropout (2 to 1) at 690 V (inherent). This 2 to 1 dropout must be set before any other dropout is set. Adjust air gap set screw on lower right coil. Tighten lock nut after each adjustment before checking voltage again. If relay has an adjusting screw at left coil too, back it out several turns and lock so it won’t interfere. Check for proper contact wipe on completion.
9. Set FTR pick-up (2 to 3), raise voltage to 910 V and wait for FS contactor to pick up. Then raise voltage to 930 V, FTR should pick up, adjust band on right front resistor.
10. Check dropout of FTR, should be 610–640 V. Adjust air gap screw to bring in range. Check for proper contact wipe on completion.
11. Set drop out of FSR (2 to 3) at 540 V. Adjust top band on left front resistor.
   NOTE: This band may be near the top of the rear resistor. When FSR drops out power contactors should change to parallel. If transition takes place before FSR drops out, check CD interlocks on FS contactor.
12. Set drop out of FSF (4 to 3), raise voltage to 910 V again and pick up FS contactor in No. 4 transition. Reduce voltage to 600 V, FSR should drop out. Adjust middle band on left front resistor.
13. Make sure bands are tight and put paint on heads of locking screws.
14. Replace relay covers and seal.
15. Remove motor generator and voltmeter and reconnect GS & GN wires to transition panel.
SETTING F7 TRANSITION
(Standard)

- Diagram with electrical connections and labels:
  - PRG, GS, GS7, MA, GN
  - Voltages: 540 V, 600 V, 910 V, 1000 V
  - D.O., Adj. Air Gap
  - FGR: D.O. 2 - 1
  - FTR: D.O. 610 - 640 V

- Diagram with electrical connections and labels:
  - Q51, Q57, PR, MA, A, B, MB, G, H
  - Voltages: +, -
  - VM, MG
SETTING TRANSITION ON F-7

3 RELAY TYPE 2 BANDS ON FSR RESISTOR
(Use only an approved voltmeter)

1. Remove GS and GN wires from GS & GN studs on panel, replace nut and tighten so two remaining relay wires will be secure.

2. Put negative motor generator output and negative voltmeter leads on GN stud.

3. Put positive motor generator output and negative voltmeter leads on GS stud.

4. Connect motor generator input to 74 V, observe polarity.

5. With engine dead, set up controls in forward motor position.

6. Raise motor generator output voltage to about 850 V and let relays and resistors heat up for 2 or 3 minutes.

7. Set FSR pickup (1 to 2 & 3 to 4) at 910 V. Adjust bottom band on left front resistor. NOTE: If unit is equipped with FSTD relay, there should be a 4.3 sec. delay from time FSR picks up until FS contactor picks up. Replace FSTD if otherwise.

8. Set FSR dropout (2 to 1) at 690 V (inherent). This 2 to 1 dropout must be set before any other dropout is set. Adjust air gap set screw on lower right coil. Tighten lock nut after each adjustment before checking voltage again. If relay has an adjusting screw at left coil too, back it out several times and lock so it won't interfere. Check for proper contact wipe on completion.

9. Set FTR pick up (2 to 3), raise voltage to 910 V and wait for FS contactor to pick up. Then raise voltage to 930 V, FTR should pick up, adjust band on right front resistor.

10. Check dropout for FTR, should be 610-640 V. Adjust air gap screw to bring in range. Check for proper contact wipe on completion.

11. Check dropout of FSR (2 to 3) at 600 V. Adjust top band on left front resistor.
NOTE: This band may be near the top of the rear resistor. When FSR drops out power contactors should change to parallel. If transition takes place before FSR drops out, check contacts on FSR and interlocks on FS contactor.

12. Check dropout of FSR (4 to 3), raise voltage to 910 V again and pick up FS contactor in No. 4 transition. Reduce voltage to 600 V, FSR should drop out. Adjustment in Step 11 sets this dropout, it should not have to be reset.
13. Make sure bands are tight and put paint on heads of locking screws.
14. Replace relay covers and seal.
15. Remove motor generator and voltmeter and reconnect GS & GN wires to transition panel.
SETTING F7 TRANSITION
(2-BAND)
SETTING EI TRANSITION ON CENTRAL OF GEORGIA
F UNITS 905 & 907
(Zero Current)

NOTE: All settings must be made with engine running and auxiliary generator voltage 74 volts.

1. Remove GS and GS7 wires from top of front 10,000 ohm FSR resistor on transition panel. Replace nut so remaining wire will be tight.

2. Remove SHP wire from top of front 7500 ohm PTR resistor on transition panel. Replace nut so remaining wire will be tight.

3. Connect positive of a 1000 V voltmeter and MG set to stud on resistor where SHP was removed. Connect negative of voltmeter and MG set to GN wires at bottom of small 10 ohm resistor right side of panel. (See sketch) Connect input of MG set to 74 volts DC.

CAUTION: Correct polarity must be observed.

4. Lock reverser in neutral and jumper C-D reverser interlocks. Remove BF fuse and load engine in forward, make sure power contactors SF and BF pick up. See that auxiliary generator is 74 V.

5. FSR PICKUP & DROPOUT
   a. Set FSR pickup 1-2 and 3-4 at 363 V, move slider on front 10,000 ohm FSR resistor to adjust.

   NOTE: You will notice MG set voltage fall back as soon as FSR and FS pick up, this is normal and is partly due to the 1000 MFD capacitor across PTR coils charging since A-B interlocks on FS are now open. (See sketch) PTR should not pick up at this time, if it does, the capacitor is open or PTR is set too low.

   b. Set FSR dropout 2-1 at 165 V, move P4H1 slider on back 20,000 ohm FSR resistor to adjust.

6. PTR PICKUP & DROPOUT
   a. Set PTR pickup 2-3 at 363 V, move slider on back 15,000 ohm PTR resistor to adjust.

   NOTE: FSR will pick up first and MG set voltage will fall back, increase voltage to 363 V again and PTR should pick up, power contactors will change as soon as PTR picks up. (Transfer voltage will be set in Step 7.) If the capacitor across PTR coils is shorted, the PTR relay will not pick up.
6. **PTR PICKUP & DROPOUT** (Cont’d)
   b. Set PTR relay dropout 3-1 at 110 V, move PRE slider on front 7500 ohm PTR resistor to adjust.

7. **FSR TRANSFER VOLTAGE**
   Set FSR dropout 2-3 at 380 V. Run MG set quickly to 500 V and hold, SF and BF should drop out indicating that FSR and PTR have picked up. Slowly reduce voltage until power contactors change to parallel at 380 V. Adjust band on small 500 ohm resistor on transition panel, repeat until correct. Start in series each time.

8. **FSR DROPOUT 4-3**
   Set FSR relay dropout 4-3 at 135 V. Run MG set voltage to a little over 363 V and hold at this voltage until unit changes to No. 4 transition. Reduce voltage slowly until FSR relay falls out at 135 V, move P4G slider on back 20,000 ohm FSR resistor to adjust. Unit must be in No. 4 transition to check this dropout.

9. a. Replace GS, GS7 and SHP wires.
   b. Unblock reverser.
   c. Remove jumper from C-D reverser interlocks.
   d. Remove test equipment.
   e. Apply date decal to transition panel.
   f. On completion, see that unit loads in forward and reverse.

10. Relay Part Numbers:

    FSR and PTR ........................................ 8235328
    TR .................................................. 8216610
    Capacitor 1000 MFD - 150 V ..................... 8225149
    Wiring Diagram ............................... 100 M - 1273
    Wiring Diagram ............................... 100 M - 1273
1. Remove all GS wires from GS stud on transition panel.

2. Connect the positive lead of a 1000 V voltmeter and the positive output of a motor generator to the GS wire from the two 10,000 ohm resistors above the transition panel.

3. Connect the negative of the voltmeter and the motor generator output to the GN stud on the transition panel.

4. Connect a 150 MA meter in series with the KJ-PN bucking coils of the BTR relay. Remove the P to J jumper from the P stud of BTR, put positive lead of milliampmeter on the P wire, negative lead of meter on the P stud.

5. Connect input of motor generator to 74 V, observe polarity.

6. Raise output of motor generator to 468V and wait about three minutes for resistor and relay to warm up, then read 104 MA on milliampmeter with 468 V on voltmeter. Adjust both hands evenly on the two 10,000 ohm resistors above the transition panel to obtain this 104 MA reading. NOTE: Relay will not pick up at this setting, this is a bias or bucking voltage to the main generator buss. Reduce voltage to zero but leave hook-up as is for next step.

7. Make a standstill backward transition test. (USE EXTREME CAUTION) Be sure no one is under unit and there is sufficient room between other units. With unit running and motor generator connected as in Steps 1, 2, 3, 4 & 5, apply 468 V to BTR KJ - NP coils.

8. Apply engine brakes fully. Load unit in forward or reverse. As soon as throttle is opened jumper AB contacts of parallel. (3rd. and 4th. stud from top, left side of parallel relay) This will put unit in parallel. Increase throttle and observe load meter, unit should make backward transition at approximately 575 amps. NOTE: On B units shunt will have to be connected to main generator buss to read current at which backward transition is made.

9. On a standstill test without motor generator voltage on KJ-NP coils unit will make backward transition at approximately 175 amps.

10. Remove meters and motor generator. Reconnect all GS wires at transition panel.

SETTING VE9-T TYPE BTR RELAY
USED ON F-7 WITH BRAKING CONTACTOR

Sheet 2 of 2
SETTING WHEEL SLIP RELAYS ON F-7

(Refer to M1-5353)

1. With engine shut down, controls in, throttle off, connect jumper from positive side control switch to S24-H. (To pick up BF contactor.)

2. Connect test light from WS terminal on master terminal board to negative. (To check operation of wheel slip light.)

3. Connect leads of wheel slip test box to the coil terminals of WSR1.

4. Press button on test box and turn knob C.W. until WSR picks up. BF should drop out and WS light should come on. Repeat the above and note reading on milliampmeter the second time WSR picks up, this is the pick up value. Adjust the spring tension nut (Fig. 2, Item A) for 17 to 19 m.a. pick up.

5. With the pick up value set correctly, reduce the current until the WSR drops out, adjust the closed air gap screw. (Fig. 2, Item B) for 10 to 12 m.a. dropout.

6. The relay should snap in and out. There should not be any partial movement or hesitation. If there is, increase the spring tension and adjust the open air gap screw (Fig. 2, Item C) to correct the increased pick up value. Contact wipe plays an important part in the drop out value. Too much wipe or overtravel will cause an early drop out, or partial movement. Set contact air gap and wipe as in (Fig. 1). Tight or loose armature pivot pins can cause erratic action.

7. After relay pick up and dropout values are properly set, check the coil interlock circuit. With the WSR1 relay picked up with the test box, pick up the S13 power and see that the current on the milliampmeter rises. This checks the continuity of the EF interlocks on S13 power contactor.

8. Repeat Steps 3 thru 7 for WSR2 and S24 power contactor.

9. On units with 2 motor cutout switches on cam switch, the CD interlocks on the BR relay are in WSR2 coil circuit in braking. Check by picking up WSR2 and with test box, then put unit in braking and current value on milliampmeter should rise a little.

10. It is important that the WSR contacts are checked with the BF contactor picked up and with a test light on the WS terminal to be sure there is no contact arcing. Also, to be sure BF contactor actually drops out when WSR picks up.

---

MASTER TERMINAL BOARD
WSR - WS - WSS AND WCR RELAYS

MAINTENANCE DATA

<table>
<thead>
<tr>
<th>Resistance</th>
<th>Inside Contact Should Make At</th>
<th>Outside Contact Should Make At</th>
</tr>
</thead>
<tbody>
<tr>
<td>542 Ohms</td>
<td>.073&quot;</td>
<td>.027&quot;</td>
</tr>
<tr>
<td>+ 10% @ 20°C.</td>
<td>to</td>
<td>to</td>
</tr>
<tr>
<td>17-19 MA after 11 MA Dropout</td>
<td>.005&quot;</td>
<td>.041&quot;</td>
</tr>
<tr>
<td>10-12 MA after 18 MA Pickup</td>
<td>.077&quot;</td>
<td>.045&quot;</td>
</tr>
<tr>
<td>13.5-15.5 MA w/Calibrating Coil</td>
<td>.005&quot;</td>
<td>.028&quot;</td>
</tr>
<tr>
<td>8-10 MA w/Calibrating Coil</td>
<td>.065&quot;</td>
<td>.035&quot;</td>
</tr>
<tr>
<td>115-130 Amps. w/thru Cable</td>
<td>.015&quot;</td>
<td>.023&quot;</td>
</tr>
<tr>
<td>55% of Pickup min. w/thru Cable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8-10 MA w/Calibrating Coil</td>
<td>.015&quot;</td>
<td>.023&quot;</td>
</tr>
<tr>
<td>17-19 MA after 11 MA Dropout</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-12 MA after 18 MA Pickup</td>
<td></td>
<td></td>
</tr>
<tr>
<td>542 Ohms + 10% @ 20°C.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INTERLOCK CROSS-SECTION

NORMALLY CLOSED NORMALLY OPEN

NORMALLY OPEN

STATIONARY CONTACT ASSEMBLY BLOCK

CONTACT STUDS

TRANSPARENT CONTACT COVER

MAGNET FRAME

BEARING PIN

ARMATURE

AIR GAP PICKUP

AIR GAP DROPOUT

POLE PLATE

TOP PLATE

RETURN SPRING

SPACER

WHEEL SLIP RELAY - TYPE 388

- 804.1 -
SETTING TYPE 1 REGOHM DYNAMIC BRAKE REGULATOR OF F7 UNITS

(Refer to M.I. 4508)

NOTE: Type 1 is located below the starting contractors, do not confuse with Type 3 which is in same location but has an SFT Relay mounted on front of regulator panel.

1. Remove No. 9 wire from top of 115 ohm adjustable resistor, left side, front of panel, replace nut so remaining wire will be tight.

2. Connect negative output of MG set to No. 9 wire, positive to the top of 115 ohm resistor where No. 9 wire was removed.

3. Remove the BRN wire from left stud at bottom of regulator panel, replace nut so remaining No. 7 wire will be tight.

4. Connect negative of a 1000 V voltmeter to the BRN stud, positive to the BRN wire that was removed from BRN stud.

5. Connect a 150 V voltmeter, positive to B terminal, negative to A terminal of Rehohm.

6. Center the SFT relay so neither the top nor bottom contacts are touching.

7. Connect input of MG set to 74V DC, observe polarity.

8. Increase MG set voltage slowly to 980 V for 700 amp grids, 840 V for 600 amp grids, at this point the 150 V meter should begin to move and then slowly increase to between 30 and 80 volts without raising MG set voltage higher. Voltage on the 1000 V meter will decrease as 150 V meter increases. If 150 V meter moves too soon or too late, move the bands on the two 10,000 ohm resistors on right side of panel to adjust. Try to keep bands even.

9. If the 150 V meter does not register over 30 volts or if the voltage increase is erratic or jumps too fast, change the operator and repeat Step 8.

10. If 1000 V meter does not register, check for open circuit in Regohm panel, grids or locomotive wiring.
   a. Remove test equipment.
   b. Unblock SFT relay.
   c. Replace BRN wire, Step 3.
   d. Replace No. 9 wire top of 115 ohm resistor, Step 1.
   e. Apply date decal to Regohm name plate.

M.B. 3555 – 1/13/65

- 805 -
Note: 700 amp regulator is shown above, 600 amp is identical except 115 ~ resistor marked A is removed or jumped out.
SETTING TYPE 2 DBR ON F7
(Mounted over Power Contactors)

1. Remove SFT—D wire from A of Regohm.
2. Remove BBP wire from top of front 10,000 ohm resistor in back of panel to the right of the six 115 ohm resistors. Be sure it’s the BBP wire that comes from the cam switch. Leave the 14 wire and the jumper on and replace the nut. NOTE: BBP wire may be on back resistor on some units.
3. Center the SFT relay so neither top or bottom contacts touch.
4. Connect a 1000V voltmeter; positive to the top terminal of the front 10,000 ohm resistor where BBP was removed. Negative on BRN terminal, top terminal of back 10,000 ohm resistor. NOTE: BRN may be on front resistor on some units.
5. Connect a 150V voltmeter positive to B terminal of Regohm, negative to A terminal of Regohm.
6. Connect the output of a motor generator, positive to SFT—D wire that was removed from A terminal of Regohm, negative on the A terminal of Regohm.
7. Connect input of motor generator to 74V DC, observe polarity.
8. Determine capacity of grids of unit under test and see that Regohm is same capacity. 700 amp Regohm has six 115 ohm resistors, 600 amp Regohm has five 115 ohm resistors.
9. Increase output of motor generator to 980V for 700 amp grids, 840V for 600 amp grids. At this point the 150V meter should slowly rise to between 30 and 90V. If the 150V meter does not read or if movement is erratic, change out operator and repeat Step 9.
10. If meter registers too soon or too late, adjust bands on 10,000 ohm resistor to correct. Try to keep bands even.
SETTING TYPE 3 DBR OF F7
(SFT Mounted on DBR Panel Below Start Contactors)

1. Remove RGA and RGA1 wires from A terminal of Regohm.
2. Remove No. 3 wire from No. 3 stud at bottom of Regohm panel, replace nut so other wires will be tight.
3. Center the SFT relay so neither the top or bottom contacts are touching.
4. Connect the negative output of a motor generator to the A terminal of Regohm.
5. Connect the positive output of MG to the RGA1 wire which was removed from A of Regohm.
6. Connect a 150V voltmeter, positive to B terminal of Regohm and negative to A terminal of Regohm.
7. Connect a 1000V voltmeter, positive to No. 6 terminal at bottom of regulator panel. Negative to No. 3 terminal on regulator panel.
8. Connect the input of the motor generator to 74V, observe polarity.
9. Increase motor generator output to 980V (840V for 600 amp grids), at this point the 150V meter should begin to move and then slowly move to between 30 and 90V. If 150V meter begins to move too soon or too late, move the bands on the two 10,000 ohm resistors on the front of panel left side to adjust. Try to keep bands even.
10. If 150V meter does not register or if movement is erratic, change the operator and repeat Step 9.
11. Remove meters and motor generator. Take blocking out of SFT relay.
12. Replace RGA and RGA1 wires on A terminal of Regohm.
13. Replace No. 3 wire on No. 3 stud at bottom of panel.
14. Make sure bands on 2, 10,000 ohm resistors are tight.

NOTE: Two rectifiers on panel are not in use.
SETTING WHEEL SLIP RELAYS ON F7 WITH BRAKING CONTACTER
(Units wired by DLW 10018 10023 10025 AND 10028)
(Refer to MI 5353)

1. With engine shut down, controls in and cam switch in MOT connect a jumper from positive side of control knife switch to the D contact of the S23 contactor. BF contactor should pick up.

2. Connect a test light from the WS terminal on the master terminal board to negative (To check operation of WS light).

3. Connect the leads of the wheel slip test box to the coil terminals of WSR1. Turn the knob on the test box to increase the current until the relay picks up. Note that BF drops out and the WS light comes on. Reduce the current from the test box till WSR1 drops out but do not reduce any further. Increase the current again and when the relay picks up note the reading on the milliamppmeter. This is the pickup value. Adjust spring tension nut (Fig. 2, Item A) for 17 to 19 MA pick up.

4. With the pick up value set correctly reduce the current until the relay drops out. Adjust the closed air gap screw (Fig. 2, Item B) for 10 to 12 MA drop out.

5. The relay should snap in and out; there should not be any partial movement or hesitation. If there is, increase the spring tension. This will change the pickup and dropout values but this can be corrected by adjusting the pickup air gap screw (Fig. 2, Item C) and the dropout air gap screw (Fig. 2, Item B). Contact wipe plays an important part in the drop out value. Too much wipe will cause an early dropout or partial movement. Set contact air gap as in Fig. 1. Tight or loose armature pivot pins can cause erratic action. Be sure contacts have enough wipe so there is no arcing.

6. To check the continuity of WSR1 circuit pick up the relay with the test box, then pick up S14 manually and the reading on the milliamppmeter should rise a little.

7. Repeat Steps 1 thru 5 for WSR2. Step 6 is the same except S23 is used instead of S14.

8. These units are equipped with two thru cable wheel slip relays, WSB1 and WSB2 for wheel slip protection in dynamic brake. They are located on the grid leads going into the front end of the grid hatch, one on each side near the roof.

9. Repeat Steps 1 thru 5 for WSB1 and WSB2. There is no continuity check.

10. Make visual inspection of all contacts to see if they have proper wipe. See that all adjusting screws are tight. Remove jumper and test equipment.

---

MASTER TERMINAL BOARD

- 808 -
TESTING AND SETTING BWR RELAY (8187957) ON F7 UNITS

1. Shut unit down and put in dynamic brake sequence. Remove BB46 wire from top left terminal of BWR relay.

2. Connect positive lead of 1000V voltmeter and positive output lead of MG set to the BB46 wire.

3. Connect the negative leads of the voltmeter and MG set to the top left terminal where BB46 was removed.

4. Connect the input leads of the MG set to 74V DC, observe polarity.

5. Determine the capacity of the grids on unit under test and use the pickup and dropout valves shown in table below:

<table>
<thead>
<tr>
<th>GRID CAPACITY</th>
<th>PICKUP</th>
<th>DROPOUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 AMP</td>
<td>525 V</td>
<td>485V ± 10V</td>
</tr>
<tr>
<td>600 AMP</td>
<td>460 V</td>
<td>425V ± 10V</td>
</tr>
</tbody>
</table>

6. Increase output of the MG set to just below pickup valve and let circuit warm up for 5 minutes.

7. After warm-up period, increase voltage from MG set and note voltage at which BWR relay picks up. Move the band on the 10,000 ohm resistor to the right of the relay to adjust. NOTE: This may be a 7500 ohm resistor on some units. On units with the BWR and DBR mounted on a panel over the power contactors this resistor will be found on the back of the panel.

8. See that the BWR light lights and the “”)” valve is energized when the BWR picks up. ON “B” units check the BWR light circuit at the master terminal board. NOTE: The BF contactor must be picked up to check “0” valve operation at BWR pick-up.

9. Slowly decrease voltage from MG set and note voltage at which relay drops out. If the dropout valve is not within the limits, see MI 5328 for adjustments or change relay and repeat from Step 1.

10. Inspect relay contacts for bruning and proper wipe. Check beaded shunt in relay. Inspect two rectifiers in grid protection circuit mounted near BWR relay.

11. Remove MG set and voltmeter leads. Replace BB46 wire on top left stud of BWR relay. See that band on adjusting resistor is tight. Seal BWR cover. See that BF contactor is not blocked. Apply date decal.

F7 — Elec.
9—64
REPLACEMENT OF ALLIS CHALMERS BRAKE REGULATOR 
WITH REGOHM DBR

1. Remove Allis Chalmers regulator, 500 ohm resistors and mounting brackets.
2. Tape up BB47 and BR47 wires that were removed from AC regulator. Do not tape up 13B wire as it will be used.
3. Mount the Regohm regulator panel.

AT THE SFT RELAY

4. Remove 12G wire from SFT relay, D interlock, and tape up.
5. Remove the jumper between B&K interlocks of SFT relay and discard.
6. Connect the SHP and GS7 wires to B interlock of SFT relay. SHP wire was on SFT-K, GS7 was on SFT-J.

AT THE REGOHM

7. Run new wire from A terminal to SFT relay D interlock, label SFT-D.
8. Connect the 13B wire, which was removed from the AC regulator, to the B terminal of regulator.
9. Run new wire from C terminal to SFT relay J interlock, label SFT-J.
10. Run new wire from D terminal to SFT relay K interlock, label SFT-K.
11. Run new wire from BRN on regulator panel (left terminal) to BB3 terminal on cam switch, label BRN. (See sketch.)
12. Run new wire from BBP on regulator panel (right terminal) to BR1 terminal on cam switch, label BBP. (See sketch.)
13. Remove the BR47 wire from the BR4 terminal of cam switch and tape up. CAUTION: DO NOT remove the BR46 wire which is also on this terminal.

AT THE GRIDS

14. Remove the 12G wire from the .2 ohm tap and tape up.
15. Remove the BB47 wire from the center tap of grids and tape up. CAUTION: DO NOT remove the BB46 brake warning wire which is also on the center tap of grids. If in doubt, ring it out.
16. Recheck all new connections, compare with sketches.
17. Check setting of regulator as outlined in shop manual. Be sure regulator is same rating as grids.
REPLACEMENT OF ALLIS CHALMERS BRAKE REGULATOR WITH REOHM D3R
(Refer to Unit Wiring Diagram)

CAM WITH 2 TM CO

CAM WITH NO TM CO

Remove & tape

BBP

BR1

BRN

BB3
REPLACEMENT OF ALLIS CHALMERS BRAKE REGULATOR WITH RECOHM DBR

NEW CONNECTIONS AT SFT RELAY

CONNECTIONS AT RECOHM

- 810.2 -
A. Voltage Drop Comparison Test of Motor Field Coils.

1. Put the unit in dynamic brake and read the output of the main generator with a DC voltmeter connected to the stationary contacts of the starting contactors. Positive on left, negative on right.

2. Increase the braking till the voltmeter reads 32 V. NOTE: On “B” units use the dynamic brake test plug to operate braking. Read and record the voltage drop across each field at the F and FF leads of each motor. This can be done by sticking knives in the F and FF leads at the motor and connecting a voltmeter to the blades. A difference of 15% or 1 volt condemns the motor that is out.

3. Return unit to idle.

B. Checking Field Shunting Circuit.

1. Connect a test light or jumper from positive to the positive coil terminal of FS contactor magnet valve. FS contactor should pick up.

2. Put unit in full dynamic and read and record voltage drop at the F and FF leads of each motor. This reading will be low, a low scale meter is necessary. Any difference here will probably be caused by a loose connection or bad contact at FS contactor or shunting resistors.

3. Return unit to idle and remove jumper. Remove test plug, if a “B” unit.
LOAD REGULATOR HOOKUP F-7 WITH FIELD LOOP

TO CHECK WIRING OF LOAD REGULATOR

1. Take all wires off terminal board at base of load regulator.
2. Lift all brushes on load regulator arm.
3. Using an ohmmeter identify and label wires 53A, BF8 and BFP placing them on proper terminal. See Figure 1.

TO CHECK WIRING TO LOAD REGULATOR

4. Identify wires BF8 and BFL, (BKL on some units)
   a. Put cam switch in MOT.
   b. Put BF fuse in.
   c. Connect one end of a test light to a negative, other end is on BF8 when test light lights. Label and put on B terminal with 53A and BF8 from load regulator.
   d. Connect one end of a test light to a positive, other end is on BFL if test light lights when BF contactor is picked up. (NOTE: A convenient positive is the BF8 wire identified in Step 4C.) Put on A terminal with BFP.
5. NOTE: On Tests 4C and 4D light should light on only one wire.
6. Replace brushes in load regulator.
7. Test unit for loading and braking.
LOAD REGULATOR HOOKUP – F-7 WITH LRP

TO CHECK WIRING OF LOAD REGULATOR

1. Take all wires off terminal board at base of load regulator.
2. Lift all brushes on load regulator arm.
3. Using an ohmmeter identify and label wires 53A - BF9 and BLP placing them on proper terminal. See Figure 1.

TO CHECK WIRING TO LOAD REGULATOR

4. Identify wires BKK - BF8 and BLP1.
   a. Remove LRP relay.
   b. Center BKA relay on LRP panel.
   c. Put cam switch in TOW.
   d. Put BF fuse in.
   e. Connect one end of a test light to a negative, other end is on BF8 when test light lights. Label and put on B terminal with BF9.
   f. Connect one end of test light to a positive, other end is on BKK when test light lights. (A convenient positive is the BF8 wire identified in Step 4E.) Label and put on A terminal with 53A.
   g. Only wire left is BLP1, label and put on C terminal with BLP. Another check for BLP1 is to put test light from positive to BLP1 and light should light only when BF contactor is picked up.
5. NOTE: On tests 4E and 4F test light should light on only one wire.
6. Take blocking out of BKA relay, replace LRP relay and replace brushes in load regulator.
7. Test unit for loading and braking.
F-7 GRID LOAD TEST FORM

1. Hook up jumpers at cam in applicable method shown below. Cam switch terminals are identified as follows: L1 is top left, L8 is bottom left, R1 is top right, R8 is bottom right, etc.

A. For units with two MCO on cam and two on reverser.
   1. L1 to L6  Applied ________ Removed ________
   2. L7 to Pos. Buss  Applied ________ Removed ________
   3. R6 to Pos. Buss  Applied ________ Removed ________
   4. R8 to top P1  Applied ________ Removed ________

B. For units with four MCO on reverser.
   1. R1 to R2  Applied ________ Removed ________
   2. R3 to R4  Applied ________ Removed ________
   3. R6 to R7  Applied ________ Removed ________
   4. R8 to top P1  Applied ________ Removed ________

C. For units with braking contactor.
   1. L1 to top P1  Applied ________ Removed ________
   2. L3 to R2  Applied ________ Removed ________
   3. L5 to R8  Applied ________ Removed ________
   4. L6 to L7  Applied ________ Removed ________
   5. R4 to Pos Buss  Applied ________ Removed ________
   6. R6 to Pos Buss  Applied ________ Removed ________

(THE FOLLOWING APPLIES TO ALL UNITS)

2. Lock reverser in center.  Applied ________ Removed ________
3. Block wheel slip relays.  Applied ________ Removed ________
4A. Jump out G-H interlocks on S13 and S24 of units using Method A and Method B jumpers at cam.  Applied ________ Removed ________
4B. Jump out C-D interlock on S14 and S23 of units using Method C jumpers at cam.  Applied ________ Removed ________
5. Cut out control air (cam in Motor)  Cut out ________ Cut In ________
6A. Remove BRN from regohm.  Removed ________ Applied ________
6B. Remove BR47 from AC regulator.  Removed ________ Applied ________

Unit ___________ Date ___________ Foreman ___________

M.B. 3756  1/65
LOAD TEST F UNIT (LOAD BOX) WITH BRAKING CONTRACTOR

1. Load box pos. leads to M. Gen. pos. buss.
2. Load box neg. leads to GN4 (6 from top left side cam sw.) and GN1 (top P1 power sw.)
3. Block reverser and wheel slip relays.
4. Jump out C-C interlocks on S14 and S23 power sw.
5. Cam sw. in motor.
6. Cut out control air.
7. On completion repeat Steps 1, 2, 3, 4 & 6 in reverse.

LOAD TEST F UNIT (LOAD BOX) WITHOUT DYNAMIC BRAKES

1. Load box pos. leads to M. Gen. pos. buss.
2. Load box neg. leads to GN1 (top P1 power sw.) and AS4 (above M. Gen. pos. buss).
3. Block reverser and wheel slip relays.
4. Jump out C-D interlocks on S14 and S23 power sw.
5. Cut out control air.
6. On completion repeat Steps 1, 2, 3, 4 & 5 in reverse.

2/8/63
LOAD TEST F UNIT (LOAD BOX) 4 TM CUTOUTS ON REV.

1. Load box pos. leads to M. Gen. pos. buss.

2. Load box neg. leads to GN4 (3 from top right side cam sw.) and GN1 (Top P1 power sw.)


4. Jump out G-H interlocks on S13 and S24 power sw.

5. Cam sw. in motor.

6. Cut out control air.

7. On completion repeat Steps 1, 2, 3, 4 & 6 in reverse.

LOAD TEST F UNIT (LOAD BOX) 2 TMCO ON REV. & 2 TMCO ON CAM SW.

1. Load box pos. leads to M. Gen. pos. buss.

2. Load box neg. leads to GN4 (6 from top left side cam sw.) and GN1 (top P1 power sw.)

3. Block reverser and wheel slip relays.

4. Jump out G-H interlocks on S13 and S24 power sw.

5. Cam sw. in motor.

6. Cut out control air.

7. On completion repeat Steps 1, 2, 3, 4 & 6 in reverse.
SETTING 1100 OHM SERIES TYPE ALLIS CHALMERS
DYNAMIC BRAKE REGULATOR, PART NO. 8182999, ON F7
(Refer to M.I. 2049)

1. With engine dead and controls out remove BR47 wire from 500 ohm adjustable resistor below regulator. Replace nut so remaining wire will be tight.

2. Connect MG set input to 74 V DC, observe polarity.

3. Connect the negative output of the MG set to the D contact of the SFT relay.

4. Connect the positive output of the MG set and the positive lead of a 1000 V voltmeter to the terminal on the resistor where BR47 was removed.

5. Check the continuity of the 13B wire and the resistors in the regulator by connecting the negative voltmeter lead to the A contact of the SFT relay. Increase the MG set voltage, if the voltmeter reads, continuity is good. Reduce voltage and connect negative voltmeter lead to the BR47 wire removed in Step 1.

6. Increase MG set voltage slowly and note voltage at which sector arm first begins to move along commutator.

   600 amp grids ......................... 420 V
   700 amp grids ......................... 490 V

Move band on 500 ohm adjustable resistor to adjust. Let sector arm go its full travel to be sure there is no mechanical binding or broken springs. If voltmeter does not read or regulator does not move, check for open circuit in regulator or locomotive wiring.

7. a. Remove test equipment.
   b. Replace BR47 wire.
   c. Be sure adjusting band is tight.
   d. Examine beaded shunt on front of regulator.
   e. Apply date decal to regulator cover.

M.B. 3558 1/31/65
ALLIS CHALMERS DYNAMIC BRAKE REGULATOR
(1100 OHM Series Type)
8182999
TO CALIBRATE ELECTRIC SPEEDOMETER SD-24, GP-30 AND "F" TYPE LOCOMOTIVES

Measure rim thickness with steel wheel gauge to determine size of wheel and record rim thickness.

Inspect seals on speedometer resistor box and locomotive overspeed panel box and note seal markings below if other than Atlanta seal is found.

Resister Box_________________________________ L.O.S. Box__________________________

Attach drive unit to axle generator and connect portable test instrument (Grey Box) leads to right two terminals on resistor box. Set selector switch of Grey Box on "A" and increase speed of Drive Unit until 62 cycles on cycle scale of Grey Box. Check speedometer reading to correspond with chart below. Note reading at 10, 40 and 62 column as found in chart below. (Replace speedometer if pointer sticks.) After making above test, make sure that speedometer hand is zeroed correctly. Speedometer should read within limits for relative wheel size as shown below in chart. If not, remove resistor of wheel wear adjustment box by turning adjustment shaft with screw driver until speed corresponds with chart. List on chart below reading at 10, 40, and 62 MPH as left.

If variation is in excess of limits, as shown on chart at 10 and 40 MPH reading, replace speedometer. If new speedometer does not check with chart at 10 and 40 MPH, renew wheel wear adjustment box and recalibrate.

Increase speedometer reading until overspeed relay picks up. Note pick-up speedometer reading in MPH on chart below as found. Adjust pick-up reading to 65 MPH. This adjustment to be made by decreasing speedometer reading to 55 MPH, stop whistle blowing, turn overspeed relay adjustment one turn counter-clockwise, increase speedometer reading to 65 MPH, and turn overspeed relay adjustment shaft clockwise until overspeed relay picks up. Tap overspeed panel "LIGHTLY", reduce speedometer reading and recheck. Note reading in MPH on chart below as left.

### Rim Thickness (Nearest Whole No.)
<table>
<thead>
<tr>
<th>Rim Thickness</th>
<th>Wheel Size</th>
<th>10</th>
<th>40</th>
<th>62</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>37</td>
<td>7.0</td>
<td>11.0</td>
<td>37 39 58.5</td>
</tr>
<tr>
<td>1-1/4&quot;</td>
<td>38</td>
<td>7.5</td>
<td>11.5</td>
<td>38 40 60.0</td>
</tr>
<tr>
<td>2&quot;</td>
<td>39</td>
<td>8.0</td>
<td>12.0</td>
<td>39 41 61.5</td>
</tr>
<tr>
<td>2-1/4&quot;</td>
<td>40</td>
<td>8.5</td>
<td>12.5</td>
<td>40 42 63.5</td>
</tr>
<tr>
<td>3&quot;</td>
<td>41</td>
<td>9.0</td>
<td>13.0</td>
<td>41 43 65.0</td>
</tr>
</tbody>
</table>

Locomotive Overspeed

Record of Speedometer readings as found

Record of Speedometer readings as left

Locomotive

- 818 -
INSTRUCTIONS APPLICATION 3 BAND TRANSITION TO 6130-6149

1. Remove MA Wire from M contactor interlock. Remove tag splice and run to P2 power contactor (top left) A interlock (normally closed) label P2A. Also go to parallel relay G interlock and relabel MA to P2A.

2. Remove MB wire from M contactor splice, remove tag and run to P2 splice, remove tag and run to P2 contactor (B) interlock normally closed. Label P2B. Go to transition panel and relabel MB stud to P2B also relabel MB wire P2B.

3. Run jumper from P2b to P2E normally open interlock. Label J.

4. Run new wire from P2 (F) interlock to B on M contactor. M Contactor interlock must be normally open. Label P2F at (F) on P2 and (B) on M contactor.

5. Run new wire from A interlock on M contactor to band on left front resistor. (NOTE: This band will have to be applied. Move upper band that is now on resistor up near top and put new band near center. It may be necessary to apply new jumper to move old band to top.) Label new wire MA at M contactor interlock and band on resistor.

6. Remove 400 ohm shunt field discharge resistor. Apply female adapter on present stud. Apply two (2) 200 ohm resistors.

6A. Tape up all wires in harness.

7. Set Transition:
   (1) FSR P.U. 1–2 – 910V (700V.D.O. – Inherent) (Bottom Band)
   (2) FTM P.U. 2–3 – 930V (Band on right hand bank resistors)
   (3) FSR D.O. 2–3 – 540V (Top Band)
   (4) FSR P.U. 3–4 – 910V (Step 1)
   (5) FSR D.O. 4–3 – 620V (Center Band)
SECTION 900

EMD E-8 PASSENGER
E-8 TRANSITION

1. Remove B.F. fuse both engines.

2. Disconnect top right on F.T.R. relay coil and folk back. Connect the negative high voltage lead from M.G. Set and the negative lead of 0-1000 Voltmeter to the negative terminal post of the F.T.R. Coil.

3. Connect the positive high voltage lead from M.G. Set and positive lead of Voltmeter to the upper terminal G S on front resistor of the two 10,000 ohm resistors.

4. Connect power leads of motor generator set to source of low voltage power.

5. Close control and generator field breakers, place reverser in forward or rev. and put throttle in Run 1 and Isolation S W on the line. (Block N.V.R. if engine not running.)

6. Raise voltage to 850 Volts for about five minutes.

7. After resistors warm up, increase voltage to 910 + 10 and F.T.R. Relay should pick up, if not, adjust slider band on resistor and P.P. relay should pick up when F.T.R. picks up and S.H. and B.F. drops out.


9. Increase Voltage to pick F.T.R. back up —this should pick up M contactors.

10. Remove blocking and couple up circuits for normal operation and replace B. F. fuse.
SETTING BWR ON E-8 6900-6905, 6916 WITH REGOHM DYNAMIC BRAKE REGULATOR

1. At Dynamic Brake regulator panel in upper Right Hand corner remove BWR wire that goes to center top on grids, Right Hand side. Ring this wire for continuity.

2. Put nut on stud and tighten.

3. Connect (+) positive motor generator and 1,000 volt meter to stud.

4. Connect negative motor generator and 1,000 volt meter to BRN terminal at bottom of panel.

5. Put selector in "B" and increase voltage to 525 volts, relay should pick up and brake warning light should burn. Adjust by band on resistor, drop out of relay in 485 volts.

6. Remove wire and connect BWR back to terminal.
CONNECTIONS FOR SETTING BWR ON 6900-6905, 6916

Grids R. H. Side

.66 ohm. → .66 ohm.

EWR

(+)

7000

1000 V.

VM

ME

525 P. U.

485 D. O.

BRN Term. on Panel
1. Remove panel over Regulator, put No. 1 (one) cam in motor position.
2. Locate BBP terminal on panel.
3. Disconnect BBP wire that goes to 2nd stationary terminal on Right Hand side No. 1 cam switch. Ringout to be sure.
4. Remove wire tagged No. 2 (which goes to one side 10,000 resistor) (Refer to sketch).
5. Apply nut and tighten No. 2 wire to stud.
6. Disconnect BRN wire from DBR panel at stud and Ringout to bottom Right Hand stationary contact on cam switch. Reapply wire and tighten nut.
7. Connect (+) Motor generator set to No. 1 wire which was removed in Step 4. Also connect positive 1,000 volt meter to same wire. (Make sure polarity of M.G. set and meter are correct.
8. Connect negative motor generator set to BBP stud on panel.
9. Connect (-) Negative 1,000 Volt meter to BRN stud.
10. Center SFT relay.
11. Connect (+) Positive 250 volt meter to "B" on Regohm regulator.
12. Connect (-) Negative 250 volt meter to "A" on Regohm regulator.
13. Apply voltage and adjust, 10,000 Resistor until at 980 volts, the 250 meter reads 60 – 80 volts.
14. Remove and tighten all wires.
CONNECTIONS FOR SETTING REGULATOR ON 6900 - 6905 AND 6916

[Diagram showing electrical connections and settings for regulators.]
SETTING BRAKE WARNING RELAY ON 6906 - 6915 EQUIPPED WITH AC REGULATOR

1. Remove wire from top Right Hand terminal on Brake warning relay.

2. Connect positive (+) motor generator and voltmeter to relay terminal. (Refer to Sketch)

3. Connect negative (−) motor generator and voltmeter to bottom 10,000 ohm BWR resistor located left of transition resistors above BC rectifier.

4. Observe polarity of motor generator connection. Increase voltage to 520 volts relay should fall out, if not change relay and recheck.

5. On completion, remove test equipment and connect wires.
SKETCH FOR CONNECTIONS SETTING
BRAKE WARMING RELAY ON 6906 - 6915

---

BWR

1000 V.

VM

MC

Resistor
SETTING AC DYNAMIC BRAKE REGULATOR E-8
LOCOMOTIVE 6906-6915


2. Place Cam Switch in Motor Position.

3. Connect Negative (−) Motor Generator to SFT Relay (D) interlock. (Located below M contactor, No. 1 Engine)

4. Connect Negative (−) Voltmeter to BB26 wire (wire which was removed from Resistor in Step 1).

5. Increase voltage to 490 ± 5 volts. Regulator should go to full travel. If not adjust pick-up band on Resistor.
SETTING DYNAMIC BRAKE REGULATOR
E8 - 6906-6915
SETTING BRAKE WARNING RELAY ON E8 - 6906 - 6915
EQUIPPED WITH A. C. REGULATOR & 700A DYN. BRAKE

1. Remove wire from top right hand stud on BWR.

2. Connect positive (+) motor generator and voltmeter to relay stud.

3. Connect negative (−) motor generator and voltmeter to bottom 10,000 ohm BWR resistor located left of transition resistors.

4. Observe polarity of motor generator connections. Increase voltage to 560V. Relay should pick up, if not adjust band on resistor.

5. Decrease voltage to 520. Relay should fall out. If not, charge relay and check.

6. On completion, remove test equipment and connect wires.
SETTING G.E. SPEED RECORDER ON E-8 LOCOMOTIVES
6900 – 6916
S-51

Atlanta, Georgia, Date__________________

The speedometer of Unit ___________ has been checked under my supervision as listed below.

Measure rim thickness No. 1 idler with wheel gauge and record rim thickness ____________________________.

Inspect seal on resistor box. BROKEN – Yes ______ No ________

Use Model 17MM37A1 Test Set For Calibration
Green Color Box

1. Disconnect A & B wires from A & B terminals on wheel slip palen.

2. Using 17MM37A1 test kit in level position, connect D. C. input to locomotive battery. Turn frequency controls all way to off and place meter switch to 0-350 cycles. (Be sure and observe polarity on input leads.)

3. Plug in multiple out put plug. Connect BLACK 3 to A terminal on W.S.P., RED 3 to B terminal on W.S.P.

4. Turn switch to USE position on Test Kit.

5. Referring to chart (next page), select rim thickness for correct wheel size and read across chart in straight line. (No. 1 idler) Reading’s should be ± 1%. Check indicator in resistor box to make sure set on correct wheel size.

6. Set indicating meter on cycle per second for 80 MPH and adjust wheel size adjustment in resistor box.

7. Set indicating meter on cycles per second for 50 MPH then 20 MPH. If variation is in excess of ± 1% as shown on chart at 50 MPH and 20 MPH, replace speedometer. If new speedometer does not fall within limits, renew resistor box and recalibrate.

8. Set locomotive overspeed pick up at 83 MPH. Use CPS adjustment on 357 cards. Observe overspeed pick up and drop out.
### Setting G.E. Speed Recorder on E-8 Locos.

**Table: Cycles Per Second**

<table>
<thead>
<tr>
<th>Rim Thickness (Nearest given no.)</th>
<th>Wheel Diameter (Size)</th>
<th>Cycles Per Second 0–350 Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>80 MPH</td>
</tr>
<tr>
<td>3&quot;</td>
<td>36&quot;</td>
<td>250.00</td>
</tr>
<tr>
<td>2-(\frac{1}{2})&quot;</td>
<td>35&quot;</td>
<td>257.14</td>
</tr>
<tr>
<td>2&quot;</td>
<td>34&quot;</td>
<td>264.70</td>
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<tr>
<td>1-(\frac{1}{2})&quot;</td>
<td>33&quot;</td>
<td>272.72</td>
</tr>
<tr>
<td>1&quot;</td>
<td>32&quot;</td>
<td>281.25</td>
</tr>
</tbody>
</table>

Record of speedometer 80 MPH 50 MPH 20 MPH Overspeed
Reading as found ________ CPS ________ CPS ________ CPS ________ CPS

Record of speedometer 80 MPH 50 MPH 20 MPH Overspeed
Reading as left ________ CPS ________ CPS ________ CPS ________ CPS

Mechanic ______________________ Foreman ______________________

---

- 907.1 -
E6 - E7 - E8
2 STAGE COMPRESSOR SWITCH

Square D
Type DCW853
102 - 039 - 50

CR

CC

CR

CC

CC

CC

CC

CC 310 VALVE

CCS

1/2" Copper or Larger
SECTION 1000

GE U-23-B ROAD SWITCH
INSTRUCTIONS:
1. Install TEST PANEL, METER and JUMPER WIRE per above sketch. (See CAUTION note below.)
2. Set Locomotive up for Dynamic Braking.
3. Notch 1 Adjustment, throttle handle in notch 1:
   A. Turn BKMR (Mxr. card – EXP) full CCW (may read about 1/2ma).
   B. Turn BKMR CW to minimum reading on meter. Record reading and add 0.48ma. Turn BKMR CW until added total is read on meter. Lock BKMR.
4. Notch 8 Adjustment, throttle handle in notch 8:
   A. Adjust BKLR to read 9.0ma on meter. Lock BKLR.
5. Remove test equipment and restore locomotive controls to normal.

CAUTION: – ON U-33-C UNITS 3810 TO 3814 AND ON U-23-B UNITS 3900 ON UP, THE FOLLOWING STEPS ARE NECESSARY WHEN SETTING BKMR & BKLR: (1) Independent brake must be in release position, and (2) Extended range braking must be nullified –Insulate RC to OY interlock on S14 on U-33-C units, Insulate RY to RO interlock on P1 on U-23-B units.
<table>
<thead>
<tr>
<th>TYPE</th>
<th>UNIT NUMBERS</th>
<th>GE PART NUMBERS</th>
</tr>
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<tbody>
<tr>
<td>U23B</td>
<td>3900 - 3904</td>
<td>41R971400G8</td>
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<tr>
<td>U30C</td>
<td>3800 - 3804</td>
<td>41R971400G2</td>
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<tr>
<td></td>
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<td>41R971400G7</td>
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<td>U33C</td>
<td>3805 - 3809</td>
<td>41R971400G1</td>
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<tr>
<td>U33C</td>
<td>3810 - 3814</td>
<td>41R971400G9</td>
</tr>
</tbody>
</table>
G.E. ALTERNATOR DIODE TESTER

PROCEDURE:
1. Turn rheostat full counter clockwise.
2. Turn battery switch on.
3. Adjust rheostat for 6 volts on meter.
4. Use common buss on diode panel for RED or BLACK lead depending on type of diode panel. Check name plate on panel.
   (a) On FM210 panels, use red lead on buss.
   (b) On FM307 panels (which have) two different types of diodes, use the same color test lead as the diode pig tail you are testing and the other connect to base of diode or common buss for string of diodes. i.e., on RED PIGTAIL DIODES use BLACK for base and RED for pigtail. The opposite would apply for black pigtail diodes.
5. You will find one of following conditions on testing diodes.
   (a) A good diode will read 0.2 – 0.5 v on meter scale in forward direction and meter will stay on or very near to 6.0 on reverse test. Once connected to diode use FOREWORD REVERSE switch for changing polarity without removing leads. Test each diode separately.
   (b) A shorted diode will read near zero both directions. Disconnect diode and test if suspect. The capacitor could be bad and diode O.K. if short appears.
   (c) An OPEN diode will give approximately 6.0 volts in both FORWARD and REVERSE directions.
   (d) Replace defective diodes in kind using same color and type as removed.
   (e) Use recommended torque for applying diodes which is 25 ft. per lbs.
   (f) Use silicone lube on face of diode also.
The Speedometer of Unit has been checked under my supervision, as listed below:

Measure rim thickness with steel wheel gauge to determine size of wheel and record rim thickness.

No. 2 wheel overspeed No. 3 wheel speedometer

Inspect seals on speedometer resistor box and locomotive overspeed panel box and note seal markings below if other than Atlanta seal is found.

Resistor Box L.O.S. Box

OPERATION OF MODEL 17MM26K1 TEST SET FOR CALIBRATING G.E. SPEEDOMETERS ON U23B LOCOMOTIVES, 3905-14

PART ONE – LOCOMOTIVE OVERSPEED

1. Disconnect CL wire from terminal E on Locked Wheel Panel (AWSP) located in “Doghouse” over electrical cabinet.

2. Using 17MM26K1 test kit, connect DC input to locomotive battery. Turn frequency controls all the way to “Off” and turn meter switch to 0 - 350 cycles.

3. Connect AC output leads to terminals E and F on Locked Wheel Panel.

4. Put test light on coil of OSR relay located in electrical cabinet along the top, No. 2 end.

5. Turn switch to “Use” on test kit.

6. Place test kit in level position.

7. Set locomotive overspeed per the following chart which gives cycles per second input corresponding to 65 MPH pick up and 63 MPH drop out for given No. 2 Wheel Size.

<table>
<thead>
<tr>
<th>RIM THICKNESS (Nearest Whole No.)</th>
<th>WHEEL SIZE</th>
<th>PICKUP 65 MPH CPS</th>
<th>DROPOUT 63 MPH CPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 2 Wheel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1”</td>
<td>37</td>
<td>198</td>
<td>192</td>
</tr>
<tr>
<td>1-½”</td>
<td>38</td>
<td>192</td>
<td>186</td>
</tr>
<tr>
<td>2”</td>
<td>39</td>
<td>187</td>
<td>182</td>
</tr>
<tr>
<td>2-½”</td>
<td>40</td>
<td>183</td>
<td>176</td>
</tr>
<tr>
<td>3”</td>
<td>41</td>
<td>178</td>
<td>173</td>
</tr>
</tbody>
</table>

NOTE: See PICKUP on P-1 rheostat (bottom) on 475-2 card on transition panel (TEP) located in electrical cabinet. Set DROPOUT on P-2 rheostat (top) same card. Observe test light on OSR for pickup and drop out.
8. Remove test light, AC wires and restore CL wire on Terminal E on Locked Wheel Panel.

PART TWO - SPEEDOMETER CALIBRATION

1. Disconnect IEEA and EEA wires from A terminal in Speedometer Resistor Box (SRB) on control stand.

2. Using 17MM26K1 test kit, connect DC input to locomotive battery. Turn frequency controls all the way to "Off" and turn meter switch to 0 – 350 cycles.

3. Connect one set of AC output leads to Terminals A and B in resistor box.

4. Turn switch to "Use" on test kit.

5. Referring to below chart, which gives speedometer readings for various cycles per second readings on test kit for given No. 3 wheel size, start with 173 CPS column and set the speedometer according to the respective No. 3 wheel size by adjusting the rheostat in the resistor box.

<table>
<thead>
<tr>
<th>Rim Thickness (Nearest Whole no.)</th>
<th>Wheel Size</th>
<th>CYCLES ON INSTRUMENT READ TOP SCALE (0 – 350)</th>
<th>SPEEDOMETER READINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>37</td>
<td>14.5 - 18.5</td>
<td>57.0</td>
</tr>
<tr>
<td>1-1/4&quot;</td>
<td>38</td>
<td>15.0 - 19.0</td>
<td>58.5</td>
</tr>
<tr>
<td>2&quot;</td>
<td>39</td>
<td>15.5 - 19.5</td>
<td>60.0</td>
</tr>
<tr>
<td>2-1/4&quot;</td>
<td>40</td>
<td>16.0 - 19.5</td>
<td>61.5</td>
</tr>
<tr>
<td>3&quot;</td>
<td>41</td>
<td>16.5 - 20.5</td>
<td>63.0</td>
</tr>
</tbody>
</table>

6. Check the speedometer at the 50 and 125 CPS settings.

7. Remove test kit and restore IEEA and EEA wires on A terminal in resistor box.
Setting Speed Recorder on U23B Locomotives
3905 – 3914

Measure rim thickness with steel wheel gauge to determine size of wheel and record rim thickness.
No. 2 wheel overspeed No. 3 wheel speedometer

Inspect seals on speedometer resistor box and locomotive overspeed panel box and note seal markings below if other than Atlanta seal is found.
Resistor Box L.O.S. Box

Operation of Model 17MM37A1 Test Set for Calibrating G.E. Speedometers on U23B Locomotives, 3905-14
Part One – Locomotive Overspeed

1. Disconnect CL wire from terminal E on Locked Wheel Panel (AWSP) located in “Doghouse” over electrical cabinet.
2. Using 17MM37A1 test kit, connect DC input to locomotive battery. Turn frequency controls all the way to “Off” and turn meter switch to 0 – 350 cycles.
3. Connect AC output leads to terminals E and F on Locked Wheel Panel.
4. Put test light on coil of OSR relay located in electrical cabinet along the top, No. 2 end.
5. Turn switch to “Use” on test kit.
6. Place test kit in level position.
7. Set locomotive overspeed per the following chart which gives cycles per second input corresponding to 65 mph pick up and 63 mph drop out for given No. 2 WHEEL SIZE.

<table>
<thead>
<tr>
<th>Rim Thickness (Nearest Whole no.) No. 2 Wheel</th>
<th>Wheel Size</th>
<th>PICKUP 65 m.p.h. CPS</th>
<th>DROPOUT 63 m.p.h. CPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1”</td>
<td>37</td>
<td>198</td>
<td>192</td>
</tr>
<tr>
<td>1-½”</td>
<td>38</td>
<td>192</td>
<td>186</td>
</tr>
<tr>
<td>2”</td>
<td>39</td>
<td>187</td>
<td>182</td>
</tr>
<tr>
<td>2-½”</td>
<td>40</td>
<td>183</td>
<td>176</td>
</tr>
<tr>
<td>3”</td>
<td>41</td>
<td>178</td>
<td>173</td>
</tr>
</tbody>
</table>

8. Remove test light, AC wires and restore CL wire on Terminal E on Locked Wheel Panel.

Note: Set PICKUP on P-1 rheostat (bottom) on 475-2 card on transition panel (TEP) located in electrical cabinet. Set DROPOUT on P-2 rheostat (top) same card. Observe test light on OSR for pickup and drop out.
PART TWO – SPEEDOMETER CALIBRATION

1. Disconnect EEA wire from A terminal in Speedometer Resistor Box (SRB) on control stand. Be sure EEA is left on terminal and is tight.

2. Using 17MM37A1 test kit, connect DC input to locomotive battery. Turn frequency controls all the way to “Off” and turn meter switch to 0 - 350 cycles.

3. Connect one set of AC output leads to Terminals A and B in resistor box.

4. Turn switch to “Use” on test kit.

5. Referring to below chart, which gives speedometer readings for various cycles per second readings on test kit for given No. 3 wheel size, start with 173 CPS column and set the speedometer according to the respective No. 3 wheel size by adjusting the rheostat in the resistor box.

<table>
<thead>
<tr>
<th>Rim Thickness (Nearest Whole no.)</th>
<th>Wheel Size</th>
<th>CYCLES ON INSTRUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>READ TOP SCALE (0 - 350)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 CPS</td>
</tr>
<tr>
<td>1&quot;</td>
<td>37</td>
<td>14.5 - 18.5</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>38</td>
<td>15.0 - 19.0</td>
</tr>
<tr>
<td>2&quot;</td>
<td>39</td>
<td>15.5 - 19.5</td>
</tr>
<tr>
<td>2-1/2&quot;</td>
<td>40</td>
<td>16.0 - 19.5</td>
</tr>
<tr>
<td>3&quot;</td>
<td>41</td>
<td>16.5 - 20.5</td>
</tr>
</tbody>
</table>

Locomotive Overspeed

Record of Speedometer reading as found.

Recorder of Speedometer reading as left.

6. Check the speedometer at the 50 and 125 CPS settings.

7. Remove test kit and restore and EEA wires on A terminal in resistor box.
VALVE TAPPET CLEARANCE ADJUSTMENT
G.E. 12 AND 16 CYLINDER ENGINES

1. Open cylinder compression relief plugs (test cocks) 1½ turns.

2. Install barring over jack so that crankshaft will be rotated in CLOCKWISE DIRECTION as determined when facing timing ring or front end of crankshaft. (This is normal running rotation.)

3. Bar engine over until "1 – 8 SET" (NOT "1 – 8 T.D.C.") mark on timing ring is aligned with right bank pointer. (Use "1 – 6 SET" on 12 cylinder engines.)

4. Remove R1 cylinder cover and crankcase cover and determine if R1 piston is coming up on compression stroke.

   **IF R1 IS ON COMPRESSION STROKE:** Inlet and exhaust cam lobes will be down with inlet and exhaust rollers on round parts of cams. Inlet and exhaust crossheads, pushrods and rocker arms will be loose and all four R1 valves will be fully closed. The fuel cam lobe (center cam) will be up with the fuel crosshead roller about 1/2 way up the ramp of the cam lobe.

   **NOTE:** If R1 is on compression stroke, with right bank pointer at "1 – 8 SET" mark, fuel pump timing can also be checked. DO NOT USE "1 – 8 T.D.C. AS THIS MARK IS USED ONLY WHEN TIMING CAMSHAFT GEARS.

5. If the R1 cylinder is found not to be on the compression stroke, check R8 (R6 on 12 cylinder engines) and it should be.

6. The exhaust and inlet valve tappet clearance can now be set on the cylinder which was found to be on the compression stroke per above — R1 or R8 (or R6 on 12 cylinder engines).

   **A. Exhaust Valves:** The exhaust valves are the two valves in the cylinder closest to the exhaust manifold and farthest away from you as you face the cylinder.

   The exhaust valve tappet clearance should be **0.028" to 0.030"**. (A 0.031" feeler gage should not fit between the end of the exhaust valve stem and the tappet and a 0.028" feeler should.)

   **B. Inlet Valves:** The inlet valves are the two valves in the cylinder closest to the air manifold and closest to you as you face the cylinder.

   The inlet valve tappet clearance should be **0.018" to 0.020"**. (A 0.021" feeler gage should not fit and a 0.018" should.)
C. Use a *Snap On FB-300* feeler gage, or equivalent, if possible. This gage has feelers with a 45° bend which makes it easier to set the right inlet valve.

BEFORE setting the valve tappets, shake both rocker arms in the cylinder hard. (This will clear the valve train of excess oil and give a more accurate reading.)

BE SURE AND TIGHTEN THE TAPPET LOCK NUTS FOLLOWING ADJUSTMENT OF THE TAPPET. RECHECK CLEARANCE AFTER LOCK NUT IS TIGHTENED.

7. Bar engine to next “SET” mark (should be “3 – 6” on 16 cylinder engine or “2 – 5” on 12 cylinder engine) to right bank pointer and set valves on next right bank cylinder in firing order.

   Firing order for 16 cylinder engine 1, 3, 7, 4, 8, 6, 2, 5.
   Firing order for 12 cylinder engine 1, 5, 3, 6, 2, 4.

8. Repeat above until right bank cylinders are set. Then go to left bank and repeat procedures 1 - 7 using left bank pointer.

SECTION 1100

GE U-30-C & U-33C ROAD SWITCH
GROUND RELAY U-30 – 33

1. Apply jumper wire from GA terminal on excitation panel to ground.

2. Attach 150 volt meter with positive on GA and negative on GN3 – both terminals on excitation panel.


4. If does not trip, replace and use same procedure for checking.

5. **NOTE: DO NOT APPLY JUMPER TO GN-3.**

6. Reset GOLR.
Excitation Panel

Can Be Changed. Set F1 = F2.

Transition Panel

Speed Sensing & Wheel Slip Panel

Variable Braking Panel

Voltage Regulator Panel

Can Be Changed

Card A

Card B

Card C

Card D

Card E

Card F

Card G

Card H

Card I

Card J

Card K

Card L

Card M

Card N

Card O

Card P

Card Q

Card R

Card S

Card T

Card U

Card V

Card W

Card X

Card Y

Card Z

Can Not Be Changed

Sets Max. Braking

Sets Min. Braking

Can Change

Can Not Change

EXP

EXP M

EXP N

EXP C

EXP BE

EXP AR

PA

EFR2

EFR3

EPI

EPI2

Exciter Generator

Switch & Stabilizing

ACCR

Throttle

LCP

Diesel Engine

Traction Panel

Traction Alternator

Traction Rectifier

GM

CA

Fraction

DC Power to Traction Motors

Voltage Measure

Should Be 115v in #8 (open control air)

Set LCR 7

Can Not Be Changed

Can Be Changed. Set F1 = F2.

Card Does Nothing

Over Speed, No Load

Pull Way Back

Control Air to Exhaust
SETTING DYNAMIC BRAKE REGULATOR ON 3800 - 3804 U-30-C LOCOMOTIVES

1. Start engine, put on line.

2. Place reverser in forward or reverse, put in full dynamic brake.

3. Apply clamp – ON (1000 AMPS) to any motor field lead and set field current to 1000 AMP. By adjusting BKLR rheostat on 303 Card.

4. Put unit in 1st notch dynamic brake and adjust field current to approximately 50 AMP by adjusting BKMR rheostat on 303 Card.

5. In right rear high voltage cabinet locate BKER2 resistor and remove B1 wire from resistor.

6. Connect (+) output of M.G. set and (+) lead of 1000 volt meter to resistor where B1 wire was removed.

7. Connect (−) output of motor-gen. to D-14 wire on BKER resistor.

8. Put unit in full dynamic brake. Apply 185–195 volts on M.G. and note that field current on 1000 AMP meter on field leads reduce to approximately zero at 185 volts. If it does not—take unit out of dynamic brake and decrease voltage to zero.

9. Remove 433 Card and adjust R-70 rheostat slightly and repeat Step (8) until obtained.

1. Start unit, put on line.


3. Locate two (2) D14 wires on R11 remove large wire (one going to grids) tighten other wire.

4. Locate BKER-1 Resistor top of cabinet above 452 Card.

5. Correct (−) output of M.G. set to AA1B1 wire on BKER1 resistor.

6. Correct (+) output of M.G. set to D14 wire on R11 resistor.

7. Apply CLAMP ON ammeter to any field lead to T.M. and adjust BKLR on 464 Card to 1000 A field current with unit in full dynamic brake.

8. Apply 185V output of M.G. set to terminals of R11 (+) and BKER1 where M.G. connected.

9. Notice T.M. field current should reduce to 150 AMP or lower at a voltage of 185 – 195. If it does not, reduce throttle to idle, M.G. set off.

10. Remove 433 Card and adjust R70 M Card and repeat Step No. 9 until obtained.

11. After Item (10) is complete, set BWR pick up to 250 volts thusly:
    (A) Increase voltage on M.G. to 205 and visually note that BWR picks up and lights in cab.
    (B) Adjust this pick-up with R11 if needed.

12. To test operations BWR, pick up manually by hand after Step (11) above and note 400 to 500 AMP reduction in field current on meter on field leads.

13. Remove equipment and restore wire to R11.
LISTED BELOW ARE ITEMS THAT CAN BE CHECKED, SET OR OBSERVED ON G.E. U30, U33C ENG. GOVERNORS

I. 3800 – 3804 – PART NO. 136X1745 (NO SUBSTITUTE)

II. 3805 – 3809 – PART NO. 136X1740 (NO SUBSTITUTE)

III. When applying new eng. gov. or checking out old eng. gov. account low horse power, smoking excessively, shutting down, etc.
DO FOLLOWING STEPS:

1. Set eng. racks using Block No. 147X1296. Full load is 11/32" (.344) under power piston. When setting racks (3800–3809) jack up temp. compensator under power piston until line on stem in top of apparatus just lines up with top plate.

2. Adjust ALL pomp racks to 22MM.

3. Check engine speeds.

   3800 - 3804 - (136X1745 GOV.)
   IDLE - 627-637 (CHECKED AT TACHOMETER)
   8TH - 1515-1526 TRUE MECHANISM
   No. 6-1262-1273 (FULLRUM NUT)

   3805 - 3809 (136X1740)
   IDLE - 658-671 (CHECKED AT TACHOMETER
   No. 8- 1549-1564 TRUE MECHANISM)
   No. 6-1301-1312 (FULERUM NUT)

IV. Low water trip pressure is 14–18' lbs. No. 8 under load and 0–3 lbs. in No. 2 under load. To check, disconnect water line from eng. governor and eng of inlet and outlet header apply a gage in end of inlet header to cylinder at R-8 cylinder where line was removed. This is to observe what water pressure is while setting low water shut down with air. Use air regulator gage and apparatus to check low water shut down. Plug hole in top side of low water diaphragm block on governor apply setting apparatus to bottom. Set air pressure to 14 lbs. load unit to No. 8 throttle—observe trip out button on low water to see if it starts moving out. It should trip in about 45 - 60 rev. slight movement of slide block up will raise point at which it trips and down will lower point at which trips.
After HI side set come to No. 2 notch and trip pressure should be about 1.5 lbs. If higher, turn screw in block CCW direction to obtain. If lower, turn CW direction. Take all air off low water and unit should shut down in IDLE in about 1½ minutes.

1½ – TO FULL H.P. ON 1745.
(minutes)
50 SECS. TO FULL H.P. ON 1740.

V. SOME OTHER OBSERVATIONS TO MAKE:

If unit fails to start, 1, E racks fail to come out—when cranking—observe racks on fuel pumps, they should advance to No. 13, 14 position, if not you can adjust two large nuts on fuel limiter to cause racks to come out.

Excessive smoking (black) loading unit from 1 – 8 throttle is caused by improper adjustment of fuel limiter compensator screws (two long black screws) in top of governor. Observe engine governor under load. As you face engine governor the L.H. screw controls fuel from throttle position 1 – 4 and the right hand screw controls fuzz from 5 – 8 position. The screw on left should be tight on plate from 1 – 4 throttle (under load) and should leave L.H. screw and pressure will be exerted on R.H. screw in 5th throttle on to 8. However, in 8th throttle position under load both screw should be free on plate.

Do not attempt to adjust these fuel limiter screws unless it is apparent that there is too much smoke since they affect the time it takes to get full load on engine. It takes approximately 1½ minutes for full load (idle to B) using 136X1745 governor and about 50 seconds using 136X1740 governor.

If a speed correction adjusting fulcrum, idle on 8th notch will not bring governor to proper operation after making above preliminary checks settings and observation, renew governor and start over. DO NOT attempt to set pilot valve.
CORRECTION ON ENGINE TACHOMETER DRIVE SPEEDS
ON U30C, AND U33C LOCOMOTIVE WITH TWO-SLOPE PRESSURE BIAS
ENGINE GOVERNORS.

LOCOMOTIVES 3800 – 3804 – 136X1745 – GOV.

IDLE – 627 – 637
No. 8 – 1515 – 1526
No. 6 – 1262 – 1273

LOCOMOTIVES – 3805 – 3809 – 136X1740 GOV.

IDLE – 658 – 671
No. 8 – 1549 – 1564
No. 6 – 1301 – 1312
PROPER CONNECTION OF TRACTION MOTOR TO CARBODY LEADS
GE U30B/U33C LOCOMOTIVES

The information given below is condensed from GEI-73235D, "Power-Cable Terminal Application and Connection", Tab RE-7, G.E. Maintenance Manual. See this bulletin for the complete procedure.

When connecting traction motor leads to carbody leads on the G.E. locomotives, it is important that the following items be adhered to. Correct application of copper (traction motor leads) to aluminum (carbody leads) terminals is necessary to prevent failure of this connection. IF THIS CONNECTION IS MADE PROPERLY, IT IS VERY UNLIKELY THAT IT WILL FAIL. IF IT IS MADE IMPROPERLY, IT WILL VERY LIKELY FAIL.

1. Make sure that terminals are clean and that plating is in good condition.

2. NEVER FILE TERMINALS OR OTHERWISE DISTURB OR REMOVE PLATING. USE CLEANING SOLVENT – DO NOT BRUSH!


4. Install terminal hardware per sketch. Torque specified on 3/8"-16 bolts is 21-24 ft.-lbs. DO NOT OVER OR UNDER TORQUE TERMINAL BOLTS.

5. Secure main hose, shim hose and clamps per sketch. MAKE SURE CONNECTION IS PROPERLY SEALED BY CORRECT APPLICATION OF HOSE AND CLAMPS.

6. When clamping leads to platform, make sure connection is located correctly with respect to cable clamps. This is necessary to prevent the development of a high voltage ground due to a terminal coming in contact with a clamp.

7. Connect traction motor ground lead.
INSTRUCTIONS:
1. Install TEST PANEL, METER and JUMPER WIRE per above sketch.
2. Set Locomotive up for Dynamic Braking.
3. Notch 1 Adjustment, throttle handle in notch 1:
   A. Turn BKMR (303 card - EXP) full CCW (may read about ½ma).
   B. Turn BKMR CW to minimum reading on meter. Record reading and add 0.48ma. Turn BKMR CW until added total is read on meter. Lock BKMR.
4. Notch 8 Adjustment, throttle handle in notch 8:
   A. Adjust BKLR to read 9.0ma on meter. Lock BKLR.
5. Remove test equipment and restore locomotive controls to normal.
SETTING OF DYNAMIC BRAKE REGULATOR ON UNITS 3810 – 3814

1. Remove **AND** wire off of D-terminal of Excitation Panel.
2. Remove **AMW** wire off of ACCR at D-terminal.
3. Remove Power Match Cards — Card No’s ________ and ________
4. Hook short lead of Bridge Rectifier to D-terminal of Excitation Panel. (No. 13)
5. Hook long lead of Bridge Rectifier to D on ACCR. (No. 50)
7. Remove AA1B1 from BKER1 and 2 and apply negative of M.G. set to where wire was removed.
8. Hook Positive of M.G. set on 1D14 and 2D14 on BKER1.
9. Hook M.G. Set to starting contractors for 74 volt.
11. Put Unit in Notch 8 and should read 9 MA on meter, if not adjust BKLR until 9MA is read on meter.
12. Apply 185 volts on M.G. Set. Field current should gradually go to zero; if not, take unit out of 8th notch braking and adjust R-70 rheostat on 433 card.
13. Repeat Step 12 until Step 12 reading is obtained.
This manual is to discuss the normal and unusual operation of the CMR wheel slip system as it is installed on our locomotives. The various types of malfunctions that might be encountered are:

A. At standstill, wheel slips are indicated although none actually take place, when the throttle is moved from IDLE to the first throttle notch.

B. At standstill, wheel slips are indicated, although none actually take place, when the throttle handle is pulled out and traction motor current raised to higher values.

C. No trouble at standstill but continuous signal when speed reaches a little over a mile per hour. Further speed increase not possible due to continuous operation of the panel.

D. Continuous signal in one motor connection, but not in the other.

E. Continuous signal at or above certain locomotive speeds, usually 50 mph or higher, at any throttle position, including IDLE.

F. No trouble in motoring, but continuous signal whenever braking is attempted.

G. Brief signal at transition.

H. Brief signals at low speeds while in dynamic braking.

I. Steady signals at some speeds while in dynamic braking.

J. No detection, although slips are known to exist.

This instruction will discuss each of these problems and suggest what may be the fault. It will also give suggested procedures to further analyze the system and will provide instructions on how to adjust the panel to get correct performance.
A. Signals at standstill must be caused by the measuring circuits not agreeing on what currents exist. This means that one or more of these things might be wrong.

- Wiring at a CMR reactor is shorted or open.
- Motor contactor sequence is wrong, with something not picking up at all. Check contactor operation.
- There may be a high resistance connection in one of the power circuits, or an open circuit due to cable connection not made. Look for loose joints, or smoke or heat.
- There may be an open circuit within the traction motor itself.
- A pinion may have come off one of the traction motors.

B. If signals develop as the handle is pulled out it might mean that measuring reactor shielding is not applied properly, or that the reactor performance has deteriorated. See TESTING section.

C. If signals develop as you start to roll is almost certainly means that one traction motor is either locked or has reverse rotation due to improper motor connections. Check motor rotation. It could also occur if a motor with the wrong gearing has been applied and you unbalance the currents by enough due to difference in armature speed. If unusually wide variation exist in wheel diameter it might cause pick up while rolling under higher currents. We allow for up to 2” difference in diameter between largest and smallest wheel on a unit.

D. Continuous signal in one mode means a fault in contactor or cable circuits for that particular motor connection. See TESTING.

E. Continuous signal above a certain speed means that the simultaneous or synchronous slip portion of CMR is set too low.

F. Signals in braking means that there is an open circuit in one of the grid circuits. Look for a grid burned open, or cable burned off.

G. Brief signals at transition usually mean sensitivity set a shade too high, but may be normal if contactor action is a little slow. Nothing much to worry about unless it gets worse.

H. Brief signals at low speeds in braking may be due to operation of extended range braking contactors not coming in at the same time.
1. Steady signals at certain speed ranges in extended range dynamic braking usually means that one of the extended range contactors did not operate. The signal started when it was supposed to pick up, shorting out some grid sections, and stopped when the next contactor picked up to short out those same sections plus some more.

J. No detection can be caused by several things . . .
   - No AC due to CT failure, or wiring failure to panel. See TESTING.
   - No DC network within the panel. See TESTING.
   - Bad order mercury wetted reed relax (WSX).
   - Panel disabled by wiring error or jumper left on after testing.

TESTING: This description will give suggested testing procedures and will discuss what each test might detect.

1. NO AC TO PANEL. Start engine, pump up air, set brakes, station man in cab to put throttle in notch one and observe safety regulations. Operate test switch on CM R panel. If panel operates at all, AC is available. If panel does not operate when test switch is thrown to LEVEL or RATE position, it may not mean AC failure. Test for DC network failure as shown next. If later it is found that there is no AC, check for AC volts at the secondary of the current transformer. Use care, high voltages may exist.

2. NO DC NETWORK. With throttle in IDLE, engine running or dead, apply jumper from N wire to test point on face of the 411 or 445 card. This should cause operation of WSX and WSR, if control breaker is closed. If this occurs when jumpered, but not when LEVEL testing, it probably means loss of AC from CT. While jumper is applied, make sure that sanding equipment operates properly and that wheel slip light comes on at the operator’s console.

3. LEVEL AND RATE Test. With same setup as in No. 1, operate the test switch and note the following . . .
   - Before operating switch the CMR light should be out.
   - In LEVEL testing the light should flash repeatedly as long as the switch is held down. Meter in cab should show low amps.
   - In the RATE position, the panel should flicker several times and eventually stop. It may settle out with the light DIM. As long as it does something other than flash continuously it means that the rate circuit is good. If it flashes continuously, it will require adjustment as shown later.
4. WHAT IS UNBALANCED ... the panel or the locomotive?

- Apply jumpers as the panel to put all inputs in parallel, thus assuring yourself that the panel is receiving identical inputs on all channels. To do this put jumpers on
  
  C to D
  D to E
  E to F
  + F to G on a 6 axle locomotive.
  + G to H on a 6 axle locomotive.

Now try panel again. If panel is now silent, and had operated abnormally before the jumpers were applied, it means that the panel is probably all right and the unbalance is somewhere in the power circuit. To find out which circuit, proceed to next test. Remove jumpers.

5. WHICH CIRCUIT? Insulate the required interlock to hold out the power tie contactors and prepare to measure the voltages across the 400 ohm resistors on the CMR cards. (4 on a B, 6 on a C.)

Put jumper on last two CMR terminal on the right hand end to over-ride panel corrections. Then pull up throttle and measure DC volts on each of the resistors, with about 300 to 600 amps in the motors. Reading must agree within 7% usually well within 5%. The two motors in series with each other will usually be almost identical with each other, but from one pair to another may show some differences due to difference in cable length to rear truck. If one circuit is a lot lower than the other, it would be nice to know which of the two motors might have the problem. Sometimes the trouble can be determined by blocking the unit into parallel by putting a hot wire on CR1 coil and then taking the reading again on the 400 ohm resistors. Notice what happened to the two reactors in the circuit that had the low readings. If one of them is now low and the other normal, check the circuit with the low reading.

- Reactor terminals shorted with conducting dirt, or material from the locomotive washing fluids. Inspect them and clean.

- Loose bolted joints, either in motor connections, within the motor itself, or somewhere in the bus bars or cables in the compartment. Check traction motor shunt connection.

- Ineffective shielding. On early locomotives, with CMR shields not applied, they may need some work. Either move the reactors and cables to separate them from nearby cables. If that doesn’t work, apply the shields.
NOTE: MAKE THIS TEST IN BOTH FORWARD AND REVERSE DIRECTIONS TO SEE IF THAT MAKES A DIFFERENCE. IF IT DOES, THE TROUBLE IS PROBABLY WITHIN THE CONTROL COMPARTMENT AND NOT OUT IN THE MOTOR CABLING.

- If one reactor persists in giving improper readings, it can be changed out with a new or other good one, without changing the whole set. They are all matched against a master in Erie.

If the trouble is thought to be inside the panel itself, proceed with the next section, to changeout the defective component or to make the proper adjustment.

6. SENSITIVITY. At low levels of traction motor currents, the panel is very sensitive. It is designed to detect difference in motor currents of about 50 amps. The measuring circuits have a precision factor of 4 volts DC for each 100 amps motor current. The volts are measured across the 400 ohm resistors within the panel.

To see this effect it is necessary to inject a small DC signal into the panel. To do this, build up a small battery powered supply using a 9 volt battery and a suitable potentiometer. Disconnect one of the incoming wires at the panel and prepare to install this voltage between the stud and wire with the stud connected to plus.

On a B unit the stud is W.

On a C unit the stud is AC.

The engine need NOT be running. Close battery switch and control breaker. Insert the test power supply as described set at 2.5V and note that the WS relay picks up and stays up. Do it again set at 2.0V and note that the relay picks up once and then drops out. If it does this, P1 is properly set. (Level.) It is a little more complicated to check the densitizing circuits. We must simulate high traction motor currents either by...

a. Applying another DC voltage to C1 capacitor. 16 V for a B unit, 24 volts for a C unit.

b. Connecting a low voltage variable AC power supply to the A and B terminals of the CMR panel and adjusting the input until this 16 or 24 volt reading is noted on capacitor C1, as before.

With this condition another pair of voltages are supplied to verify the two taper adjustments, P2 and P3. See sketch on next page.
When testing the rate circuits the voltage input must be done as a step input in order to trigger the proper rate circuit. This is quite difficult to do unless a fairly complicated set up is made to insert the voltage as a step from zero up to the proper voltage.

Ordinarily the taper adjustment is not as important as the settings at zero amps. An easier method of setting the rate circuit is this . . . First set the level circuit as described, setting P1. Then adjust P4 so that the voltage at test point C is 0.2V DC less than the voltage at test point B.

It is probably easier to have a spare card than to try to reset one on the locomotive.

P5 seldom needs any resetting. It is factory set to match the OpAmp DA1. To set it, adjust it, with PC power on panel until the C2 has 1 volt with polarity in a direction to make ZD4 block.

7. SYNCHRONOUS SLIP. This is a good old-fashioned speed detecting circuit, like the transition panels. It is set at 80 mph, or 675 rpm or 225 cps. Use any axle simulator, 17MM26, 37, or whatever you have. Turn the P1 pot on the 408 card until you get pick up. All you need is PC and battery power. No need to run engine or load unit.

8. STALL TEST. The locomotive must be able to pull hard enough to move, with the brakes fully applied, without developing any CMR activity. To test this, start engine and make full service brake application to get maximum brake cylinder pressure. If possible, couple up to another unit to use it for an anchor. Turn on sand and move reserver to a safe direction. Pull up throttle until something happens. You will either move or one wheel will slip enough to give a slip correction visible on the load-meter. If you can get over 1,000 amps with no signal you probably are...
in good shape. Don't hold the current very long or motor damage might result. If you repeat it, wait for cooling or move a little to get new position on commutator.

Don't be fooled. CMR will detect slips that are almost too small to be seen. You will have to look closely to see them when they happen. Wheel rim will move just a fraction of an inch by the time CMR has detected it.

**TIPS . . . .**

- A 411 and 445 card are identical except for setting on P2 and P3.

- Test the mercury wetted reed relay in its normal, vertical position.

- Test all 3 circuits separately. One can fail and the other two not.

- If the 400 ohm DC voltages don't balance, it might be due to a failure of one of the transformers on the CMR panel. Check them by comparing their AC voltages with throttle in notch 1 so see how they compare. The ratio of DC on 400 ohms, to AC into panel should all be about the same.

- A bad order filter capacitor mounted on each of the 400 ohm resistors can cause faulty panel operation.

- The panel can be observed while on load box, partially, by operating the built in test switch and noting that LEVEL drives power down to a low level. In RATE position it will provide less correction. This is a fairly comprehensive test of everything except the motor circuit cabling.

- If a WSX relay has contact failure, check the arc suppression capacitors on the 411 (445) card. They are not very firmly mounted and may have vibrated enough to break their leads.

- If the 7–8–9 contact on WSX shorts it probably will overheat the R19 resistor on the 411 (445) card. This resistor is 220 ohm, 2W. Not hard to change out.

- It saves time if you have a couple of spare cards of your own with the leads from the 400 ohm resistors brought out to test terminals on the face of the cards. Future cards will all have this feature.

- When checking the film cutout on the current transformer, watch out not to damage the finger that contacts its top surface. The finger design is quite flimsy.
- If someone jumpers a dead battery and has the cables crossed it will cause assassination of the rectifier bridge on the right hand end of the CMR panel.

- The voltage on AB to R on a C unit and R to N on a B unit must be 13.7 to 13.9 volts DC. It is not adjustable, but is zener controlled. Check this with normal DC power supplied to panel. Engine not needed.

- If you are adjusting one of the small pots on the CMR panels you will find that it takes about 20 turns to go from one end all the way to the other. At the end of travel the screws keeps on turning and you cannot tell that you have come to the end, unless you are watching a meter hooked up to the brush arm. When you turn it the other way it will start moving again. Don't worry about going off the end.

- Interlock wiring on the cards carries the current going through the main field transistor. Don't pull the card, or the extender, with any load on the exciter. It's O.K. to pull it with the battery switch closed and the engine running. If there is some doubt, insulate the GS interlock in the FT1 circuit to stop the current before pulling out the card. The pins were not designed to interrupt much current.

- The reactors should be centered on the cable they are measuring. Make sure the rubber supporting cones are inserted into the reactors. There is no best position as far as how it is turned on the cable and it doesn't matter which way the current flows through the reactor.

- Make sure that the wire at the reactor is bolted up against a nut and not just into the black potting material. If there is no support for the terminal it will eventually become loose when the black material finally flows a little and we loose the squeeze on the terminal. Early reactors with push-on terminals are suspect due to possibility of loose connections. They are replaceable with the new type one at a time. They are electrical the same as the stud type now in use.

- You can check the wiring to the reactors by disconnecting the wires from the C, D, E, and F plug, G and H for a 6 axle unit and measuring the resistance between the wire and the stud. Or by measuring C to D and then D to E, and so on, you can check them by pairs. Do this with the engine shut down and the DC power removed to protect your meter. Look for unbalanced resistances. The one that is different is wrong.
MAIN RECTIFIERS

CURRENT TRANSFORMER

MAIN ALTERNATOR

CURRENT TRANSFORMER

LOCOMOTIVE BATTERY

VOLTAGE CLIPPER

AC FOR USE IN CMR NETWORK

1.0 K +

1.0 K -

IF OPEN CIRCUIT

CLIPPED @ 75V

TIME
LOCOMOTIVE OVERSPEED AND/OR SIMULTANEOUS SLIP
WSX CORRECTION - DYNAMIC BRAKING

- 75v +
  - PA
  - LCR2
  - LCR3
  - LCR4
  - BKT
  - R8 (1000 ohms)
  - ACCR
  - GRID AMPS LIMIT
  - VCR
  - OFF
  - 2ma-OFF
  - PWM
  - R19
  - 220
  - 500
  - LCR5
  - XB
  - 24 PIN
  - 74v-Max
  - 0-Min
  - WSX
  - LP
  - 44 ohms
EFR₁ - EFR₄
Ohms Vary With Model,
HP, No. Axles, etc.

WSX CORRECTION - MOTORING
EXTERNAL VOLTS TO C1
0 2 4 6 8 10 12 14 16
FOR "B" LOCOMOTIVE
(4 AXLE)

FOR "C" LOCOMOTIVE
(6 AXLE)

WSX

PC

TRAINLINE ON #10 PIN

WSR

ON CMR PANEL

SAND

WSR

- 1110.15 -
1. Start engine, put on line.

2. Place reverser in forward or reverse, put in full dynamic brake.

3. Apply clamp—on (1000 AMPS) to any motor field lead and set field current to 1000 AMP. By adjusting BKLR rheostat on 303 card.

4. Put unit in 1st notch dynamic brake and adjust field current to approximately 50 AMP by adjusting BKMR rheostat on 303 card.

5. In right rear high voltage cabinet, locate BKER2 resistor and remove B1 wire from resistor.

6. Connect (+) output of M.G. set and (+) lead of 1000 volt meter to resistor where B1 wire was removed.

7. Connect (−) output of motor-generator to D-14 wire on BKER resistor.

8. Put unit in full dynamic brake. Apply 185–195 volts on M.G. and note that field current on 1000 AMP meter on field leads reduce to approximately zero at 185 volts. If it does not—take unit of dynamic brake and decrease voltage to zero.

9. Remove 433 card and adjust R-70 rheostat slightly and repeat Step (8) until obtained.

10. Remove equipment connect B1 wire and tighten. Lock all rheostats.
INSTRUCTIONS:

1. Install TEST PANEL, METER and JUMPER WIRE per above sketch. (See CAUTION note below.)
2. Set Locomotive up for Dynamic Braking.
3. Notch 1 Adjustment, throttle handle in notch 1:
   A. Turn BKMR (Msr. card—EXP) full CCW (may read about $\frac{1}{2}$ma).
   B. Turn BKMR CW to minimum reading on meter. Record reading and add 0.48ma. Turn BKMR CW until added total is read on meter. Lock BKMR.
4. Notch 8 Adjustment, throttle handle in notch 8:
   A. Adjust BKLR to read 9.0ma on meter. Lock BKLR.
5. Remove test equipment and restore locomotive controls to normal.

CAUTION — ON U33C UNITS 3810 to 3814 AND ON U23B UNITS 3900 ON UP, THE FOLLOWING STEPS ARE NECESSARY WHEN SETTING BKMR & BKLR: (1) Independent brake must be in release position, and (2) Extended range braking must be nullified — Insulate RC to OY interlock on S14 on U33C units, Insulate RY to RC interlock on P1 on U23B units.

JCA
1/25/72
G. E. ALTERNATOR DIODE TESTER

PROCEDURE:
1. Turn rheostat full counter clockwise.
2. Turn battery switch on.
3. Adjust rheostat for 6 volts on meter.
4. Use common buss on diode panel for RED or BLACK lead depending on type of diode panel. Check name plate on panel.
   (a) On FM210 panels use red lead on buss.
   (b) On FM 307 panels (which have) two different types of diodes, use the same color test lead as the diode pig tail you are testing and the other connect to base of diode or common buss for string of diodes. i.e., on RED PIGTAIL DIODES use BLACK for base and RED for pigtail. The opposite would apply for black pigtail diodes.
5. You will find one of following conditions on testing diodes.
   (a) A good diode will read 0.2 – 0.5v on meter scale in forward direction and meter will stay on or very near to 6.0 on reverse test. Once connected to diode use FOREWARD REVERSE switch for changing polarity without removing leads. Test each diode separately.
   (b) A shorted diode will read near zero both directions. Disconnect diode and test if suspect. The capacitor could be bad and diode O.K. if short appears.
   (c) An OPEN diode will give approximately 6.0 volts in both FORWARD and REVERSE directions.
   (d) Replace defective diodes in kind using same color and type as removed.
   (e) Use recommended torque for applying diodes which is 25 ft. per lbs.
   (f) Use silicone lube on face of diode also.
# List of Radiators for Use on G.E. Locomotives

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit Numbers</th>
<th>G.E. Type Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>U23B</td>
<td>3900 – 3904</td>
<td>41R971400G8</td>
</tr>
<tr>
<td>U30C</td>
<td>3800 – 3804</td>
<td>41R971400G2</td>
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<tr>
<td></td>
<td></td>
<td>41R971400G7</td>
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<td>U33C</td>
<td>3805 – 3809</td>
<td>41R971400G1</td>
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<td>41R971400G5</td>
</tr>
<tr>
<td>U33C</td>
<td>3810 – 3814</td>
<td>41R971400G9</td>
</tr>
</tbody>
</table>
INSTRUCTIONS FOR TESTING G.E. ROC WHEELSLIP SYSTEM

NOTE: Southern U33C Units 3805 to 3809 are equipped with the ROC (Rate of Change) Wheelslip System and these instructions apply specifically to these units.

The ROC Wheelslip System works by sensing CHANGES of current in the power tie circuits on the locomotive which occur during wheelslip. The system operates only when the unit is in series-parr. Traction motor connection (below 26 MPH) as when the unit is in parr. motor connection (above 26 MPH) the power ties are no longer in the circuit.

When the ROC Wheelslip System operates it takes one action only and that is to unload the unit during wheelslip. The Axle Alternator Wheelslip System activates the wheelslip light and the automatic sand at all times during wheelslip and also unloads the unit during wheelslip above 26 MPH (in parr. motor conn.)

The details of the ROC Wheelslip System are shown on Sections D, D1, E1 & E2 of the Schematic Diagram (41B512626) for S.R. Units 3805-09.

PROCEDURE FOR TESTING:

1. Remove BPX & BPY wires from Terminals E & G on ROC Panel.
2. Connect Test Set leads (See attached sketch) to Terminals E & F on ROC Panel. (DC Voltmeter should be connected to read 0 to 6 volts on Terminals E & F.)
3. Load unit in notch 1 with brakes set. Raise voltage at Terminals E & F slowly. Unit should unload approximately 35% (400 amps to 260 amps) on load-meter when input voltage on Panel Terminals E & F reaches 3 volts. Repeat test with input voltage polarity on Terminals E & F reversed.
   NOTE: Rheostat RSR on ROC Panel adjusts amount unit unloads when 3 volt pick up is reached.
4. If unit unloads during above test but at wrong input voltage at Terminals E & F, adjust Rheostat RAR-1 on ROC Panel for 3 volt pick up.
5. If unit does not unload at all during above test, remove and test Micro-positioner Relay ROC-1. Renew Relay, if defective, and repeat test.
6. Connect Test Set leads to Terminals G & M on ROC Panel and repeat Steps 3, 4 & 5, above.
   NOTE: Adjustment now made with RAR-2 rheostat for 3 volt pick up and relay test refers to ROC-2 Micro-positioner Relay.
7. Test continuity to Reactors RRE-1 & RRE-2 as follows: Measure resistance with ohmmeter from BPX wire (still removed from Panel) to BFW wire on Panel Terminal F. Should read approximately 1000 ohms. Repeat test from BPY wire (still removed) to BRR wire on Terminal M.

8. Make sure Power Tie Contactors PT1 & PT2 pick up when unit loaded in notch 1.

9. Replace BPX & BPY wires on Terminals E & G on ROC Panel.

GENERAL ELECTRIC ROC WHEELSLIP SYSTEM TEST SET

1. Use 4 flashlight batteries for 6 volt power supply.
2. 1000-$\Omega$ pot. varies voltage on test leads and on relay plug coil pins from 1 to 6 volts.
3. 6 volts DC meter can either be built into set or meter lead terminals used for external meter.
4. (REV.) DPDT switch used to reverse polarity on test leads and on relay coil.
5. (TEST) push button switch used to test indicating light.

- 1115.1 -
VALVE TAPPET CLEARANCE ADJUSTMENT
G.E. 12 AND 16 CYLINDER ENGINES

1. Open cylinder compression relief plugs (test cocks) 1½ turns.

2. Install barring over jack so that crankshaft will be rotated in CLOCKWISE DIRECTION as determined when facing timing ring or front end of crankshaft. (This is normal running rotation.)

3. Bar engine over until "1 – 8 SET" (NOT "1 – 8 T.D.C.") mark on timing ring is alligned with right bank pointer. (Use "1 – 6 SET" on 12 cylinder engines.)

4. Remove R1 cylinder cover and crankcase cover and determine if R1 piston is coming up on compression stroke.

   If R1 Is On Compression Stroke: Inlet and exhaust cam lobes will be down with inlet and exhaust rollers on round parts of cams. Inlet and exhaust crossheads, pushrods and rocker arms will be loose and all four R1 valves will be fully closed. The fuel cam lobe (center cam) will be up with the fuel crosshead roller about 1/2 way up the ramp of the cam lobe.

   NOTE: If R1 is on compression stroke, with right bank pointer at at "1 – 8 SET" mark, fuel pump timing can also be checked. DO NOT USE "1 – 8 T.D.C. AS THIS MARK IS USED ONLY WHEN TIMING CAMSHAFT GEARS.

5. If the R1 cylinder is found not to be on the compression stroke, check R8 (R6 on 12 cylinder engines) and it should be.

6. The exhaust and inlet valve tappet clearance can now be set on the cylinder which was found to be on the compression stroke per above -- R1 or R8 (or R6 on 12 cylinder engines).

   A. Exhaust Valves: The exhaust valves are the two valves in the cylinder closest to the exhaust manifold and farthest away from you as you face the cylinder.

      The exhaust valve tappet clearance should be 0.028" to 0.030". (A 0.031" feeler gage should not fit between the end of the exhaust valve stem and the tappet and a 0.028" feeler should.)

   B. Inlet Valves: The inlet valves are the two valves in the cylinder closest to the air manifold and closest to you as you face the cylinder.

      The inlet valve tappet clearance should be 0.018" to 0.020". (A 0.021" feeler gage should not fit and a 0.018" should.)
C. Use a *Snap On FB-300 feeler gage, or equivalent, if possible. This gage has feelers with a 45° bend which makes it easier to set the right inlet valve.

BEFORE setting the valve tappets, shake both rocker arms in the cylinder hard. (This will clear the valve train of excess oil and give a more accurate reading.)

BE SURE AND TIGHTEN THE TAPPET LOCK NUTS FOLLOWING ADJUSTMENT OF THE TAPPET. RECHECK CLEARANCE AFTER LOCK NUT IS TIGHTENED.

7. Bar engine to next “SET” mark (should be “3 – 6” on 16 cylinder engine or “2 – 5” on 12 cylinder engine) to right bank pointer and set valves on next right bank cylinder in firing order.

Firing order for 16 cylinder engine 1, 3, 7, 4, 8, 6, 2 5.

Firing order for 12 cylinder engine 1, 5, 3, 6, 2 4.

8. Repeat above until right bank cylinders are set. Then go to left bank and repeat procedures 1 – 7 using left bank pointer.

SETTING SPEED RECORDER ON U30C LOCOMOTIVES
3800 – 3809

Measure rim thickness with steel wheel gauge to determine size of wheel and record rim thickness.

OPERATION OF MODEL 17MM37A1 TEST SET FOR CALIBRATING G.E. SPEEDOMETERS ON U30C LOCOMOTIVES

1. Disconnect CJ and CG wires from J & K terminals on wheel slip panel. Disconnect CA and CD wires from A & B terminals on wheel slip panel.
2. Using 17MM37A1 Test Kit connect DC input to locomotive battery. Turn frequency controls all way to off and put meter switch to 0–350 cycles.
3. Plug in multiple out put plug. Connect block 3 to A terminal on WSP, Red 3 to B terminal on WSP, Black 4 to J terminal on WSP and Red 4 to K terminal on WSP.
4. Put test light on overspeed (OSR) coil above panel.
5. Turn switch to USE position on test kit.
6. Place kit in Level position.
7. Referring to chart below start with the 173 cycle per second column and set the speedometer according to the respective rim thickness and MPH, by adjusting Res. Box.
8. Then check the speedometer at the 50 and 125 CPS setting for falling in the range as shown on the chart.
   If variation is in excess of limits, as shown on chart at 125 & 50 CPS reading, replace speedometer. If new speedometer does not check with chart at 10 and 40 MPH, renew wheel wear adjustment box and recalibrate.

*9. Set locomotive overspeed pick up to 65 MPH and drop out to 63 MPH. Bottom Rheostat on 210 card for P.U. and top for drop out. Observe light on OSR for pick up and drop out of overspeed setting.

<table>
<thead>
<tr>
<th>Rim Thickness (Nearest Whole no.)</th>
<th>Wheel Size</th>
<th>CYCLES ON INSTRUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>READ TOP SCALE (0 – 350)</td>
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<tr>
<td></td>
<td></td>
<td>50 CPS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SPEEDOMETER READINGS</td>
</tr>
<tr>
<td>1&quot;</td>
<td>37</td>
<td>14.5 - 18.5</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>38</td>
<td>15.0 - 19.0</td>
</tr>
<tr>
<td>2&quot;</td>
<td>39</td>
<td>15.5 - 19.5</td>
</tr>
<tr>
<td>2-1/2&quot;</td>
<td>40</td>
<td>16.0 - 19.5</td>
</tr>
<tr>
<td>3&quot;</td>
<td>41</td>
<td>16.5 - 20.5</td>
</tr>
</tbody>
</table>

* 453 Card on Locomotives 3805 – Thru – 3809.
1. With engine shut down, controls & throttle set up for motoring, unit on run position move throttle to 1st notch. Observe power switches and GF contactors pick-up.

2. Disconnect CG & CJ wires from bottom of transition panel.

3. Connect input to test kit from 75V supply to receptacles named DC input.

4. Turn frequency controls rheostats all way to off. Place master switch to "use" position. Place meter switch to 0–350 cycles.

5. Connect two loads marked output to panel to terminals where CG & CJ wires were removed.


7. Set drop out to 62 1/2 CPS (22 MPH) adjust top rheostat on 210–1 card.
SECTION 1200

EMD SD7 & SD9 ROAD SWITCH
SETTING TRANSITION ON 1750 HP SD-9
(Refer to M.I. 6835)

1. Remove GNR7 wire from top right terminal of FTR relay, replace nut so remaining wire will be tight.
2. Connect negative of a 1000 V voltmeter and MG set output to top right terminal of FTR relay.
3. Connect positive of voltmeter and MG set to GPS4 stud at bottom of right back FTR resistor back of high voltage cabinet, engineer's side.
4. Connect input of MG set to 74V DC, observe polarity.
5. Set the time delay relays as follows and seal nut.
   TDR . . . . 2.5 Seconds TDO . . . . 2.5 Seconds FSD . . . 3 Seconds
6. **FTR PICKUP 1-2, 965 V**
   With unit dead, BF fuse out, ER relay blocked in, load engine in No. 1 forward. Raise MG set voltage to 900 V and let circuit warm up. Raise voltage to 965 V, FTR should pick up unloading engine. Move bottom band on right front FTR resistor to adjust. **NOTE: FTS should not pick up at this time.**
   **NOTE:** Go to idle, then load in No. 1 again each time this 1-2 pickup is checked.
7. **FTR DROPOUT 2-1, 615 V**
   Reduce voltage to 615 V and FTR should fall out, changing power contacts to parallel. Move middle band on right front FTR resistor to adjust.
8. **FTR PICKUP 2-3, 965 V**
   **FTS PICKUP 3-4, 965 V**
   Raise voltage to 965 V to pick up FTR, reduce quickly to 900 V as soon as FTR picks up FSI & FSD. (This pickup was set in Step 6) Raise voltage to 965 again, FTS should pick up and pick up FS2. Move bottom band on left front FTS resistor to adjust. Keep unit in No. 4 transition and go to next step.
9. **FTS DROPOUT 4-3, 615 V**
   With unit in No. 4 transition as in Step 8, block TDR relay plunger up. Reduce voltage to 615 V, FTS should drop out dropping FS2. Move top band on left front FTS resistor to adjust.
10. **FTR DROPOUT 3-2, 560-580 V (TDR picked up)**
    With unit in No. 3 transition as in Step 9, reduce voltage to 560-580 V, FTR should drop out dropping FS1. Move top band on right front FTR resistor to adjust.
11. On completion:
    a. Remove test equipment
    b. Replace GNR 7 wire on FTR, Step 1.
    c. Unblock TDR relay.
    d. Unblock ER relay.
12. **BTR SETTING 2-1, 2225 - 2275 Amps. 740 - 755 Amps on loadmeter.**

M.B. 6110 - 1/28/65

- 1201 -
Located in back of H. V. cabinet, engineers side.

Moving band in direction of arrows raises voltage value.
SECTION 1300

EMD SD24 & SD35 ROAD SWITCH
SETTING BWR ON SD-24
(Use only an approved voltmeter)

1. Remove BB50 and BB wires from bottom terminal of front resistor R4.
2. Connect the positive of a 1500 V voltmeter and the positive output of a motor generator to the lower front terminal of R4 resistor where above wires were removed.
3. Connect the negative of the voltmeter and the motor generator output to the "K" terminal of the BWR relay.
4. Connect the input of the motor generator to 74 V DC, observe polarity.
5. Increase the output of the motor generator to about 950 V and let relay and resistors warm up a minute or so. Then raise the voltage to 1010V and BWR should pick up. Move the band on the front R4 resistor to adjust.
6. The dropout value is 1000V, move the band on the middle R4 resistor to adjust. Increasing resistance of middle R4 resistor lowers dropout value. If the relay is properly set, you will notice after you pick up BWR the motor generator voltage will fall to the dropout value without touching the rheostat on the motor generator.
7. Inspect contacts of BWR for burning. See if contact fingers have been melting nylon actuating arm.
8. See that BW light comes on and ORS is energized when BWR picks up in braking. Inspect grid protection rectifier to the right of BWR.
9. Replace BWR cover, remove motor generator and meter.
10. Replace BB50 and BB wires on lower stud of front R4 resistor.
11. Be sure bands are tight on R4 and put paint on locking screws.
TO SET DBR ON SD-24

1. Remove BB & BB50 wires from bottom of front R4 resistor.
2. Connect negative output of motor generator to A terminal of regohm.
3. Connect positive output of motor generator to SFT-F.
4. Connect input of motor generator to 74 V. Observe polarity.
5. Connect 150 V voltmeter, positive to “B” terminal of regohm and negative to “A” terminal of regohm.
6. Connect 1000 V voltmeter, positive to BB wire that was removed from R4, negative to “K” terminal of BWR relay.
7. Increase motor generator output to 980 V, at this point the 150 V meter should begin to move and then slowly move to between 30 and 90 V. If 150 V meter begins to move too soon or too late, move bands on R2 resistor to adjust. (Try to keep bands even.)
8. If 150 V meter does not register or if movement is erratic, change the operator and repeat Step 7.
9. Remove meters and motor generator and replace BB and BB50 wires on bottom of R4 resistor.
10. Make sure bands of R2 resistor are tight.
SETTING TRANSITION
SD-24

1. Get engine running and hot, run manual sequence with test button to see if circuitry is O.K. Put switch back to normal.

2. With engine running, auxiliary charging 74 volts, throttle No. 1, reverser in forward or reverse, on line, GF in, connect 0–600 milliammeter across CD interlocks of BTRA relay, reading should be 300 MA, if not adjust POL1 slider on R11 resistor to obtain.

3. Leave locomotive set up as in No. 2, turn selector switch to H.V. sequence. Connect neg. (−) motor generator set to terminal on test panel, connect positive (+) of main generator set to bolt on buss between P5–P6 contacts. Connect 0–1500 voltmeter same as M.G. set. Increase voltage a little and observe polarity.

4. Increase voltage to 305–320 volts. Locomotive should go through all steps of transition to parallel FS2 somewhere between the voltages given above. As transition is progressing, you will note that voltage on meter will fluctuate up and down and may be necessary to raise or lower voltage to keep at 305–320.

5. After all steps of transition are made, run voltage to 900V and allow resistors 50 heat up for 10 minutes.

6. Decrease voltage to zero and allow backward transition to series. Run voltage up to 305–320 volts. Note that FTR picks up at this voltage; if not, adjust FRH slider on R13 resistor. This in setting no load FTR pick up. Refer to chart and note that voltage is between two (2) parallel lines for FTR pickup.

7. Decrease voltage to zero allow backward transition to series. Run voltage quickly to 800 volts and hold at that voltage until transition stops, and locks out just before going to series parallel. Transition from series to series parallel should take place at 540 volts, decrease voltage and observe, if necessary to be set, adjust POA28, POA29 slider on 1000 ohm resistor. This step and Step 8 are difficult to set. If not right, start at beginning of Step 7 and repeat until correct.

8. Start in series increase voltage to 400 volts, allow transition to go to series parallel FS1 and then increase voltage quickly to 800 volts. Transition will progress to series parallel FS6 and lock out. You are now setting no load FTR drop-out from series parallel to parallel. This should occur at 580 volts. Decrease voltage and observe. If not correct, adjust PO X slider on 1000 ohm resistor. Repeat Step 8 until correct.
9. Setting BTR drop-out at no load. Increase voltage to 320 and allow 3 or 4 steps of shunt to come in. Decrease voltage to about 250 to stop transition. Decrease voltage to 220–205 V backward transition should progress backward to series. If not correct, adjust slider on 7500 ohm resistor, repeat until correct.

10. Start in series, increase voltage to about 400 volts and allow transition to progress to parallel FS2. Decrease voltage to 150–135 volts. Backward transition should take place. If not, adjust BRD slider on 15000 ohm resistor, repeat Step 10 until correct.

11. Repeat Step 9 to see if drop-out setting of 220–205 volts is still in range. Step 10 affects Step 9 and visa versa, may be necessary to repeat both Steps 9 and 10 several times to get both correct.

12. All no load relay settings have been made, not set up for short circuit test and use chart for voltage at a given value of current. Before any settings are made, do the following:

(a) Put throttle in idle, leave other controls as is, LEAVE ENGINE RUNNING.
(b) Remove MG buss right rear of H.V. cab and apply 3000A, 100 MV shunt connect positive (+) lead of 0–150 MV meter to left side and negative (−) to right side of shunt.
(c) Go to load regulator and remove panel over resistors. Use No. 8 wire and alligator clips and jumper LX to No. 24 on resistors.
(d) Remove wires from G interlock of GFR relay, if more than one, tie together.
(e) Jumper GH interlocks on BF contactor to keep ORS energized.
(f) Connect two (2) 1325 cables as follows:
   1. One from stationary side of P6 to movable of P3 contactor.
   2. Second cable from stationary side of P4 to movable of P1 contactor.
(g) Put in BB fuse, selector No. 1, unit on line, GF in, Rev. in forward or Rev. move throttle to No. 1.

13. You will note MV meter jumps up rapidly. Multiply each MV by 30 to obtain current main generator is producing. It is advisable to take reading at 1500 amp first in order to get on high side of chart and MV meter would read 50 MV. It will be necessary to move jumper on load regulator resistors to obtain this. Short out more resistors for increase current and visa versa. Every time jumper is moved shut throttle off.
14. Use of chart:

There is an infinite number of values to be obtained from chart. (Example—Pick 1000 amp. FTR pickup should be 720 volts, BTR drop out series—SER PAR, FS1, FS5 would be 600 V, and BTR D.O SPFF and FS6, PFF, FS1, FS2 would be 400 V.) Each value of current picked will have different voltages on the various curves. Familiarize yourself with chart before making short circuit test.

15. If necessary to adjust FTR pick up with a given main generator current, adjust FRH slider on R13.

16. If necessary to adjust BTR drop out for series, series parallel FS1 through FS5, adjust slider on 7500 ohm resistor.

17. If necessary to adjust BTR D.O. for series parallel no shunts in, and SP FS1 through FS6 in, and also parallel FS2 adjust BRD slider on 15000 ohm resistor.

18. These relays should fall on chart if not defective and if the no load settings are made properly. If necessary to adjust on high side, recheck point about 600 or 800 amp to see how readings are. If you can get three points on graph from zero to 1800 amp, assume relay setting to be correct. If not, relays will have to be changed out and start over at Step 1.

19. On completion:
(a) Remove MG set
(b) Remove 0-1500 voltmeter
(c) Remove M.G. shunt and apply buss
(d) Remove jumper from LR and apply cover
(e) Put wires on GFr H interlock
(f) Remove jumper from GH interlocks of BF
(g) Remove MG jumpers
(h) Run manual sequence
(i) Check unit for load and dynamic brake.
SD-24 TRANSITION CIRCUIT
(VOLTAGE)
Fig. 6 - FTR-BTR Transition Relay Settings
CHECKING FOR HIGH VOLTAGE GROUNDS ON SD-24

1. First determine if ground is in main generator or traction motors. Cut out all four motor cut out switches and meg generator. If generator is clear start isolating motors, Steps 2 thru 10. If ground shows in main generator start with Steps 11 thru 15, consulting engine wiring diagram. Be sure ground relay is cut loose.

TO ISOLATE TRACTION MOTORS

2. With all the motor cut out switches cut out, all the motors can be megged at the P contactors in the cab, except the field coils of motors 1, 2, 5, and 6 which must be megged at the RVF1, RVF2, RVR5 and RVR6 contactors, respectively. See Step 6 - 9.

3. Local control switch must be on to pick up BKP12 and BKP45. Meg 1 and 4 motors at stationary contact of P1 contactor. If ground shows up here remove AIR (small wire) from top of BKP12 contactor, second terminal from right. Then meg No. 1 motor at stationary contact of P1 and No. 4 motor at movable contact of P4.

4. Meg 2 and 5 motors at stationary contact of P2 contactor. If ground shows up here remove A2R (small wire) from top of BKP12 contactor, second terminal from left. Then meg No. 2 motor at stationary contact of P2 and No. 5 motor at movable contact of P5. If ground shows up in No. 2 motor isolate the load meter by removing IN and IP wires from load meter shunt.

5. Meg 3 and 6 motors at stationary contact of P3 contactor. If ground shows up here remove A3R (small wire) from top of BKP23 contactor second terminal from left. Then meg No. 3 motor at stationary contact of P3 and No. 6 motor at movable contact of P6.

6. Meg No. 1 motor field at F1 lead, top left terminal of RVF1.

7. Meg No. 2 motor field at FF2 lead, top left terminal of RVF2.

8. Meg No. 5 motor field at FF5 lead, top left terminal of RVR5.

9. Meg No. 6 motor field at FF6 lead, top left terminal of RVR6.

10. Be sure you replace any wires (AIR, IN, IP, etc.) that were removed during search for ground. Reconnect ground relay.

ISOLATING THE MAIN GENERATOR

11. Center the SFT relay. This isolates the shunt field circuit which can be megged at SFT-B.

12. Remove the positive shunt bar in rear of No. 1 cabinet.

13. Disconnect GN1, GN2 and GN3 from negative buss to left of FTR relay.

14. Raise brushes to isolate armature.

15. Consult engine wiring diagram.

Revised 2/63
TESTING AND SETTING BWR AND DBR ON SD-35
(Refer to Charts & Graphs 8351898)

1. Remove BR60 wire from K of BWR relay. Connect positive of a motor generator set and 1500 V voltmeter to BR60 wire and negative to K of BWR. Connect a 150V voltmeter to bottom of test jacks.

2. Connect MG set input leads to battery switch, observe polarity. Increase MG set voltage to 300 V and warm circuit for 5 minutes.

3. After warmup period reduce voltage to zero and remove BKJ8 wire from 4 of DBR relay to isolate DBR while setting BWR.

4. SETTING BWR PICKUP
With unit in full dynamic brake increase MG set output to 330 V, BWR should pick up and telegraph. Note that main generator voltage on 150 V meter is knocked down and BWR light comes on. Reduce MG set voltage to zero and return to idle. Move band on RE61B to adjust pickup.

5. SETTING BWR DROPOUT
Pick up BWR again as in Step 4 and note voltage that BWR drops out while telegraphing. Return to idle, reduce MG set voltage to zero. Adjust RE61A for 290V dropout.

6. SETTING DBR
Reconnect BKJ8 wire on 4 of DBR relay. Take MG set input leads off of battery switch and connect to bottom of test jacks, positive on left, negative on right. Turn MG set rheostat full on.

7. Put unit in full dynamic brake, DBR should regulate at 310 volts on 1500V meter, adjust RH10 rheostat to correct. Loosen locknut on rheostat before adjusting and tighten on completion. While still in full brake turn off MG set switch, voltage on 150V meter should rise, this indicates that DBR was doing the regulating and not the PLS. Return to idle.

8. COMPATABILITY TEST
Bring unit slowly to full dynamic brake, quickly reduce to No. 1, then back to No. 8. DBR should control voltage so that it does not overshoot and pick up BWR. If it overshoots, replace CA60 and CA64 and recheck.
9. On Completion:
1. Remove test equipment.
2. Replace BR60 wire on K of BWR.
3. Apply date decals on BWR cover and RH10.

10. Part Numbers:

<table>
<thead>
<tr>
<th>Component</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBR Relay</td>
<td>8331302</td>
</tr>
<tr>
<td>Z1 50 Volt Zener</td>
<td>8331020</td>
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<tr>
<td>BWR Relay</td>
<td>8277235</td>
</tr>
<tr>
<td>RH10 500 ohm Rheostat</td>
<td>8228114</td>
</tr>
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<td>CA 60 50 MFD</td>
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<tr>
<td>CA 64 50 MFD</td>
<td>8315873</td>
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</table>

M.B. 2065 1/12/66
SETTING WHEEL SLIP RELAYS ON SD-24

(Refer to MI 5353)

1. With engine dead, controls in and throttle off, connect a jumper from the “C” interlock of SF contactor to the “G” interlock of the SF contactor. SF contactor should pick up.

2. At the WS 14 relay, remove the small 600 ohm resistor from one side of the coil terminals. Connect the leads of the wheel slip test box to the coil terminals. Turn the knob on the test box to increase the current until the WS 14 picks up. Note that SF drops out and WS light comes on. Reduce the current from the test box until WS 14 drops out but do not reduce any further. Increase the current again and when the relay picks up note the reading on the milliampmeter. This is the pick up value. Adjust the spring tension nut (Fig. 2, Item A) for 17 to 19 MA pick up.

3. With the pick up value set correctly, reduce the current until the relay drops out. Adjust the closed air gap screw, (Fig. 2, Item B) for 10 to 12 MA drop out.

4. The relay should snap in and out, there should not be any partial movement or hesitation. If there is, increase the spring tension. This will also change the pick up and drop out value but this can be corrected by adjusting the pick up air gap screw (Fig. 2, Item C) and the drop out air gap screw (Fig. 2, Item B). Contact wipe plays an important part in the dropout value. Too much wipe will cause an early dropout or partial movement. Set contact air gap and wipe as in Fig. 1. Tight or loose armature pivot pins can cause erratic action. Be sure contacts have enough wipe so there is no arcing.

5. To check the WS 14 circuit for continuity pick up relay with test box then pick up S14 and reading on milliampmeter should rise a little. This can be done by putting unit in forward power sequence and putting it on line (engine dead). Check the 600 ohm resistor that goes across relay coils for continuity, then reconnect resistor to relay coils. Take unit off the line.

6. Repeat Steps 1 thru 4 for WS 36. Step 5 is the same except S36 is used instead of S14.

7. Repeat Steps 1 thru 4 for WS 25. Two continuity checks are necessary for WS 25. Put unit on line as before with relay picked up, if current on milliampmeter does not increase. Flip the reversing switch on test box and current should rise. (Due to rectifier CR 11 in the circuit.) Take unit off line. With WS 25 relay picked up, connect a jumper from any positive to the positive coil terminal of SP25R to pick it up. Current on milliampmeter should rise.
8. To check the WS 16 relay, connect another jumper from SF—C to SF—B, SF and BF contactors should pick up. Connect test leads from wheel slip box to coil terminals of WS 16. Repeat Steps 2, 3 and 4 as for other relays except BF should drop out instead of SF and there is no 600 ohm resistor and no continuity check.

9. The WCR relay is set in the same manner as the others but the pick up value is 13.5 – 15.5 MA and drop out is 8–10 MA. WCR picks up TDS relay only. There is no resistor or continuity check.

10. Make a visual inspection of all contacts to see if they have proper wipe. Remove jumpers and test equipment.
### WSR & WS

<table>
<thead>
<tr>
<th>PICKUP</th>
<th>DROPOUT</th>
<th>MAGNET COIL RESISTANCE</th>
<th>MAGNET AIR GAP OPEN</th>
<th>MAGNET AIR GAP CLOSED</th>
<th>INSIDE CONTACT SHOULD MAKE OF</th>
<th>OUTSIDE CONTACT SHOULD MAKE OF</th>
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<tr>
<td>17-10 MA</td>
<td>10-12 MA</td>
<td>542 Ohms</td>
<td>.073&quot;</td>
<td>.005&quot;</td>
<td>.041&quot;</td>
<td>.027&quot;</td>
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<td>after 18 MA</td>
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<td>+10%</td>
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<td>to</td>
<td>to</td>
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<td>Pickup</td>
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<td>.015&quot;</td>
<td>.045&quot;</td>
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### WCR

<table>
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<th>13.5-15.5 MA</th>
<th>8-10 MA</th>
<th>542 Ohms</th>
<th>.063&quot;</th>
<th>.005&quot;</th>
<th>.028&quot;</th>
<th>.025&quot;</th>
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<tr>
<td>w/Calibrating</td>
<td>w/Calibrating</td>
<td>+10%</td>
<td>to</td>
<td>to</td>
<td>to</td>
<td>to</td>
</tr>
<tr>
<td>Coil</td>
<td>Coil</td>
<td>20 C.</td>
<td>.065&quot;</td>
<td>.015&quot;</td>
<td>.035&quot;</td>
<td>.027&quot;</td>
</tr>
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<td>55% of Pickup</td>
<td>Min. w/thru Cable</td>
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<td>w/thru Cable</td>
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<td></td>
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</table>

- **Interlock Cross-Section** -

- **Wheel Slip Relay - Type 168** -
SETTING WHEEL SLIP RELAYS AND
MOTOR FIELD PROTECTION ON SD-35
(Refer to MI 6849 & 5353)

1. With unit dead, controls in, reverser in neutral, selector handle in one and isolation switch off the line, connect a jumper from F1 of PR relay to A of SF contactor. Connect another jumper from A of SF contactor to PA10 wire on E of FS1A. This will pick up SF and BFA contactors. Remove 10A wire from TDS relay coil to keep sand from running. Remove AS22 wire from K of OCP relay, K terminal.

2. At No. 2 high voltage cabinet connect a test light from B of WCR relay to any convenient 74V negative. This light will indicate dropout out of BFA contactor when it goes out.

3. **WS36 ADJUSTMENT**
   
   Connect wheel slip test box leads to the relay coil terminals, pickup and dropout relay several times and note that BFA drops out as indicated by test light. Now increase the current slowly, relay should pick up between 17 and 19 milliamps. Adjust spring tension nut, Ref. A, Figure 1. Check pickup starting from zero current each time to be sure relay is fully dropped out.

4. With pickup value set correctly, reduce current until relay drops out. Adjust dropout air gap screw, Ref. B, Figure 1 for 9 to 12 MA dropout.
   
   **NOTE:** To be sure relay drops out fully, reduce current until test light lights, do not reduce any further. Raise current until relay picks up again, it should pick up at same value it was set at in Step 3, if it picks up sooner the relay did not drop out fully. Step 5 explains how to correct this.

5. The relay should snap in and out, there should not be any partial movement or hesitation. If there is, increase the spring tension. This will change pickup and dropout values but they can be corrected with the pickup air gap screw, Ref. C and the dropout air gap screw, Ref. B.
   
   Contact wipe plays an important part in the dropout value, too much wipe will cause an early dropout or partial movement. Be sure contacts have enough wipe so there is no arcing or poor contact. Tight, dirty or loose armature pivot pins can cause erratic action. On normally closed contacts the actuating screw should not touch the movable contact flat spring when deenergized.

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1309
6. Check continuity of WS36 coil circuit by picking up relay with test box, now pick up S36 contactor by hand, reading on milliampmeter will rise a little if circuit is good.

7. **WS25 ADJUSTMENT**
   Repeat Steps 3 thru 5 to adjust WS25 relay. There are four continuity checks for this circuit, see Fig. 2, set up as follows:
   Place a thin piece of insulation between the right front contacts of BKB56 in No. 2 cabinet to isolate circuit.
   Pick up WS25 with test box, lock button down and note milliamp reading.
   
   a. Pick up S45 contactor by hand and note that there is an increase in milliamps in only one position of polarity reversing switch on test box. This is due to CR46D in circuit. Drop out S45 and leave polarity reversing switch in position where current increase was noted. Leave WS25 picked up.
   
   b. Note reading on milliamps meter, go to No. 1 cabinet and block in SP25R relay. There should be an increase in milliamps on test box. Unlock SP25R.
   
   c. Connect a jumper from A interlock of SP14 to stationary contact of SP25, there should be an increase in milliamps. Leave jumper on between SP14 and SP25.
   
   d. Go to No. 1 cabinet block in SP25R but insulate A—B contacts. There should be an increase in milliamps. Remove jumper from SP14—A to SP25, unblock SP25R and remove insulation from AB contacts. Remove insulation from BKB—56.

8. **WS46 ADJUSTMENT**
   Repeat Steps 3 thru 5 for WS46 relay. There is no continuity check.
   **NOTE:** WS46 coil is energized by FTR relay after 9th step of transition for 6 axle simultaneous wheel slip protection.

9. **WCR ADJUSTMENT**
   Mechanical adjustment of WCR relay is the same as in Steps 3 thru 5 except that relay is set more sensitive than others. Set pickup at 13.5 to 15.5 MA, dropout at 8 to 10 MA.
   **NOTE:** WCR relay coil is used in dynamic brake to protect the traction motor fields from excessive current. If any changes are made in mechanical adjustments of WCR, the motor field protection circuit pickup value must be checked. See Step 11 in this bulletin. Apply date decals to the four relays just checked, remove test light and go to No. 1 high voltage cabinet with test box.
10. **WS14 ADJUSTMENT**
   Repeat Steps 3 thru 5 to adjust WS14. To check continuity put unit on line and move reverser lever to forward and milliamp reading should rise when S14 picks up. Apply date decal to relay. Remove test jumpers from SF and PR relays.

11. **MOTOR FIELD PROTECTION – WCR RELAY**
    Whenever this check is made it must be known that the WCR settings, shown in Step 9, are correct.
    Start engine and put on line. Connect a 150V voltmeter across bottom of test jacks. Remove wires from No. 1 terminal of PLS, put unit in full dynamic brake. WCR relay should pick up at 80 volts and drop BFA contactor.

    **CAUTION:** Do not operate in full dynamic brake with PLS nullified for over one minute. Move band on RE63C to adjust WCR pickup.

    **NOTE:** If main generator will not build up to 80 volts in full dynamic with PLS nullified use the following method:

    Place a thin piece of insulation in between main contacts of BK contactor. Put unit in dynamic brake and increase throttle slowly until WCR picks up, adjust band on RE63C.

12. a. Replace wires on No. 1 terminal of PLS.
    b. Remove insulation from BK contactor if used.
    c. Replace 10A wire on TDS relay.
    d. Replace AS22 wire on K of OCP relay.
    e. Check loading and braking.
SD-24 HORSEPOWER TEST ON LOAD BOX
2500 H.P. — .96 RACK FULL LOAD

1. Hand brake has been properly applied and wheels chocked _____________________________ Foreman

2. Remove buss between GP & GS at shunt panel in bottom of high voltage cabinet.
   Removed ___________________________ Replaced & Tightened ___________________________

3. Connect positive load box leads to GP stud.
   Applied ___________________________ Removed __________________________

4. Connect negative load box leads to GN buss at transition relays.
   Applied ___________________________ Removed __________________________

5. Connect a jumper from A to G interlock of SF contactor to pick up SF & BF.
   Applied jumper ____________________ Removed jumper __________________________

6. Remove 89A3 wire from D interlock of FOR relay to keep power contactors out.
   Removed __________________________ Replaced __________________________

7. Turn switch on sequence test panel to manual to prevent transition.
   To Manual __________________________ To Normal __________________________

8. Start engine & put on line
   Remarks ____________________________


10. Load gradually to No. 8

11. Record readings below:
    Volts ____________________________
    Amps ____________________________
    H. P. ____________________________
    Rack ____________________________
    L.R. Balanced At __________________

12. On completion shut engine down and complete Steps 6-5-4-3 & 2 in reverse, initialing in proper space.

13. Check engine loading and braking __________________________

14. Make manual sequence test & return sequence test switch to normal __________________

15. I have checked Steps 12 - 13 & 14 ____________________________
    Foreman

UNIT _____________________________ DATE _____________________________

- 1310 -
SD-35 HORSEPOWER TEST ON LOAD BOX
2500 H.P. - .96 RACK FULL LOAD 900 RPM

1. Remove buss between GS and GP at shunt panel in bottom of H.V. cabinet. Move small GS15 wire from GS to GP stud on shunt panel.
   Removed ______________________  Replaced ______________________

2. Connect P1 and P2 load box leads to GP stud and N1 and N2 load box leads to GN stud.
   Applied ______________________  Removed ______________________

3. Remove ML6 wire from GS contactor micro switch to keep power contactors out.
   Removed ______________________  Replaced ______________________

4. Connect a jumper from A of SF contactor to right coil terminal of SF contactor.
   Applied ______________________  Removed ______________________

5. Nullify PLS by removing EL6 wire from center tap of RH4 rheostat.
   Removed ______________________  Replaced ______________________

6. See that all main generator covers are in place ______________________  Elect.

7. See that load box switches are correctly set ______________________  Elect.

8. With reverser in forward or reverse load unit gradually to No. 8 throttle.

9. To check operation of power limit, reduce throttle to idle and replace EL6 wire on center tap of RH4 rheostat. Close No. 2 and No. 3 load box switches. Load unit gradually to No. 8, note that load regulator goes toward maximum field and compare amps and volts with charts and graphs 8351898.

10. To check TMCO power limit reduce throttle to idle and cut out a pair of motors.
    MOTORS CUT OUT _______________  MOTORS CUT IN _______________

11. Lead unit gradually to No. 8 and compare amps and volts with graph.

12. On completion shut engine down and work steps 10–5–4–3–2 and 1 in reverse and initial in proper space.

13. Check loading and braking ______________________  Elect.
    VOLTS ______ AMPS_________  H.P. _______ RACK __________
    LD. REG. _______________

UNIT ______________________  DATE ______________________

M.B. 2116  11/20/70

- 1311 -
SETTING COLR SD-24

1. Adjust sliders on Resistors to Dimension as shown below: (These are preliminary adjustments and are not necessary except when new resistors are applied.)

   - R - 43 (200 Ohm) COLN1 - 1 11/16" from left end.
   - R - 43 (100 Ohm) BVA - 1 11/16" from left end.
   - R - 43 (300 Ohm) DSB - 1 7/8" from left end.
   - R - 43 (300 Ohm) DSC - 1 15/16" from left end.
   - R - 42 (1500 Ohm) CVB - 1 15/16" from left end.
   - R - 42 (1500 Ohm) CVC - 1 13/32" from left end.
   - R - 42 (1500 Ohm) AVA - 1 3/8" from left end.

2. Remove GS13 wire from R-41, replace nut so other wire will be tight.

3. Remove COL3 wire from R-41 and couple 0–500 M.A. Milliampmeter Pos. to R41 where COL3 wire was removed Neg. to COL3 wire.

4. Couple 0–1000V voltmeter plus (+) lead to GS13 term of R-41 and negative (−) lead to movable contact of P3.

5. Couple 1000 volt motor gen. plus (+) lead to GS13 term of R-41 and negative (−) lead to movable contact of P3.

6. Raise motor generator output to 1000V and adjust bands on R-41 to read 25 M.A. Adjust both bands evenly.

7. Remove motor generator and meters.

8. Couple COL3 wire back on R-41.


   The following procedure is sued to set the pickup value of the COLR in each throttle position with two motors cut out and loading thru gruds:

10. Apply load test jumpers, 1 to 1, 2 to 2, etc.

11. Remove main generator buss and apply 3000 amp 100 MV shunt. (8160927) Connect millivolt meter to shunt, observe polarity.

12. Connect 1000V meter across GS and GN.
13. Cut out 2 and 5 motor cut out switches.
15. Remove 89A3 from FOR-D. (To isolate Power Contactor)
16. Remove 89AJ1 wire from S23-A.
17. Connect jumper from POA to S23-A. (Picks up SP-3 and SP-4)
18. Connect jumper from SF-A to SF coil positive terminal. (To pick up SF and BF)
19. Connect test light from BF-H to Neg. Disconnect NFA4 wire from BF-A. (To isolate DBR)
20. Reverser lever in neutral, selector in No. 1.
22. Open throttle to No. 1 notch, eng. should load.
23. Advance throttle to No. 2 then to No. 3, light should blink intermittently.
24. Advance throttle to No. 8 and note that light blinks continuously.
25. Using EMD work sheet WS 10927, plot the current and voltage for each throttle notch in order shown below:

<table>
<thead>
<tr>
<th>STEP</th>
<th>THROTTLE</th>
<th>ADJUST TO LOWER</th>
<th>M. G. OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>POSITION</td>
<td>SLIDER RESISTOR</td>
<td>AMMETER VOLTMETER</td>
</tr>
<tr>
<td>1.</td>
<td>8</td>
<td>COLN1 R-43</td>
<td>To Left</td>
</tr>
<tr>
<td>2.</td>
<td>7</td>
<td>BVA R-43</td>
<td>To Left</td>
</tr>
<tr>
<td>3.</td>
<td>6</td>
<td>DSB R-43</td>
<td>To Left</td>
</tr>
<tr>
<td>4.</td>
<td>5</td>
<td>DSC R-43</td>
<td>To Left</td>
</tr>
<tr>
<td>5.</td>
<td>4</td>
<td>CVB R-42</td>
<td>To Right</td>
</tr>
<tr>
<td>6.</td>
<td>3</td>
<td>CVC R-42</td>
<td>To Right</td>
</tr>
<tr>
<td>7.</td>
<td>2</td>
<td>AVA R-42</td>
<td>To Left</td>
</tr>
</tbody>
</table>

26. Plot voltage and amperage readings on sheet and adjust resistors until the EI value falls on the graph line plus or minus 20 amps.
27. Go thru steps 10 thru 19 in reverse to remove meters, jumpers, etc., and replace wires removed.
### FS CONTACTOR INTERLOCKS ON SD-24

#### FS CONTACTOR INTERLOCKS

**Left MK 515**

<table>
<thead>
<tr>
<th>FS</th>
<th>J-K</th>
<th>L-M</th>
<th>N-P</th>
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<th>A-B</th>
<th>C-D</th>
<th>E-F</th>
<th>G-H</th>
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**Right MK 514**

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<th>A-B</th>
<th>C-D</th>
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**Left MK 502**

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**Right MK 508**

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<tr>
<td>6B</td>
<td>--</td>
<td>NO</td>
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</tr>
</tbody>
</table>

Spool No. 8279976 on FS – As.
No. spools on FS – Bs.

(Ring out interlocks to be sure)
Blank space means interlocks not used.
(No = overlapping interlock)

![Diagram](image-url)
BALANCE TEST ON SD-24 TRACTION MOTOR
FIELDS AND MOTOR SHUNTING CIRCUIT

(Unit Must Be Over a Pit)

A - Voltage Drop Comparison Test of Motor Field Coils.
1. Put the unit in dynamic brake and read the output of the main generator with a DC voltmeter connected to GS and GN. Connect voltmeter positive to buss between stationary contacts of P5 and P6, negative to buss between movable contacts of P3 and P1.

2. Increase the braking until the voltmeter reads 36 volts. Read the voltage drop across each field at the F and FF leads of each motor. This can be done by sticking a knife in the F and FF leads at the motor and connecting a voltmeter to the blades. The voltage should average about 6 volts. A difference of 15% or 1 volt condemns the motor that is out.

3. Return unit to idle.

B - Amperage Comparison Test of Motor Field Coils and Shunting Circuit.
1. Remove the positive coil wire from FSA relay.

2. Connect a jumper from the positive coil terminal of the BR relay to the right terminal of coil resistor of FS6A contactor (See Fig. 2). This will pick up six steps of shunt when unit is put in dynamic brake.

3. Put unit in brake and increase braking to 36 volts at GS and GN. With a tong meter, record the current in the FF lead of each motor (right hand lead).

   NOTE: When using a tong meter, take the average of two readings as follows:
   a. Try to hold the FF lead away from other leads.
   b. Clamp the tongs around the lead and take one reading, remove meter and turn 180°, clamp on lead and take another reading.
   c. See that face of each tong is clean each time it is clamped around a lead.

4. The readings should not vary more than 15 amperes, over 30 amps will cause wheel slip trouble.

5. If there is more than 15 amps differential, it will be necessary to find out which step of shunt is causing the difference as follows:
   a. Return unit to idle.
   b. Move jumper from FS6A to FS5A and take tong meter readings again as in step B–3.
c. If trouble disappears, check FS6 contactor and resistor circuit of motor in trouble. (Fig. 1)

d. Repeat Step 5 going to the next lower step of shunt each time.

6. Return the unit to idle and remove the jumper from the last FS contactor tested. Repeat Step B–3 and take tong meter readings again. Any difference here will probably be in FS1A or FS1B contact or circuit, a stuck contact or wires shorted in back of contactor could cause this unbalance. Return unit to idle.

7. Be sure test jumper is removed and FSA coil wire is replaced.

---

**FIG. 1**

---

**FIG. 2**

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SD–Elec.

5/63

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- 1314.1 -
TO CALIBRATE ELECTRIC SPEEDOMETER S-21
SD-24, GP-30 AND "F" TYPE LOCOMOTIVES

Measure rim thickness with steel wheel gauge to determine size of wheel and record rim thickness.

Inspect seals on speedometer resistor box and locomotive overspeed panel box and note seal markings below if other than Atlanta seal is found.
Resistor Box
L.O.X. Box

Attach drive unit to axle generator and connect portable test instrument (Grey Box) leads to right two terminals on resistor box. Set selector switch of Grey Box on "A" and increase speed of Drive Unit until 62 cycles on cycle scale of Box. Check speedometer reading to correspond with chart below. Note reading at 10, 40 and 62 column as found in chart below. (Replace speedometer if pointer sticks.) After making above test, make sure that speedometer hand is zeroed correctly. Speedometer should read within limits for relative wheel size as shown below in chart. If not, move resistor of wheel wear adjustment box by turning adjustment shaft with screwdriver until speed corresponds with chart. List on chart below reading at 10, 40, and 62 MPH as left.

If variation is in excess of limits, as shown on chart at 10 and 40 MPH reading, replace speedometer. If new speedometer does not check with chart at 10 and 40 MPH, renew wheel wear adjustment box and recalibrate.

Increase speedometer reading until overspeed relay picks up. Note pick-up speedometer reading in MPH on chart below as found. Adjust pick-up reading to 65 MPH. This adjustment to be made by decreasing speedometer reading to 55 MPH, stop whistle blowing, turn overspeed relay adjustment one turn counter-clockwise, increase speedometer reading to 65 MPH, and turn overspeed relay adjustment shaft clockwise until overspeed relay picks up. Tap overspeed panel "LIGHTLY", reduce speedometer reading and recheck. Note reading in MPH on chart below as left.

<table>
<thead>
<tr>
<th>Rim Thickness (Nearest Whole no.)</th>
<th>Wheel Size</th>
<th>CYCLES ON GREY BOX</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>10 40 62</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SPEEDOMETER READINGS</td>
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<tr>
<td>1&quot;</td>
<td>37</td>
<td>7.0 11.0 37 39 58.5</td>
</tr>
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<td>1½&quot;</td>
<td>38</td>
<td>7.5 11.5 38 40 60.0</td>
</tr>
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<td>2&quot;</td>
<td>39</td>
<td>8.0 12.0 39 41 61.5</td>
</tr>
<tr>
<td>2½&quot;</td>
<td>40</td>
<td>8.5 12.5 40 42 63.5</td>
</tr>
<tr>
<td>3&quot;</td>
<td>41</td>
<td>9.0 13.0 41 43 65.0</td>
</tr>
</tbody>
</table>

Locomotive Overspeed

Record of Speedometer readings as found

Record of Speedometer readings as left

- 1315 -
SECTION 1400

EMD SD-40 & SD-45 ROAD SWITCH
1. Remove 4 GP leads from main generator shunt panel in bottom of H.V. Cabinet. Connect 4 positive load box leads to the 4 GP leads just removed. Be sure lugs are well insulated from floor and other equipment.
   REMOVED ___________________________ REPLACED ___________________________

2. Connect 4 negative load box leads to GN buss.
   APPLIED ___________________________ REMOVED ___________________________

3. Connect a jumper between B1 and B2 of PR relay.
   APPLIED ___________________________ REMOVED ___________________________

4. Check AR10 alternator for BO fuses and diodes, replace before load testing ___________________________ Electrician.

5. See that all AR10 alternator covers are in place ___________________________ Elect.

6. See that load box switches are correctly set ___________________________ Elect.

7. With reverse lever in forward or reverse load unit gradually to No. 8 throttle.

8. To check PCP reduce throttle to idle and remove jumper from B1 and B2 of PR relay. Close load box switches 9 and 10. Load gradually to No. 8 and note that load regulator goes toward maximum field. Compare AMPS and VOLTS WITH Charts and Graphs 8438840.

9. To check TMCO power limit, reduce throttle to idle and cut out any pair of motors. MOTORS CUT OUT ___________________________ MOTORS CUT IN ___________________________

10. Load unit gradually to No. 8 and compare AMPS and VOLTS with Charts and Graphs ___________________________ Electrician.

11. On completion stop engine and work Steps 9–3–2 and 1 in reverse, initial in proper space.

12. Check loading and braking ___________________________ Electrician.

13. VOLTS _____ AMPS _____ H.P. _____ RACK _____ LD. REG. _______

UNIT ___________________________ DATE ___________________________

MB 2116  12/21/70

- 1400 --
SECTION 1500

EMD SW-1500 SWITCH
# Locomotive Temperature Switches

Revised 6-18-74

<table>
<thead>
<tr>
<th>LOCOMOTIVE</th>
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<th>TB</th>
<th>ETS</th>
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<td>8409069</td>
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<td></td>
<td>8418385</td>
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- 1501 -
<table>
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<tr>
<th>SWITCH PART NO.</th>
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</table>
| 8379564        | ETS for 2716 – 2822  
|                | HES for 2330 – 2347 |
| 8379942        | ETS for 2716 – 2822  
|                | HES for 2330 – 2347 |
| 8409067        | TA for 2716 – 2822  |
| 8409069        | TB for 2716 – 2822  
|                | ETS for 2300 – 2329  |
| 8409070        | TA for 2716 – 2822  |
| 8409072        | TB for 2716 – 2822  
|                | ETS for 2300 – 2329  |
| 8418385        | ETS for 2330 – 2347  |
| 8424293, 8424290 | TA for 2823 – 2878  
|                | 5000 – 5138         |
| 8424295, 8424292 | TB for 2823 – 2878  
|                | 5000 – 5138         |
| 8425575, 8425023 | ETS for 2823 – 2878  
|                | 5000 – 5138         |
| 8314889, 8334771 | TA for 2880 – 2886  |
| 8314887, 8334773 | TB for 2880 – 2886  |
| 8323900, 8334774 | ETS for 2880 – 2886  |
SUBJECT: High Potential Test on SW1500 Locomotives Having Either the Factory or Field Applied Connection of the Ground Relay to the Negative Side of the Generator

(Factory applied on all SW1500 locomotives built after September, 1972.)

TEST PROCEDURE:

The subject locomotives are equipped with D32–P generators. After the GR circuit modification has been applied, the maximum potential which can exist between any part of the generator A–D circuit and ground is 45 volts (the generator A–D circuit is comprised of two parallel branches of the interpole coils, the compensating windings and the differential coils.)

To eliminate the application of test voltages to the A–D circuit of the subject generators which would be approximately twenty times higher than the maximum voltages encountered in normal service the following test procedure is recommended:

Before application of the 1050 volt, 60 Hertz test to the generator armature and the locomotive’s high potential circuits:

1. Unbolt the external generator negative connection and insulate between the generator bus and locomotive cable lugs. (This is the external connection on the right side of the generator when facing the commutator.)

2. Lift all the generator negative brushes so the minimum distance to the commutator is that of the brush holder itself. (The negative holders are those which connect to the brush holder ring which is closer to the bearing end of the generator.)

3. Connect the generator negative bus (which has just been unbolted) to ground (Use No. 10 to No. 14 flexible wire with clips).

4. Also connect the generator negative bus to a negative brush holder. (Use No. 10 to No. 14 flexible wire with clips.)

5. Proceed to apply high potential tests to the generator’s other circuitry according to previously employed customary procedures.
6. Remove jumper wires. Install negative brushes in their boxes. Reconnect the generator negative bus to the locomotive cabling and reinsulate the connection.
CALIBRATION OF HUMP SPEED INDICATOR
DUAL SCALE 0 – 10, 0 – 80 mph

<table>
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<tr>
<th>Rim Thickness</th>
<th>Wheel Size</th>
<th>RPM ON METER</th>
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<td></td>
<td>20 MPH</td>
<td>40 MPH</td>
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<tr>
<td>1&quot;</td>
<td>181</td>
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<td>2&quot;</td>
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<td>344</td>
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<td>2½&quot;</td>
<td>168</td>
<td>336</td>
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<tr>
<td>3&quot;</td>
<td>163</td>
<td>326</td>
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</table>


2. Turn RPM dial to X1, power dial to 75V and frequency controls COARSE and FINE to OFF position.

3. Remove cover from resistor box panel on throttle stand. Remove SPX wire from A or B terminal (left hand terminals); place hump switch in ON position and scale switch on LO position.

4. Select rim thickness of speed indicator wheel from chart above and move horizontally across the page for 20, 40, 60 and 80 MPH. Use the rheostat for Hi scale in resistor box to adjust meter to RPM, as indicated on test kit, for the particular wheel size and test point chosen. (i.e. - 20, 40, 60 MPH.)

5. When meter is set correctly at 80 MPH reduce the meter to 8 MPH (still on Hi scale) and place the hump switch in OFF. The meter should revert to 8 MPH on LO scale. If not, adjust the LO rheostat in box to obtain. Recheck both valves repeating Steps 4 and 5.

6. The meter is wired so that you can only get a LO scale reading when in hump position. This is to prevent damage to the meter. If this is not the case re-check the wiring to conform to print below.
SPEED SETTINGS ON SW1500

1. Place throttle in No. 6 Position and bring to specified speeds by adjusting Fulcrum Nut. (735–743 RPM’s)

2. Move throttle to No. 8 Position and set speeds by adjusting the “D” Solenoid. (900–908 RPM’s)

3. With the throttle in No. 7 Position adjust the “A” Solenoid to set speeds. (817–825 RPM’s)

4. With the throttle in No. 4 Position, adjust the “B” Solenoid to set speeds. (571–579 RPM’s)

5. With the throttle in No. 2 Position, adjust the “C” Solenoid to set speeds. (396–426 RPM’s)

6. Check Idle Speed setting. If Idle Speed is high, lower speed by adjusting the “A” Solenoid. (325–333 RPM’s) This adjustment will cause others to be off slightly.

SPEED SETTINGS ON GP-38

1. Place throttle in No. 6 Position and bring to specified speeds by adjusting Fulcrum Nut. (730–738 RPM’s)

2. Move throttle to No. 8 Position and set speeds by adjusting the “D” Solenoid. (900–908 RPM’s)

3. With the throttle in No. 5 Position, adjust the “A” Solenoid to set speeds. (645–653 RPM’s)

4. With the throttle in No. 3 Position, adjust the “B” Solenoid to set speeds. (475–483 RPM’s)

5. With the throttle in No. 2 Position, adjust the “C” Solenoid to set speeds. (390–398 RPM’s)

6. Check Idle Speed Setting. If Idle Speed is high, lower speed by adjusting the “A” Solenoid. (307–323 RPM’s) This adjustment will cause others to be off slightly.

PILOT VALVE SETTING ON BOTH GP-38 AND SW-1500

Pilot Valve should be set at .83 Rack in 8th Notch.
Pilot Valve should be set at 1.75 Rack in Idle Position.
USE BELTS NO. 5V-1120

"Tension the SW1500 and SW1001 fan drive V-belts as follows:

Using a belt tension tester (8396624), adjust the belts to a tension tester force of 10 lbs. minimum, to 15 lbs. maximum, at 1/4" belt deflection with the tension tester located at the center of the belt span between the upper sheave and the idler."
<table>
<thead>
<tr>
<th>Item</th>
<th>Unit Switch</th>
<th>Series Forestalling Switch</th>
<th>Booster Switch</th>
<th>Hump Cont.</th>
<th>Load Inc./Dec. Switch</th>
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<tbody>
<tr>
<td>1</td>
<td>Lead Unit (2-Unit Oper) with Booster</td>
<td>Two Unit</td>
<td>Series Forestalling</td>
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<td>ON</td>
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<td>Trail Unit (2-Unit Oper) with Booster</td>
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<td>Series Forestalling</td>
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<td>OFF</td>
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<td>3</td>
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<td>One Unit</td>
<td>Series Forestalling</td>
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<td>ON</td>
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<td>Single or Multiple (Normal Switcher)</td>
<td>One Unit</td>
<td>As Required</td>
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<td>OFF</td>
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</table>

Items (1) and (2) normal two unit hump operation with booster.

**NOTE:**

1. To resume two unit multiple operation with booster between, shut throttle to idle, center reverser, turn booster switch to OFF, place unit switch in ONE UNIT position.

2. When operating booster with one switch engine (item 3 above) place M.U. headlight switch on booster to SINGLE UNIT.
<table>
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<th>STEP</th>
<th>NOTCH</th>
<th>ENG. RPM</th>
<th>GOV RPM</th>
<th>A/D</th>
<th>ENERGIZED</th>
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<td>796±4</td>
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<td>A, B, C, D</td>
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<td>#8</td>
<td>904±4</td>
<td>985±4</td>
<td>D</td>
<td>A, B, C</td>
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<td>570±4</td>
<td>621±4</td>
<td>B</td>
<td>A, C</td>
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<td>278±4</td>
<td>C</td>
<td>A, D</td>
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<td>5.</td>
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<td>347±4</td>
<td>A, D</td>
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