

# Electricity

**safe use**

# Agenda

- Law
- Hazards
- Working with electricity
- Inspection and testing

# Law

- **Electricity at Work Regulations 1989**
- Competency – *no person shall work on electrical equipment unless competent to do so.*
- Live working - *no person shall work on/near any live conductor where danger may arise.*

Competency - we have trained and competent technical staff – particularly in the electronics workshop.

Live working - not allowed unless by trained and competent staff.

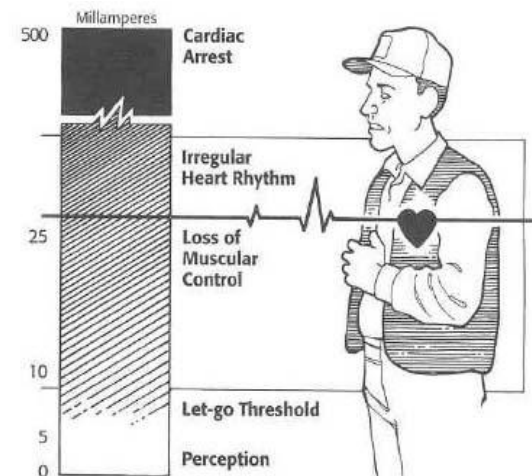
- Risk assessment

# Hazards

- **Burns** - heat generated by current – serious injury can result.
- **High temperatures** – close to body - caused by flash burns and arc.
- **Contact** with overheated equipment.
- **Explosive** – electric arcs can easily eject molten metal at high velocity.
- **Internal injury** - damage to internal organs, tissue destruction caused by current.
- **Involuntary muscle contraction** - can rupture tendons and muscles and fracture bones – caused by extreme muscular contraction by excessive amounts of current.

*It's the volts [e.g. from a charged capacitor] that jolts -----  
the mills [e.g. from a power supply] that kill.  
[an electrical engineers adage]*

*[A current of about 25mA across the heart muscle  
will cause fibrillation]*



**Fig. 1.** Increasing levels of current above the "let-go" threshold causes loss of muscular control, irregular heart rhythm, and finally, cardiac arrest.

# Hazards

- 240v ac – can cause injury, and death in the correct circumstances.
- The department has power supplies of up to 100kV and 100's mA. - these WILL kill.
- Electricity at radio frequency [RF] can cause severe burns. The department has RF heaters with powers of kW's, and transmitters in NMR with power at VHF, UHF, and Microwave.
- Three phase outlets [415V ac] for machine tools and furnaces - supply high power - 30kW typically.

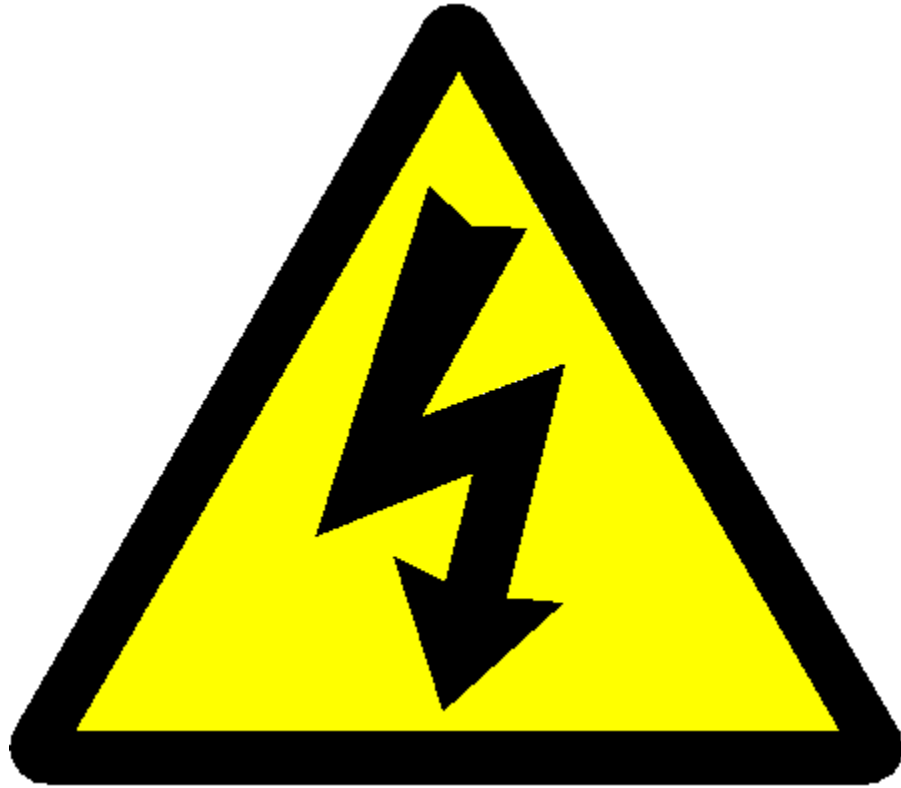
# Working with electricity

- Department: we do not allow work with voltages  $> 25V$  ac/dc– unless trained, have permission to do so, and the work is risk assessed.

*25 V is a very low voltage and will not cause a shock – however if the supply can deliver 10's of amps then beware of a short circuit causing an arc or heating.*

*e.g. A car battery ----- 12 V dc and can deliver  $>300A$  into a short circuit = 3600 J -----  
----this will melt something !! ].*

*An analogue telephone line has a circuit voltage of 50 Volts dc.*



**Standard warning sign for high voltage – electrical hazards**



## Melted Plug

The connection to the live pin and the fuse holder was poor – the resistance led to heating and eventual failure.



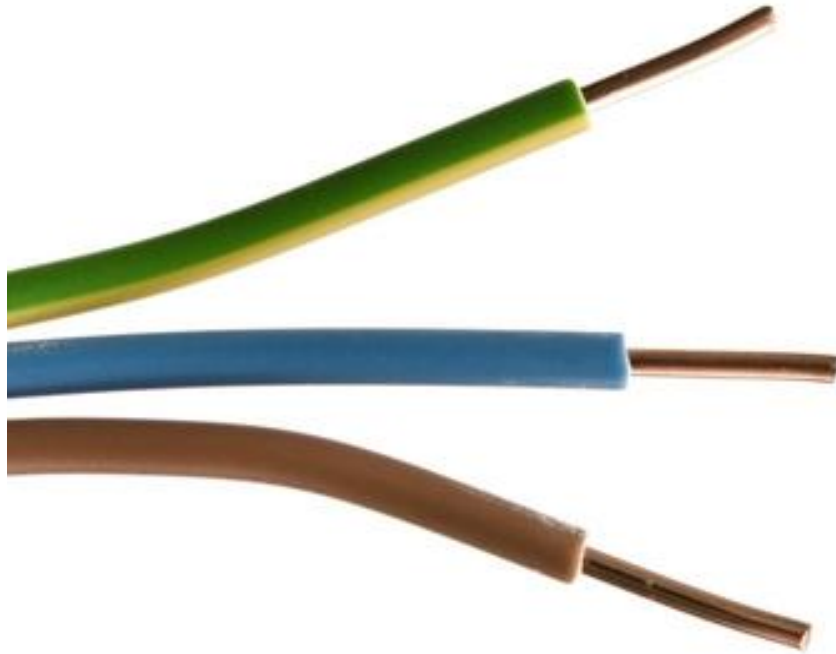


## Socket - double trouble

Overloaded double mains outlet [in a domestic environment] – complete with: plug which cannot be pushed fully home and plug cover not secured

NOTE - all types of multi-way ADAPTORS are banned from use in the University.

Also note - switches would be difficult to reach in an emergency single insulation ??



### Conventional wiring colours

**LIVE -**

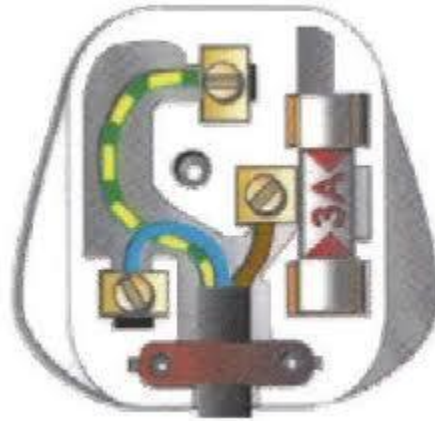
**Brown**

**NEUTRAL -**

**Blue**

**EARTH -**

**Green/ Yellow**



## Wiring connections for a 13A plug

- Use the correct fuse rating.
- Ensure correct cable connections and no damage to insulation.
- Make sure that the earth wire is slightly longer than the live/neutral.
- Ensure terminals are tight.
- Ensure cable grip is secure.
- Refit the cover securely.
- Check for damage.



## Testing

- Everyone can check an appliance by visual inspection:
- Check the plug for damage
- Check the fuse
- Check the cable grips
- Check the cable itself for damage



adastrahire.co.uk

## **Portable Appliance Testing [ PAT ]**

Some items are subject to a full electrical test - this is the tester we use in the department.

The tester produces a label which is stuck to the item on test. Each item is identified by a unique serial number.

# Visual testing/checking of electrical appliances

- Simple – easy and straightforward to carry out.
- The HSE asserts that the vast majority of electrical faults [ >75%] can be detected by visual inspection of equipment.
- Can be done by everyone - no extensive training required.
- Recording inspections is desirable
  - Management of health and safety.
  - We indicate that an item has been visually checked by affixing a coloured label [calendar year colour].
- Good laboratory practice
  - We encourage all staff to be vigilant and not to tolerate faulty or damaged equipment. Faulty electrical items would be challenged by a formal safety inspection.

# Visual

## CHECK - **switch off the socket - unplug the plug.**

**1. That the plug is in good condition** – no damage to pins or the moulding- no sign of overheating.

**2. That the cable is in good condition:**

1. There is no damage to the casing [ cuts or heat damage].
2. There is no sign of general overheating.
3. There is no exposure of the inner conductor insulation or the conductor itself.
4. That the cable is secured at both ends.

**3. Remove the plug top cover**

Note – moulded plugs cannot be taken apart - check the fuse rating and the moulding/pins for damage.

**4. Check that:**

1. The cables are correctly wired [note check that the earth wire is the longest so it releases last if the cable is pulled away from the plug].
2. The terminals are tight and secure.
3. The fuse is the correct rating.
4. The cable grip is tight and holding the cable securely.
5. There is no internal damage to the moulding or the parts.

**5. Replace the plug top cover**

**6. Check the equipment:**

1. For damage.
2. For security of the cable clamp at the entry position.

**If all is well – or has been repaired satisfactorily  
– attach the correct \* annual sticker to the plug top.**



\* yellow for 2012



# PAT

- Training is required for PAT so this is mainly left to technical or safety staff to carry out. Sometimes specialist companies are employed if a lot of items require testing
- A PAT check is :
  1. A visual inspection
  2. A test carried out by the PAT appliance tester – the type of test is specified for the equipment, e.g. for double insulated [ type 2] equipment a different test is employed to a normally earthed [type 1] item.
  3. A sticker is attached with some detail of the test and retest dates.





Any questions?