

# TRAINING

**CLASS 50  
PROCEDURE FOR SETTING UP  
ETH CIRCUITS**

MECHANICAL  ELECTRICAL  
**ENGINEERING**  
BRITISH RAILWAYS BOARD · HEADQUARTERS



# CLASS 50

## PROCEDURE FOR SETTING UP

### ETH CIRCUITS

SAFETY PRECAUTIONS TO WRSD 1/A/105 MUST BE CARRIED OUT BEFORE TESTING COMMENCES

READ ALL INSTRUCTIONS AND RELEVANT SCHEMATICS BEFORE TESTING

WARNING The ETH circuits normally operate at 850 V. During some of the tests this can rise to 1000 V. Extreme caution is required at all times.

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## 1. INTRODUCTION

To ensure the correct operation of the ETH generator and its earth fault protection system, the following must be set up correctly:

- 1) CU 6 input boards
- 2) Earth fault desensitising resistor, Z71
- 3) Heating Earth Fault Relay (HEFR) operating current
- 4) Heating Over Voltage Relay (HOVR) operating voltage

PLEASE NOTE:-

These tests involve a great deal of engine stopping and starting.

To avoid unnecessary battery drain it is essential to release the engine start button as soon as the engine-stopped light goes dim.

## 2 SETTING UP CU6 INPUT BOARDS

DANGER 850 V

CARRY OUT SAFETY PRECAUTIONS TO WRSO I/A/105

2.1 Equipment required: Model 8 AVO  
CU6 input board extension lead  
Earth strap  
2-amp fuse

2.2 Using the AVO check for earth faults:

- 2.2.1 HA to earth, min resistance 2.2 k ohms ( $Z_{71} + Z_{69}$ )
- 2.2.2 HN to earth, min resistance 5.0 meg ohms
- 2.2.3 HP to earth, min resistance 5.0 meg ohms

Any resistances found to be less than those specified above must be investigated and cleared, especially any on HN circuit.

2.3 Put BIS to 'OFF', COS to 'OUT'.

2.4 Connect AVO (on 1000V dc scale) between HA (+ve) and HAA (-ve). HA is on Z23 resistance panel adjacent to HOVR. HAA is located on HOVR operating coil. Place AVO in cab (ensuring compartment door cannot slam shut on leads).

2.5 Connect HP (on rear of MC1 contactor) to earth using earthing strap and 2-amp fuse in series.

- 2.6 Remove CU 6 front input board and reconnect using the extension lead and box.
- Note: if new boards are being fitted, turn R8 fully anticlockwise and then 8 turns clockwise; turn R12 fully anticlockwise and then 9 turns clockwise,
- 2.7 Put BIS 'IN', COS to 'NORMAL'.
- 2.8 Start engine. On releasing start button AVO reading should increase to approximately 700V. Whilst in EO slowly open power handle to notch 7. The AVO reading should rise to  $850V \pm 5V$ .
- 2.9 Press ETH 'ON' button and hold it in. The AVO reading should fall to  $800V \pm 5V$  (ie drop by 50V). ETH should drop out on releasing the button
- 2.10 If either setting is incorrect, adjust as follows:
- \* 2.10.1 Adjust R8 for 850V setting
  - \* 2.10.2 Adjust R12 for 800V setting
- Note: R8 and R12 affect each other so both must be re-checked and adjusted until correct. Do not exceed 950V as HOCR will trip
- 2.11 On completion reduce engine rpm to idling and shut down engine. Put COS to 'OUT'.
- 2.12 Replace and secure CU 6 input board, unless Z71 is to be checked (see section 3).

- 2.13 Return to section 2.8 and re-check the two settings.
- 2.14 If correct, shut down engine, put BIS to 'OFF'.
- 2.15 Remove AVO and earthing strap.
- 2.16 Put COS to 'NORMAL'.

\* Note:

When adjusting R8 and R12, a CLOCKWISE rotation increases volts.

R8 is 50 volts per turn under all conditions

R12 is 50 volts per turn normally, and

100 volts per turn with positive earth fault.



### 3 SETTING UP Z71

DANGER 850 V

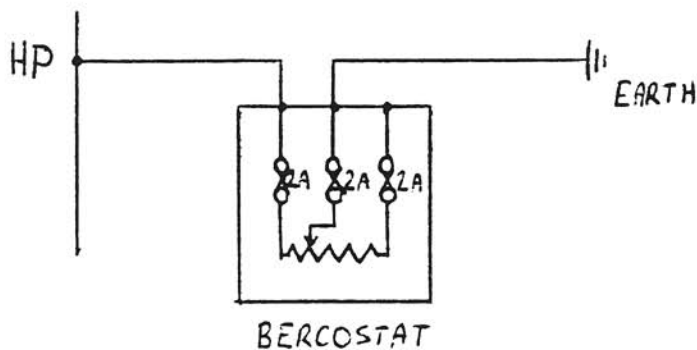
CARRY OUT SAFETY PRECAUTIONS TO WRSO 1/A/105

3.1 Equipment required: Model 8 AVO  
Bercostat 1k ohm potentiometer  
CU6 input board extension lead  
Earthing strap

3.2 Using AVO check for earth faults as specified in section 2.2

3.3 Put BIS to 'OFF', COS to 'OUT'.

3.4 Connect Bercostat as shown below, with zero ohm terminal (red) to HP terminal on HC1 contactor and the slider terminal (black) to earth.



3.5 Remove CU6 front input board (if not already done) and reconnect using the extension lead and box.

3.6 Set Bercostat to zero ohm position and connect AVO (1000V dc scale) across HA (+ve) and HAA (-ve)

3.7 Put BIS to 'IN', COS to 'NORMAL' and start the engine. Whilst in 'EO', slowly open the power handle to notch 7. The AVO should read  $850V \pm 5V$ .

Press the ETH on button and hold it in - the AVO reading should drop to  $800V \pm 5V$ . The ETH should drop out again on releasing the button.

If either of these readings is incorrect, the CU6 input boards must be reset as specified in section 2.

3.8 Set Berostat to 1000 ohm position.

3.9 With engine still at full revs, switch on the train heat and release the button - ETH should stay on. Slowly reduce the setting of the Berostat until relay HEFR trips (becomes energised) and drops out ETH. Make a note of the Berostat position.

If it is in the range 380-400 ohms, no adjustment is required on Z71. Proceed to section 3.17.

If the reading is outside the range 380-400 ohms, Z71 requires adjustment. Proceed to section 3.10.

3.10 Stop engine, put BIS to 'OFF'.

3.11 Subtract 400 ohms from the Berostat reading obtained in section 3.9 (this may result in a negative figure).

3.12 With BIS 'OFF' use AVO to measure the resistance of Z71 between terminals E6 (on slider) and earth E. Make a note of this reading (should be in the region of 1900 ohms).

3.13 ADD the AVO reading from section 3.12 to the figure obtained in section 3.11 .

3.14 With ENGINE STOPPED and BIS 'OFF' adjust Z71 to the resistance calculated in section 3.13 using E6 slider. Do not adjust HF4 slider.

3.15 Two sample calculations:

	<u>1</u>	<u>2</u>	Section ref.
Becostat reading	600	300	3.9
Minus 400	<u>-400</u>	<u>-400</u>	
Equals:	200	-100	3.11
Plus Z71 AVO reading	<u>+1800</u>	<u>+1800</u>	3.12
Equals:	2000 ohms	1700 ohms	3.13

Example 1: Z71 must be adjusted to 2000 ohms

Example 2: Z71 must be adjusted to 1700 ohms

WARNING: DO NOT UNDER ANY CIRCUMSTANCES ATTEMPT TO ADJUST Z71 WITH THE ENGINE RUNNING.

- 3.16 Return to section 3.6 and recheck the 850V and 800V settings. Adjust again if necessary and recheck Z71 (section 3.5).
- 3.17 Reduce engine rpm to idling and stop engine. Put COS to 'OUT' and replace CU6 front board and secure.
- 3.18 Turn Berostat to zero position. Put COS to 'NORMAL'. Start engine.
- 3.19 Recheck the 850V and 800V settings as in section 3.6.
- 3.20 Turn Berostat to 1000 ohm position. Switch on ETH and release button. Finally recheck that HEFR trips when Berostat is slowly turned down to 380 - 400 ohms.
- NOTE: if difficulty is experienced in adjusting Z71 it will be necessary to check the trip setting of HEFR (section 4).
- 3.21 With Z71 and CU6 boards now correctly set and checked, stop engine, put BIS to 'OUT'. Disconnect and remove all equipment.
- 3.22 On Z71 panel mounting panel write, in yellow paint or similar, the date Z71 was set up.

## 4 SETTING UP HEFR

- only required if Z71 cannot be set correctly

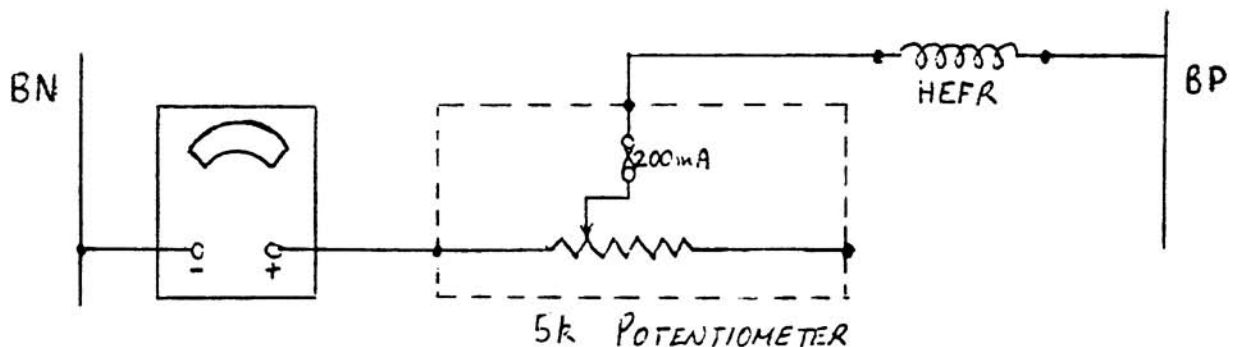
CARRY OUT SAFETY PRECAUTIONS TO WR50 1/A/105

4.1 Equipment required : Model 8 AVO  
5 k ohm potentiometer (5 watt)

4.2 Put BIS to 'OFF', COS to 'OUT'.

4.3 Disconnect cables H27 and H36 from HEFR coil.

4.4 Set AVO to 0.1 A dc scale with negative lead to cable BN and positive lead to one end of 5k ohm potentiometer. Set slider to all resistance in circuit and connect the slider to H36 terminal on HEFR. Connect H27 terminal on HEFR to BP. See schematic below:



4.5 Put BIS to 'ON'

4.6 HEFR should be de-energised. Gradually decrease resistance using slider until HEFR energises. Make a note of the AVO reading.

- 4.7 The current required to energise HEFR should be  $11 \text{ mA} \pm 0.1 \text{ mA}$ . If it is not, adjust the spring tension on HEFR and repeat the test until the correct setting is obtained.
- 4.8 When correct, lock the spring adjusting screw and recheck the setting.
- 4.9 On completion, put BIS to 'OFF', disconnect AVO, reconnect HEFR coil and put COS to 'NORMAL'.
- 4.10 If HEFR spring tension was adjusted then Z71 and CU6 input boards will have to be reset.

## 5 SETTING UP HOVR

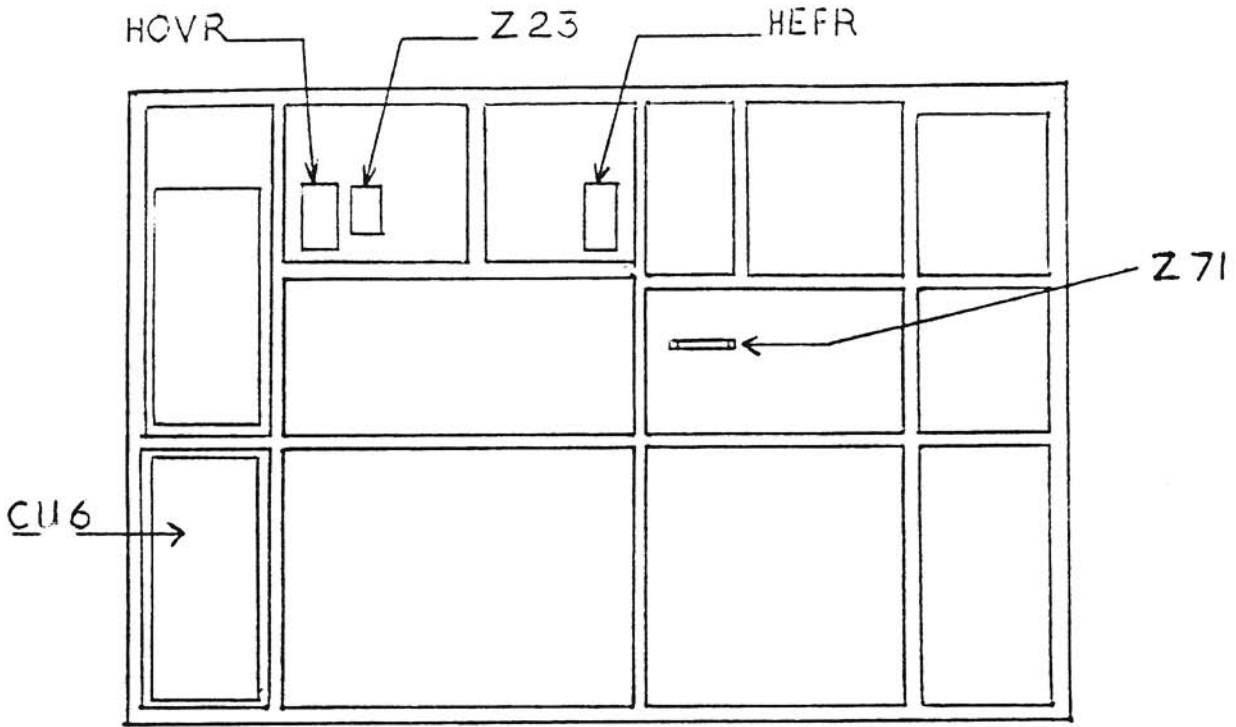
DANGER 1000V

CARRY OUT SAFETY PRECAUTIONS TO WRSO 1/A/105

- 5.1 Equipment required: Model 8 AVO
- 5.2 With BIS 'OFF' and COS 'OUT', remove front input board from CU 6.
- 5.3 Connect AVO (1000V dc scale) across HA (+ve) and HAA (-ve). Put AVO in cab, ensuring door will not slam shut on cables.
- 5.4 Put BIS 'ON' and COS to 'NORMAL' and start engine. Check AVO reads 650V to 750V at idling.
- 5.5 SLOWLY open the power handle whilst in EO and note the voltage at which HOVR energises (engine shuts down - approximately notch 4 or 5).  
  
DO NOT UNDER ANY CIRCUMSTANCES EXCEED 1000V as this may flush over the rad fan motor and/or ETH generator.
- 5.6 If HOVR does not energise at 960-930V, stop the engine and adjust the spring tension (increase tension to raise tripping voltage).
- 5.7 Repeat from section 5.4 until setting is correct. Secure lock nut on tension spring screw.
- 5.8 Shut down engine. Replace CU 6 board. Remove AVO

APPENDIX 1

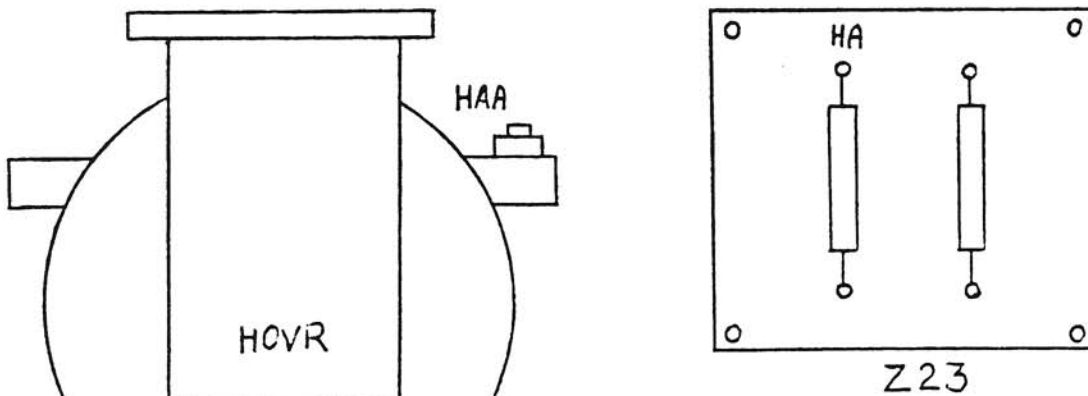
LOCATIONS OF EQUIPMENT



THIN - MANS SIDE OF CONTROL CUBICLE

APPENDIX 2

LOCATIONS OF HA & HAA



Use crocodile clips on HA and HAA.  
Support cables on one of door catches.

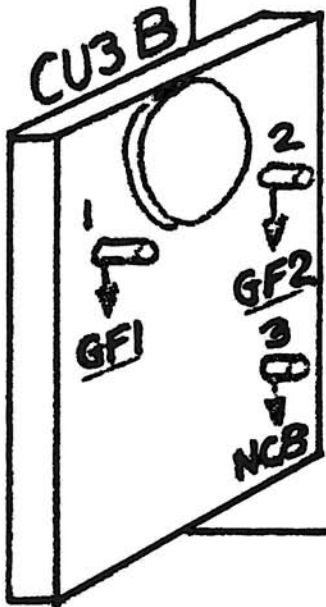
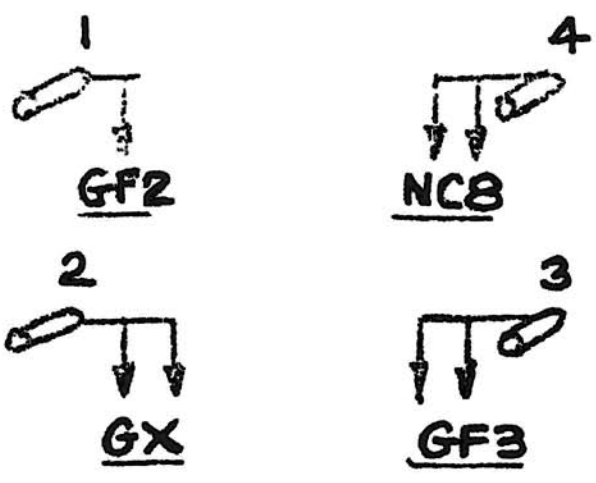
Some locos have a hole above thinman's compartment door - this can be used to pass cables through to cab and avoid door cutting cables.



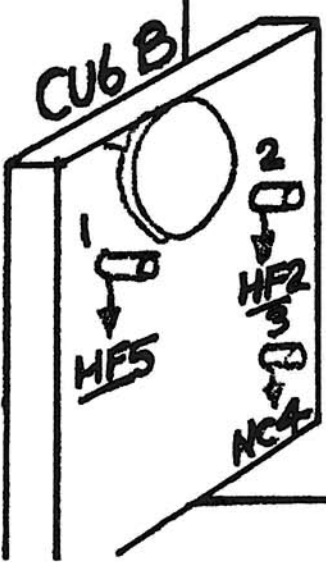
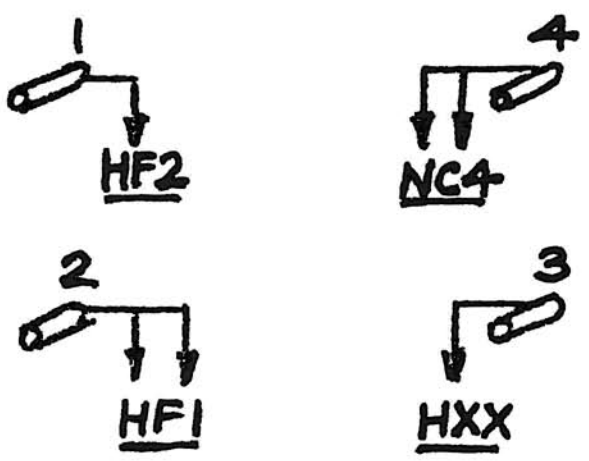
CABLE CONNECTIONS  
ONTO CU3 & CU6

1

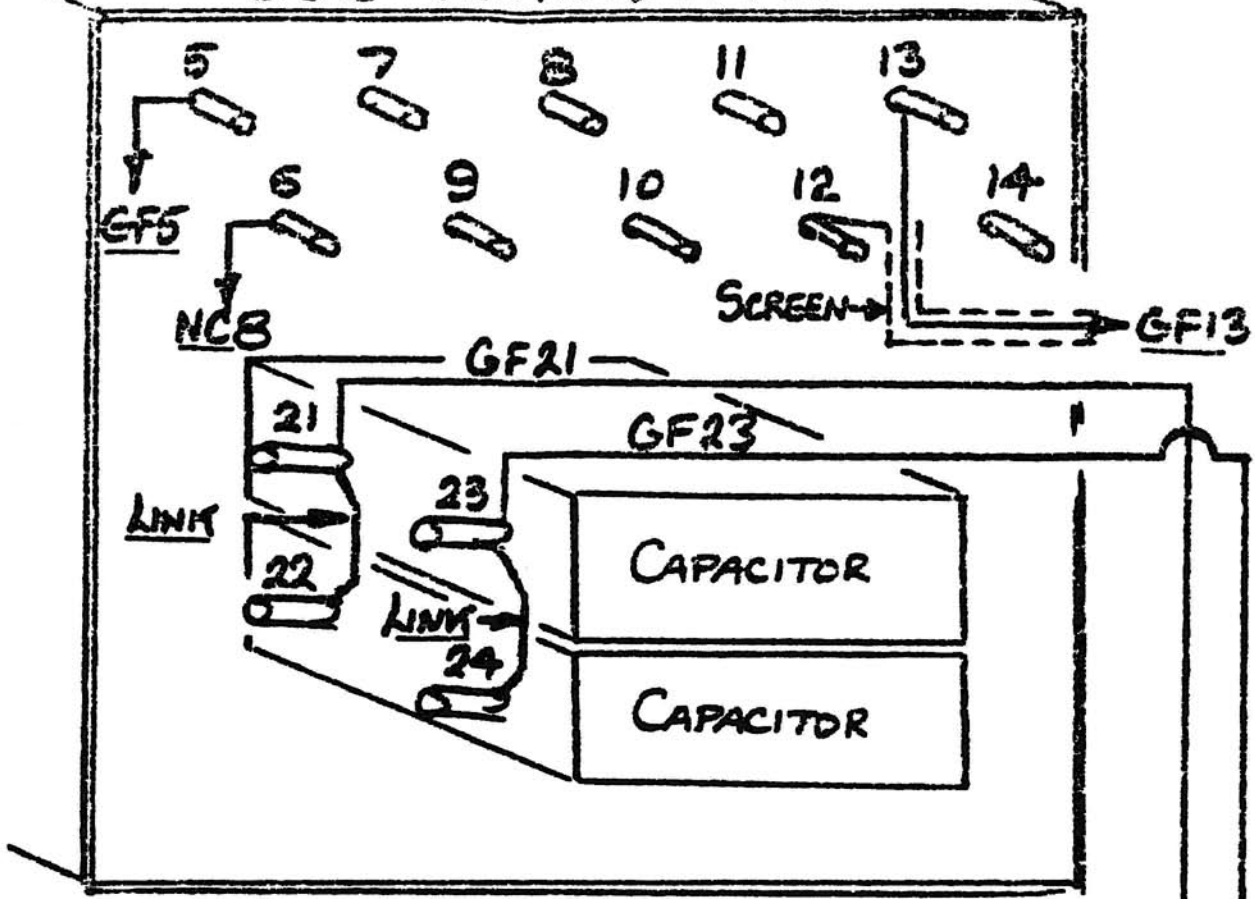
CU3 (FRONT) KVIO



CU6 (FRONT) KVIO



### CUB (BACK) KV10



### CUG (BACK) KV10

