

INSTRUCTION MANUAL
NON-DESTRUCTIVE INSULATION TESTER

TYPE JP30

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INTRODUCTION

The JP30 Insulation Tester provides a dc voltage adjustable up to 30 kV. The output voltage and current are indicated on separate meters.

Ionisation is indicated audibly by a built-in loudspeaker.

SPECIFICATIONS

Test Voltage:	0-30 kV dc adjustable by coarse and fine controls. Resolution better than 30 V.
Voltmeter:	3 ranges, 3 kV - 10 kV - 30 kV full scale, accuracy 5% f.s.
Max. Output Current:	Approx. 200 μ A at 30 kV, decreasing to 100 μ A at 3 kV and to 10 μ A with output shorted.
Current Meter:	3 ranges, 1 μ A - 10 μ A - 100 μ A full scale, accuracy 5%. Megohm scale: 10 M Ω /kV to 200 M Ω /kV, 3 ranges, x 1 - x10 - x100.
Output Resistance:	About 2 M Ω from 30 kV down to 10 kV, increasing to approx. 15 M Ω at low voltages.
Stability:	Output voltage varies less than 1% for 10% supply voltage variation.
Indication of Ionisation:	A 3-stage amplifier feeds a loudspeaker providing an audible indication of ionisation. Amplifier gain adjustable by a potentiometer. An output socket provides for external indication, using headphones or oscilloscope. Min. load 1 k Ω .
Test Voltage Output:	The test voltage is supplied via a high voltage socket to a shielded test lead terminated in a test probe. 2 interchangeable probe tips are provided, one ballpointed for use up to 30 kV and one straighttipped with 4 mm shank for use up to 15 kV. Low tension lead is connected to earth terminal.

Test Voltage Switch:	3-position key for locking or non-locking switching. Socket for external switch.
Meter Outputs:	Meter outputs in output socket. 1 volt full scale, min. load 10 k Ω .
Guard Terminal:	For connection to guard electrode. Current to this terminal by-passes current meter.
Power Supply:	100 to 130 volts and 200 to 260 volts, 50 to 60 Hz.
Power Consumption:	15 to 30 watt depending on output voltage and current.
Mounting:	Cabinet in blue plasticcoated aluminium with front panel in light-grey enamel.
Dimensions:	420 wide x 260 high x 300 deep mm (16 $\frac{1}{2}$ x 10 $\frac{1}{4}$ x 11 $\frac{3}{4}$ inch.) overall.
Weight:	12 $\frac{1}{2}$ kilos (27 $\frac{1}{2}$ lbs.).

2. OPERATING INSTRUCTIONS

2.1. INSTALLATION

2.1.1. Supply Voltage

Set supply voltage selector switch on rear panel to the required range (pull the switch knob, turn and push back). The 115 volt setting covers the range 100 to 130 volts, and the 230 volt setting the range 200 to 260 volts. Check that the correct fuse is fitted, on 115 volts 0.5 A slow, on 230 volts 0.25 A slow (fuse dimensions 5 x 20 mm).

2.1.2. Earth Connection

If a 3 lead power socket with earth is not available, the instrument must be earthed using the front panel earth terminal.

2.2. FUNCTION OF CONTROLS, METERS, CONNECTORS, ETC.

Power Switch

Switched on in the down position. Green lamp indicates power on.

H.T. Switch

Applies high tension in lower or upper positions. Lower position with spring return, upper locked. Red lamp indicates H.T. on.

H.T. Controls

Fine and coarse controls for adjusting high tension.

KV Meter Switch

Switches the H.T. meter ranges in steps of 3 kV, 10 kV, 30 kV full scale.

μ A Meter Switch

Switches the μ A meter ranges in steps of 1 μ A, 10 μ A, 100 μ A full scale or for resistance measurement in steps of multiplier, x 100, x 10, x 1.

Amplifier Gain

Adjusts the noise amplifier gain to provide a suitable noise output.

H.T. Connector

Female panel connector for the supplied shielded high tension output cable. The low terminal of test object is returned to instrument earth terminal.

Guard Terminal.

For connection to a guard electrode on the test object to eliminate unwanted leakage currents from the measurement.

Ext. H.T. Switch Connector

For connecting external switch to apply high tension. Switch to be connected between pins 1 or 3 and pin 2. Switch must be rated for 6 V/2 A ac.

Phone Connector

For external phone or oscilloscope. Pin 3 is earth connection, pin 2 noise voltage output. Minimum external load impedance 300 Ω . Meter outputs and pin 4 μ A meter output. Both meter outputs provide + 1 volt for full scale meter reading. Pin 3 is common negative output. Minimum external load resistance 10 k Ω .

2.3. OPERATION

Plug in high tension connector. Connect earth lead to low terminal of test object.

Turn H.T. controls fully anti-clockwise. Switch H.T. key to center position. Set gain control to mid-position. Set meter switches to required range.

Apply high tension probe to test object terminal.

Switch on H.T. key and adjust high tension output by the coarse and fine controls.

When the high tension output is increased above a certain value, in most cases a noise is heard from the loudspeaker. This is an indication of ionisation in the material tested.

The ionisation current produces a characteristic noise signal, usually starting with a hissing noise. On increasing the voltage the noise gets louder, and eventually sharp clicks are heard, which indicate partial break-down of the insulation.

Finally, total break-down occurs and the test voltage drops to zero.

Ionisation normally occurs in air voids or other inhomogenities in the insulation. Thus, completely homogenous materials, e.g. plastics do not produce any noise before complete break-down occurs.

For measurement of leakage current and resistance set the meter switch to provide a suitable reading. The resistance value is obtained by multiplying the meter scale reading by the switch factor and the output in kV.

Example: Meter reading 30 M Ω , switch factor x 10,
kV reading 5 kV.
Actual resistance: 30 M Ω x 10 x 5 equals
1.500 M Ω .

2.4. OPERATIONAL NOTES

When reading the current meter the voltmeter must be on a range providing on-scale reading. If the voltmeter is grossly overloaded, the current meter will give a false reading.

Inversely, overload of the current meter does not influence the voltmeter reading.

Both meters are completely protected against overload. At ambient temperatures below or above normal a small meter zero shift will occur. This may be corrected if necessary by the mechanical meter zero adjusters.

When the high tension output is increased gradually, a small noise output will be observed. This is due to charging effects in the dielectrics of the H.T. unit and the probe cable, and disappears when the output stabilizes.

A momentary deflection of the current meter will also be observed due to charging of the cable capacitance, but this disappears in a few seconds.

A resistor in the probe tip limits the short-circuit discharge current to a safe value, so that no damage results from intermittent spark discharges. None the less, repeated discharges at high output voltage should be avoided in order not to damage the probe resistor.

The discharge energy is max. 0.2 Joules at maximum output voltage, ensuring safe operation. However, if used for testing capacitors of above 500 pF at high voltages, the usual precautions are necessary to prevent access to high potential points.

The instrument is not suitable for tests on higher value capacitors (above about 0.02 μ F), as the available

charge current at low voltage is limited to about 10 μ A, thus an excessive charging time will result.

The ball-point probe tip provided is suited for use up to the maximum test voltage. The pin-end probe tip may be used up to about 15 kV, or, when applied to a large diameter test point, at higher voltage depending on the distance to earthed objects.

The probe tip may also be used as screw terminals by fixing a lead between the tip and the insulating probe shaft.

All critical components in the high voltage units are hermetically encapsulated so that the instrument is suitable for operation in all normal environments. However, in case of prolonged exposure to high humidity during storage or transport it is adviseable to operate the instrument continuously for some days at maximum output voltage in order to eliminate any absorbed moisture which may cause spurious noise currents.

3. CIRCUIT DESCRIPTION

The description of the circuit is divided into four sections corresponding to the physical layout. These are indicated by broken lines on the circuit diagram.

3.1. Regulated Power Supply and Power Oscillator

Mounted on a p.c.b. on the right-hand side of the instrument.

3.2. High-Voltage Circuit

Mounted on rear panel.

3.3. Meter Amplifiers

P.c.b. mounted on terminals of μ A meter.

3.4. Noise Voltage Amplifier

P.c.b. on left-hand side of instrument.

The individual circuits are described in detail in the following paragraphs.

3.1. Regulated Power Supply and Power Oscillator

One half-section of bridge rectifier RC provides the main positive supply (about +37 V) for the stabilizer. An auxiliary +6.8 V output stabilized by D9 is taken from the main supply.

The second half-section of RC provides a negative supply, stabilized at -6.8 V by D4.

A further 6.8 V supply is furnished via the network C1, C2, D2, D3, C3 and stabilized by D32. This supply is superposed on the positive stabilized rail and supplies T3 and T5.

3.1.1. Regulated Power Supply

The regulating circuit comprises series transistor T4, driver T1 and voltage amplifier T3.

T2 is a current limiter activated by the voltage across R4, which passes the total load current.

The transistors T5 and T6 are used in a circuit to compensate the variation of the high voltage output due to loading. This circuit functions as follows:

The emitter current of T5 is proportional to the voltage across R13 and in turn determined by the current through R4, which varies according to the high voltage output current.

A proportional voltage develops at the collector of T5 and the base of T6 and the same voltage appears between T6 collector and emitter.

This voltage is added to the voltage across P1, P2, and increased the output voltage to compensate the drop due to increase in current.

3.1.2. High-Voltage H.T. Switching

With Sw.3 switched off, T3 is biased to saturation by R12, D7, and the regulator output drops to zero.

When Sw.3 is switched on, a negative voltage from D1, C7 is applied to reverse-bias D7 for normal regulating operation.

3.1.3. Power Oscillator

This is a push-pull class C oscillator operating at a frequency of about 25 kHz. (the resonant frequency of the high voltage secondary winding).

A bias network (D10-TP1-D11-D12-C12-R19) applies a positive bias to the oscillator power transistors T7-T8. TP1 adjusts the bias to set the total emitter currents of T7-T8 to about 40 mA in order to ensure reliable start of the oscillator at low supply voltages.

A peak-limiting network R25-R26-D14-D15-R21-C13 eliminates positive spikes at the collectors of T7-T8.

A separate centre-tapped feedback winding on TR2 is connected to the bases of T7-T8.

D13-D16 prevent negative basedrive.

3.2. High-Voltage Circuit

The output winding on TR2 supplies an A-C voltage of max. 6 kV peak to the quintupler circuit D19 to D23-C19 to C23. The quintupler output is smoothed by R29-C18

and fed to the output connector via R28-R76.

R27 is part of the voltage divider for the kV meter circuit and C17 couples the noise voltage developed across R28 into the audio amplifier.

D17-D18 suppress high-voltage spikes.

The negative line is floating and is connected to the input to the current meter amplifier and to the guard terminal.

C16 decouples the line to ground.

3.3. Meter Amplifiers

The two meter amplifiers are similar in design. The input stage is a differential amplifier to reduce temperature drift.

A preset potentiometer TP2 (TP4) nulls the zero offset.

The voltmeter amplifier is connected as a unity-gain non-inverting amplifier with feedback from the output to the base of the second input transistor. Potentiometer TP3 adjusts the gain to compensate for variations in the high voltage resistor R27 (5% accuracy). The current through the range resistors R45 to R47 goes to the negative high voltage line and is not measured on the current meter.

The current meter amplifier is connected as an inverting amplifier with current feedback from the output through the range resistors.

To compensate the bias currents of T12 and T16 a small current is injected via R62. R62 is adjusted for current meter zero on the 1 μ A range.

3.4. Noise Voltage Amplifier

This is a 3 stage high-gain amplifier driving a small built-in loudspeaker.

Diodes D24-D25 are spike suppressors.

L1-C31 rejects ripple at the oscillator frequency to prevent amplifier overload.

4. MAINTENANCE AND SERVICE

4.1. Dismantling and Reassembly.

Before dismantling the instrument disconnect the power supply.

Loosen the screws holding the front panel. Turn the instrument upside down, remove the 4 screws holding the bottom cover and remove cover.

Remove the top cover by pulling the lower edges of the side panels outwards until the cover front-edge is clear of the front panel upper fixing screws. Then lift cover off.

Fasten front-panel screws lightly to ensure that the control knobs are free of the front panel.

To reassemble the instrument, put on the top and bottom covers and fasten the bottom cover screws lightly. Then adjust the front panel frame so that it is flush with the top cover on all sides and tighten the top and side screws on the front panel.

With the instrument upside down, center the bottom cover and tighten the bottom front panel screws. Finally tighten the bottom cover screws.

To disconnect the high voltage unit the cables to the output connector and the transformer TR2 must be unsoldered. The insulating sleeve on the output connector and the lid of TR2 shield box must be unscrewed.

Note: When resoldering the cables take care to obtain a round solder blob with no points or sharp edges.

4.2. Adjustments

Normally no adjustments are necessary except when certain components are replaced.

If the input transistors in the meter circuits are changed adjust TP2 or TP4 for meter/zero. Note that the current meter potentiometer TP4 at bottom of p.c.b. alters both meter zeroes and should be adjusted before TP2 (top left).

TP3 on the meter board (top right) adjusts the kV meter sensitivity and should only be adjusted if an accurate voltmeter is available with a range of minimum 1 to 2 kV full scale and current of not above 50 μ A full scale.

After replacement of the high voltage unit of TR2, connect an oscilloscope input between contacts 2 and 3 on the output connector, set to 30 kV and adjust C31 on amplifier board for minimum oscillator output.

4.3. Hints on Fault Finding

Symptom

Probable Fault

1. No High Voltage:

A. No regulator output

Check unstabilized supply T1 or T4 open, T2 or T5 shorted. D1 open, C7 shorted. Short circuit in power oscillator circuit, T7 or T8.

B. A ok, no oscillator output (measure at pin 6 or 7 on TR2 primary).

Defect in high voltage unit. Disconnect cable from TR2 to high voltage unit and check that power oscillator functions.

2. High Voltage output above 30 kV, adjustment not possible:

T1, T4, or T5 shorted. T3 or T6 open.

3. Max. High Voltage output less than 30 kV:

A. Noise output increases with voltage.

Flashover in high voltage unit or cabling.

B. Noise normal.

Defective high voltage unit. T7 or T8 open. (Check voltage across R20, R22 about 0.2 V at 30 kV). KV meter circuit defective. Check regulated output (0-20 V.)



