SIRIM QAS International Sdn Bhd

PROCEDURE & STANDARD REQUIREMENT ON ELECTRICAL CABLE TESTING

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Presentation Outline

1. Introduction
2. Our roles & services
3. Procedure & standard requirement for electrical cable testing
4. Video – some of our test activities

Why are we here and why electrical product requires compliance testing?

1
when using any electrical products, the safety of consumers/users are of the most important and they should be protected

2
any electrical products supplied by manufacturer are safe and complied with standard requirement

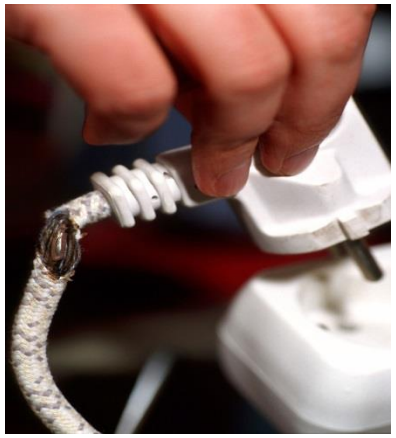
We want to ensure that

3
any electrical products before they are made available in our market - are approved by ST & complied with all regulatory requirements

4
any electrical products in our market are of high quality…and at the same time avoiding our market from becoming a dumping ground of low quality and unsafe products

How safe are your electrical equipment / appliances in your house?

Do they have “SIRIM ST” labels / SIRIM mark?



“ Based on the Fire and Rescue Department's record, 759 cases of fire that occurred nationwide in 2006 were caused by faulty electrical appliances including televisions.

The appliances are mostly cheap and without SIRIM label .

The scratch-and-win scams promote sub-standard products as well, because all of them sell electrical products without the labels,“

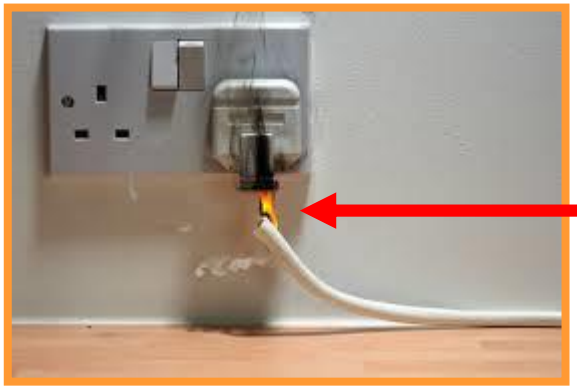
–BERNAMA 28 Feb 2007.

Some of faulty electrical products

Faulty appliances can cause overheating and catch fire

Burnt mark

Broken – due to low quality insulating material – unable to withstand an impact



A flexible cable – caught fire – due to – undersize or substandard cable – unable to withstand a rated current

Some of faulty electrical products

A hair dryer caught fire – due to the product do not have a thermal cut out , a protection required for a product with heating element

Dishwasher & Washing machine – potentially due a faulty electronic component / to a short circuit.

The cost of a non-compliance of electrical products – to user

Electrical incidents – resulted in fatality / injury

-Instantaneous water heater / Storage water heater incidents

-Ceiling fans falling down

26 Oct 2007

12 Nov 2009

Injury to school Children
- injury due to falling of a ceiling fan

The cost of a non-compliance of electrical products – to supplier / manufacturer

-cost of product recall / affect company's reputation

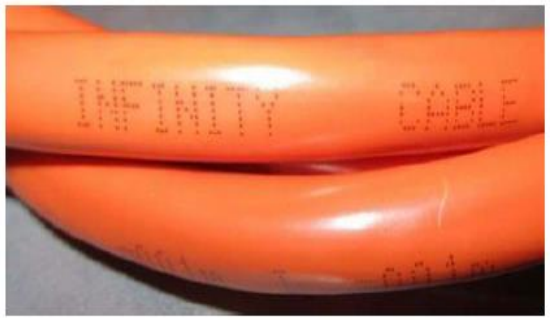
RECALL ALERT: Gree Dehumidifiers Recalled Due To Fire Hazard (165 reported incidents)

Dehumidifiers made by Gree Electric Appliances of China have been recalled due to serious fire and burn hazards. The recalled models are sold under the brand names Danby, De'Longhi, Fedders, Fellini, Frigidaire, Gree, Kenmore, Norpole, Premiere, Seabreeze, SoleusAir and SuperClima.

The dehumidifiers can overheat, smoke, and catch fire. There have been 165 reported incidents, including 46 fires, causing $2.15 million in property damage.

The cost of a non-compliance of electrical products – to supplier / manufacturer

-cost of product recall / affect company's reputation



2014: Australia: Infinity and Olsent branded cables, which failed to meet electrical safety standards due to poor quality plastic coating resulted in a cable recall from around 40,000 homes.
The recall costs are being largely met by suppliers of the cable (clean-up bill of £16-32 million has been estimated).
More than 2,000km still unaccounted for - one in five won't allow remedial action due to `do-it-yourself' homeowners fearing reprisals. 2016 has seen repeated calls by the ACCC (Australian Competition and Consumer Commission)
An installation amnesty is being considered while one house fire has already been as a result of the faulty cable.

Source: Sydney Morning Herald 19th October 2015

The cost of a non-compliance of electrical products – to regulator / country

-influx of low quality / sub standard product in the market

Sub-standard cable in market

Substandard Cables : The Ugly Truth

Behind every wall at home, an office or a building in general, there are cables that channel electricity for our daily consumption. These are housing cables and they connect all electricity-powered items and sockets to the main electricity source.

Often, many Malaysians make the mistake of paying little attention to the kind of cables that wire their homes. A cable is just a cable, some may think. But is it really that simple when there have been many documented incidences of fire, blackouts, short circuits and electrocution caused by unsafe cables?

These cables are called **substandard cables**.

What are substandard cables?

Substandard cables are cables that are not designed, manufactured or test-approved to meet the requirements in safety standards. The flooding of substandard cables in the market is largely due to unscrupulous manufacturers who skimp on quality and safety to produce cheaper cables.

Characteristics of a substandard cable:-

1. Reduced diameter of copper conductor
2. Metal content does not meet specifications, using copper-clad aluminium or other metals instead of copper conductor
3. Substandard insulation
4. Reduced insulation thickness
5. Shorter length per coil
6. Fake labels & packaging, even in terms of quality certifications

UC on ntv7's Art of Living

The show's host talks to Mr Tan Kok Hong, MD of UC about substandard cables

About us…

Being the leading, certification, inspection and testing body in Malaysia, SIRIM QAS International provides a full range of certification, inspection and testing services.

The Electrical and Electronics Testing Section (EEST) of SIRIM QAS International has the facilities required to conduct product compliance for the following test requirements;

SAFETY

PERFORMANCE & **ENERGY EFFICIENCY**

About us…

We started in 1974. For more than 42 years, we have worked successfully with multinationals company/manufacturers and retailers in Malaysia as well as around ASEAN and China to ensure products they supplied to our local market comply with ST / EIU regulatory requirement

The key elements to us are;

1) Our expertise and competency
2) Our test facilities
3) Our vast experience over the years
4) Our credentials and recognitions from local & international bodies

Our roles….

With our comprehensive test facilities, we are able to offer / provide services for conformity assessment activities to;

Government

- Assist Regulatory Bodies (ST, BOMBA, SKMM,JPJ) in implementing regulations/legislations.

Industry

- Test for compliance to company, association, national and international standards.
- Assist exporters meeting importing country's regulatory requirements.
- Support companies' Research and Development activities

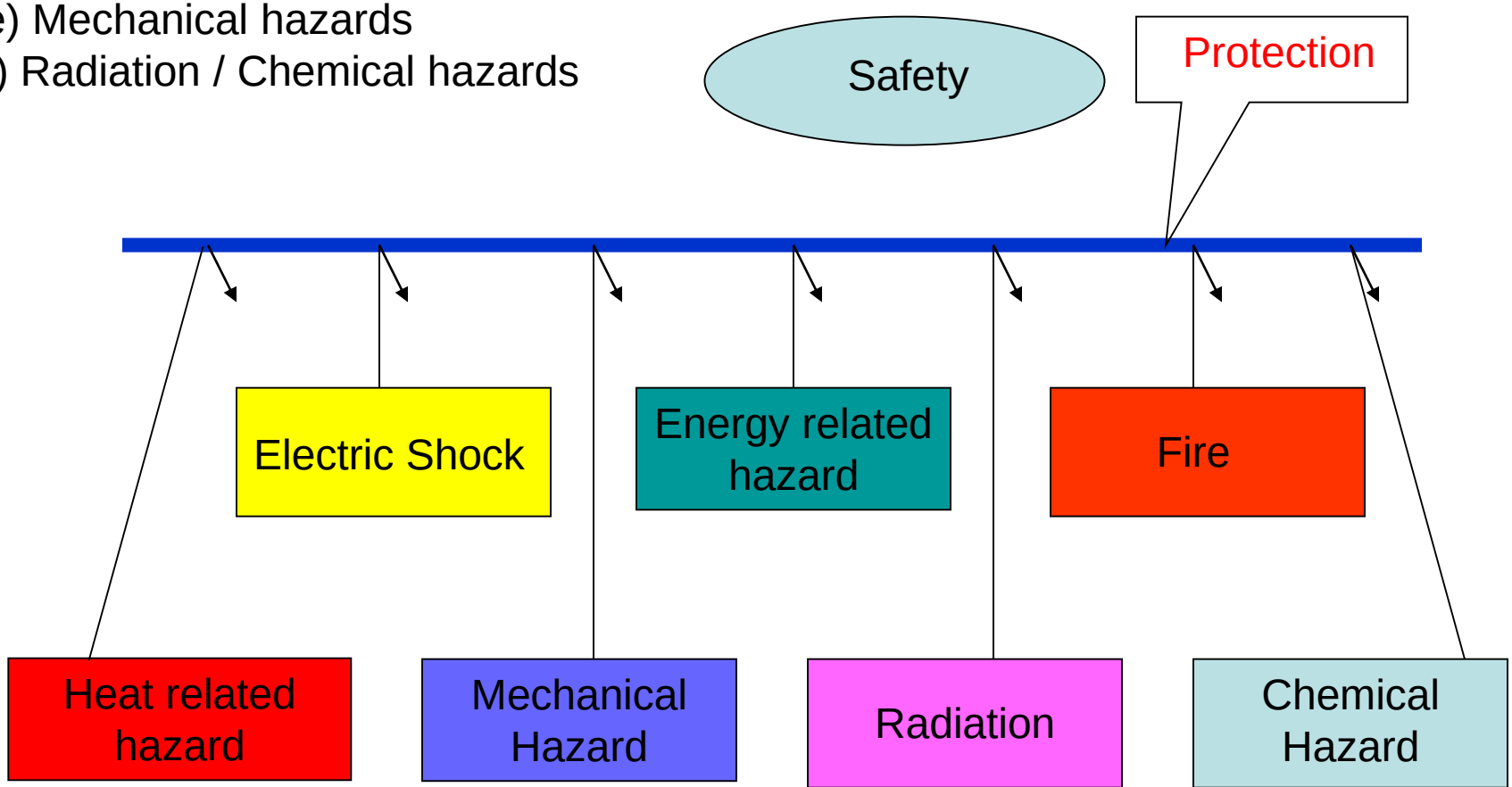
Safety test

- to verify safety level of a given product / appliance as against requirement of standard
- to evaluate if a product / an appliance would cause any danger to users or surrounding

Safety Test : Protection from hazards

The safety of electrical appliance / equipment and application of a safety standard are intended to reduce the risk of injury or damage due to the followings:

a) Electric shock
b) Energy related hazards
c) Fire / Heat related hazards
e) Mechanical hazards
f) Radiation / Chemical hazards



Cable Testing:
Procedure & standard requirement

Type of cables

- Low voltage cables up to 1 kV
- Medium voltage cables up to 33 kV
- Submarine cable up to 175 kV
- PVC insulated, XLPE insulated, paper impregnated
- Aluminium conductor for transmission line
- Communication cables and fiber optic
- Automotive cables
- Housing cable
- Flexible cable for appliance

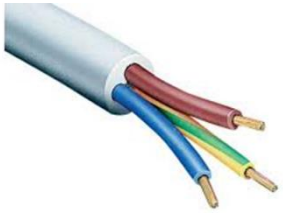
LV Cable

HV Cable

Shipboard

-Aerial Bundled Cable

Housing cable



Flexible cable

General

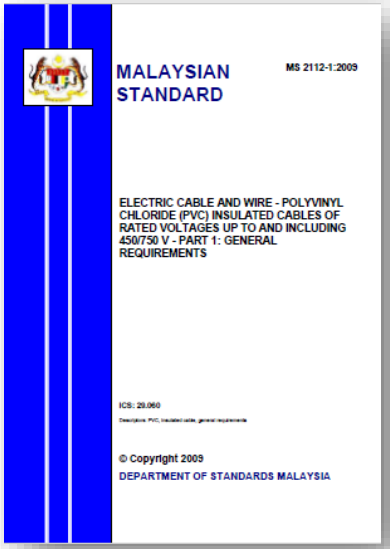
- There are a few types of cables used in Malaysia using different standards

Type of cables	Standards	Area of usage
Flexible cords up to 500V	MS 2112-5, BS 6500, IEC 60227-5	Portable socket-outlet, household appliances, audio-video products
Housing cables up to 750V	MS 2112-1 to MS 2112-6, BS 6004	Fixed wiring and lighting
PVC insulated 600V to 1 kV	MS 2100 to MS 2111, BS 6346	Low voltage electricity supply
XLPE insulated from 1 kV to 3 kV	IEC 60502-1	Low voltage electricity supply
XLPE insulated from 6 kV to 30 kV	IEC 60502-2	Medium voltage electricity supply

Type of cables	Standards	Area of usage
XLPE insulated cable	IEC 60840	Underground transmission line 30 kV to 150 kV
Fire rated cables	IEC 60331, IEC 60332, BS 6387, IEC 61034, IEC 754	Oil and gas industry, high rise buildings
Bare conductor	BS 215, ASTM D 233	Overhead transmission line
Low frequency cables	IEC 60189, SKMM	Data and communication cables
Fiber optic cables	IEC 60794	Data and communication cables
Automotive cable	JIS or mfr spec	Cables used in automobile

Test Standards

Type of cables	MS Standards for PVC cables
Electric Cable and Wire: Polyvinyl Chloride(PVC) insulated cables of rated voltages up to and including 450/750 V	**MS 2112-1:2009 Part 1:General Requirements**
	MS 2112-2:2009 Part 2:Test Method
	MS 2112-3:2009 Part 3:Non-Sheathed Cables for Fixed Wiring
	MS 2112-4:2009 Part 4:Sheathed Cables for Fixed Wiring
	MS 2112-5:2009 Part 5:Flexible Cables
	MS 2112-6:2009 Part 6:Cables for Lift & Flexible Connections



Basic Construction of Electric Cables

- Conductor

  copper, aluminium,

  tinned Copper

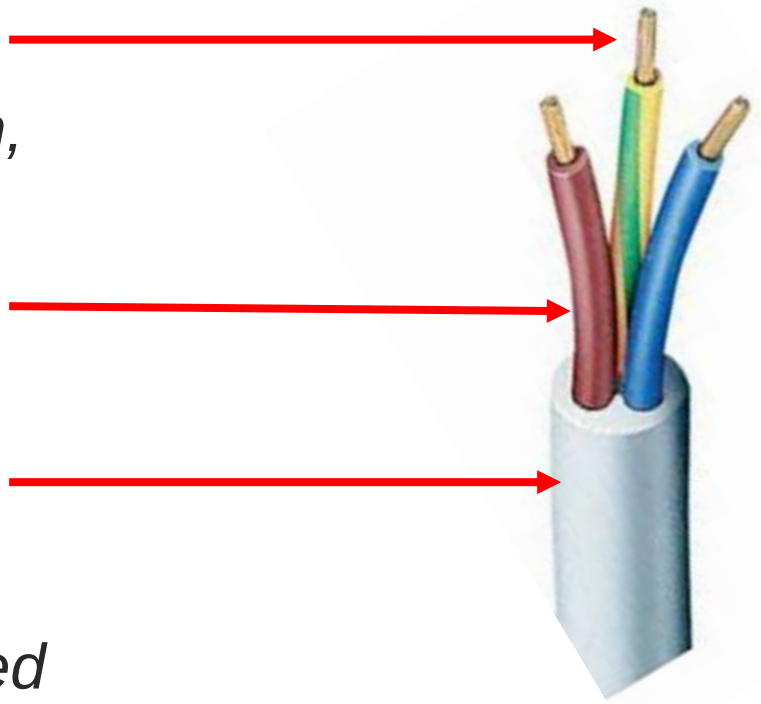
- Insulation

  PVC, XLPE, EPR

- Protective layer

  PVC sheath,

  steel wire armoured



GENERAL TEST REQUIREMENT FOR CABLE

Cables testing
In general – to ensure that they are safe and that they fit for purpose.

Test requirements for cable

- **Visual inspection/verification**
- **Various Tests on a completed cable**

GENERAL TEST REQUIREMENT FOR CABLE

VISUAL INSPECTION & VERIFICATION

a) **Marking**

- **Name of manufacturer**
- **Voltage designation**
- **Number and sizes of conductor**
- **Standard number**

Marking shall be durable & legible

Name of manufacturer

Cable's type, Number and size of conductor and material

Certification mark or name of certification body

Standard reference number

Rating / Voltage designation

b) **Core identification by colour & numbers**

GENERAL TEST REQUIREMENT FOR CABLE

TEST ON COMPLETED CABLE

Basically, test requirements for cable can be divided in to a few categories;
Some requirements apply only for specific type of cables

1. **Electrical tests**
   - a) Conductor resistance
   - b) Voltage test – on insulation & sheath
   - c) Long term stability

2. **Mechanical (physical) test**
   - a) Tensile test
   - b) Low temperature properties – bending / impact
   - c) Resistance to heat – heat shock

3. **Fire test**
   - a) Resistance to fire
   - b) Conductor and armour wire plating thickness
   - c) Smoke emission

4. **Chemical test**
   - a) Halogen gas determination
   - b) Flame retardance / propagation
   - c) Smoke emission

GENERAL TEST REQUIREMENT FOR CABLE (LV)

1. ELECTRICAL TESTS

a) Resistance of conductors

b) High Voltage at 1000V / 1500V / 2500V

c) Insulation Resistance at 70°C

Conductor Resistance Test

- This test measures the amount of electricity that a cable can safely transmit,
- Resistance of a conductor tells us how easily a conductor allows the flow of current through it.
- This test is used to determine the DC resistance of copper or aluminium conductors and broadly measures the amount of copper / aluminium present.
- Higher the resistance, lesser the current will flow though the conductor.
- Resistance of a conductor is influenced by;
  - conductor dimension and
  - construction, processing, conditions, temperature and resistivity.
- It is normally expressed as **ohms per km**
- Any conductor having size smaller than that marked on the cables, could result in overloading and overheating in use

Conductor Resistance Test

Procedure of Conductor Resistance Test

- Connect the specimen to the resistance measuring bridge and make sure that proper considerations are taken into account about the contact resistance.
- Measure the resistance and note down the temperature.
- Measured resistance is converted to the standard temperature and length

Conductor resistance test with Precision Double Bridge

Calculation

Observed Resistance at a particular temperature ,

$$R=(R_t \times k)/L \times 1000\ \Omega/km$$

Where,

R_t = Observed Resistance

K = Temperature correction factor

L = Length of specimen in m.

Conclusion - The sample meets/does not meet the requirements of the specification.

High Voltage Test

Procedure:

Approximate 3 meters long core is removed as sample from the finished cable or cord.

(Water Immersion Test) :

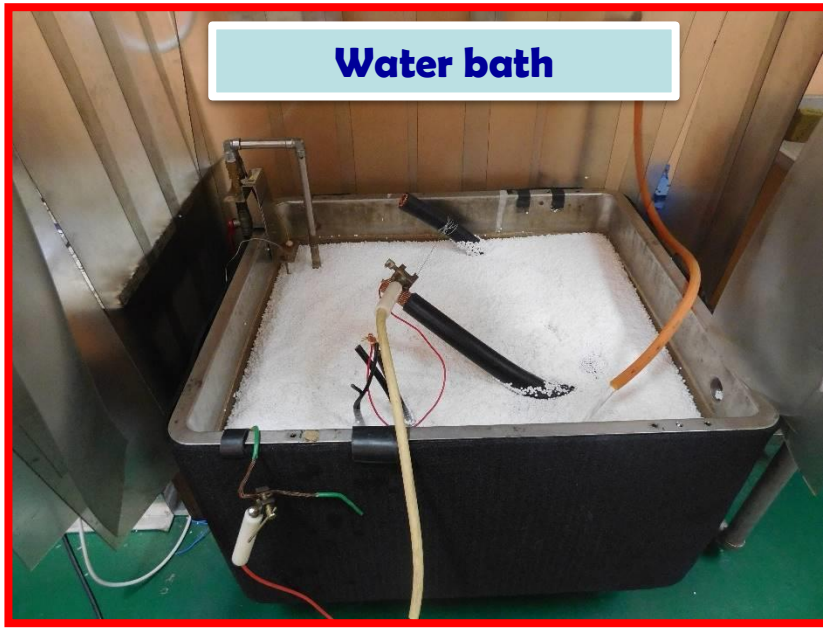
The sample then is so immersed in a water bath at room temperature that its ends protrude at least 200 mm above the water level.

(High Voltage Test) :

After 24 hours , an alternating voltage of required level is applied between conductor and water .

This voltage is raised as per requirement within 10 sec and hold constant at this value for 5 min.

If the sample fails in this test, one more sample can be subjected to this test.



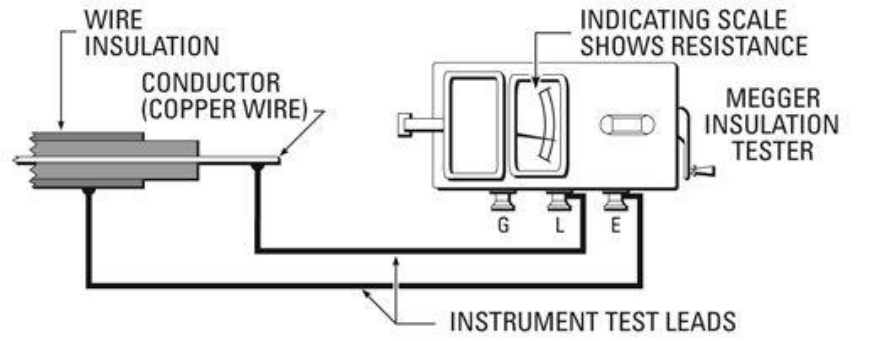
Water bath

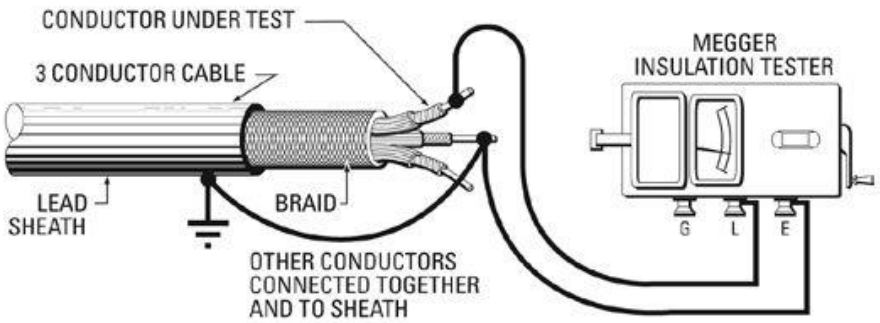
High voltage tester – up to 10kV

Insulation resistance test

The insulation resistance measurement is used to

1) determine if the circuit will operate without excessive leakage current through the insulation when energized
2) verify the electrical insulation level of cable





Insulation resistance test with High Range MegaOhmeter (MEGGER)

GENERAL TEST REQUIREMENT FOR CABLE

2. CONSTRUCTIONAL & DIMENSIONAL CHARACTERISTICS

a) Checking compliance with constructional provisions

b) Measurement of insulation thickness

c) Measurement of overall diameter

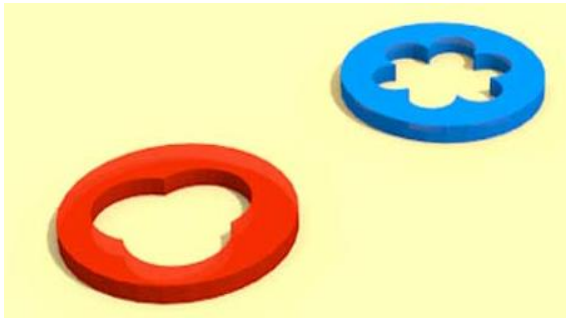
Plane Faced Micrometer with scale division at least 0.01 mm is used to measure the diameter of the specimen used in the test

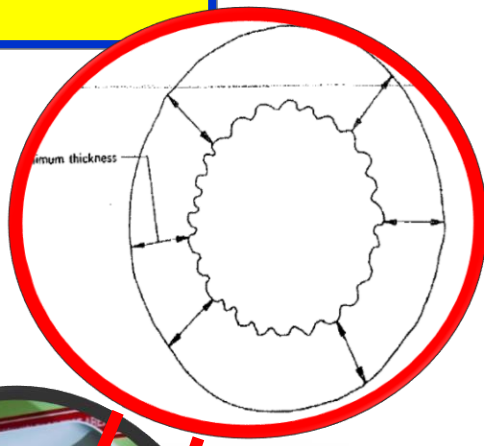
GENERAL TEST REQUIREMENT FOR CABLE

Measurement of insulation thickness

The measurement of such thickness is necessary to verify whether it is as per specified limit or not. These dimensions ensure safe and reliable performance of the cable

A sliced section the specimen is placed under a measuring microscope along the optical axis.





Profile Projector set

GENERAL TEST REQUIREMENT FOR CABLE

3. MECHANICAL PROPERTIES OF INSULATION

a) Tensile Tests before ageing

b) Tensile test after ageing

c) Loss of mass test
– before & after ageing
(% different of mass)

Ageing test

GENERAL TEST REQUIREMENT FOR CABLE

3. MECHANICAL PROPERTIES OF INSULATION

Universal Tensile Machine

– An automatic machine, with two end grips properly designed to hold the conductor with sufficient strength so that the conductor cannot slid by any means during the test.

The machine should have sufficient capacity to apply required tension during test

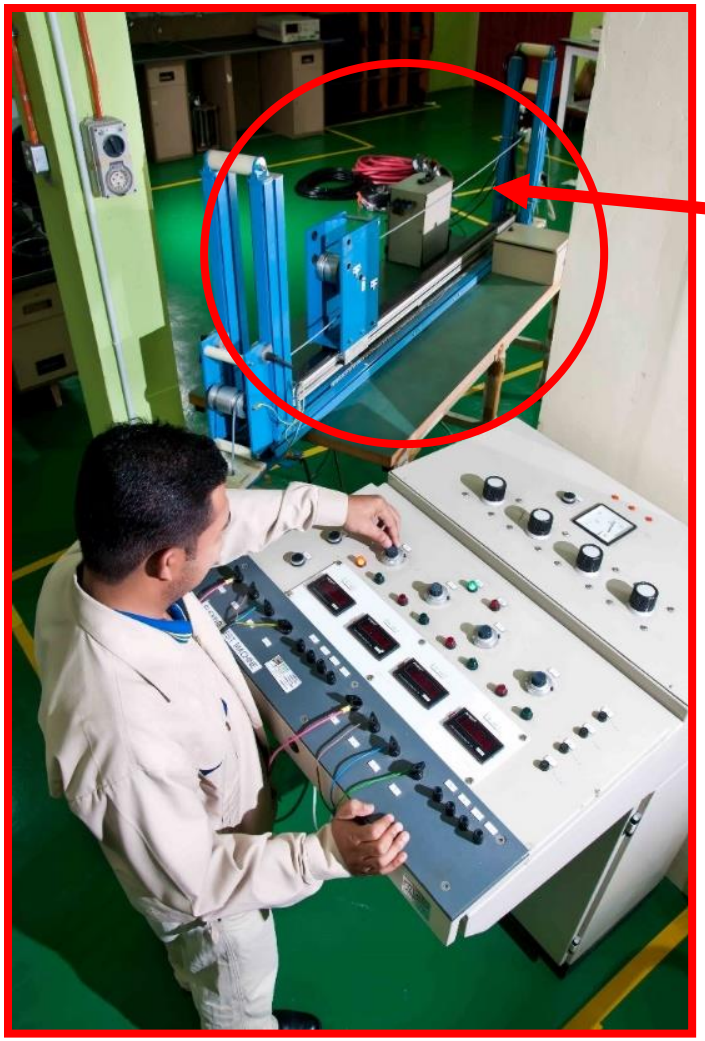
Before test

After test

- This test is performed to confirm tensile strength of PVC insulation and sheathing
- This test is performed on PVC/conductor material from the complete cable to judge the strength of this material.
- A cable is often subjected to pull from one end during laying, installing and manufacturing hence it should be strong enough to tolerate the pulling force as well.

GENERAL TEST REQUIREMENT FOR CABLE

3. MECHANICAL PROPERTIES OF INSULATION



Flexing tester for flexible cable

GENERAL TEST REQUIREMENT FOR CABLE

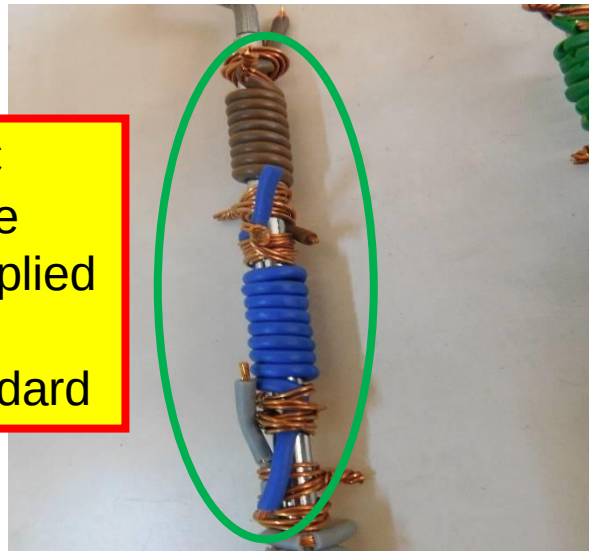
4. Pressure test at high temperature (for PVC)

a) Insulation
b) Sheath

5. Heat shock test

Heat and Cold
Cables are used in a wide variety of environments, so several tests assess their performance in very hot and very cold conditions, to check whether the insulation and sheathing material melts or cracks and hence ensuring safety

Low temperature freezer



PVC cable complied with standard

Material crack / break

PVC cable failed to meet standard requirement after treatment to heat test

GENERAL TEST REQUIREMENT FOR CABLE

6. Test of flame retardance

Flammability test :

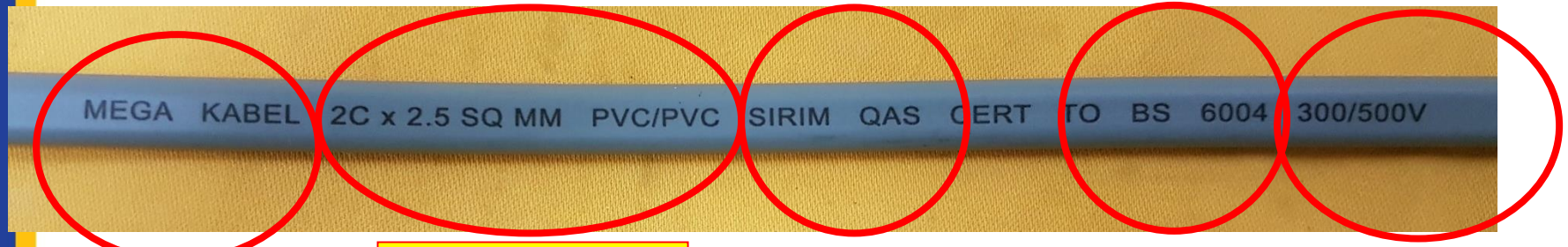
Some cables are used in specialist fire systems and have to withstand a fire for duration specified in standard

For a single cable / PVC, a period of burning after removal of the flame shall not exceed 60 sec.

And the unaffected portion from the lower edge of the top clamp shall be at least 50 mm

Vertical burning tester on single cable

Certification marking & substandard cable



Name of manufacturer

Cable's type, Number and size of conductor and material

Certification mark or name of certification body

Standard reference number

Rating / Voltage designation

Certification Requirement for Cable

Marking

1 Certified cables shall be marked with the requirements of clause 5 and 7 of MS 2112-1 and SIRIM QAS requirements:

1. Printing, external indenting or embossing:

   - Manufacturer's name or trade mark;
   - Voltage designation;
   - Number of cores and nominal cross-sectional area;
   - Cables for use at a conductor temperature exceeding 70°C shall be marked with the maximum conductor temperature;
   - The words 'SIRIM QAS certified to MS 2112-3'
   - Certification number PCXXXXXX.

2. The distance between the end and start of each element shall not exceed 50 mm.

   - The distance between the end of one complete elements and the beginning of the next elements of each of the above marking shall not exceed 550mm.

3. The SIRIM Certification Mark shall be marked on the tag/label of the smallest packaging of the cable.

4. The marking shall be legible and easily discernible. Any marking by printing shall be durable.

5. Sample of SIRIM Certification Mark on smallest packaging shall be as below :

Certification Requirement for Cable

Example of SIRIM Certification Mark:

SIRIM
CERTIFIED TO MS 2112-3 : 2009
Certification No.: PCXXXXXX

Note : *
PCXXXXXX (to use number printed on the license)

Control in place (additional for cable product);

Cable product that failed under Market Surveillance, Licensee shall be placed under a Consignment Program where;

Every batch shall be selected for tests

-Tests are for Marking, High Voltage Test, Conductor Resistance, Constructional & dimensional

2 consecutives PASS/COMPLIANCE results are required before lifting of the Consignment Programme

Sub-Standard Cables

Cables which are not designed, constructed, test approved, installed or used in accordance their prescribed safety standards and specifications

- Identity /Characteristics of a substandard cable;
  1. **Undersized**
     a) conductor construction not in accordance to prescribed standards on dimensions such as;
        - » size & number of wires,
        - » thickness
        - » Length

     b) conductor does not meet the minimum cross-sectional area as determined by its specific resistance.

     c) reduced size of copper resistance

  2. **Mixed content**

     Instead of pure copper – 'they' use mixed content or other metal

Sub-Standard Cables

3. **Reduced in insulation properties**

   a) insulation & protective layers construction not in accordance to prescribed standards on size, thickness or dimensions

   b) Insulation & protective layers type does not meet the required mechanical properties for long term ageing and environmental tests

4. **No identification / certification marking**

   Completed cables are not identified by markings as stipulated by the standards.

How to identify a sub-standard cable

1) Check and verify MARKINGS on Cable
   – shall be as per standard requirement

2) Check and verify APPROVAL / CERTIFICATION Mark/Label

3) Measure conductor resistance (need to have a proper equipment/meter)

4) Measure size(s)
   - conductor
   - each strand (and no of strands)

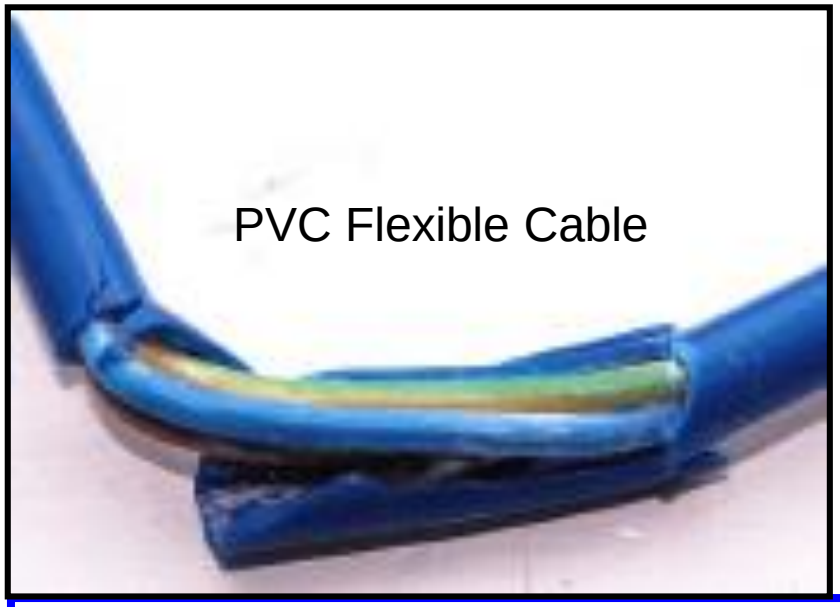
5) Check and verify copper content
   - normally by conductor resistance
   - weight the sample
     - Sometimes –by weighing the sample, with some experience, we can identify if the samples / weight of sample due to copper content or sheath of insulation

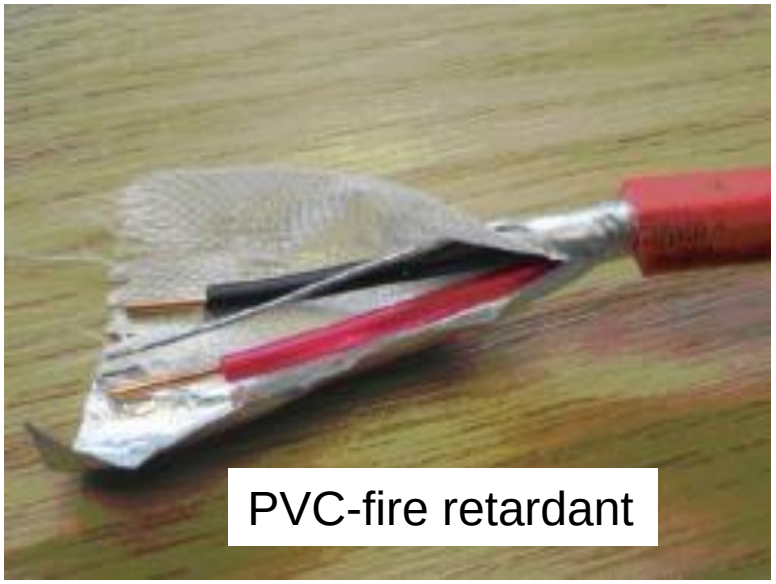
Example of sub-standard cable

MARKING on Cable

- Marking vs No marking
  - No manufacturer's name/trademark
  - No cable markings such as size, electrical parameters
- Marked with label / certification Mark vs No label / not certified
  - Certified / Approval body not identified
- Fake labels vs proper label
  - Counterfeit

Example of sub-standard cable





Non-compliant PVC Flexible Cable

- Undersized conductor – low conductivity – 1mm^2 instead of 1.5mm^2
- Cable sheath fall apart in low temperature bend test
- No compliant with standard marked on sheath
- For fire retardant –
  - Not fire resistance –PVC insulation &PVC sheath – fails within 2 minutes instead of 30 minutes as required by standard

How can SIRIM assist?

SIRIM will always playing it's roles in providing assistance to industry & regulator in fighting issue of sub standard cable

How can we do that?–

a) through compliance testing
b) through our product certification scheme
c) through SIRIM's market surveillance activities
d) by carrying out verification testing on samples picked up from market - through enforcement & market surveillance –by Suruhanjaya Tenaga
e) by providing a support to ST & MCMA initiatives to raise the issue of sub-standard cable to the widest audience possible

Problems / Challenges

- The ability to buy cable from anywhere in the world means there remains a need for better market surveillance as some imported cable – of which are not in compliance with standard requirement

- Contractors have little interest in standards while some distributors encourage the manufacturer of `undersized cable'

- Inferior cable product is sold unmarked - making it untraceable and misuse of trade marks is common place

- No follow-up market surveillance (though is essential) to ensure future compliance.

Moving forward

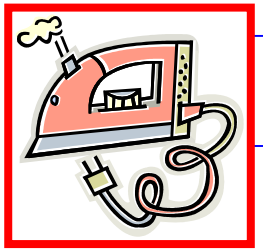
CONCLUSION

- **We all want safer cables and this can only be achieved with;**
  - **acceptance of the problem,**
  - **better monitoring and enforcement at every level of the supply chain**

APPLICATION PROCESS FLOW FOR SIRIM TESTING

Application by *a SUPPLIER

*A supplier includes importer, manufacturer and trader.



A supplier submit test application to SIRIM QAS International test lab

Submit to

SIRIM QAS International test lab performs a type test to a standard (MS / IEC Std + National Deviation(if any)

SIRIM QAS INTL TEST LAB

SIRIM QAS International test lab shall issue a full type test report

The report shall then be used for submission for a COA application with a regulatory body

Contact Information

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THANK YOU FOR YOUR KIND ATTENTION

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Video - test activities