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International Copper
Association
Copper Alliance

Executive Summary of Wire Test – India

10TH MAY 2022



Table of Content

1. Background
2. Methodology
3. Executive Summary
4. Conductor Test Analysis
5. Copper Purity Test Analysis
6. Insulation Test Analysis
7. Finding Conclusions
-  8. Recommendations to BIS

Background

11,000+ fire accidents are reported every year and more than **10,000** lives are lost in these fire accidents every year

40% of fire incidents are caused by **faults, defects or use of non-standard electrical products** leading to short circuits

Following causes attributes to poor quality of PVC Wire & Cables :

- Excessive heating of conductor
- Melting of PVC insulation due to excessive heating
- Deterioration of insulation due to ageing

The study aims to understand and quantify the quality related issues in building wires

Methodology

Selection of Samples

- 50 Samples from pan India retail shops of 1.5 Sq. mm
- Sample represents National, Regional and local wire manufacturers
- Distribution of sample collection from all zones - N:12, S:14, E:13, W:11
- Collected samples of Class 2 & Class 5 Conductors with FR grade

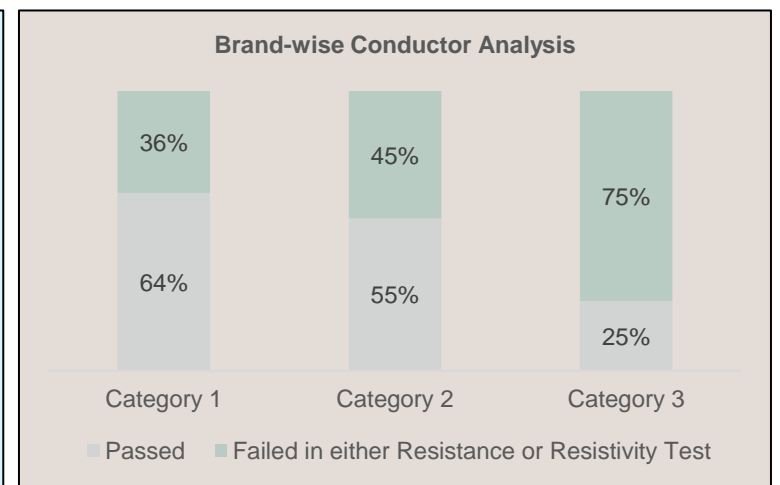
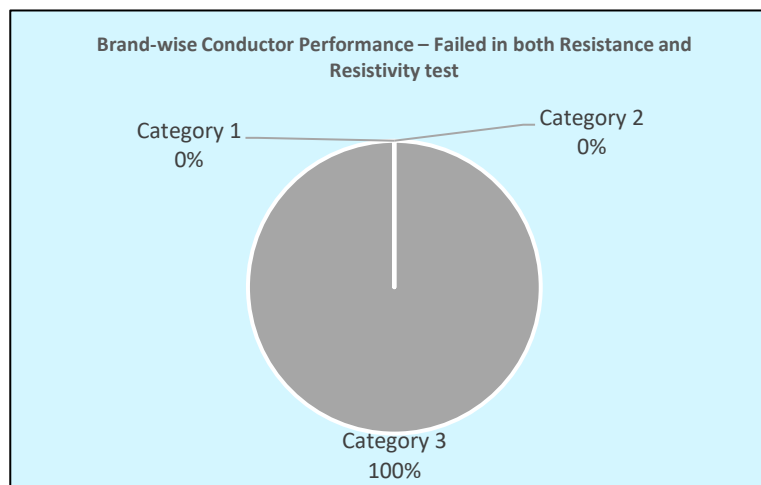
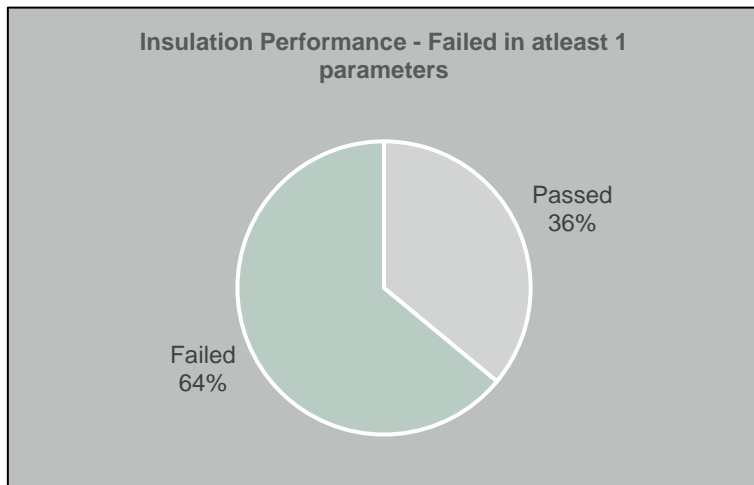
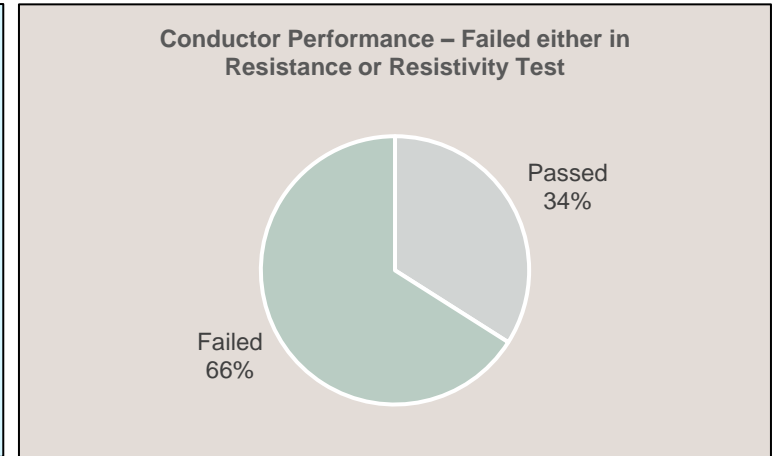
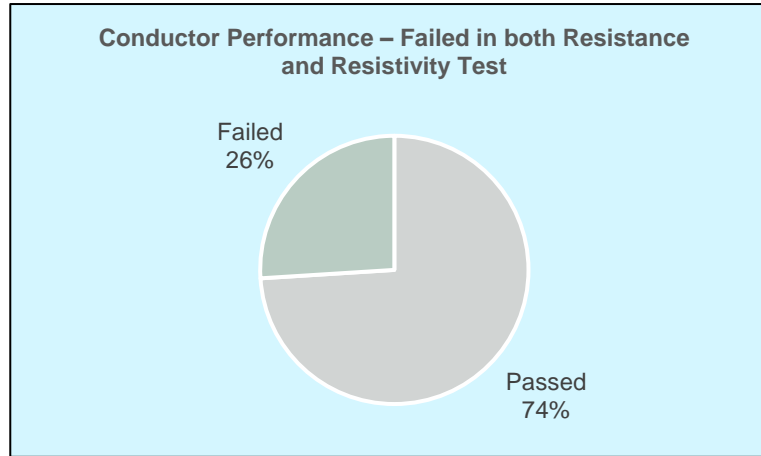
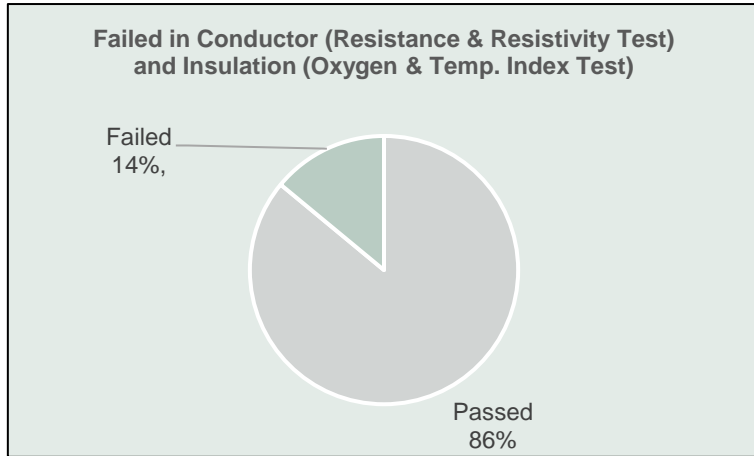
Test Methodology

- As per IS 694

Test Setup

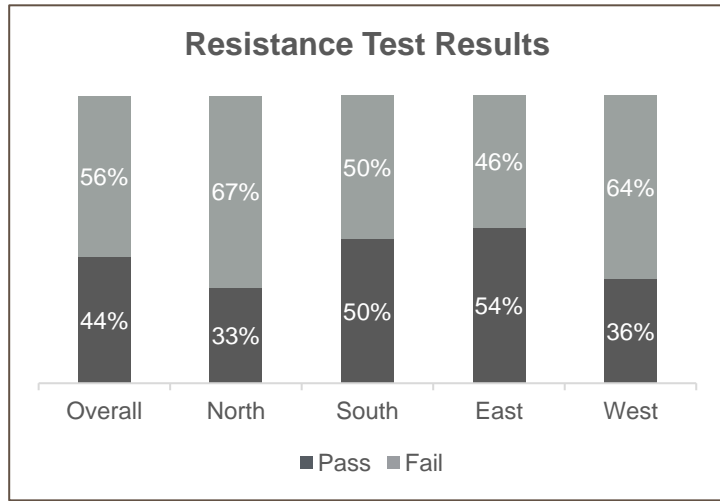
- NABL accredited laboratory – Sriram Institute of Industrial Research

Executive Summary



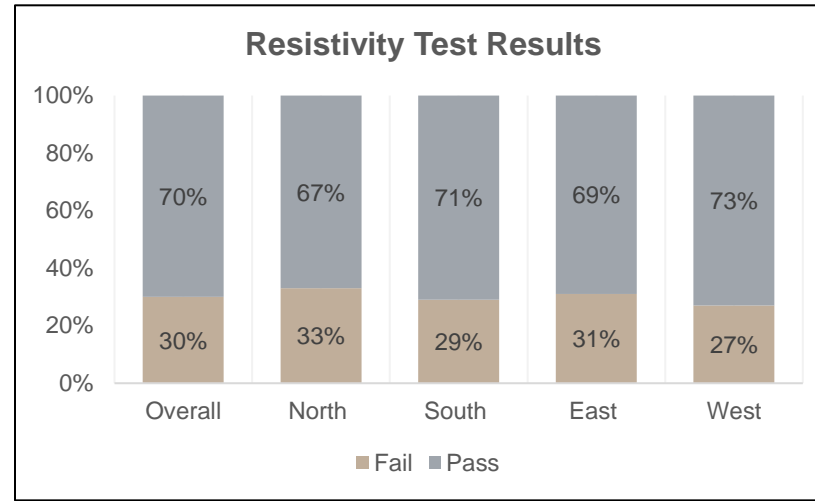
Category 1 – 11 Listed National brands; Category 2 – 11 Regional Non Listed Brands, Category 3 – 28 Local Non Listed Brands

Conductor Test Analysis



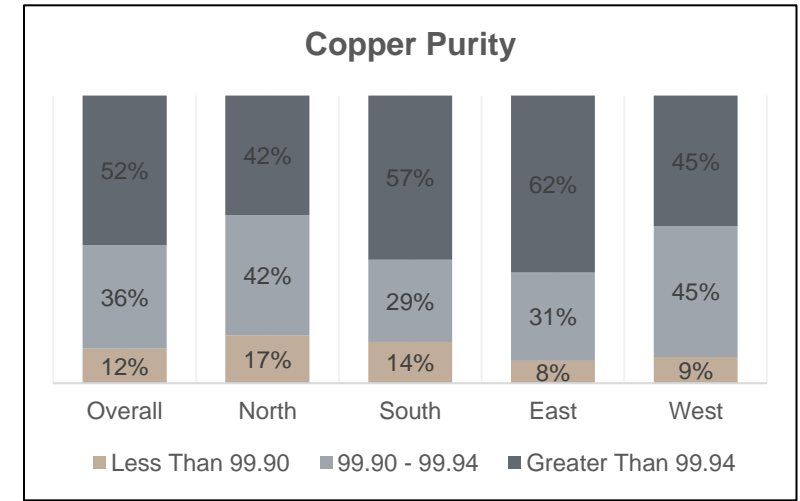
Resistance:

- 1) Overall, 56% (28) samples failed
- 2) 75% (21) of Cat. 3 samples failed
- 3) Failure rate in Cat. 1 and Cat. 2 was 27% (3 samples) and 37% (4 samples) respectively



Resistivity:

- 1) Overall, 30% sample failed in resistivity
- 2) 46% (13) of Cat.3 samples failed
- 3) 1 sample each of Cat.1 and Cat.2 failed

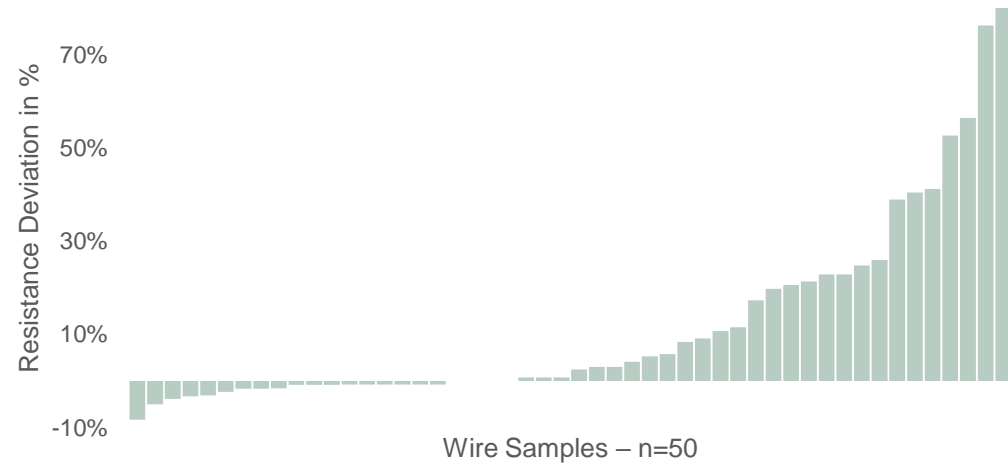


Copper Purity:

- 1) Overall 12% samples failed
- 2) All Cat.1 samples had 99.99% copper purity
- 3) 1 sample of Cat.2 failed having 99.83 purity
- 4) 5 samples of Cat.3 failed having below 99.90 purity

Conductor Test Analysis

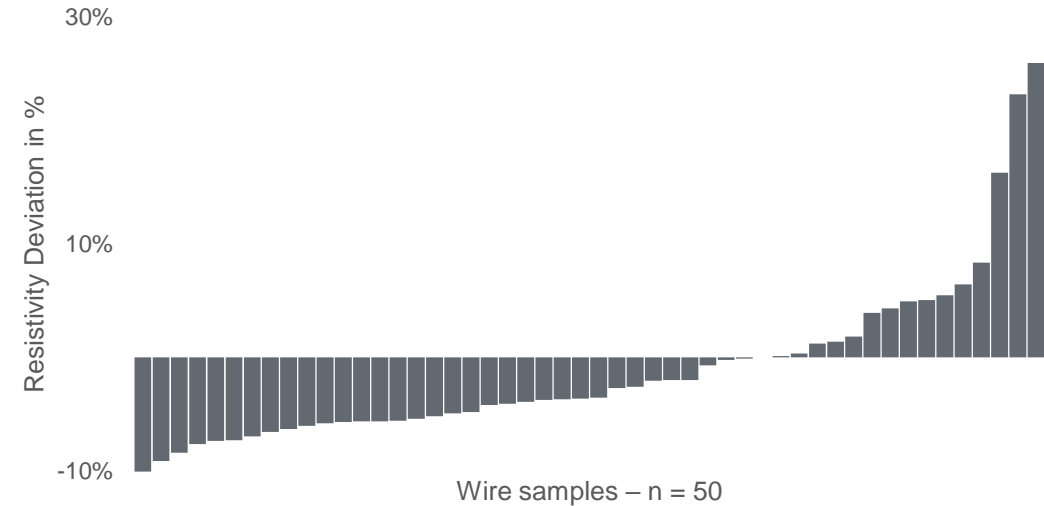
Conductor Resistance Deviation



▪ Observation:

- 1) 18 samples i.e. 36% performed better than the defined standard value achieving lower resistance
- 2) 4 samples i.e. 8% samples achieved resistance value exact as per standard value
- 3) 23 samples i.e. 46% samples failed with deviation of up to 40% higher than the standard value
- 4) 5 samples i.e. 10% Samples failed with deviation above 40% higher than the standard value

Conductor Resistivity Deviation

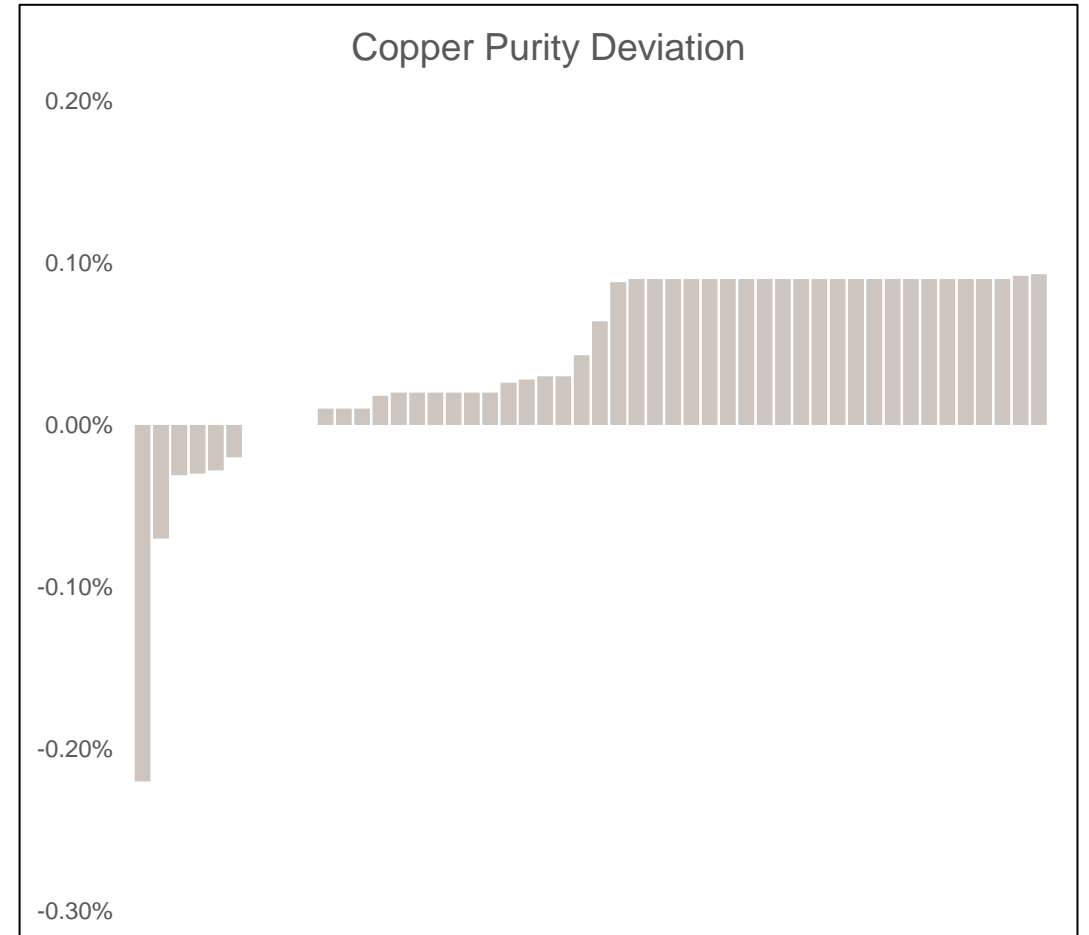


▪ Observation:

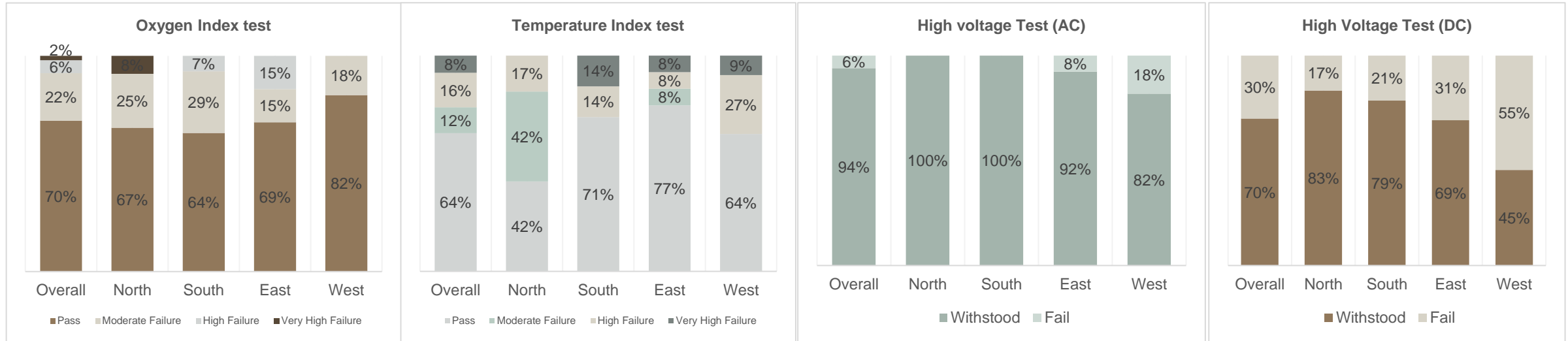
- 1) 34 samples i.e. 68% performed better than defined standard value achieving lower resistivity
- 2) 1 sample i.e. 2% sample achieved resistance value exact as per standard value
- 3) 12 samples i.e. 24% samples failed with deviation of up to 10% Higher than the standard value
- 4) 3 samples i.e. 6% Samples failed with deviation above 10% higher than the standard value

Copper Purity Test Analysis

- Overall 6 samples failed in Copper Purity (Base value as per Standard is 99.90%)
- 36% samples (18 samples) had borderline copper purity
- 4 samples had copper purity same as base value of 99.90%
- 12 out of 18 samples having borderline purity, failed in resistivity
- 15 out of 18 samples having borderline purity, failed in resistance



Insulation Test Analysis



Oxygen Index Test:

- 1) 70% samples passed having values in line with standard ($\geq 29\%$)
- 2) 22% samples failed with values ranging between ≥ 27 and $< 29\%$
- 3) 6% samples failed with values ranging between ≥ 26 and $< 27\%$
- 4) 2% samples failed having values $< 26\%$

Temperature Index Test:

- 1) 64% samples passed with values in line with standard (250 min)
- 2) 12% samples failed with values between ≥ 200 and < 250
- 3) 16% samples failed with values between ≥ 150 and < 200
- 4) 8% samples failed with values < 150

High Voltage AC Test:

- 1) Performance in AC High Voltage is fairly good with only 6% failure reported
- 2) However west has 18% failure and East has 8%
- 3) Standard values are - Withstand 6 kV (rms) for 5 minutes

High Voltage DC test :

- 1) DC High voltage test which is a more stringent test and reflects on the quality of insulation has reported significant failure of 30% overall
- 2) West has the highest failure of 55% and North has the least of 17%
- 3) Standard values are - Withstand 1.2 kV DC for 240 hours

Brief Analysis - Insulation (Other Tests)

- Thickness of insulation and TS/Elongation before ageing - All samples passed indicates manufacturing process has been established fairly robustly
- TS/Elongation after ageing – All except 2 have passed, the failure in 2 samples seems to be an aberration hence ignored
- Basic thermal properties such as - heat shock, hot deformation, flammability – all samples passed. 15% failure in loss of mass properties
- Thermal stability – 12% samples failed
- Insulation resistance and volume resistivity – All passed
- Acid gas and smoke density – 5 samples for each were tested and all passed

Conclusion

There is serious concern of the result of resistance where 56 % sample failed with higher failure of 65 % in north and west region

12-15% failure were observed in thermal property like loss of mass and thermal stability which reflects poorly on the performance in fire condition

Performance in thickness of insulation, TS & elongation before and after ageing, high voltage (ac) and IR are satisfactory

Significant high failure of 30 % in DC high voltage test, an important criteria of insulation property which is a concern area as it reflects on quality of insulation in cable

Significant high failure of 30-36% in oxygen index/temperature Index reflects poor performance of PVC insulation in actual fire condition

Samples tested in toxic gas/smoke density, though less in number but found passing

Recommendations

Quality of Wires & cables available in the market need urgent attention and BIS need to take improved quality certification and stringent monitoring process

BIS may focus on quality of raw material, production process and inhouse test process so that cable produced by all type of manufacturers meet the required specification

Large scale sourcing of poor-quality copper rod for production of cable by some manufacturers may be responsible for poor result in conductor. Manufacturers also need to focus their attention on their sourcing process

Sourcing of PVC also need attention as some of the failures of insulation can be attributed to quality of PVC and their production process

Concerned technical department in BIS may also take note of this study and decide on specifying improved requirements for some of these test requirements



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Thank You

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