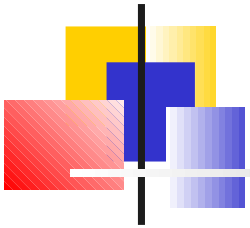
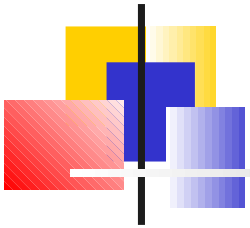
Induction and Introduction

- Who am I?
- ICE – Fire exits
- Time Scale of course
- Exam Registration and Fees
- Exam requirements
- Lunch and Tea breaks
- You provide: Yourselves, COP 3rd ed., Exam Success
- I provide: Course notes, Assessment Practicals
- and Mock exam sheets



Timetable Day 1

- Introduction
- Course notes: Introduction, Legislation
- Course notes: Scope, Classification
- Video
- Visual Inspection of plugs
- Lunch
- Course Notes: Inspection, Testing, Results
- Mock Exam
- Homework

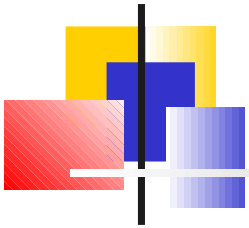


Timetable: Day 2

- Homework Autopsy
- Mock Exam 2
- Assessment sheets Practical Testing
- Completion of paperwork
- Exam

Portable Appliance Testing 1

- Contents:
  - Dangers of Electricity
  - Scope of Code of Practice
  - Statutory Regulations
  - Health and Safety
  - Classification of Appliances
  - User Checks and Inspection
  - Testing of Appliances
  - Frequency of inspection and testing



Portable Appliance Testing 2

- Contents:
  - Formal Inspection
  - Test Instruments
  - Essential Tests
  - Optional Tests
  - Expected Values
  - Interpretation of Results
  - Labeling and Documentation
  - Other Information

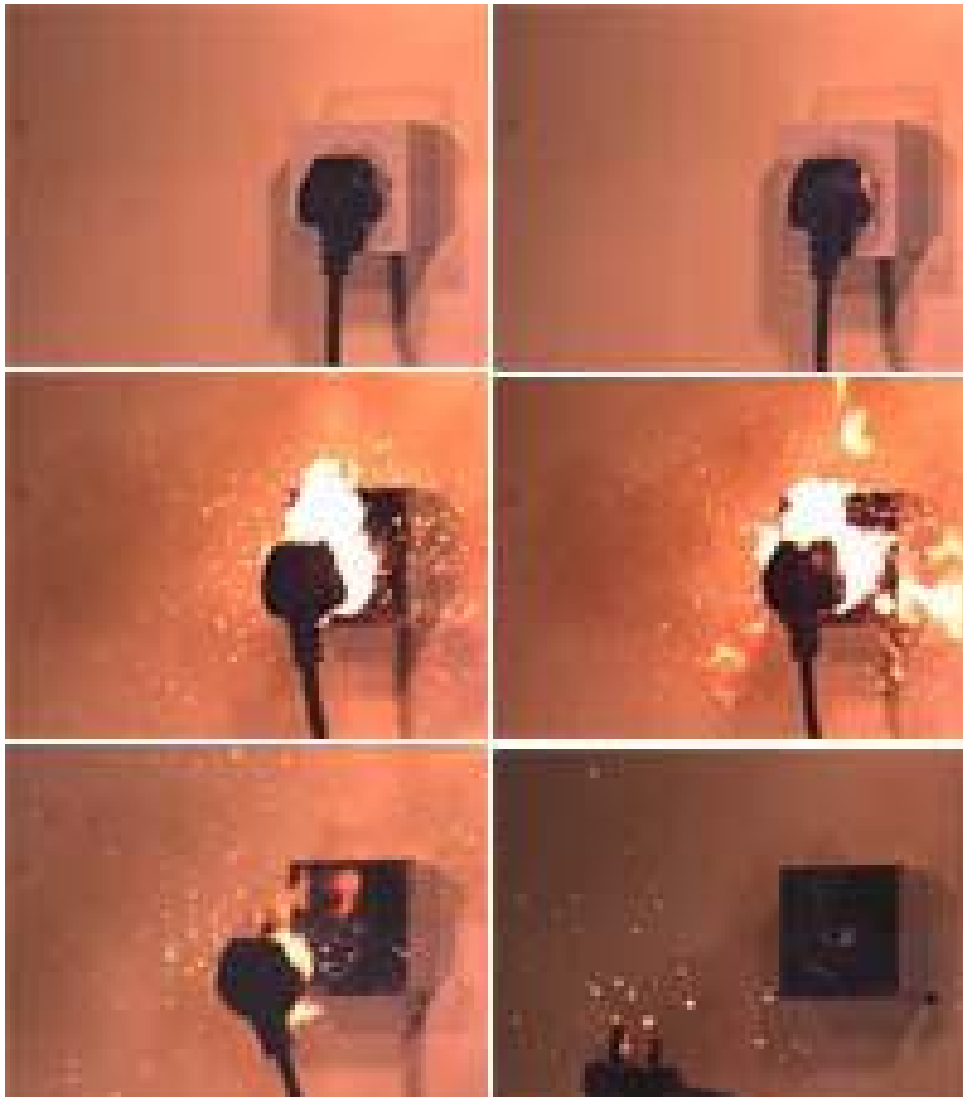
Dangers of Electricity : faults:

- **Shock –** 1-5mA perceptible

10 – 20mA Noticeable, 30 – 60mA Possible Fribulation, 60mA+ will cause burns and Fatality

- **Burns –** worst of which are arc flashes, effects of UV, molten metal embedded in your skin
- **Explosion –** having a plug explode in your hands might cause a violent reaction
- **Arcing and Sparking –** poor contacts and terminations
- **Fires –** caused by the last two above can be serious!

Types of Fault : Page 9



ASTA BEAB testing shows faulty batch of plugs imported into the country

Poorly positioned appliances

Poorly positioned appliances

Borrowed from 'Sparky Heaven'

Dangerous extension leads

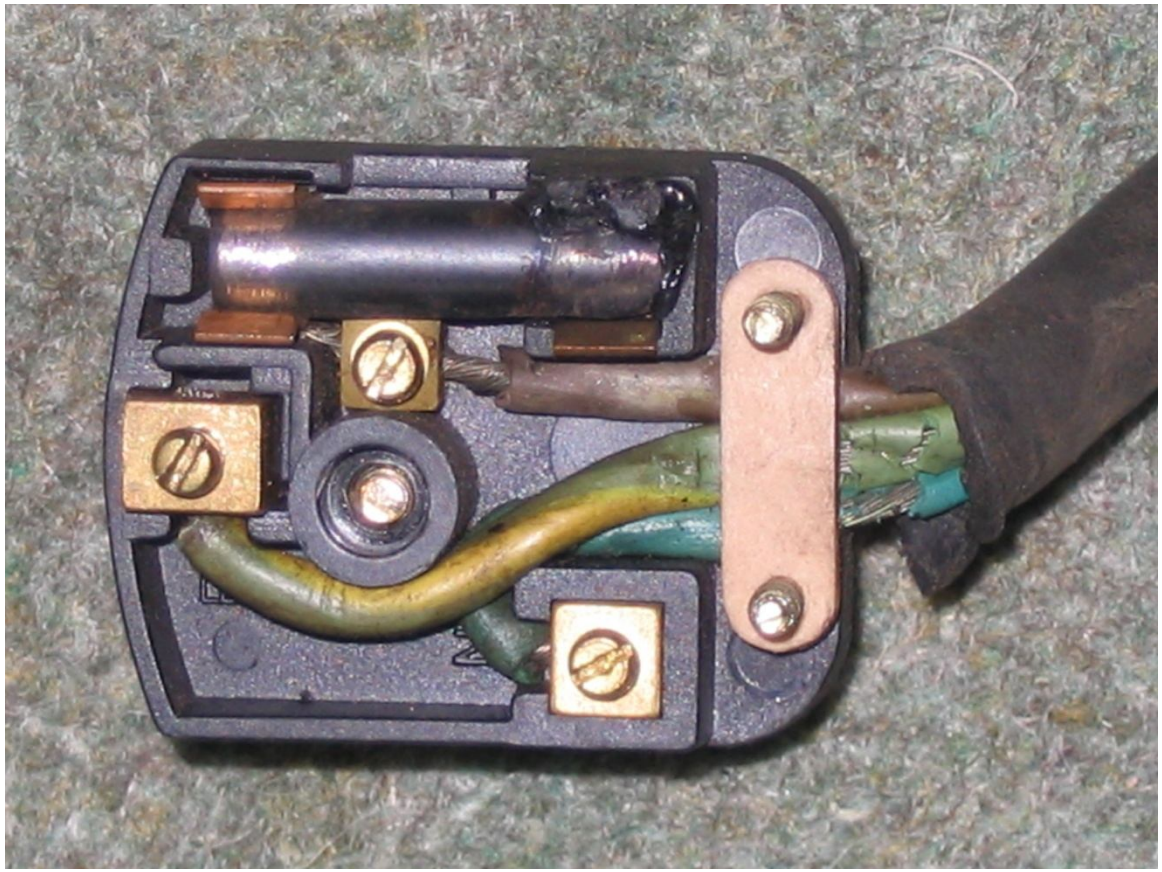
An extension lead used in a domestic environment

Rewire?

Poor condition of heater without proper fixings

Abused and Dangerous Plug

Plug was once attached to an Arc Welder



Loose connections in the plug

Overheating due to loose connection

Borrowed from some bloke up North

Overheating due to loose connection

Duty of Inspector to make an assessment of the sockets where appliances are fitted

Borrowed from some bloke up North

Recent Prosecutions: Page 5

Some tragic cases

- Barnsley Fish and Chip Shop
- Teesside Company Fined for shoddy equipment
- Graduate Death due to prodding electrical equipment

Statutory Regulations: Page 10

- Health and Safety at Work Act 1974- HASAWA
- Electricity at Work Regs 1989 - EAWR
- Management of Health and Safety in the Workplace 1999
- Provision of User Work Equipment Regulations – PUWER
- Plugs and Sockets Regs

Statutory Regulations

- Health and Safety at Work Act 1974- HASAWA
  - All persons at work to take responsibility
  - Duty of Care
- Management of Health and Safety in the Workplace 1999
  - Risk Assessment
- Electricity at Work Regulations 1989
  - Maintenance of Electrical systems & Equipment
  - Competence of Inspectors

Statutory Regulations

The legal requirement is rooted within the realms of HSAW, EWAR, PUWER which ALL place duties on employers, along the lines of Employers who provide equipment for use by ordinary persons are legally required to ensure the electrical safety of such equipment

The combination apply to all electrical equipment used in, or associated with, places of work. And extend down to the smallest piece of electrical equipment.

The Health & Safety at Work Act 1974 puts the duty of care upon both the employer and the employee to ensure the safety of all persons using the work premises. This includes the self employed.

Statutory Regulations

- **The Management of Health & Safety at Work Regulations 1999**

  "Every employer shall make suitable and sufficient assessment of:

  (a) the risks to the health and safety of his employees to which they are exposed whilst at work, and

  (b) the risks to ensure the health and safety of persons not in his employment arising out of or in connection with the conduct by him or his undertaking."

Statutory Regulations

PUWER 1998

"Every employer shall ensure that work equipment is maintained in an efficient state, in efficient working order and in good repair."

The PUWER 1998 covers most risks that can result from using work equipment. With respect to risks from electricity, compliance with the Electricity at Work Regulations 1989 is likely to achieve compliance with the PUWER 1998..

Statutory Regulations

EAWR 1989

All systems shall at all times be of such construction as to prevent, so far as reasonably practicable, such danger.

As may be necessary to prevent danger, all systems shall be maintained so as to prevent, so far as reasonably practicable, such danger.

Scope of Code of Practice: Page ??

- The Code of Practice includes all appliances
- The COP refers to Appliances in the Work Place but could include appliances installed anywhere where they are used in the process of making money

- An Appliance = A current using machine or instrument providing heat, light, movement, sound, conversion of energy

Portable Appliance Scope: Page 12

- Hand Held – Drills, Hair driers
- Portable < 18kg – Kettles, toasters
- Moveable / Transportable – Pressure washers, Air conditioners, Large Battery Chargers
- Stationary – Fridges, Freezers, Washing Machines
- Fitted – Ovens, Hobs, Extractors
- Fixed – Wall Heaters, Towel Rails
- Single phase & 3 phase – fitted with plugs and/or Hard-Wired

Extension Leads: Page ??

Supplementary Protection (RCD)	Connector Type		Conductor Core Area		Max. Length
BS 7071 BS EN 61008/9 BS 4293	BS EN 60309	BS 1363	Class I 3- core	Class II 2-core	
Optional Ind Mandatory Dom	Yes	Yes	1.25mm^2	Never	12 meters
Optional Ind Mandatory Dom	Yes	Yes	1.5 mm^2	Never	15 meters
Optional Ind Mandatory Dom	Yes	No	2.5 mm^2	Never	25 meters
Always	Yes	Optional	Any	Never	$\geq$ 25 meters

2-core cables never to be used as extension leads

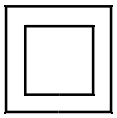
Leads in General

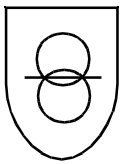
- **Supply cord or Cord Set –** supplied with the appliance maybe 2 or 3-core, if used outside will be coloured orange

- **Extension lead –** supplied as a separate entity and will always be 3-core, that is Phase, Neutral and CPC

Classification: Page 14

Appliance Classification refers to the method of Earthing or protection offered by the appliance against electric shock

- Class I – Require CPC
- Class II – No CPC - 
- Class III – by SELV TX - 

and 
- Class 0 – Special case
- Class 0I – Special case

Both 0 and 0I classes rely on non-conducting locations

Classification of Insulation

- Basic Insulation - Air/rubber compound
- Supplementary Insulation – Plastic/rubber covering
- Reinforced Insulation – Hardwearing plastic covering
- Metal-Encased Class II - Very hardwearing metal covering over plastic insulation

Definitions: Double Insulation

- Double Insulation - Unlikely to touch live parts
  1. Supplementary Insulation
  2. Reinforced Insulation

"Where the protective measure of double or reinforced insulation is used for the complete installation or part of the installation, electrical equipment shall comply with the following:"

1. **equipment type tested and marked to the relevant standard 412.2.1.1**
2. **equipment with basic insulation only shall have supplementary insulation applied in the process of being erected 412.2.1.2**
3. **equipment having no insulation around live parts shall have reinforced insulation applied in the process of being erected 412.2.1.3**

- **412.2.2 relates directly to enclosures which is applicable to (ii) and (iii) above"**

Classification of Environment

The environment will play an important part in determining the

1. Appropriateness of equipment
2. The Frequency of Inspection and Test

Types of environment:

- Domestic
- Commercial
- Industrial
- Educational
- Shops
- Access to Public
- Construction and demolition sites

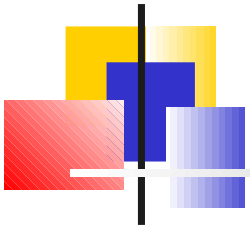
Portable Appliance testing

- Three types of Inspection

1. User Checks
   - Daily or when equipment is used
1. Formal Inspection
   - Agreed frequency
   - Paperwork and results to be completed
1. Formal Inspection and Test
   - Agreed frequency
   - Paperwork and results to be completed

User Checks and Inspection

- Plugs – burn marks, damage, loose pins
- Sockets – damage and burns
- Flexes – split coverings, damaged
- Casings and enclosures , broken or damaged, loss of IP protection



Frequency of inspection and testing

- Table 7.1 page 34 Code of Practice
- User checks
- Formal Inspections
- Formal Inspection and Test

Formal Inspection

Extract from COP frequency of inspections and tests

Equipment use	Type of equipment	User checks	Class I		Class II	
		Not recorded unless a fault is found	Formal visual inspection (Note 1) Recorded	Combined inspection and testing Recorded	Formal visual inspection (Note 1) Recorded	Combined inspection and testing Recorded
a	b	c	d	e	f	g
Construction sites 110 V equipment	S	none	1 month	3 months	1 month	3 months
	IT	none	1 month	3 months	1 month	3 months
	M } Note 2	weekly	1 month	3 months	1 month	3 months
	P } Note 2	weekly	1 month	3 months	1 month	3 months
	H } Note 2	weekly	1 month	3 months	1 month	3 months
Industrial including commercial kitchens	S	weekly	none	12 months	none	12 months
	IT	weekly	none	12 months	none	12 months
	M	before use	1 month	12 months	3 months	12 months
	P	before use	1 month	6 months	3 months	6 months
	H	before use	1 month	6 months	3 months	6 months

PAT Testers

- Test Instruments
  - Portable Appliance Tester
    - Earth Bond
    - Insulation
    - Earth Leakage
    - Load Test
    - Flash Test
    - Recording and Storage
    - Programmable
    - Sockets and Connectors

Test Instruments

- Basic Go-No-go testers are not really very useful
- Test Instruments should show quantitive values of the test
- Must be able to test for
  - Continuity of CPC (Earth Bond)
  - Insulation Resistance (Strength Test)

  To fulfil the requirements of some Manufacturer's product test it may not be suitable to use a Low-reading Ohmmeter/ Insulation Resistance Tester

Test Instruments

Continuity Ranges:

- 1.5 times current rating (sometimes known as Fuse rating) up to a maximum of 25 or 26A
- Soft Test 100mA - 200mA max

  (20mA - 200mA)

Test Instruments

Insulation Resistance Testers

- 250V – 500V at 1mA
- Run test 1.06 times nominal voltage leakage current is measured

  (<2.5mA – 7.5mA)
- Strength Test 1500 - 3750V AC for 1 minute

  leakage:

  Class II < 0.25mA

  Class I < 0.75mA

Essential Tests Pages 31, 33

1. **Continuity of Earthing conductor** (Earth Bond Test) Class I enclosures

2. **Insulation Resistance** Between live conductors and casing – Both Class I and Class II enclosures

3. **Functional Tests** for switches and effective running

Optional Tests: Page 34

- **Fuse Test** – Phase Neutral loop with switch on
- **Earth Leakage tests** – current leakage from phase conductor to CPC under normal conditions
- **Touch Current Test** – likelihood of shock level current under normal working conditions
- **Run and Load Tests** – simulation of normal running and actual power of appliance
- **Flash Test** – High Voltage insulation integrity test, performed at the manufacturing stage (product testing) and after repair work

Test Values: Page 31

- Continuity of earth within appliance <= 0.1Ω
- Continuity of Lead = RΩ
- Total continuity of CPC = 0.1 +RΩ
- Values should be declared – not Pass or fail
- Minimum Insulation Resistance Values
- Class I = 1MΩ
- Class II = 2MΩ

Interpretation of results: Page 37

- 'Earth Bond' Test Pass Levels
- *Old Standard*
- **Equipment** <3 Amps Must be <0.5 Ohms
- **Equipment** >3 Amps Must be <0.1 Ohms
- *New Standard*
- Makes reference to **Appliance** rating but states
- Earth Bond Level shall not exceed 0.1 Ohms +(r) where r is the resistance of the supply cord.

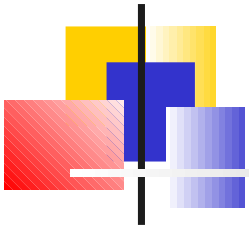
Test Values and Interpretation of results

Insulation Resistance

- *Old Standard*
- Class 1 Appliances Pass Level >2 MOhm
- Class 2 Appliances Pass Level >7 MOhm
- *New Standard*
- Class 1 Appliances Pass Level >1 MOhm
- Class 2 Appliances Pass Level >2 MOhm

Test Values and Interpretation of results

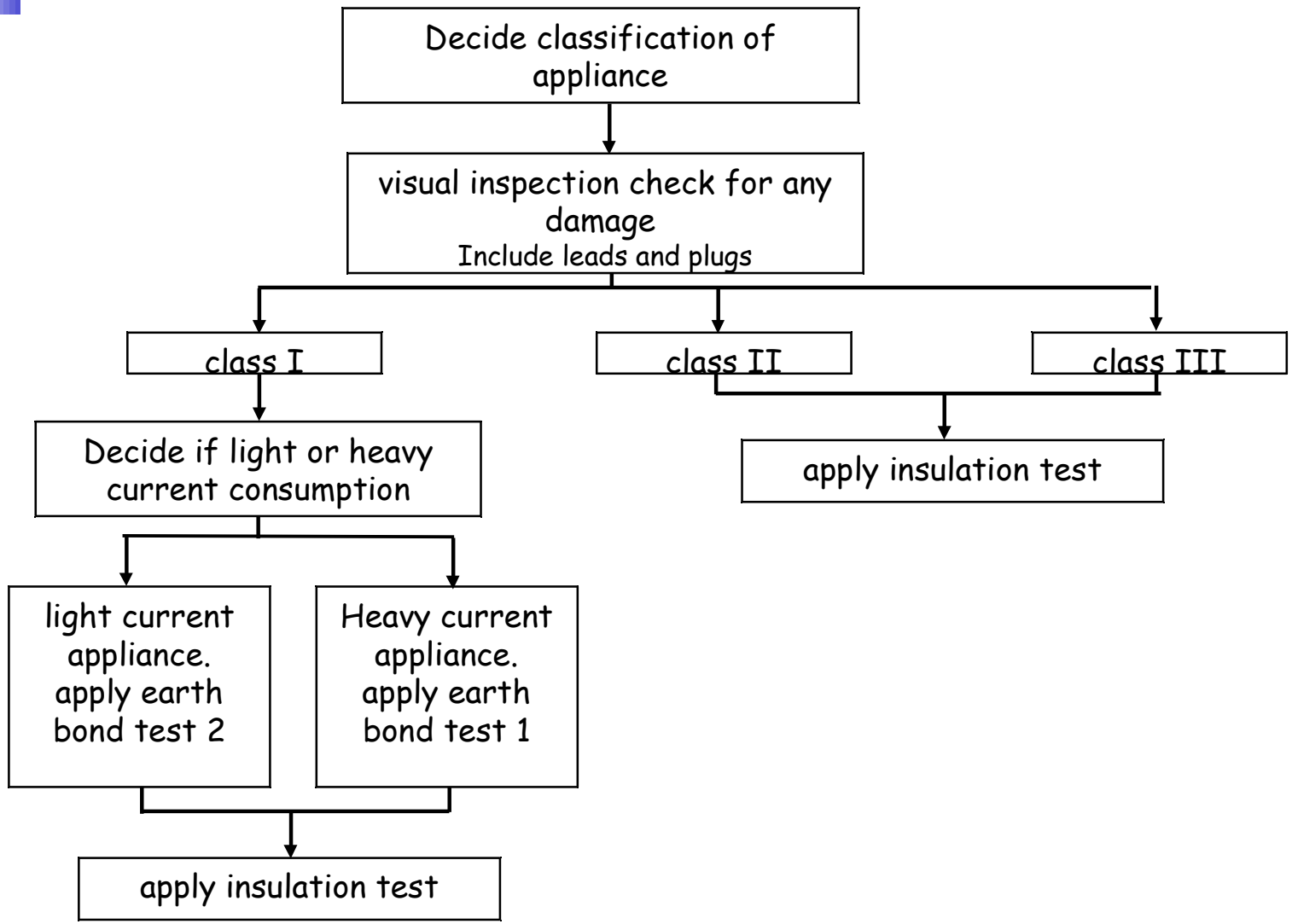
- **Earth Leakage/Touch Current Test**
- This test is an alternative to the Insulation Test and used where it would be dangerous for the appliance as well as reliable results cannot be obtained by the standard Insulation test
-
- Not All **Portable Appliance** Testers have this extremely useful Test Function



Test Values and Interpretation of results

- **Class 1 Earth Leakage Test**
- The Leakage current is measured from live parts to earth.
- Hand Held or **Portable Equipment** <0.75mA
- Heating Appliances <0.75mA or 0.75mA per kW (Whichever is greater) Up to a Maximum of 5mA
- All Other Class 1 Appliances <3.5mA
- **Class 2 Touch Current Test**
- The Touch Current is measured from Live Parts to Accessible surfaces. For all **Appliance** types the reported value must not exceed 0.25mA

Deciding which tests to apply: Page 27



Producing a test method

list all appliances
Include new appliances as well as existing ones Allow no exceptions. Prepare initial sheet

↓

Complete initial sheets
Enter details of item and note any special factors or testing procedures for the appliance

↓

Carry out physical checks
Inspect for damage. Check leads and plugs. Enter results on sheet

↓

check classification of appliance
Decide which essential tests to apply . Enter details on sheet

↓

Carry out essential tests
Ensure that only tests specific to the appliance are administered. Enter details on sheet

↓

Carry out optional tests
Only if applicable and desirable. Enter details on sheet

↓

label appliance
Ensure appliance ID, current safety status, next test date or last test date and duration of service

↓

complete master log
Update running record and check that no appliance has been overlooked

Typical test sheet

Venue: [redacted] Date: 22/06/07

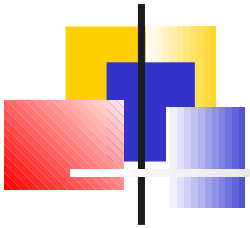
Test Equipment: Robin 5500 **Portable Applaince Test sheet shedule** **Name of Inspector : Legh Richardson** **Signed:**

S/N: 8621-001

Items:	S/N	ID code	V.I	Class	Watts	EB Ω	IR MΩ	Load kW	Leak (mA)	Location	Comments
SuperStart 520 Car Starter	215057-96	650592001	Yes	1		0.04	>300			Workshop	
Vynal Swift Battery Charger	25131	650592002	Yes	1		0.09	>300	0.038		Workshop	Split lead at grommet resoldered fixed
Spaldings Band Saw	M4000110	650592003	Yes	1		0.07	>300	1.110	0.20	Workshop	
Hitachi Angle Grinder G18SE2	D920309	650592004	Yes	2		N/A	>300	0.732	0.00	Workshop	
Hitachi Angle Grinder G13SB	D540208	650592005	Yes	2	750	N/A	>300	0.195	0.00	Workshop	
Hitachi Angle Grinder G13SB	MD10011	650592006	Yes	2	750	N/A	>300	0.298	0.00	Workshop	
Hitachi Impact Drill DV20V2	GM20103	650592007	Yes	2		N/A	>300	0.224	0.00	Workshop	
Hitachi Hand Drill V10?	S880017?	650592008	Yes	2		N/A	>300	0.154	0.00	Workshop	
Hitachi Battery Charger VC12	914209	650592009	Yes	2		N/A	>300	0.014	0.00	Workshop	Lead has nic in it
Makita Bench Grinder 9908	2152E	650592010	Yes	1		0.08	>300	0.434	0.00	Workshop	Earth connection in Plug repaired
Blue extention lead BS1363	N/A	650592011	Yes	1	3000	0.09	>300	N/A	0.00	Workshop	Skt repaired
25m Ext lead Black cable drum BS1363	N/A	650592012	Yes	1	3000	0.37	>300	N/A	0.00	Workshop	
20m Ext lead on Drum BS1363	N/A	650592013	Yes	1	3000	0.40	>300	N/A	0.00	Workshop	
6m Ext Lead on Drum BS1363	N/A	650592014	Yes	1	3000	0.10	>300	N/A	0.00	Workshop	
Bush CD Radio FMTC004Xi	B172943467	650592015	Yes	2		N/A	>300	0.009	0.00	Workshop	
EFCO chainsaw blade sharpener	10988	650592016	Yes	1		0.05	>300	0.217	0.00	Workshop	
Hitachi Powerhouse 5600 Vac. Cleaner		650592017	Yes	2		N/A	>300	0.584	0.00	Stores	
Sealey Power Attack Vacuum Cleaner		650592018	Yes	2	150	N/A	>300	1.070	0.00	Stores	
Kenwood Kettle JK400		650592019	Yes	1		0.05	>300	2.500	0.00	Kitchen	
Electrolux Mini Fridge	1371142	650592020	Yes	1		0.11	>300	0.089	0.00	Kitchen	
Warwick HXi00 Pressure washer		650592021	Yes	1		0.09	>300	1.760	0.40	Workshop/Outside	
AIWA Hi Fi mini Stacking unit		650592022	Yes	2		N/A	>300	0.023	0.00	Stores	
15m ext lead Black drum BS1363	N/A	650592023	No	1	3000	0.09	>300			Stores	Split outer sheath by plug
Blue PC ext lead BS1363		650592024	Yes	1	3000	0.11	>300			Sales/Stores	
Vale PC with ADC CRT		650592025	Yes	1		0.09	>300	0.092	0.10	Sales/Stores	
Sharp EX1490X Fax Machine		650592026	Yes	2		N/A	>300	0.018	0.00	Accounts office	
Photo-copier Z8-10	75850324	650592027	Yes	1		0.20	>300	0.834	0.60	Accounts office	
Rexel Paper Shreader 11D1A4		650592028	Yes	1		0.66	>300	0.002	0.00	Accounts office	Earth bond rather high
Dimplex Floor convection Heater		650592029	Yes	1		0.09	>300			Accounts office	
Surge protected 4 way ext lead white		650592030	Yes	1	3000	0.09	0.240			Accounts office	Low Insulation resistance (filter circuit)
Surge protected 6 way ext lead white		650592031	Yes	1	3000	0.05	0.371			Accounts office	Low Insulation resistance (filter circuit)
Mesh PC with TFT screen		650592032	Yes	2		N/A	>300	0.029	0.20	Accounts office	
Mesh PC 1/2 Tower case		650592033	Yes	1		0.09	>300	0.095	0.00	Accounts office	
Xerox Lazer Printer 6120		650592034	Yes	1		0.11	>300	0.026	0.20	Accounts office	
Homebase Desktop Fan		650592035	Yes	2		N/A	>300	0.000	0.00	Accounts office	
Sealey SuperMig 185 welder	425679	650592036	Yes	1		0.03	>300			Workshop	New BS EN 60309-2 Plug installed
Draper Stand Drill	0406048	650592037	Yes	1		0.06	>300			Workshop	Hard Wired
Draper 150L Compressor DA150/392B	0020223605	650592038	Yes	1		0.03	>300			Workshop	Hard Wired

Labelling and Documentation: Page 24

- Documentation
  - Auditable and Inventory
  - Maintaining Records
  - Inspection and Test Sheets
  - Labels and Labelling
  - Insurance



Labeling and Documentation

- Date of Test
- Date of Next Test
- Time between tests
- Pass or Fail Status
- Unique Identification code
- Initials or name of inspector and tester

Documentation: Typical Test Label

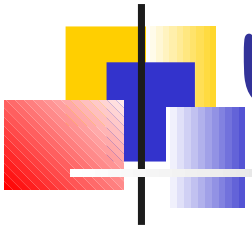
Company Logo

Status of Equipment: √ or ×

Unique Identification number:_____

Date of Inspection and Test / Frequency of Testing
or
Date of next Inspection and Test:_____

Name of Inspector:_____



Useful sites for more information

- http://www.theiet.org.uk/forums
- http://www.pat-testing.info/

Portable Appliance Testers

- Fluke 6200
- Fluke 6500
- Kewtech KT71
- Kewtech KT73
- Kewtech KT75
- Martindale EasyPat 1600
- Martindale EasyPat 2100
- Martindale MicroPat
- Megger PAT32
- Megger PAT4DV/3
- Metrel AutoPat
- Metrel AlphaPat
- Metrel BetaPat
- Metrel OmegaPat

- Seaward Primetest 50
- Seaward Primetest 100
- Seaward Primetest 200
- Seaward Primetest 300
- Seaward EuropaPAC Plus
- Seaward Europa Plus
- Seaward Supernova Plus
- Robin Smart PAT 5500
- Robin SmartPAT 5000
- Robin SmartPAT 3500
- Transmille 5080
- Transmille 6080
- Robin Smart PAT 6500