# WESTON
# ELECTRICAL INSTRUMENTS
# FOR AIRCRAFT

Weston Aircraft Instruments are supplied to the Air Ministry and to leading military and civil aircraft manufacturers throughout the world.

Sangamo Weston Ltd. are Design Approved by the Ministry of Supply, and the engineers at our Works and at our Branches are always available to discuss any problems or to give any assistance which may be required in connection with these instruments. Enquiries at any of our addresses will receive immediate attention.

MODEL 3.128 FORM 5

INFORMATION CONTAINED IN THIS MANUAL AFFECTING SAFE OPERATION, MAINTENANCE AND OVERHAUL HAS BEEN VERIFIED AND APPROVED BY THE AIR REGISTRATION BOARD IN ACCORDANCE WITH CHAPTER A6-2 OF BRITISH CIVIL AIRWORTHINESS REQUIREMENTS. 29. 3. 55.

Amendments to this publication invalidate the approval statement unless issued by the manufacturers with the concurrence of the Air Registration Board.


## SANGAMO WESTON LIMITED.

Head office and Works :

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LONDON GLASGOW NEWCASTLE-on-TYNE

MANCHESTER LEEDS LIVERPOOL

WOLVERHAMPTON NOTTINGHAM BRISTOL

SOUTHAMPTON BRIGHTON

# MODEL S.128

# DUAL INDICATOR

## DESCRIPTION

Two movements, each with a scale arc of 100°, and with their pivot centres opposite and equally disposed on each side of a vertical centre line, are contained in a large S.A.E. case.

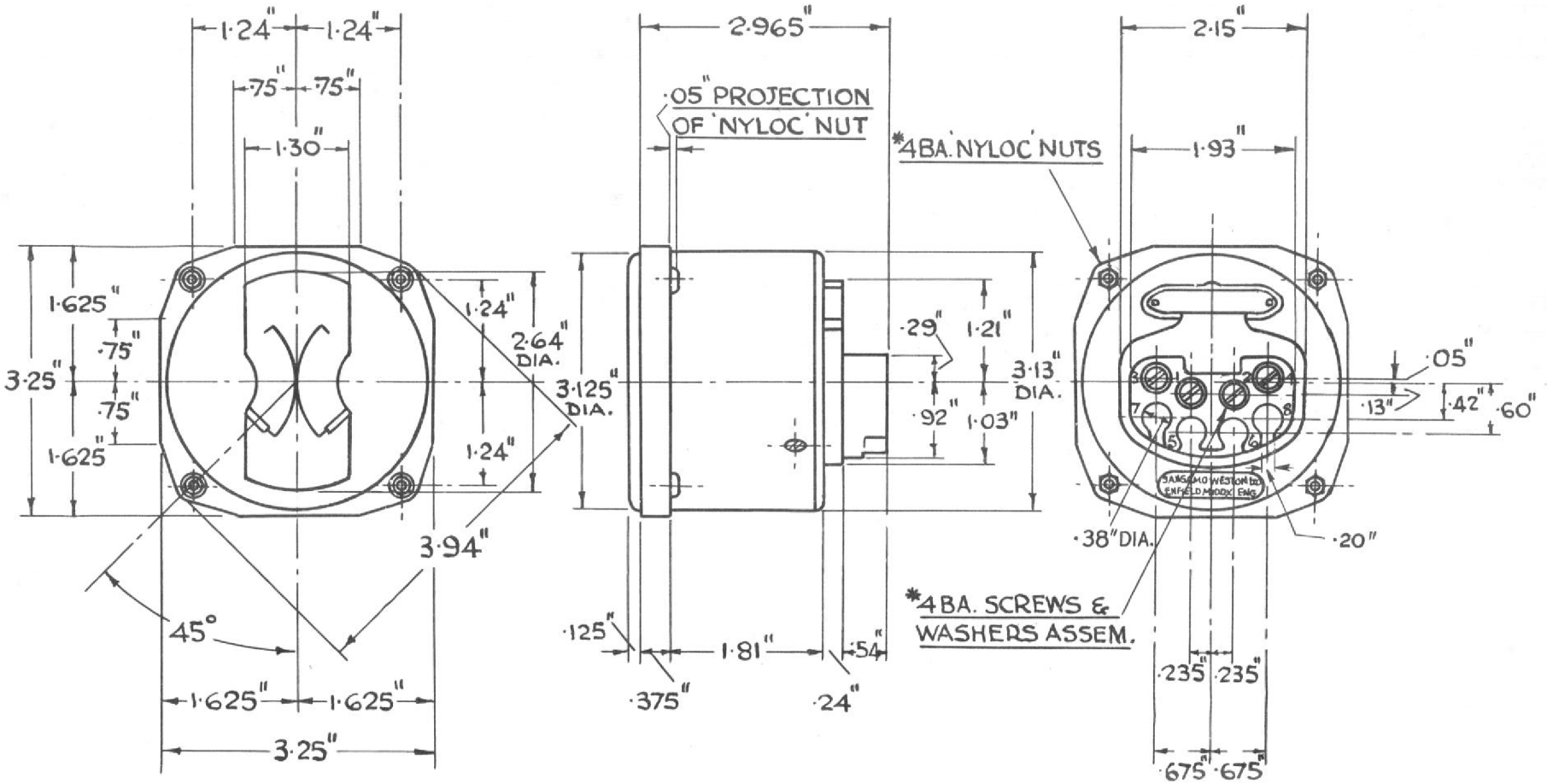
Among the uses to which the instrument may be put is the function of temperature measurement from two separate sources. To this end, it is fitted with a bi-metal cold end compensator and is used in conjunction with copper/constantan, iron/constantan or chromel/alumel thermocouples.

A moulded terminal block is fitted to the rear of the instrument.

This model was designed in the first instance to comply with an A.M. Specification, and meets the test conditions imposed by the relevant British Standards Specification.

## INSTALLATION

The instrument is mounted from the rear of the panel, and is secured in position by four No. 4 B.A. bolts. The scale must be vertical when the aircraft is in level flight. Under certain circumstances it may be desirable to use an anti-vibration mounting of the type 10A/12954.




## MODEL S.128 FORM 5

## MAINTENANCE AND REPAIR.

If a fault is obviously electrical, the first step is to check the connections to the movement. An electrical check of the movement itself will be necessary if no fault is revealed by the inital investigation.

Make sure that the moving coil is definitely the part affected, and that the fault is not caused by a defective spool or damaged return springs. If these appear intact, make a resistance test across the coils. To do this, remove the cover and unsolder the lead connected to the top bridge and measure the resistance across the top and bottom bridges.

Resistance values vary according to the particular use for which the instrument is designed. Customers are therefore advised to contact the manufacturers to obtain this information. The complete code number which appears on the front of the scale must be quoted.

The following procedure should be adopted where it is necessary to replace a moving coil. Read carefully through the instructions before starting operations.

Remove the scale. Take off the magnet clamps and screws and detach the magnets from either side. Unsolder the connecting wires to the top and bottom bridges. Remove pole piece fixing screws, and carefully turn the movement to withdraw it from the mounting plate.

Unsolder the springs from the abutments Unsolder the connecting wire from the compensating element to top bridge. Now take off the bridge carrying the compensating element, and take off the top and bottom bridges.

The top and bottom springs are not interchangeable as they have a predetermined ratio to match the cold end compensator, (which operates on the top spring only),and, therefore, must be replaced in their original positions. On removal,these springs must be carefully segregated because of the impossibility of identifying them visually. If either is damaged, a new pair,together with a new matching cold end compensator, must be fitted.

The cold-end compensator on each movement must be assembled so that, when traced from the outer end, the convolutions are in an anti-clockwise direction for the port movement, and in a clockwise direction for the starboard movement Careful note must be made of the position of the control spring tails in relation to the moving coil and pointer so as to assist in re-assembly.

The inner side of the pole piece carries a screw which holds the sensitivity compensating strips. Remove this screw and take off the strips,noting their position in relation to the pole piece. The order of assembly shouldbe one or more thicknesses of compensating strip nearest the pole piece and a covering silicon-iron plate.

Remove the screw from the front of the pole piece and take off the magnetic shunt. The core may now be extracted from the pole piece and the coil taken off.

Place the new coil over the core with the soldered joint on the right hand side looking down the length of the pointer.

Re-assemble in a sequence of operations in a reverse order to those already quoted, but before replacing the bridges make sure that the springs tails are in their original positions relative to the coil.

Note that the connecting wire in the negative side must be constantan.

Refit the bridges and adjust the jewels by turning the jewel screw clockwise in small increments in the order of 1/10th turn until pointer "flop" just disappears. ("Flop" is the movement of the pointer due to the pivots being able to move laterally in the jewels). Back off the jewel screw by an amount 1/10th to 1/8th turn until a definite pointer "flop" is apparent.

Resolder the springs, and replace the compensating bridge making sure that the linking wire is soldered into position.

With the movement completely assembled, replace on to mounting plate. Leave the magnets and clamps slightly slackened.

RAISING THE MAGNETS.

A single turn raising bar is positioned on the diametric centre of the magnet system, and a current of approximately 10,000 amperes passed through it to saturate the magnets.

After this operation, the assembly will be held together by magnetic attraction, and should be clamped in this position.

AGEING THE MAGNETS.

In their present state the magnets are in a saturated condition, and the gap fluxes must be reduced to give the magnetic circuit its required stability

A single conductor is inserted through the centre of the magnet system and a current of 150 amperes 50 cycles A.C. passed through it. This current must be raised to its maximum and reduced to zero over a period of not less than 5 seconds, once only.

CHECKING MAGNETIC POLARITY.

When approximately 1 milliamp is passed through the moving coil, the pointer must deflect upscale from zero under the following conditions:-

(a) Port Movement: ..... Bottom bridge negative.

(b) Starboard Movement: ..... Bottom bridge positive.

## BALANCING THE MOVEMENT.

With the instrument scale horizontal, adjust the current in the coil to give centre scale deflection. Now place the instrument in a vertical position and adjust the tail and side arm balance weights so that the balance error is at a minimum.

## READJUSTMENT AND RECALIBRATION.

Balance:

Check and rebalance if necessary.

Sensitivity:

Check full-scale deflection current and compare with specification.

Calibration:

1. Set pointer to zero.

2. Connect a decade resistance box with 0.1 ohm steps in series with the indicator under test, and connect the whole across a millivoltmeter of suitable range.

3. Apply to the millivoltmeter the millivolts equivalent to the maximum temperature of the indicator. This figure can be obtained from the EMF/Temperature table for the relevant thermocouple. Adjust the decade box to give full scale on the indicator.

4. Check the intermediate points on the scale against the values given in the tables, making any slight alteration in the decade resistance box necessary to even up the scale errors.

5. Check that the final reading of the resistance box is exactly that of the external resistance (marked on indicator dial) representing the resistance of the thermocouple and its extension leads. No further adjustment is necessary.

6. When the decade box resistance differs from the correct external resistance, the series spool in the indicator must be increased or decreased in value by the same amount that the resistance box is greater or less than the correct external resistance.

7. Use only manganin, minalpha or similar material for adjustment, and note that this resistor is in the positive side of the movement. Because they produce parasitic E.M.F.'s, Eureka, Constantan, Advance and similar alloys must not be used.

Cold End Compensation:

This may be checked as follows:

1. Connect a thermocouple and its extension leads of the correct resistance and type to the indicator. Place the thermocouple in an ice flask at $0^{o}C.$, and set the indicator pointer to zero.

Cold End Compensation (Cont'd.)

2. Place the indicator in a controlled temperature chamber maintained at any temperature between -50°C. and +70°C., at the same time keeping the thermocouple in the ice flask at 0°C.

3. The indicator reading should remain at 0°C. within 4% of full-scale deflection throughout the test, irrespective of the temperature of the chamber.

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## INSPECTION.

Subsequent to satisfactory installation, the instrument should be checked visually to ensure that the glass is unbroken, and that the terminal screws are tightly connected. No other maintenance is necessary for a period of 1,000 flying hours. On the completion of this period, the instrument should be checked for accuracy, preferably "in situ", as apparatus of this nature is more liable to damage from handling than from years of service. If the calibration errors are within permissible limits, the instrument should be classed as serviceable for a further 1,000 hours service.

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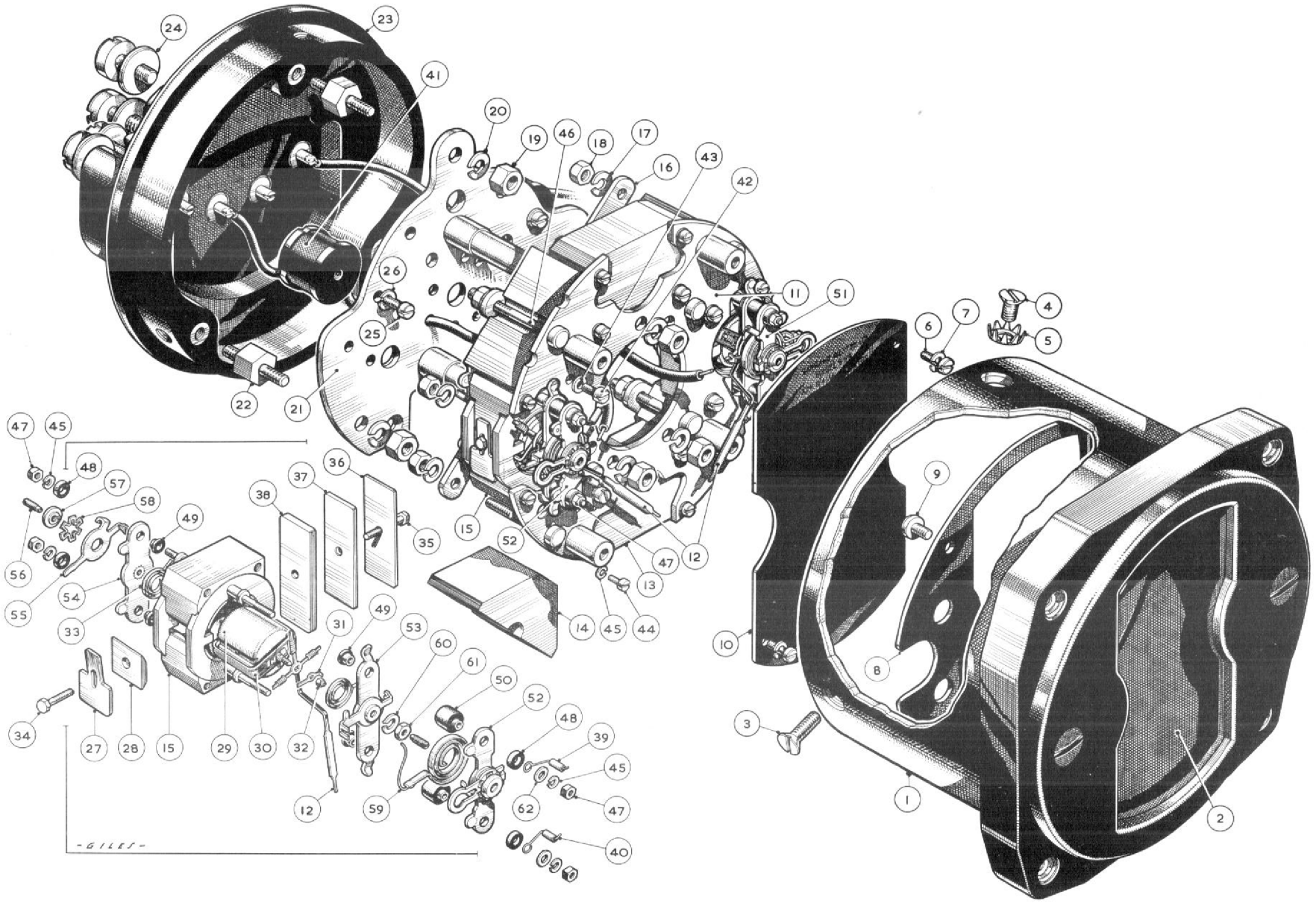
## DECLARATION

## INFORMATION REQUIRED BY BRITISH STANDARD G.100.

## MODEL S.128. FORM 5.

| | | | |
|---|---|---|---|
| Weight. | 21 ozs. | Vibration Grade. | 3 when mounted on instrument flight panel. |
| Max. Storage period without preservation packing. | 6 months. | Fire Resistance Grade | Fire resistant |
| Acceleration Grade. | 1B. | Compass Safe Distance. | 12". |
| Climatic Grade. | 1 | C. G. Position. | 1.5/16" from glass along geometric centre. |
| Altitude Rating. | 60,000ft. | | |


SANGAMO WESTON
-GILES-

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# PARTS LIST.

## MODEL S.128, FORM 5.

| Ref. No. | Part No. | Description. | No. Off. |
|---|---|---|---|
| 1 | 166951 | Cover Assem. | 1 |
| 2 | 166116 | Glass. | 1 |
| 3 | 150146 | Screw 6 BA. C/SK | 2 |
| 4 | 168862 | Sealing Screw 6 BA. | 1 |
| 5 | 168013 | Sealing Cup. | 1 |
| 6 | 156396 | Scale Screw 10 BA. | 2 |
| 7 | 159306 | Lock Washer 10 BA. | 2 |
| 8 | 166117 | Shield. | 1 |
| 9 | 160756 | Screw 8 BA. x $\frac{1}{8}$". | 4 |
| 10 | 166119 | Scale Plate. Specify Code. | 1 |
| 11 | 166121 | Mtg. Plate & Scale Pillars Ass. | 1 |
| 12 | Specify Code. | Pointer Mtd. | 1 |
| 13 | 166123 | Pole Piece Blank. | 2 |
| 14 | 164712 | Magnet. | 4 |
| 15 | 168482 | Pole Piece Assem. Specify | 2 |
| | 168480 | " " " Code. | |
| 16 | 164713 | Magnet Clamp. | 4 |
| 17 | 103854 | Lock Washer 8 BA. | 8 |
| 18 | 150168 | Nut 8 BA. | 8 |
| 19 | 150166 | Nut 6 BA. | 6 |
| 20 | 156976 | Lock Washer 6 BA. | 6 |
| 21 | 166959 | Sub Mtg. Plate Ass. | 1 |
| 22 | 166966 | " " Pillar. | 3 |
| | 166935 | Base Drilled 6 Terms Brass | |
| 23 | 166933 | " " 2 Terms Specify | 1 |
| | 169227 | " " 4 Terms Brass | |
| 24 | 157703 | Screw & Washer Assem. | 4 |
| 25 | 150330 | Screw 10 BA. x 3/16 (Spools) | 3 |
| 26 | 153367 | Lock Washer 10 BA. (Spools) | 3 |
| 27 | 166147 | Magnet Shunt. | 2 |
| 28 | 164715 | Core Plate. | 2 |
| 29 | 166146 | Core .4. | 2 |
| 30 | Specify Code. | Coil Wound. | 2 |
| 31 | 154735 | Spring Terminal Tag. | 4 |
| 32 | 153320 | Pivot Base Nut. | 4 |
| 33 | Specify Code. | Spring with Term Tag. | 4 |
| 34 | 166855 | Core Screw x .33" Lg. | 2 |
| 35 | 166148 | " " x .39" Lg. | 2 |
| 36 | 164268 | Temp. Comp. Mag. Shunt Iron. As req. Specify Code. | |
| 37 | 164267 | " " " " .028". " " " | |
| 38 | 164266 | " " " " .064" " " " | |
| 39 | 164702 | Pointer Stop R.H. | 2 |
| 40 | 164703 | " " L.H. | 2 |
| 41 | Specify Code | Spool Wd. | 3 |
| 42 | 155546 | Screw 10 BA. x $\frac{1}{8}$" Ch.Hd. | 8 |

| Ref. No. | Part No. | Description. | No Off. | |
|---|---|---|---|---|
| 43 | 157031 | Washer 10 BA. | 8 | |
| 44 | 150122 | Screw 12 BA x $\frac{1}{8}$" Ch.Hd. | 8 | |
| 45 | 155830 | Lock Washer 12 BA. | 18 | |
| 46 | 155373 | Screw 8 BA. x 13/16". | 8 | |
| 47 | 155125 | Nut 12 BA. | 8 | |
| 48 | 154399 | Insul. Washer. | 8 | |
| 49 | 154397 | " Bush. | 8 | |
| 50 | 166143 | Insul. Bush for Comp. Coil Bridge. | 4 | |
| 51 | 164260 | Bridge Assem. (Comp. Coil) R.H. | 1 | Specify Code |
| | 166150 | " " " " R.H. | | |
| 52 | 166142 | " " " " L.H. | 1 | Specify Code. |
| | 168306 | " " " " L.H. | | |
| 53 | 164259 | Top Bridge Mtd. | 2 | |
| 54 | 160898 | Bott. Bridge Mtd. | 2 | |
| 55 | 164695 | Bottom Abutment. | 2 | |
| 56 | 160669 | Bearing Screw. | 4 | |
| 57 | 153421 | Bearing Nut. | 2 | |
| 58 | 153422 | Spring Washer. | 2 | |
| 59 | 160780 | Comp. Coil. | 2 | |
| 60 | 153367 | Lock Washer 10 BA. | 2 | |
| 61 | 151234 | Hex. Bearing Nut. | 2 | |
| 62 | 153364 | Washer 12 BA. | 6 | |

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# MODEL S.128.5.63
# DUAL CENTRE ZERO D.C. AMMETER
## (40-0-40 Amperes)

*Information contained in this manual affecting safe operation, maintenance and overhaul has been verified and approved by the Air Registration Board in accordance with Chapter A6-2 of British Civil Airworthiness Requirements. 28.2.57.*

*Amendments to this publication invalidate the approval statement unless issued by the manufacturers with the concurrence of the Air Registration Board.*


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SOUTHAMPTON BRIGHTON

# MODEL S.128 : 5 : 63
# DUAL CENTRE ZERO D.C. AMMETER
## (40-0-40 Amperes)

### DESCRIPTION

Two movements, each with a scale arc of 100°, and with their pivot centres opposite and equally disposed on each side of a vertical centre line, are contained in a large S.A.E. case.

The instrument is used in conjunction with an external shunt giving a millivolt drop of 30 millivolts to the indicator for the indication of 40-0-40 Amperes D.C.

A moulded terminal block is fitted to the rear of the instrument.

### INSTALLATION

The instrument is mounted from the rear of the panel, and is secured in position by four 4 B.A. bolts. The scale must be vertical when the aircraft is in level flight. Under certain circumstances it may be desirable to use an anti-vibration mounting of the type 10A/12954.

### METHOD OF TESTING

The instrument may be tested separately from its external shunt by connecting the instrument alone into the circuit as given in Fig. 1.

Apply the requisite millivolts to the circuit and check that the millivolt indications of the precision grade instrument conform to the following table:—

| Cardinal Mark | mV. |
|---|---|
| 40 | 30 |
| 30 | 22.5 |
| 20 | 15 |
| 10 | 7.5 |
| 0 | 0 |
| 10 | 7.5 |
| 20 | 15 |
| 30 | 22.5 |
| 40 | 30 |

### ACCURACY

With the precision grade instrument indicating a particular cardinal marking, the indicator under test should read within ±2%.

(*a*) **Friction**

1. The instrument must be mounted so that its dial is in a vertical plane and so arranged that at an end-scale indication the pointer is in a horizontal position.
2. With the pointer at zero, the instrument must be lightly tapped. The pointer is then gradually brought to end-scale indication and the applied millivolts as shown by the precision grade instrument in the circuit carefully noted. Call this voltage (a).
3. Care must be taken that the end point is not overshot or the instrument subjected to any vibration, or the test will be rendered useless and must be recommenced.
4. The pointer must then be deflected beyond the end-scale mark, and the instrument lightly tapped.
5. Now bring the pointer back to the end-scale position and note the applied millivolts necessary to do this. Call this voltage (b).
6. The difference between voltages (a) and (b) expressed as a percentage of full scale millivolts must be not greater than 2%.

(*b*) **Balance**

1. The pointer must be accurately set to the centre of any cardinal mark with the instrument in a horizontal plane.
2. The instrument is then placed with its dial in a vertical plane and moved so that the pointer is successively positioned:—
   - (*a*) Horizontally left.
   - (*b*) Vertically upward.
   - (*c*) Horizontally right.
   - (*d*) Vertically downward.
3. The movement of the pointer from the set scale mark expressed as a percentage of full scale deflection in any of these positions must not be more than 2%.

(*c*) **Insulation Resistance**

1. The insulation resistance must be measured between the instrument circuit and the case, and is to be taken after the application of 500 volts D.C. for 1 minute.
2. The value of insulation resistance so obtained must not be less than 20 megohms.

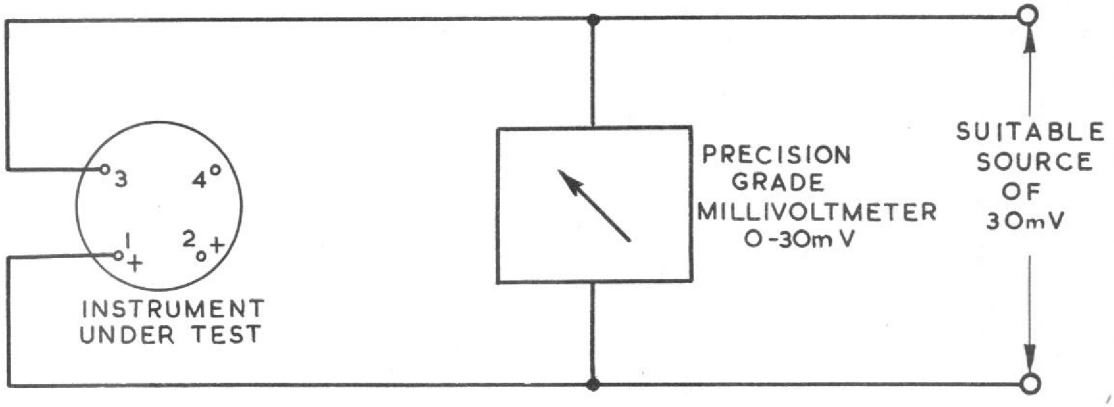



FIG. 1. CALIBRATION CHECKING CIRCUIT

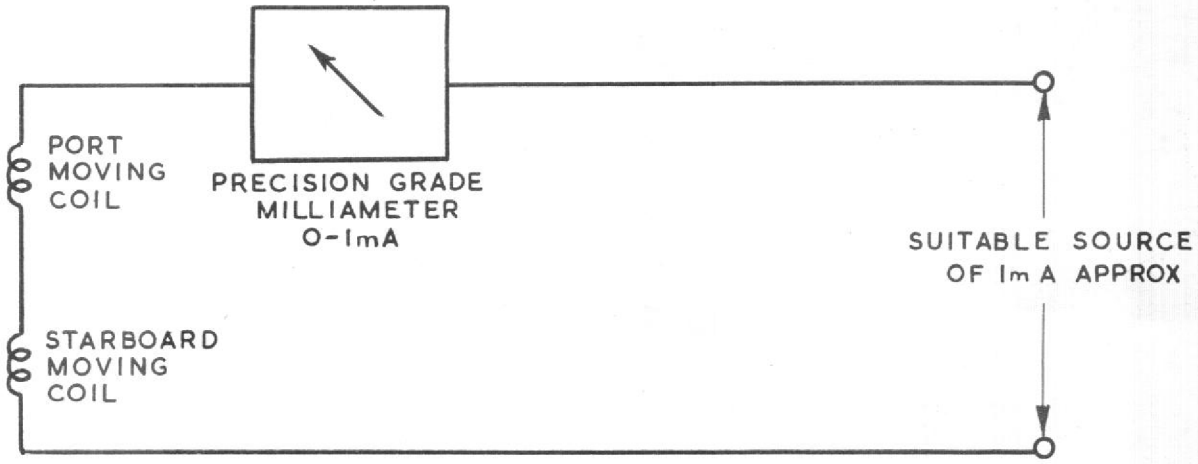



FIG. 2. AGEING CIRCUIT

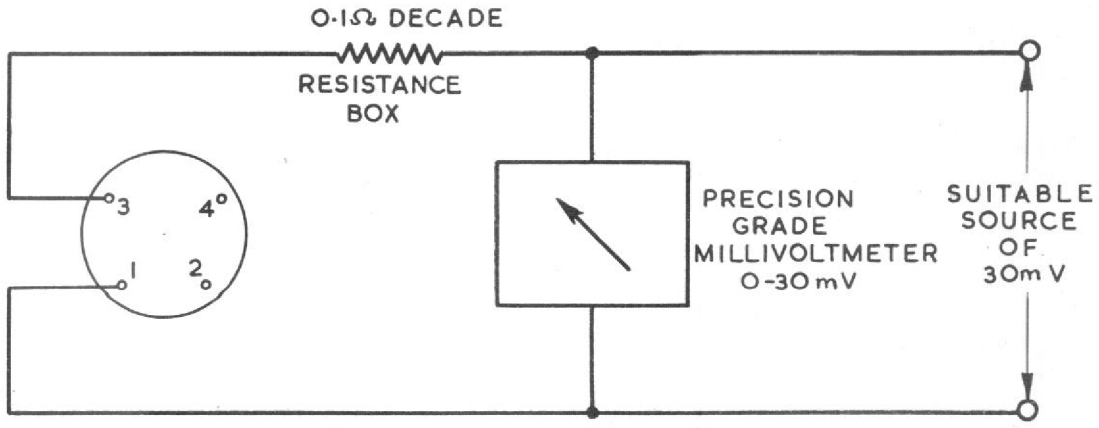



FIG. 3. ADJUSTMENT CIRCUIT

## MAINTENANCE AND REPAIR

If a fault is obviously electrical, the first step is to check the connections to the movement. An electrical check of the movement itself will be necessary if no fault is revealed by the initial investigation.

Make sure that the moving coil is definitely the part affected, and that the fault is not caused by a defective spool or damaged return springs. If these appear intact, make a resistance test across the coils. To do this, remove the cover and unsolder the lead connected to the top bridge and measure the resistance across the top and bottom bridges.

The resistance value so obtained should be between 3.4 and 4.2 ohms. Use a low voltage ohmmeter for this test.

The following procedure should be adopted where it is necessary to replace a moving coil. Read carefully through the instructions before starting operations.

Remove the scale. Take off the magnet clamps and screws and detach the magnets from either side. Unsolder the connecting wires to the top and bottom bridges. Remove the pole piece fixing screws, and carefully turn the movement to withdraw it from the mounting plate.

Unsolder the springs from the abutment and take off the top and bottom bridges. The top and bottom springs are not interchangeable and, therefore, must be replaced in their original position. On removal, these springs must be carefully segregated because of the impossibility of identifying them visually. If either is damaged, a new *pair* must be fitted.

Remove the core fixing screws by taking off the nut on the inside face of the pole piece. This will release the core clamp and enable the core screw to be withdrawn. The core may now be extracted from the pole piece and the coil taken off.

Place the new coil over the core with the soldered joint on the right hand side looking down the length of the pointer.

Re-assemble in a sequence of operations in a reverse order to those already quoted, but before replacing the bridges make sure that the spring tails are in their original positions relative to the coil.

Refit the bridges and adjust the jewels by turning the jewel screw clockwise in small increments in the order of 1/10th turn until pointer " flop " just disappears. (" Flop " is the movement of the pointer due to the pivots being able to move laterally in the jewels). Back off the jewel screw by an amount 1/10th to 1/8th turn until a definite pointer " flop " is apparent.

Re-solder the springs making sure that they are in their same relevant positions as they were before dis-assembly. With the movement completely assembled, replace on the mounting plate, but leave the magnets and clamps slightly slackened.

## RAISING THE MAGNETS

A single turn raising bar is positioned on the diametric centre of the magnet system, and a current of at least 10,000 amperes passed through it to saturate the magnets.

After this operation, the assembly will be held together by magnetic attraction, and should be clamped in this position.

## AGEING THE MAGNETS

In their present state the magnets are in a saturated condition, and the gap flux must be reduced to give the magnetic circuit its required stability.

Firstly, connect the re-assembled movements in series and also in series with a precision grade milliammeter and a suitable source of 1 milliamp D.C. as shown in Fig. 2. Apply $\pm 0.75$ milliamps from centre scale to end scale for each movement. It will be seen that the magnetic circuit needs to be de-magnetised in order to give a correct indication at full scale deflection. This can be achieved by approaching the ring magnetic circuit with a suitable A.C. de-magnetising field, until full scale indication is obtained for this current. Balance between the movements can be achieved by the use of the magnetic shunt across the face of each pole piece.

## CHECKING MAGNETIC POLARITY

When approximately 0.75 milliamps is passed through the moving coil, the pointers must deflect up-scale from centre zero under the following conditions:—

(*a*) Port movement .. .. .. .. .. .. .. .. bottom bridge negative.
(*b*) Starboard movement .. .. .. .. .. .. .. bottom bridge positive.

## BALANCING THE MOVEMENT

With the instrument scale horizontal, adjust the current in the coil to give end scale deflection. Now place the instrument in a vertical position and adjust the tail and side arm balance weights so that the balance error is at a minimum.

## RE-ADJUSTMENT AND RE-CALIBRATION

Connect the instrument as shown in Fig. 3. Apply the requisite millivolts equivalent to 40 amps mark. Adjust the series resistance box to give full scale deflection for these millivolts (approximately 36 ohms). Reverse the supply and check that the other end scale mark is within calibration accuracy. Make any slight alteration in the decade resistance box necessary to even up the scale errors. Transfer the leads to the other movement and carry out the foregoing adjustment procedure once more. Note the value of the resistance box in each case, and have spools wound using minalpha or manganin wire.

## INSPECTION

Subsequent to satisfactory installation, the instrument should be checked visually to ensure that the glass is unbroken, and that the terminal screws are tightly connected. No other maintenance is necessary for a period of 1,200 flying hours. On the completion of this period, the instrument should be checked for accuracy, preferably " in situ ", as apparatus of this nature is more liable to damage from handling than from years of service. If the calibration errors are within permissible limits, the instrument should be classed as serviceable for a further 1,200 hours service.

## DECLARATION

### INFORMATION REQUIRED BY BRITISH STANDARD G.100

### MODEL S.128

| | |
|---|---|
| Weight | 21 ozs. |
| Maximum storage period without preservation packing | 6 months |
| Acceleration Grade | 1B. |
| Climatic Grade | 1 |
| Altitude Rating | 60,000 ft. |
| Vibration Grade | 3 when mounted on instrument flight panel. |
| Fire Resistance Grade | Fire Resistant. |
| Compass Safe Distance | 12 ins. |
| C. G. Position | $1\frac{5}{16}$ in. from glass along geometric centre. |

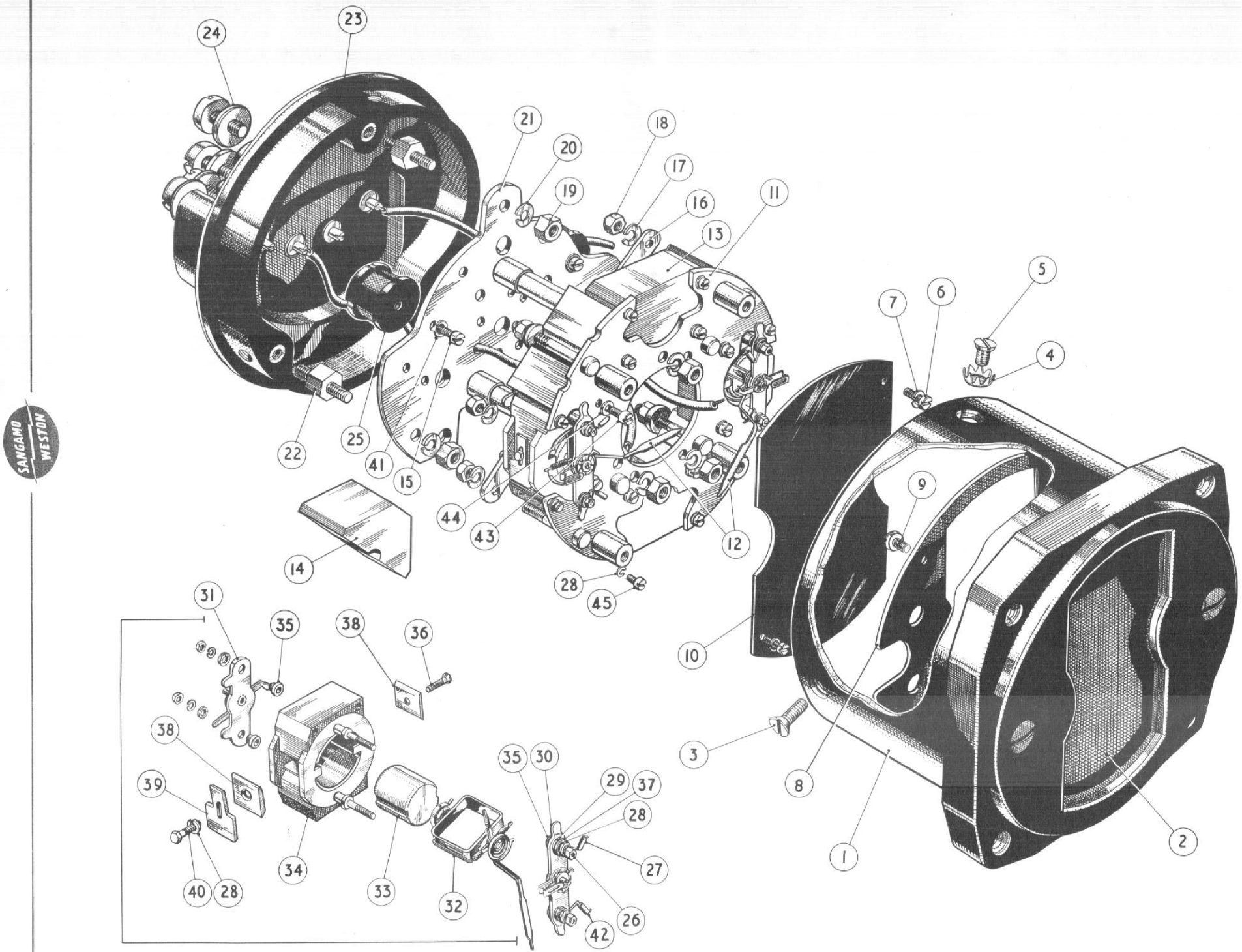
# PARTS LIST

## MODEL S.128 FORM 5 SUB 63

| Ref. No. | Description | Part No. | No. Off | Estimated requirement for 100 instruments |
|---|---|---|---|---|
| 1 | Cover Assembly | 166951 | 1 | 5 |
| 2 | Glass | 166116 | 1 | 10 |
| 3 | Screw 6 B.A. × $\frac{1}{4}$″ C'sk | 150146 | 2 | 20 |
| 4 | Cover Seal | 168013 | 1 | 20 |
| 5 | Sealing Screw | 168862 | 1 | 20 |
| 6 | Screw 10 B.A. × .19″ (Scale) | 156396 | 2 | 10 |
| 7 | Lockwasher 10 B.A. (Scale) | 159306 | 2 | 10 |
| 8 | Shield | 166117 | 1 | 10 |
| 9 | Screw 8 B.A. × $\frac{1}{8}$″ Ch. Hd. | 160756 | 4 | 10 |
| 10 | Scale | Specify Code No. 166119 | 1 | 5 |
| 11 | Mounting Plate | 166121 | 1 | — |
| 12 | Pointer | 169665 | 2 | 20 |
| 13 | Pole Piece Blank | 166123 | 2 | — |
| 14 | Magnet | 164712 | 4 | — |
| 15 | Screw 10 B.A. × $\frac{3}{16}$″ Ch. Hd. | 150330 | 2 | — |
| 16 | Magnet Clamp | 164713 | 4 | — |
| 17 | Lockwasher 8 B.A. | 103854 | 8 | — |
| 18 | Nut 8 B.A. | 150168 | 8 | — |
| 19 | Nut 6 B.A. | 112243 | 6 | — |
| 20 | Lockwasher 6 B.A. | 156976 | 6 | — |
| 21 | Sub Mounting Plate | 166959 | 1 | — |
| 22 | Sub Mounting Pillar | 166966 | 3 | — |
| 23 | Base 4 Brass Term. | 169227 | 1 | 1 |
| 24 | Screw and Washer Assembly | 157703 | 4 | 10 |
| 25 | Spool 35 ohms Unadjusted/14 ft./190M Turns/33K | 158363 | 2 | 5 sets |
| 26 | Nut 12 B.A. | 155125 | 8 | 20 |
| 27 | Pointer Stop L.H. | 164703 | 2 | 20 |
| 28 | Lockwasher 12 B.A. | 155830 | 18 | 50 |
| 29 | Insulating Washer | 154399 | 8 | 20 |
| 30 | Top Bridge | 169207 | 2 | 10 |
| 31 | Bottom Bridge | 166144 | 2 | 10 |
| 32 | Moving Element c/w Pointers, Springs, etc. | Specify Code No. 171449 | 2 | 5 |
| 33 | Core .4″ | 166146 | 2 | — |
| 34 | Pole Piece | 168480 | 2 | — |
| 35 | Insulating Bush | 154397 | 8 | 20 |
| 36 | Core Screw 12 B.A. × .25″ C'sk | 150125 | 2 | — |
| 37 | Washer 12 B.A. | 153364 | 4 | 5 |
| 38 | Core Plate | 164715 | 4 | — |
| 39 | Magnet Shunt | 166147 | 2 | — |
| 40 | Core Screw 12 B.A. × .33″ Hex. | 166855 | 2 | — |
| 41 | Lockwasher 10 B.A. | 153367 | 2 | — |
| 42 | Pointer Stop R.H. | 164702 | 2 | 20 |
| 43 | Screw 10 B.A. × $\frac{1}{8}$″ Ch. Hd. | 155546 | 8 | — |
| 44 | Washer 10 B.A. | 157031 | 8 | — |
| 45 | Screw 12 B.A. × $\frac{1}{8}$″ Ch. Hd. | 150122 | 8 | — |

NOTE : SANGAMO WESTON Code Number appears on front of Dial.

The items printed in blue should be stocked by the customer in order to cater for conditions arising due to careless handling or accidental damage. They are quoted for this purpose only and do not form part of a normal overhaul requirement.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## METHOD OF TESTING.

The instrument may be tested by using our Model S.137 portable test set which has been specially designed for "in situ" testing. This enables checks to be made during periodical overhaul.

The precision-grade instrument used in any other test circuit (See Fig. 1.) for reference purposes should be similar to our Model S82 Millivoltmeter with preferred ranges of 0/20mV. and 0/50mV. Care should be taken to ensure that the voltage supply source is so controlled that excessive overloading of the instruments is avoided.

The following tables are provided to give relationships between temperatures and equiva lent millivolt ranges.

### COPPER/CONSTANTAN THERMOCOUPLES.

| Temperature. | | Equivalent EMF Millivolts. |
|---|---|---|
| °F. | °C. | C.J at 0°C. |
| 122 | 50 | 2.03 |
| 212 | 100 | 4.24 |
| 302 | 150 | 6.65 |
| 392 | 200 | 9.20 |
| 482 | 250 | 11.90 |
| 572 | 300 | 14.70 |
| 662 | 350 | 17.65 |

### CHROMEL/ALUMEL THERMOCOUPLES.

| Temperature. | | Equivalent EMF Millivolts. |
|---|---|---|
| °F. | °C | C.J at 0°C. |
| 212 | 100 | 4.10 |
| 392 | 200 | 8.13 |
| 572 | 300 | 12.21 |
| 752 | 400 | 16.39 |
| 932 | 500 | 20.64 |
| 1112 | 600 | 24.90 |
| 1292 | 700 | 29.14 |
| 1472 | 800 | 33.31 |
| 1652 | 900 | 37.36 |
| 1832 | 1000 | 41.31 |
| 2012 | 1100 | 45.16 |
| 2192 | 1200 | 48.89 |
| 2372 | 1300 | 52.46 |

## ACCURACY.

With the precision grade instrument indica ting a particular cardinal marking, the indicator under test should read within the specified limits given in the relevant M.o.S. Specification.

Temperature indicators should comply with the previous tables when tested in the following fashion. The instrument terminals must be connected to an external resistance equivalent to the circuit value for which the instrument is designed. A voltage must be applied across this circuit and measured with a precision grade millivoltmeter.

The instrument must be checked for accuracy by bringing the pointer to each cardinal mark in turn, setting the pointer to zero before doing so.

The maximum error must not exceed the specification limits.

(a) Friction:

1. The instrument must be mounted so that its dial is in a vertical plane and so arranged that at mid-scale indication the pointer is in a horizontal position.

2. With the pointer at the zero end of the scale the instrument must be lightly tapped. The pointer is then gradually brought to mid-scale indication and the applied millivolts as shown by the precision grade instrument in the circuit carefully noted. Call this voltage (a).

3. Care must be taken that the mid point is not overshot or the instrument subjected to any vibration, or the test will be rendered useless and must be recommenced.

4. The pointer must then be deflected to the maximum end-scale reading, and the instrument lightly tapped.

5. Now bring the pointer back to the mid-scale position and note the applied millivolts necessary to do this. Call this voltage (b).

6. The difference between voltages (a) and (b) expressed as a percentage of full scale millivolts must be not greater than 2%.

(b) Balance:

1. The pointer must be accurately set to the centre of any cardinal mark with the instrument in a horizontal plane.

2. The instrument is then placed with its dial in a vertical plane and moved so that the pointer is successively positioned:-

(a) Horizontally left.
(b) Vertically upward.
(c) Horizontally right.
(d) Vertically downward.

3. The movement of the pointer from the set scale mark expressed as a percentage of full scale deflection in any of these positions must not be more than 2%.

(c) Insulation Resistance:

1. The insulation resistance must be measured between the instrument circuit and the case, and is to be taken after the application of 500volts D.C. for 1 minute.

2. The value of insulation resistance so obtained must not be less than 20 megohms.

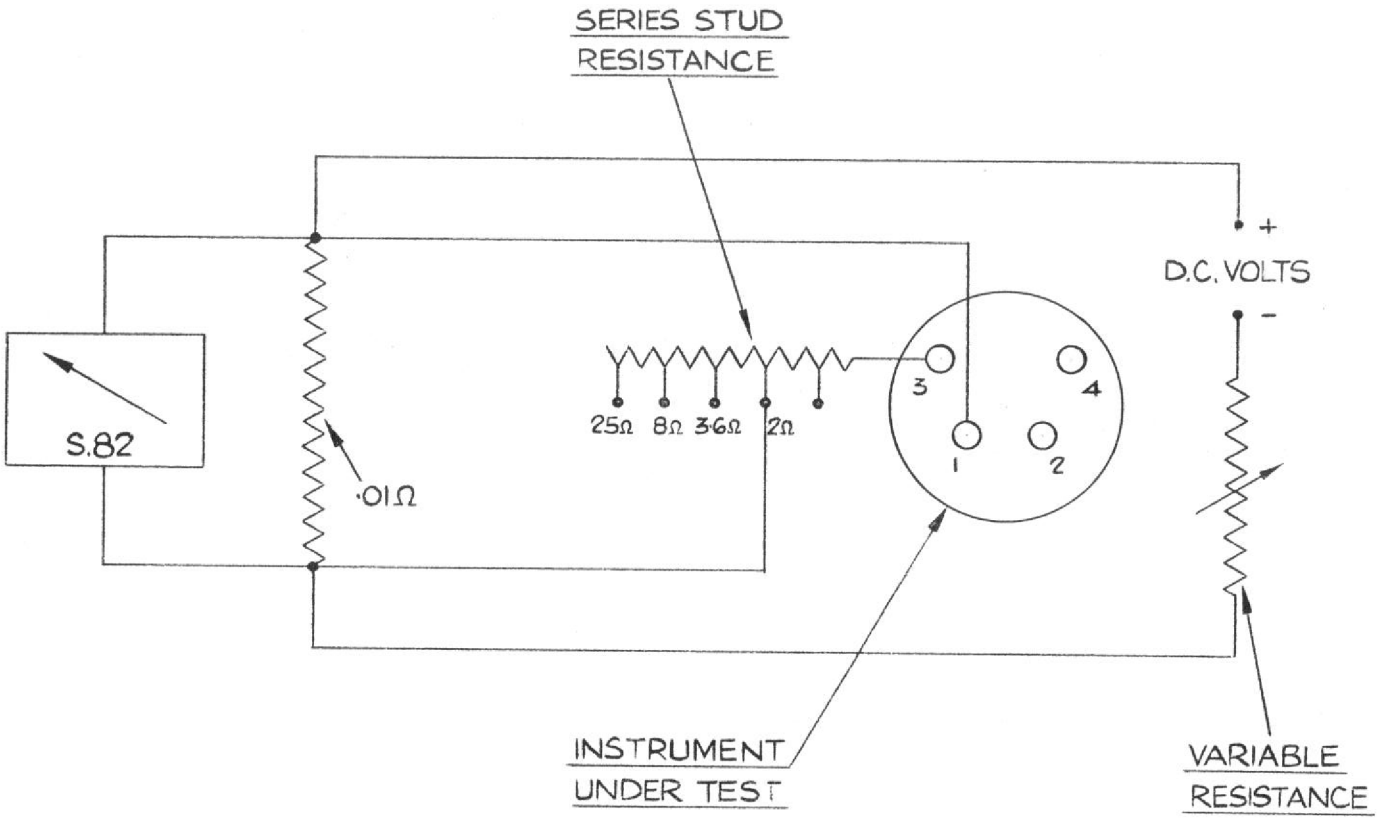


FIG. 1.
TEST CIRCUIT