

N-2111

REV. D

11 / 2011

CONTEC

Comissão de Normalização
Técnica

SC-16

Segurança Industrial

**Segurança na Limpeza, Inspeção e Reparo
de Tanques de Armazenamento e Vasos de
Pressão**

Revalidação

Revalidada em 01/2016.

Safety in Cleanup, Inspection and Repair of Storage Tanks and Pressure Vessels

Procedure

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 sections, subsections and enumerates thereof.

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 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 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.

Proposed revisions to this Standard shall be submitted to the CONTEC - Authoring Subcommittee, indicating the alphanumeric identification and revision of the Standard, the section, subsection and enumerate 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."

CONTEC

Comissão de Normalização
Técnica

SC - 16

Industrial Safety

Introduction

PETROBRAS Technical Standards are prepared by Working Groups - WG (consisting specialized of Technical Collaborators from Company and its Subsidiaries), are commented by Company Units and its Subsidiaries, are approved by the Authoring Subcommittees - SCs (consisting of technicians from the same specialty, representing the various Company Units and its Subsidiaries), and ratified by the Executive Nucleus (consisting of representatives of the Company Units and its 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 PETROBRAS Technical Standard [N-1](#). For complete information about PETROBRAS Technical Standards see PETROBRAS Technical Standards Catalog.

Foreword

This Standard is the English version (issued in 11/2011) of PETROBRAS N-2111 REV. D 11/2011. In case of doubt, the Portuguese version, which is the valid document for all intents and purposes, shall be used.

1 Scope

1.1 This Standard establishes the safety conditions to be observed in cleanup, inspection and repair services for out-of-service atmospheric storage tanks, low-pressure storage tanks and pressure vessels.

1.2 This Standard is also applied to buried atmospheric tanks.

1.3 This Standard is not applied to services performed in:

- a) pressurized tanks;
- b) cryogenic tanks and vessels;
- c) ship tanks
- d) tank trucks and wagons
- e) drums
- f) transportable cylinders of compressed gases
- g) portable containers of compressed fluids
- h) fire extinguishers
- i) pipelines and piping systems for conveying fluids
- j) vessels intended for human occupancy in diving activities.

1.4 This Standard is applied to services starting from its issue date.

1.5 The application of this Standard in the case of companies of the PETROBRAS System headquartered abroad shall be based on respect for local legislation, as well as for the other applicable requirements. It shall be understood that all other existing Brazilian legislation or references pointed out in this Standard may serve as input to its adaptation process.

1.6 This Standard contains Technical Requirements and Recommended Practices.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies.

Norma Regulamentadora no 10 (NR-10) - Instalações e Serviços em Eletricidade;

PETROBRAS N-38 - Criterion for Design of Drainage, Segregation, Flow and Preliminary Treatment of Liquid Effluents of Onshore Installations;

PETROBRAS N-270 - Projeto de Tanque Atmosférico;

PETROBRAS N-2162 - Work Permit;

PETROBRAS N-2344 - Safety in Industrial Radiography Work;

PETROBRAS [N-2349](#) - Safety in Industrial Radiography Work;

PETROBRAS [N-2622](#) - Resíduos Industriais;

PETROBRAS [N-2637](#) - Safety for Work in Confined Spaces;

ABNT [NBR 5410](#) - Instalações Elétricas de Baixa Tensão;

ABNT [NBR 17505-1](#) - Armazenamento de líquidos inflamáveis e Combustíveis - Parte 1: Disposições gerais

ABNT [NBR NM 60335-1](#) - Segurança de aparelhos eletrodomésticos e similares - Parte 1: Requisitos gerais;

ABNT [NBR IEC 60079-17](#) - Atmosferas explosivas Parte 17: Inspeção e manutenção de instalações elétricas;

API [STD 620](#) - Design and Construction of Large, Welded, Low-Pressure Storage Tanks;

API [RP 2003](#) - Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents;

API [RP 2219](#) - Safe Operation of Vacuum Trucks in Petroleum Service.

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 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1

tank contention basin

region delimited by a dike used for containing the volume of product in the tank in accordance with ABNT [NBR 17505-1](#)

3.2

manhole

an opening in the shell or roof of a tank or vessel for access inside it

3.3

chemical uncontamination

application of the combination of products and processes which allow the gas freeing, elimination of the pyrophoric product (FeS), toxic and cleanup of equipments or piping systems, random and structured fillings, trays, structural components, serpentines etc., including the cleanup for removal of solids and liquids inside equipments, extracting the hydrocarbons and the materials with possible power of solubility or suspension, so as to allow the removal through pumping; the remains solids inside equipments, after chemical cleanup, shall be innocuous and allow its removal through simple cleanup with gross water or manual removal in a site previously uncontaminated

3.4

cleanup door

opening in the tank shell flush with the bottom used for waste removal

3.4**low-pressure storage tank**

equipment subject to pressure in the vapor space higher than the atmospheric pressure and lower than 15 lbf/in² (1.05 kgf/cm²), designed to storage crude oil, petroleum products and alcohol, according to API [STD 620](#)

3.5**pressure vessel**

equipment not subject to flames, containing any fluid having a gauge pressure equal to or higher than 103 kPa (1.05 kgf/cm²) or subject to external pressure

4 General Procedures

The cleanup, inspection and repair services shall be done according to the following procedures:

- a) preliminary arrangements;
- b) actions of preparation for entry;
- c) work performance;
- d) in-service equipment;
- e) wastes discard.

4.1 Preliminary Arrangements**4.1.1 Planning**

Any service involving cleanup, inspection and repair shall be preceded by a planning with multidisciplinary team (see Note 1), so as to detail all its following steps:

- a) define the operational procedures needed for commissioning and releasing the tank or pressure vessel, which include: taking the equipment out of service, emptying equipment by the usual means, checking the quantity and nature of wastes, removing wastes, elimination of gases and vapors (see Note 2);
- b) elaborate an isolation plan with racket for equipment isolation, ensuring blockages of energy sources including residual energies (see Note 3);
- c) define the procedures to the work performance;
- d) define the duties of the departments involved in the procedures mentioned in 4.1.1 a) and b);
- e) define those responsible for each step of the work;
- f) define the procedures for putting the equipment back into operation;
- g) define the measures of risk control;
- h) define the procedures of an emergency;
- i) define the control of ignition sources, signs and Personal Protective Equipment (EPI, with the abbreviature in Portuguese).

NOTE 1 It is recommended that the multidisciplinary team is composed of, at least, representatives of the involved areas in the performed area, such as: Safety, Environment and Health (SMS, with the abbreviature in Portuguese), maintenance and operation. **[Recommended Practice]**

NOTE 2 It shall be considered the viability of apply the process of chemical uncontamination.

NOTE 3 The isolation plan with racket shall contain the updated drawings of the equipment for consultation.

4.1.2 Training of Personnel

All personnel involved shall be trained in the activities to be performed. In the specific case of services in confined spaces, the requirements established in the PETROBRAS [N-2637](#) shall be obligatory.

4.2 Actions of Preparation for Entry

4.2.1 For out of service operation, drainage and depressurization, isolation, elimination of gases and vapors and monitoring of the equipment atmosphere, the requirements established in the PETROBRAS [N-2637](#) shall be obligatory.

4.2.2 In the case of cleaning and decontamination using chemical process in the pressure vessels shall be alert to this washing is performed during the removal operation, to ensure that the equipment is delivered decontaminated.

NOTA Make sure that there are no signs or occurrence of atmospheric discharges.

4.3 Work Performance

4.3.1 For the activities to be performed shall be issued an Work Permit (PT, with the abbreviature in Portuguese), according to PETROBRAS [N-2162](#) and confined spaces shall be issued an Home and Work Permit (PET, , with the abbreviature in Portuguese) according to PETROBRAS [N-2637](#).

4.3.2 Industrial radiography works shall comply with PETROBRAS [N-2344](#).

4.3.3 Welding and cutting works shall comply with PETROBRAS [N-2349](#).

4.3.4 Electrical equipments used in cleanup, inspection and repair services on tanks and pressure vessels shall comply with [NR-10](#).

4.3.5 Electrical devices and equipments, as well as artificial lighting and feeder cables, shall be of the type approved for hazardous areas, in accordance with the observations of its brazilian conformity certificate, and to receive the initial inspection, in accordance with ABNT [NBR IEC 60079-17](#), being fed through circuits with a separator transformer (insulator) and relays of instantaneous disconnection for deflect to the ground.

4.3.6 It is permitted to use another protection system in accordance with ABNT [NBR 5410](#), as to the contact voltage and the maximum disconnection time.

4.3.7 It is recommended the preferably use of machines and pneumatic hand tools in the place of those of electrical drive. **[Recommended Practice]**

4.3.8 Electrical machines and hand tools should be used up to a maximum voltage of 110 V, fed by a safety transformer with an instantaneous ground system short-circuit device and with double isolation characteristic, in accordance with ABNT [NBR NM 60335-1](#). **[Recommended Practice]**

NOTE 1 The feeder cables shall have isolation for 600 V.

NOTE 2 In the case, which is not possible to use equipments with a voltage up to 110 V, these equipments shall be analyzed by the maintenance and industrial safety areas of the operational unit, so as to prevent electric shock.

NOTE 3 The electrical equipments and cables shall be inspected as to its integrity before its use, with splices not being allowed.

4.3.9 It is recommended the use of the safety extra-low voltage (Separated Extra Low Voltage - SELV) lighting, in accordance with ABNT [NBR 5410](#). **[Recommended Practice]**

4.3.10 If there is the artificial lighting, it shall be provided an alternative system of lighting (of emergency) for evacuation in cases of lack of energy in the interior of the confined space, accepting for this case appropriate portable devices for hazardous areas.

4.3.11 The electrical cables which cross the tank basin shall be located aboveground and with suitable signs, so as to not compromise the displacement and the integrity of people and equipments. In the other areas, the electrical cables shall also be disposed so as to not compromise the displacement and the integrity of people and equipments.

4.4 In-Service Equipment

4.4.1 After the service conclusion, an internal inspection shall be performed, checking the following items, among others:

- a) effective conclusion of the services;
- b) equipment removal, remains of materials and wastes;
- c) integrity of internal and external components of the equipment;
- d) drains and vents;
- e) rackets or flanges removal according to the racking plan;
- f) presence of personnel.

4.4.2 In the in-service equipment operation, the fire fighting system of the equipment shall be in operational conditions and, in case of tanks, the dike shall be closed.

4.4.3 There shall be monitoring for possible leaks during the in-service equipment operation, in points such as manholes, flanges, valves, among others.

4.4.4 Pressure vessels, which contain flammable substances, shall be inerted so as to avoid the explosive mixtures formation during the equipment gasifying process.

4.5 Wastes Discard

4.5.1 It shall be provided a drainage system and final disposal for liquid wastes in accordance with PETROBRAS [N-38](#) and PETROBRAS [N-2622](#).

4.5.2 It is not permitted to dispose wastes in the contention basin even for temporary storage purposes.

4.5.3 The transport and final disposal of the wastes shall be simultaneously done with the equipment cleanup.

5 Specific Conditions

5.1 In the case that the stored product has possibility to form iron sulfide, it shall be taken prevention measures, so as to avoid its exothermic oxidation.

5.2 If the stored product contains hydrogen sulfide (H₂S) or benzene atmosphere or Immediately Dangerous to Life or Health (IPVS, with the abbreviature in Portuguese), preventive measures shall be taken in order to protect worker's health.

5.3 The requirements established in API [RP 2003](#) shall be complied with, so as to prevent risks from static electricity.

5.3.1 The water washing using sprays shall only be done in an inerted or non-flammable atmosphere.

5.3.2 If water steam is used to purge a tank or pressure vessel, all conductive objects, including the water steam discharge pipe or nozzle, shall be bonded to the tank or pressure vessel.

5.3.3 The following precautions shall be taken if there is a risk of a flammable atmosphere in the case of vacuum truck operations:

- a) use electrical conductive vacuum hose and other fittings according with API [RP 2219](#);
- b) thin wall, spiral wound, hose shall not be used;
- c) all the system shall be bonded so that there is a continuous conductive path from the truck through the nozzle to the tank of pressure vessel; bonds shall not be broken until all transfer equipment (hose) has been withdrawn from the container opening;
- d) ground the vacuum truck prior to each operation, with the ground being directly in the ground points, without use points such as setting screws of equipments and piping systems;
- e) ground points shall be free of painting and corrosion;
- f) avoid the use of unbonded conductive objects such as funnels and buckets;
- g) portable containers only drivers shall be used as intermediate collection vessel in vacuum truck operations, shall be grounded between the hose nozzle of the wand and the vessel being drained.

NOTE The hose shall be checked regularly for electrical continuity, as well as constructed of a conductive material or thick wall embedded wire.

5.4 The cleanup doors shall be opened in a controlled manner so as to maintain the discard capacity.

5.5 In the case of agitation of sludge by means of water nozzle, or by other means, inside equipments, it shall be attempted against flammable vapours release.

NOTE In case of ignorance of the composition of the sludge, it is recommended to collect samples of the sludge for analysis. **[Recommended Practice]**

5.6 The following requirements shall be obligatory for floating roof atmospheric tank:

- a) the floating roof compartments shall be checked for the presence of liquid;
- b) peripheral seals shall be checked for the existence of contamination from products accumulation;
- c) ensure that block valves of the roof drains are not closed.

5.7 The following requirements shall be obligatory for fixed roof atmospheric tank:

- a) the roof physical conditions shall be checked before release for personnel transit;
- b) it is recommended the use of tubular scaffold in roof maintenance services; **[Recommended Practice]**
- c) foam chambers shall be checked for the existence of contamination from products accumulation;
- d) the seal seated on the bottom and the absence of contamination with product on its top part shall be checked for tanks with floating seal; peripheral seals and column seals shall be checked for the existence of contamination from products accumulation.



5.8 For the tanks and vessels should also watch for:

- a) existence of products in the bottom of tank bottom plates;
- b) existence of fluids in low spots on tanks or vessels (drainage points in tanks and vessels boots);
- c) presence of poisonous animals, so as to protect the worker integrity;
- d) presence of oxi-cut gases (for instance hoses block);
- e) thermal stress (IBUTG evaluation);
- f) conditions for rescue in case of accident.

REV. A and B

There is no index of revisions.

REV. C

Affected Parts	Description of Alteration
All	Revision

REV. D

[illegible]