

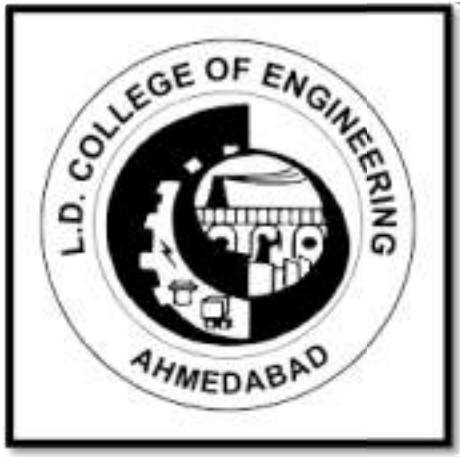
A REPORT ON AN INDUSTRIAL VISIT  
IS UNDER THE AEGIS OF IEI STUDENT'S CHAPTER, EED, LDCE  
TO TRANSFORMER & RECTIFIER LIMITED

Submitted to

L.D.COLLEGE OF ENGINEERING (AHMEDABAD)

Department of Electrical Engineering

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Industrial visit to "TRANSFORMER & RECTIFIER LTD." was done under the supervision of

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## INTRODUCTION

An Industrial visit to "Transformer & Rectifier Ltd." Changodar, Ahmedabad, Gujarat was organized by the Electrical engineering department of L.D. College of Engineering on Thursday, 20th April 2023. Approx. 40 students of Second year pursuing Degree in Electrical engineering and two faculty members Mr. Tejas patel and Mrs. Nupur Sinha visited "Transformer & Rectifier Limited" of Power Transformer manufacturing process like Core & Winding manufacturing, cooling process and Testing etc. To understand how actual equipment looks and how it's processing, to see the latest advancements of equipment, management in plant and safety to be followed in Electrical industries. Also to Experience the job and responsibilities of an Electrical Engineer.

### COMPANY PROFILE:-



Incorporated in 1994, Transformers & Rectifiers (I) Limited has consolidated its position in the Indian Transformer Industry as a manufacturer of a wide range of transformers, which conform to the quality expectations of both the domestic and the international market.

An ISO 9001, 14001 & 45001 company today, T&R as it is more popularly known, is proud to have executed a number of prestigious orders from developed countries such as Canada and the United Kingdom.

## WORK PLAN

In the morning at 9:45 a.m. we visited "Power Transformer Manufacturing Unit of Transformer & Rectifier Ltd".

Before entry to the manufacturing area a very informative session about the company and the safety instructions to be followed in the workplace was conducted and they also provided the personal protective equipment like 'Helmet' to be safe at the workplace.

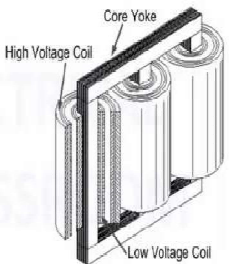
From 10:00 a.m. industrial visit was started, we visited to manufacturing plants of Power Transformer.

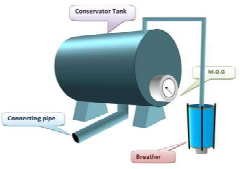
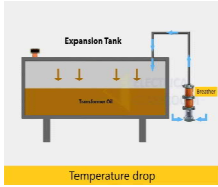

## POWER TRANSFORMER UNIT

TARIL offers a wide range of power transformers from medium to ultra-high voltage (1200 kV AC) and from small (5 MVA) to very large power ratings (500 MVA) tailored to meet global customer's needs.

Latest technologies in design, measurement and testing tools are applied in TARIL transformers to ensure each transformer meets and exceeds the latest industry standards, as well as operational and customer specifications. Sophisticated and extensive simulation tools are used at TARIL to prove the product design and ensure superior product performance in the field. Reliable design is supported by state-of-art manufacturing and extensive quality control. Power transformers designed and manufactured by TARIL provides exceptional performance, quality and reliability.

➤ Parts of Transformer :-




Sr.No.	Parts	Description
1.	Core	<p>: The core of the transformer is used to support the windings. It is made of soft iron or Cold Rolled Grain Oriented (CRGO) to reduce eddy current loss and hysteresis loss, and provide a low reluctance path for flux current.</p> <p>Thickness of Cylinder Core :- 1.5 mm to 4mm.</p>
2.	Winding  <p>Core type transformer with HV windings surrounding the LV windings</p>	<p>: Transformer windings consist of paper-insulated, current carrying conductors wound around sections of the core.</p> <p>Types of Winding:-</p> <p>For Large Transformer</p> <ol style="list-style-type: none"> <li>1) Tertiary Winding</li> <li>2) Common Winding</li> <li>3) Regulating Winding</li> <li>4) Series Winding</li> </ol> <p>For Low Transformer</p> <ol style="list-style-type: none"> <li>1) High-Voltage Winding(CTC)</li> <li>2) Low-Voltage Winding (PICC)</li> </ol> <p>Winding Temperature :- 50 to 60°C</p>

3.	Insulating Materials	: Insulating materials such as paper and cardboard are used to isolate the primary and secondary coils from each other as well as the transformer core. These coils are made of copper due to their high conductivity.
4.	Transformer oil	: Transformer oil insulates as well as cools the core assembly and windings.
5.	<p>Conservator</p> 	: The conservator is an airtight metal cylindrical drum mounted above the transformer to store transformer oil. It is vented at the top and is only half filled with oil to allow expansion and contraction during temperature changes. However, the transformer's main tank is connected to the storage unit, which is completely filled with oil through a pipe.
6.	<p>Breather</p> 	: The breather is a cylindrical container filled with silica gel, which is used to keep the air entering the vessel from becoming damp. This is because insulating oil reacts with moisture which can affect the insulation.
7.	Cooling Tube	: The cooling tube is used to cool the transformer oil. The circulation of oil in the transformer can be natural or forced.
8.	<p>Buchholz Relay</p> 	: Placed on the connecting pipe that runs from the main storage tank to the storage tank, the Buchholz Relay senses faults in the transformer. It operates on the gases emitted by the breakdown of transformer oil during internal faults. So this device is used to sense and in turn protect the transformer from internal faults.
9.	Explosion Vent	: The boiling hot oil from the transformer is drained out in case of internal fault through the vent of the generator to avoid explosion of the transformer. This is generally placed above the level of the conservatory tank.

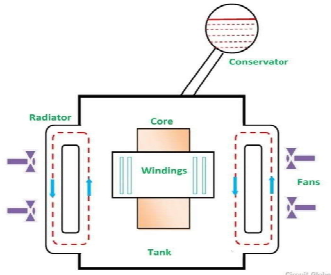
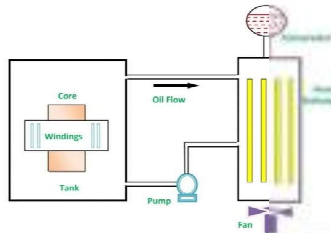
➤ Testing Of Transformer :-

Sr. No.	Test of Transformer	Description
1.	Ten-Delta Test	: The main purpose of the tan delta test is to make sure of maintaining a secure and reliable functioning of the transformer. With the calculation of dissipation factor and capacitance values, it provides the result of insulation behavior of bushings and in windings too.
2.	BDV Test	: BDV test means the Breakdown Voltage Test. This test is performed for verifying the dielectric strength of the oil of the transformer. Dielectric Strength is the maximum capacity to resist the voltage of insulating oil. This test demonstrates the dielectric Strength of Transformer Oil.
3.	IFT Test	: Interfacial Tension - The interfacial tension of the transformer oil was determined to be $32.86 \pm 0.01$ mN/m. It has been reported that the IFT of fresh insulating oil is ranging from 40 to 50 mN/m. The lifetime of insulating oil is considered to have expired when its IFT is lower than 25 mN/m.
4.	Resistivity Test of Oil	: The definitive specific value of resistance for transformer oil at a set value of 90°C is found as $35 \times 10^{12}$ ohm-cm and at 27°C the value change as $1500 \times 10^{12}$ ohm-cm.

➤ Cooling Of Transformer :-

Sr. No.	Types of Cooling	Description
1.	Air Natural (AN)  	: By Air Natural method the generated heat in the transformer is cooled by the circulation of natural air. This method is also known as a self-cooled method. This method is used for cooling the smaller output transformer rating that is up to 1.5 MVA.
2.	Oil Natural Air Natural (ONAN)  	: Natural convection process is used for this type of cooling. The assembly of the core and windings are placed in the oil-immersed tank. This type of cooling is used for the transformer rating up to 30 MVA.
3.	Air Forced or Air Blast(AF)  	: In this method, the heat generated is cooled by the forced air circulation method. With the help of fans and blowers, high velocity of air is forced on the core and the windings of the transformer. This method is used for transformer rating up to 15MVA.



<p>4.</p>	<p><b>Oil Natural Air Forced (ONAF)</b></p> 	<p>:</p> <p>ONAF method is used for the cooling of the transformer of rating up to 60 MVA. As discussed above that in ONAN method, the dissipation of heat is taking place by the convection process in which air is naturally circulated to cool down, but in this type, the forced air is used for the purpose of cooling the transformer.</p>
<p>5.</p>	<p><b>Oil Forced Air Forced (ONAF)</b></p> 	<p>:</p> <p>As the name itself says that both the oil and the air are applied by force for cooling of a transformer. The Heat Exchanger is installed through which hot oil is circulated with the help of a pump. Air is forced to pass on the heat exchanger with the help of high-speed fans.</p>



