

CONTEC

Comissão de Normalização
Técnica

SC-06

Electricity

**Dry Transformer for Lighting or
Instrumentation Systems**

Revalidation

Revalidated in 01/2011.

CONTEC

Comissão de
Normalização Técnica

SC-06

Electricity

**Dry Transformer for Lighting or
Instrumentation Systems**

1st Amendment

This is the 1st Amendment to PETROBRAS N-2201 REV. A and it is used to alter the text of the Standard in the parts indicated below:

NOTE 1 The news pages with the performed amendments is placed in its corresponding positions.

NOTE 2 The amended page, indicated the date of the amendment, is placed at the end of this standard, in chronological order, and shall not be used.

- Chapter 2: **(1st Amendment)**

Exclusion of PETROBRAS [N-2202](#).

Replace the ABNT NBR 5356 by ABNT [NBR 5356-1](#), [NBR 5356-2](#), [NBR 5356-3](#), [NBR 5356-4](#) e [NBR 5356-5](#).

Replace the ABNT NBR 5380 by ABNT [NBR 5356-1](#).

Replace the ABNT NBR 6146 by ABNT [NBR IEC 60529](#).

- Item 3.1: **(1st Amendment)**

Charge in the text.

- Item 3.2: **(1st Amendment)**

Charge in the text.

- Item 3.6: **(1st Amendment)**

Inclusion of item.

- Item 3.7: **(1st Amendment)**

Inclusion of item.

- Item 4.1.7: **(1st Amendment)**

Charge in the text.

- Item 4.1.8: **(1st Amendment)**

Charge in the text.

- Item 4.3.1.1: **(1st Amendment)**

Charge in the text.

1st Amendment

- Annex A: **(1st Amendment)**

Inclusion of Annex.

DRY TRANSFORMER FOR LIGHTING OR INSTRUMENTATION SYSTEMS

Specification

This Standard replaces and cancels its previous revision.

The CONTEC - Authoring Subcommittee provides guidance on the interpretation of this Standard when questions arise regarding its contents. The Department of PETROBRAS that uses this Standard is responsible for adopting and applying the clauses thereof.

CONTEC

Comissão de Normas
Técnicas

Technical Requirement: a provision established as the most adequate and which shall be used strictly in accordance with this Standard. If a decision is taken not to follow the requirement ("non-conformity" to this Standard) it shall be based on well-founded economic and management reasons, and be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by the verb forms "shall," "it is necessary...", "is required to...", "it is required that...", "is to...", "has to...", "only ... is permitted," and other equivalent expressions having an imperative nature.

Recommended Practice: a provision that may be adopted under the conditions of this Standard, but which admits (and draws attention to) the possibility of there being a more adequate alternative (not written in this Standard) to the particular application. The alternative adopted shall be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by the verbal form "should" and equivalent expressions such as "it is recommended that..." and "ought to..." (verbs of a nonmandatory nature). It is indicated by the expression: **[Recommended Practice]**.

Copies of the registered "non-conformities" to this Standard that may contribute to the improvement thereof shall be submitted to the CONTEC - Authoring Subcommittee.

SC - 06

Elettricity

Proposed revisions to this Standard shall be submitted to the CONTEC - Authoring Subcommittee, indicating the alphanumeric identification and revision of the Standard, the clause(s) to be revised, the proposed text, and technical/economic justification for revision. The proposals are evaluated during the work for alteration of this Standard.

"The present Standard is the exclusive property of PETRÓLEO BRASILEIRO S.A. - PETROBRAS, for internal use in the Company, and any reproduction for external use or disclosure, without previous and express authorization from the owner, will imply an unlawful act pursuant to the relevant legislation through which the applicable responsibilities shall be imputed. External circulation shall be regulated by a specific clause of Secrecy and Confidentiality pursuant to the terms of intellectual and industrial property law."

Foreword

PETROBRAS Technical Standards are prepared by Working Groups – GTs (consisting of specialists from PETROBRAS and its Subsidiaries), are commented by PETROBRAS Units and PETROBRAS Subsidiaries, are approved by the Authoring Subcommittees - SCs (consisting of specialists from the same specialty, representing the various PETROBRAS Units and PETROBRAS Subsidiaries), and ratified by the CONTEC Plenary Assembly (consisting of representatives of the PETROBRAS Units and PETROBRAS Subsidiaries). A PETROBRAS Technical Standard is subject to revision at any time by its Authoring Subcommittee and shall be reviewed every 5 years to be revalidated, revised or cancelled. PETROBRAS Technical Standards are prepared in accordance with standard PETROBRAS N-1. For complete information about PETROBRAS Technical Standards see PETROBRAS Technical Standards Catalog.

FOREWORD

This Standard is the English version (issued in OCT/2004) of Standard PETROBRAS N-2201 REV. A JAN/2003.

1 SCOPE

1.1 This Standard sets the requirements for purchasing a dry transformer destined mainly, for energizing lighting or instrumentation systems, for use in PETROBRAS facilities.

1.2 Unless otherwise specified on the Data Sheet, this Standard does not apply to:

- a) dry power transformer, in which case standard PETROBRAS [N-1911](#) is to be used;
- b) special transformers, such as: voltage regulating transformers;
- c) control transformers, for internal use on panels.

1.3 This Standard applies for supplies beginning from its issue date.

1.4 This Standard contains Technical Requirements and Recommended Practices.

2 SUPPLEMENTARY DOCUMENTS

The documents listed below are mentioned in the text and contain valid requirements for the present Standard.

PETROBRAS N-381	- Execution of Drawing and Other General Technical Documents;
PETROBRAS N-1219	- Cores;
PETROBRAS N-1735	- Pinturas de Máquinas e Equipamentos Elétricos e Instrumentos;
PETROBRAS N-1911	- Transformadores Secos para Transmissão e Distribuição de Energia Elétrica;
PETROBRAS N-2033	- Fabrication Inspection - Personnel Qualification;
ABNT NBR 5356-1	- Transformadores de Potência - Parte 1: Generalidades;
ABNT NBR 5356-2	- Transformadores de Potência - Parte 2: Aquecimento;
ABNT NBR 5356-3	- Transformadores de Potência - Parte 3: Níveis de Isolamento, Ensaio Dielétricos e Espaçamentos Externos em Ar;
ABNT NBR 5356-4	- Transformadores de Potência - Parte 4: Guia para Ensaio de Impulso Atmosférico e de Manobra para Transformadores e Reatores;
ABNT NBR 5356-5	- Transformadores de Potência - Parte 5: Capacidade de Resistir a Curtos-Circuitos;
ABNT NBR 5458	- Transformador de Potência - Terminologia;
ABNT NBR 5597	- Eletroduto Rígido de Aço-Carbono e Acessórios com Revestimento Protetor, com Rosca ANSI/ASME B1.20.1;
ABNT NBR 10295	- Transformadores de Potência Secos;



- ABNT [NBR 10861](#) - Prensa-Cabos;
- ABNT [NBR IEC 60529](#) - Graus de Proteção para Invólucros de Equipamentos Elétricos (código IP);
- ASME [B1.20.1](#) - Pipe Threads, General Purpose.

Note: For documents referred to in this Standard and for which only the Portuguese version is available, the PETROBRAS department that uses this Standard should be consulted for any information required for the specific application.

3 GENERAL CONDITIONS

3.1 The transformer shall be designed and manufactured in compliance with the recommendations contained in the standards ABNT [NBR 10295](#), [NBR 5356-1](#), [NBR 5356-2](#), [NBR 5356-3](#), [NBR 5356-4](#) and [NBR 5356-5](#) the latter where applicable. The technical documentation to be presented shall adopt standard ABNT [NBR 5458](#) terminology.

3.2 Routine transformer tests, as well as type and special tests, when requested on the Data Sheet, shall be conducted in accordance with standard ABNT [NBR 5356-1](#).

3.3 The manufacturer shall indicate, when filling out the Data Sheet, other standards ABNT/IEC also applicable to the supply, in addition to those listed in Chapter 2 of this Standard. In case of conflicts, the requirements of the standards explicitly mentioned in Chapter 2 of this Standard prevail.

3.4 The transformer Data Sheet is, in general, partially and issued by PETROBRAS, being the manufacturer responsible for integrally filling it out. Each transformer identification number corresponds to one Data Sheet, which receives a specific identification for the application. The form (blank) used for issuing the Data Sheet is standardized by standard PETROBRAS [N-381](#). Additional sheets, eventually required, shall follow the standards defined in standard PETROBRAS [N-381](#).

3.5 When there are discrepancies between the Data Sheet and this Standard, the information contained in the Data Sheet shall prevail.

3.6 Each of the sheets comprising the Data Sheet may be reproduced more than once to compose the final document according to the user's needs. If necessary, use an additional sheet according to the applicable model of standard PETROBRAS [N-381](#).

3.7 The header and footer shall be filled in according to standard PETROBRAS [N-381](#).

4 CONSTRUCTIVE FEATURES

4.1 General Features

4.1.1 The transformer shall be resistant to corrosion resulting from installation in a petrochemical industrial environment, as well as suitable to all other environmental features specified in the Data Sheet. Anticorrosive treatment to which the transformer shall be submitted shall present an final result, at least, equivalent to standard PETROBRAS [N-1735](#).

4.1.2 The final finishing color shall be light gray (code 0065), in accordance with standard PETROBRAS [N-1219](#).

4.1.3 When specified on the Data Sheet, single-phase transformer with 3 wire secondary distribution system, 1 phase, the transformer shall be built according to the sketch indicated in FIGURE 1.

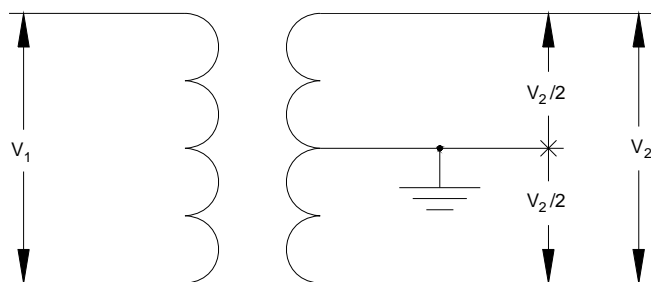


FIGURE 1 - SINGLE-PHASE TRANSFORMER, WITH 3-WIRE SECONDARY DISTRIBUTION SYSTEM, 1 PHASE

4.1.4 When specified on the Data Sheet, the shielding between windings shall be designed in order to reduce the coupling capacitance between the primary and secondary, providing the equipment with an insulating transformer features. Such requirements are not needed for transformers destined to lightning systems, but are mandatory in case of transformers feeding sensitive electronic instrumentation systems or similar.

4.1.5 Unless otherwise specified on the Data Sheet, three-phase transformers with triangle-connected primary winding and star-connected secondary winding shall present a 30 angular displacement, being the star winding voltage delayed in relation to the other winding (Dyn1).

4.1.6 Unless otherwise specified on the Data Sheet, the transformer shall have at least 4 shunts in the primary winding, besides the main one, corresponding to $+ 2 \times 2.5 \%$, and $-2 \times 2.5 \%$ of the nominal voltage. The transformer shall be designed to allow nominal power operation in any one of the shunts specified in here.

4.1.7 Temperature rise of the transformer's windings insulated with temperature class B materials or higher shall not exceed 80°C , when tested in accordance with standard ABNT [NBR 5356-1](#). For materials which assigned temperature limit is less than 120°C , the maximum temperature rise to be considered in the transformer design shall be compatible with the limit temperature of the used material.

4.1.8 The transformer shall have an outer protection metal casing, and any energized part shall be properly protected. The minimum protection grade provided by the casing shall be the one indicated on the Data Sheet, in accordance with standard ABNT [NBR IEC 60529](#).

4.1.9 Unless otherwise specified on the Data Sheet, the transformer shall have a natural air cooling.

4.2 Transformer Insulating Material

4.2.1 Unless otherwise specified on the Data Sheet, the transformer insulating material shall be compound putty or resin.

4.2.2 When the specified material is resin, it shall be flame retardant, self-extinguishable and have low toxic gas emission content.

4.2.3 For effect of this Standard application, the following definitions are used regarding the manner of applying the transformer insulating material, as explicitly indicated on the Data Sheet:

- a) encapsulated transformer - the insulating material is applied to windings, which are accessible, by opening the transformer protection metal casing;
- b) submerged transformer - the transformer active part is assembled inside a metal tank, being the tank totally filled with the insulating material.

4.3 Accessories

4.3.1 Bushing Protection Box

4.3.1.1 If requested in the Data Sheet, bushing protection boxes of the primary and secondary windings shall have flanged covers, fitted with protection against moisture penetration, water splashes, dust and other harmful elements to the transformer fine operation. The minimum protection grade shall be IP-54, in accordance with standard ABNT [NBR IEC 60529](#).

4.3.1.2 Box seals and all other transformer covers shall be made from elastomer gaskets, resistant to attack by products and fumes characteristic of the installation site and to sunlight exposure. Such gaskets shall not suffer any distortion during use or during cover removal for access to inner parts.

4.3.1.3 Unless otherwise specified on the Data Sheet, electric cable inlets into the bushing protection boxes shall be made of sleeves welded to the bottom of respective protection boxes, as shown in FIGURE 2. The sleeves shall have NPT thread, in accordance with standard ASME [B1.20.1](#), being destined for rigid conduit connection, in accordance with standard ABNT [NBR 5597](#), flexible conduit cable or cable gland.

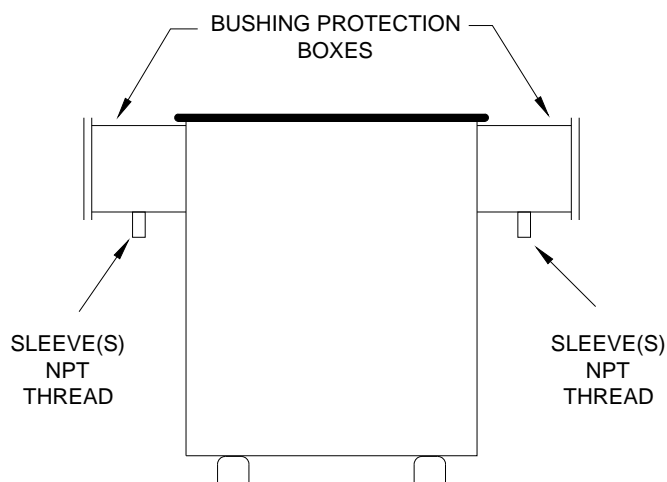


FIGURE 2 - BUSHING PROTECTION BOXES OR TERMINALS

4.3.1.4 The protection box corresponding to the transformer grounded side shall have an additional 40 mm (1 1/2") NPT sleeve, in accordance with standard ASME [B1.20.1](#), welded to the bottom of the box, destined for passage of the system grounding cable. The sleeve shall be positioned under the neuter bushing.

4.3.2 General Accessories

4.3.2.1 The terminals or bushings of the transformer's primary, secondary and neuter shall be made with appropriated connectors for connection to cables with nominal sections indicated on the Data Sheet. Unless it is otherwise specified on the Data Sheet, copper cables with thermoplastic insulation and coating shall be considered.

4.3.2.2 A connector shall be predicted for grounding the transformer steel parts. The connector shall be located on the outer side face of the steel casing and shall be adequate for bare copper cable, with nominal section defined on the Data Sheet.

4.3.2.3 When cable glands for single pole cables are requested on the Data Sheet, the cables glands for single pole cables shall meet standard ABNT [NBR 10861](#) and be built with non-magnetic material. The plate on which the cable gland belonging to the same single pole cable circuit should be assembled shall also be of non-magnetic material. When used, cable glands shall be built with material compatible with the material of the plates where they should be fastened in order to prevent galvanic corrosion.

4.3.2.4 When requested on the Data Sheet, the transformer shall be fitted with supports, in the rear, for fastening to the wall. It shall also allow being supported by the casing base.

4.3.2.5 The transformer nameplate shall be made of corrosion-resistant material (aluminum or AISI 316 stainless steel) and shall contain, beside the information required by standard ABNT [NBR 10295](#), the following data:

- a) PETROBRAS - PETRÓLEO BRASILEIRO S. A.;
- b) department name;
- c) PETROBRAS transformer identification number;
- d) Material Requisition number (RM);
- e) Material Purchase Order number (PCM);
- f) Material Supply Authorization number (AFM);
- g) in alternatives to paragraphs d) and f), contract number, in cases of purchase built into Global Price type contract ("Turn Key", "Lump Sum" etc.).

Note: Data contained in paragraphs a) to g) can be included in the nameplate or in an additional plate of identical material to the main plate.

5 INSPECTION

5.1 It is recommended that the manufacturing inspection be conducted by a qualified professional as established by standard PETROBRAS [N-2033](#). **[Recommended Practice]**

5.2 Inspection shall check, at least, the points indicated in items 5.2.1 to 5.2.7.

5.2.1 Conformity with the equipment technical documentation referring to this supply, duly approved by PETROBRAS design department (Data Sheet, specifications, drawings and manuals).

5.2.2 Calibration certificates of instruments to be used in the tests.

5.2.3 Visual characteristics and painting tests (adherence and thickness).

5.2.4 Equipment size characteristics.

5.2.5 Inner spaces of bushing protection box(es) as well as their components (insulators, terminal connectors, ground connectors, electric cable inlet sleeves etc.) and transformer protection casing, if internally accessible.

5.2.6 Routine tests prescribed in the technical standards adopted in this supply.

5.2.7 Type and special tests stipulated by the technical standards adopted in this supply, if specified on the Data Sheet.

5.3 Type and special tests, when requested on the Data Sheet, it is recommended that they be described in the proposal, with their respective individual prices separately.
[Recommended Practice]

6 TECHNICAL DOCUMENTATION

6.1 With the Proposal

This item deals with the technical documentation that shall be attached to the proposal. Such documents shall contain, at least, the following information:

- a) preliminary drawing, containing main sizes of the transformer and its accessories;
- b) approximate weight of the complete transformer;
- c) Data Sheet duly filled in and authenticated by supplier, according to item 3.4 of this Standard;
- d) initial magnetization current value of the transformer;
- e) list of technical standards applicable to this supply complementing the list in Chapter 2 of this Standard;
- f) list of tests; as mentioned in item 5.3 of this Standard;
- g) painting scheme adopted for the transformer and accessories, as mentioned in item 4.1.1 of this Standard.

6.2 After Material Supply Authorization

6.2.1 This item deals with the technical documentation that shall be forwarded for approval, after effectively purchasing the transformer.

Note: The documents shall consider the information in the proposal, added by technical clarifications supplied by the manufacturer during the technical opinion.


6.2.2 The documents to be submitted shall contain, at least, the following information:


- a) transformer layout drawing, containing general dimensions, views, constructive details and list of components;
- b) transformer total weight;
- c) location and details of bushing protection boxes;
- d) location and details of accessories for cable inlet, such as: threaded sleeves;
- e) location and sizes of casing grounding terminals;
- f) location and details of transformer support, hoisting and fastening systems;
- g) diagram and name plates;
- h) Data Sheet with all items filled out according to item 3.4 of this Standard, containing revisions resulting from the technical opinion.

6.3 Assembly, Operation and Maintenance Manual

After final approval of all technical documentation established in the previous item, transformer assembly, operation and maintenance manuals shall be supplied, containing, at least, the following information:

- a) duly filled out Data Sheet, containing "as built" transformer data;
- b) all documents certificated, supplied and listed in item 6.2 of this Standard, as well as other complementary documents that the manufacturer deems necessary;
- c) transformer storage and packing procedures;
- d) assembly procedures;
- e) operating procedures;
- f) transformer preventive and corrective maintenance procedures;
- g) result of all tests to which transformer was submitted during and after the manufacturing phase.

 PETROBRAS	DATA SHEET				No.					
	CLIENT:							SHEET:		
	JOB:							of		
	AREA:									
TITLE: DRY TYPE TRANSFORMER FOR LIGHTING OR INSTRUMENTATION SYSTEMS										
INDEX OF REVISIONS										
REV.	DESCRIPTION AND/OR REVISED SHEETS									
	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H	
DATE										
DESIGN										
EXECUTION										
CHECK										
APPROVAL										
THE INFORMATION CONTAINED IN THIS DOCUMENT IS PETROBRAS PROPERTY AND MAY NOT BE USED FOR PURPOSE OTHER THAN THOSE SPECIFICALLY INDICATED HEREIN.										
THIS FORM IS PART OF STANDARD PETROBRAS N-2201 REV. A ENGLISH ANNEX A - SHEET 01/02.										

		DATA SHEET		No.:		REV.	
						SHEET:	
		TITLE:				of	
		DRY TYPE TRANSFORMER FOR LIGHTING OR INSTRUMENTATION SYSTEM					
1	PETROBRAS IDENTIFICATION			23	EFFICIENCY		
2	QUANTITY				% LOAD	POWER FACTOR = 1.0	POWER FACTOR = 0.8
3	ENVIROMENTAL CHARACTERISTICS				100		
	INSTALLATION INDOOR <input type="checkbox"/> OUTDOOR <input type="checkbox"/>				75		
	AMBIENT TEMP. °C ALTITUDE m				50		
	NEAR THE SEA YES <input type="checkbox"/> NO <input type="checkbox"/>				25		
	CLASSIDIED AREA YES <input type="checkbox"/> NO <input type="checkbox"/>			24	REGULATION (%)		
	ZONE GROUP TEMP. CLASS			25	TOTAL MASS kg		
4	SPECIAL CONDITIONS				ACCESSORIES		
				26	NUMBER OF PRIMARY TERMINALS / BUSHINGS		
5	MANUFACTURER				CABLE CONNECTOR - CROSS-SECTIONAL AREA mm ² <input type="checkbox"/>		
6	RATED POWER kVA				TYPE OF CABLE		
7	NUMBER OF PHASES PRIMARY			27	NUMBER OF SECONDARY TERMINALS / BUSHINGS		
	TWO-PHASE THREE-WIRE SECONDARY <input type="checkbox"/>				CABLE CONNECTOR - CROSS-SECTIONAL AREA mm ² <input type="checkbox"/>		
	ONE-PHASE TWO-WIRE SECONDARY <input type="checkbox"/>				TYPE OF CABLE		
	3-PHASE 4-WIRE SECONDARY <input type="checkbox"/>						
8	RATED FREQUENCY Hz						
9	PRIMARY RATED VOLTAGE V			28	NEUTRAL BUSHING		
	SECONDARY RATED VOLTAGE V				CABLE CONNECTOR - CROSS-SECTIONAL AREA mm ² <input type="checkbox"/>		
10	PRIMARY WINDING CONNECTION				CABLE CONNECTOR - CROSS-SECTIONAL AREA mm ² <input type="checkbox"/>		
	SECONDARY WINDING CONNECTION				TYPE OF CABLE		
11	PRIMARY TAPS			29	TRANSFORMER PROTECTIVE ENCLOSURE <input type="checkbox"/>		
	SECONDARY TAPS				DEGREE OF PROTECTION		
12	INSULATING MATERIAL				PLATE THICKNESS mm		
	MATERIAL TEMP. CLASS			30	BUSHING PROTECTION BOX <input type="checkbox"/>		
13	WINDING TEMP. RISE °C				DEGREE OF PROTECTION		
14	INSULATING MATERIAL APPLICATION METHOD			31	COUPLINGS OF CABLE ENTRY <input type="checkbox"/>		
	ENCAPSULATED TRANSFORMER <input type="checkbox"/>					COUPLING DIAMETER (mm)	QUANTITY
	IMMERSED TRANSFORMER <input type="checkbox"/>				PRIMARY		
					SECONDARY		
15	GROUNDED NEUTRAL YES <input type="checkbox"/> NO <input type="checkbox"/>			32	CABLE GLANDS (INCLUDED IN SUPPLY) <input type="checkbox"/>		
16	ELECTROST. SHIELDING BETWEEN WINDINGS <input type="checkbox"/>			33	ENCLOSURE GROUNDING CONNECTOR <input type="checkbox"/>		
17	ANGULAR OFFSET (OR POLARITY)				FOR CABLE mm ²	QUANTITY	
	CONNECTION			34	MEANS FOR LIFTING TRANSFORMER <input type="checkbox"/>		
18	EXCITATION CURRENT %			35	NO LOAD TAP CHANGER <input type="checkbox"/>		
	INITIAL EXCITATION CURRENT A				TAP PANEL <input type="checkbox"/>		
19	MAXIMUM VOLTAGES (INSULATION LEVELS)				TESTS		
	PRIMARY kV (EFFECTIVE)			36	ROUTINE TESTS <input type="checkbox"/>		
	SECONDARY kV (EFFECTIVE)			37	TYPE / SPECIAL TESTS <input type="checkbox"/>		
20	REFERENCE TEMPERATURE (T _{REF}) °C						
21	IMPEDANCE (T _{REF}) %						
22	NO-LOAD LOSSES (T _{REF}) W			38	COMPLEMENTARY STANDARDIZATION		
	ON-LOAD LOSSES (T _{REF}) W						

THE INFORMATION CONTAINED IN THIS DOCUMENTS IS PETROBRAS PROPERTY AND MAY BE USED FOR PURPOSES OTHER THAN THOSE SPECIFICALLY INDICATED HEREIN.

THIS FORM IS PART OF STANDARD PETROBRAS N-2201 REV. A ENGLISH ANNEX A - SHEET 02/02.



INDEX OF REVISIONS

There is no index of revisions.

REV. A

[illegible]

FOREWORD

This Standard is the English version (issued in OCT/2004) of Standard PETROBRAS N-2201 REV. A JAN/2003.

1 SCOPE

1.1 This Standard sets the requirements for purchasing a dry transformer destined mainly, for energizing lighting or instrumentation systems, for use in PETROBRAS facilities.

1.2 Unless otherwise specified on the Data Sheet, this Standard does not apply to:

- a) dry power transformer, in which case standard PETROBRAS N-1911 is to be used;
- b) special transformers, such as: voltage regulating transformers;
- c) control transformers, for internal use on panels.

1.3 This Standard applies for supplies beginning from its issue date.

1.4 This Standard contains Technical Requirements and Recommended Practices.

2 SUPPLEMENTARY DOCUMENTS

The documents listed below are mentioned in the text and contain valid requirements for the present Standard.

PETROBRAS N-381	- Execution of Drawing and Other General Technical Documents;
PETROBRAS N-1219	- Cores;
PETROBRAS N-1735	- Pinturas de Máquinas e Equipamentos Elétricos e Instrumentos;
PETROBRAS N-1911	- Transformadores Secos para Transmissão e Distribuição de Energia Elétrica;
PETROBRAS N-2033	- Fabrication Inspection - Personnel Qualification;
PETROBRAS N-2202	- Transformador Seco para Sistemas de Iluminação ou Instrumentação - Folha de Dados;
ABNT NBR 5356	- Transformador de Potência - Especificação;
ABNT NBR 5380	- Transformador de Potência - Método de Ensaio;
ABNT NBR 5458	- Transformador de Potência - Terminologia;
ABNT NBR 5597	- Eletroduto Rígido de Aço-Carbono e Acessórios com Revestimento Protetor, com Rosca ANSI/ASME B1.20.1;
ABNT NBR 6146	- Invólucros de Equipamentos Elétricos - Proteção;
ABNT NBR 10295	- Transformadores de Potência Secos;
ABNT NBR 10861	- Prensa-Cabos;
ASME B1.20.1	- Pipe Threads, General Purpose.

Note: For documents referred in this Standard and for which only the Portuguese version is available, the PETROBRAS department that uses this Standard should be consulted for any information required for the specific application.

3 GENERAL CONDITIONS

3.1 The transformer shall be designed and manufactured in compliance with the recommendations contained in the standards ABNT NBR 10295 and ABNT NBR 5356, the latter where applicable. The technical documentation to be presented shall adopt standard ABNT NBR 5458 terminology.

3.2 Routine transformer tests, as well as type and special tests, when requested on the Data Sheet, shall be conducted in accordance with standard ABNT NBR 5380.

3.3 The manufacturer shall indicate, when filling out the Data Sheet, other standards ABNT/IEC also applicable to the supply, in addition to those listed in Chapter 2 of this Standard. In case of conflicts, the requirements of the standards explicitly mentioned in Chapter 2 of this Standard prevail.

3.4 The transformer Data Sheet is, in general, partially and issued by PETROBRAS, being the manufacturer responsible for integrally filling it out. Each transformer identification number corresponds to one Data Sheet, which receives a specific identification for the application. The form (blank) used for issuing the Data Sheet is standardized by standard PETROBRAS N-381. Additional sheets, eventually required, shall follow the standards defined in standard PETROBRAS N-381.

3.5 When there are discrepancies between the Data Sheet and this Standard, the information contained in the Data Sheet shall prevail.

4 CONSTRUCTIVE FEATURES

4.1 General Features

4.1.1 The transformer shall be resistant to corrosion resulting from installation in a petrochemical industrial environment, as well as suitable to all other environmental features specified in the Data Sheet. Anticorrosive treatment to which the transformer shall be submitted shall present an final result, at least, equivalent to standard PETROBRAS N-1735.

4.1.2 The final finishing color shall be light gray (code 0065), in accordance with standard PETROBRAS N-1219.

4.1.3 When specified on the Data Sheet, single-phase transformer with 3 wire secondary distribution system, 1 phase, the transformer shall be built according to the sketch indicated in FIGURE 1.

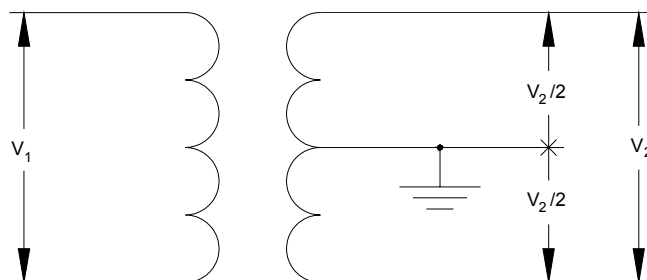


FIGURE 1 - SINGLE-PHASE TRANSFORMER, WITH 3-WIRE SECONDARY DISTRIBUTION SYSTEM, 1 PHASE

4.1.4 When specified on the Data Sheet, the shielding between windings shall be designed in order to reduce the coupling capacitance between the primary and secondary, providing the equipment with an insulating transformer features. Such requirements are not needed for transformers destined to lightning systems, but are mandatory in case of transformers feeding sensitive electronic instrumentation systems or similar.

4.1.5 Unless otherwise specified on the Data Sheet, three-phase transformers with triangle-connected primary winding and star-connected secondary winding shall present a 30 angular displacement, being the star winding voltage delayed in relation to the other winding (Dyn1).

4.1.6 Unless otherwise specified on the Data Sheet, the transformer shall have at least 4 shunts in the primary winding, besides the main one, corresponding to $+2 \times 2.5\%$, and $-2 \times 2.5\%$ of the nominal voltage. The transformer shall be designed to allow nominal power operation in any one of the shunts specified in here.

4.1.7 Temperature rise of the transformer's windings insulated with temperature class B materials or higher shall not exceed $80\text{ }^{\circ}\text{C}$, when tested in accordance with standard ABNT NBR 5380. For materials which assigned temperature limit is less than $120\text{ }^{\circ}\text{C}$, the maximum temperature rise to be considered in the transformer design shall be compatible with the limit temperature of the used material.

4.1.8 The transformer shall have an outer protection metal casing, and any energized part shall be properly protected. The minimum protection grade provided by the casing shall be the one indicated on the Data Sheet, in accordance with standard ABNT NBR 6146.

4.1.9 Unless otherwise specified on the Data Sheet, the transformer shall have a natural air cooling.

4.2 Transformer Insulating Material

4.2.1 Unless otherwise specified on the Data Sheet, the transformer insulating material shall be compound putty or resin.

4.2.2 When the specified material is resin, it shall be flame retardant, self-extinguishable and have low toxic gas emission content.

4.2.3 For effect of this Standard application, the following definitions are used regarding the manner of applying the transformer insulating material, as explicitly indicated on the Data Sheet:

- a) encapsulated transformer - the insulating material is applied to windings, which are accessible, by opening the transformer protection metal casing;
- b) submerged transformer - the transformer active part is assembled inside a metal tank, being the tank totally filled with the insulating material.

4.3 Accessories

4.3.1 Bushing Protection Box

4.3.1.1 If requested in the Data Sheet, bushing protection boxes of the primary and secondary windings shall have flanged covers, fitted with protection against moisture penetration, water splashes, dust and other harmful elements to the transformer fine operation. The minimum protection grade shall be IP-54, in accordance with standard ABNT NBR 6146.

4.3.1.2 Box seals and all other transformer covers shall be made from elastomer gaskets, resistant to attack by products and fumes characteristic of the installation site and to sunlight exposure. Such gaskets shall not suffer any distortion during use or during cover removal for access to inner parts.

4.3.1.3 Unless otherwise specified on the Data Sheet, electric cable inlets into the bushing protection boxes shall be made of sleeves welded to the bottom of respective protection boxes, as shown in FIGURE 2. The sleeves shall have NPT thread, in accordance with standard ASME B1.20.1, being destined for rigid conduit connection, in accordance with standard ABNT NBR 5597, flexible conduit cable or cable gland.

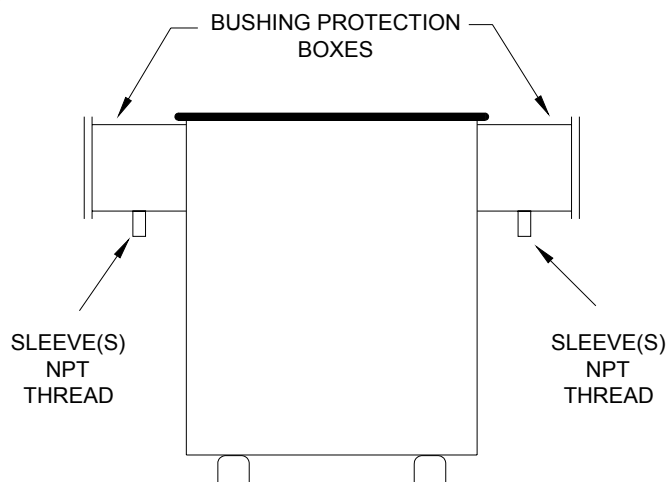


FIGURE 2 - BUSHING PROTECTION BOXES OR TERMINALS