

It is strongly recommended that all sections of this manual are read and fully understood by all those intending to carry out or supervise any activity involved in electrical safety testing using this test equipment.

INTRODUCTION.....2
Reasons for inspection and testing
Methods of construction for electrical safety
Test requirements to determine electrical safety
Safety test records

INSTRUMENT DESCRIPTION.....9
Controls and Indicators

APPLIANCE TEST PROCEDURES.....17
Precautionary Measures
Visual Inspection
Electrical Safety Verification

INSTRUMENT INTEGRITY.....29
Calibration
Operation Checks

APPENDIX.....33
Useful Reference Material
Useful Addresses

REASONS FOR INSPECTION AND TESTING

In order to satisfy the objectives of the Electricity at Work Regulations 1989, there is a clear need for a structured programme of continual risk assessment for each and every item of electrical equipment in the workplace. Such a programme should be monitored through reviews of the results obtained during regular visual inspection and periodic electrical safety testing.

The frequency of inspection and testing will depend on the type of item and the manner in which it is used -

- static electrical items, such as desk-top computers, fax machines, photo-copiers etc. which are normally used in offices, and other low-risk sector premises, may not need to be checked and tested as frequently as hand-held industrial power tools and the like, which, even in normal use, can be subjected to pretty arduous operating conditions and suffer considerable mechanical stresses.
- likewise, the environment in which an electrical item is used, or stored, should be also be taken into account - a cold, damp, workshop contributing to a higher risk than a nice dry office, for instance.

Repaired items should be subjected to thorough inspection and testing, to ensure full compliance with original manufacturers specifications and any relevant safety standards, before being returned to service.

In order to fully assess potential risks there is also a need for a clear understanding of how construction methods and test requirements aim to provide 'electrical' safety.

METHODS OF CONSTRUCTION FOR ELECTRICAL SAFETY

To provide the user with protection against electric shock general methods of construction must ensure firstly that all 'live' parts are insulated and secondly that should this basic insulation fail the 'live' parts are prevented from creating a hazard to the user.

This second level of protection is achieved either by 'earthing' all accessible conductive surfaces or by providing 'double insulation' in the form of a second insulating layer or by reinforcing the primary insulation layer.

Earthed equipment is referred to as Class I and earthing is achieved by connecting all accessible conductive surfaces (the tool body or outer casing and associated fixings etc.) to the supply earth via a low impedance protective conductor, then if any 'live' part comes into contact with these surfaces the hazardous current is drawn harmlessly to earth through the protective conductor rather than through the person holding the tool. The protective conductor is the green/yellow 'earth' wire in standard 3 core mains supply leads.

Double insulated equipment is referred to as Class II. All accessible conductive surfaces are additionally insulated from internal 'live' parts and components. No 'earth' wire is present in the supply lead. All Class II equipment is identified by a prominent square within a square symbol.

TEST REQUIREMENTS TO DETERMINE ELECTRICAL SAFETY

The most appropriate way of verifying electrical safety is to carry out a series of routine safety tests that both reflect those tests used in the manufacturing process and, particularly in the hire industry, that take into account the effects of normal wear and tear.

VISUAL INSPECTION

It is important when carrying out routine testing to first check for signs of undue wear and tear by a thorough visual inspection - a nick in the supply cable or a cracked casing etc can easily lead to hazardous situations when the power tool or appliance is in use.

ELECTRICAL SAFETY

The tests to verify satisfactory 'earth bonding' and insulation levels will depend on the basic construction of the tool or appliance - Class I (Earthed) or Class II (Double insulated) - and the original standard to which it was manufactured, the most common British Standards being BS2769 for hand held power tools, BS3456 for general appliances and BS415 for mains operated electronic, mainly audio/visual equipment.

However, clear guidance should be sought from the manufacturer, or importer, to determine the appropriate requirement.

EARTH BOND CONTINUITY

Most type testing standards, including those referred to above, require that the earth bond resistance, between all accessible conductive surfaces and the 'earthing' terminal within the appliance, does not exceed 0.1 Ohm and that compliance should be checked by resistance measurement using a test current equal to 1.5 times the rated current or to 25 Amps, whichever is greater, from an a.c. voltage source not exceeding 12 Volts.

The test current for BS415 equipment is limited to 8 Amps due to the wide use of printed circuit tracks in the earth bond path.

In practice, routine testing will also include the protective conductor (Earth wire) in the supply lead and the measurement will be made between the earth pin of the supply plug and exposed metal (conductive) surfaces on the tool or appliance.

WARNING

High current Earth Bond tests may cause damage if inappropriately applied to certain equipment. The A252 does incorporate a special low current (100mA) Functional Earth test for sensitive equipment. If in doubt, consult the manufacturer of the item before applying any test.

ELECTRICAL INSULATION

To check the insulation, between the 'live' conductors (line and neutral) and all exposed metal surfaces, a high voltage a.c. Flash Test is applied. The voltage applied will be dependant on the construction class of the tool or appliance -

- **500V** the minimum test voltage recommended by the HSE in Guidance Note PM32
- **1250V** for standard Class I (earthed) tools and appliances
- **3000V** for routine testing of Class II (double insulated) equipment (2500V for BS415 equipment)
- **3750V** for Class II equipment following repair or reconditioning operations.

Under normal conditions the permissible leakage current at the appropriate flash test voltage should not exceed 5mA. However, some Class I equipment may have higher inherent leakage due to an extra long supply lead or high capacitance suppression filtering, or a combination of the two, under these conditions an increased acceptance level, of up to 10mA, may be permissible. For certain sensitive equipment it may even be advisable to not apply a Flash Test but to only carry out a 500V d.c. Megohmmeter test. If in doubt advice must be sought from the appliance manufacturer.

NOTES

All safety tests must be carried out with the supply switch of the tool or appliance in the ON position to ensure that all 'live' parts are included when checking insulation.

Some specialised equipment with heavy duty motors etc. may employ contactor or relay start switching techniques, therefore to apply a satisfactory insulation (flash) test through such devices the contacts must be held closed by some, safe, manual means - the advice of the manufacturer must be sought on methods to achieve this in the least hazardous manner.

Some 'trigger' operated equipment may require the switch to be temporarily held in the ON position with insulating tape or string - under no circumstances should it be held in by hand,

REMEMBER TO RELEASE THE SUPPLY SWITCH WHEN TESTING IS COMPLETE.

Multi - function tools and appliances must be fully tested with supply and function switches set for each operating mode.

SAFETY TEST RECORDS

The recording of test results, to provide a traceable history of equipment worthiness, can also prove beneficial as a management tool for monitoring the effectiveness of the overall maintenance system, for reviewing test frequencies, and for asset tracking purposes etc.

To provide a meaningful structure for such results recording, **CLARE** have developed a fully featured, paper-based, **TEST LOG** system with full recording facilities for equipment details, test routines, checklists, and detailed test reports. With it's easy to follow format, it provides an invaluable reference to equipment status and is therefore suitable for most industrial / workplace applications where routine testing to a regular schedule is required.

For data intensive applications **CLARE** can also offer the **DATAPAT 600** system which combines a bar-code reader, electronic data logging and a comprehensive suite of management software. Fully inter-active with all CLARE Portable Appliance Testers the system provides easy to follow, menu-driven, routines to guide the user through data collection and storage, transfer of data - through an integral RS232 link - to a host PC and manipulation of data to automatically up-date, or create, records and reports.

A252

PORTABLE APPLIANCE TESTER

The CLARE A252 instrument is specifically designed to provide a quick and simple means of verifying the electrical safety of most commonly found Class I (Earthed) and Class II (Double Insulated) power tools and appliances.

With additional facilities for testing even the most sensitive of Information Technology (IT) type equipment, the A252 is ideally suited to both industrial and office / shop environments.

The instrument is fitted with Test Sockets for both standard 240V/13Amp (BS1363A) and industrial 110V/16Amp (BS4343) connectors.

Appliances fitted with other plug styles can be readily accommodated using suitable adaptors, refer to P.15 for more details.

Accessories supplied with the instrument, including a high voltage Safety Probe, Earth Return lead and a simple to use Appliance Fault Simulator - for checking the integrity of the fault detection circuitry - are stored in the compartment at the rear of the instrument.

CONTROLS AND INDICATORS

The following section acts as a guide to the instrument and to provide familiarisation with each of the controls and associated functions.

Supply Input the permanently attached mains lead is fitted with a 13A (BS1363A) plug for connection to a 240V a.c. Earthed supply. The plug top fuse should be rated at **3Amps**. The lead is stored in the rear compartment.

Supply Lamps these two lamps, 1 amber and 1 red, are used to indicate the condition of the Incoming supply. It is important that the external supply circuit is correctly wired and provides a sound earth connection for this instrument.

The amber lamp must be ON whenever the instrument is connected to a live mains supply. If the amber lamp fails to glow AND / OR the red FAULT lamp is ON there is likely to be a connection fault on the supply socket - such as reversed polarity of Line and Neutral or no Earth connection at the supply socket. Disconnect the instrument immediately and have the supply fault investigated and corrected, by qualified personnel, before re-using the suspect socket for either this instrument or any other tool or appliance.

NOTE

If neither lamp glows, check that the supply is ON - if it is ON check the wiring of the A252 plugtop and fuse. Failing this, the fault is within the instrument. It must be withdrawn and thoroughly investigated and corrected, by qualified personnel, before carrying out any appliance testing.

Flash Test PASS/FAIL lamps glow to indicate the result of the applied test.

When applying a double insulated test via the flash probe a PASS indication should be taken to indicate that no fault was found at the point of application of the probe.

Test Selector rotate switch and set to required test as follows

for Class I equipment

Earth Test also use appropriate Earth Return socket to select 25A or 8A test current.
500v Flash mainly only used for equipment with inherently high capacitance suppression.
1250v Flash for normal Class I equipment.

for Class II equipment

2500v Flash for routine testing of audio/visual appliances and other BS415 related equipment.
3000v Flash for routine testing.
3750v Flash for repaired or reconditioned tools.

for Information Technology (IT) Equipment

Functional Earth 100mA continuity test, purely functional - not to be confused with safety Earth Test.
500vDC Megohms for measuring insulation resistance if Flash Test considered too severe.

Set Inf. These two controls, adjacent to the test selector, are multi-turn adjusters for setting-up the associated metering circuits. Select Earth Test or Functional Earth, plug the clip lead into the appropriate socket, this also selects the associated metering range, and isolate the clip. Depress the main Test button and adjust the Set Inf. control until the meter pointer is on the Inf. mark of the appropriate scale.

Earth Return Sockets These sockets are used, with the earth return clip lead (see below), to select the test current to be applied Use the yellow socket for the **8A** test required for electronic audio/visual (BS415) apparatus or the green socket for the **25A** test required for power tools and electrical appliances. The blue **100mA** socket is used when applying the low current Functional Earth test on sensitive IT equipment.

Earth Return Clip Lead this lead is used to complete the Earth circuit test path, it is plugged into the appropriate green, yellow or blue Earth Return socket and then clipped to clean, exposed, metalwork on the appliance. Ensure that the clip is soundly connected to prevent any high current arcing causing damage to polished surfaces. This lead is not required when testing double insulated appliances.

DEPRESS TO TEST this momentary action push button is used to apply the selected safety test.

10mA TRIP this push button is used to select the higher trip threshold for Class I Flash Tests.

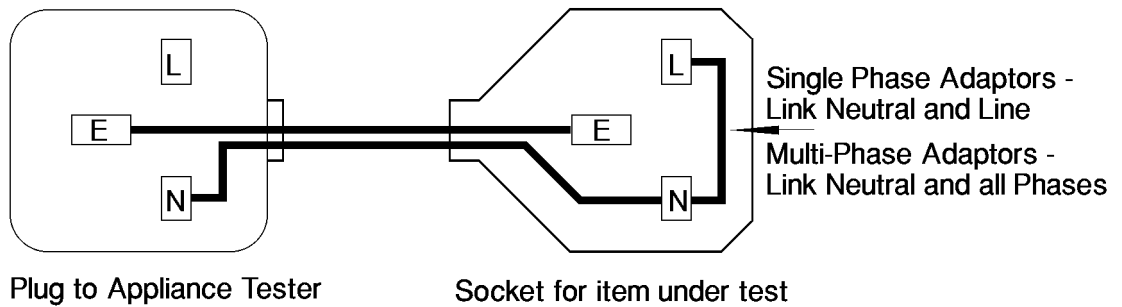
Flash Test Probe this high voltage safety probe is used when applying the Flash Test, or taking Insulation Resistance measurements, with Double Insulated appliances.

The test tip, which is exposed by depressing the red actuator on the probe handle, should be applied to any exposed metal on the appliance including screwheads and rivets etc and to casing joints, particularly around handgrips, switches and cable entries.

The high voltage is only applied when the TEST button is depressed. Tiny sparks and a light crackling sound may be observed when applying the test tip, this is quite normal at such high voltage levels and should not be confused with a flash-over, which, if it occurs, will be clearly indicated by the Flash Fault lamp and alarm.

Test Sockets the two sockets fitted as standard, 240V/13A (BS 1363A) and industrial 110V/16A (BS 4343), will suit most appliances found in the workplace environment.

Equipment fitted with other plug styles can be readily accommodated by making and using suitable adaptors generally as illustrated below.



Inter-connection and link wires must be kept as short as is practical and must be suitably rated to withstand the high current and high voltages that will be present during a Safety Test.

APPLIANCE TEST PROCEDURES

PRECAUTIONARY MEASURES

Appliance testing, by its very nature, can be hazardous and various common sense precautions should be observed -

- Ensure that the person responsible for testing is competent and fully trained in the general principles of Safety Testing AND the correct use of any required test instruments.
- Ensure, where possible, that a 'test area' is clearly defined and offers limited access to all persons not involved in the testing.
- Ensure that the appliance to be tested is on an insulated (non-conducting) worksurface - **never use metal, or metal edged, worktops** - a robust wooden bench with a securely fitted rubber covering is best.

For those 'on site' situations where dedicated test areas are unavailable, an old plastic tea tray or rubber car mat can come in very useful for creating the insulated worksurface. Do not use 'anti-static' matting as this is highly conductive - which rather defeats the object.

- Arrange appliances and test equipment so that controls are easily accessible without having to reach over or lean across the item during testing - **never come into contact with an appliance under test.**

- Securely fix down motorised appliances and ensure that moving parts are adequately guarded.
- Check that the intended test is suitable for the appliance - if in doubt contact the Manufacturer or Importer of the appliance.

Although CLARE are the recognised experts in the field of Electrical Safety Testing we can't possibly have an intimate knowledge of every item of electrical apparatus in the marketplace!

- Always carry out a thorough Visual Inspection, and complete any necessary repairs, before applying any electrical test.
- If any Safety Test failure occurs ensure that the appliance is fully re-tested after undergoing appropriate repairs.

VISUAL INSPECTION

Before applying the Earth Bonding and Insulation tests a thorough visual inspection of the appliance must be carried out. This may well form the greater part - 75% or more - of any test routine.

CASING

Check for signs of undue wear, cracks or dents, missing components such as guards, covers or hand grips etc.

Ensure that all screws and catches are present and secure.

Check for evidence of excessive dust and dirt build up in and around any ventilation slots, especially carbon-brush dust which is highly conductive and could create a 'live' path around insulation barriers.

Also ensure that all movable guards operate smoothly.

SUPPLY Lead

Check for any signs of damage or fraying along the entire length, this should also include any extension lead that may be regularly used with the appliance.

Ensure that any cable entry or connector is sound and secure.

PLUGS AND FUSES

Thoroughly check plug tops for damage and ensure that all wires are correctly connected.

Ensure that cable grips and strain relief bushes are properly secure.

Check that the correctly rated fuses are fitted - even a 5A fuse fitted in place of a recommended 3A fuse may give rise to a potentially dangerous fault condition.

SWITCHES AND FUNCTION SELECTORS

Ensure that all switches, including rotary selector devices, operate smoothly and in the expected manner.

Set supply switches to the ON position in preparation for the Safety Test. Multi-function appliances, such as a two heat/two speed heater, will require testing in each operating mode.

NOTE Any fault or irregularity highlighted by the visual inspection must be corrected before electrical testing is carried out.

ELECTRICAL SAFETY VERIFICATION

All safety tests must be carried out with the supply switch of the tool or appliance in the ON position to ensure that all 'live' parts are included when checking insulation - refer also to the NOTES in the Test Requirements section.

Connect the test instrument to an Earthed supply socket and switch ON, connect the appliance to be tested into the appropriate 110V or 240V socket.

EARTH CONTINUITY MEASUREMENT - 25A AND 8A

Select **Earth Test** on the instrument. Plug the yellow 'Earth Return' clip lead into the appropriate **25A** or **8A** Earth Return socket on the instrument and attach the clip to clean exposed metal on the appliance. Good connections are essential for accurate measurement and to prevent any high current sparks occurring when the test is applied.

Depress the TEST button for 3 to 5 seconds and observe the resistance indicated on the appropriate meter scale - **25A** or **8A**. If the resistance of the earth path is greatly in excess of the anticipated value, a broken earth wire, loose connections or corroded terminals should be suspected.

WARNING

- The high current of the Earth Test will cause a certain amount of self-heating, particularly if using the 25A circuit, to both the appliance wiring and the test circuitry. To keep this within acceptable limits and prevent overheating, do not apply an Earth Test for more than 5 seconds and do not apply more than two tests in any one minute period.

NOTE

- Where exposed metal parts do not form part of a continuous surface with all other exposed metal the test must be repeated with the earth clip attached to each exposed metal surface in turn.

FLASH TEST - EARTHED APPLIANCES

Although all tests can be applied independently it is advisable, when testing earthed equipment, to ensure that there is a satisfactory earth path BEFORE applying a Flash Test .

Connect the appliance into the appropriate test socket and select the 1250V Flash Test.

Depress the TEST button and observe the Flash Test lamps, the green PASS lamp should come on to indicate a satisfactory test.

If the warning buzzer sounds continuously and the red Flash FAIL lamp comes on, one of the following conditions is indicated -

- the insulation is unsatisfactory, permitting a leakage current in excess of the nominal 5mA.
- a flash-over has occurred between the Earth path and one or other of the Line and Neutral paths.

The appliance should be considered unsafe, clearly marked as such and withdrawn for full workshop investigation and repair. It must be FULLY re-tested before being returned to service.

If the failure is thought to be caused by the presence of a high leakage suppression filter, an extra long supply lead or a high brightness neon in the supply circuit, - giving rise to a total leakage current in excess of the nominal 5mA - it may be permissible (on the advice of the appliance manufacturer) to re-apply the test at the lower setting of 500V or using the higher 10mA trip threshold.

FLASH TEST - DOUBLE INSULATED APPLIANCES

All tests must be carried out with the supply switch of the tool or appliance in the ON position to ensure that all 'live' parts are included when checking insulation - refer also to the NOTES in the Test Requirement section. The special safety Flash Test Probe is used for this test.

Ensure that the appliance is secured and positioned so as to allow access to the various test points - if it becomes necessary to move the appliance for easier access to a test point, release both the probe and the Test button first.

Select the 2500V, 3000V or 3750V test to suit the requirement - refer to the Safety Test Selector section under Controls and Indicators.

Depress and hold the TEST button and apply the Flash Probe tip to all exposed metal surfaces, including screw heads and rivets, and to casing joints - especially those around switches and cable entries.

Observe the TEST RESULT lamps, the green Flash PASS lamp should come on, and then remain on, to indicate that no flash-over has occurred at those points to which the probe tip is applied.

FAULT INDICATION

If the fault warning buzzer sounds continuously and the red Flash FAIL lamp comes on, the insulation - between the Line or Neutral paths and the point of test - has failed to withstand the applied voltage.

INSULATION RESISTANCE MEASUREMENT @ 500VDC - EARTHED APPLIANCES

Connect the test instrument to an Earthed supply and switch ON. Connect the appliance to be tested into the appropriate 110V or 240V socket and ensure that appliance switches are ON.

Select the **500vDC Megohms** test and depress the TEST button. The test voltage is applied across the Earth path and both the Line and Neutral paths and the Insulation Resistance (in Megohms) will be indicated on the lower meter scale - for the insulation to be considered as satisfactory, the resistance must be greater than **2 Megohms** for earthed appliances.

INSULATION RESISTANCE MEASUREMENT @ 500VDC - DOUBLE INSULATED APPLIANCES

Connect the test instrument to an Earthed supply and switch ON. Connect the appliance to be tested into the appropriate 110V or 240V socket and ensure that appliance switches are ON.

Select the **500vDC Megohms** test and depress the TEST button. Apply the safety Flash Probe to relevant test points on the appliance to measure the Insulation Resistance between the test point and both the Line and Neutral paths.

Observe the value (in Megohms) on the lower meter scale - it must be greater than **7 Megohms**.

FUNCTIONAL EARTH MEASUREMENT

Connect the test instrument to an Earthed supply and switch ON. Connect the appliance to be tested into the appropriate 110V or 240V socket and ensure that appliance switches are ON.

Select the **Functional Earth** test. Plug the yellow 'Earth Return' clip lead into the blue **100mA** Earth Return socket on the instrument and attach the clip to the relevant test point on the equipment being tested. Good connections are essential for accurate measurement.

Depress the TEST button and observe the resistance indicated on the **100mA** scale on the meter.

INSTRUMENT INTEGRITY

CALIBRATION

Regulatory Authorities require that test instruments are re-calibrated at least annually.

CLARE offer a full calibration service for this instrument, although any other suitably approved test establishment can be used.

OPERATIONAL CHECKS

As well as undergoing annual, or more frequent, re-calibration by qualified personnel

**THIS INSTRUMENT MUST BE CHECKED AT REGULAR INTERVALS
BY THE USER
TO DETERMINE THE INTEGRITY OF THE SAFETY TEST CIRCUITS**

The **Y250 FAULT SIMULATOR** is supplied with the **A252** specifically for this purpose, it can be used for checking both Earthed Appliance tests and Double Insulated Appliance tests. It is recommended that such checks are carried out weekly.

CHECK PROCEDURE - EARTH MEASUREMENTS

Connect and set-up the instrument in the normal way and plug the simulator into the 13A Test Socket.

Attach the clip of the Earth Return lead across the two brass tags on the simulator and connect the plug into the blue **100mA** socket on the instrument.

Set the selector to **Functional Earth** and depress the Test button. The meter should read approximately 0.2 ohms on the 100mA scale. Release the Test button.

Move the plug of the clip lead into the 8A socket, set the selector to **Earth Test** and again depress the Test button. The meter should read approximately 0.2 ohms on the 8A scale. Release the Test button.

Now move the plug of the clip lead into the 25A socket and once again depress the Test button. The meter should now read approximately 0.2 ohms on the 25A scale. Release the Test button.

CHECK PROCEDURE - FLASH TEST TRIPS

With the clip lead still attached across the simulator terminals, select **500v Flash** and depress the Test button. The green Flash PASS lamp should come on. Release the Test button.

Now select **1250v Flash** and depress the Test button. This time the warning buzzer and the red Flash FAIL lamp should come on continuously. Release the Test button.

With **1250v Flash** still selected, now depress and hold the **10mA TRIP** button and then depress the Test button. This time the green Flash PASS lamp should come on. Release both buttons.

Detach and put away the Earth Return clip lead and get the safety Flash Probe out ready for the next check.

Set the test selector to **3750v Flash**, depress and hold the Test button and note that the green Flash PASS lamp comes on.

With the Test button still depressed, apply the tip of the safety Flash Probe to the **HT PROBE** test point on the simulator, the warning buzzer and the red Flash FAIL lamp should come on continuously. Release the Test button.

APPENDIX

USEFUL REFERENCE MATERIAL

The following short list of British standards, Legislative Documents and Guidance Notes is intended as a pointer to reference material that will assist in a greater understanding of the whys and wherefores of Electrical Safety Testing.

References made to such documents within this Manual are for guidance and illustration only and as such are generalised interpretations of the spirit of the various regulations.

STATUTORY LEGISLATION -

The Health and Safety At Work Act 1974

ISBN 0 10 543774 3

The Electricity at Work Regulation 1989

ISBN 0 11 096635 X

The Plugs & Sockets (Safety) Regulation 1987

ISBN 0 11 076603 2

HEALTH AND SAFETY EXECUTIVE GUIDANCE NOTES -

GS 23 Electrical Safety in Schools

GS 27 Protection Against Electric Shock

GS 38 Electrical Test Equipment

HS(G)13 Electrical Testing

HS(R)25 Memorandum on the Electricity at Work Regulations 1989

PM 32 The Safe Use of Portable Electrical Apparatus

BRITISH STANDARDS -

- BS 415 Safety requirements for mains operated electronic apparatus for household and similar use.
BS 2754 Construction of electrical equipment for protection against electric shock.
BS 2769 Hand-held electric motor-operated tools.
BS 3456 Safety of Household and similar electrical appliance.

The British Standards Institute publishes an extensive list of other standards relevant to electrical equipment under the designation SL 26.

Certain trade organisations and manufacturers also publish useful 'how to' guides and 'Codes of Practice' with particular emphasis on their member or customer requirements or product line.

USEFUL ADDRESSES

British Standards Institute	2 Park Street LONDON W1A 2BS	071 629 9000
Health and Safety Executive	Stanley Precinct, Bootle, Merseyside L20 3QZ	051 051 4000
H.M. Stationery Office	PO Box 276 LONDON SW8 5DT	071 873 0011