MODEL S.196 FORM 1

REVISION RECORD SHEET

Revision No.	Date of Issue	Incorporated by:	Date	Remarks
1	Jan. 1965	Sangamo Weston Ltd.	Jan. 1965	Revision page 32 and Parts List page 36
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6	FEB 70	D.M.T.	SEPT 70	1/2 ~~3/4~~ 3/6 ; 21/22 ; 33
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OVERHAUL MANUAL

MODEL S.196 FORM 1 - INDICATOR TEMPERATURE

TABLE OF CONTENTS

ILLUSTRATIONS

MODEL S.196 FORM 1 - INDICATOR TEMPERATURE

The overhaul procedure contained in this manual is applicable, in general, to all S.196 Form 1 indicators. Occasionally reference is made in the text to the addendum which contains information relevant to a particular application of the indicator; the addenda will be found immediately following the main part of the manual.

1. Description and operation

A. General

Model S.196 Form 1 temperature indicator is housed in a 2 in. diameter case which is flangeless and sealed. The indicator is designed for use with an external nickel-chromium/nickel-aluminium thermocouple and is, basically a d.c. millivoltmeter. The movement is of the permanent magnet, moving coil type and is fitted with a bimetal coil which provides "cold end" compensation. Compensation for circuit resistance changes, produced by variations in ambient temperature, is effected by a thermistor connected in the indicator circuit.

B. Detail (Refer to Fig.1 and 2)

(1) Pre. Mod.T indicators

The movement complete (12) comprises the moving element, supported between jewelled bearings housed in the top and bottom bridges, the pole piece and block magnet, both embraced by the yoke, and the additional bridge which carries the bimetal coil and pointer adjusting wheel.

The moving element, which swings between a gap formed by the pole piece and the core of the movement complete (12), consists of an aluminium winding upon which are mounted the pivot bases, pivots, pointer and control springs. The ends of the winding terminate at the pivot bases which are in direct contact with the control springs. The control springs have the dual function of connecting the winding to the indicator circuit and balancing the electro-magnetic torque developed when the winding is energised.

Owing to the special method of assembly, disassembly of the movement complete is not permitted.

The movement complete (12), mounted on spacers (15), is clamped against the bottom mounting plate (15A). This assembly rests on a moulded ring (18) which is designed to support the movement complete, and its mounting plate, on a rubber moulding so as to prevent the moving element from being subjected to direct vibration and shock.

All spools (24) and the thermistor (21) are secured to spool mounting plate (20).

Connections to the indicator are made to two unified thread or 4 B.A. shrouded terminals, mounted on the end plate (29). The positive terminal is made of brass and is identified by a + sign; the negative terminal is made of copper-nickel. The pointer adjuster, which engages the pointer adjusting wheel is also located on the end plate.

The indicator scale subtends an angle of 240°. The upper scale is of the platform type and is secured to the lower scale. The upper scale is marked with dividing lines and the lower with the range figures.

The flangeless case (3) is bonded to the end plate (29) by means of sealing wire (1) which is covered by solder to form a seal.

The outer end of the bimetal coil used for cold end compensation engages with the free end of one of the control springs and thus the pointer. The torque ratio of the control springs and the torque of the bimetal coil are arranged to compensate for the loss or gain of thermal e.m.f. generated by the couple formed at the point where the copper-nickel lead connection is made to the moving coil. An increase in ambient temperature increases this thermal e.m.f. which opposes the e.m.f. produced by mV input, with the result that the pointer (when no compensation is provided) indicates a figure below the true value of the external thermocouple temperature. The bimetal coil, which is affected also by the change in ambient temperature, moves to compensate for this loss and the pointer indicates the true temperature of the external thermocouple. The thermistor compensates for changes in the resistance of the indicator circuit and maintains a sensibly constant resistance over the functional temperature range of the indicator.

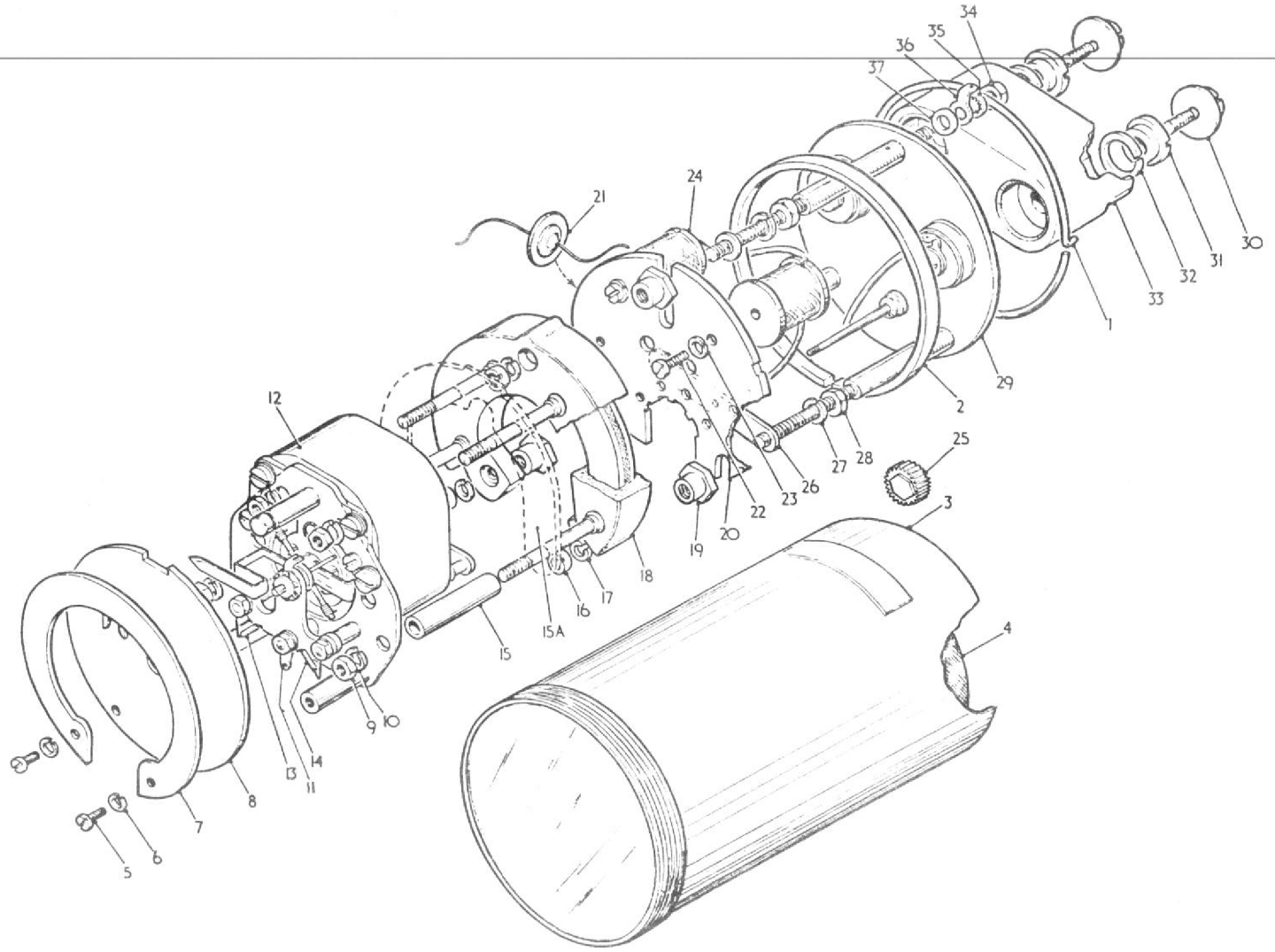

Fig. 2. S.196 Form 1 Exploded view.

A. **Procedure** (Refer to Fig. 2.)

(1) Hold the indicator firmly, grip the projecting end of the sealing wire (1) with pliers and pull it away clear of the case.

(2) Grasp the terminal block and withdraw the main assembly from the case (3) until there is sufficient clearance to prise out seating ring (2); remove case (3).

NOTE: In order to renew a spool or thermistor, it is not necessary to withdraw the spool mounting plate (20) completely. Slacken nuts (28) on the underside of the mounting plate, and then partially withdraw the plate and change the defective component.

(3) Release the two screws (5) and two 10 B.A. lockwashers (6) and remove the upper scale (7) and lower scale (8).

CAUTION: CARE MUST BE TAKEN NOT TO DAMAGE THE POINTER WHEN REMOVING THE SCALE.

(4) Unsolder the leads from the tags on the top and bottom bridges.

(5) Remove the four 6 B.A. nuts (9) and lockwashers (10) and withdraw movement complete (12) from its position on the assembly.

(6) Collect the four spacers (15) and, in the case of pre Mod.T indicators, the bottom mounting plate (15A).

(7) Remove the three 6 B.A. round nuts (16) and lockwashers (17) and withdraw moulded ring (18).

(8) Unsolder wires from terminal tags on end plate (29) and note position of wires to aid reassembly.

(9) Remove the three special 6 B.A. nuts (19) and withdraw the spool mounting plate (20).

NOTE: It is inadvisable to remove thermistor (21) or spools (24) unless a damaged mounting plate is being renewed. Refer to note following operation (2).

(10) Remove screws (22), lockwashers (23) and spools (24) as appropriate to overhaul.

(11) Collect the three 6 B.A. lockwashers (27) and remove the three 6 B.A. nuts (28).

(12) Remove the two screws and washer assemblies (30), two 0 B.A. fixing nuts (31), two lockwashers (32) and terminal shroud (33) from the end plate (29).

(5) That spools are adequately covered with insulating material and that their ohmic values are as stated in the relevant addendum.

(6) That the pointer is not damaged and aligns correctly with scale markings.

(7) With the aid of an eyeglass examine the gap in which the moving coil swings, for any obstructions. Carefully remove any particles adhering to the surface of the pole piece or core.

CAUTION: FOR THE REMOVAL OF PARTICLES USE A SHAPED PIECE OF VERY SOFT WOOD OR A PIECE OF CELLULOID. SPECIAL CARE MUST BE TAKEN NOT TO DAMAGE THE CONTROL SPRINGS.

6. Assembly

During the assembly, the threads of all screws and nuts must be coated with Bostik to SANGAMO WESTON specification B.S.104 in order to lock them against the effects of vibration. Cement jewel screws and coat all soldered connections with Red Thermolene lacquer. These materials may be obtained either from SANGAMO WESTON LTD., ENFIELD, MIDDLESEX, ENGLAND, or from the suppliers listed in sub paragraph E (**Schedule of materials**).

A. Procedure (Refer to Fig.2.)

(1) Solder the copper-nickel wire to its terminal tag (copper-nickel terminal) on the inside of the end plate (29)

CAUTION: ENSURE THAT THE ENDS OF THE COPPER-NICKEL WIRE ARE CAREFULLY SCRAPED AND TINNED BEFORE SOLDERING INTO POSITION.

(2) Place terminal shroud (33) in position and secure by means of the two lockwashers (32), nuts (31) and screw and washer assemblies (30)

(3) Fit the three 6 B.A. nuts (28) on to the spool mounting plate supports followed by the three 6 B.A. lockwashers (27).

(4) Secure spools (24) to the spool mounting plate (20) by means of the 10 B.A. lockwashers (23) and 10 B.A. screws (22). Solder all connecting wires from the spools to their appropriate connections.

(5) Solder the thermistor (21) in position.

(6) Mount the spool plate (20) on the mounting plate supports.

(7) Replace the three special 6 B.A. nuts (19), moulded ring (18), three 6 B.A. lockwashers (17) and three 6 B.A. round nuts (16). For pre-mod.T indicators replace the bottom mounting plate (15A).

NOTE: The position of the mounting plate (15A) (pre Mod.T) must now be adjusted, relative to the end plate (29) to ensure that the movement complete (12) will be correctly positioned when secured in place.

(8) Adjust special 6 B.A. nuts (19) and 6 B.A. round nuts (28) so as to give a spacing of 1.675 in. between the outside surface of the end plate (29) and the lower surface of the bottom mounting plate (15A) in the case of pre Mod.T. indicators.

In the case of post Mod.T. indicators the 6 B.A. nuts (19) and 6 B.A. round nuts (28) should be adjusted to give a spacing of 1.725 in. between the outside surface of the end plate (29) and the underside of the yoke of the movement complete (12).

(9) Adjust the three 6 B.A. nuts (28) to bring the spool mounting plate (20) firmly against the special 6 B.A. nuts (19).

(10) Position the four spacers (15) on to the pillars of the moulded ring (18).

C. **Pre-sealing procedure**

(1) Check that the case (3) interior, which will be in contact with the sealing wire (1) is free from excess solder, and carefully insert the indicator into its case.

(2) Withdraw the indicator approximately 0.5 in. from its case and place the complete assembly in an oven to "dry out " for 8 hours at a temperature of 60°C.

D. **Case to end plate sealing procedure**

The indicator must be sealed immediately on removal from the drying oven. If this is not possible the indicator must be kept in a dry atmosphere. Failure to do this will necessitate re-drying as specified in the pre-sealing procedure given in sub-paragraph C.

(1) Place the indicator inside the case (3) with the end plate (29) resting on the seating ring (2).

(2) Fit the sealing wire (1) into the gap between the end plate (29) and case (3); the sealing wire must fit into the gap leaving no spaces.

(3) Solder the sealing wire into position and ensure that the end plate is completely sealed to the case.

The wire must overlap at the split and must not be embodied in solder at this junction.

The finished seal must be made to allow the sealing wire (1) to be prised out of position if necessary. The soldered join must be flat and level with the end plate (29).

CAUTION: USE A LARGE SOLDERING IRON TO OBTAIN A SMOOTH FLOW OF SOLDER AND COMPLETE THE OPERATION AS QUICKLY AS POSSIBLE TO AVOID OVERHEATING THE CASE.

The indicator must now be subjected to the sealing test given in paragraph 8 (**Testing**).

E. **Schedule of materials**

(1)	B.S.104	Bostik No.772 thinned with acetone to a brushable consistency.
(2)	Paint 165	Messrs. CANNING'S Red Thermolene Lacquer No.186.
(3)	Solder 50/50 tin lead	Messrs. DUBOIS LTD., 15, Britannia Street, London, W.C.1.

(3) Light tapping of the indicator is permitted in all tests other than the friction test. When the indicator is placed in a cabinet for tests, a small vibrator may be mounted adjacent to the indicator.

(4) All tests must be made with the scale of the indicator in the vertical plane or as stated in the relevant addendum for a particular variant.

B. Preparation

Ensure that the indicator is balanced before proceeding with the adjustments given in C.

C. Adjustments (Refer to Figs. 3 and 9)

Indicators with 25 ohms or more external resistance

The following procedure is applicable to all indicators with 25 ohms or more external resistance unless otherwise detailed in the appropriate addendum for a particular Variant.

NOTE: Spool A is not fitted in all indicators; its use is dependent upon temperature test results at initial assembly. When used, it should not be handled or subjected to heat as it is wound with copper wire.

(1) Check the resistance of the moving element. If the resistance is less than 19 ohms at 20°C, build out with Spool A, to a value of 19–21 ohms at 20°C. The value of Spool B must be as follows:

(a) When the moving element resistance is 19–21 ohms at 20°C (built out with Spool A, if necessary), Spool B must be 12 ohms ±0.12 ohm.

(b) When the moving element resistance is greater than 21 ohms (25 ohms max.) at 20°C, Spool B must be 14 ohms ±0.14 ohm.

NOTE: If the ambient temperature is other than 20°C use the chart (Fig. 4a) to obtain the value of resistance to which the indicator must be adjusted to obtain the correct value at 20°C.

(c) If Spool A has been fitted, do not disturb this spool unless the movement complete or the thermistor is being renewed. If either of these components is renewed, remove Spool A and follow the procedure given at (1) (a) and (b).

(2) Connect the thermistor in circuit across Spool B.

(3) Adjust spool C as follows.

(a) Connect a decade resistance box in series with the indicator and adjust the total circuit resistance to a nominal value of 33 ohms plus the external resistance specified in the addendum for the particular variant.

(b) Apply a millivolt input equivalent to the SET position (or initial adjustment position) given in the relevant addendum, and, by means of the pointer adjuster, set the indicator pointer to align over the cardinal for the SET position (or the initial adjustment position).

(c) Apply a millivolt input for the maximum temperature adjustment of the particular variant as given in the relevant addendum, and adjust the decade resistance box to deflect the pointer to the cardinal for this temperature (see addendum); record the resistance value of the box.

(d) Apply a millivolt input for the minimum temperature adjustment of the indicator as given in the relevant addendum, and adjust the decade resistance box to deflect the pointer to the cardinal for this temperature (see addendum); record the resistance value of the box.

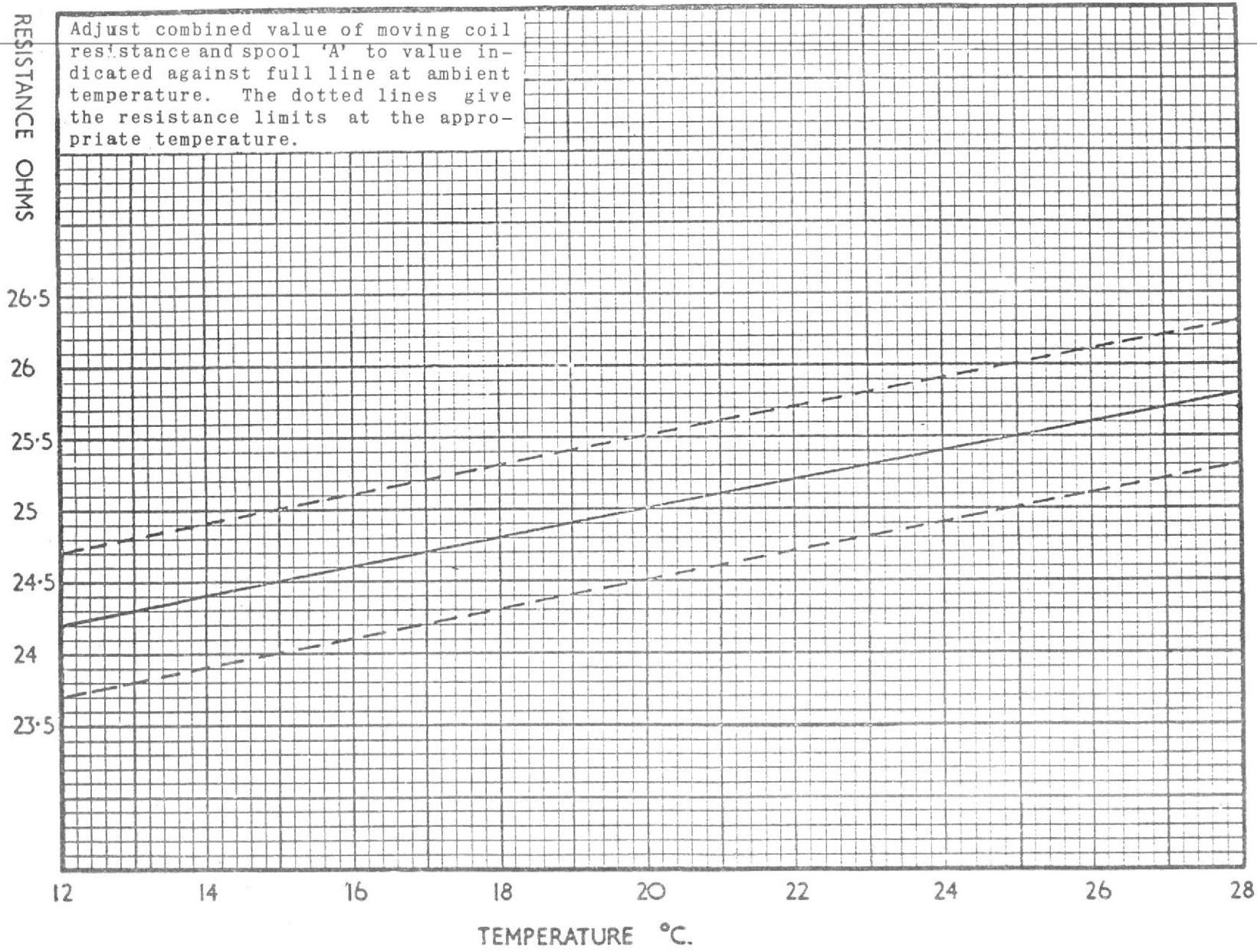

Fig.4a. Temperature resistance chart (25 ohms, or above, external resistance).

The value of spool D is determined as follows:

(e) Subtract the value recorded in operation (d) from twice the value determined in operation (c).

(f) Subtract the value of the external resistance for the particular variant (see addendum) from the value calculated at operation (e) to obtain the final value of spool D.

(g) Check the calibration of the indicator using the millivolt input values given in the addendum for the indicator being overhauled.

(8) To adjust an indicator fitted with a replacement thermistor, check the calibration of the indicator as detailed in the appropriate addendum.

If the indicator deflection is outside the limits, and the indicator is used with an external resistance of 25 ohms or more, re-adjust spool C as described in sub-paragraph C(3). If the indicator is used with an external resistance of 8 ohms re-adjust spool D as described in sub-paragraph C(7).

Apply the temperature tests detailed in sub-paragraph C(13) of this section. If the indicator does not satisfy the requirements of the temperature tests the thermistor must be renewed and this operation must be repeated.

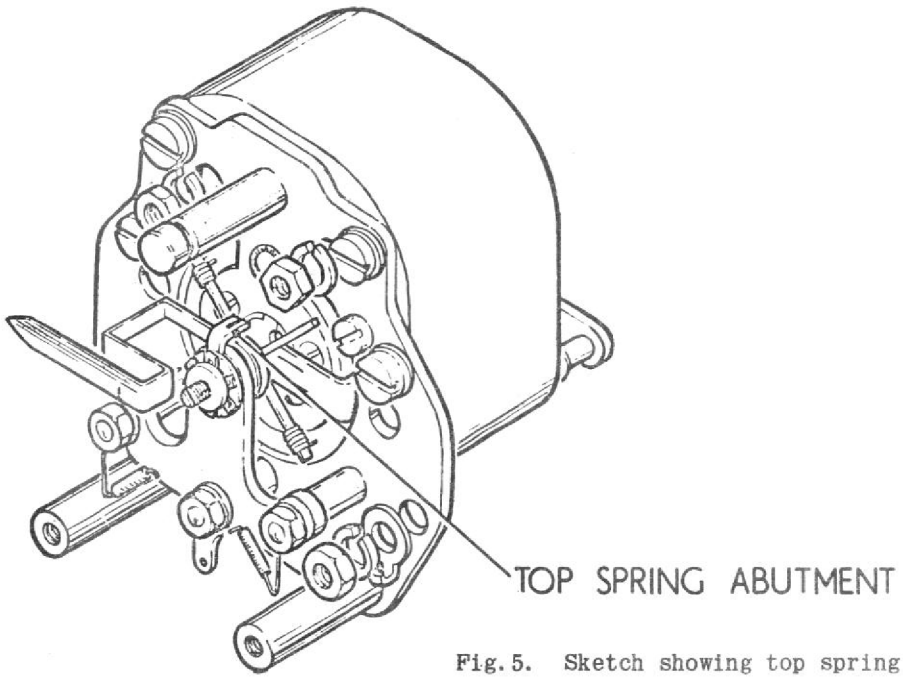

Fig. 5. Sketch showing top spring abutment.

(9) Pointer adjustment is made with the top spring abutment (Fig. 5.) positioned so that the available pointer adjustment is symmetrical about the SET cardinal. Connect the indicator into the circuit described in sub-paragraph A(2). Inject millivolts corresponding to the SET cardinal and adjust the top spring abutment to give symmetrical movement of the pointer either side of this cardinal when the pointer adjuster is manipulated.

(d) Start the vacuum pump motor and obtain the required degree of vacuum which is 0.1mm of mercury.

(e) When the correct vacuum is indicated open valve C and the manifold tap and allow the system to regain the required vacuum.

NOTE: If it is not possible to maintain the vacuum, close the manifold tap, remove the indicator and check for leakage as detailed in sub paragraphs (h) and (i). Inspect and if necessary reseal the indicator. Reconnect the indicator to the system, open the manifold tap and regain the required vacuum.

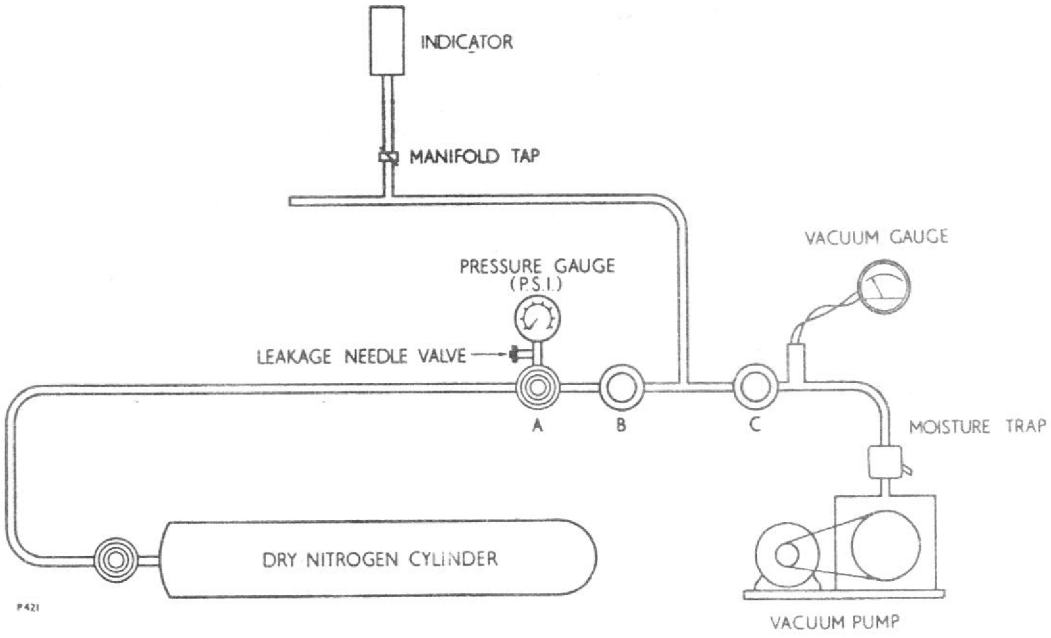

Fig. 6 Sealing test diagram

(f) Close valve C and open valve B to admit dry nitrogen into the indicator. Adjust control valve A to obtain a pressure of 15 lb per square inch gauge.

(g) After a lapse of 30 seconds, manipulate control valve A and the leakage needle valve to reduce the indicator pressure to 10 lb per square inch gauge.

(h) The indicator, still under pressure, must now be completely immersed in a tank containing 99.5% distilled water and 0.5% wetting agent.

NOTE: A suitable wetting agent is Shell Teepol 514.

(i) Shake the indicator to remove any trapped air that may be present and then check over a period of 5 minutes, for any sign of leakage.

Leakage will be shown by the presence of bubbles leaving the case.

(14) High voltage and insulation tests

(a) Apply 500 volts r.m.s. gradually between the strapped terminals of the indicator and its case for 1 minute. There must be no flashover or breakdown of insulation.

(b) The insulation resistance between the strapped terminals and the case must not be less than 20 megohms when measured after 15 seconds electrification at 500V d.c. Use a Megger test set for this test.

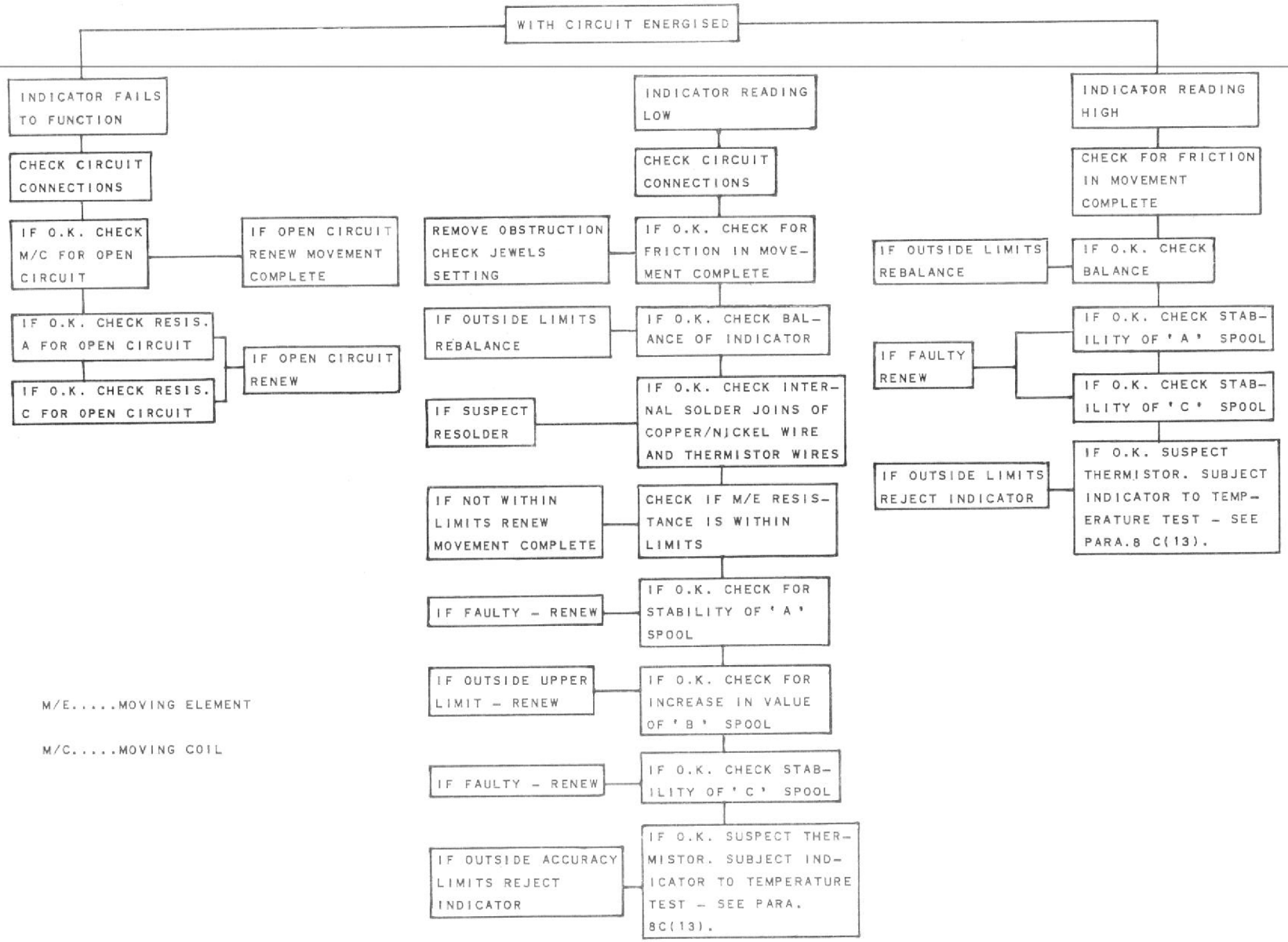

Fig.7. Trouble Shooting Chart

11. Special tools, fixtures and equipment

Item	Description	Part No. or Fixture No.
1	Suitable flask or beaker to contain melting ice	Local Supply
2	Precision grade millivoltmeter	Sangamo Weston Ltd.
3	Ohmmeter	Local Supply
4	Balance weight wrench	271157
6	Sealing test equipment	Local Supply
7	Cylinder of dry Nitrogen gas	Local Supply

13. Overhaul period 'On Condition'

NOTE: The term 'On Condition' is applicable to systems/components on which airworthiness is determined by inspections, measurements and tests, or other means specified, without extensive disassembly or removal.

Inspections or checks of the aircraft indicator are scheduled at intervals shown in the aircraft maintenance schedule which will determine the repairs, replacements and refinishing needed to maintain the required airworthiness standard.

OVERHAUL MANUAL

ADDENDUM

MODEL S. 196. 1. 17 – INDICATOR, TEMPERATURE 60/800°C

The information contained in the main section of the Overhaul manual 31-09-206 is applicable to this variant. Additional details, applicable to Model S. 196. 1. 17 only, are given in this addendum.

REVISION RECORD SHEET

Revision No.	Date of Issue	Incorporated by	Date	Remarks
1	Jan. 1965	Sangamo Weston Ltd	Jan. 1965	Parts List revised
2	Sept. 1965	Sangamo Weston Ltd	Sept. 1965	Page 3 revised
3	Nov. 1967	Sangamo Weston Ltd.	Nov. 1967	Pages 3, 4 and 5 revised.
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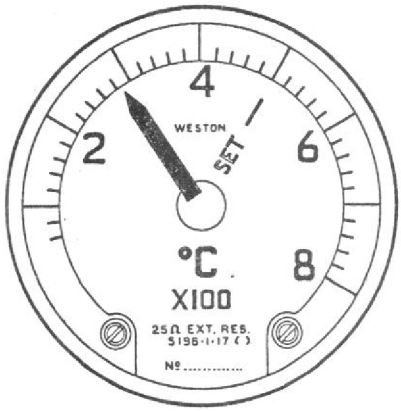
OVERHAUL MANUAL

ADDENDUM

MODEL S.196.1.17 - INDICATOR, TEMPERATURE 60/800°C



Description

Model S.196.1.17 temperature indicator has a range of 60/800°C and is designed for use with a nickel-chromium/nickel-aluminium thermocouple which is built out to an external resistance of 25 ohms.

The scale presentation is illustrated, the caption °C x 100, figures, cardinals, division lines and lance type pointer are finished photogenic white on a matt black background with the word SET and associated line finished green.

Connections to the indicator are by means of two shrouded 4 B.A. terminals on the end plate which also incorporates a pointer adjuster. The positive terminal, which is identified by a + sign, is of brass; the other terminal is of copper-nickel alloy.

Data

Resistance of moving element		18.5–25.0 ohms at 20°C
Resistance of spools		
A (if required)		1.5 ohms ±0.1 ohm
B		12.0 ohms ±0.12 ohm (if moving element resistance (with Spool A) is 19–21 ohms at 20°C)
	or	14.0 ohms ±0.14 ohm (if moving element resistance is greater than 21 ohms (25 ohms max.) at 20°C)
C		8.0 ohms +5% –0 (unadjusted)
Thermistor Type K.S.2		14.0 ohms nominal at 20°C

This list to be used with Common Parts List for Model S.196 Form 1 (Mods. J & T onwards)

VARIANT PARTS LIST

S. 196. 1. 17

	Fig. and Index No.	Nomenclature	Part No.	Units per Assy.
R	Fig. 8	Indicator, temperature 0-800°C	S. 196. 1. 17	
	5	Screw, 10 B. A.	169910	2
	6	Lockwasher, 10 B. A.	159306	2
	7	Scale & Clip Upper	168367	1
	8	Scale Blank Lower	168368	1
	12	Movement Complete (Pre Mod T)	12/S. 196. 1. 17	1
	or 12	Movement Complete (Mod T)	12/S. 196. 1. 17 (T)	1
R	or 12	Movement Complete (Mod. AC)	12/S. 196. 1. 17(AC)	1
	22	Screw, 10 B. A. x 3/16 in (Spool)	150330	3
	23	Lockwasher, 10 B. A.	153367	3
	24	Spool	24A/S. 196. 1. 17	1
			24B/S. 196. 1. 17	1
			24C/S. 196. 1. 17	1
	29	Plate, End Assembly, (4 B. A.)	174941	1
	30	Screw and Washer Assembly (4 B. A.)	157716	2

Sangamo Weston Code appears on front of Scale