

Making Portable Appliance Testing Fast and Easy

Application Note

There is a requirement in law for employers to ensure the safety of employees at all times and the only way to protect against electrocution is to regularly undertake portable appliance and installation testing. In fact, more people get injured from faulty appliances than from faults occurring from the installation itself.

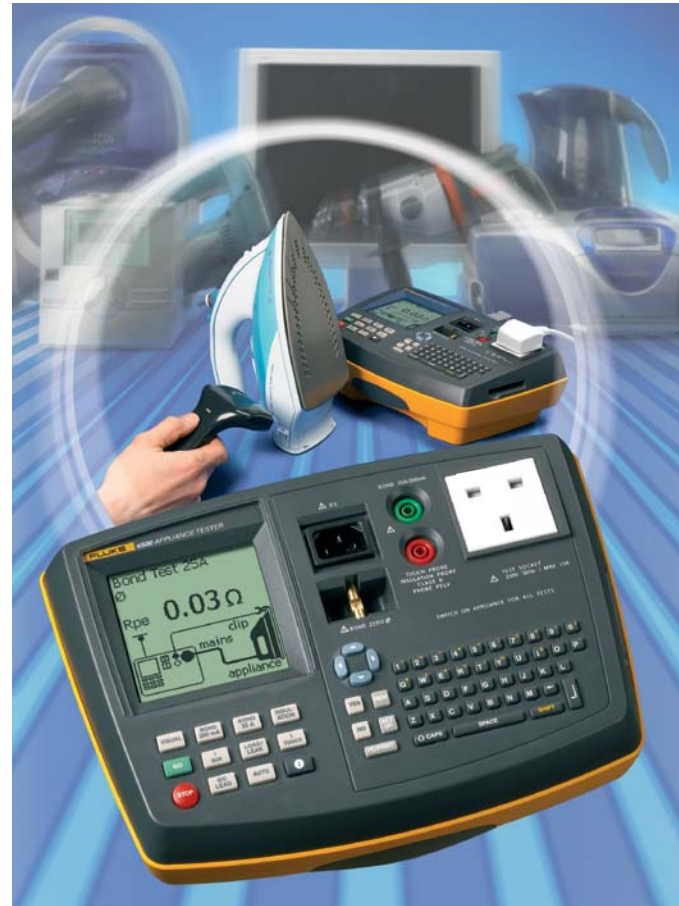
PAT testing is a repetitive and time consuming task, it consists of uniquely identifying appliances, testing, documenting results, taking care of any remedial actions and marking the appliance with the next test due date. It is essential therefore, to be well organised and use modern well designed PAT testers such as the Fluke 6200 and 6500, to help improve the efficiency.

Which Class?

Most appliances are either of Class I or Class II construction with each class having different testing requirements.

Class I equipment utilizes basic insulation of electrical parts and provides a means of connecting any metal parts that could become live, should the basic insulation fail, to the main protective earth of the building. The flexible mains cable of such equipment consists of three wires a live, neutral and earth conductor. PAT testing of class I appliances confirms the integrity of this protective earth connection and that it is of low enough resistance to ensure the removal of any dangerous voltages. It also confirms the quality of the basic insulation to ensure that it is higher than minimum levels.

Class II equipment does not rely on the protective earth of the installation but provides double or reinforced insulation to the user. These appliances are identified by the double square symbol \square . They are usually supplied with a mains cable that consists of two conductors a live and neutral. However some manufacturers supply cables with three conductors so the number of conductors is not a means to identify the class of equipment. PAT testing will measure the quality of the double insulation to ensure that it meets minimum standards.



Testing in the correct sequence

The correct sequence of testing is important and should a fault be found it should be rectified before continuing with the rest of the testing sequence.

The sequence is as follows:
 Visual inspection
 Earth continuity testing (class I)
 Insulation testing
 Functional tests Load/leakage or Touch current testing

The first task is the important visual check. The purpose of this is to check for any damage to the casing, mains cable and plug for, signs of misuse, over-



heating, correct connections in the plug, frayed leads, a safe working environment is present, correct rating of fuses and correct anchorage on leads.

The importance of the visual check must not be underestimated as many problems can be detected before the appliance fails the electrical safety checks. For instance it is important to change a fraying lead before further damage becomes a hazard and starts shorting to earth.

Earth Bond (Earth continuity)

For class I appliances the earth bond test comes next. Fluke testers offer users the choice of a high current 25A test or a 200mA test. The latter is for equipment that is sensitive to a high current test such as IT equipment. The measured value must be less than 0.1 ohm plus an allowance for the resistance of the flexible cable. If there is a problem with this resistance the fault should be rectified before continuing with any further testing. If the 25A current is selected the earth clip and not the probe should be used to connect the appliance.

A popular feature of the Fluke PAT testers is the earth bond lead that is detachable. This eliminates the requirement of the instrument being returned to a service department for replacement as well as offering a speedy solution for packing the instrument away. The resistance of this test lead can be regularly tested and automatically removed from the test result.

Insulation resistance

After the earth bond test for class I and the first electrical test for class II appliances, comes the insulation resistance test.

For class I appliances the Fluke tester automatically combines the live and neutral conductors together and measures the resistance between these conductors and the protective earth.

For class II appliances the live and neutral conductors are again combined together and the insulation probe or crocodile clip is connected to any exposed metal surface on the appliance. The option of the probe is of particular assistance when there is only, perhaps, a screw head that provides a metal surface. In both cases the appliance must be switched on for this test. It is also important to wait for the test to complete to ensure that all capacitances have discharged.

The minimum requirements for insulation resistance is 1.0 Mohm for class I and 2.0 Mohm for class II appliances with a special allowance for Class I heating equipment over 3kW.

Insulation resistance testing applies 500V dc to stress the insulation; it should not be regularly applied to IT equipment that does not comply to the standard BS EN 60950. This test can also not be successfully used on certain heating and cooking appliances where the elements of such equipment have high leakage paths.

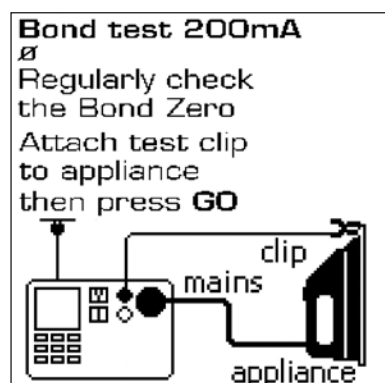
Additions to insulation testing

Some appliances have a low insulation reading by design, for these type appliances or where an insulation test cannot be carried out, it is possible to conduct a protective earth conductor current test for class 1 and a touch current test for class II equipment.

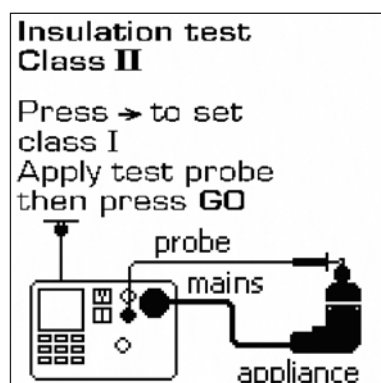
In many cases it is good practice to run these tests anyway to monitor the on-going condition of the appliance. During these tests the appliance is powered up with mains voltage so the user must make sure that the appliance is properly secured and that they stand clear of dangerous equipment.

For protective earth conductor current Fluke testers actually measure three parameters at the same time, these are load current, power consumption and protective earth conductor current. For class I portable or hand held equipment the leakage current must not exceed 0.75 mA, for other class 1 equipment it must not exceed 3.5mA and special allowances are again made for heating appliances. This test function can be used on class II appliances to determine their power consumption and load current.

Touch current for class II appliances is sometimes confused for the above protective earth conductor current test. It is also a live test so precautions must also be made to ensure the safety of the user, however this test is conducted using a probe which is placed onto external metal parts of the appliance. The resultant measured current must not exceed 0.25 mA.



Earth Bond



Insulation resistance

IEC and Extension lead testing

IEC leads are considered as appliances themselves and can be tested quickly and easily by use of the IEC socket on the front panel.

Extension leads can also be tested with the short IEC lead optional accessory EXTL100. On pressing the IEC lead test function the tester checks for earth bond resistance, insulation resistance and polarity.

Single or continuous testing

Sometimes it is necessary to run a continuous test, for example, when running a 200mA earth bond test on an extension lead. The tester can be set in continuous mode whilst the user uses both hands to flex the cable through its length.

Continuous mode is also essential when conducting a protective earth conductor current / load test on appliances with long start up periods like computers or appliances where tests have to be made in several switch positions.

Testing by Manual or Auto-mode

Fluke offers the choice of a manual tester, Fluke 6200, where each test is started manually or an automated tester, Fluke 6500, which incorporates automatic test sequences and a memory with the ability to include descriptive text for fast documentation.

Both testers offer swift systems to the user and the tester of choice will depend on the amount of testing required, type of testing and the skill of the operator.

The Fluke 6200 manual tester provides 'one touch testing' for six test functions as well as an IEC lead test, it also provides for a basic memory and printing capabilities. One touch testing enables the user to initiate any test by pressing just on button.

The Fluke 6500 downloading tester increases the speed of testing and documentation over the manual tester in two ways, the first is in its ability

to run automatic test routines and secondly in its fast documenting systems for data entry. This allows for appliances to be referenced with ID numbers, descriptions, location, the test results and any relevant comment. After testing, this data can be downloaded into desktop software for recording and certificate generation.

Auto-testing

The Fluke 6500 has a sophisticated memory system. There are several factory-set auto-test routines for class I and class II appliances as well as allowing the user to program their own. The user activates an auto-test by pressing the 'auto' key. He is then prompted on screen to enter an auto test number, the instrument remembers the last one used so in many cases only an acknowledgement is required.

A search and review facility in the memory menu allows for auto test sequences to be viewed, if need be.

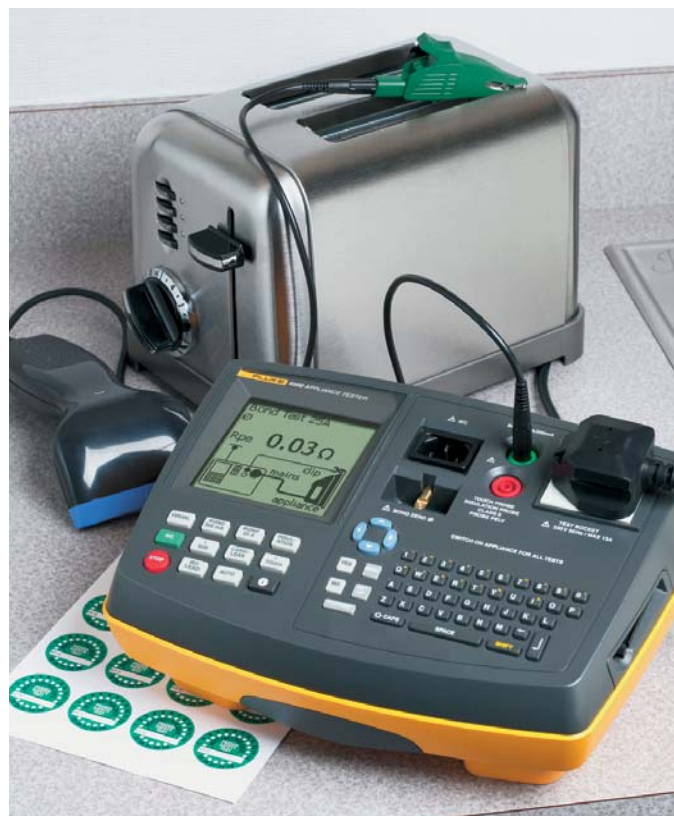
On initiating an auto-test, the instrument then runs through the sequence prompting the user when there are actions to be taken. There is a special fast mode that cuts out some of the prompt screens for the more experienced user.

Auto-testing can be a better option for semi-skilled operators as it provides screen prompts as to what to do. The Fluke 6500 supervisors to lockout manual testing so that this type of users have to use the auto-test routines with the on-screen prompts.

Documenting

The Fluke 6200 manual tester can be used in conjunction with an appliance register such as the Fluke IRP1 which is offered as an optional accessory.

The Fluke 6500 tester provides a comprehensive capability for portable appliance testing data capture. The tester has a large graphical display and after testing the user can press the Memory key to save the test results. The user is then shown a single screen that



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prompts him for an appliance number, the location, the appliance description and any note or comment that applies.

The Fluke 6500 uses special systems to speed this process up. The appliance number automatically increments by one after each saving operation. This is of huge benefit when testing on a site for the first time. This feature only applies if the number system is numeric and under 9999. If it is not desired the first keystroke will over-write the incremented number. Alternative ways of entering appliance number are by use of the QWERTY keyboard or using the barcode scanning facility.

Likewise, the location field can be filled by use of a barcode scanner or typing using the QWERTY keyboard. On storing a record for the first time after power up, the instrument will remember the text entered for location until the tester is powered down again. So this field should only need information once at each location.

The description field can

be entered using either the QWERTY keyboard or the bar-code scanner.

In conjunction with the optional Fluke software the description and location can be entered using four digit numeric codes again another time saving solution.

Help at hand

The Fluke 6500 has contextual help screens that are available to the user at the touch of the help button. The Fluke 6200 has a printed label on the front panel that details pass and fail levels for quick reference.

Both instruments have pre-programmed pass fail limits. In the case of the 6500 these can be changed by the responsible person. For the 6200 these are fixed, in case of the measurement exceeding these, a limit warning is displayed and the user can make reference to the front panel label for the most appropriate limit.

Keeping the instrument in the field

The Fluke 6500 has a unique compact flash card memory facility that can be used as a memory back up and as a medium to enable testing data to be returned to the office whilst the tester remains in the field.

What you see is what you get

These new Fluke testers use techniques that eliminate parallel earth paths from insulation and earth bond tests therefore giving a true reflection of the state of the appliance. Without these techniques any parallel earth connection, for instance a washing machine that is connected by copper pipe or an appliance on a metal work bench, would show a lower earth bond resistance and insulation resistance measurement.

Staying ahead of possible future standards

A future development of portable appliance standards may utilize the substitute leakage test as an alternative to the protective conductor current measurement. The Fluke testers conduct this test at 35V and then calculate and display the value at full mains voltage. This offers the benefit of not having to power up the appliance at full mains voltage.

110V testing

Some electrical hand tools are rated at 110V, typically those used on construction sites, these can be tested for earth bond resistance and insulation resistance using the optional adaptor TA700.

Identifying and safety testing indications on appliances

It is common practice to give a unique identification number, a pass / fail status and the next test due date on tested appliances. Fluke offer a comprehensive range of labels to do this. Barcode labels are offered for appliance ID as well as for auto-code number. The usage of these increases the speed of testing for repeat years. Pass and fail labels are available some utilize tick boxes for the next testing due date which reduces writing time.



Fluke. *Keeping your world up and running.*

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