



NATIONAL PETROCHEMICAL COMPANY STANDARDS

MATERIAL STANDARD FOR POWER TRANSFORMERS

NPCS-MS-EL-05

REVISION : 0

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SCOPE

1.1

This standard covers the minimum requirements for design, manufacture, quality control testing and supply of power transformers for use in 3-phase system. The transformers shall be new and in first class condition.

1.2

Compliance by the manufacturer with the provisions of this standard does not relieve him of the responsibility of furnishing unit of proper design, mechanically suited to meet operating guarantees at the specified operating conditions.
Such deviations from this standard, which the manufacturer may consider advisable, shall be submitted in writing to Purchaser, together with his quotation, in order Purchaser may approve or reject such deviations. Exceptions other than those included in the above mentioned document shall not be considered.
Vendor shall only supply equipment of proven design and construction, of which satisfactory operation over at least a two year period can be proven in similar service and operating conditions.
These references must have been manufactured at the same point of manufacture as the equipment, proposed for projects.

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UNITS, LANGUAGES

2.1

All documentation shall be issued, using SI metric system of measurement, except for:

- Pipe and flange sizes in inches.
- Flange ratings in lbs.
- Pressure in bars.
- Viscosity in Cps.

2.2

The English languages shall be used for all correspondence documents, drawings and nameplates.

Note:

For system of units see NPCS-ES-GN-03.

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STANDARDS AND CODES

The transformers shall be designed, constructed and tested in accordance with all applicable sections of the latest edition of IEC Standard as listed below. Other standards and codes may be used after purchaser approval.

- IEC 38 Standard Voltages.
- IEC 76-1 Power Transformers-General.
- IEC 76-2 Power Transformers-Temperature Rise.
- IEC 76-3 Power Transformers-Insulation levels and Dielectric Tests.
- IEC 76-3-1 Power Transformers-Insulation levels and Dielectric Tests, External Clearances in Air.
- IEC 76-4 Power Transformers-Tapping and Connections.
- IEC 76-5 Power Transformers-Ability to Withstand Short Circuit.



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- IEC 85 Thermal Evaluation and Classification of Electrical Insulation.
- IEC 137 Bushing for Alternating Voltages above 1000 V.
- IEC 296 Specification for Unused Mineral Insulating oils for Transformers and Switchgears.
- IEC 354 Loading Guide for Oil-Immersed Transformers.
- IEC 529 Degrees of Protection Provided by Enclosures (IP Code).
- IEC 551 Determination of Transformer and Reactor Sound Levels.

4

DESIGN

4.1

TEMPERATURE RISE

Where transformers are specified for a temperate climate, they shall be capable of continuous operation at full rating without exceeding the following temperature rise (above 30 °C):

- a) 60°C for the winding (measured by the resistant method).
- b) 50°C for the liquid insulant (measured by thermometer).

Where transformers are specified for a tropical climate the corresponding temperature rises shall not exceed 55°C and 45°C respectively.

Rated power to be based on the ambient condition specified in Attachment 1 and the temperature rise limits given above. Average daily temperature shall not be used as a design criteria.

4.2

FREQUENCY & PHASES

Unless otherwise specified the frequency shall be 50 HZ and the system shall be 3-phase.



4.3

ARRANGEMENT & INSULATION OF WINDING

Unless otherwise specified:

- a) The transformer shall be double-wound using copper conductors.
- b) The neutral point on the lower-voltage side shall be accessible for connection to a 4-wire system and shall also be brought out separately to a terminal or stud for earthing purposes.
- c) The transformer connections shall be Dyn11, i.e. delta/star unless specified otherwise in data sheet.
- d) The transformer windings shall be fully insulated to earth.

4.4

OFF-LOAD TAP CHANGER

Tap changers with a minimum of five steps are required for matching of the actual line voltage to the transformer. If not specifically called for otherwise in the data sheets. The adjustment range shall be $\pm 5\%$ in $2 \times 2.5\%$ fully rated steps above and below the nominal primary voltage. The tap changer shall be sized thermally for 120% of the load under rated operating condition.

The thermal sizing shall allow for the rating of the transformer with forced ventilation, whether existing or planned for the future.

A locking device or other suitable means to prevent unauthorized interference shall be provided and shall be of a type that it can be locked only with the switch on a definite tapping. The spindle of the tapping switch shall be enclosed in an oil or grease-filled chamber to prevent gas or oil leakage, and shall be situated under the cold oil level.

The temperature rise requirements of Clause 4.1 shall apply to the principal tapping.

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5 CONSTRUCTION

5.1 CONSTRUCTION TYPE

- 5.1.1 The transformers up to 1,250 KVA not exceeding 6 KV primary shall be hermetically sealed, according to IEC-76 with the following addition:

A type of self-contained transformer which is non-breathing and which has a constant combined volume of liquid insulant and inert gas.

- 5.1.2 The transformers in excess of 1,250 KVA shall be conventional type with expansion tank.

5.2 COOLING SYSTEM

- 5.2.1 The transformers shall be oil immersed self-cooled IEC type ONAN.

- 5.2.2 The transformers in excess of 1,250 KVA shall have provisions for fan cooling, with a following fan cooled rating:

<u>Self-Cooled KVA</u>	<u>Fan-Cooled Rating</u>
1,251-2,499	120%
2,500-10,000	125%

If fans are specified, fan motors shall be three phase squirrel-cage induction type.

5.3 RATED POWER

- 5.3.1 Unless otherwise specified, the rated power shall be arranged for continuous operating conditions.

- 5.3.2 All transformers components shall be electrically and mechanically sized to meet the maximum rating levels required for the use of fans, under ONAF cooling conditions.



5.4 INSULATION AND LEVEL, CLASS

The insulation level and test voltage shall be according to IEC-76, with the following values:

Rated system Voltage (V)	Insulation level KV	Impulse wave test voltage 1,2/50 50Hz 1 min
380	1	3
6,300	7.2	60
20,000	24	125
		50

5.5 VOLTAGE REGULATION

5.5.1 Voltage regulation shall be done by means of off-load tap changer as specified in Clause 4.4. The off-circuit tap changers shall be specially designed to withstand transient short circuit overloads and overcurrents and shall be sized for a minimum of 1.4 times the transformer rated current with ONAF cooling where feasible.

5.5.2 In any event, use shall be made of tap changers with sufficient breaking capacity to break at least the transformer magnetizing current.

5.6 IMPEDANCE VOLTAGE

5.6.1 Transformers shall normally have the following impedance voltage:

- Rated up to 630 KVA : 4%
- Rated above 630 KVA up to 1250 KVA : 5%
- Rated above 1250 KVA up to 3150 KVA : 6.25%
- For transformers above 3150 KVA impedance voltage should not usually exceed 10%.

These figures shall be applicable at 75°C.

In special cases, different values shall be provided in order to reduce short-circuit current, voltage drops or to allow the parallel operation together with existing transformers.