Cable Testing –

A sneak preview of some of the less well known tests

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Introduction During its life-cycle a cable undergoes numerous and varied testing regimes from…..

simple dimensional checks such as insulation thickness…..

to

more complex reaction to fire testing…..

Testing Regimes

A BASEC approved cable is of assured quality throughout it's life cycle via the effective application of sets of prescribed testing regimes referred to as…

Type Tests

Sample Tests

Routine Tests

Surveillance Tests

Type Tests

Tests required to be made before supplying a type of cable covered by a cable design standard on a general commercial basis, in order to demonstrate satisfactory performance characteristics to meet the intended application.

These tests are of such nature that, after they have been made, they need not be repeated unless changes are made in the cable materials, design or type of manufacturing process which might change the performance characteristics.

Sample Tests

Tests made on samples of completed cable, or components taken from a completed cable adequate to verify that the finished product meets the design specifications.

Routine Tests

Tests made on all production lengths of cable to demonstrate their integrity.

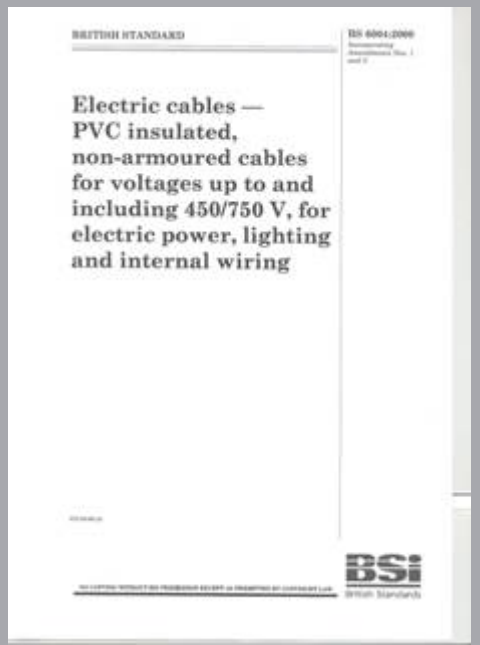
Sample Tests

Tests made on samples of completed cable, or components taken from a completed cable adequate to verify that the finished product meets the design specifications.

Surveillance Tests

BASEC select product 4 times per year (can be 150+ samples taken). The samples are then tested by the independent BSI Cable Testing Laboratories against a sampling scheme devised by BASEC.

Let’s consider the humble PVC Flat Twin 6242Y……


BRITISH STANDARD

BS 6004:2000

Electric cables — PVC insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring

BSI British Standards

This cable is required to meet BS6004:2000 and the tests undertaken are as follows….

Type Testing 6242Y

"Tests at the start of a cable's life"

Voltage test on cores at 1500V

Flame propagation of a single cable

Compatibility test

Insulation material properties

Sheath material properties

Type Testing 6242Y "Tests at the start of a cable's life"

Voltage test on cores at 1500V

Aim: To determine electrical integrity of conductor and insulation

Method: In BS6004

Summary: 5m of insulated core extracted from completed cable immersed in water at 20±5°C for 1hour then apply 2000V for 15 mins.

Requirement: No breakdown of insulation.

Type Testing 6242Y "Tests at the start of a cable's life"

Flame propagation of single cable

Aim: Does cable propagate a flame

Method: BS EN 60332-1-2:2004

Summary: Short length of completed cable is exposed to a flame of known energy for a set time. Flame is removed and extent of propagation recorded.

Requirement: Flame must not propagate beyond a prescribed limit.

Type Testing 6242Y "Tests at the start of a cable's life"

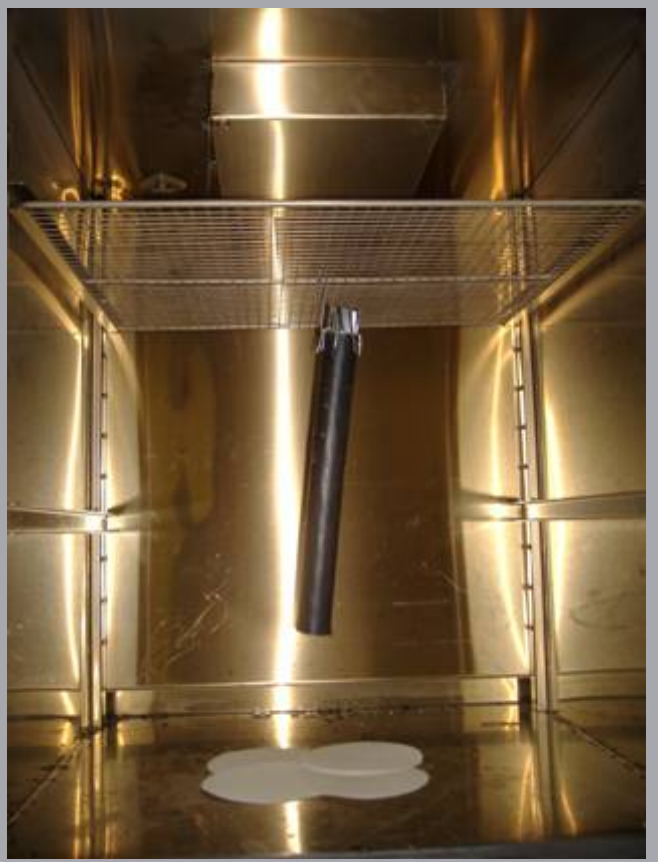
Compatibilty test

Aim: To determine whether the insulation & sheath are likely to deteriorate due to contact with other components e.g. plasticiser migration

Method: BS EN 60811-1-2:1995

Summary: Short length of completed cable is placed in an oven at 80±2°C for 7 days. The tensile properties of both the insulation & the sheath are measured before and after the heat treatment.

Requirement: Variation in tensile properties not to be beyond a prescribed limit.



Type Testing 6242Y "Tests at the start of a cable's life"

Insulation & sheath material properties

The insulation and sheath materials have to meet the requirements of a specific grade of material in a separate compendium of materials standards called BS EN 50363.

A set of tests are made to another compendium called BS EN 60811 to ensure the insulation and sheath materials have the correct balance of properties for satisfactory in-service performance.

Tests included are….

Tensile Properties in the state as manufactured

Tensile properties after ageing in air oven

Bending at low temperature

Elongation at low temperature

Pressure test at high temperature

Resistance to cracking

Loss of mass

Insulation resistance

Type Testing 6242Y "Tests at the start of a cable's life"

Tensile properties of insulation

Aim: To determine whether the mechanical properties of the insulation are likely to deteriorate over time due to repeated heat cycling in service.

Method: BS EN 60811:1995

Summary: Samples of insulation extracted from completed cable and placed in an oven at 80±2°C for 7 days. The tensile properties of the samples are measured before and after the heat treatment.

Requirement: Variation in tensile properties not to be beyond a prescribed limit.

Type Testing 6242Y "Tests at the start of a cable's life"

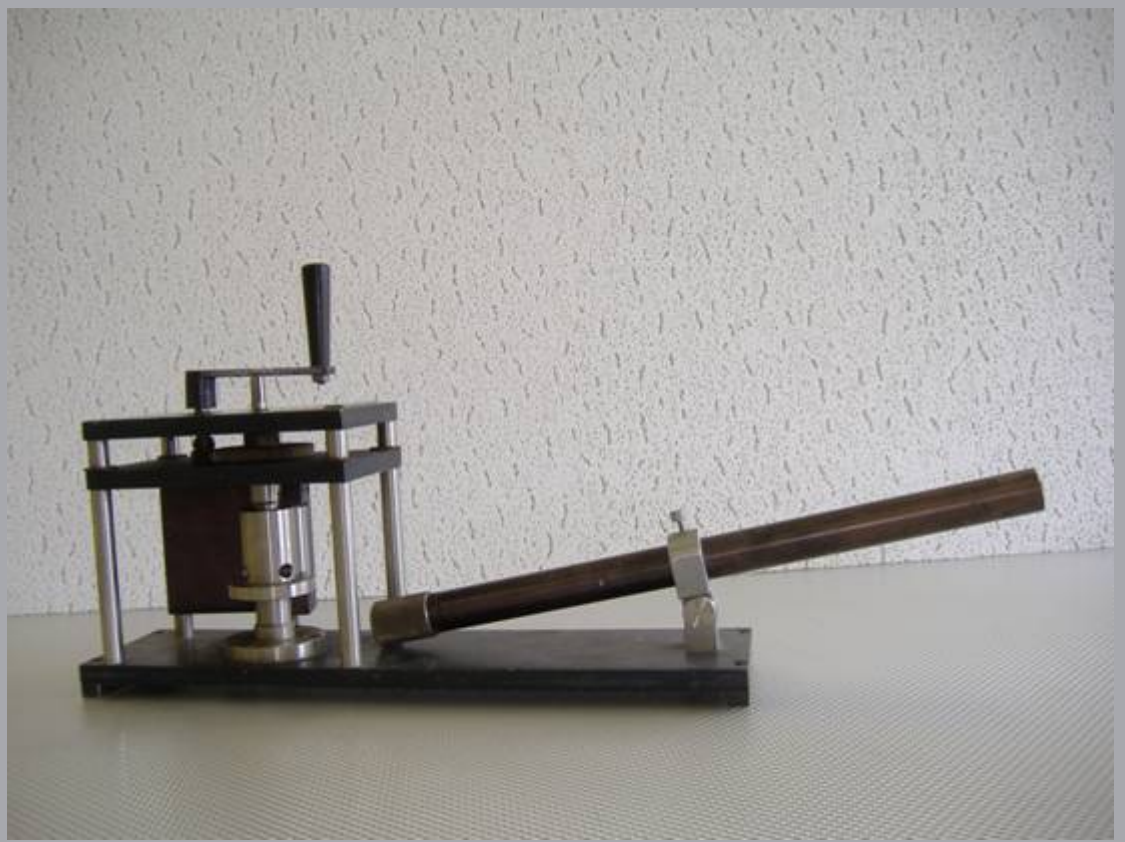
Bending at low temperature

Aim: To determine whether the sheath is likely to crack due to exposure to sub-zero temperatures in service.

Method: BS EN 60811:1995

Summary: Samples of completed cable are inserted into the rig opposite and placed in a freezer at -15±2°C for several hours. The rig is removed from the freezer and via a rotary action the cooled cable is formed around a mandrel.

Requirement: No cracks in sheath



Type Testing 6242Y “Tests at the start of a cable’s life”

Elongation at low temperature

Aim: To determine whether the insulation & sheath are likely to break due to exposure to pulling tensions at sub-zero temperatures in service.

Method: BS EN 60811:1995

Summary: Samples of insulation & sheath are taken from the completed cable and inserted into the rig opposite and exposed to a temperature of -15±2°C for several hours. The rig is removed from the freezer and via a rotary action the cooled sample is stretched to a pre-determined limit depending on the type of material.

Requirement: Samples should be intact after application of pre-determined stretch.

Type Testing 6242Y “Tests at the start of a cable’s life”

Pressure test at high temperature

Aim: To determine whether the insulation & sheath are likely to deform due to contact with hot surfaces in service.

Method: BS EN 60811:1995

Summary: Samples of insulation & sheath are taken from the completed cable are inserted into the rig opposite and exposed to a temperature of 80±2°C for several hours. The rig is removed from the oven and the permanent indentation measured as a % of the original thickness.

Requirement: The permanent indentation should not be greater than 50% of the original thickness of the sheath.

Type Testing 6242Y "Tests at the start of a cable's life"

Resistance to cracking

Aim: To determine whether the insulation & sheath are likely to crack open due to high ambient conditions as may be experienced during a short circuit in service.

Method: BS EN 60811:1995

Summary: Samples of completed cable or insulated core are wrapped around a mandrel and exposed to a temperature of 150±2°C for several hours.

Requirement: No cracks when cool.

Type Testing 6242Y "Tests at the start of a cable's life"

Loss of mass

Aim: To determine the amount of volatile material lost from the insulation & sheath during long term exposure to temperatures above the operating temperature of the cable. Loss of volatile materials can lead to hardening of the insulation or sheath to a point whereby the tensile properties are adversely affected.

Method: BS EN 60811:1995

Summary: Samples of insulation & sheath are exposed to a temperature of 80±2°C for 7 days. The mass of the samples are recorded before and after the heat treatment and equated to the surface area of the sample.

Requirement: Volatile loss must not be greater than known maximum.

Type Testing 6242Y "Tests at the start of a cable's life"

Insulation resistance

Aim: To determine the electrical integrity of the insulation and sheath when loaded above the normal voltage rating of the cable whilst immersed in water.

Method: BS 6469: Section 99.2

Summary: A known length of insulated core extracted from completed cable or completed cable is immersed in water at either 70±2°C or 20±2°C for 24 hours. A voltage test is carried out after immersion followed immediately by an insulation resistance test. IR value used to determine the Insulation Resistance Constant K.

Requirement: Insulation resistance constant must not be greater than known maximum.

Sample Testing 6242Y "Let's have a regular look"

Conductor construction & resistance

Insulation resistance after voltage test

Insulation & sheath thickness

Insulation & sheath application

Mean overall dimensions

Durability of marking

Voltage test on completed cable

Routine Testing 6242Y "Must do routinely during manufacture"

During manufacture there are many in-process checks made to ensure the various components can proceed or be rejected

There is also a set of tests undertaken at the end of manufacture to double check the n-process checks and determine the final electrical integrity of the finished cable

The 6242Y cable undergoes the following Routine Tests as a minimum prescribed by the respective cable deign standard BS6004:2000

Absence of faults in the insulation:

-High voltage test on insulated cores

- In-process Spark Testing

Cable Markings

Routine Testing 6242Y "Must do routinely during manufacture"

Absence of faults in the insulation:

-High voltage test on insulated cores

Routine Testing 6242Y "Must do routinely during manufacture"

Absence of faults in the insulation:

-In-process Sark Test

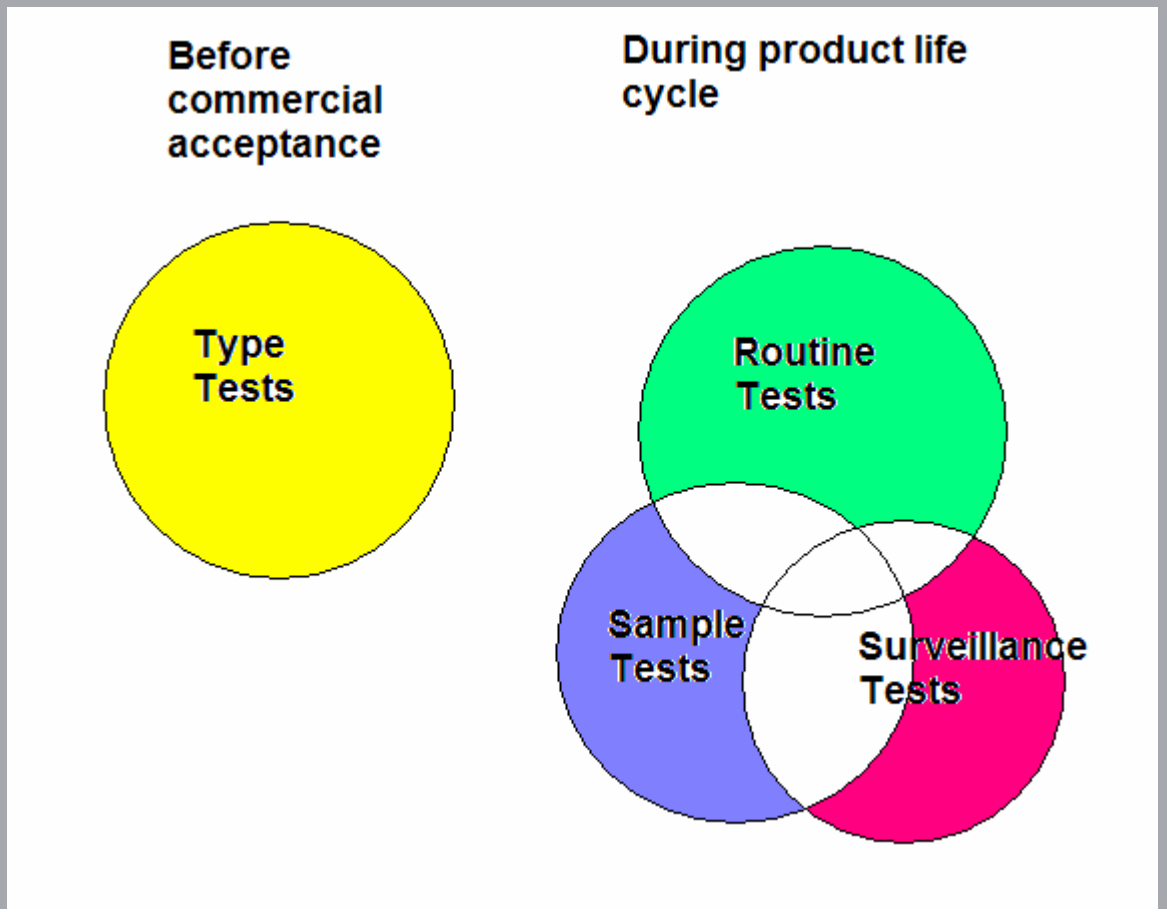
Surveillance Testing "A regular look by an independent authority"

BASEC approved cable is also sampled by BASEC 4X per year and sent to The BSI Cable Testing Laboratory to be independently tested.

The frequencies of tests to be undertaken on the samples selected are governed by BASEC and are based on the following categories:

Test Category	Frequency
F100	100% OF SAMPLES
F50	50% OF SAMPLES
F25	25% OF SAMPLES
F5	5% OF SAMPLES

In Summary


Before commercial acceptance
During product life cycle
Type Tests
Routine Tests
Sample Tests
Surveillance Tests