



Republic of the Philippines
NATIONAL POLICE COMMISSION
NATIONAL HEADQUARTERS, PHILIPPINE NATIONAL POLICE
OFFICE OF THE CHIEF, PNP
Camp BGen Rafael T Crame, Quezon City

MAY 06 2021

MEMORANDUM CIRCULAR

NO.: 2021 - 049

**TEST PARAMETERS IN THE CONDUCT OF TEST AND EVALUATION
FOR 75kVA DISTRIBUTION TRANSFORMERS (DT)**

1. REFERENCES:

- a. Republic Act No. 9184 entitled "An Act Providing for the Modernization, Standardization and Regulation of the Procurement Activities of the Government and for other Purposes" and its Revised Implementing Rules and Regulations (RIRR);
- b. Routine Test: International Electromechanical Commission (IEC) 60076-5, Measurement of Winding Resistance (IEC 60076-1 10.2), Measurement of Voltage Ratio and Check of Phase Displacement (IEC 60076-1 10.3), Measurement of Short-Circuit Impedance and Load Loss (IEC 60076-1 10.4);
- c. Distribution Transformer Handbook IEC/CENELEC related specifications ABB Ident No. 1LAC000003 Copyright 2003 ABB Ltd;
- d. Institute of Electrical and Electronics Engineers (IEEE) Standard Interpretation for C57.12.00™-2000 Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers Copyright © 2;
- e. C57.12.20-2011-IEEE Standard for Overhead-Type Distribution Transformers 500kVA and Smaller: Medium Voltage, 34,500V and Below; Low Voltage, 7970/13 800Y V and Below;
- f. IEEE C57.12.90-2006, IEEE Standard Test Code for Liquid Immersed Distribution, Power, and Regulating Transformers;
- g. National Electrical Manufacturers Association (NEMA) Standard Publications No. TR 1-193, Transformers, Regulators and Reactors;
- h. American Society for Testing Materials (ASTM) D3487;
- i. American National Standard (ANSI) for Transformers - Standard for Overhead Type Distribution Transformers, 500kVA and Smaller: High Voltage 34,500Volts and Below: Low Voltage, 7970/13800Y Volts and Below;
- j. NAPOLCOM Resolution No. 2016 – 660 entitled: "Approving the PNP UESB No. 2016-009 dated February 23, 2016, Amending NAPOLCOM Resolution No. 99-160 on the Minimum Standard in the Specification for 75kVA Distribution Transformer".
- k. PNP Memorandum Circular (MC) No. 2015-015 entitled: "General Policy Guidelines in the conduct of Test and Evaluation".

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2. RATIONALE:

- a. To establish test and evaluation procedures for post qualification and acceptance tests for 75kVA DT;
- b. To determine whether the particular equipment/device meets or exceeds the performance standards and test methods identified in these guidelines;
- c. To ensure that the equipment meets all the specific environmental conditions, which the equipment may encounter during its service life; and
- d. To ensure compliance and conformity to the approved NAPOLCOM Standard Specifications for 75kVA DT.

3. SITUATION:

The Philippine National Police (PNP) needs to improve the delivery of police services by upgrading its infrastructures/facilities/equipment. However, the upgrading is adversely affected when these infrastructures/facilities/equipment inside PNP camps cannot be provided with sufficient power supply that they need.

Thus, it is important that the voltage being used in the distribution lines can be inversed/stepped down to a suitable level of utilization so that a safety power requirement can be provided to all infrastructures/facilities/equipment throughout PNP camps and offices. Secondary terminal of a distribution transformer or service transformer can perform this function.

4. PURPOSE:

This PNP Memorandum Circular (MC) sets forth the policy guidelines, procedures, and test parameters for the conduct of functional test of 75kVA DT during post-qualification and acceptance as required in every procurement activity.

5. DEFINITION OF TERMS:

For purposes of this PNP MC, the following terms shall mean:

- a. Acceptance Testing – refers to a test conducted in evaluating properties of one or more items to determine if the requirements or specifications included in the contract are met. It involves physical tests (visual and dimensional), chemical tests (laboratory tests), and/or performance tests.
- b. American National Standards Institute (ANSI) – refers to a private non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel. These standards ensure that the characteristics and performance of products are consistent, that people use the same definitions and terms, and that products are tested the same way. ANSI

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also accredits organizations that carry out product or personnel certification in accordance with requirements defined in international standard.

- c. Defect – refers to any nonconformance of the unit of product with specified requirement.
- d. Delta Connection – is used for connecting three single phase transformers for 3-phase operation. Each side of the delta would represent one winding of each transformer. The three corners of the delta are then connected to the 3-phase supply or load.
- e. Distribution Transformer (DT) – refers to a transformer that provides the final voltage transformation in the electric power distribution system, stepping down the voltage used in the distribution lines to the level used by the customer.
- f. Functional Test – refers to the test to demonstrate that the product unit can meet the performance requirements as specified in the specifications and/or for the intended purpose.
- g. Institute of Electrical and Electronics Engineers (IEEE) – refers to an association dedicated to advancing innovation and technological excellence for the benefit of humanity and is the world's largest technical professional society. It is designed to serve professionals involved in all aspects of the electrical, electronic, and computing fields and related areas of science and technology that underlie modern civilization.
- h. International Electrotechnical Commission (IEC) – refers to a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international cooperation on all questions concerning standardization in the electrical and electronic fields.
- i. Kilovolt Ampere (KVA) – is equivalent to 1,000-volt amperes.
- j. Major Defect – refers to a defect, other than critical, that is likely to result in failure, or in reducing materially the performance/efficiency or the usability of the unit or product for its intended purpose.
- k. Minor Defect – refers to a defect that is not likely to reduce materially the performance/efficiency or the usability of the unit or product for its intended purpose, or from established standards and not having an effect in the use or operation of the unit.
- l. National Electrical Manufacturers Association (NEMA) – refers to the association of electrical equipment and medical imaging manufacturers, which devised a rating system for enclosures, connectors, and other equipment that are exposed to liquids, rain, ice, corrosion, and contaminants such as dust. NEMA sets standards for the manufacture

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of safe and effective electrical products. NEMA's work has resulted in contributions to public policy development and in promoting competitiveness, technological progress, and public safety.

- m. Post-Qualification – refers to an orderly evaluation performed to ascertain if an item is capable of meeting necessary requirements prior to the Acceptance Test.
- n. Primary Voltage – is the voltage applied to the terminals of the primary winding of a transformer.
- o. Secondary Voltage – refers to the coil winding supplying the output voltage. The output voltage of a transformer varies, some with varying load resistances, even with a constant voltage input.
- p. Single Phase Transformer – refers to a type of transformer that utilizes single-phase alternating current, meaning the transformer relies on a voltage cycle that operates in a unified time phase. They are often used to step-down long distance and localized transmission voltage into power levels more suitable for residential and light-commercial applications.
- q. Technical Working Group (TWG) – refers to a pool of technical, financial and/or legal experts to assist in the procurement process.
- r. Thermometer – refers to an instrument that measures temperature. It can measure the temperature of a solid such as food, a liquid such as water, or a gas such as air. The three most common units of measurement for temperature are Celsius, Fahrenheit, and kelvin. The Celsius scale is part of the metric system.
- s. Three-Phase Transformer – is made of three sets of primary and secondary windings, each set wound around one leg of an iron core assembly. Essentially, it looks like three single-phase transformers sharing a joined core.
- t. Transformer temperature rise – is defined as the average temperature rise of the windings above the ambient (surrounding) temperature when the transformer is loaded at its nameplate rating.
- u. Wye connection – is made by connecting the ends of the primary or secondary coils of three single-phase transformers into a common bank.

6. GUIDELINES:

a. General Guidelines:

- a) The Directorate for Research and Development (DRD) shall function as independent testing facility of the PNP. The DRD Test Team shall

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perform their duties pursuant to the mandates of PNP MC No. 2015-015;

- b) The DRD Test Team shall conduct physical inspection (components) and functional test on the sample item submitted to determine conformity with the approved NAPOLCOM Minimum Standards and PNP Minimum Technical Specifications;
- c) The test result containing findings shall be forwarded to the Bids and Awards Committee (BAC) and Committee on Inspection and Acceptance of PNP units/offices or Philippine International Trading Corporation/Procurement Service Department of Budget and Management that requested the conduct of test and evaluation for a particular sample/test specimen/prototype;
- d) Sample unit/test specimen submitted for post-qualification and test and evaluation shall not be considered part of the delivered item, unless otherwise specifically provided in the bidding documents;
- e) If test equipment is not available in the DRD facility, or any certified Government/Private agencies/reputable scientific organization during the conduct of test and evaluation procedures specified under this MC, the test and evaluation shall be conducted in an accredited government institution or a third party (independent organization) testing facility consistent with the international standard and procedures;
- f) In case of additional test imposed by the BAC which is not included in the approved test parameters, the same maybe allowed only if the additional test parameters are properly reflected in the bidding documents or in its Supplemental Bid Bulletin with proper consultation with the DRD;
- g) GPPB Circular No. 06-2016 with subject "Expenses Related to the Conduct of Post-Qualification" shall be observed during the conduct of post-qualification. Hence, the administrative and operational expenses shall be charged to the proceeds of the sale of the bidding documents as indirect cost or administrative cost pursuant to GPPB Resolution No. 04-2012;
- h) Administrative and operational expenses for the conduct of test and evaluation during the delivery inspection and acceptance shall be imposed upon the supplier/requesting party if the same were included in the computation of the Approved Budget and Contracts and integrated in the preparation of the Project Management Plan. If such expenses were not considered therein, the same may be charged to the proceeds of the sale of the bid documents as indirect cost or administrative cost allocated to the bidding activities, pursuant to GPPB Resolution No. 04-2012;

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- i) Consistent with the "pass or fail criteria," nonconformance with the approved NAPOLCOM Minimum Standards and PNP Technical Specifications during post-qualifications test is ground for post-disqualification;
- j) As appropriate, all testing fees and/or needed materials/equipment (automated and calibrated equipment) and other incidental expenses related to the test and evaluation of equipment/item shall be borne by the requesting party during post qualification and acceptance;
- k) Manufacturer/Supplier/Distributor for the distribution transformer must have the equipment and technicians throughout the required testing; and
- l) Transformer testing shall be done chronologically.

7. TEST PROPER:

- a. Purpose: To determine conformity to the basic design and performance before commissioning of 75kVA DT.
- b. Procedure:
Visually and manually inspect the nameplate rating, components, and parts of the 75kVA DT.
- c. Physical Inspection (visual and dimensional):

Technical Specifications	Class of Defect
1) Standard Capacity : 75kVA	Major
2) Primary Voltage : as appropriate	Minor
3) Secondary Voltage Rating : 120/240V (Delta Connection) or 127/277V (Wye Connection)	Major
4) Phase Selection : Single Phase System (1Φ) or Three Phase (3Φ)	Minor
5) Mounting : Pole or Pad mounted	Minor
6) Temperature : Not to exceed Rise of Winding 65°C	Major
7) Cooling Class : Oil Immersed Type	Major
8) Insulating Fluids : Brand new mineral oil	Major
9) Material of Winding : All Copper	Major
10) Casing/Tank : Based on Manufacturer's Product Brand Brochures as offered	Major
II. Standard:	

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1) Latest ANSI or	Major
2) NEMA or	Major
3) IEEE or	Major
4) Equivalent IEC	Major
III. Enclosure	
Appropriate NEMA Rating	Major

d. Standard:

	Test Procedure	Class of Defect
The 75kVA DT shall be complete, free from dents, blister, cracks, oil leaks, chipped or sharp corners, loose connections, broken strands of conductor, high contact resistance in tap changers, high voltage leads, and bushings and other visible defects that can affect its serviceability.	visually check/inspect the physical component/parts of the transformer	Major

e. Nameplate Rating: Each transformer shall be fitted with a rating plate of weatherproof material, fitted in a visible position, showing the information listed below. Etching, engraving, or stamping shall legibly mark entries on the plate.

	Test Procedure	Class of Defect
Manufacturer's name/supplier	visually check/inspect the physical nameplate of the transformer	Major
Type of equipment – Distribution Transformer		Minor
Year of manufacture		Major
Number of phases		Major
Rated power - kVA		Major
Rated frequency - Hz		Major
Rated voltages - kV		Major
Rated currents - A		Major
Connections symbol (Vector Group) - Dyn11		Major
Impedance voltage at rated current - %		Major
Resistance - ohm		Minor
Type of cooling - Oil Natural Air Natural (ONAN) or AOA		Minor
Total mass - kg		Major
Total mass of core and windings - kg		Major
Volume of oil - Liter		Minor
Connection diagram		Major
Table giving tapping voltages of the tap positions		Major
Ambient temperature - °C		Minor
Applicable Standard (e.g. IEEE/ANSI/NEMA/ASTM)		Major

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8. FUNCTIONAL AND EVALUATION TEST:

a. Transformer Winding Resistance Measurement (Current Voltage or Bridge Method)

1) Purpose:

- a) Calculations of the I^2R component of copper losses (where: I – current, R - Resistance);
- b) Calculation of winding temperature at the end of a temperature test cycle;
- c) As a base for assessing possible damage in the field; and
- d) To check for abnormalities due to loose connections, broken strands of conductor, high contact resistance in tap changers, high voltage leads, and bushings.

2) Test equipment:

- a) Voltmeter
- b) Ammeter
- c) Wattmeter
- d) Polarity tester; and
- e) Insulation Resistance Test Meter/Kelvin Bridge meter.

3) Procedure:

- a) For Star (Wye)-connected winding, the resistance shall be measured between the line and neutral terminal;
- b) For Delta-connected windings, measurement of winding resistance shall be done between pairs of line terminals,
- c) Before measurement, the transformer should be kept in OFF condition without excitation for at least three to four hours. During this time, the winding temperature will become equal to its oil temperature;
- d) Connect the Voltmeter and Ammeter based on schematic diagram and recommendation from the supplier;
- e) Measurement is done with Direct Current (D.C.);
- f) To minimize observation errors, polarity of the core magnetization shall be kept constant during all resistance readings;
- g) The readings shall be taken after the current and voltage have reached steady state values. Record the result (table to be provided by the supplier);
- h) The test current shall not exceed 15% of the rated current of the winding. Large values may cause inaccuracy by heating the winding and thereby changing its resistance; and
- i) The resistance winding shall be calculated by the formula:

$$R = V/I$$
 (where: V – voltage, I – current, and R – Resistance)

4) Standard:

Resistance Test	Test Procedure	Class of Defect
If all readings subsequent to the first (initial) reading have one percent difference with the	use formula:	Major

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<p>immediately preceding reading, then they are acceptable. However, if one of the result has more than 1% difference with the immediately preceding reading, then it is not acceptable.</p> <p>Further, the result of reading must be certified by an Electrical Engineer from the Supplier or Third party technical expert.</p>			$\frac{(R_1 - R_2)}{R_1} \times 100\%$ <p>= >1% (not acceptable) or = ≤1% (acceptable)</p>
Windings	Tap Position	Resistance (millions)	
H1-H2	1	(e.g. 750.3)	<p>where:</p> <p>R_1 = preceding reading R_2 = proceeding reading</p>
H2-H3	1	(e.g. 749.8)	
H3-H1	1	(e.g. 748.5)	
H1-H2	2		
H2-H3	2		
H3-H1	2		
H1-H2	3		
H2-H3	3		
H3-H1	3		

b. Voltage and Turn Ratio Test (Bridge method or by measuring the voltage ratios of the windings)

- 1) Purpose: To confirm the no-load voltage ratio and determine the condition of both the windings and connections and to examine the problems (if any).
- 2) Test equipment:
 - a) Voltmeter
 - b) Ammeter
 - c) Wattmeter; and
 - d) Three Phase Transformer Turns Ratio meter.
- 3) Procedures:
 - a) First, the tap changer of transformer is kept in the lowest position and Low Voltage (LV) terminals are kept open;
 - b) Connect the cable based on the schematic diagram from the supplier;
 - c) Then apply 3-phase 415 V supply on High Voltage (HV) terminals. Measure the voltages applied on each phase (Phase-phase) on HV and induced voltages at LV terminals simultaneously;
 - d) After measuring the voltages at HV and LV terminals, the tap changer of transformer should be raised by one position and repeat test; and
 - e) Repeat the same for each of the tap position separately.

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4) Standard:

	Test Procedure	Class of Defect
At no-load test, the turn ratio must not deviate from nameplate rating	visual/ demonstration/use formula: $TR = \frac{V_p}{V_s}$	Major
Turns ratio must be not more than 0.5% from the rated voltage ratio (ANSI Standard C57.12)		

c. Transformer Oil and Winding Temperature Rise Test

- 1) Purpose: To check if the transformer oil and winding temperature rise limits are based on the specifications.
- 2) Test equipment:
 - a) Three Thermometers
 - b) Wattmeter
- 3) Procedures:
 - a) First the LV winding of the transformer is short circuited;
 - b) One thermometer is then placed in a pocket in transformer top cover. Another two thermometers are placed at the inlet and outlet of the cooler bank, respectively;
 - c) The voltage of such value is applied to the HV winding that power input is equal to no load losses plus load losses corrected to a reference temperature of 75°C;
 - d) The total losses are measured by three watt-meters method;
 - e) During the test, hourly readings of top oil temperature are taken from the thermometer already placed in the pocket of top cover;
 - f) Hourly readings of the thermometers placed at inlet and outlet of the cooler bank are also noted to calculate the mean temperature of the oil;
 - g) Ambient temperature is measured by means of thermometer placed around the transformer at three or four points situated at a distance of one to two meters from and half-way up the cooling surface of the transformer; and
 - h) Temperature rise test for top oil of transformer should be continued until the top oil temperature has reached an approximate steady value that means testing would be continued until the temperature increment of the top oil becomes less than 3°C in one hour. This steady value of top oil is determined as final temperature rise of transformer insulating oil.

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4) Standard:

	Test Procedure	Class of Defect
Temperature rise limits of transformer is 65°C (oil immersed).	read the thermometer reading after the steady value of top oil is reached	Major

d. Insulation Dielectric of Transformer (Separate Source Voltage Withstand Test)

- 1) Purpose: To check the ability of main insulation to earth and between winding.
- 2) Test Equipment:
 - a) Variable Transformer
 - b) Test Transformer; and
 - c) Peak Volt meter
- 3) Procedures:
 - a) All three-line terminals of the winding to be tested are connected together;
 - b) Other winding terminals which are not under test and the tank of the transformer should be connected to earth;
 - c) Then a single-phase power frequency voltage of shape approximately sinusoidal is applied for 60 seconds to the terminals of the winding under test;
 - d) The test shall be performed on all windings one by one.
 - e) The test is successful if no breakdown in the dielectric of the insulation occurs during test; and
 - f) The values of test voltage for different fully-insulated windings are furnished below in the table.

Nominal Voltage Rating	Rated short power frequency withstand voltage
37.5kV	70kV
50kV	95kV
75kV	150kV
100kV	185/230kV
167kV	275/325kV
250kV	360/395kV
333kV	570/630kV

4) Standard:

	Test Procedure	Class of Defect
The test is successful if no breakdown in the dielectric insulation occurs after the test.	Manufacturer's Test Standard	Major

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The test is successful if no breakdown in the dielectric insulation occurs after the test.	Manufacturer's Test Standard	Major
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e. Short Circuit Test

- 1) Purpose: To determine the ability of the 75kVA DT if can withstand short circuit test when exposed to over-current through external short circuits.
- 2) Test Equipment:
 - a) Variable Transformer (Auto Transformer 0-2KV);
 - b) Voltmeter
 - c) Ammeter; and
 - c) Wattmeter.
- 3) Procedures:
 - a) Short circuited LV phases/ side and connect these short circuited terminals to neutral;
 - b) Energize HV side by LV supply;
 - c) Slowly increase the Variac (Auto Transformer) applied voltage until the ammeter gives reading equal to the rated current of the HV side;
 - d) Measure current in neutral, HV voltage and HV line currents;
 - e) Indicate total cu loss of the transformer through Wattmeter;
 - f) Duration of test is 0.5 sec;
 - g) All three instruments reading (Voltmeter, Ammeter and Wattmeter readings) are recorded; and
 - h) Number of tests for single phase transformer is three:
 - (1) One test with tap at highest voltage;
 - (2) One test in principal tapping; and
 - (3) One test in lowest voltage ratio.
 - i) Number of tests for three phase transformer is nine:
 - (1) Three tests with tap at highest voltage;
 - (2) Three tests in principal tapping; and
 - (3) Three tests in lowest voltage ratio.
- 4) Maximum Losses: The indicated figures below are the maximum acceptable values. Transformers with losses exceeding these values will be rejected.

Rating	Silicone Metal Core				Amorphous Metal Core			
	No Load Losses, Watts	Load Losses, Watts	Total Losses		No Load Losses, Watts	Load Losses, Watts	Total Losses	
			Watts	% of Rated kVA			Watts	% of Rated kVA
37.5	105	360	465	1.24	30	360	390	1.04
50	135	500	635	1.27	32	500	532	1.06
75	190	650	840	1.12	45	650	695	0.93
100	210	850	1,060	1.06	50	850	900	0.90

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333	650	2,500	3,150	0.94	120	2,500	2,620	0.79
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5) Standard:

	Test Procedure	Class of Defect
Total losses must not exceed the allowable percentage losses as indicated in the table (depending on the core material)	compare the recorded reading of the instrument with the table	Major

f. Audible Sound Level

1) Purpose: To determine the allowable sound level of 75kVA of DT

2) Test equipment:
Sound Level meter/Noise Level meter

3) Procedures:
With the transformer energized, place the sound pressure level meter 0.3m away from a vertical surface and around the periphery of the transformer or integral enclosure.

kVA	Average Sound Level (Decibels)	Test Procedure	Class of Defect
50 and below	48	compare the reading of Decibel Tester with the average sound level table <i>Formula:</i> =< average sound level is acceptable; > Average sound level is not acceptable	Major
75 - 100	51		Major
167 - 250	55		Major
333	56		Major

9. PROCEDURES:

a. For Post-qualification:

- 1) The submitted sample/s will be used in the conduct of functional and evaluation test.
- 2) Three minor defects shall constitute one major defect.
- 3) One Major defect shall constitute post-disqualification.

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- 2) Three minor defects shall constitute one major defect.
- 3) One Major defect shall constitute post-disqualification.

b. For Acceptance:

- 1) The sample must pass the given functional test otherwise it shall mean outright rejection.
- 2) Three minor defects shall constitute one major defect.
- 3) One Major defect shall constitute rejection.

10. RESCISSION:

All other test parameters, guidelines or standard operating procedures contrary to or inconsistent with the provisions of these test parameters are hereby rescinded, modified or amended.

11. EFFECTIVITY:

This MC shall take effect after 15 days from filing a copy thereof at the UP Law Center in consonance with Section 3, Chapter 2, Book VII of Executive Order 292 otherwise known as the "Revised Administrative Code of 1987," as amended.



[Signature]
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