WOSS 533/1

British Railways Board

Director of Mechanical and Electrical Engineering

ELECTRICAL ANALOGUE INSTRUMENTS

WORKSHOP OVERHAUL STANDARD SPECIFICATION

WOSS 533/1

REVISION RECORD

This Specification will be updated when necessary by the issue of amended pages accompanied by revision letters. The amended or additional part of re-issued pages will be marked with a vertical black line.

If you consider that an amendment is necessary, complete BR Form 14298 and pass it to the local BRB Resident Engineer or Area Quality Engineer. Submission of a form does not authorise the proposed amendments.

Revision No.	Re-issued Page Nos	Date	Inserted by
1		Jul 82	
2		Oct 82	
3		Jul 83	
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5	Contents	Jan 85	
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Should any query arise regarding the contents of this document telephone 0332 42442 Ext. 3516, BR Code is 056 3516, or write to the above address.

This Specification applies to equipment fitted to the vehicles indicated 'X' below, but it is only to be implemented when authorised by an appropriate maintenance/overhaul document.

LOCOMOTIVES

03	X
08	X
09	X
20	X
25	X
26	X
27	X
31	X
33	X
37	X
43	X
45	X
47	X
50	X
56	X
58	X

73	X
81	X
85	X
86	X
87	X
88	X
89	X
91	

DMU's

101	X
104	X
107	X
108	X
110	X
111	X
114	X
115	X
116	X
117	X
119	X
121	X
122	X
123	X
140	X
141	X
142	X
143	X
150	X
151	X
210	X

EMU's

302	X
303	X
304	X
305	X
307	X
308	X
309	X
310	X
311	X
312	X
313	X
314	X
315	X
317	X
318	X
319	X
504	X
507	X
508	X

411	X
412	X
413	X
414	X
415	X
416	X
419	X
421	X
422	X
423	X
432	X
455	X
485	
486	
487	X
488	
489	X
491	X

DEMU's

201	X
202	X
203	X
204	X
205	X
207	X

COACHING STOCK

Mk 1	
Mk 2, 2a-c	
Mk 2d-e	
Mk 2f	
Mk 2 DBSO	X
Mk 3a	
Mk 3b	
Mk 3 (HST)	
Mk 3 SLE and SLEP	
Non Passenger	

WORKSHOP OVERHAUL STANDARD SPECIFICATION 533/1

ELECTRICAL ANALOGUE INSTRUMENTS

CONTENTS

REFERENCE DOCUMENTS

CEPS 1034 'Refurbishing of Drivers Instruments'

SPL 192 'Pressure Gauges Drivers Panel Layouts Rationalised Range'

TOOLS AND MATERIALS

Paint:	
Matt black lettering	BR Cat No 28/44520
White lettering	BR Cat No 28/44500
Signal red BS 381C no.537	BR Cat No 28/44210
Golden yellow BS 381C no.357	BR Cat No 28/44260
Grass green BS 381C no.218	BR Cat No 28/44240
Anti Static Cleaning Fluid	RS Components Cat No. 554-967
Paraffin Wax	BR Cat No. 7/75925
Shellac	BR Cat No. 28/76760
Solvent SBP11	BR Cat No. 7/68268
PVC Adhesive tape, black	BR Cat No. 55/121230
Watch Oil 'Superfine'	SWCS* Cat No. 940502
Pith Stick	SWCS* Cat No. 924000

*Southern Watch & Clock Supplies
48-56 High Street
Orpington
BR6 0JH

SECTION 1 REPAIR PROCEDURE

1. Discard any speedometer with an 80° arc scale.

2. Clean the instrument externally with soapy water.

3. Remove the instrument case.

4. Renew the glass if it is in any way damaged, ensuring that all old glazing compound is removed before re-glazing. Toughened glass is to be fitted to driver's desk instruments.

5. Clean the inside of the case with anti-static cleaning fluid.

6. Disconnect the movement and remove from the base.

7. Renew the base if it is damaged. Examine any shunt, compensating resistors and associated wiring for security of connections and signs of overheating. Renew any overheated resistors or wiring. Check that terminals and earth connections are serviceable and identified. In the case of 'Betalight' instruments ensure that the radiation (trefoil) symbol is attached.

8. Unsolder the hairsprings from their outer posts.

9. Remove front and rear brackets.

10. Examine the pivots. Renew the pivots if there is any detectable wear.

11. Renew jewels if their associated pivots have been renewed. Clean jewels to be reused in a solvent bath and examine for cracks. Check that the jewels move freely against their housing springs. Renew if stiff.

12. Lubricate the jewels with watch oil.

13. Remove any dirt from the annular space between the magnet yoke and inner pole with masking tape or, if badly contaminated, clean with solvent.

14. Check that the pointer is straight and that its Betalight strip (if fitted) is not broken and is securely fixed. Repaint if required.

15. Where appropriate, refurbish the dial in accordance with CEPS 1034.

16. Clean the dial and examine the scale. Retouch calibrations with matt paint if they have become indistinct. Refer to Section 3 for any specified painting instructions. Ensure that 'Betalight' strips (if fitted) are not broken and are firmly secured. Erase any red maximum speed line (except shunters).

17. Clean the hairsprings with solvent. Resolder the springs to their posts, ensuring that the coils are flat and do not overlap each other. Renew any springs which are distorted.

1.19 Ensure that the movement runs freely and adjust the jewels to give maximum freedom of rotation with minimum longitudinal movement of the pivots. The movement should be suspended centrally around the inner pole and the pointer clear of the dial.

1.20 Zero the pointer using the front bracket zeroing adjuster and ensure that the pointer retains this position with the movement held at various positions about its horizontal axis. Adjust the balancing weights as required, and lock in position with shellac.

1.21 Refit the movement to the base and check that any zeroing mechanism is properly aligned. Reconnect the cables.

1.22 Class 20, 26 (Crompton types), 37 and 40 Main Ammeters.

In order to increase the earth clearance, ensure that the following modifications have been carried out.

1.22.1 Class 20, 37 and 40: the dial has been changed for a non-conductive type in accordance with CEPS 1034.

1.22.2 Class 37 and 40: the zero adjustment arm has been cut off to about half of its original length.

1.22.3 Class 26 (Crompton types): the calibration board has been repositioned and a piece of 0.015" Nomex (BR Cat. No. 55/16844) is inserted. See Figures 1 and 2.

1.23 Set the pointer stops to prevent the movement from jamming past the extreme deflection positions.

1.24 Examine the case seal and renew if distorted. Temporarily refit the case.

1.25 Test the instrument in accordance with Section 2.

1.26 Refit case and seal the head of any security screw with wax or sealing compound. Seal the case/base joint with PVC tape.

1.27 Megger test as follows :

Speedometers and tachometers	-	500 V
All other instruments	-	1000 V

Minimum acceptable reading 20 M ohms.

1.28 Pack the instrument in a polythene bag.

Section 2 - Test Specification

1. Testing

Equipment: variable stabilised power supply. Voltmeter or ammeter as required, digital readout.

1.1 Connect the instrument to the power supply and meter. Refer to Data Section for any specific instructions. When testing ammeters, ensure that leads of the correct ohmic value are fitted as specified on the instrument label.

1.2 Raise the supply voltage slowly to the f.s.d. value specified in the Data Section and check that the pointer moves freely over the full scale range. If there is any tendency for the movement to stick, the instrument must be checked for dirt or bearing defects.

1.3 Check the instrument readings at a minimum of four intermediate scale positions, allowing the tolerance stated in the Data Section.

1.4 In the case of centre zero instruments, reverse the polarity and repeat the test for the other half of the scale.

1.5 Discrepancy in the full scale reading is to be corrected by adjustment of the shunt plate (if fitted) or by recalibrating the instrument as per Section 2. Discrepancies in intermediate readings may be corrected by adjustment of the movement compensating weights.

1.6 If low readings are experienced on instruments fitted with internal rectifiers (e.g. speedometer indicators) the polarity should be reversed and the instrument rechecked. Renew the rectifier if the forward and reversed polarity calibrations are discrepant.

2. Recalibration

2.1 Remove calibration resistor and connect a decade box across its terminals, set to the resistor value. Set the shunt plate (if fitted) to its mid position.

2.2 Raise supply voltage to full scale value and adjust decade box to give the correct reading.

2.3 If correct calibration cannot be achieved by this adjustment, the moving coil must be tested for short or open circuits. If the coil is correct the frame will require remagnetising.

2.4 Replace decade box with a fixed resistance, 2% tolerance, high stability resistor of the value indicated by the decade box setting.

2.5 Repeat the test procedure.

SECTION 3 TECHNICAL DATA

Index

Class	Speedometers		Ammeters		Fuel Gauge	Notch Ind	Engine Speed Ind
	Main	Slow	Main	Battery			
08	2	–	23	40	–	–	–
20	4,5	3	24	41	–	–	–
25	6	–	25	42	–	–	–
26	1,7	8	26	43	–	–	–
27	9	–	27	44	–	–	–
31	6	–	28	45	–	–	–
33/0	1	–	29	43	–	–	–
33/1	1	–	29	43	–	–	–
33/2	7	8	29	43	–	–	–
37	10,11	–	25,30	46	48	–	–
43	12	–	31	42	–	–	–
45	13	–	32	42	–	–	–
47	6,7	8	33,34	42,47	–	–	–
50	14	–	35	46	–	–	–
56	16	15	36	42	–	–	–
58	16	15	37	42	–	–	–
73	1	–	38	46	–	–	–
81	17	–	24	–	–	51	–
85	17	–	24	–	–	51	–
86/0	17	–	56	–	–	52,53,54	–
86/1	18	–	56	–	–	54	–
86/2,3	17	–	56	–	–	52,53,54	–
87	18	–	56	–	–	54	–
101-140	1	–	–	–	–	–	49,50
141	37	–	–	–	–	–	–
201-207	1	–	39	–	–	–	–
210	19	–	–	–	–	–	–
302-303	1	–	–	–	–	–	–
304	20	–	–	–	–	–	–
305-309	1	–	–	–	–	–	–
310	20	–	–	–	–	–	–
311	1	–	–	–	–	–	–
312	6,20	–	–	–	–	–	–
313	21	–	–	–	–	–	–
314-315	22	–	–	–	–	–	–
317	14	–	–	–	–	–	–
411-414	1	–	–	–	–	–	–
415-416	55	–	–	–	–	–	–
419-437	1	–	–	–	–	–	–
455	22	–	–	–	–	–	–
487	1	–	–	–	–	–	–
489	1	–	–	–	–	–	–
501	1	–	–	–	–	–	–
504	20	–	–	–	–	–	–
507	21	–	–	–	–	–	–
508	22	–	–	–	–	–	–
DBS0	14	–	–	–	–	–	–

1. Class 26, 33/0, 33/1, 73, 101-141, 201-207, 302, 303, 305-309, 311, 411, 412, 414, 419, 421, 422, 423, 432, 437, 487, 489, 501 — Smith-Stone Type Speedometers

All instruments have the same sensitivity and differ only in the full scale reading, as follows.

Class	Scale Reading	Tolerance
487	0-50	± 0.5 mile/h
101-141 201-207 Driver Trailers 303 311 501	0-75	± 0.75 mile/h
26 33/0 33/1	0-90	± 1 mile/h
73 302 305-308 421-423 432 437	0-100	± 1 mile/h
201-207 Driver Motors* 309 411* 412* 413* 414* 419* 489*	0-120	± 1.2 mile/h

*Originally calibrated for 0-200 km/h and fitted with a conversion label.

Use the appropriate part of the following table for calibration.

Input Vac.	0	3.25	6.5	9.75	13	16.25	19.5	26	32.5	39
Scale Reading	0	10	20	30	40	50	60	80	100	120

2. Class 08 — 0-20 Speedometer

Input revs/min	0	6.4	12.8	19.2	27.2	32	64	96	128
Scale Reading	0	1	2	3	4	5	10	15	20

Tolerance on scale readings ±0.2 mile/h

Maximum speed sector in red between 15 and 20 mile/h.

3. Class 20 — 0-3 Speedometer

Input mA d.c.	0	2	4	6
Scale Reading	0	1	2	3

Tolerance on scale readings ±0.05 mile/h

4. Class 20 001-127 — 0-90 Speedometer or 0-100 Speedometer

Input Vac	0	3.33	6.66	13.33	20	26.66	30	33.33
Scale Reading	0	10	20	40	60	80	90	100

Tolerance on scale readings ±1 mile/h

5. Class 20 128-228 — 0-120 Speedometer

Input mA a.c.	0	1	2	3	4	5	6
Scale Reading	0	20	40	60	80	100	120

Tolerance on scale readings ±1.5 mile/h

6. Class 25, 31, 47. 312/0, 312/1 — 0-100 Speedometer

Input V a.c.	0	7.8	15.6	31.2	46.8	62.4	78
Scale Reading	0	10	20	40	60	80	100

Tolerance on scale readings ±1 mile/h.

7. Class 26, 33/2, 47 — 0-100 Speedometer

(locos fitted with slow speed equipment)

Input mA d.c.	0	0.5	1	2	3	4	5
Scale Reading	0	10	20	40	60	80	100

Tolerance on scale readings ±1 mile/h.

8. Class 26, 33/2, 47 — 0-3 Speedometer

Input mA d.c.	0	0.33	0.66	1
Scale Reading	0	1	2	3

Tolerance on scale readings ±0.05 mile/h.

9. Class 27 — 0-100 Speedometer

Input Vac	0	6.66	13.33	19.99	26.66	33.33
Scale Reading	0	20	40	60	80	100

Tolerance on scale readings ±1 mile/h.

Do not fit Smith's and Venture instruments to the same locomotive.

10. Class 37 — 0-120 Speedometer

Input mA a.c.	0	2.22	4.44	8.88	13.3	17.7	22.2	26.6
Scale Reading	0	10	20	40	60	80	100	120

Tolerance on scale readings ±1.5 mile/h.

11. Class 37 — 0-120 Speedometer

Input V a.c.	0	4.8	9.5	13.7	18.2	22.6	27.2
Scale Reading	0	20	40	60	80	100	120

Tolerance on scale readings ±1.5 mile/h.

11. Class 37 — 0-120 Speedometer

Input V a.c.	0	4.8	9.5	13.7	18.2	22.6	27.2
Scale Reading	0	20	40	60	80	100	120

Tolerance on scale readings ± 1.5 mile/h.

12. Class 45, 46 — 0-100 Speedometer

Input mA a.c.	0	4.45	8.9	13.35	17.8	22.25
Scale Reading	0	20	40	60	80	100

Tolerance on scale readings ± 1 mile/h

Maximum speed line in red at 90 mile/h.

13. Class 37, 50, 73 — 150-0-150 Battery Charge Ammeter

Input mV d.c.	1125	75	66.7	0	66.7	75	112.5
Scale Reading	150	100	50	0	50	100	150

Tolerance on scale readings ± 10A.

14. Class 26, — 0-3000 Ammeter

Input mV d.c.	0	37.5	50	75	87.5	100
Scale Reading	0	1000	1500	2000	2500	3000

Tolerance on scale readings ± 50A

Class 40 maximum current line in red at 2600 A.

15. Class 37, 40 — 0-120 Speedometer

Input mA a.c.	0	222	4.44	8.88	13.3	17.7	22.2	26.6
Scale Reading	0	10	20	40	60	80	100	120

Tolerance on scale readings ± 1.5 mile/h.

16. Class 20 001-127 — 0-90 Speedometer

Input Vac	0	3.33	6.66	13.33	20	26.66	30
Scale Reading	0	10	20	40	60	80	90

Tolerance on scale readings ± 1 mile/h.

Maximum speed line in red at 75 mile/h.

17. Class 20 128 + — 0-120 Speedometer

Input mA a.c.	0	1	2	3	4	5	6
Scale Reading	0	20	40	60	80	100	120

Tolerance on scale readings ± 1.5 mile/h

Maximum speed line in red at 75 mile/h.

18. Class 27 — 0-100 Speedometer

Input Vac	0	6.66	13.33	19.99	26.66	33.33
Scale Reading	0	20	40	60	80	100

Tolerance on scale readings ± 1 mile/h.

Maximum speed line in red at 90 mile/h.

Do not fit Smith's and Venture instruments to the same locomotive.

19. Class 27 — 150-0-150 Battery Charge Ammeter

Input mV d.c.	75	50	25	0	25	50	75
Scale Reading	150	100	50	0	50	100	150

Tolerance on scale readings ± 10A.

20 Class 47 — 250-0-250 Battery Charge Ammeter

Input mV d.c.	125	100	75	50	25	0	25	50	75	100	125
Scale Reading	250	200	150	100	50	0	50	100	150	200	250

Tolerance on scale readings ± 10A.

20. Class 304, 310, 312/2, 504 — 0-80 Speedometer

Input V a.c.	0	7.8	15.6	31.2	46.8	62.4
Scale Reading	0	10	20	40	60	80

Tolerance on scale readings ±1.0 mile/h.

21. Class 313, 507 — 0-90 Speedometer

Input mA d.c.	0	1.0	2.0	3.0	4.0	4.5
Scale Reading	0	20	40	60	80	90

Tolerance on scale reading ±1 mile/h.

22. Class 314, 315, 455, 508, — 0-100 Speedometer

Input mA d.c.	0	1.0	2.0	3.0	4.0	5.0
Scale Reading	0	20	40	60	80	100

Tolerance on scale readings ±1 mile/h

23. Class 08 — 0-1000 Ammeter

Input mV d.c.	0	37.5	75	112.5	150	187.5
Scale Reading	0	200	400	600	800	1000

Tolerance on scale readings ±20A

Maximum current line in red at 8000A.

24. Class 20 — 0-2000 Ammeter

Input mV d.c.	0	25	50	75	100
Scale Reading	0	500	1000	1500	2000

Tolerance on scale readings ±50A.

Max. amps line in red at 1800A.

25. Class 25, 37120-37308 — 0-3000 Ammeter

Input mV d.c.	0	18.75	37.5	56.25	75	93.75	112.51
Scale Reading	0	500	1000	1500	2000	2500	3000

Tolerance on scale readings ±50A.

Class 37 maximum current line in red at 2500A.

26. Class 26 — 0-3000 Ammeter

Input mV d.c.	0	37.5	50	75	87.5	100
Scale Reading	0	1000	1500	2000	2500	3000

Tolerance on scale readings ±50A.

27. Class 27 — 0-3500 Ammeter

Input mV d.c.	0	25	50	75	87.5
Scale Reading	0	1000	2000	3000	3500

Tolerance on scale readings ±50A.

28. Class 31 — 0-2500 Ammeter

Input mV d.c.	0	50	100	150	200	250
Scale Reading	0	500	1000	1500	2000	2500

Tolerance on scale readings ±50A.

Maximum current line in red at 2000A.

29. Class 33 — 0-3000 Ammeter

Input mV d.c.	0	25	50	75	100	125	150
Scale Reading	0	500	1000	1500	2000	2500	3000

Tolerance on scale readings +20A.

30. Class 37/001-119 — 0-3000 Ammeter

Input mV d.c.	0	20.8	41.6	62.5	83.3	104.2	125
Scale Reading	0	500	1000	1500	2000	2500	3000

Tolerance on scale readings ±50A.

Maximum current line in red at 2500A.

31. Class 43 — 0-2000 Main Ammeter

Input mA d.c.	1.5	3.0	4.5	6.0
Scale Reading	500	1000	1500	2000

Tolerance on scale readings ±50A.

32. Class 45 — 0-4500 Main Ammeter

Input mV d.c.	0	16.6	33.3	50	66.6
Scale Reading	0	500	1000	1500	2000

Input mV d.c.	83.3	100	116.6	113.3	150
Scale Reading	2500	3000	3500	4000	4500

Tolerance on scale readings ±50A.

33. Class 47 (all parallel) — 0-10000 Ammeter

Input mV d.c.	0	30	60	90	120	150
Scale Reading	0	2000	4000	6000	8000	10000

Tolerance on scale readings ±100A.

34 Class 47 (series/parallel) — 0-5000 Ammeter

Input mV d.c.	0	30	60	90	120	150
Scale Reading	0	1000	2000	3000	4000	5000

Tolerance on scale readings ± 50 A.

35. Class 50 — 0-3000 Ammeter

Input mA d.c.	0	1.66	2.5	3.33	5
Scale Reading	0	1000	1500	2000	3000

Tolerance on scale readings ±30A.

Maximum current line in red at 2400A.

36. Class 56, 58 — 0-5000 Ammeter

Input A a.c.	0	0.304	0.608	0.912	1.216	1.52
Scale Reading	0	1000	2000	3000	4000	5000

Tolerance on scale readings ±50A.

37. Class 141 — 0-90 Speedometer

Input mA d.c.	0	0.22	0.44	0.66	0.88	1.0
Scale Reading	0	20	40	60	80	90

Tolerance on scale readings ±1 mile/h.

38. Class 73 — 0-2000 Ammeter

Input mV d.c.	0	37.5	75	112.5	150
Scale Reading	0	500	1000	1500	2000

Tolerance on scale readings ±50A.

39. Class 201-207 — 0-1500 Main Ammeter

Input mV d.c.	0	46.9	93.7	140.6
Scale Reading	0	500	1000	1500

Tolerance on scale readings ±50A.

42. Class 31 — 0-2500 Ammeter

Input mV d.c.	0	50	100	150	200	250
Scale Reading	0	500	1000	1500	2000	2500

Tolerance on scale readings ± 50A.

Maximum current line in red at 2000A.

43 Class 31 — 150-0-150 Battery Charge Ammeter

Input mV d.c.	150	100	50	0	50	100	150
Scale Reading	150	100	50	0	50	100	150

Tolerance on scale readings ± 20A.

44. Class 81, 82, 83, 85, 86/1, 87 — 0-Weak Field Notch Indicator

Input V a.c.	0	12.1	24.2	36.4	48.5	60.6	72.7
Scale Reading	0	20%	40%	60%	80%	100%	Weak Field

Tolerance on scale readings ± 5%.

45. Class 86/0, 86/2, 86/3. — 0-100% Notch Indicator

Input V a.c.	0	20	40	60	80	100
Scale Reading	0	20%	40%	60%	80%	100%

Tolerance on scale readings ± 5%.

46. Class 26, 33 — 300-0-300 Battery Charge Ammeter

Input mV d.c.	75	50	25	0	25	50	75
Scale Reading	300	200	100	0	100	200	300

Tolerance on scale readings ± 10A.

47. DEMU — 0-1500 Main Ammeter

Input mV d.c.	0	46.9	93.7	140.6
Scale Reading	0	500	1000	1500

Tolerance on scale readings ± 50A.

48. Class 33 — 0-300 Ammeter

Input mV d.c.	0	25	50	75	100	125	150
Scale Reading	0	50	100	150	200	250	300

Tolerance on scale readings +20A.

49. Class 314,315,508,510 — 0-100 Speedometer

Input mA d.c.	0	1.0	2.0	3.0	4.0	5.0
Scale Reading	0	20	40	60	80	100

Tolerance on scale readings ± 1 mile/h

Maximum speed line at 75 mile/h

50. Class 73 — 0-2000 Main Ammeter

Input mV d.c.	0	37.5	75	112.5	150
Scale Reading	0	500	1000	1500	2000

Tolerance on scale readings ± 50A.

51. Class 56,58 — 0-100 mile/h Speedometer

Input mA a.c.	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Scale Reading	0	10	20	30	40	50	60	70	80

Input mA a.c.	4.5	5.0
Scale Reading	90	100

Tolerance on scale readings ± 1 mile/h

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50. Class 110-111, 114-115, 128 — 0-2000 r/min Indicator

Scale Reading	400	600	800	1000	Down
Input V a.c.	8.3	13.0	17.0	22.5	24.7

Scale Reading	1200	1400	1600	Up	2000
Input V a.c.	26.9	32.0	37.2	43.0	46.5

Generator type M6. Tolerance on scale readings ±20 r/min.

51. Class 81, 85 — 0-Weak Field Notch Indicator

Input Vac	0	14.5	29.1	43.6	58.2	72.7	110
Scale Reading	0	20%	40%	60%	80%	100%	Weak Field

Tolerance on scale readings ±5%

52. Class 86/0, 86/2, 86/3 (Non-Multiple) — 0-100% Notch Indicator

Input V a.c.	0	20	40	60	80	100
Scale Reading	0	20%	40%	60%	80%	100%

Tolerance on scale readings ±5%.

53. Class 86/0, 86/3 (Multiple) Leading Loco — 0-100% Notch Indicator

Input Vac	0	12	24	36	48	60**	
Scale Reading	0	20%	40%	60%	80%	100%	*

Tolerance on scale readings ±5%.

*F.S.D. is not used.

** Input must be at 3 mA at 100% scale reading

54. Class 86/0, 86/3 (Multiple) Trailing Loco
Class 86/1,
Class 87 Leading & Trailing Loco

0-Weak Field Notch Indicator

Input Vac	0	16	32	48	64	80	110**	150
Scale Reading	0	20%	40%	60%	80%	100%	Weak Field	*

Tolerance on scale readings ±5%.

*FSD not used.

** Input must be at 5 mA at weak field scale reading.

55. Class 415, 416

0-120 Speedometer

Input Vac	0	5.75	11.5	17.25	23	28.75	34.5
Scale Reading	0	20	40	60	80	100	120

Tolerance on scale readings ±1.2 mile/h.

56. Class 81, 85, 86, 87

0-2000 Ammeter

Input mV d.c.	0	25	50	75	100
Scale Reading	0	500	1000	1500	2000

Tolerance on scale readings ±50A.

Scale backgrounds are coloured as follows.

Colour	Sector		
	Cl 85	Cl 86	Cl 87
Green	0-720A	0-720A	0-885A
Yellow	720-1500A	720-1370A	885-1675A
Red	1500-2000A	1370-2000A	1675-2000A
Instrument BR Cat	90/280	90/305	90/6319

SECTION 4 ADDITIONAL PROCEDURES

AP1. Class 47 Speedometer Modification

MATERIALS	BR Cat. No.
Tufnol 1.6mm	55/118307
Turret Tags, 2 off,Cambion 160-1724-2-05	26/143982
Fixing tool, type Z.9018-00	26/143986.
Resistor, 220k ± 1% 0.5 W	26/151900
Cable 19/0.15 mm	6/112010

1.1 Remove the two 4BA nuts and small washers (3.1). Discard the two large flat washers (3.2). Retain the insulating washers on the studs.

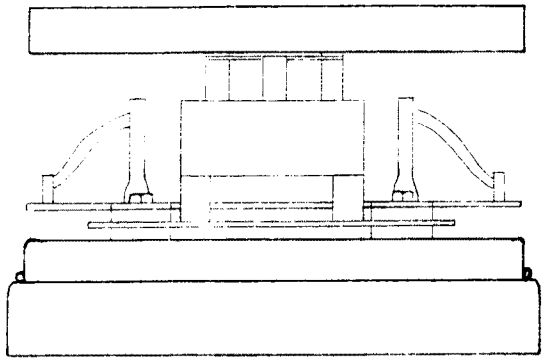
1.2 Manufacture the mounting board (3.7) in accordance with Figure 3.

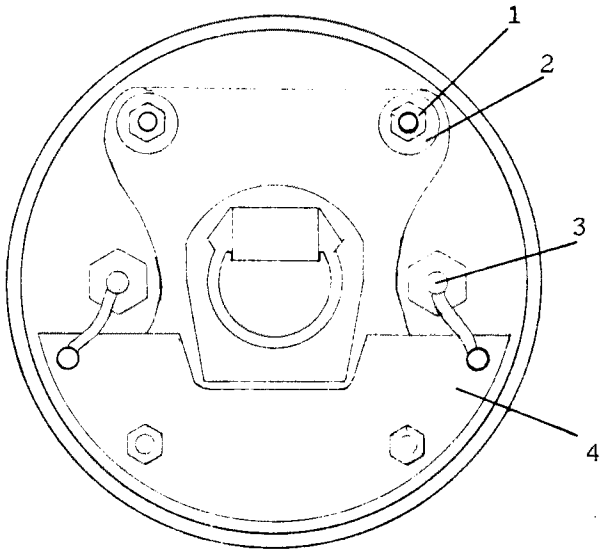
1.3 Fit the component mounting tags (3.6) to the mounting board.

1.4 Fit and solder the 20k resistor (3.5) to the mounting tags (3.6).

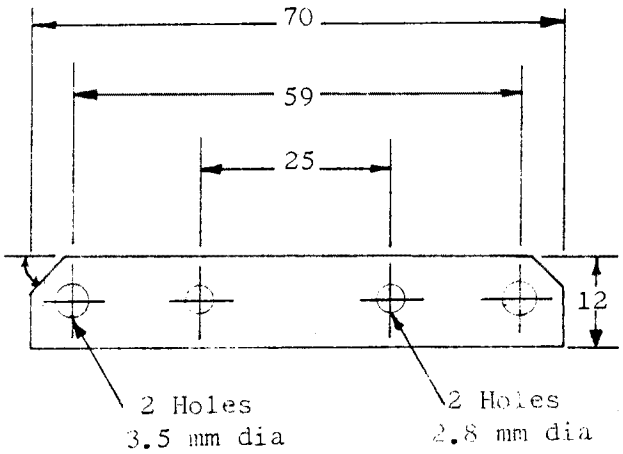
1.5 Fit the mounting board to the fixing studs and secure with the two 4BA nuts and the small flat washers.

1.6 Cut two appropriate lengths of cable, strip and solder the cable to the terminal posts (3.3) and the mounting tags (3.6).

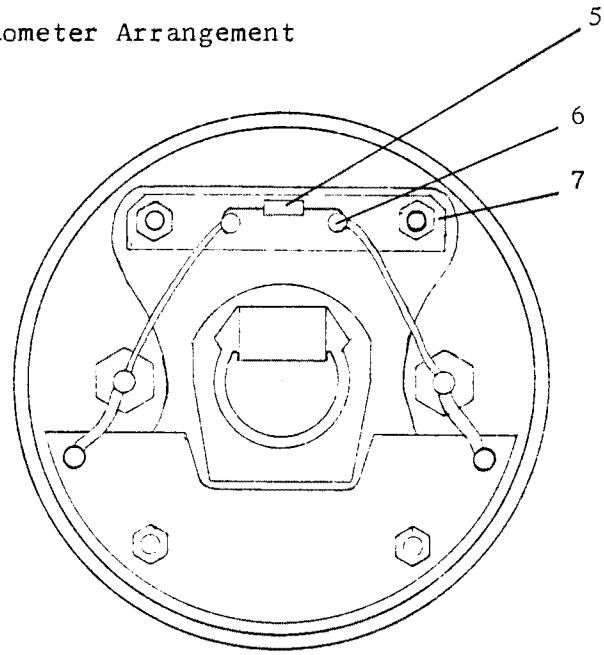




Original Speedometer Arrangement



Mounting Board Details



Modified Speedometer Arrangement

Items List

1. Nut 4BA.
2. Large flat washer.
3. Terminal post.
4. Calibration board.
5. Resistor.
6. Component mounting tag.
7. Mounting board.

Figure 3 Speedometer Modification Details