

REPORT ON 24 DAYS INTERNSHIP IN NATIONAL TEST HOUSE

Submitted in partial fulfilment of the requirements for the completion of

PROFESSIONAL TRAINING

By

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**DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING**

SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with grade "A++" by NAAC

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This is to certify that this Internship Report submitted for EPICS is the bonafide work of ADITYA TEJAS VEERARAGHAVAN (41140006) who carried out the Internship during the period MAY 15 TO JUNE 09 - 2023

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LIST OF SYMBOLS AND ABBEREVIATIONS

R	Resistance
I	Current
V	Voltage
T	Temperature
H	Humidity
M	Mass
694	Standard Test Method for Electrical Insulation - Voltage Endurance Test
CRT	Conductor Resistance Test
IRT	Insulation Resistance Test
LOM	Loss of Mass Test
AC	Alternating Current
DC	Direct Current
Ae	Axial depth of cut (mm)
Ap	Radial depth of cut (mm)
R _a	surface roughness factor
ϵ_r	Relative permittivity
μ_r	Relative permeability
δ	Loss factor
Z	Impedance

CHAPTER 1

INTRODUCTION ABOUT THE COMPANY

1.1 BROAD INTRODUCTION

Testing is the process by which materials are tested against various factors to be certified as a quality product that is fit for commercial and domestic use. NTH or the National Test House is a subordinate office under the administrative control of Department of Consumer Affairs and is headquartered in Kolkata with 6 regional branches in the cities of Kolkata, Mumbai, Chennai, Ghaziabad, Jaipur, and Guwahati. Companies and manufacturers often rely on NTH to validate the quality and compliance of their products with national and international standards.

The primary mission of the National Test House is to ensure the quality, safety, and reliability of products and materials used in various sectors, including civil engineering, metallurgy, textiles, and consumer goods. It accomplishes this through a wide range of testing, inspection, and certification services.

1.2 KEY FEATURES AND FUNCTIONS OF THE NATIONAL TEST HOUSE INDIA:

1.2.1 Scope of Services: NTH provides a comprehensive range of testing, inspection, and certification services across diverse sectors, including civil engineering, electrical engineering, mechanical engineering, non-destructive testing, metrology and calibration, rubber, plastic, and textile industries. Its services encompass materials testing, structural analysis, electrical safety testing, mechanical testing, and more.

1.2.2 Quality Assurance: NTH serves as a trusted third-party verification and certification body, helping manufacturers and businesses validate the quality, safety, and compliance of their products with national and international standards. This assurance is essential for product competitiveness and consumer confidence.

1.2.3 Research and Development: In addition to its core testing and certification functions, NTH is actively involved in research and development activities. It conducts research to

develop and improve testing methodologies, standards, and technologies, contributing to the advancement of quality assurance practices in India.

1.2.4 Consumer Protection: NTH plays a vital role in safeguarding consumer interests by ensuring the quality and safety of products. Its testing and inspection services help prevent the distribution of substandard or unsafe goods in the market, promoting consumer safety and satisfaction.

1.2.5 Industry Collaboration: The National Test House collaborates closely with various government departments, regulatory bodies, industry associations, and international organizations to align standards, facilitate trade, and uphold the highest quality standards. This collaboration enhances the credibility and reliability of its services.

1.2.6 Infrastructure and Expertise: NTH boasts state-of-the-art testing facilities equipped with advanced instruments and machinery. It employs a team of highly skilled and qualified experts in various fields of engineering, science, and technology to conduct precise and reliable tests.

1.2.7 National and International Recognition: NTH's services are recognized and respected both within India and internationally. Its certifications and test reports are often accepted as benchmarks for product quality and compliance.

1.3 DEPARTMENTS OF TESTING

The National Test House focuses on various departments of material testing including

- Civil Engineering
- Electrical Engineering
- Mechanical Engineering
- Non-destructive
- Metrology and Calibration, and
- Rubber, Plastic, and Textile.

1.3.1 Civil Engineering

The Civil Engineering Department at NTH specializes in testing and inspecting construction materials, structures, and geotechnical properties. It ensures the safety and quality of buildings, bridges, dams, and other civil engineering projects, providing critical support to the construction industry.

1.3.2 Electrical Engineering

NTH's Electrical Engineering Department focuses on testing electrical appliances, equipment, and systems to ensure they meet safety and performance standards. It plays a pivotal role in certifying the reliability of electrical products used in homes, industries, and infrastructure projects.

1.3.3 Mechanical Engineering

This department specializes in evaluating the mechanical properties and performance of machinery, components, and industrial equipment. It conducts tests to assess the durability, efficiency, and safety of mechanical systems.

1.3.4 Non-Destructive Testing (NDT)

NTH's Non-destructive Testing Department employs advanced techniques to inspect materials and components without causing damage. It's instrumental in detecting hidden defects and ensuring the integrity of critical structures and machinery.

1.3.5 Metrology and Calibration

Responsible for precision measurement and calibration, this department ensures the accuracy of measuring instruments and equipment used in various industries. It plays a vital role in maintaining measurement standards and traceability.

1.3.6 Rubber, Plastic, and Textile

This department conducts tests on rubber, plastic, and textile products to verify their quality, strength, and compliance with industry standards. It supports manufacturers and consumers by ensuring the reliability of products in these sectors.

1.4 STANDARDS

The primary focus of material testing is to approve the materials in accordance with the ISI standards issued by the Government of India. The ISI standards dictate the tests that need to be carried out on a specific product, the passing and failing grades of the materials and the values and parameters that need to be calculated in order to approve the product for commercial or domestic use.

1.4.1 Tests

The tests that are performed on the materials are dictated by the standard procedures provided in their respective ISI certification booklets. The tests can vary from thermal to physical and chemical property testing.

1.4.2 Equipment

Drilled holes are characterized by their sharp edge on the entrance side and the presence of burrs on the exit side (unless they have been removed). Also, the inside of the hole usually has helical feed marks.

CHAPTER 2

NATURE OF WORK DONE

The field I was trained in was the Electrical Engineering Testing Department. As such, the testing methods are completely different from the other departments and the machinery and equipment used also vary greatly.

The Electrical Engineering Testing Lab at the National Test House (NTH) is a critical component of the organization's mission to ensure the quality, safety, and reliability of electrical appliances, equipment, and systems.

This lab specializes in a wide range of testing and inspection services related to electrical engineering, serving as the deciding authority for product validation and regulatory compliance.

One of the primary functions of the lab is to conduct safety testing on various electrical appliances and equipment. This involves checking whether products meet the necessary safety standards and pose no hazards to consumers. Common tests include insulation resistance, earth continuity, and leakage current tests to ensure that appliances do not pose electrical shock or fire risks.

The lab also assesses the performance characteristics of electrical devices to determine if they meet specified standards. The scientists were asked to evaluate factors such as voltage regulation, power factor, efficiency, and power consumption. Performance testing ensures that electrical equipment operates optimally and efficiently.

The lab conducts EMC tests to record the electromagnetic emissions and susceptibility of electronic and electrical equipment. This is important to see if the material pose any interference with other devices and to ensure that the equipment can operate disruptions.

Products may undergo environmental testing to determine their resistance to various environmental conditions. This includes tests for humidity, temperature, and vibration. Such tests help assess the durability and reliability of electrical equipment, especially those used in challenging environments.

The lab conducts type testing on electrical products to verify compliance with established standards. Successful type testing results in product certification, indicating that a product meets the requisite quality and safety criteria.

NTH often acts as a third-party verification agency, impartially evaluating products to ensure that they meet regulatory and industry standards. This verification process provides confidence to manufacturers and consumers that products are of high quality.

The lab engages in research and development activities to advance testing methodologies and keep up with evolving technologies. This ensures that NTH remains at the forefront of electrical engineering testing practices.

In addition to testing, the lab provides technical consultation services to manufacturers, businesses, and government agencies. This includes explaining testing results, offering guidance on compliance, and helping clients understand and address any issues that may arise during testing.

It also plays a crucial role in supporting regulatory bodies by ensuring that electrical products adhere to safety and performance standards, thus contributing to consumer safety and market fairness.

CHAPTER 3

METHODS AND PROCESSES

My training primarily focused on 694 testing, which is a branch of the various testing carried out in the Electrical Engineering department. It is concerned with the evaluation of the 694-line of electrical conductors.

The methodology and the tests that were carried out on the conductors are presented below:

Initially, the NTH Lab receives a package containing around 5 meters or more of the sample. All the samples that come in to the lab are recorded and each sample receives a brown file.

Inside the brown file, there are various columns that will display the results of the various tests that will be carried out on those samples. Some of these samples have an ISI stamp already while some do not.

All the samples have writings on their sheaths which are noted down in their respective files. These writings will help identify the samples as they go through the various tests. These files are then entered into an online register and the samples are either accepted or rejected. With each test the values are uploaded into this register to keep track of their passings and failings in each.

After the samples are accepted by the lab through the online portal, the testing begins.

3.1. TESTING METHODOLOGY

The First step in the testing process is the collection and sorting of the samples.

The conductors come in different thicknesses and colors, in order to sort them accordingly the first step in the process is measuring their thickness using a vernier caliper.

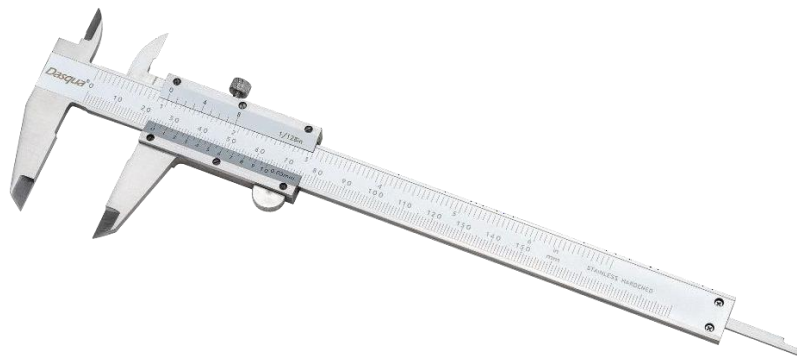


Figure 3.1 A Vernier Caliper

The samples are all held against a ruler and cut at 20mm exactly. Tri-core conductor samples must be separated into their R, Y and B components along with their outer sheath. All of these are measured and cut down to 20mm. These conductors are then measured with a vernier caliper to determine their thickness.

The measured thickness of the conductor sheath ranged between 0.5 and 2.5mm.

After the thickness of the conductors are measured and noted down, the first test in the ISI 694 testing standards is carried out:

3.2 THE TESTS

3.2.1 Test 1: Break-Load Test (IS 5831, IS 10810 pt. 7)

The lab attendant marked each pair of conductors (black, red, yellow, blue, and outer sheath) at 20mm with a marking. Then, the conductors were plugged into the tensile test machine, and the elongation was followed with a divider and measured in terms of percentage relative to the initial length. At the breaking of the conductor sheath, the load was noted and taken down as break load.

The break load ranged between an average of 50N to 180~200N, with the outer PVC sheath having the highest break load and the red, yellow, and blue EVC conductors having the lowest break load.

A new sample pack was selected, but this time with phase 1, phase 2, phase 3, and a lightning conductor instead of outer, red, yellow, blue, and black. The same procedure was carried out.

Another sample was selected with phase 1, phase 2, phase 3, and a messenger conductor instead of a lightning conductor. Messenger conductors are made of alloy and hold the poles together.

A tensile test is a mechanical test that measures the strength and ductility of a material by subjecting it to a tensile load. In a tensile test, the material is stretched until it breaks, and the force required to break it is measured. This force is known as the break load.

Elongation is a measure of how much a material stretches before it breaks. It is expressed as a percentage of the original length of the material.

In the case of the EVC conductors, the elongation was measured at the breaking of the conductor sheath. This is because the sheath is the weakest part of the conductor.

The break load of the EVC conductors was found to be lower than the break load of the outer PVC sheath. This is because the PVC sheath is a stronger material than the EVC insulation.

The second and third sample packs were tested to see if the break load of the EVC conductors was affected by the type of conductor they were paired with. However, the break load was found to be the same in all three sample packs.

The results of the tensile test show that the EVC conductors are strong enough to withstand the loads that they are typically subjected to. However, it is important to note that the break load is only a measure of the strength of the conductor sheath. The strength of the conductor as a whole also depends on the strength of the core and the insulation



Figure 3.2 A Tensile Test machine

$$\text{Tensile strength, N/mm}^2 = \frac{F}{A}.$$

$$\text{Elongation at break, percent} = \frac{G_2 - G_1}{G_1} \times 100.$$

Figure 3.3 Formula for Tensile Strength from IS 10810

3.2.2 Test 2: Ageing in The Air Oven (IS 5831, IS 10810 pt. 11)

The aging test is the most time-consuming step in conductor testing, taking about 15-20 days to complete. Therefore, it is done first to get it out of the way.

Samples of the conductors are collected and placed in a hot air oven, which simulates the long-term effects of surrounding temperatures and weathering. The samples are checked after the set duration to see how much they have aged.

The aging test is used to determine how well a conductor will withstand the effects of long-term exposure to heat, sunlight, and other environmental factors. The test is conducted by placing samples of the conductors in a hot air oven for a set period of time. The temperature of the oven is typically set to be higher than the maximum temperature that the conductors are expected to experience in service.

After the aging test is complete, the conductors are examined for signs of damage, such as cracking, discoloration, or loss of strength. The results of the aging test are then used to evaluate the quality of the conductors and to determine their suitability for use in a particular application.

Why is the aging test done first?

The aging test is done first because it is the most time-consuming step in conductor testing. By doing the aging test first, the lab can get it out of the way and then focus on the other tests, which are typically much faster to complete.

How are the samples checked after the set duration?

The samples are checked after the set duration by examining them for signs of damage, such as cracking, discoloration, or loss of strength. The samples may also be tested for their electrical properties to see if they have changed as a result of the aging process.

Tabulation of Observations

Specimen No.	Cross-Sectional Area (A) mm ²	Tensile Strength N/mm ²		Elongation, Percent	
		Before Ageing (T ₁)	After Ageing (T ₂)	Before Ageing (E ₁)	After Ageing (E ₂)

figure 3.4 Tabulation of values for Ageing



Figure 3.5 Ageing Oven

3.2.3 Test 3: Thermal Stability Test (IS 10810 pt. 60)

The thermal stability test is a test that is used to measure how well a sample of PVC can withstand the effects of high temperatures. The test is conducted by placing a small sample of PVC in a tube with a litmus paper and then heating the tube in an oven. The oven is set to a temperature of 200 degrees Celsius.

As the PVC sample heats up, it will start to decompose and release hydrochloric acid gas. The hydrochloric acid gas will turn the litmus paper red. The time it takes for the litmus paper to turn red is a measure of the thermal stability of the PVC sample.

The thermal stability test is an important test for PVC because it can be used to evaluate the quality of the PVC and to determine its suitability for use in a particular application. For

example, PVC that is used in electrical applications needs to have a high thermal stability so that it can withstand the heat generated by the electrical current.

Steps:

Cut a small sample of PVC into bits that weigh no more than 0.2mg.

Place the PVC sample in a tube with a litmus paper.

Place the tube in an oven that is set to a temperature of 200 degrees Celsius.

Start a timer.

Monitor the litmus paper.

When the litmus paper turns red, stop the timer.

Record the time it took for the litmus paper to turn red.

A longer time to turn red indicates a higher thermal stability. A shorter time to turn red indicates a lower thermal stability.

If the litmus paper turns red before a specific amount of time, the PVC sample is deemed unfit for consumer use. The specific amount time is set by the manufacturer of the PVC.

IS : 10810 (Part 60) - 1988

9. Tabulation of Observations

Test Specimen No.	Compound Description/ Cable Insulation/Sheath Description	T_1		T_2		Thermal Stability T in Minutes
		h	min	h	min	

1
2
3

where,

T_1 = time at which the test tube with specimen is inserted into the heating bath, and

T_2 = final time to reach the colour change of the pH paper into red (pH 3).

10. Calculation — If the time of keeping the specimen is T_1 and final time is T_2 , thermal stability $T = T_2 - T_1$ in minutes.

figure 3.6 ISI specification for thermal stability

3.2.4 Test 4: Conductor Resistance Test (IS 8130, IS 10810 pt. 5)

The conductor resistance test is conducted in accordance with ISI standards to ensure that the conductor resistance of a cable sample meets the specified requirements.

Sample preparation: The cable sample is carefully prepared by ensuring that it is properly cleaned and stripped to expose the conductor. This is important to ensure that the test results are accurate and reliable.

Connection to resistance measuring device: The cable sample is then securely connected to a resistance measuring device. This is done using specialized connectors that ensure a stable and reliable connection.

Current injection: A controlled and known current is passed through the conductor. The magnitude of the current is chosen to be within the range of currents that the cable is expected to carry in service.

Voltage drop measurement: The resulting voltage drop across the conductor is precisely measured using calibrated instruments. The voltage drop is measured across a specific length of the conductor, which is typically 1 meter.

Resistance calculation: Ohm's law is then applied to calculate the resistance value of the conductor, using the following formula:

$$\text{Resistance } (\Omega) = \text{Voltage drop (V)} / \text{Current (A)}$$

Comparison to ISI standards: The calculated resistance value is then compared to the specific ISI standards for the type of cable being tested. If the resistance value is within the specified range, the cable sample passes the test. Otherwise, the cable sample fails the test.

The conductor resistance test is an important test for cables because it ensures that the cable can safely carry the intended current load without overheating. Cables with high conductor resistance are more likely to overheat, which can lead to insulation failure, cable damage, and even electrical fires.

The conductor resistance test is a critical test for cables that is used to ensure that they meet the specified ISI standards. The test is conducted using a meticulous procedure that involves

careful sample preparation, accurate current injection, precise voltage drop measurement, and correct resistance calculation. By passing the conductor resistance test, cables can be safely used in a variety of applications.

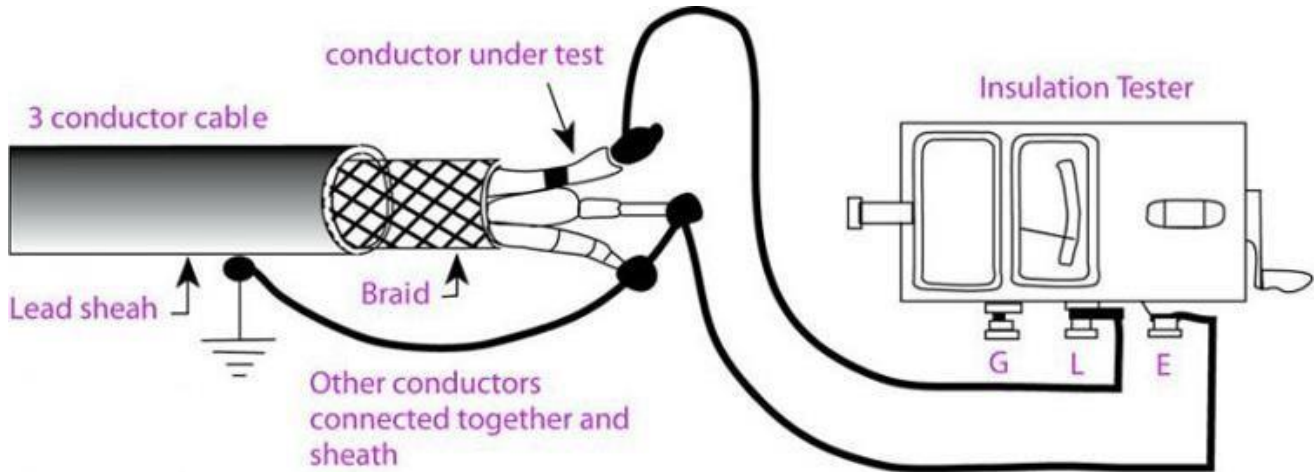


Figure 3.7 Conductor Resistance Testing Apparatus

10. Calculation — The value of resistance R shall be calculated from observed resistance at a particular temperature as indicated below:

$$R = \frac{R_t \times k}{L} \times 1000 \Omega/\text{km at } 20^\circ\text{C}$$

Where

R_t = observed resistance,

k = temperature correction factor (see Table 1), and

L = length of test specimen in m.

figure 3.8 ISI specifications for calculation of conductor resistance

3.2.5 Test 5: Insulation Resistance Test (IS 8130, IS 10810 pt. 43)

The insulation resistance test is a systematic procedure that is conducted in accordance with ISI standards to assess the insulating properties of a cable. The test is essential to ensure that the cable's insulation can withstand the applied voltage and prevent leakage current, thereby protecting users from electrical hazards.

The test begins with disconnecting the cable from any power sources and effectively grounding it to create a safe testing environment. This is necessary to prevent any accidental electric shock. Next, a high-voltage direct current (DC) is applied to the cable's insulation using a megohmmeter. The megohmmeter is a specialized instrument that is designed to measure very high resistances. The test voltage is typically 500 or 1000 volts, depending on the type of cable being tested.

The application of the high-voltage DC source initiates a test current through the cable's insulation. The magnitude of the test current is very small, typically less than 1 microampere. The resulting current leakage through the insulation is meticulously measured using the megohmmeter.

The recorded current leakage values are then compared against the ISI standards for the type of cable being tested. If the current leakage values are below the specified limits, the cable passes the insulation resistance test. Otherwise, the cable fails the test.

The insulation resistance test is a critical test for cables that is used to ensure that they meet the specified ISI standards. The test is conducted using a systematic approach that involves careful safety precautions, accurate voltage application, and precise current leakage measurement. By passing the insulation resistance test, cables can be safely used in a variety of applications.



Figure 3.9 Testing Kit

$$\text{Volume resistivity} = \frac{2\pi L R \times 10^8}{\log_6 \frac{D}{d}} \text{ ohm cm}$$

$$\text{Insulation resistance Constant } K = \frac{L R}{1000 \log_{10} \frac{D}{d}} \text{ Megohm km}$$

where

R = Measured resistance ($M\Omega$);

L = length of cable (m);

D = diameter over insulation (excluding screens, if any), (mm); and

d = diameter over conductor (including screens, if any), (mm);

Figure 3.10 ISI Calculation of Insulation Resistance

3.2.6 Test 6: Loss of Mass Test (IS 5831, IS 10810 pt. 10)

The loss of mass test, conducted in accordance with ISI standards, is a comprehensive evaluation of a cable's resistance to environmental factors and material degradation. The test is designed to simulate the effects of long-term exposure to adverse conditions, such as elevated temperature and humidity, on the cable sample.

The test begins by precisely weighing the cable sample in its initial state. The sample is then placed in a controlled environment where it is exposed to accelerated aging conditions. The duration of the exposure period depends on the type of cable being tested and the specific ISI standards being followed. Once the aging period is complete, the cable sample is carefully reweighed. The difference in mass between the initial and final measurements is calculated to determine the loss of mass. This loss of mass is a critical indicator of any deterioration or material degradation that may have occurred due to environmental factors.

The loss of mass test is an important test for cables because it helps to ensure the long-term reliability and performance of these critical components. By passing the loss of mass test, cables can be safely used in a variety of demanding applications, such as electrical power distribution, telecommunications, and industrial control.



Figure 3.11 Loss of Mass Test oven

10. Calculation

10.1 Surface Area

a) For tubular specimens

Surface area A = Outer surface + inner surface + cut surface

$$A = \frac{2\pi(D-t) \times (L+t)}{100} \text{ cm}^2$$

where

t = mean value of thickness of test specimen, in millimetres, to two decimal places for values up to and including 0.4 mm and to one decimal place above this limit.

D = mean value of outer diameter of test pieces, in millimetres, to two decimal places for values up to and including 2 mm and to one decimal place above this limit.

L = length of test specimens in millimetres, to one decimal place.

Both t and D are measured on a thin slice cut from the end of each tubular test specimen [see IS : 10810 (Part 6)-1984 Methods of test for cables : Part 6 Thickness of thermoplastic and elastomeric insulation and sheath]. In case of sheaths of flat cables and cords, the inner and outer surfaces of evaporation shall be calculated from the dimensions of the cross-section of sheath, determined in millimetres, to two decimal places. The inner side of flat sheaths having a wedge shaped ridge may be considered as being flat for this purpose.

b) For standard dumb bell test specimen [see Fig. 1 of IS : 10810 (Part 7)-1984] :

$$A = \frac{1256 + (180t)}{100} \text{ cm}^2$$

c) For smaller dumb bell test specimen [see Fig. 2 of IS : 10810 (Part 7)-1984] :

$$A = \frac{624 + (118t)}{100} \text{ cm}^2$$

where t is the mean thickness of the strips, in millimetres to two decimal places.

10.2 Loss of mass of specimen, $\text{mg/cm}^2 = \frac{W_1 - W_2}{A}$

10.2.1 The median value of the results from each core, shall be taken as the loss of mass.

Figure 3.12 ISI Calculation for Loss of Mass

These were only a few of the numerous tests that are performed on 694 cables to be able to pass them as fit for consumer consumption. There are over 50 tests that must be conducted. Out of these I was fortunate enough to observe and participate in 10 of those.

The 694 testing is a tedious testing process that takes a lot of time, the average testing period for this is around a month and a half.

All tests as shown above are conducted in accordance with the ISI standard of testing of electrical cables (IS 10810). Each test has its own sub domain under it with multiple ISI standard pages.

CHAPTER 4

KNOWLEDGE AND EXPERIENCE

4.1 KNOWLEDGE GAINED

During my training, I gained a deep understanding of how materials are tested and deemed fit for commercial use. It is surprising to consider the numerous procedures that even a seemingly insignificant object like a conductor wire must undergo before it can be sold on the market. I learned about the various tests conducted on materials and how each test simulates different environmental conditions to assess the material's ability to withstand natural pressures.

I also learned that network analysis, a subject I studied in my third semester of electrical engineering at Sathyabama, is essential for conductor testing, especially 694 testing. Theorems such as Thevenin's theorem, the superposition theorem, Norton's theorem, and the reciprocity theorem are crucial for understanding and conducting the tests correctly. One of the most important theorems of network analysis used in this testing is the maximum power transfer theorem.

I also learned about the numerous data recording steps that must be taken to ensure a smooth transfer of the sample testing data between the lab and the customer. I learned that scientists sometimes have to work overtime to complete all the numerous tests so that the cables can be deemed pass or fail accordingly, and the results can be communicated to the customer.

Conductor testing is a critical process for ensuring the quality and safety of electrical cables.

The tests conducted on conductors vary depending on the type of cable and its intended application. However, common tests include the conductor resistance test, the insulation resistance test, and the loss of mass test.

Network analysis is a powerful tool for analysing and designing electrical circuits and systems. The theorems of network analysis are used in conductor testing to understand the behaviour

of the circuits under test and to design test circuits that can accurately assess the performance of the conductors.

The accurate recording and transfer of sample testing data is essential for ensuring that the customer receives reliable and accurate information about the quality of the cables.

4.2 EXPERIENCE

My experience at the National Test House was incredible. All the scientists in the lab were incredibly welcoming and appreciative of the even small contributions I was able to make to their work.

The lab assistant played a crucial role in conducting the tests, as he was responsible for preparing the necessary samples for all the tests. Without him, all testing procedures would come to a halt.

I would like to express my gratitude to my mentor of sorts, Mr. Prince, who was very kind to me and treated me as a friend. He was willing to explain each and every step of the testing procedures so that I could understand what was going on. Throughout the training, I shadowed him and learned a great deal from his procedures.

Dr. Ilayraj, the head of the electrical engineering department at the National Test House, helped me throughout the training process. He assigned me tasks that I was good at, and even gave me my own table to work on. I had a very educational and amazing time, and I truly value the knowledge that I gained.

CHAPTER 5

SUMMARY AND CONCLUSION

5.1 SUMMARY

During my training at the National Test House, I gained valuable experience in conductor testing, network analysis, data recording, and the importance of collaboration and mentorship in the scientific field.

I learned about the various tests that are conducted on conductors to ensure their quality and safety, such as the conductor resistance test, the insulation resistance test, and the loss of mass test. I also gained a deeper understanding of how network analysis is used to analyze and design electrical circuits and systems.

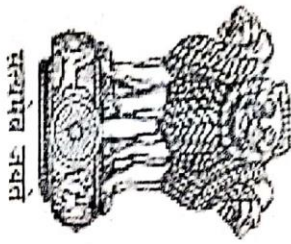
In addition, I learned about the importance of accurate data recording and transfer. I also experienced firsthand the importance of collaboration and mentorship in the scientific field. I worked with experienced scientists and engineers, and I learned a great deal from them. I also had the opportunity to mentor other trainees and share my knowledge with them.

5.2 CONCLUSION

My training at the National Test House was an invaluable experience that provided me with the knowledge, skills, and values necessary to succeed in a career in conductor testing or a related field. I am confident that I will be able to use the knowledge and skills I gained at the National Test House to make a significant contribution to the field of conductor testing or a related field.

It made me put all the concepts I had learnt at Sathyabama University into practical use and helped me figure out how to navigate real life scenarios using my theoretical knowledge

I am grateful for the opportunity to have trained at the National Test House, and I am excited to begin my career in science and technology.



GOVERNMENT OF INDIA
MINISTRY OF CONSUMER AFFAIRS, FOOD & PUBLIC DISTRIBUTION
DEPARTMENT OF CONSUMER AFFAIRS
NATIONAL TEST HOUSE (SR)
CSIR Road, Taramani, Chennai-600113



CERTIFICATE OF TRAINING

Certified that **Shri Aditya Tejas Veeraraghavan** (Register no. **4114006**),
Student of Sathyabama Institute of Science and Technology has successfully
completed Internship in Electrical Laboratory from 15.05.2023 to 09.06.2023
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