

Manufacture and Assembly of Metallic Structures

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.

"This Standard is exclusive property of Petróleo Brasileiro S. A. - PETROBRAS, internal application and PETROBRAS Subsidiaries and shall be used by its suppliers of goods and services under contracts or similar under the conditions established in Bidding, Contract, Agreement or similar.

The use of this Standard by other companies / organizations / government agencies and individuals is the sole responsibility of the users.."

CONTEC

Comissão de Normalização
Técnica

SC - 04

Civil Construction

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.

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Foreword

This Standard is the English version (issued in 04/2014) of PETROBRAS N-293 REV. H 08/2010. 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 conditions required for the fabrication and assembly of conventional metallic structures in onshore units, metallic structures of modules and auxiliary metallic structures for fixed production platforms, floating production platforms, FSOs, FPSOs, SS and TLP.

1.2 The application of this Standard is limited to carbon steel and carbon-manganese steel structures.

1.3 This Standard applies to designs started as of their date of issuance.

1.4 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.

PETROBRAS [N-13](#) - Requisitos Técnicos para Serviços de Pintura;

PETROBRAS [N-133](#) - Soldagem;

PETROBRAS [N-134](#) - Chumbadores para Concreto;

PETROBRAS [N-279](#) - Projeto de Estruturas Metálicas;

PETROBRAS [N-1594](#) - Ensaio Não Destrutivo - Ultrassom em Solda;

PETROBRAS [N-1595](#) - Ensaio Não Destrutivo - Radiografia;

PETROBRAS [N-1596](#) - Ensaio Não Destrutivo - Líquido Penetrante;

PETROBRAS [N-1597](#) - Ensaio Não Destrutivo Visual;

PETROBRAS [N-1598](#) - Ensaio Não Destrutivo - Partículas Magnéticas;

PETROBRAS [N-1644](#) - Construção de Fundações e de Estruturas de Concreto Armado;

PETROBRAS [N-1812](#) - Estruturas Oceânicas;

PETROBRAS [N-1852](#) - Estruturas Oceânicas - Fabricação e Montagem de Unidades Fixas;

PETROBRAS [N-1930](#) - Avaliação da Integridade Operacional de Guindaste "Offshore";

PETROBRAS [N-1965](#) - Movimentação de Carga Inspeção, Manutenção e Operação de Equipamentos Terrestres;

PETROBRAS [N-2301](#) - Elaboração da Documentação Técnica de Soldagem;

PETROBRAS [N-2719](#) - Estocagem de Tubo em Área Descoberta;

ABNT [NBR 5426](#) - Planos de Amostragem e Procedimentos na Inspeção por Atributos;

ABNT [NBR 6118](#) - Projeto de Estruturas de Concreto;

ABNT [NBR 6122](#) - Projeto e Execução de Fundações;

ABNT [NBR 8400](#) - Cálculo de Equipamento para Levantamento e Movimentação de Cargas;

ABNT [NBR 8800](#) - Projeto de Estruturas de Aço e de Estruturas Mistas de Aço e Concreto de Edifícios;

ABNT [NBR 9062](#) - Projeto e Execução de Estruturas de Concreto Pré-Moldado;

ABNT [NBR 14842](#) - Critérios para Qualificação e Certificação de Inspetores de Soldagem;

ABNT [NBR 15523](#) - Qualificação e Certificação de Inspetor de Controle Dimensional;

ABNT [NBR NM ISO 9712](#) - Ensaio Não Destrutivo - Qualificação e Certificação de Pessoal;

AISC [348](#) - Specification for Structural Joints using ASTM A325 or A490 Bolts;

API [Spec 2B](#) - Specification for the Fabrication of Structural Steel Pipe;

ASME [B1.1](#) - Unified Inch Screw Threads (UN and UNR Thread Form);

ASME [B18.2.1](#) - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series);

ASME [B18.2.2](#) - Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series);

ASTM [A143/A143M](#) - Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement;

ASTM [A500/A500M](#) - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes;

ASTM [A501](#) - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing;

AWS [D1.1/D1.1M](#) - Structural Welding Code.

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 terms and definitions indicated in PETROBRAS [N-1812](#) are adopted, complemented by the following items.

3.1 components

any structural element used as part of a set or subset

3.2 conventional metallic structures

industrial metallic structures that may be installed onshore or on production platforms, which directly support equipment and systems and enable the access to them. They are subdivided into two types, as described in 3.2.1 and 3.2.2

3.2.1**supporting metallic structures**

industrial metallic structures, installed onshore or in platforms, which directly support loads, equipment or systems, such as: piping supports, pressure vessel equipment supports, metallic sheds, flare stacks in industrial units, and fixed production platforms, floating production platforms, FSOs, FPSOs, SS and TLP housings

3.2.2**conventional accessibility structures**

metallic structures, installed onshore or in platforms, which enable the access to equipment and systems, such as: stairways, guard rails, hand rails, access platforms, operation platforms, and accessories of production platforms

3.3**metallic structures of module for platforms**

metallic structures responsible for the integrity of the module and which are supported on the decks of production platforms

3.4**auxiliary metallic structures for platforms**

metallic structures that are independent from the deck or complementary thereto, such as: flare boom, crane pedestal structure, work-over production rigs, helipad, mooring buoys, single-point mooring systems, monorails, and pull-in / pull-out structures

3.5**naval structures**

metallic structures integrating hulls and decks of ships, platforms FPSO, FSO, SS types self-hoisting, as well as buoys and single point moorings

3.6**steel-deck slabs**

Mixed slabs in which the steel formwork is incorporated into the load supporting system

4 Symbols or Acronyms

ABNT	- Associação Brasileira de Normas Técnicas;
AISC	- "American Institute of Steel Construction";
API	- "American Petroleum Institute";
ASME	- "American Society of Mechanical Engineers";
ASTM	- "American Society for Testing and Materials";
AWS	- "American Welding Society";
NDT	- Non-Destructive Testing;
FPSO	- "Floating Production Storage and Offloading Systems";
FSO	- "Floating Storage and Offloading Systems";
IEIS	- Instrução de Execução e Inspeção de Soldagens;
JAPT	- Full-Penetration Fillet Joint;
JASA	- Fillet Joint with Fillet Weld;
JTPT	- Full Penetration Butt Joint;
SS	- Semi-Submersible;
TLP	- "Tensile Leg Platform".

5 General Conditions

5.1 Documentation

5.1.1 Procedures for Receipt, Identification and Storage of Materials and Components

It shall contain at least:

- a) scope;
- b) applicable standards;
- c) definitions;
- d) criteria for verification of manufacturing documents: manufacturing certificates for components, quality certificates for materials, NDT reports and dimensional examinations;
- e) method and extent for receipt inspection, including the following items: identification, general condition of surface, dimensional examination, and protection of parts and components;
- f) identification system and marking method;
- g) definition of storage conditions, division of storage areas and storage and preservation method for all used components and materials;
- h) methods for handling materials and components;
- i) safety in storage of flammable products.

5.1.2 Manufacturing Procedure

It shall contain at least:

- a) scope;
- b) applicable standard and manufacturing design documents;
- c) definitions;
- d) forming processes, including requirements for controlling the degree of forming, in the case of hot forming, the range of allowable temperatures and method used for controlling temperatures;
- e) component welding sequence and deformation control and correction method;
- f) method used for coupling, adjustment and pre-attachment of components;
- g) pre-assembly;
- h) dimensional control (tolerances, preliminary study of post-welding contractions, temperature variations, equipment, methods, references, acceptable settling of supports and inspection plan containing the execution phases).

5.1.3 Assembly Procedure

It shall contain at least:

- a) scope;
- b) applicable standard and manufacturing design documents;
- c) definitions;
- d) types of temporary and permanent bases and supports, swivel saddles and pivoted supports;
- e) method used for alignment and leveling of structure supports;
- f) preparation and testing of land;
- g) method used for coupling, adjustment and pre-attachment of components to structure:
 - relative position of components (method and equipment for checking, measurements and areas for performing measurements);
 - adjustment and pre-attachment devices (types, application, quantity, clearance and dimensions);

- h) types of scaffolds, stairways, ladders and elevators (installation, inspection and maintenance plan);
- i) general precautions to be taken for welding;
- j) deformation control and correction method;
- k) dimensional control (tolerances, previous study of post-welding contractions, temperature variations, acceptable settling of supports, deformations before, during and after assembly, pre-deformation, axes of sections and inspection plan containing the execution phases).

5.1.4 Load Moving Procedure

It shall be in accordance with PETROBRAS [N-1930 and 1965](#), and hoisting devices shall comply with the provisions of ABNT [NBR 8400](#).

It shall contain at least:

- a) scope;
- b) applicable standards;
- c) definitions;
- d) general conditions:
 - machines available;
 - catalogs and tables;
 - accessories used;
 - inspection of machines and accessories;
- e) load moving (rigging) plan;
 - calculation notes;
 - descriptive memorandum covering all phases of load moving.

5.1.5 Dimensional Control Procedure

It shall contain at least:

- a) scope;
- b) applicable standards;
- c) definitions;
- d) components to be inspected;
- e) equipment used and gauges;
- f) method for dimensional examinations of components;
- g) method for dimensional examinations of subsets;
- h) methods for dimensional examinations of structure, covering at least the following points:
 - columns;
 - wind bracing;
 - main beams;
 - trussed beams;
 - lattice girders;
 - floors, bulkheads and other hard panels;
 - stairways and walkways;
 - structural walls;
 - elevations and geometries;
- i) utilization methods of topography equipment;
- j) tolerances;
- k) reports.

5.1.6 Procedure for Receiving, Treating, Preserving and Handling Welding Consumables

It shall contain at least:

- a) scope;
- b) applicable standards;
- c) definitions;
- d) control system for distribution of consumables for welders and welding operators;
- e) requirements from PETROBRAS [N-133](#).

5.1.7 Heat Treatment Procedure

It shall contain at least:

- a) scope;
- b) applicable standards;
- c) definitions;
- d) specifications and/or features of heating equipment used: dimensions and capacity;
- e) physical layout of parts under treatment;
- f) method for fixation and removal of thermocouples and area inspection after removal;
- g) quantity and location of thermocouples of component; drawings with quantity and location of thermocouples, as well as their position regarding the heating and isolating elements between thermocouples - thermocouple/heating elements;
- h) features and materials of thermocouples;
- i) region to be heated and isolated;
- j) method for heat isolation;
- k) method for preparation of parts: locking, supports and removal of heat isolation;
- l) parameters of heat treatments;
- m) records and reports with the results.

5.1.8 Preheating Procedure

It shall be in accordance with PETROBRAS [N-133](#) and shall contain at least the following:

- a) scope;
- b) applicable standards;
- c) definitions;
- d) methods and equipment to be used;
- e) type and composition of fuels and comburentes;
- f) method and extent of verification and measurement of the maximum and minimum temperature limits.

5.1.9 Procedure for Visual and Dimensional Inspection of Welds

This procedure shall contain at least:

- a) scope;
- b) reference standards;
- c) test method;
- d) available condition of surface;
- e) surface preparation method;
- f) surface condition required for testing;
- g) required illuminance;
- h) instruments;
- i) inspection (regarding discontinuities, irregularities to be examined and/or observations to be done);

- j) test sequence;
- k) additional requirements;
- l) methodology of result recording.

5.1.10 Procedure for Additional Filling, Weld Repair and Base Metal

It shall comply with PETROBRAS [N-333](#) and contain, at least:

- a) scope;
- b) applicable standards;
- c) definitions;
- d) methods and equipment for additional filling;
- e) method for removal of defects:
 - inspection and non-destructive testing phases;
 - limits regarding dimensions of defects to be repaired, type of defects, positions, finishings;
 - methods to remove metal from the defect region;
- f) welding procedure of the executing company, if applicable;
- g) final inspections (non-destructive tests);
- h) maximum number of repairs in the same location.

5.2 Foundations for Assembly of Structures

5.2.1 The design of foundations for the assembly stages shall be in accordance with ABNT [NBR 6118](#), [NBR 6122](#) and [NBR 9062](#).

5.2.2 Land preparation and the construction of reinforced concrete foundations and structures (blocks and loading strips) shall be in accordance with PETROBRAS [N-1644](#).

5.2.3 Provision shall be made for a settling control and compensation system during assembly.

5.3 Definitive Foundations

5.3.1 Land preparation and the construction of reinforced concrete foundations and structures shall be in accordance with PETROBRAS [N-1644](#), ABNT [NBR 6118](#) and ABNT [NBR 6122](#).

NOTE Base dimensions shall be in accordance with the structure foundation drawing and be recorded on the base conformity certificate as per 5.3.6.

5.3.2 Anchor bolts shall be in accordance with PETROBRAS [N-134](#) and the following tolerances:

- a) diameter: see ASME code [B1.1](#);
- b) thread length: shall not be shorter than that specified in the foundation design;
- c) thread condition: shall not present cracks and dents or corrosion preventing nut movement;
- d) temporary corrosion protection shall be provided for anchor bolts after their installation.

5.3.3 The relative position of anchor bolts on the base shall comply with the tolerances specified in PETROBRAS [N-134](#) and [N-1644](#).

5.3.4 Marking of axes and elevations on bases shall be made.

5.3.5 Base leveling shall be performed by placement of shims. Shims shall be sized and spaced in such a way as to support the structure, according to the following requirements:

- a) a tolerance of approximately ± 1 mm relative to the design elevation shall be adopted for the elevation;
- b) shims shall be totally contained within the support area;
- c) the maximum height of the shim (metal plus mortar) shall be 5 mm above the height specified in the design;
- d) the minimum width of the shim shall be 50 mm;
- e) the minimum length of the shim shall be 100 mm;
- f) after placing the base plate of the structure and shims, there shall be enough space for grouting.

5.3.6 The base conformity certificate shall contain records of:

- a) coordinates;
- b) elevation;
- c) dimension;
- d) relative position between anchor bolts and base;
- e) leveling.

5.3.7 Grouting shall be performed in accordance with the conditions established in PETROBRAS [N-1644](#).

NOTE Grouting of bases shall only be performed after correcting the plumb line and column alignment and after final tightness of bolts.

5.4 Receiving, Identification and Storage

5.4.1 The materials and structural components delivered at the work sites shall be received by dimensional control inspectors, specialized in boilermaking, and qualified as per ABNT [NBR 15523](#).

5.4.2 Structural components and materials shall be inspected according to the following requirements:

- a) all materials and components shall be checked in accordance with 5.8.4;
- b) all plates, profiles and pipes shall be in accordance with 5.8.4 and 5.8.5;
- c) components received shall be subjected to a dimensional inspection in accordance with 5.10;
- c) chamfers received shall be subjected to a visual dimensional inspection in accordance with 5.8.7;
- e) factory welded joints shall be subjected to a visual-dimensional inspection in accordance with 5.8.9 and to verification of reports of applicable inspections;
- f) it shall be checked whether the components were subjected to the NDTs expected to be performed.

5.4.3 The plates, profiles or pipes shall not present dents, burrs or knurling or cracking edges.

5.4.4 All structure components shall be numbered and marked in accordance with the identification system established in the manufacturing procedure. The identification shall coincide with the numbering adopted in the material certificates and certified manufacturing drawings.

5.4.4.1 Whenever possible, identification shall be made by using a punch with rounded tips.

5.4.4.2 The identification area shall be covered with varnish so that the marking is maintained until the structure is used and demarcated with ink with a color contrasting with the base material, ensuring its identification. In case the component is painted immediately after marking and the painting allows the identification to be read, varnish may be dispensed with.

5.4.4.3 The identification shall be arranged in such a way that the digits are contained within a rectangle not larger than 250 mm x 300 mm and not smaller than 120 mm x 200 mm.

5.4.4.4 Every material with specified minimum flow limit greater or equal to 345 MPa (50 ksi), for example, the material ASTM A 131 Grade AH36, shall be directly supplied by the metallurgical plants, together with presentation of certificates, or by official representative companies of the metallurgical plants, with presentation of certificates where it is clearly included that those representatives are customers of the manufacturers. The certificates shall be mentioned on suppliers' invoices and shall have traceability with respect to its invoices, by means of copy control, with a stamp containing the following: No. and date of the invoice, supplier signature and No. of purchase order. The supplied materials not complying with the minimum conditions aforesaid shall not be accepted by PETROBRAS.

5.4.5 All materials received shall be identified and this identification shall be checked considering:

- a) plates, seamless pipes or rolled profiles: factory material certificate;
- b) welded profiles and pipes: manufacturing certificate;
- c) materials subjected to galvanization shall comply with the requirements of ASTM [A143/A143M](#).

5.4.6 Unloading and handling of components shall be made without causing damage thereto. Direct contact of wire ropes with painted components shall be avoided. This contact is not allowed for galvanized components.

5.4.7 Painted components shall present the general painting conditions set out in [PETROBRAS N-13](#).

5.4.8 Welding consumables shall be inspected upon receipt and stored in accordance with [PETROBRAS N-133](#).

5.4.9 For storage of materials (plates, profiles, pipes and structure components) outdoors, care shall be taken to avoid buckling due to improper positioning, insufficient shoring, or puddles.

NOTE If the storage period is greater than 3 months the materials shall be transferred to sheltered locations or be painted or coated with anticorrosive protection.

5.4.10 Materials cannot be stored in direct contact with the ground. Suitable shims shall be used at a minimum distance of 300 mm from it.

5.4.11 Galvanized or painted pipes and profiles shall be stored in such a way as to avoid damages to the protective layer.

5.4.12 Plates shall be stored one on top of the other with a distance on their edges to facilitate handling. This distance shall be protected with waterproof product. Plates shall be stored unleveled, in order to make the water flowing easier, and on ground covered with crushed stone.

5.4.13 Storage of pipes in an uncovered area shall be in accordance with PETROBRAS [N-2719](#).

5.4.14 All certificates for materials and welding consumables shall be evaluated and formally accepted by a level 2 welding inspector.

5.5 Welding

5.5.1 Requirements not covered by this Standard and by PETROBRAS [N-133](#) shall comply with AWS [D1/D1.1M](#).

5.5.2 Welding procedures shall be prepared and qualified in accordance with PETROBRAS [N-133](#) and AWS [D.1.1/D1.1M](#), and such qualification shall have been witnessed by a Level 2 welding inspector.

5.5.3 Welders and welding operators shall be qualified by the party performing the work (PETROBRAS department or contracted company), in accordance with PETROBRAS [N-133](#) and AWS [D1.1/D1.1M](#).

5.5.4 Welding inspectors shall be qualified in accordance with ABNT [NBR 14842](#).

5.5.5 Preheating and interpass temperatures, as well as their controls, shall be in accordance with the provisions of PETROBRAS [N-133](#).

5.5.6 Temporary welds and spot welding shall follow the requirements of PETROBRAS [N-133](#) and the following conditions:

- a) weld nuggets shall be, at least, 50 mm long and there shall be as many of them as necessary for the interval between those nuggets to be 400 mm at most;
- b) for weld nuggets that can be removed by gouging, an examination shall be made on the spot by liquid penetrant or magnetic particles;
- c) the weld nuggets to be incorporated into the butt welds shall be ground and visually inspected;
- d) all auxiliary assembly devices shall be removed after completion of the assembly work; the precautions for removing the auxiliary assembly devices are those recommended by PETROBRAS [N-133](#).

5.5.7 Welded joints shall be marked in accordance with PETROBRAS [N-133](#).

5.5.8 Welds shall not be interrupted before at least 25 % of the cross-sectional area of the joint has been completed.

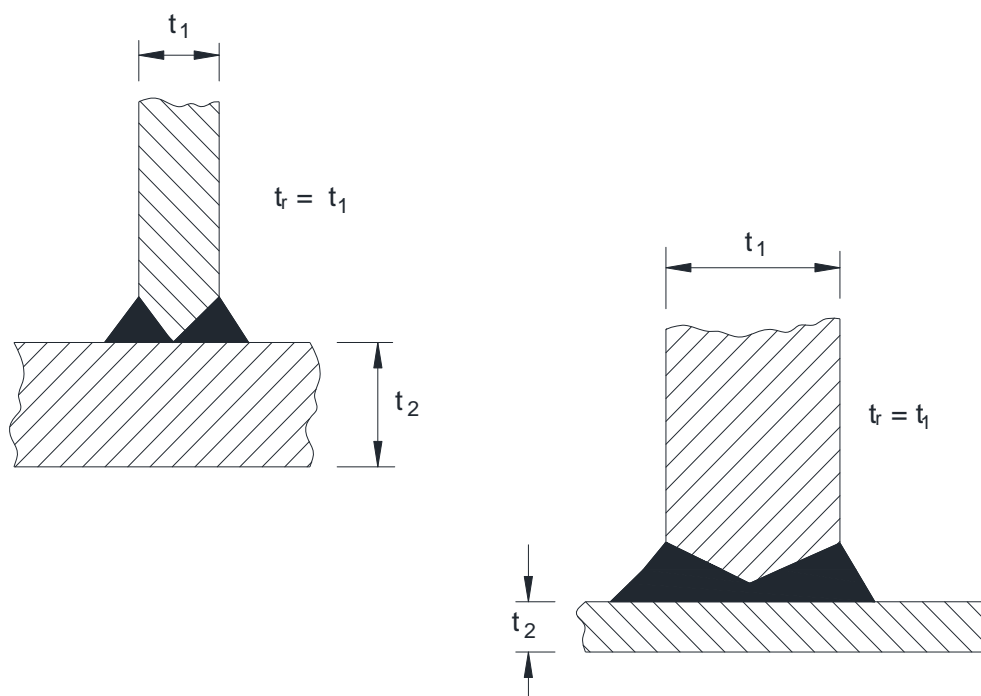
5.5.9 Gouging operations, even when not applied to repairs, shall be entirely polished and inspected by visual inspection and penetrating liquid or magnetic particles testing.

5.5.10 Spot welding and welding may only be started when the IEIS is issued, in accordance with PETROBRAS [N-2301](#).

5.6 Post Weld Heat Treatment

5.6.1 The post weld heat treatment shall be performed in the following situations:

- a) strain rates in the manufacturing process exceeding the following limits according to the steel employed:
 - 5 % for fully aluminum-killed steels (Al content > 0,015 %, soluble);
 - 4 % for silicon-killed steels (minimum Si content > 0,15 %);
 - 2 % semi-killed steels;
- b) butt welded or fillet joints, with total penetration, with reference thickness greater than 63 mm or fillet joints T,K and Y with total penetration, with reference thickness greater than 38 mm (see Figure 1);
- c) when specified by the design.



t_r = Reference thickness

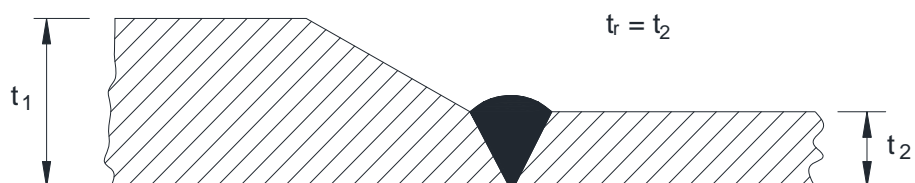


Figure 1 - Reference Thickness

5.6.2 NDTs of the parts to be heat treated shall be carried out before heat treatment.

5.6.3 The magnetic particle test shall be done after the heat treatment.

5.6.4 When repair work is required after the heat treatment, it shall be repeated when the repair depth exceeds 51 mm;

5.6.5 The post weld heat treatment shall meet the following requirements:

- a) AWS [D1.1/D1.1M](#);
- b) heat treatment in furnace shall be used whenever possible;
- c) heat across both sides shall be used whenever possible;
- d) before starting any heat treatment check the calibration records of thermocouples and recording pyrometers;
- e) temperatures shall be controlled by thermocouples in contact with the part being treated; a sufficient number of thermocouples shall be used to ensure the temperature ranges and gradient limits specified, so as to minimize the risk of deformations and/or stresses resulting from the heat treatment;
- f) the temperatures indicated by the thermocouples shall be continuously recorded on graphs during the entire treatment;
- g) when local heat treatment is applied, an area, at least, five times the reference thickness of the material on each side of the weld shall be kept at the specified temperature for the specified time period;
- h) the heated area shall be isolated so that the temperature of the material at the end of the insulation does not exceed 300 °C;
- i) heat treatment is forbidden on parts whose weights cannot be relieved; for example: legs of platforms, towers and columns in general.

5.7 Fabrication and Assembly

5.7.1 After tracing and cutting, the identification of the plates and marking of the rolling direction of the parts and leftover materials shall be transferred.

5.7.2 Chamfer discontinuities as well as rolling discontinuities shall be analyzed and evaluated according to AWS [D1.1/D1.1M](#).

5.7.3 The thickness transition for butt joints shall comply with AWS D1.1/D1.1M.

5.7.4 The dimensions of the chamfer of components shall comply with the conditions specified in [AWS D1.1/D1.1M](#), with due observance of the tolerances specified in that standard.

5.7.5 The parts to be coupled shall be fully inspected and approved in the applicable NDTs, in accordance with Table 5.

5.7.6 The fine adjustment devices used in the coupling between components shall not introduce stresses at the structure.

5.7.7 Chamfers affected by surface damages shall be repaired by grinding or welding and for performing repairs, the parts shall be placed away or removed from the coupling point.

5.7.8 The assembly and welding sequence shall be such as to minimize deformations. The assembly sequence shall be contained in the assembly procedure, as described in 5.1.3.

5.7.9 For the additional weld filling ("build up") to be possible, the root opening shall not exceed 20 mm or twice the thickness of the thinnest plate, whichever is smaller.

NOTE Filling shall be made with the pieces uncoupled and chamfers shall be reconstructed and inspected by NDTs with magnetic particles or penetrating liquid.

5.7.10 The locations of the structure where components or subsets are to be set up shall be previously checked as to the dimension and leveling, finishing, approval in NDT and repairs and guides for coupling.

5.7.11 Before coupling the actual lengths of each component, the relative positions of welds and other changes in the conditions of the component shall be checked and recorded.

5.7.12 No butt joints other than those specified in the design are permitted. Joints for utilizing leftovers from components will only be permitted if the requirements set forth in PETROBRAS [N-279](#). These joints shall fall into inspection level 1 as defined in Annex A of this Standard, unless another inspection level is specified by the designer. Typical detailing of the joint shall be defined by the designer.

5.7.13 The adjustment tolerances of the fillet joint root opening on pieces to be welded with fillet weld shall be considered and added to the dimensions of the weld legs determined on project.

5.7.14 The axis of the parts and the project "North" direction shall be indicated for all columns, beams, trusses and wind-bracing. On parts where inverted assembly is possible, the top region of the parts shall be indicated.

5.7.15 The alignment and plumb line of the columns of bases of equipment shall be adjusted by means of metallic shims placed underneath the base plate of columns and checked by means of topography instruments.

5.7.16 The dimensional repair of components shall be made in the cold state whenever possible..

NOTE Whenever localized heating is used, the local temperature of the component shall not exceed 550 °C.

5.7.17 The alignment of the cross-sections for butt joints shall be in accordance with AWS [D1.1/D1.1M](#).

5.8 Inspection

5.8.1 NDT inspectors and operators shall be qualified according to ABNT [NBR NM ISO 9712](#).

5.8.2 Level 1 and 2 dimensional control inspectors shall be qualified in accordance with ABNT [NBR 15523](#). In case of Level 2 dimensional control inspectors, qualification is required based on a specific training program for categories boilermaking and industrial topography, as applicable.

5.8.3 Inspection by means of NDT shall be according to qualified procedures and the following standards:

- a) ultrasound (as per PETROBRAS [N-1594](#) for thickness measurement and as per AWS [D1.1/D1.1M](#) for weld inspection);
- b) X-ray (as per PETROBRAS [N-1595](#));
- c) liquid penetrant (as per PETROBRAS [N-1596](#));
- d) visual (as per PETROBRAS [N-1597](#));
- e) magnetic particles (as per PETROBRAS [N-1598](#)).

5.8.4 For pipes with an external diameter smaller than 400 mm (16") the tolerances to be used shall be those specified in ASTM [A500/A500M](#) or ASTM [A 501](#), respectively, for cold or hot formed pipes.

NOTE For pipes with an outside diameter equal to or larger than 400 mm (16"), the dimensions shall comply with the tolerances of API [Spec 2B](#).

5.8.5 The surfaces of chamfers shall be smooth and uniform, with no deep grooves and shall be inspected in accordance with AWS [D1.1/D1.1M](#).

5.8.6 Welds shall be dimensionally inspected in order to check the shape, dimensions and alignments according to AWS [D1.1/D1.1M](#).

5.8.7 Weld inspection shall be performed in accordance with AWS [D1.1/D1.1M](#), with the acceptance criteria for structures subjected to static and dynamic loads, as applicable.

5.8.8 The extent of the weld inspection as well as the acceptance criterion shall be in accordance with 6.1.1 and 6.3.2.

5.9 Dimensional Control

Dimensional tolerances shall be in accordance with the tolerances values established by the design or, in the absence of the latter, the values described in 5.9.1 and 5.9.2 shall be used.

5.9.1 The dimensions of panels shall be within the tolerances established by Figure 2 of this Standard.

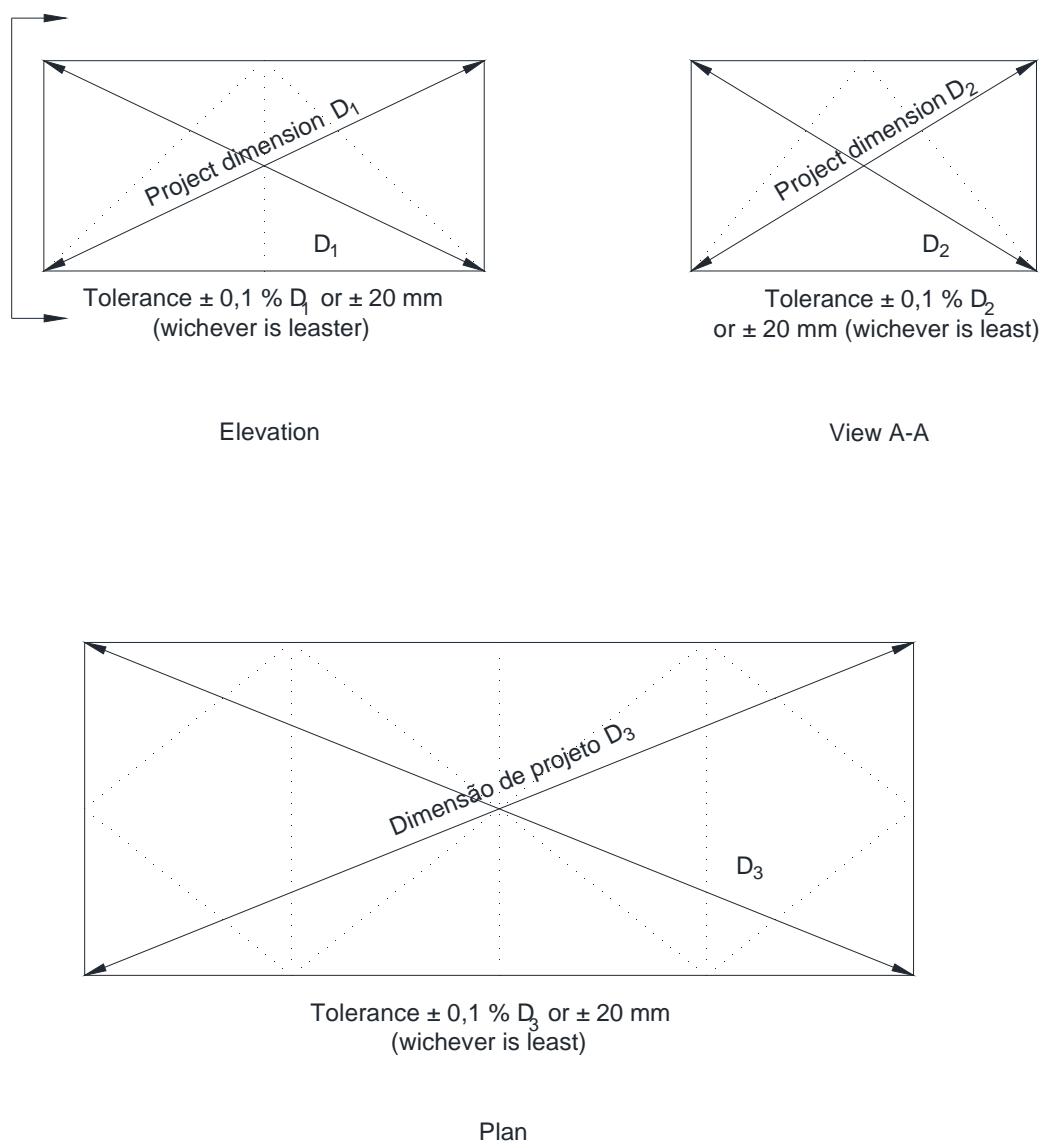


Figure 2 - Dimensional Tolerances

5.9.2 For prefabricated tubular ties, the tolerances shall be in accordance with the information below.

5.9.2.1 After welding, the tie shall comply with the tolerances in Figure 3. For ties manufactured in site (full assembly, no pre-fabrication), only the work points shall be controlled.

5.9.2.2 At the end of each member, after assembly and welding, measurements of perimeter and out of roundness shall be made. Such measurements shall be within the tolerances provided in this Standard.

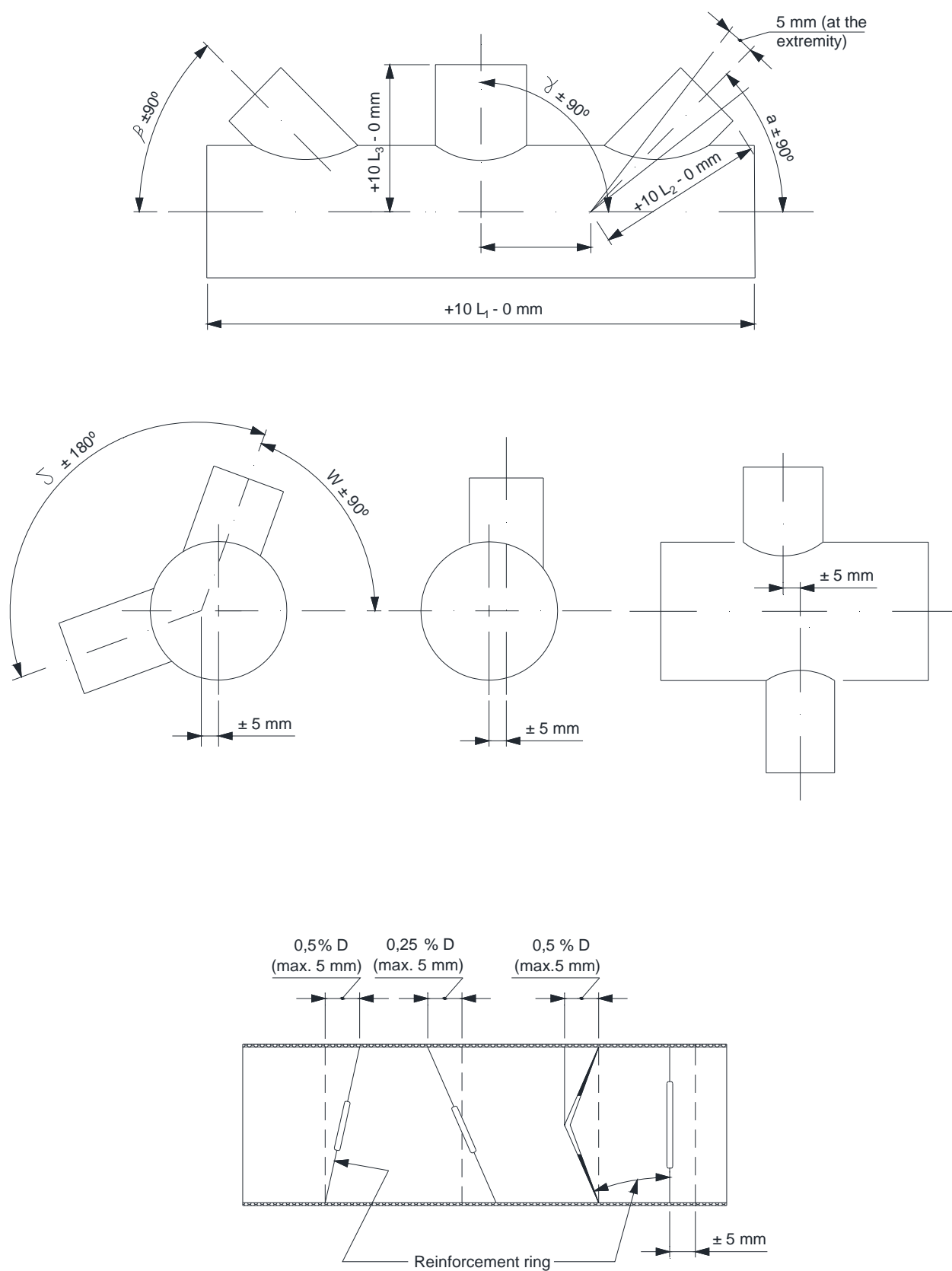


Figure 3 - Dimensional Tolerances in Tie

5.9.3 For leveling of floors, the maximum difference between the level of any of the points is 12 mm measured on the crossings of the main beams (see Figure 4).

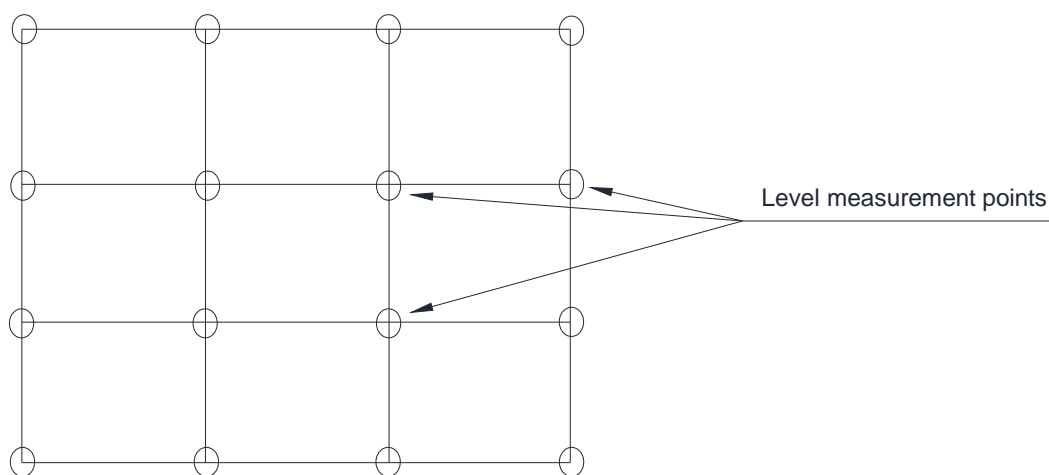


Figure 4 - Level Measurement Points of Floors

5.9.4 For longitudinal and cross reinforcements, the dimensional tolerances shall comply with Tables 1 and 2, respectively, and with Figure 5.

Table 1 - Tolerance for Longitudinal Reinforcements in Profiles

Type	Rating	Reference elevation	Tolerance %
Normal deflection to beam core	f1	Lo	± 0.30
Parallel deflection to beam core	f2	Lo	± 0.30
Rotation	R	b	± 1.5
Position deviation	V	h	± 1.0
NOTE If there are different elevations (Lo, b or h), the lowest value of each case shall be adopted as reference elevation.			

Table 2 - Tolerance for Cross Reinforcements in Profiles

Type	Rating	Reference elevation	Tolerance %	Maximum value (mm)
Normal deflection to beam core	f1	h	± 0.30	-
Parallel deflection	f2	h	± 0.30	-
Rotation	R	b	± 1.5	15
Position deviation	V	Lo	± 1.0	15
NOTE If there are different elevations (Lo, b or h), the lowest value in each case shall be adopted as reference elevation.				

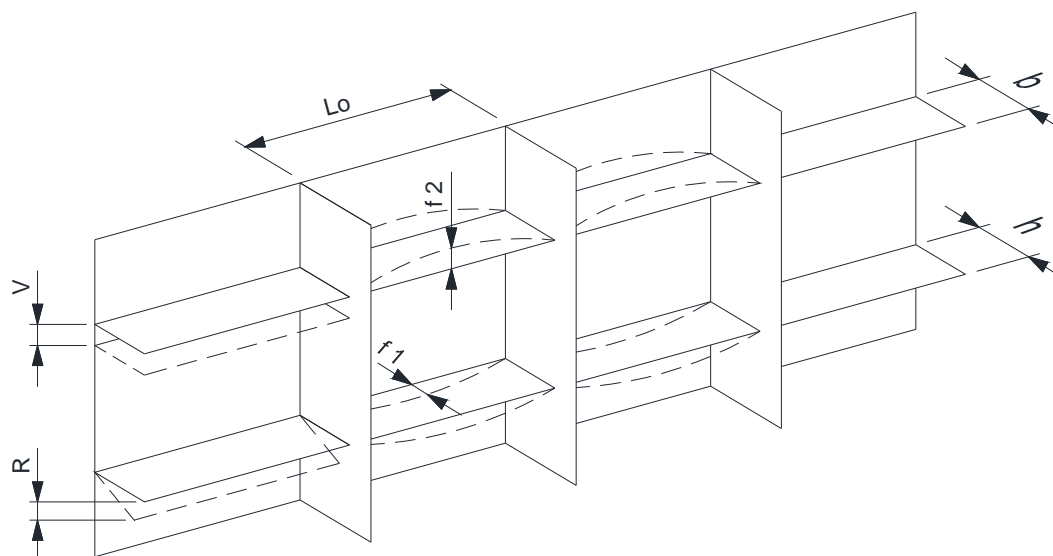


Figure 5 - Cross and Longitudinal Reinforcements in Profiles

5.9.5 Conventional accessibility structures shall be within the following tolerances:

- elevation of platforms: ± 12 mm of the design specification;
- the vertical and horizontal distance between stairway steps shall be between ± 12 mm of the design specification (see Figure 6);
- the difference in elevation of the plating or grating on splices shall not exceed 2 mm;
- misalignment in the cross-shaped joints: $m = t/2$, maximum 8 mm where "t" is the smallest thickness of non-continuous plates;
- the tolerance for deformations for the plating is 20 mm of the maximum deflection measured with 1 000 mm gauge.

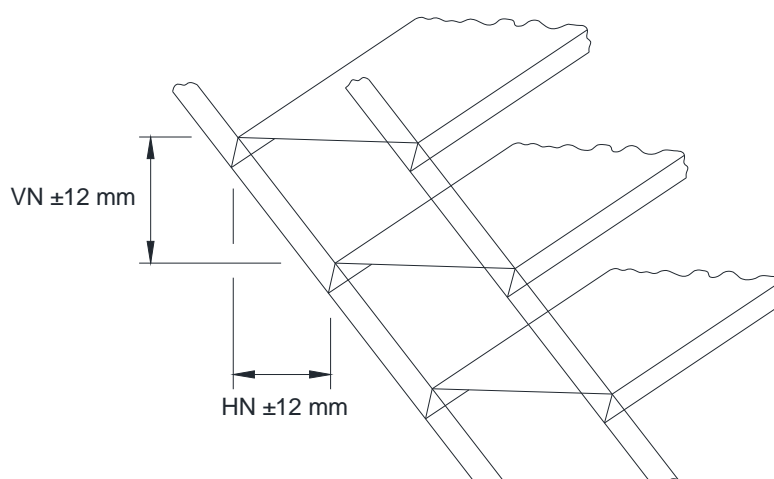


Figure 6 - Stairway Tolerance

6 Specific Conditions

6.1 Conventional Welded Structures - Inspection

The extent of NDTs shall follow the recommendations in this Standard or in the design, in case the latter is stricter.

6.1.1. All welds shall be visually inspected according to AWS [D1.1/D1.1M](#).

6.1.2 Welded joints of conventional accessibility structures shall be inspected in accordance with Table 3. The acceptance criterion shall be that specified for structures subjected to static loads of AWS [D1.1/D1.1M](#).

Table 3 - Type and Extent of NDT for Conventional Welded Structures for Accessibility

Joint	Thickness	NDT	Extent
JTPT JASA JAPT	Any	Magnetic particles or liquid penetrant	5 %
		Visual	100 %
<p>NOTE 1 The tests extension indicated on this Table shall be applied to each lot of welded joints inspection of the structure. For fillet joints, the set extension for the tests shall be applied to each side of the joint. For inspection effects, it is understood that the lot is formed by the joints already welded as similar geometry (JTPT, JASA, or JAPT), performed by a welder and a welding operator in common.</p> <p>NOTE 2 When the inspection of a welded joints lot in which is specified partial extension of a NDT disclose defects, 2 other regions of the same lot, performed by a welder and a welding operator in common, shall be examined, each one with its original extension. If in the additional two tests no defects are disclosed, the lot can be accepted after repairing and testing of the repaired region. If one of the two additional exams disclose defects, 2 other regions of the same lot shall be examined per each defective region, performed by a welder and a welding operator in common, each one with its original extension, and thus successively until the approval or inspection and total repair of the lot.</p>			

6.1.3 Welded joints of pipes or profiles of supporting metallic structures shall be inspected according to Table 4.

Table 4 - Type and Extent of NDT for Conventional Welded Structures for Support

Joint	Thickness	NDT	Extent
JTPT	< 6 mm	X-ray	10 %
		Magnetic particles	20 %
		Visual	100 %
	≥ 6 mm	X-ray or ultrasonic	10 %
		Magnetic particles	20 %
		Visual	100 %
JASA	Any	Magnetic particles	20 %
		Visual	100 %
JAPT	Any	Ultrasonic	20 %
		Magnetic particles	50 %
		Visual	100 %

NOTE 1 The extension of the tests indicated on this Table shall be applied to each welded joint of the structure and shall include, for each joint, all the welders and welding operators involved in its execution. For fillet joints, the set extension for the tests shall be applied to each side of the joint.

NOTE 2 When the inspection of a welded joints lot in which is specified partial extension of NDT disclose defects, two other regions of the same lot, adjacent or not, at the discretion of PETROBRAS, performed by a welder and a welding operator in common, shall be examined, each one with its original extension. If in the additional two tests no defects are disclosed, the lot can be accepted after repairing and testing of the repaired region. If one of the additional two exams shows defects, the entire welded joint by the welder or welding operator shall be tested.

NOTE 3 When the inspection of a welded joint in which is specified partial extension of a NDT disclose severe defects graves, such as cracks and other planar defects or dross inclusions aligned in a three times higher amount than the maximum limit allowed by the applicable acceptance criteria, all the welds performed using the same welding procedure shall be tested in its entire length until characterization of the period in which there are no longer defects reported. Once this last period is determined, the inspection can return to its execution in the extension set on this Table.

6.2 Bolted Conventional Structures

6.2.1 Receiving Inspection

6.2.1.1 It shall be checked whether all bolts and nuts lots are identified with the following characteristics: specification, thread type, nut type, bolt type, dimensions and quantities.

6.2.1.2 The material quality certificates for all lots of bolt and nuts shall be checked against the applicable ASTM specifications.

6.2.1.3 The following characteristics of nuts and bolts shall be checked by sampling (see 6.2.1.4) in each lot to verify if they are in accordance with the design and specifications adopted:

- a) ASTM symbol stamped on bolt and nut;
- b) bolt length;
- c) bolt and nut diameter, according to ASME code [B1.1](#);
- d) height and distance between faces and edges of nut and bolt head, according to ASME codes [B18.2.1](#) and [B18.2.2](#);
- e) thickness, and internal and external diameters of washers;
- f) thread type and pitch;
- g) general conditions regarding dents, crack, corrosion and general finishing and protection (see 6.2.1.5).

6.2.1.4 The sampling plan shall be in accordance with ABNT [NBR 5426](#) and shall have the following characteristics:

- a) single sampling;
- b) inspection level II;
- c) consumer risk 10 %;
- d) limit quality 10 %.

6.2.1.5 Threads shall not present cracks and dents or corrosion preventing the movement of the nut in relation to the bolt.

6.2.1.6 Bolts, nuts, rivets and washers shall always be stored at a sheltered location. Bolts and nuts shall be protected against corrosion by means of greases or other appropriate components.

6.2.1.7 Dimensional limits for the drilling process for bolt application shall be in accordance with ABNT [NBR 8800](#).

6.2.2 Documentation

The assembly procedure shall contain, besides the provisions in 5.1.3, the following data:

- a) bolt tightening tools and devices (type, calibration);
- b) bolt tightening sequence;
- c) application (or control) method of the pretension force of bolts (see Notes 1 and 2).

NOTE 1 The methods specified in ABNT [NBR 8800](#) are permitted (nut turning method, method using a calibrated wrench or manual wrench with a torque meter or direct tension indicator method);

NOTE 2 When the method using a calibrated wrench or manual wrench with a torque meter is adopted, the method for experimentally determining the torque shall be presented.

6.2.3 Assembly

6.2.3.1 The inclination of the surface of the parts in contact with the heads of bolts and nuts in relation to the plane perpendicular to the axis of bolts shall be smaller than 1:20. For inclinations greater than 1:20, chamfered or wedge washers shall be used.

6.2.3.2 In the case of structures with bolted connections, the following shall be observed:

- a) the type of holes and the tolerance at the position of the holes shall be strictly in accordance with the design;
- b) out of roundness of the holes by any process for axes to coincide is not permitted; holes at a wrong position shall be completely closed with weld, using a qualified procedure, and reopened by an adequate process;
- c) bolts may not be replaced with other ones smaller in diameter, even if the other material has a higher mechanical resistance, and with or without washers;
- d) bolts and nuts on the legs of angle bars and rolled shapes shall necessarily have chamfered washers.

6.2.3.3 In case high resistance bolts are used, the provisions in ABNT [NBR 8800](#) and AISC [348](#) shall be followed as well as the following conditions:

- a) bolts that have been removed from joints after tightening torque shall not be used;
- b) contact surfaces shall be free from paint, oil and grease;
- c) the specified torque shall be used; the daily experimental determination of the torque to be used is obligatory, using the methodology set on AISC [348](#), not being allowed the use of torque values obtained from tables, abacuses or calculations.

6.2.3.4 The final bolt tightening shall only be made after checking the correct position of the parts by dimensional inspection.

6.2.3.5 Bolt tightening shall be performed using appropriate tools, and the use of extension or other resources causing excessive tightening is not permitted.

6.2.3.6 The tightening sequence shall be established from the most rigid parts to the free parts.

6.2.3.7 The tightening sequence shall be repeated as many times as necessary until the tightening of all coupling bolts reaches the specified torque.

6.3 Metallic Structures of Modules, Auxiliary Structures of Platforms and Vessels

6.3.1 Welding

6.3.1.1 The joints to be welded shall be sequentially numbered, in order to allow the joints traceability on the inspection reports.

6.3.1.2 The welding repairs shall be made using the welding procedure, as per 5.5.1. In cases that an impact test is required, a maximum of two repairs can be performed in a common part of the joint.

6.3.1.3 After repair, the NDTs shall be performed in the entire repaired area, increased 25 mm from each end.

6.3.1.4 Production tests shall be done according to PETROBRAS [N-1852](#) procedure.

6.3.2 Inspection of Welded Joints

6.3.2.1 All welds shall be entirely inspected by a visual examination. For the other NDTs, the selection shall be made consonant to the inspection level, as set forth on Table 5. The extent of the tests shall be in accordance with Annex A of this Standard.

Table 5 - Inspection Levels

Inspection level	Structures of modules and auxiliary elements of platforms	Naval structures
I	<ul style="list-style-type: none"> - any lifting eyes; - columns, bracings of fixed platforms; - life boat davits; - crane pedestal; - intersection of level II and III inspection components and accessories with level I inspection accessories. 	<ul style="list-style-type: none"> - any lifting eyes; - columns, bracings and main decks of floating platforms, jack-ups, FPSOs and FSOs; - intersection of level II and III inspection components and accessories with level I inspection accessories.
II	<ul style="list-style-type: none"> - other structures defined as auxiliary and pertaining to modules, framework, and floors of decks other than the main deck; - plating (when not considered as the main structure); - intersection of level III inspection components and accessories with level II inspection accessories. 	<ul style="list-style-type: none"> - beams and floors of decks other than the main deck; - plating (when not considered as the main structure); - main structures of buoys and single point moorings; - intersection of level III inspection components and accessories with level II inspection accessories.
III	<ul style="list-style-type: none"> - all other components not included in levels I and II. 	<ul style="list-style-type: none"> - all other components not included in levels I and II.

6.3.2.2 The acceptance criteria for of discontinuities detected through the NDT shall be the one specified in [D1.1/D1.1M](#), for statically or dynamically loaded structures, as applicable.

6.3.2.3 For ultrasonic testing the criterion for acceptance of discontinuities in PETROBRAS [N-1852](#) shall be used.

6.3.2.4 All heat treated joints shall be totally inspected by magnetic particles after the treatment.

6.3.2.5 After repair, the extent of the NDTs shall be increased by 25 mm from each end.

6.3.2.6 Conventional structures within the modules and auxiliary ones shall follow the acceptance criterion specified in 6.3.2.2 and 6.3.2.3.

6.3.3 Manufacturing and Assembly

6.3.3.1 The manufacturing and assembly of pipes and structural profiles, ties and other welded components shall follow the provisions of PETROBRAS [N-1852](#).

6.3.3.2 In tube joints the window opening technique shall not be used on the secondary member, it is preferable the use of nipples, consonant to the assembly limits of PETROBRAS [N-279](#).

6.4 Steel-Deck Slab

6.4.1 Receiving, Identification and Storage at the Job Site

6.4.1.1 The steel deck shall be supplied in bundles, with materials firmly banded, so as to prevent vibration during transportation which might cause dents on the parts.

6.4.1.2 Upon arrival of the materials at the job site, the person responsible for unloading shall check the identification tags of the bundles as well as the number of parts and thickness of the steel deck.

6.4.1.3 A visual inspection shall be carried out, to guarantee that no panel is damaged and only after such check material can be received at the work site.

6.4.1.4 During hoisting, in order for materials not to be dented and for bands not to be ripped, it is recommended that a wooden or rubber protection be used, so that the bands are not in direct contact with the steel deck. The distance between bands should be 3.50 m or smaller. All necessary precautions shall be taken to prevent the steel deck and metal parts from bumping into each other during handling. **[Recommended Practice]**

6.4.1.5 After lifting the bundles, the steel deck shall be positioned over the steel beams of the structure. If the structure is not ready to receive the panels, the latter shall be temporarily stored in piles at a location previously determined by the supervisor, with due care being taken to prevent accumulation of water in the panels, with the possibility of "white rust" occurring on the galvanized material.

6.4.1.6 Temporary storage shall be in a dried, covered location, with small temperature variations and protected from moisture, and the following conditions shall be considered:

- a) the piles shall be positioned on wooden or steel "beds" so as to prevent direct contact between the steel deck and the floor. As a precaution, the piles shall be inclined so as to ensure water flow in case of accidents. It is also necessary to leave space between the bundles of steel deck so as to allow ventilation and avoid possible condensation of water between panels;
- b) even if the material is packed it is essential that the piles be covered with an impermeable canvas;
- c) it is essential that the steel deck be prevented from being wetted. If that occurs, the piles shall be provisionally unmade and all the material shall be manually dried;
- d) temporary storage of galvanized material at the job site shall not occur for more than 30 days. During this storage period load shall not be placed under any circumstances whatsoever over the steel deck piles.

6.4.2 Installation, Assembly and Concreting

6.4.2.1 Before the materials begin to be installed, the detailed design drawings shall be available to the assembly team, with the geometry, paging and attachment details of the parts.

6.4.2.2 During assembly, the information described on the paging drawings shall be strictly followed.

6.4.2.3 Upon completion of assembly of the beams of the structure, the steel deck and its accessories may begin to be installed, with the top of the steel beams leveled, dry and free from dirt or rust. **[Recommended Practice]**

6.4.2.4 For welding stud-bolt type shear connectors, the upper face shall be without painting for the welding process not to be adversely affected.

6.4.2.5 After checking that the beams of the structure are according to the leveling and cleaning conditions, the bundles of steel decks may be opened so that assembly services can be started. **[Recommended Practice]**

6.4.2.6 After opening the bundles, the individual panels shall be manually removed and positioned on the metal beam, according to the elevations and measures indicated on the paging drawing. Cuts at the ends of panels at corners or contour may be occasionally necessary to allow for final adjustment of the geometry of the structure. If necessary, these cuts may be performed by using machines with metal cutting disks.

6.4.2.7 After adjustment and alignment, the panels shall be attached to the structure. It is important that at the end of the work day no steel deck panel is left over the structure without preliminary attachment and that all opened bundles be tied up again.

NOTE It is recommended that in the beginning, a preliminary attachment of rivets is made and, subsequently, in order to ensure locking of support beams, the panels shall be definitively attached by electrical welding. **[Recommended Practice]**

6.4.2.8 Definitive attachment of the steel-deck to the structure shall be made by plug weld. Each of these weld nuggets shall be performed according to the recommendations of the steel deck manufacturer and design drawings.

6.4.2.9 Provision shall be made for assembly and welding of the steel deck complements deemed necessary and usually adopted for this type of structure, such as: finishing details on slab, lateral closing, etc., as indicated by the steel deck manufacturer.

6.4.2.10 During and after the assembly of the panels, it is not recommended to store materials on the platform. Only equipment needed for assembly, such as welding machines or electrode drums, shall be positioned on the platform.

6.4.2.11 Wooden plates shall be used to distribute the weight of equipment on the steel deck, thus avoiding localized damages. **[Recommended Practice]**

6.4.2.12 Shear connectors shall be applied after the steel deck has been assembled and shall be attached to the beams through the low waves of the panels according to the location of the connectors specified on design drawings.

6.4.2.13 For the quality of the weld of stud bolts not to be jeopardized, it is recommended that connectors be applied right after assembly of the steel-deck. It is also recommended that, at the end of the work day, all connectors corresponding to the regions with steel deck already assembled be applied. **[Recommended Practice]**

6.4.2.14 Provision shall be made for installation of stud bolts, all devices and equipment needed for welding within the safety and quality criteria required for this type of work.

6.4.2.15 In case it is not possible to pump concrete, vertical transportation of aggregates, cement and additives needed for making the slab shall be carried out by vertical hoisting with bags with a capacity of up to 1 200 kg.

6.4.2.16 The positioning of the additional reinforcements and welded wire meshes shall strictly follow the provisions on the reinforcement drawings.

6.4.2.17 Prior to concreting the slab, the surface of the steel deck shall be cleaned using water jet and all dirt and impurities that may affect the resistance of the concrete shall be eliminated.

6.4.2.18 Slab concreting shall be performed in such a manner as to prevent accumulation of materials and personnel on the platform. It is not permitted under any circumstances whatsoever to form concrete "lumps" during laying operations. If pouring of concrete has to be interrupted without the surface of the slab having been concreted, it is recommended that the interruption occur outside the support beams, as follows:

- a) on the region on beams perpendicular to ribs: interruption shall occur at a distance equivalent to 1/3 of the span of the panels;
- b) on the region parallel to ribs: interruption shall occur before the axis of the beam, approximately 1 m from its axis;
- c) upon completion of concreting, curing shall be performed similarly to the usual process adopted for solid reinforced concrete slabs.

Annex A - Table
Table A.1 - Extent and Selection of NDTs (Note 1)

Inspection level (see Note 2)	Weld type (see Notes 4 and 8)		Extent of the tests (%) (see Notes 3, 4, 5, 9, 10, 11, 12, 13, 14 and 16)		
			ER (see Note 15)	US	PM (see Notes 6 and 7)
I	Plates and profiles	JASA	-	-	100
		JTPT	-	50	100
		JAPT	-	100	100
	Pipes	JASA	-	-	100
		JTPT longitudinal	5	50	100
		JTPT circular	5	100	100
		Tubular	-	100	100
II	Plates and profiles	JASA/JTPT	-	-/50	50/50
		JASA/JAPT	-	-/50	20/50
	Pipes	JTPT longitudinal	5	20	20
		JTPT circular	5	20	50
		Tubular	-	20	20

NOTE 1 The extent of the tests indicated in the Table is according with the same requirements defined in PETROBRAS [N-1852](#) for deck.

NOTE 2 The extent of the tests indicated in the Table for level I and II Inspection are applicable to each weld. Welds of inspection level III components shall be inspected only by visual testing.

NOTE 3 The extent of tests may be reduced to half in the welds fully performed by an automatic process (submerged arc), except for the welds found on trunks.

NOTE 4 The symbols used have the following meanings:

- a) JASA: fillet joint with fillet weld;
- b) JTPT: full penetration butt joint;
- c) JAPT: full-penetration fillet joint;
- d) ER: radiographic test;
- e) US: ultrasonic test;
- f) PM: magnetic particle test.

NOTE 5 When defects are detected in the inspection of a weld where the partial extent of a NDT is specified, two other adjacent regions of the same weld shall be examined each with the original extent. If damages are not identified in the two additional tests, the weld may be accepted after the original region is repaired and tested. If defects are found in one of the two additional exams, the entire weld shall be tested.

NOTE 6 From the internal side, when there is access, apply the same percentage.

NOTE 7 In regions without access for magnetic particle testing, liquid penetrant may be used.

NOTE 8 Applicable to fillet joints with a fillet weld of pile claws.

NOTE 9 If post weld heat treatment of a welded joint is specified, NDTs, except for radiography, shall be repeated to the same extent indicated in the Table after treatment.

NOTE 10 In the cases of chamfers repair, the surface shall be tested with liquid penetrant on 100 % or by means of magnetic particles (electrode technique).

Table A.1 - Extent and Selection of NDTs (Continued)

NOTE 11	In the case of build-up with weld on the chamfer, the surface shall be tested 100 % with liquid penetrant and ultrasonic testing.
NOTE 12	When partial radiographic testing is required, the two ends shall preferably be examined.
NOTE 13	In locations of level I and level II members, from which provisional welds were removed, a magnetic particle test shall be performed on 100 % of the region after grinding.
NOTE 14	NDTs shall only be applied 24 h after completion of the welds. When post-heat treatment is conducted according to PETROBRAS N-133 , with requirements referring to manganese carbon steel, nondestructive tests may be performed as soon as the part reaches ambient temperature.
NOTE 15	For full penetration joints welded from one side only, without a backing, except for circumferential joints in piles, the nondestructive inspection percentage shall be complemented as follows: <ul style="list-style-type: none"> a) JTPT = 100 % ER; b) JAPT = 100 % US.
NOTE 16	For JTPT where there is access for visual testing from the side of the root of the welded joint and in those cases where there is no access, but the fatigue life of the joint is longer than 100 years, the radiographic test may be replaced with the ultrasonic test. The percentage of the other tests shall be maintained as indicated in the Table.

INDEX OF REVISIONS	
REV. A, B, C, D and E	
There is no index of revisions.	
REV. F	
Affected Parts	Description of Alteration
1.1, 2, 3, 4, 4.2, 4.4, 4.5.1, 4.5.2, 4.8	Revised
Note of item 5.1.3	Eliminated
5.1.5 and 5.1.10	Revised
5.1.11	Included
5.2.2.2	Eliminated
5.3.1, 5.4.1, 5.4.3.4, 5.4.7, 5.6.1 paragraph b), 5.6.2 paragraph b)	Revised
5.6.7	Eliminated
5.6.8 to 5.6.10	Renumbered
Note of items 5.7.3, 5.7.4 and 5.7.6.1	Eliminated
5.7.7	Renumbered
5.7.8	Revised and Renumbered
5.7.9, 5.7.10, 5.7.10.1	Renumbered
5.7.10.2	Revised and Renumbered
Figure 1	Revised
5.7.11 to 5.7.15	Renumbered
5.7.11.2.1, 5.7.12	Included
5.9.2, 5.9.3 paragraph a), 5.9.4	Revised
5.9.7	Eliminated
5.9.8 to 5.9.11	Renumbered
Note of item 5.9.9	Eliminated
Items 5.9.11 and 5.10.3	Eliminated
6.1.1.3.1, 6.1.1.3.2, 6.1.1.4.1, 6.1.1.4.2, 6.1.1.4.3	Included
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6.2.1.7	Renumbered
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