



MODEL ES-4980

SERIAL/ITEM 533/hnn

OPERATING HANDBOOK

ISSUE 6, APRIL 2008

PATENTS PENDING

DESIGNED AND MANUFACTURED IN AUSTRALIA

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MADE IN AUSTRALIA

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MODEL ES-4980

Multi-function Installation Tester - Advanced Model

Operating Instructions

PART	CONTENTS	PAGE
1	Overview	1
2	Notes	2
3	Compliance	3
4	Disclaimer	3
5	General Description	4
	Usage and Benefits	4
6	Tests in detail	5
7	Battery Check & Maintenance	8
8	Quick User Guide	10
9	Specifications	11
10	Service Information	12
	Warranty	12

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1. Overview

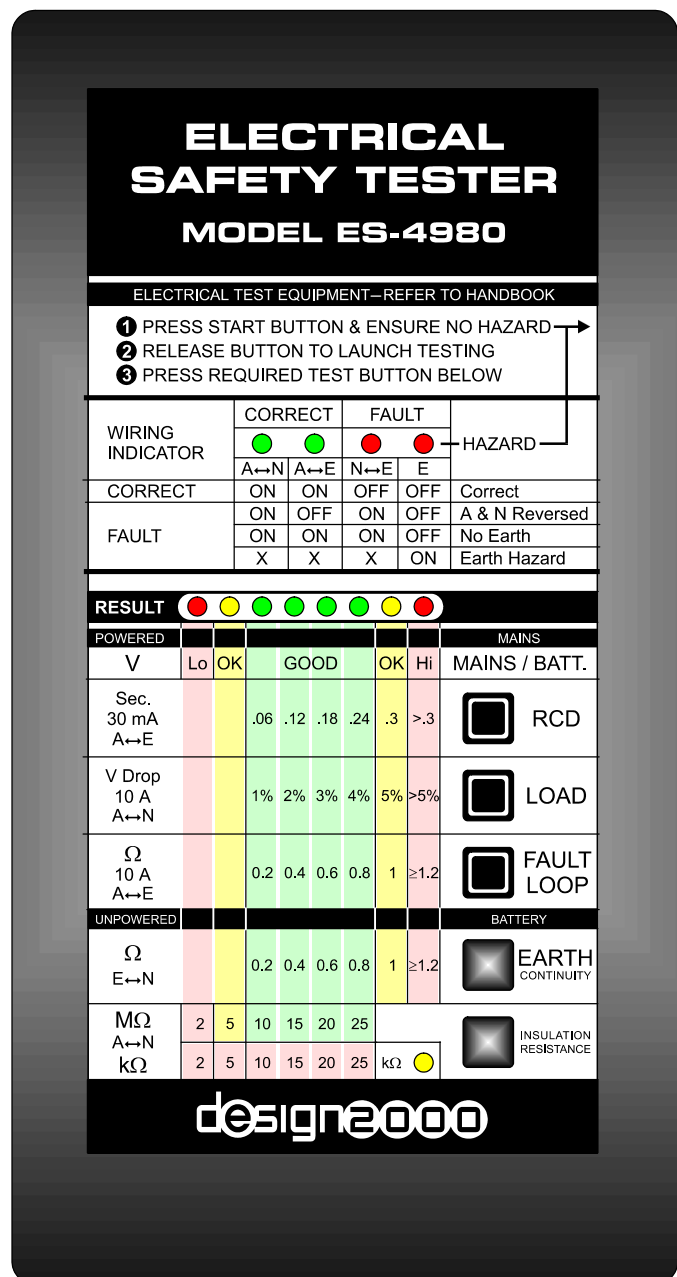
ELECTRICAL SAFETY TESTER Model ES-4980

MULTI-FUNCTION ELECTRICAL SAFETY TESTER

FEATURES

This unit performs comprehensive electrical wiring tests implicit in AS/NZS 3000:2007 from a socket outlet, with no need for a separate earth reference, no need to bridge out RCDs, and no need to disconnect electrical appliances!

- ❑ **EARTH CONTINUITY**
AS/NZS 3000:2007 Clause 8.3.5
- ❑ **INSULATION RESISTANCE**
AS/NZS 3000:2007 Clause 8.3.6 (prelude)
- ❑ **POLARITY**
AS/NZS 3000:2007 Clause 8.3.7 / 8.3.8
- ❑ **IDLE SUPPLY VOLTAGE**
Check for voltage to AS 60038
ie. 230V +10%, -6%
- ❑ **TOTAL FAULT LOOP (A TO E) IMPEDANCE**
(Without tripping RCDs)
AS/NZS 3000:2007 Clause 8.3.9
- ❑ **LOAD TEST**
AS/NZS 3000:2007 Clause 8.2.2 / 8.3.9
- ❑ **RCD TEST**
AS/NZS 3000:2007 Clause 8.3.10
- ❑ **EARTH RESISTANCE**
(AS/NZS 3000:2007 Clause 8.3.5)
- ❑ **EARTH LEAKAGE**
AS/NZS 3000:2000 Clause 2.5
- ❑ **EXTENSION LEAD TESTING**
(IMPORTANTLY UNDER 10A MOMENTARY LOAD!)
- ❑ **AUTOMATIC PROTECTION OF UNPOWERED TESTS**
(IF MAINS POWER IS APPLIED)



Congratulations and thank you for purchasing this Australian engineered and manufactured innovative product. You are guaranteed to have years of dependable and trouble free service from this new compact multi-function Safety Tester. We trust that it will make the testing of electrical outlets a very straightforward process.

2. Notes

- The ES-4980 is designed to be plugged directly into a three pin power point (General Purpose Outlet (GPO), now called a Socket Outlet). It can also be connected to other socket types such as bayonet and Edison screw but interconnecting cables and leads may affect readings.
- Only use the supplied power cable. If it is damaged, replace only with part number K3741 or manufacturer's equivalent.
- If the ES-4980 indicates a wiring fault, a qualified electrician should correct it before testing is continued.
- The tester may be used to test the wiring of extension leads, power boards and double adaptors but please be aware that the *LOAD TEST* and *FAULT LOOP TEST* will reveal voltage drop (or increased resistance) in thin gauge flex cables. Refer to a qualified electrician if necessary.
- The ES-4980 is a professional piece of electrical test equipment. It is not considered to be a consumer electronics appliance.
- Although the ES-4980 is splash proof, do not subject or submerge the unit into any liquid.
- The ES-4980 may be configured and supplied with special leads for testing power points with different mains voltages & plug styles of other countries as an option.
- Routine calibration is NOT required.
- The ES-4980 has no user serviceable parts. To prevent electric shock, never remove the rear cover without first disconnecting from the mains. Repair and calibration is to be performed by qualified personnel only.
- The internal rechargeable 2 x AAA Ni-MH 900mAh batteries are automatically charged when the unit is plugged into the mains. Should the rechargeable batteries ever need replacing it is absolutely mandatory that the unit is disconnected from the mains supply before opening the unit.

3. Compliance

- The ELECTRICAL SAFETY TESTER, ES-4980 performs both mandatory and optional tests as outlined in AS/NZS 3000, and complies with the relevant clauses of AS/NZS 3017 (prevention of a fire and preventing a person from receiving an electric shock), AS/NZS 3260 (now superceded by AS/NZS 60950), AS/NZS 3100 (guidelines covering design and testing of electrical equipment to ensure safety and protection against electric shock), AS/NZS 3350.1 (although more appropriate for household & commercial appliances themselves) and AS/NZS 61010.1 (general safety requirements for electrical test, measuring, control and laboratory equipment) for Electrical Safety.
- Independent testing by a NATA approved test house is a voluntary procedure for this type of test equipment, as outlined in the safety guidelines (revised January 2002) published by the Office of the Chief Electrical Inspector.
- The ES-4980 meets Category III – high energy circuits Industrial use as per AS 61010.1 “Safety of Electrical Equipment for Measurement, Control and Laboratory Use”.

4. Disclaimer

- The manufacturer or authorized distributor cannot accept responsibility for any unlikely damages or personal injury deemed to be as result of using the ES-4980 tester.

5. General Description

The Electrical Safety Tester, Model ES-4980, is designed to measure and test the integrity of household, commercial building and construction site mains electrical circuits in all respects. It is a portable instrument typically used by electricians involved in the installation and maintenance of the electrical wiring and outlets.

Testing is so easily performed from the power point under test simply by plugging the unit in, starting it up and pressing the required test button. The inbuilt LED (Light Emitting Diode) indicators then provide an immediate test result.

The ES-4980 Tester performs both unpowered tests (mains off, with internal battery power feed) and powered tests (mains on). It features automatic protection of unpowered tests if mains power is applied.

The ES-4980 Tester is designed for failsafe and straightforward easy operation:

- Green lights indicate GOOD or PASS
- Yellow lights indicate OK or PASS
- Red lights indicate Lo/Hi WARNING or FAIL.

This is generally all the testing officer needs to know, however the following descriptions and instructions go into more detail.

The ES-4980 is ideal for testing new electrical installations prior to hand-over of compliance certificates. It is used on construction sites to satisfy tagging and OH & S requirements. It is also the perfect test instrument for testing the wiring to power points in existing and older homes. Always of concern, old household and building wiring (whether it is visible or concealed) can be tested in seconds.

USAGE & BENEFITS

The ES-4980 will test:

- Polarity and Earth connection – is the Active and Neutral wired correctly, and is the earth connected and at a safe potential?
- Supply voltage – is the mains supply within -6% and + 10% of the specified 230Vac? (Other voltages to order).
- Voltage drop under load – is there a faulty junction, a bad termination or is the cable run too long or of insufficient gauge? Can concealed wiring handle the load?
- Residual Current Device (Earth leakage detector or Safety switch) operation – does it really work and trip in time at the power outlet?
- Fault Loop Impedance (without tripping RCDs) – is the total loop resistance of the Active and Earth wires as low as it should be so that leakage current will be detected?
- Earth Continuity – is the Earth bonded to the Neutral properly?
- Insulation resistance – is the resistance between the Active and Neutral as high as it should be? (Tested using a SAFE voltage).
- Extension leads – Test these, power boards, double adaptors etc.

Many people are afraid of electricity because it can't be seen but it can certainly bite! The main benefit of the ES-4980 is that it provides a straightforward **visual** indication of the condition of power outlets. It also offers cost savings by being quick and easy to use. Needless to say that the ultimate aim is to reduce the incidence of electrocution or fire and maximize the operating life of appliances.

6. Tests

The following test instructions assume that you have plugged the ES-4980 into the power point under test and that you have:

1. Pressed and held the START button and checked for no Earth hazard.
2. Released the START button and viewed either the battery voltage (for unpowered tests) or mains voltage (for powered tests).
3. You have pressed the required test button.

6.1. UNPOWERED TESTS ie. Mains Supply Disconnected

All unpowered test results are displayed for up to 10 seconds. You can repeat or move on to the next test before this time expires.

6.1.A. INSULATION RESISTANCE TEST (AS/NZS 3000:2007 Clause 8.3.6)

Notes:

- This tester does NOT fully comply with AS/NZS 3000:2007 Clause 8.3.6. The test calls for 500 Vdc or 250 Vdc when measuring insulation resistance. Here we use a safe 12 Vdc to provide a preliminary warning should there be poor insulation. Use an appropriate instrument if this Tester reveals a low impedance.
- This test should be performed with the individual circuit breaker turned OFF, the RCD turned ON or OFF, all other appliances on the circuit either unplugged or turned OFF at their socket outlets, and the socket outlet switch under test turned ON.

Active to Neutral Insulation Resistance is measured by applying an internally generated SAFE voltage through a known resistance to the active conductor, thus forming a voltage divider with the leakage resistance from active to neutral. The voltage between active and neutral is then measured, and the leakage resistance calculated. This is displayed by the row of LED indicators as suggested:

0 – 2 M Ω in red, 2 – 5 M Ω in yellow, then in steps of 5 M Ω up to 25 M Ω or more in green. (The auto ranging k Ω range is also provided and is scanned first, indicated by the k Ω LED. If the k Ω LED goes out, the M Ω range applies. If a reading between the two ranges is obtained, only the k Ω LED illuminates).

6.1.B. EARTH CONTINUITY (AS/NZS 3000:2007 Clause 8.3.5)

(Note: This test should be performed with the individual circuit breaker turned OFF, the RCD turned ON, and the socket outlet switch turned ON).

Earth to Neutral loop Resistance is measured by applying an internally generated current through the Earth and Neutral Conductors and the associated power point Contacts, measuring the resultant voltage across the circuit, and calculating the impedance. This is displayed by a row of LEDs in steps of 0.2 Ω

up to 0.8 Ω in Green, 1 Ω in Yellow, and 1.2 Ω and over in Red. Combining the result of this test with the Load test performed later, (after power has been applied) allows the Earth Conductor and power point Contact resistance to be calculated with a reasonable accuracy, as will be explained later under 6.2.D.

6.2. POWERED TESTS ie. with the Mains Supply Connected

All powered test results are displayed for up to 60 seconds. You can repeat or move on to the next test before this time expires.

6.2.A. POLARITY (AS/NZS 3000:2007 Clause 8.3.7 / 8.3.8)

The Wiring Indicator lights up the moment the unit is plugged into a live power point. The set of LEDs indicate the potentials between the socket outlet contacts:

Green: Active to Neutral

Green: Active to Earth

Red: Neutral to Earth

Red: Earth to the Start button and the person performing the test.

The two green LEDs indicate correct polarity. Either or both red LEDs indicate a wiring fault. Refer to the 'Truth Table' on the Tester for details.

Note: There are 2 x 1 Meg. Ω resistors in series with the Start button that limit the possible current flow. If the Earth contact potential was to be at 230 Volts, the current would be limited to a perfectly safe 120 microamps maximum.

6.2.B. IDLE SUPPLY VOLTAGE (Check for voltage to AS 60038 ie. 230V +10% -6%)

(Note: The supply voltage is displayed for up to a minute after pressing and releasing the START button).

The unloaded Active to Neutral potential is indicated by 8 LEDs: showing from Low (<230V - 6%) in Red, through marginal (230V - 6%) in Yellow, into Good (230V +9%/-5%) in Green, then marginally high (230V + 10%) in Yellow, to excessively High (>230V + 10%) in Red.

6.2.C. TOTAL FAULT LOOP (A TO E) IMPEDANCE (AS/NZS 3000:2007 Clause 8.3.9)

(Note: You will normally NOT need to bridge out the RCD. If the RCD does trip during this test then it has some leakage current or it is too sensitive. You will then need to find and remove the source of the resistance (possibly a 'leaky' appliance) or bridge out the RCD to perform the Fault Loop test).

The Fault Loop (A to E) impedance test directly measures the A to E impedance (without tripping the RCD) by drawing 10 amps for less than a millisecond. The resulting impedance is then indicated on the row of lights in steps of 0.2 Ω up to 0.8 Ω in Green, 1 Ω in Yellow, and 1.2 Ω and over in Red. The total fault loop (A to E) impedance reading is then related to the type and rating of the protective devices used to protect the circuit under test.

6.2.D. LOAD TEST (AS/NZS 3000:2007 Clause 8.2.2 / 8.3.9)

A 10 Amp load is applied between Active and Neutral via the outlet Contacts and the resultant voltage drop (no load to 10A at 230V equivalent (voltage measured at time of test)) is measured in 1% steps from 1% to 5% and above as follows: 1% to 4% in Green, 5% in Yellow, and above 5% in Red. Flashing Red is >6%.

6.2.D.1 Resistance of the Earthing System (AS/NZS 3000:2007 Clause 8.3.5)

The Load Test readings correspond closely to the resistance scale used in the Earth Continuity test, and can be taken as such, eg. 1% \approx 0.2 Ω , 2% \approx 0.4 Ω , 3% \approx 0.6 Ω , 4% \approx 0.8 Ω , 5% \approx 1 Ω etc.

The combination of the Earth Continuity and Load tests can then be used to obtain the resistance of the Earth Connection (including the power outlet Contact) as follows:

Assuming that the resistances of the Active and Neutral Conductors are equal, ie: each is half of the Active to Neutral loop resistance, then the Earth Conductor and power outlet Contact resistance equals the Earth to Neutral resistance (from Earth Continuity test 6.1.B.) minus half the resistance obtained from the Load test 6.2.D. The net resistance of the main Earthing conductor should be \leq 0.5 Ω .

In summary:

The Earth resistance = (E to N) – [(A to N)/2].

This allows a good approximation of the EARTH impedance to be obtained at any outlet, without the need of having to run extra wires to the external Earthing point – **see also 6.2.C. – Fault Loop Impedance** where half of the loop impedance should equal the Earth resistance if the Earthing conductor is the same gauge as the Active conductor.

6.2.E. RCD TEST (AS/NZS 3000:2007 Clause 8.3.10)

Pressing the test button on the RCD Safety Switch itself does NOT provide any guarantee that the RCD works at any given power point. The ES-4980 RCD Test does. A current of 30 mA is drawn from Active to Earth. The time taken for the Active to be disconnected by the RCD is measured and displayed by a set of LEDs in 60 ms steps: 10 to 240 ms in Green, 240 to 300 ms in Yellow, and over 300 ms in Red. (Please note that these readings apply for 30mA trip current RCDs. 10mA trip current RCDs are used in certain places like hospitals and to test these, the ES-4980 can be factory modified).

If the RCD fails to trip or the circuit is not protected by an RCD, all the 'Result' LEDs will flash very rapidly together.

6.2.F. EXTENSION LEADS

These can easily be tested in conjunction with a Socket Outlet with known characteristics. First fully test the socket outlet carefully noting the readings. Before plugging the extension lead into the socket plug the EST into the socket of the lead. Check the plug is not in contact with anything conductive & perform the insulation test (described above), if OK plug the extension lead into the socket outlet and switch the outlet on. Note the polarity indication and press and hold the START button to check dangerous voltages on earth. To fully test the lead, perform the LOAD TEST & TOTAL FAULT LOOP tests. The results of the socket outlet tests are simply subtracted from these results. This gives an accurate indication of the lead's performance under 10A load conditions. Power boards and double adaptors can also be tested as described above.

6.2.G. EARTH LEAKAGE & RCD's THAT ARE TRIPPING (AS/NZS 3000:2000 Clause 2.5)

(Note: not yet implemented)

To assist in the location of earth leakages, the following test can be performed. With the RCD off, and all related individual circuit breakers isolated, press and hold for 5 seconds the INSULATION RESISTANCE test button. This puts the EST into a mode where it looks for low resistance between Active and Earth. This allows the user to check circuits for any apparent low resistance, indicating a fault. (NOTE: this test is performed at safe low voltage and may not show faults eg. where water is causing conduction at higher voltages).

Active to Earth Resistance is measured by applying an internally generated SAFE voltage through a known resistance to the active conductor, thus forming a voltage divider with the leakage resistance from active to neutral (with the MEN link fitted) and Earth. The voltage between active and neutral is then measured, and the leakage resistance calculated. This is displayed by the row of LED indicators as suggested: 0 – 2 k Ω in red, 2 – 5 k Ω in yellow, then in steps of 5 k Ω up to 25 k Ω in green.

7. Battery Check & Maintenance

To display the ES-4980 internal rechargeable battery status, simply press the START button when the unit is unplugged. The battery status is indicated by a slow flashing LED in the 'RESULT' bar graph. The right hand green LED means fully charged.

The internal batteries (2 x AAA Ni-MH 900mAh) are automatically charged whenever the unit is plugged into the mains. The inbuilt charging circuitry will NOT overcharge the batteries so you can leave the ES-4980 plugged in for as long as you like. The battery charging condition is indicated by scrolling LEDs from OK to GOOD. You will see the charging indication after one minute of the unit being plugged into the mains.

NOTE: *If the MasterSafe fails to start up, the internal batteries may be fully discharged (flat). In this instance, simply leave the MasterSafe plugged in and powered up for up to 12 hours or more. The battery charging indication will resume automatically when the batteries have been sufficiently charged.*

8. Quick User Guide

Note:

- If any of the following tests fail (shown by a red LED), stop and refer the problem to a qualified electrician for rectification.
- The tests are NOT necessarily performed in the following order.

UNPOWERED TESTS (POWERED BY INTERNAL BATTERY)

1. Isolate the circuit mains active wire (without breaking the neutral) by turning off the circuit breaker. Plug the **EST** into the power point to be tested. Make sure the socket outlet switch is turned on (with mains power off).
 - Press and hold the Start button and ensure no Earth Hazard.
 - Release Start button.
- ✓ Check that the internal **battery** voltage is slow pulsing green or yellow.
 - ✓ Press '**Insulation Resistance**' button and check that a single yellow or green LED illuminates (5 – 25 M Ω).
 - ✓ Press '**Earth Continuity**' button and check that a single yellow or green LED illuminates (0.2 – 1 Ω).

POWERED TESTS (POWERED BY MAINS)

2. Turn on circuit mains, and plug the **EST** into the power point to be tested.
 - Press and hold the **Start** button and ensure no Earth Hazard.
 - Release **Start** button.
- ✓ Check that the **WIRING INDICATOR** lights are only green (correct).
 - ✓ Check that the **Mains** supply voltage is pulsing green or yellow.
 - ✓ Press '**Fault Loop**' button and check that a single yellow or green LED illuminates (0.2 – 1 Ω).
 - ✓ Press '**Load**' Test button and check that a single yellow or green LED illuminates (1 – 5% V drop).
 - ✓ Press '**RCD**' button and check that a single yellow or green LED illuminates (60 – 300 ms)
 - Reset the Safety Switch at the switchboard/meter box.
3. Check that the **EST** indicator lights turn on again, then unplug the **EST**.

The EST has verified that the Power point is OK to use.

- Fill out the attached checklist L25151A and file for future reference.

9. Specifications

Enclosure:	Part Number 90-74-109, ABS fire retardant rating UL94HB, IP-54 rated.
Dimensions:	195mm x 100mm x 45mm (H x W x D)
Label:	EBG180 Autoflex Gloss Polyester, automotive grade.
Operating Temperature Range:	-10 → 50 ° C ambient.
Storage Temperature Range:	-20 → 80 ° C ambient.
Humidity, Storage and Operating:	To 98% non condensing.
Mean Time Between Failure:	> 20 years.
Control Logic:	Texas Instruments MSP430F449, 64K bytes internal program flash memory.
Indicators:	High intensity LEDs, Red, Yellow, Green. Red LED hazard light.
Connector:	Hard-wired mains lead.
Power lead:	K3741. Other plugs to order.
Testing Criteria:	AS/NZS 3000:2007, Section 8 - Verification
Wiring Indicator:	Correct, A&N reversed, no Earth, Earth hazard
Mains Supply Indicator:	
Hi	> 10% of nominal voltage.
Lo	< 6% of nominal voltage.
OK	Within -6% and + 10% of nominal voltage.
GOOD	Within -5% to +9% of nominal voltage.
Fault Loop Test:	10A between active and earth for 1 ms. (RCD should not trip) Range 0.2 - ≥ 1.2 Ω. Display resolution 0.2 Ω
Load Test:	10A between active and neutral. Range 1 - >5% V drop referenced to supply voltage. Display resolution 1%.
RCD Test:	30 mA between active and earth. Range 10 - >300 ms trip time. Display resolution 60ms.
Battery Condition Indicator:	Slow pulsing Result LED shows charge, scrolling LEDs indicate charging.
Insulation Resistance Test:	Active to neutral resistance derived from an internally generated 12Vdc applied across active & neutral through a sensing resistor. This is a safe voltage and only a prelude to a 500V test. Auto Ranging 2 - 25 kΩ and 2 - 25 MΩ. Display resolution 3 kΩ to 5 MΩ.
Earth Continuity Test:	Earth to neutral resistance derived from an internally produced 10A (average) pulsed through the earth to neutral circuit. Range 0.2 - ≥ 1.2 Ω. Display resolution 0.2 Ω
Field Programming:	RS232C. Authorised Partners only.
Factory Programming:	Via Host Computer (RS232C).
Power Requirement:	230V ac 50 Hz., ± 20% (other voltages to order).
Power Consumption:	10 mA (2W) nominal during idle.
Internal Batteries:	2 x AAA Ni-MH 900mAh rechargeable.
Auto turn-off:	After 30 seconds (unpowered mode).
Packed Weight:	350 gms.
Warranty:	Two years.
Electrical Safety Compliance (non-prescribed)	AS 3300, AS/NZS 3017, AS/NZS 3260 (AS/NZS 60950), AS/NZS 3100, AS/NZS 3350.1, AS/NZS 61010.1 Category III, other
ACMA Compliance:	Design Two Thousand Pty Ltd ACMA supplier's Code N468.
EMC Compliance:	AS/NZS CISPR 22
Human Rights Australia:	Privacy Commissioner assent 89/328

10. Service Information

If problems are experienced with the operation of the ES-4980 Electrical Safety Tester, please call the Help Desk Number listed below before returning units to the factory for repair.

In most cases, problems can be diagnosed and rectified over the phone, avoiding unnecessary transportation and service costs.

HELP DESK NUMBER:

+61 3 9758 5933

Warranty

The equipment has a warranty against defects in material and workmanship for a period of two years from date of delivery into the customer's store. Within this period repairs, if necessary, are without charge for parts and labour.

Transport costs to the factory will be to the customer's account, and Design Two Thousand Pty Ltd will cover the return transport costs for warranty repairs. If units are sent to the factory and discovered to be 'No Fault Found', a service charge may apply and the return transport costs may be to the customer's account.

See 'SERVICE INFORMATION' above. In the explicit event of a malfunction, please send the unit, (along with an accurate fault report, contact name and number, and a return address) for repair to the place of purchase or:

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ES-4980

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PRELIMINARY SPECIFICATIONS
ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



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