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INSTRUCTION MANUAL

MODEL 1300

GAGE INSTALLATION TESTER

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Model 1300 Gage Installation Tester

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1.0 GENERAL DESCRIPTION

The Model 1300 Gage Installation Tester is a unique instrument designed to measure two important properties of an installed strain gage: (1) insulation resistance, and (2) the deviation of the gage resistance from its nominal resistance, both of which can be influenced by improper installation procedures. The exceptionally high range of the Model 1300's megohm scale (20 000 megohm) makes it appropriate for realistic measurement of insulation resistances encountered in strain gages.

Although the above two measurements do not guarantee proper gage performance, any gage installation where either measurement is questionable should not be relied upon, especially when strain measurement accuracy is a prime consideration.

Small, lightweight, and battery-operated, the Model 1300 can be used either in the laboratory or in the field.

The Model 1300 will warn the user of gage installations that are beyond the balance range of the instrument. In addition to initial installation measurements, gages subjected to severe environmental conditions can be periodically checked. Cabling quality is verified, as well as the gage installation itself, which is especially important for long-term tests. The 1300 is also usable as an ohm-megohm meter to measure resistances from 5 to 20 000 ohms or megohms.

The Model 1300 is the result of a cooperative design effort by the Instruments and Micro-Measurements Divisions to achieve maximum "usability".

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2.0 SPECIFICATIONS

INPUT CIRCUITS:	**Gages:** Three-wire quarter bridge (120 and 350Ω) and half bridge. Other value quarter bridges using customer's reference from 60 to 2000Ω. **As Ohmmeter:** Two leads (500Ω and 500 MΩ mid-scale).
INPUT LEADS:	4-ft *(1.2-m)* four-conductor AWG No. 26 *(0.4-mm dia)* twisted Teflon® cable supplied (with ground clip and three tinned leads).
METER:	3-1/2-in *(89-mm)* size [3.00-in *(76-mm)* scale length] with mirror. Tracking accuracy ±1% full range.
MODE SWITCH:	**Five Momentary Push Buttons:** Battery check, ±5% deviation, ±1% deviation, gage resistance (ohms), and insulation resistance (megohms).
DEVIATION MODE:	Two ranges, ±1% and ±5% full scale (50 graduations either side of zero). **Accuracy:** *1% Range:* 0.04% ΔR (2 meter graduations); *5% Range:* 0.2% ΔR (2 meter graduations). **Excitation:** 1.0 Vdc per gage.

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INSULATION RESISTANCE MODE:	Graduated 5 to 20 000 MΩ (500 MΩ mid-scale). **Accuracy:** 1 scale div. **Test Voltage:** 15 Vdc open circuit.
OHM MODE:	Graduated 5Ω to 20 kΩ (500Ω mid-scale). **Accuracy:** 1 scale div. **Test Voltage:** 2 Vdc open circuit (0.4 Vdc at 120Ω).
ENVIRONMENTAL:	+15° to +125° F *(–10° to +50° C)*; up to 90% relative humidity, noncondensing.
SIZE:	Dust-tight aluminum case (separable lid). 7 W x 5 H x 5 D in *(178 x 127 x 127 mm)*, with lid.
WEIGHT:	3.6 lb *(1.6 kg)* with batteries.
POWER SUPPLY:	Four 9V NEDA 1604 batteries (Eveready 216 or equivalent). **Life:** Will fully test 1000 to 5000 installations.

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3.0 FUNCTIONAL DESCRIPTION

BINDING POSTS: Provides the means for input connection of the strain gage leadwires and structure ground. Brief hookup instructions are shown inside the instrument lid.

METER: Mirror scale indicates the resistance, percent deviation or battery condition depending on which push button is pressed.

PUSH-BUTTON SWITCH: One of five momentary buttons are used to provide power to the instrument and to select one of the following modes:

BATT: Condition of batteries is checked (under simulated load) by meter deflection.

5%: Meter indicates deviation from internal or external reference, ±5% full scale.

1%: Meter indicates deviation from internal or external reference, ±1% full scale.

Ω: Meter indicates gage resistance.

MΩ: Meter indicates insulation resistance.

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4.0 OPERATING INSTRUCTIONS

The instrument case is equipped with slip hinges which allow removal of the cover. To remove, open the case and slide the cover off with a firm sideward force. However, it is highly recommended that the cover be installed, closed, and latched when the instrument is not in use, to prevent unnecessary moisture and dirt from getting into the sensitive circuitry.

4.1 NORMAL STRAIN GAGE INPUTS

4.1a Make input connections as shown. If gages are completely wired, use these gage leadwires. If only the installed gage is to be checked, use the Teflon cable supplied.

4.1b For quarter-bridge operation, the third leadwire is connected to the D120 or D350 post, depending on the gage resistance under test as shown in Fig. 1.

4.1c If the gage is other than 120 or 350 ohms, then the third wire is connected to DEXT post, and a precision reference gage or resistance must be connected between the EXT REF posts, as shown in Fig. 2. To preserve the accuracy of the instrument, the reference should have a tolerance of better than ±0.01%.

4.1d Half bridges should be connected as shown in Fig. 3.

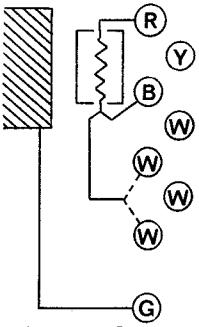


Fig. 1 — Quarter Bridge 120 or 350Ω

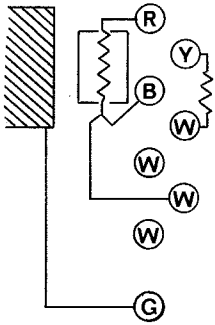


Fig. 2 — Quarter Bridge with EXT REF

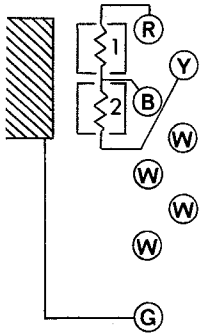


Fig. 3 — Half Bridge

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4.2 TAKE READINGS

Press BATT button: Meter should deflect beyond REPLACE BATT area on meter scale. If not, see ***paragraph 5.1*** for replacement instructions. If the instrument is being used for the first time in weeks, it may also be necessary to exercise the switch to obtain stable readings. This can be done simply by pressing each of the buttons approximately six times, particularly the MΩ and 1% sections.

Press Ω: Meter will indicate nominal gage resistance in ohms on upper scale. This reading should be used to ascertain the correct dummy-post connection. Also, a shorted or open gage will be quickly indicated by a zero or an infinity reading.

Press 5%, then 1%: Meter will indicate percent deviation of gage resistance from nominal or reference. With half-bridge input as shown in Fig. 3, the meter will indicate the percent deviation of resistance 1 from resistance 2. This reading will tell the operator if the installed gage resistance is within the balance range of the strain gage instrumentation. Balance ranges are typically specified in maximum microstrain at a gage factor of 2.00.

The relationship between strain and gage resistance change is defined by the following equation:

$$\mu\epsilon = \frac{\Delta R \times 10^6}{R \times GF}$$

where: $\mu\epsilon$ = microstrain (microinches/inch)

ΔR = gage resistance deviation from nominal in ohms (see chart on page 13)

R = nominal gage resistance

GF = gage factor

Using the above equation, it can be shown that full-scale meter deflection in the 1% mode (1% deviation) corresponds to 5000 microstrain (GF=2.0).

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Therefore, in the 1% mode the operator can read directly in thousands of microstrain by reading from the lower (5%) scale. If, for example, the strain gage instrument has a balance range of ±2000 microstrain, then all gages that fall within ±0.4% on the meter should balance. (This statement assumes that the instrument's bridge-completion components have zero tolerance from their nominal values, which is never precisely achieved.)

Press MΩ: Meter will indicate gage insulation resistance (resistance between gage foil and specimen) in megohms on upper scale.

A properly installed gage should read above 10 000 MΩ at ambient temperature. Readings below this indicate trapped foreign matter, moisture, flux or partial failure of the backing. Elevated temperatures of +300° to +600°F *(+150° to +300° C)* will greatly lower insulation resistance readings. Since leakage in the gage wiring system will also affect the reading, Teflon insulation is used in the supplied cable.

4.3 GENERAL LABORATORY USAGE

Ohmmeter: Connect unknown resistance between Red and Black binding posts, press Ω button and read from the top scale in ohms.

Megohmmeter: Connect unknown resistance between Black and Green (GND) binding posts, press MΩ button and read from the top scale in megohms.

CAUTION: Do not connect the instrument to circuits with excitation applied, or otherwise apply voltage to the binding posts, as damage may result which will void warranty.

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5.0 MAINTENANCE

The Model 1300 is a solid state design and should require a minimum amount of maintenance. Batteries generally last at least one year under normal use but should be replaced immediately if at all corroded. Leaky batteries can cause serious damage to the instrument. Any conductive film or dust must be *carefully* cleaned from the circuit using alcohol. Ensure that none of the contaminants are rinsed into the switch interior or binding posts. Should the instrument be found to be out of calibration, it can be returned to Measurements Group for service; however, an alignment procedure is included below for qualified personnel having the required precision equipment.

5.1 BATTERY REPLACEMENT

Remove the four screws from the bottom of the case. Remove the instrument from its case and place it on a flat surface with the front panel vertical. Remove the two screws holding the batteries in place. Lift the assembly and unsnap old batteries. Reverse the procedure, observing polarity, to install the fresh batteries. Use four Eveready No. 216 (NEDA 1604) or equivalent.

5.2 ALIGNMENT PROCEDURE

5.2a Check batteries by pressing BATT button. Replace if in or near REPLACE BATT area on meter scale.

5.2b Connect a precision 120-ohm half-bridge (matched to ±0.002%) as shown in Fig. 3 using short and equal wires of the same wire gauge.

5.2c Adjust meter mechanical zero with front panel in its normal orientation (usually horizontal). With the instrument in the same orientation and referring to Fig. 4, make the following adjustments:

5.2d Press 1% button and adjust R29 to center meter pointer on zero.

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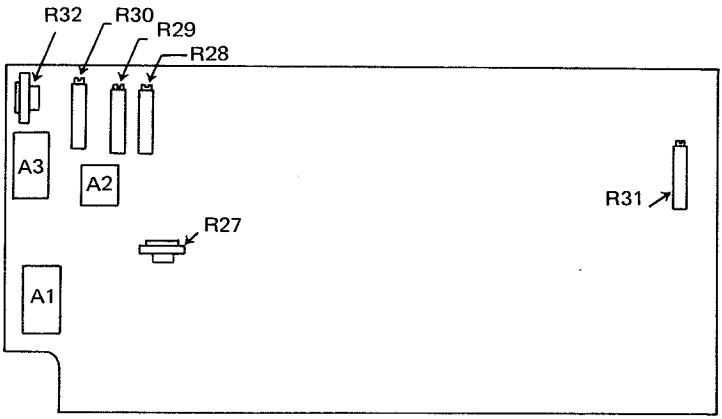


Fig. 4 — Location of Adjustments and IC's

5.2e Using three wires of the same length and wire gauge, connect a precision decade resistance box (such as Measurements Group V/E-40) as shown in Fig. 1. Set to 120.00 ohms.

5.2f Press 5% button and set V/E-40 at 114.00 and 126.00 ohms (±5.0% deviation), while adjusting R30 for the best setting to give full-scale deflection, averaged on each end of scale.

5.2g Disconnect all input wires from posts, press Ω button, and adjust R31 for full-scale deflection (infinity reading).

5.2h Short the Red and Black posts; and, pressing Ω button, adjust R32 for symmetrical deflection between a short and an open input.

5.2i Press Ω button and readjust R31 for exact 0 reading for shorted input. Recheck symmetry with open input, splitting any errors.

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5.2j Disconnect all input wires from posts; press MΩ button and adjust R28 for full-scale deflection (infinity reading).

5.2k Short the Green and Black posts; and, pressing MΩ button, adjust R27 for symmetrical deflection between a short and an open input.

5.2l Press MΩ button and readjust R28 for exact 0 reading for shorted input. Recheck symmetry with open input, splitting any errors.

5.3 PARTS LIST

Description	Part No.
Batteries 9V (four required)	
NEDA 1604 (Eveready 216 or equivalent)	23X100031
Integrated Circuits (National Semiconductor)	
A-1, LH0022CD	14X700031
A-2, LM725CN	14X700039
A-3, LM723CN	14X700040
Meter, ±50 mV, zero center	300-044950
Binding Posts	
Red	12X700090
White	12X700091
Black	12X700092
Yellow	12X700093
Green	12X700095
Case	200-130558

For repair or replacement parts other than above, consult Measurements Group, Inc.

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OHMIC DEVIATION VS. PERCENT DEVIATION

%	OHMS		%	OHMS	
	120Ω	350Ω		120Ω	350Ω
0.1	0.12	0.35	2.6	3.12	9.10
0.2	0.24	0.70	2.7	3.24	9.45
0.3	0.36	1.05	2.8	3.36	9.80
0.4	0.48	1.40	2.9	3.48	10.15
0.5	0.60	1.75	3.0	3.60	10.50
0.6	0.72	2.10	3.1	3.72	10.85
0.7	0.84	2.45	3.2	3.84	11.20
0.8	0.96	2.80	3.3	3.96	11.55
0.9	1.08	3.15	3.4	4.08	11.90
1.0	1.20	3.50	3.5	4.20	12.25
1.1	1.32	3.85	3.6	4.32	12.60
1.2	1.44	4.20	3.7	4.44	12.95
1.3	1.56	4.55	3.8	4.56	13.30
1.4	1.68	4.90	3.9	4.68	13.65
1.5	1.80	5.25	4.0	4.80	14.00
1.6	1.92	5.60	4.1	4.92	14.35
1.7	2.04	5.95	4.2	5.04	14.70
1.8	2.16	.6.30	4.3	5.16	15.05
1.9	2.28	6.65	4.4	5.28	15.40
2.0	2.40	7.00	4.5	5.40	15.75
2.1	2.52	7.35	4.6	5.52	16.10
2.2	2.64	7.70	4.7	5.64	16.45
2.3	2.76	8.05	4.8	5.76	16.80
2.4	2.88	8.40	4.9	5.88	17.15
2.5	3.00	8.75	5.0	6.00	17.50

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WARRANTY

Measurements Group, Inc., warrants all instruments it manufactures to be free from defect in materials and factory workmanship, and agrees to repair or replace any instrument that fails to perform as specified within one year after date of shipment. This warranty shall not apply to any instrument that has been:

i) repaired, worked on or altered by persons unauthorized by the Measurements Group in such a manner as to injure, in our sole judgment, the performance, stability, or reliability of the instrument;
ii) subjected to misuse, negligence, or accident; or
iii) connected, installed, adjusted, or used otherwise than in accordance with the instructions furnished by us.

At no charge, we will repair, at our plant, or an authorized repair station, or at our option, replace any of our products found to be defective under this warranty.

This warranty is in lieu of any other warranties, expressed or implied, including any implied warranties of merchantability or fitness for a particular purpose. There are no warranties which extend beyond the description on the face hereof. Purchaser acknowledges that all goods purchased from Measurements Group are purchased as is, and buyer states that no salesman, agent, employee or other person has made any such representations or warranties or otherwise assumed for Measurements Group any liability in connection with the sale of any goods to the purchaser. Buyer hereby waives all rights buyer may have arising out of any breach of contract or breach of warranty on the part of Measurements Group, to any incidental or consequential damages, including but not limited to damages to property, damages for injury to the person, damages for loss of use, loss of time, loss of profits or income, or loss resulting from personal injury.

Some states do not allow the exclusion or limitation of incidental or consequential damages for consumer products, so the above limitations or exclusions may not apply to you.

The Purchaser agrees that the Purchaser is responsible for notifying any subsequent buyer of goods manufactured by Measurements Group of the warranty provisions, limitations, exclusions and disclaimers stated herein, prior to the time any such goods are purchased by such buyer, and the Purchaser hereby agrees to indemnify and hold Measurements Group harmless from any claim asserted against or liability imposed on Measurements Group occasioned by the failure of the Purchaser to so notify such buyer. This provision is not intended to afford subsequent purchasers any warranties or rights not expressly granted to such subsequent purchasers under the law.

The Measurements Group reserves the right to make any changes in the design or construction of its instruments at any time, without incurring any obligation to make any change whatever in units previously delivered.

The Measurements Group's sole liabilities, and buyer's sole remedies, under this agreement shall be limited to the purchase price, or at our sole discretion, to the repair or replacement of any instrument that proves, upon examination, to be defective, when returned to our factory, transportation prepaid by the buyer, within one year from the date of original shipment.

Return transportation charges of repaired or replacement instruments under warranty will be prepaid by the Measurements Group, Inc.

The Measurements Group is solely a manufacturer and assumes no responsibility of any form for the accuracy or adequacy of any test results, data, or conclusions which may result from the use of its equipment.

The manner in which the equipment is employed and the use to which the data and test results may be put are completely in the hands of the purchaser. Measurements Group, Inc., shall in no way be liable for damages consequential or incidental to defects in any of its products.

This warranty constitutes the full understanding between the manufacturer and buyer, and no terms, conditions, understanding, or agreement purporting to modify or vary the terms hereof shall be binding unless hereafter made in writing and signed by an authorized official of Measurements Group, Inc.

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