TEMPERATURE INDICATORS

SMITHS

PT. Nº SF/771 MV/BU/1/700

AND SF/762 MV/BU/11

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL

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Ministry of Defence

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LIST OF EFFECTIVE PAGES

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* Prelims. 1/2	Mar.76				
Prelims. 3/4	Nov.73				
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Note...

(1) An asterisk indicates that the pages referred to have been affected by the latest amendment.

(2) References above indicate the Topic number followed by the page number.

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† SF/762MV/BU/11 only

* Incorporated

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GENERAL AND TECHNICAL INFORMATION

GENERAL AND TECHNICAL INFORMATION
(completely revised)

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0. GENERAL

0.1 Special tools

(1) Insulation tester to measure 2 megohms at 50V d.c.

* (2) Resistor 10 ohms ± 0.01%, 1W.

(3) Resistor 4 ohms ± 1%, 1W.

(4) Variable resistor, 0.5 kilohms, 1W.

(5) High resolution variable resistor, 10 ohms 1W

(6) Digital voltmeter, 0.01% accuracy, 0 to 50mV.

(7) 2V d.c. supply.

** (8) Resistor 25 ohms ± 0.1% 1W.

** (9) Resistor 0.1 ohms ± 0.1% 1W

Note... Items marked * are applicable to SF/771MV/BU/1/700 only while those marked ** to SF/762MV/BU/11/620. Remaining items apply to both codes.

0.2 Leading particulars

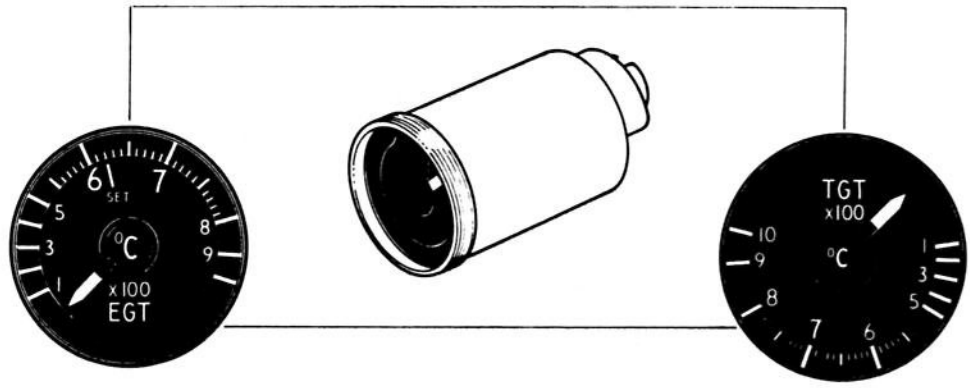
0.2.1 Part number SF/771MV/BU/1/700

Manufacturer - Smiths Industries
Range - 0 to 1000°C with expanded scale between 550 and 800°C.
Internal resistance - 300 ohms
Dimensions - Overall length 102.5mm (4.0 in) body, 51.0mm (2.0 in) diameter
Weight - 454g (1 lb) maximum
Modification state - See Mod. record

0.2.2 Part number SF/762MV/BU/11

Manufacturer - Smiths Industries
Range - 0 to 1000°C with expanded scale between 550 and 800°C.
External resistance - 25 ± 0.05 ohms (thermocouple)
Dimensions - Overall length 102.5mm (4.0 in) body, 51.0mm (2.0 in) diameter.
Weight - 454g (1 lb) maximum.
Modification state - See Mod. Record
Thermocouple characteristics: National Bureau Standards circular No.561 and BS1827

1. DESCRIPTION



SF/762MV/BU/11 SF/771MV/BU/1/700

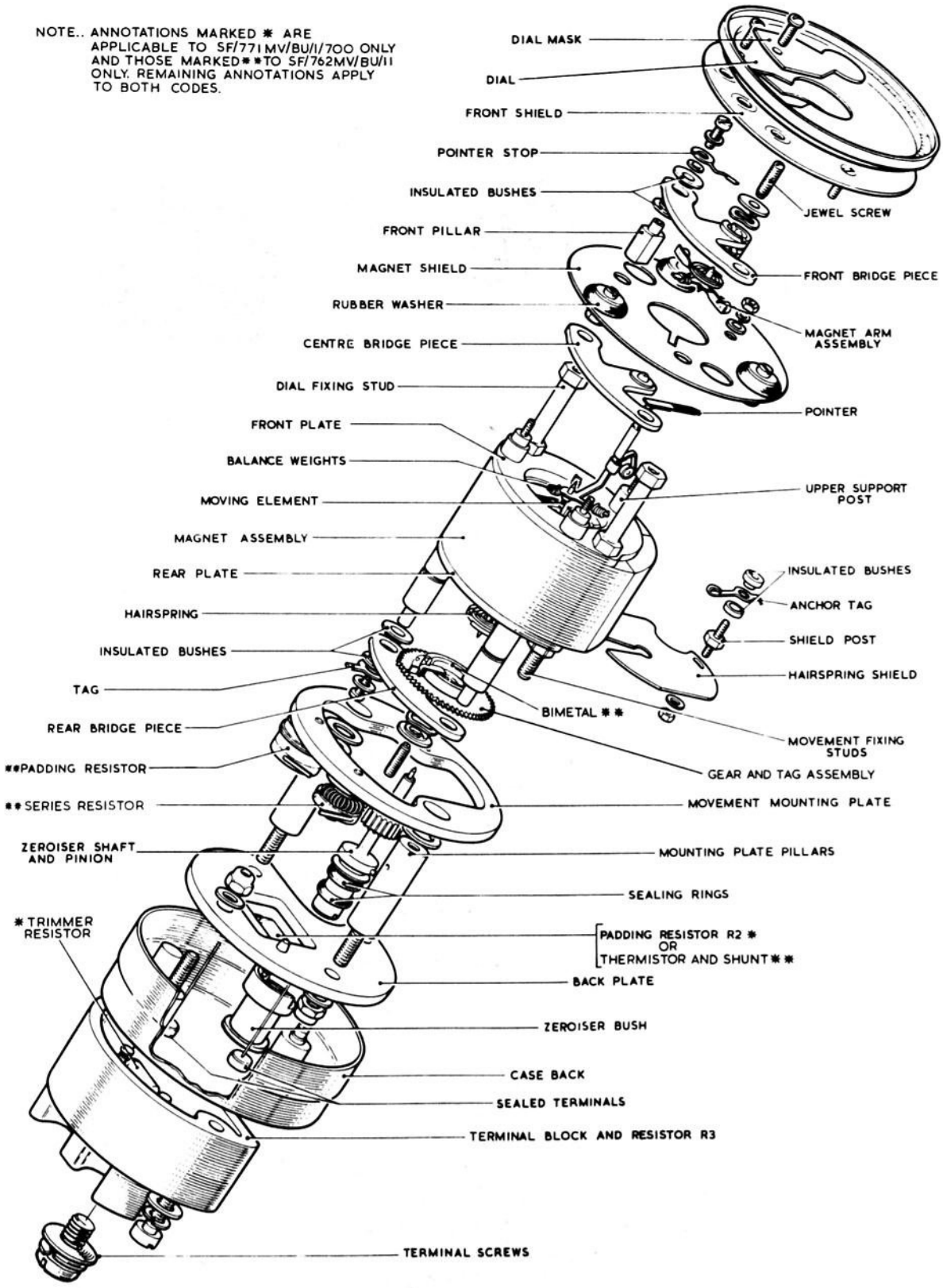
(Presentation of SF/762MV/BU/11 added)
Fig.1 General view and presentations.

1.1 Brief description

The two units covered in this publication are essentially similar except that one, code SF/771MV/BU/1/700 is basically a milliammeter movement which operates in conjunction with a constant current amplifier while the other, code SF/762MV/BU/11, is basically a millivoltmeter movement which operates in conjunction with a thermocouple system. Code SF/771MV/BU/1/700 provides continuous indication of turbine temperature and code SF/762MV/BU/11 provides continuous indication of exhaust gas temperature.

1.2 Detailed description

1.2.1 The SF/771MV/BU/1/700 indicator is basically a milliammeter and the SF/762MV/BU/11 indicator a millivoltmeter, each with a scale marked in degrees of temperature. The scale, which is calibrated from 100°C to 1000°C, is expanded over the 550°C to 800°C part of the range to provide a greater degree of accuracy and readability over the useful temperature range and yet retain the normal full scale range from zero. A range of 100°C within the expanded scale provides a further improvement in accuracy. The '700' suffix included in the code number of the SF/771MV/BU/1/700, denotes the SET point temperature used during calibration and testing while on the SF/762MV/BU/11 indicator, the SET point (620) is marked on the dial.



(Details of SF/762MV/BU/11 added)
Fig.2 Exploded view of indicator, less case

1.2.2 The indicator consists of an accurately balanced moving coil movement housed in a case which is hermetically sealed by soldering a tinned iron wire sealing ring in the recess formed between the case and case back. A capillary tube used for gas filling the indicator is soldered into the case back, to which is secured a terminal block for electrical connections.

1.2.3 A zeroiser-mechanism, see fig.2, comprises a zeroiser shaft and pinion which meshes with the gear of a gear and tag assembly on the rear bridge piece of the movement. The rear portion of the shaft is housed in a bush fitted in the case back, while the front is supported by a bearing in the movement plate. Case sealing is maintained by two sealing rings fitted on the zeroiser shaft assembly where it enters the bush in the case back.

1.2.4 A back plate secured by pillars to the case back provides a mounting for a resistor (padding) on indicator SF/771MV/BU/1/700 and for a thermistor and a resistor (shunt) on code SF/762MV/BU/11. The back plate is also secured to pillars extending from the movement mounting plate to which on code SF/762MV/BU/11, two resistors (padding and series) are secured.

1.2.5 The movement, fig.3, consists of a moving coil assembly and a magnet arm assembly. The moving coil assembly comprises a magnet assembly mounted between a front and a rear plate, which carry pillars for supporting the centre and rear bridge pieces and these house the jewel bearings in which the moving element is pivoted, the rear bearing being adjustable. A magnet shield which serves as a screen between the magnet and magnet arm assembly, is mounted on the centre bridge piece supporting pillars and an upper support post. It is secured by two front pillars and a hexagonal nut and also has mounted on it three rubber washers which act as buffer rings.

1.2.6 The moving element consists of an aluminium spindle to which is secured a pointer and spider, a double sided stop magnet, a formerless coil, a hairspring and a ligament. A shield secured to a post mounted on the rear plate, fits between the hairspring and ligament to prevent them fouling each other. The outer end of the hairspring is soldered to the tag on the gear wheel on the rear bridge and the outer end of the ligament to an anchor tag fitted on the shield post.

1.2.7 The pointer protrudes through a front shield and the dial. The moving element is balanced by the adjustment of counterweights which are carried on the arms of the spider.

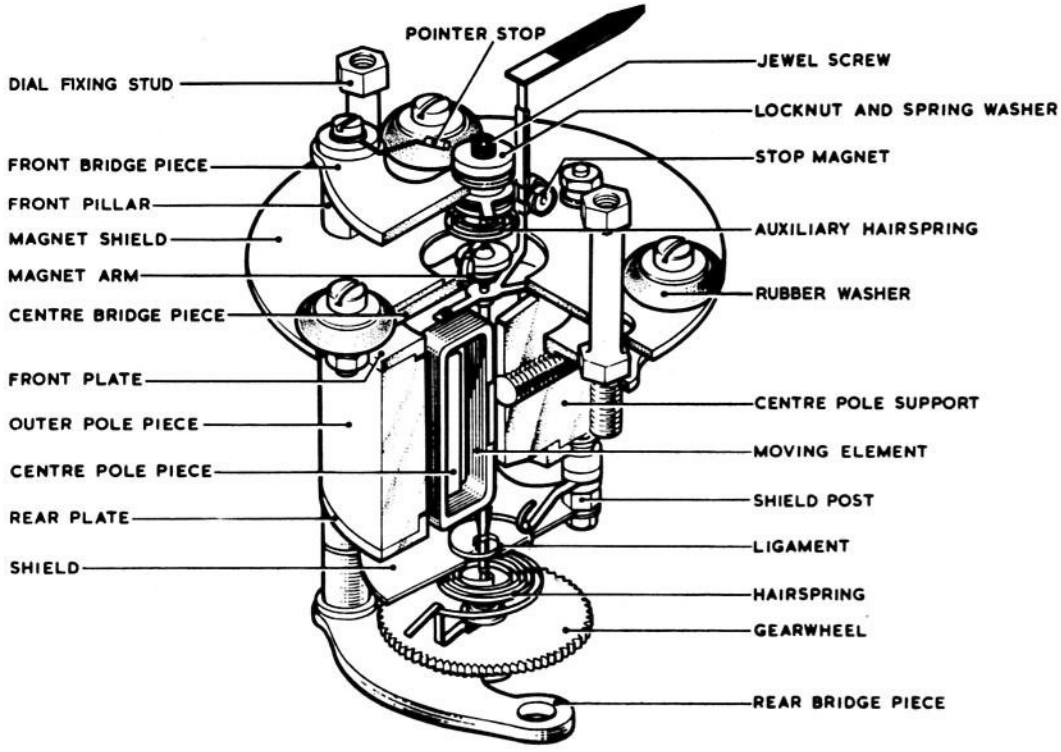


Fig.3 Sectional view of magnet assembly and moving element

1.2.8 The magnet assembly consists of two magnets, the outer pole piece and a centre pole piece, with a centre pole support. A special screw secures the centre pole piece to the centre pole support, with the magnets bonded to the ends of the outer pole piece. The outer and centre pole pieces are of opposite polarity.

1.2.9 The magnet arm assembly consists of two small magnets of opposite polarity, one secured to each end of the magnet arm, so that they oppose the double sided stop magnet on the pointer spider. The magnet arm carries a hairspring and is pivoted in jewelled bearings one of which is adjustable for end float. The magnet arm assembly hairspring in conjunction with the moving coil hairspring determines the range of the expanded and suppressed portions of the dial markings.

2. OPERATION

2.1 Indicator SF/771MV/BU/1/700

2.1.1. The indicator has a total circuit resistance of 300 ohms and is designed for use with an amplified Turbine Gas Temperature (T.G.T) system. When connected to such a system it accurately measures the current output of the amplifier which in turn is directly proportional to the T.G.T.

2.1.2 Over the expanded portion of the scale the moving coil is free to act as a normal movement, but in the upper and lower ranges, the torque of the coil is additionally controlled by the hairspring included in the magnet arm assembly.

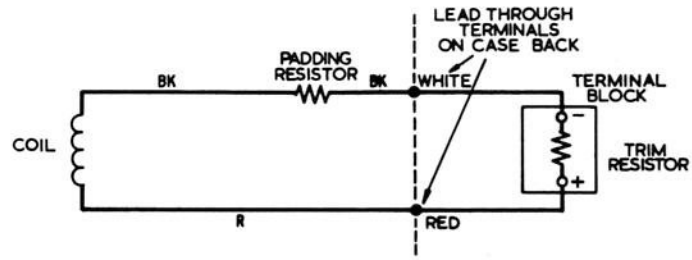


Fig.4 Circuit and wiring diagram (SF/771MV/BU/1/700)

2.1.3 A padding resistor is connected in series with the coil to give the approximate circuit resistance, and a trimmer resistor which is connected in parallel with them, is set to given control of indicator sensitivity during ranging and the additional resistance, see fig.4.

2.1.4 During calibration, turning the zeroiser shaft, turns the gear and tag assembly and moves the moving coil hairspring to adjust the pointer setting.

2.2 Indicator SF/762MV/BU/11

2.2.1 The indicator is designed to operate in conjunction with a chromel/alumel thermocouple system with an external resistance of 25 ohms. When connected to such a system it accurately measures the potential difference between the hot and cold junctions of the thermocouple which in turn is directly proportional to the T.G.T.

2.2.2 Over the expanded portion of the scale the moving coil is free to act as a normal movement, but in the upper and lower ranges, the torque of the coil is additionally controlled by the hairspring included in the magnet arm assembly.

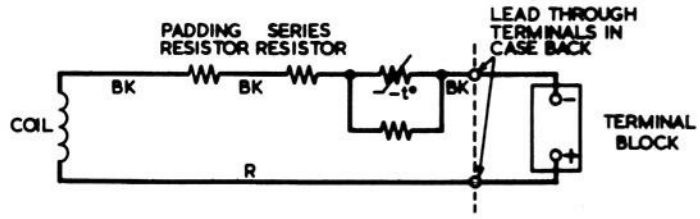


Fig.5 Circuit and wiring diagram (SF/762MV/BU/II)

2.2.3 Compensation for resistance change of the moving coil due to ambient temperature change is achieved by the shunted thermistor. The padding resistor is connected in series with the coil so that the value to be compensated is practically constant. The resistor connected in series with the padding resistor is used when necessary to make small adjustments during ranging (refer fig.5).

2.2.4 During calibration, turning the zeroiser shaft, turns the gear and tag assembly and moves the moving coil hairspring to adjust the pointer setting.

2.2.5 The bimetal compensates for differences in ambient temperature between the movement and the thermocouple system.

3. SERVICEABILITY TESTS

Note...

The following procedure applies to both indicators unless specified otherwise.

3.1 General

The following tests should be applied immediately prior to installation in an aircraft and at any time when any component has been renewed or repaired. Unserviceable indicators are to be dealt with in accordance with current Service instructions. Unless otherwise stated, all tests shall be carried out with the indicator dial in its normal viewing position. Light tapping or use of a vibrator is specified during all tests, except the friction test. The tests are to be carried out at an ambient temperature of 15°C to 25°C.

3.2 Insulation resistance

Measure the insulation resistance between the positive terminal and the case. Check that the reading is not less than 2 megohms when tested at 50V d.c.

3.3. Calibration accuracy

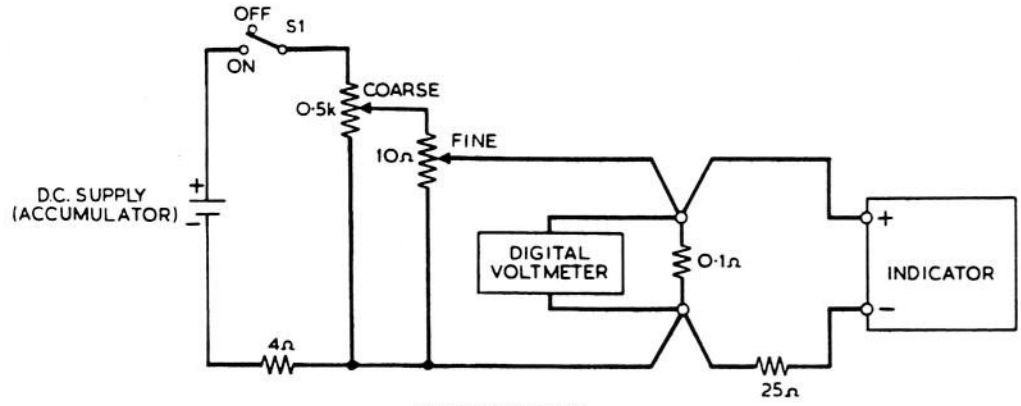
Before commencing the calibration accuracy test, the indicator must be maintained at room temperature for at least one hour. During the test, it is most important that the temperature of the indicator remains constant with ± 2°C. For all tests on SF/771MV/BU/1/700 the applied current is injected into the indicator via a 10 ohm resistor. Thus the reading of the digital voltmeter must be divided by 10 to give the value of the injected current.

(1) Connect the indicator to the test circuit shown in fig.6

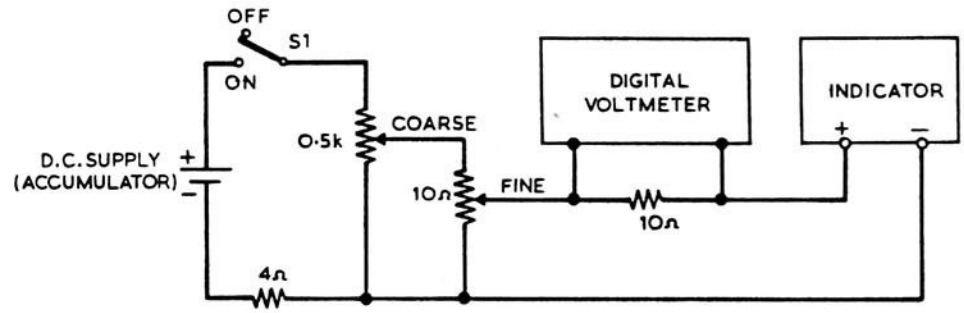
(2) Set the COARSE and FINE controls to the minimum current position and switch S1 to ON.

(3) (i) SF/771MV/BU/1/700

Adjust the COARSE and FINE controls to inject a current of 0.7mA. Check that the indicator pointer indicates 700°C ± 2°C. If necessary set the zeroiser at the rear of the indicator to align the pointer within these limits to the 700°C (SET) position.



SF/762MV/BU/11



SF/771MV/BU/1/700

(Circuit for SF/762MV/BU/11 added)
Fig.6 Test circuit

(4) SF/762MV/BU/11

Adjust the COARSE and FINE controls to inject 24.95mV. Check that the pointer indicates 620° ± 2°C. If necessary set the zeroiser at the rear of the indicator to align the pointer within these limits to the 620 (SET) position.

(5) Refer to TABLE 1 and adjust the COARSE and FINE controls to obtain, in turn, each pointer indication specified. At each setting check that the injected value is within the tolerance stated.

TABLE 1

Calibration accuracy test tolerances

Pointer indication(°C)	SF/771MV/BU/1/700 Injected current (mA)	SF/762MV/BU/11 Injected voltage (mV)
100	0.10 ± 0.020	3.30 ± 1.20
200	0.20 ± 0.020	7.33 ± 1.20
300	0.30 ± 0.020	11.41 ± 1.20
400	0.40 ± 0.020	15.59 ± 1.20
500	0.50 ± 0.020	19.84 ± 1.20
550	0.55 - 0.005 + 0.020	21.97 +1.20 - 0.40
600	0.60 ± 0.005	24.10 ± 0.20
*620	-	24.95 ± 0.08
650	0.65 ± 0.003	26.23 ± 0.20
700	0.70 ± 0.002	28.34 ± 0.40
750	0.75 ± 0.003	30.43 ± 0.40
800	0.80 - 0.020 + 0.005	32.51 + 0.40 - 1.20
900	0.90 ± 0.020	36.56 ± 1.20
1000	1.00 ± 0.020	40.51 ± 1.20

* SF/762MV/BU/11

(6) Adjust the COARSE and FINE contols to the minimum level and set switch S1 to OFF.

3.4 Friction

During the following test it is most important that the scale mark referred to in (3) should not be overshot or that the indicator is subjected to vibration. Should these conditions occur the test must be recommenced.

(1) Position the indicator so that the pointer, when aligned with the 650°C scale mark, will be vertical.

(2) Set switch S1 to ON. Adjust the COARSE and FINE controls to set the indicator pointer at the 'zero' scale mark. Lightly tap the indicator.

(3) Adjust the COARSE and FINE controls to gradually increase the input until the indicator pointer is aligned with the 650°C scale mark. Note the injected value.

(4) Adjust the COARSE and FINE controls and gradually increase the input to align the indicator pointer with the 1000°C scale mark. Lightly tap the indicator.

(5) Carefully adjust the COARSE and FINE controls and decrease the input to the level noted in (3).

(6) Check that the deviation of the indicator pointer from the 650°C scale mark does not exceed 20°C.

(7) Adjust the COARSE and FINE controls to vary the input and check that pointer movement is smooth.

(8) Adjust the COARSE and FINE controls to the minimum level and set switch S1 to OFF.

3.5 Balance

(1) Position the indicator so that the dial is in the horizontal plane.

(2) Set switch S1 to ON. Adjust the COARSE and FINE controls to align the indicator pointer with the 650°C scale mark.

(3) Position the indicator so that the dial is in a vertical plane then rotate the indicator so that the pointer successively points in the following directions and, at each point, check that the deviation of the pointer from the 650°C scale mark does not exceed ± 10°C.

(a) Horizontally left.

(b) Vertically upwards

(c) Horizontally right.

(d) Vertically downwards.

(4) Adjust the COARSE and FINE controls to the minimum level and set switch S1 to OFF.

3.6 Damping

(1) Set switch S1 to ON and adjust the COARSE and FINE controls to set the indicator pointer to the 800°C scale mark. Set S1 to OFF.

(2) Set S1 to ON. Check that the indicator pointer does not overshoot the 1000°C scale mark.

(3) Adjust the COARSE and FINE controls to the minimum level. Set S1 to OFF.

(4) Disconnect the indicator from the test equipment.

4. PRESERVATION AND PACKAGING

Preservation and packaging must be in accordance with MAS P78.