

**REGULATION STANDARD**

**NR - 13**

**BOILERS AND PRESSURE VESSELS**

## NR-13 BOILERS AND PRESSURE VESSELS

### 13.1. STEAM BOILERS - GENERAL

13.1.1. Steam boilers are equipment used to generate and accumulate steam at a pressure higher than the atmospheric pressure, using any source of heat, except reboilers and similar equipment used in process units.

13.1.2. For the accomplishment of this Regulation Standard, it is considered “Qualified Professional” the one who has legal qualification to exercise the engineering profession in the activities related to the construction design code, operational and maintenance examination, inspection and inspection supervision of boilers and pressure vessels, in accordance with the prevailing professional regulation of Brazil.

13.1.3. Maximum Permitted Working Pressure - MPWP or Maximum Allowable Working Pressure - MAWP is the highest pressure value in accordance with the design code, the resistance of the materials used, the equipment dimensions and their operational parameters.

13.1.4. It constitutes a serious and eminent risk the lack of any of the following items:

- a) safety valve with opening pressure set at or below the MAWP;
- b) device that shows the accumulated steam pressure;
- c) injector or other means of feeding water, independent from the main system, for boilers that are fired with solid fuel;
- d) fast water drain system, in recovering alkali boilers;
- e) indicating system to control the level of water or other system that avoids superheating by defective feeding.

13.1.5. Every boiler shall have attached on its body, in a visible and of easy and accessible place, an enduring identification plate with, at least, the following information:

- a) manufacturer’s name;
- b) order number given by the boiler’s manufacturer;
- c) year of fabrication;
- d) maximum allowable working pressure;
- e) hydrostatic test pressure;
- f) capacity of steam production;
- g) heating surface area;
- h) design Code and year of edition.

13.1.5.1. Besides the identification plate there shall be, in a visible place, the boiler category, in accordance with the provisions of 13.1.9 hereto, and its identification number or code.

13.1.6. Every boiler shall have, in the site it has been installed, the following records, duly updated:

- a) a “Boiler Dossier”, having the following information:
  - design Code and year of edition;
  - materials specification;
  - procedures used in the fabrication, assembly, final inspection and determination of the MAWP;
  - a set of drawings and necessary data to follow the service life of the boiler;
  - functioning characteristics;
  - safety devices data;
  - year of fabrication;
  - boiler category.
- b) “Safety Record”, in accordance with the provisions of 13.1.7;
- c) “Installation Design”, in accordance with the provisions of 13.2;
- d) “Changing or Repair Designs”, in accordance with provisions of 13.4.2 and 13.4.3;
- e) “Inspection Reports”, in accordance with provisions of 13.5.11, 13.5.12 and 13.5.13.

13.1.6.1. When nonexistent or lost, the “Boiler Dossier” shall be restored by the owner, with the manufacturer or “Qualified Professional’s” (summoned in 13.1.2) technical responsibility, being indispensable the restoration of functioning characteristics, safety devices data and procedures for MAWP determination.

13.1.6.2. When the boiler is sold or transferred to other site, the records mentioned in “a”, “d” and “e” in 13.1.6 shall follow it.

13.1.6.3. The owner of the boiler shall present, when requested by the appropriate authority of the Regional Labor Department, the records mentioned in 13.1.6.

13.1.7. The “Safety Record” shall be made up of a separate book, with numbered pages, or other similar system where the following will be recorded:

- a) all the relevant events capable to influence on the boiler safety conditions;
- b) the events of periodical and extraordinary safety inspections, containing the legible name and signature of the “Qualified Professional”, summoned in 13.1.2, and the boiler operator present in the event of the inspection.

13.1.7.1. In the event of the boiler is considered inadequate for use, the “Safety Record” shall contain such information and receive a formal conclusion.

13.1.8. The records referred in the 13.1.6 shall be at all times available for the examination of the operators, the maintenance and inspection personnel and the employee and employer representatives at the Accident Prevention Internal Commission, and the owner shall ensure complete access to these records.

13.1.9. For the accomplishment of this Regulation Standard, boilers are classified in three categories accordingly to the following:

- a) category “A” boilers are those which the operation pressure is 1,960 kPa (19.98 Kgf/cm<sup>2</sup>) or higher;
- b) category “C” boilers are those which the operation pressure is 588 kPa (5.99 Kgf/cm<sup>2</sup>) or lower, and the internal volume is 100 liters or lower;
- c) category “B” boilers are all boilers that are out of the previous categories;

### 13.2. INSTALLATION OF STEAM BOILERS

13.2.1. The authorship of the “Installation Design”, as far as this Regulation Standard is concerned, is responsibility of the “Qualified Professional”, as summoned in 13.1.2, and shall obey the safety, health and environment aspects foreseen in the Regulation Standards, agreements and legal arrangements.

13.2.2. The boilers of any enterprise shall be installed in a “Boiler House” or in a specific site for this propose, called a “Boiler Area”.

13.2.3. When the boiler is installed outdoors, the “Boiler Area” shall meet the following requirements:

- a) be at least 3 (three) meters away from:
  - other equipment of the enterprise;
  - fuel storage, except tanks for the startup with up to 2,000 (two thousand) liters of capacity;
  - from the border of third party properties;
  - from the border of public roads.
- b) provide at least 2 (two) wide exits, permanently unblocked and arranged in different directions;
- c) provide an easy and safe access, necessary to the boiler operation and maintenance, taking into account that for vacant guard rails, the gaps shall have dimensions to avoid personnel’s falls;
- d) have captivation and discharging systems for gases and particle matters from combustion to send them out of the operation area, in accordance with the prevailing environment standards;
- e) provide illumination in accordance with the prevailing official standards;
- f) have emergency illumination systems in case of operating at night.

13.2.4. When the boiler is installed indoors, the “Boiler House” shall meet the following requirements:

- a) constitute a separate building, built of fire resistant material, being able to have only one wall close to other equipment of the enterprise, however with the other walls distant, at least 3 (three) meters from other equipment, from third party properties, from the limit with public roads and fuel storage, except tanks for the startup with up to 2,000 (two thousand) liters of capacity;

- b) provide at least 2 (two) wide exits, permanently unblocked and arranged in different directions;
- c) provide permanent ventilation with air openings which cannot be blocked;
- d) provide gas leakage detecting devices when the boiler source of heat is a gaseous fuel;
- e) not be used to any other purpose;
- f) provide an easy and safe access, necessary to the boiler operation and maintenance, taking into account that for vacant guard rails, the gaps shall have dimensions to avoid personnel’s falls;
- g) have captivation and discharging systems for gases and particle matters from combustion to send them out of the operation area, in accordance with the prevailing environment standards;
- h) provide illumination in accordance with the prevailing official standards and have emergency illumination systems.

13.2.5. It constitutes a serious and eminent risk the lack of any of the following:

- a) for all boilers installed outdoors, the items “b”, “d” and “f” of 13.2.3 hereto;
- b) for the category “A” boilers installed indoors, the items “a”, “b”, “c”, “d”, “e”, “g” and “h” of 13.2.4 hereto;
- c) for the categories “B” and “C” boilers installed indoors, the items “b”, “c”, “d”, “e”, “g” and “h” of 13.2.4 hereto.

13.2.6. When the enterprise can not meet what is shown in 13.2.3 or 13.2.4 an “Alternative Installation Design” shall be elaborated, with complementary safety measures which allow the risk attenuation.

13.2.6.1. The “Alternative Installation Design” shall be shown by the owner of the boiler to obtain an agreement with union representatives of the prevailing professional category in the enterprise.

13.2.6.2. In the event of reaching no agreement, as foreseen in 13.2.6.1, the intermediation of the Regional Labor Department, can be required by any of the parties and, continuing the deadlock, the decision shall be taken by this Department.

13.2.7. The boilers classified in the category “A” shall have an instrumentation board installed in a control room, built in accordance with prevailing Regulation Standards.

### 13.3. SAFETY IN BOILER OPERATION

13.3.1. Every boiler shall have an updated “Operational Manual”, in Portuguese, in an easy and accessible place to the operators, containing at least:

- a) startup and shutdown procedures;
- b) routine operational parameters and procedures;

- c) emergency situation procedures;
- d) safety, health and environment preservation general procedures;

13.3.2. The boiler devices and controls shall be maintained calibrated and in good operational conditions, constituting a serious and eminent risk the use of tricks which neutralize control and safety systems.

13.3.3. The water quality shall be controlled and treatments shall be implemented, when necessary, to adjust its physicochemical properties to the boiler operational parameters.

13.3.4. Every steam boiler shall be compulsorily under boiler operator's operation and control, constituting a serious and eminent hazardous condition the lack of compliance of this request.

13.3.5. For the accomplishment of this Regulation Standard, it is considered boiler operator the one who satisfies at least one of the following conditions:

- a) to have the "Safety Training in Boiler Operation" certificate and prove a practical training in accordance with 13.3.11;
- b) to have the "Safety Training in Boiler Operation" certificate proclaimed herein and approved by Brazilian Regulation number 02/84 on May 8, 1984;
- c) to have corroboration of at least 3 (three) years of experience in this activity, until May 8, 1984.

13.3.6. The minimum basic requirement to participate, as a pupil in the "Safety Training in Boiler Operation", is to have the Junior High School certificate.

13.3.7. The "Safety Training in Boiler Operation" shall compulsorily:

- a) be technically supervised by a "Qualified Professional", summoned in 13.1.2;
- b) be ministered by skilled professionals qualified for this propose;
- c) obey, at least, the curriculum showed in the Appendix I-A herein.

13.3.8. The responsible personnel for the "Safety Training in Boiler Operation" performance shall be restrained from ministering new courses, as well as subjected to legal penalties, in case of noncompliance of what is required in 13.3.7.

13.3.9. Every boiler operator shall fulfill a practical training, in the boiler he will operate, which it shall be supervised, recorded and have the minimum duration of:

- a) category "A" boilers: 80 (eighty) hours;
- b) category "B" boilers: 60 (sixty) hours;
- c) category "C" boilers: 40 (forty) hours.

13.3.10. The enterprise where the supervised practical training is performed shall inform in advance the union representatives of the prevailing professional category in the enterprise:

- a) the duration of training performance;
- b) the responsible private group, company or professional for the "Safety Training in Boiler Operation";
- c) the list of training applicants.

13.3.11. The knowledge refreshment of the operators shall be continuous, by means of constant information of the physical and operational conditions of the equipment, technical refreshment, safety information, attendance in courses, speeches and concerned events.

13.3.12. It constitutes a serious and eminent risk the operation of any boiler in different conditions foreseen in the original design, unless:

- a) it is redesigned taking into account all the relevant variables contained in the new operational condition;
- b) all the safety procedures shall be adopted arising from its new classification in respect of installation, operation, maintenance and inspection.

#### 13.4. SAFETY IN THE BOILER MAINTENANCE

13.4.1 All repairs or changes in boilers shall respect the corresponding construction design code and the manufacturer's direction in respect of:

- a) materials;
- b) performance procedures;
- c) quality control procedures;
- d) personnel qualification and certification.

13.4.1.1. When the construction design code is unknown, the original concepts of the boiler shall be respected, using the toughest control procedures written in the concerned codes.

13.4.1.2. For the categories "A" and "B" boilers, by the "Qualified Professional's" judgment, summoned in 13.1.2, calculus technologies or more advanced procedures shall be used, in exchange of the prevailing design standards.

13.4.2. The "Modifying and Repair Designs" shall be admitted in advance in the following conditions:

- a) at all times that the design conditions have been changed;
- b) at all times that repairs which compromise the safety, are performed.

13.4.3. The "Modifying and Repair Designs" shall:

- a) be authorized or approved by a "Qualified Professional", summoned in 13.1.2;

b) determine materials, execution, quality control and personnel qualification procedures.

13.4.4. All the performances that require broaching or welding in parts that operate under pressure shall be followed by a hydrostatic test, with characteristics defined by the “Qualified Professional”, summoned in 13.1.2.

13.4.5. The boiler safety control systems shall be submitted to preventive or predictive maintenance.

### 13.5. BOILER SAFETY INSPECTION

13.5.1. The boilers shall be submitted to initial, periodical and extraordinary safety inspections being considered a serious and eminent hazardous condition the lack of compliance of any of the deadlines established herein.

13.5.2. The initial safety inspection shall be made on new boilers, prior to the startup, in the operational site, having to be submitted to an internal and external exam, hydrostatic and accumulation test.

13.5.3. The periodic safety inspection, constituted by an internal and external exam, shall be carried out in the maximum deadlines as follows:

- a) 12 (twelve) months to categories “A”, “B” and “C” boilers;
- b) 12 (twelve) months to recovering alkali boilers of any category;
- c) 24 (twenty-four) months to category “A” boilers, provided that at 12 (twelve) months the safety valves opening pressures are tested;
- d) 40 (forty) months to special boilers in accordance with defined in 13.5.5.

13.5.4. Enterprises which have their “Own Service of Equipment Inspection”, in accordance with the provisions established in Appendix II, may postpone the period between safety inspections, respecting the following maximum deadlines:

- a) 18 (eighteen) months to categories “B” and “C” boilers;
- b) 30 (thirty) months to category “A” boilers.

13.5.5. Boilers which operate in a continual way and use gases or residues from the process units, as main fuel to take the advantage of the heat or on purpose to environment control may be considered special when all the following conditions are satisfied:

- a) they are installed in enterprises which have their “Own Service of Equipment Inspection”, summoned in Appendix II;
- b) they have tested every 12 (twelve) months the interlock system and opening pressure of every safety valve;

- c) they do not show unexpected variations in the gases and steam outlet temperature, during the operation;
- d) there is water quality analysis and periodic control;
- e) there is material deterioration control of the boiler main parts;
- f) it is approved as special class by means of:
  - agreement between union representatives of the prevailing professional category in the enterprise and the employer;
  - the intermediation of the Regional Labor Department, required by any of the parties when there is no agreement;
  - decision of the Regional Labor Department when the deadlock continues.

13.5.6. After 25 (twenty-five) years of use, in their following inspection, the boilers shall be submitted to a strict integrity evaluation to determine their remaining life and new maximum inspection deadlines, in case of they are still in condition of use.

13.5.6.1. Enterprises which have their “Own Service of Equipment Inspection”, summoned in Appendix II, the 25 (twenty-five)-year limit may be changed in terms of boiler conditions, made by the referred department.

13.5.7. The safety valves installed in boilers shall be periodically inspected as follows:

- a) at least once a month, by means of manual action, in operation, to categories “B” and “C” boilers;
- b) demonstrating, inspecting and testing, on a bench, the flanged valves and, on site, the welded valves, recalibrating them in periods compatible with the operational experience of themselves, but respecting as a maximum limit the inspection period established in 13.5.3 or 13.5.4, if applied, to the categories “A” and “B” boilers.

13.5.8. In addition to the prescribed tests in 13.5.7, the safety valves installed in the boilers shall be submitted to accumulation tests, in the following opportunities:

- a) in the boiler initial inspection;
- b) when they have been modified or have suffered significative reforms;
- c) when there is a change in the boiler operational parameters or a MAWP variation;
- d) when there is a change in the inlet or outlet piping.

13.5.9. The extraordinary safety inspection shall be carried out in the following opportunities:

- a) at all times that the boiler is damaged by accident or other happening able to compromise its safety;
- b) when the boiler is submitted to important changes or repairs able to alter its safety conditions;
- c) prior to the boiler startup, when it has been idle for more than 6 (six) months;
- d) when there is a change in the boiler installation site.

13.5.10. The safety inspection shall be carried out by a “Qualified Professional”, summoned in 13.1.2, or by “Own Service of Equipment Inspection”, summoned in Appendix II.

13.5.11. Once the boiler is inspected, an “Inspection Report” shall be emitted, which shall belong to its records.

13.5.12. A copy of the “Inspection Report” shall be sent by the “Qualified Professional”, summoned in 13.1.2, in a time limit of 30 (thirty) days from the termination of the inspection, to the union representatives of the prevailing professional category in the enterprise.

13.5.13. The “Inspection Report”, summoned in 13.5.11, shall contain at least:

- a) the recorded data in the boiler identification plate;
- b) boiler category;
- c) type of boiler;
- d) type of inspection carried out;
- e) starting and finishing date of inspection;
- f) description of the realized inspections and tests;
- g) result of the inspections and measures;
- h) list of items from this Regulation Standard or from other legal demands which are not satisfied;
- i) conclusions;
- j) necessary recommendations and measures;
- k) foreseen date for the next boiler inspection;
- l) legible name, signature and the professional counsel recording number of the “Qualified Professional”, summoned in 13.1.2, and legible name and signature of technicians who have attended the inspection.

13.5.14. At all times that the inspection results determine changes on the identification plate data, it shall be updated.

### 13.6. *PRESSURE VESSELS - GENERAL*

13.6.1. Pressure vessels are equipment which contain fluids under internal or external pressure.

13.6.1.1. The application field of this Regulation Standard, referred to pressure vessels, is defined in Appendix III.

13.6.1.2. Pressure vessels included in this Regulation Standard are classified in categories in accordance with Appendix IV.

13.6.2. It constitutes a serious and eminent risk the lack of any of the following items:

- a) a valve or other safety device with opening pressure set at the MAWP or lower, installed directly on the vessel or in the system which includes it;
- b) a safety device against a blockage without warning of the valve when it is not installed directly on the vessel;

c) a device that indicates the operational pressure.

13.6.3. Every pressure vessel shall have attached on its body, in a visible and of easy and accessible place, an enduring identification plate with, at least, the following information:

- a) manufacturer’s name;
- b) identification number;
- c) year of fabrication;
- d) maximum allowable working pressure;
- e) hydrostatic test pressure;
- f) design code and year of edition.

13.6.3.1. Besides the identification plate there shall be, in a visible place, the pressure vessel category, in accordance with Appendix IV, and its identification number or code.

13.6.4. Every pressure vessel shall have, in the site it has been installed, the following records, duly updated:

- a) a “Pressure Vessel Dossier”, to be supplied by the manufacturer, having the following information:
  - design code and year of edition;
  - materials specification;
  - procedures used in the fabrication, assembly, final inspection and determination of the MAWP;
  - a set of drawings and necessary data to follow its service life;
  - functioning characteristics;
  - safety devices data;
  - year of fabrication;
  - pressure vessel category.
- b) “Safety Record”, in accordance with the provisions of 13.6.5;
- c) “Installation Design”, in accordance with the provisions of 13.7;
- d) “Changing or Repair Designs”, in accordance with provisions of 13.9.2 and 13.9.3;
- e) “Inspection Reports”, in accordance with provisions of 13.10.8.

13.6.4.1. When nonexistent or lost, the “Pressure Vessel Dossier” shall be restored by the owner, with the manufacturer or “Qualified Professional’s” (summoned in 13.1.2) technical responsibility, being indispensable the restoration of functioning characteristics, safety devices data and procedures for MAWP determination.

13.6.5. The “Safety Record” shall be made up of a separate book, with numbered pages, portfolios or information retrieval or not, with similar reliability, where the following will be recorded:

- a) all the relevant events capable to influence on the pressure vessel safety conditions;
- b) the events of safety inspections.

13.6.6. The records referred in the 13.6.4 shall be at all times available for the examination of the operators, the maintenance and inspection personnel and the employee and employer representatives at the Accident Prevention Internal Commission, and the owner shall ensure complete access to these records, inclusive the union representatives of the prevailing professional category in the enterprise, when formally requested.

### 13.7. *INSTALLATION OF PRESSURE VESSELS*

13.7.1. Every pressure vessel shall be installed in a way that all drains, vents, manholes and level, pressure and temperature indicators, when existing, are easily accessible.

13.7.2. When the pressure vessels are installed indoors, the installation shall meet the following requirements:

- a) provide at least 2 (two) wide exits, permanently unblocked and arranged in different directions;
- b) provide an easy and safe access to the maintenance, operation and inspection, taking into account that for vacant guard rails, the gaps shall have dimensions to avoid personnel's falls;
- c) provide permanent ventilation with air openings which cannot be blocked;
- d) provide illumination in accordance with the prevailing official standards.
- e) have emergency illumination systems.

13.7.3. When the pressure vessels are installed outdoors, the installation shall meet the items "a", "b", "d" and "e" of 13.7.2 hereto.

13.7.4. It constitutes a serious and eminent risk the lack of compliance of the following items of 13.7.2 hereto:

- a) "a", "c" and "e" to pressure vessels installed indoors;
- b) "a" to pressure vessels installed outdoors;
- c) "e" to pressure vessels installed outdoors and operate at night.

13.7.5. When the enterprise can not meet what is shown in 13.7.2 an "Alternative Installation Design" shall be elaborated, with complementary safety measures which allow the risks attenuation.

13.7.5.1. The "Alternative Installation Design" shall be shown by the owner of the pressure vessel to obtain an agreement with union representatives of the prevailing professional category in the enterprise.

13.7.5.2. In the event of reaching no agreement, as foreseen in 13.7.5.1, the intermediation of the Regional Labor Department can be required by any of the parties and, continuing the deadlock, the decision shall be taken by this Department.

13.7.6. The authorship of the pressure vessel "Installation Design" within the categories "I", "II" and "III", in accordance with Appendix IV, as far as this Regulating Standard is concerned, is responsibility of the "Qualified Professional", as summoned in 13.1.2, and shall obey the safety, health and environment aspects foreseen in the Regulation Standards, agreements and applicable legal arrangements.

13.7.7. The "Installation Design" shall contain at least the enterprise's plan, showing the position and the category of each vessel and the safety installations.

### 13.8. *SAFETY IN PRESSURE VESSEL OPERATION*

13.8.1. Every pressure vessel within the categories "I" and "II" shall have its own "Operational Manual", or operational instructions contained in the unit operational manual where it is installed, in Portuguese, in an easy access to the operators, containing at least:

- a) startup and shutdown procedures;
- b) routine operational parameters and procedures;
- c) emergency situation procedures;
- d) safety, health and environment preservation general procedures;

13.8.2. The pressure vessel instruments and controls shall be maintained calibrated and in good operational conditions.

13.8.2.1. It constitutes a serious and eminent risk the use of tricks which neutralize their control and safety systems.

13.8.3. The operation of units which have pressure vessels of categories "I" or "II", shall be done by a professional with "Safety Training in Process Unit Operation", constituting a serious and eminent hazardous condition the lack of compliance of this request.

13.8.4. For the accomplishment of this Standard, it is considered professional with "Safety Training in Process Unit Operation" the one who satisfies one of the following conditions:

- a) to have the "Safety Training in Process Unit Operation" certificate dispatched by a competent training institution;
- b) to have proved experience, in pressure vessel operation in the categories "I" or "II", of at least 2 (two) years prior to the existence of this Regulation Standard.

13.8.5. The minimum basic requirement to participate, as a pupil in the "Safety Training in Process Unit Operation", is to have the Junior High School certificate.

13.8.6. The "Safety Training in Process Unit Operation" shall compulsorily:

- a) be technically supervised by a “Qualified Professional”, summoned in 13.1.2;
- b) be ministered by skilled professionals qualified for this propose;
- c) obey, at least, the curriculum showed in the Appendix I-B herein.

13.8.7. The responsible personnel for the “Safety Training in Process Unit Operation” performance shall be restrained from ministering new courses, as well as subjected to legal penalties, in case of noncompliance of what is required in 13.8.6.

13.8.8. Every professional with “Safety Training in Process Unit Operation”, shall fulfill a supervised practical training, in the operation of pressure vessels, with the minimum duration of:

- a) 300 (three hundred) hours to vessels of categories “I” or “II”;
- b) 100 (one hundred) hours to vessels of categories “III”, “IV” or “V”;

13.8.9. The enterprise where the supervised practical training is performed shall inform in advance the union representatives of the prevailing professional category in the enterprise:

- a) the duration of training performance;
- b) the responsible private group, company or professional for the “Safety Training in Process Unit Operation”;
- c) the list of training applicants.

13.8.10. The knowledge refreshment of the operators shall be continuous, by means of constant information of the physical and operational conditions of the equipment, technical refreshment, safety information, attendance in courses, speeches and concerned events.

13.8.11. It constitutes a serious and eminent risk the operation of any pressure vessel in different conditions foreseen in the original design, unless:

- a) it is redesigned taking into account all the relevant variables contained in the new operational condition;
- b) all the safety procedures shall be adopted arising from its new classification in respect of installation, operation, maintenance and inspection.

**13.9. SAFETY IN THE PRESSURE VESSEL MAINTENANCE**

13.9.1 All repairs or changes in pressure vessels shall respect the corresponding construction design code and the manufacturer’s direction in respect of:

- a) materials;
- b) performance procedures;
- c) quality control procedures;
- d) personnel qualification and certification.

13.9.1.1. When the construction design code is unknown, the original concepts of the vessel shall be respected, using the toughest control procedures written in the concerned codes.

13.9.1.2. By the “Qualified Professional’s” judgment, summoned in 13.1.2, calculus technologies or more advanced procedures shall be used, instead of the prevailing design standards.

13.9.2. The “Modifying and Repair Designs” shall be performed in advance in the following conditions:

- a) at all times that the design conditions have been changed;
- b) at all times that repairs which compromise the safety are performed.

13.9.3. The “Modifying and Repair Design” shall:

- a) be performed or approved by a “Qualified Professional”, summoned in 13.1.2;
- b) determine materials, execution, quality control and personnel qualification procedures;
- c) be proclaimed to the enterprise’s employees who may be concerned with the equipment.

13.9.4. All the performances that require welding in parts that operate under pressure shall be followed by a hydrostatic test, with characteristics defined by the “Qualified Professional”, summoned in 13.1.2, taking into consideration what is determined in 13.10.

13.9.4.1. Small superficial performances may have the hydrostatic test dismissed, according to the criteria of the “Qualified Professional”, summoned in 13.1.2.

13.9.5. The pressure vessel safety control systems shall be submitted to preventive or predictive maintenance.

**13.10. PRESSURE VESSEL SAFETY INSPECTION**

13.10.1. The pressure vessels shall be submitted to initial, periodical and extraordinary safety inspections.

13.10.2. The initial safety inspection shall be made on new vessels, prior to the startup, in the definitive operational site, having to be submitted to an internal and external exam and hydrostatic test, considering the limitations mentioned in 13.10.3.5.

13.10.3. The periodic safety inspection, constituted by an internal and external exam and hydrostatic test, shall obey the maximum deadlines as follows:

- a) to enterprises which do not have their “Own Service of Equipment Inspection”, in accordance with the provisions established in Appendix II:

Vessel Category	External Exam	Internal Exam	Hydrostatic Exam
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I	1 year	3 years	6 years
II	2 years	4 years	8 years
III	3 years	6 years	12 years
IV	4 years	8 years	16 years
V	5 years	10 years	20 years

b) to enterprises which have their “Own Service of Equipment Inspection”, in accordance with the provisions established in Appendix II:

Vessel Category	External Exam	Internal Exam	Hydrostatic Exam
I	3 years	6 years	12 years
II	4 years	8 years	16 years
III	5 years	10 years	self criterion
IV	6 years	12 years	self criterion
V	7 years	self criterion	self criterion

13.10.3.1. Pressure vessels which can not be internally inspected due to physical impossibility shall be submitted to a hydrostatic test instead, considering the foreseen considerations in 13.10.3.5.

13.10.3.2. Vessels with internal filling or catalyst may have the periodicity of the internal exam widen, in order to coincide with the changing time of the filling or catalysts, provided that this extension do not go beyond 20 % of the established deadline in the 13.10.3 herein.

13.10.3.3. Vessels with hygroscopic internal coating, shall be hydrostatically tested prior to the application of it, being the forthcoming tests replaced by alternative techniques.

13.10.3.4. When technically impracticable and by means of writing on the “Safety Record” by the “Qualified Professional”, summoned in 13.1.2, the hydrostatic test may be replaced by other nondestructive technique or inspection which allows it to obtain similar safety.

13.10.3.5. It is considered technically impracticable to perform the hydrostatic test when:

- a) the structural resistance of base or vessel support are not compatible with the weight of the water that should be used in test;
- b) the testing fluid harms the internal parts of the vessel;
- c) it is technically impossible to blow down or dry the system;
- d) there is an internal coating;
- e) the test brings about a harming influence on subcritical defects.

13.10.3.6. Vessels which work with operational temperature under 0°C and operate in conditions with which the experience shows that deterioration does not occur, are free from the periodical hydrostatic test, being required to perform an internal exam every 20 (twenty) years and external exam every 2 (two) years.

13.10.3.7. When there is no other alternative, the pneumatic test may be performed, provided that it is supervised by the “Qualified Professional”, summoned in 13.1.2, and surrounded by special care, because it is a highly risky activity.

13.10.4. The safety valves of the pressure vessels shall be disassembled, inspected and recalibrated when the periodic internal exam is due.

13.10.5. The extraordinary safety inspection shall be carried out in the following opportunities:

- a) at all times that the vessel is damaged by accident or other happening able to compromise its safety;
- b) when the vessel is submitted to important changes or repairs able to alter its safety conditions;
- c) prior to the vessel startup, when it has been idle for more than 12 (twelve) months;
- d) when there is a change in the vessel installation site.

13.10.6. The safety inspection shall be carried out by a “Qualified Professional”, summoned in 13.1.2, or by “Own Service of Equipment Inspection”, summoned in Appendix II.

13.10.7. After the pressure vessel is inspected, an “Inspection Report” shall be emitted, which shall belong to its records.

13.10.8. The “Inspection Report”, shall contain at least:

- a) pressure vessel identification;
- b) service fluids and pressure vessel category;
- c) type of pressure vessel;
- d) starting and finishing date of inspection;
- e) type of inspection carried out;
- f) description of the realized inspections and tests;
- g) result of the inspections and measures;
- h) conclusions;

- i) necessary recommendations and measures;
- j) foreseen date for the next inspection;
- k) legible name, signature and the professional counsel recording number of the “Qualified Professional”, summoned in 13.1.2, and legible name and signature of technicians who have attended the inspection.

13.10.9. At all times that the inspection results determine changes on the identification plate data, it shall be updated.

#### **APPENDIX I-A**

##### **MINIMUM CURRICULUM TO “SAFETY TRAINING IN BOILER OPERATION”**

###### **1 - CONCEPTION ABOUT PHYSICAL MAGNITUDES AND UNITS**

Length: 4 hours

###### 1.1 - Pressure

1.1.1 - Atmospheric pressure

1.1.2 - Internal pressure of a vessel

1.1.3 - Gauge Pressure, relative pressure and absolute pressure

1.1.4 - Pressure units

###### 1.2 - Heat and Temperature

1.2.1 - General knowledge: what’s heat, what’s temperature

1.2.2 - Means of heat exchange

1.2.3 - Specific heat and sensible heat

1.2.4 - Heat exchange at a constant temperature

1.2.5 - Saturated steam and superheated steam

1.2.6.- Saturated steam table

###### **2 - BOILERS - GENERAL**

Length: 8 hours

###### 2.1 - Types of boilers and their uses

###### 2.2 - Parts of a boiler

2.2.1 - Firetube boilers

2.2.2 - Watertube boilers

2.2.3 - Electrical boilers

2.2.4 - Solid fuel boilers

2.2.5 - Liquid fuel boilers

2.2.6 - Gas boilers

2.2.7 - Burners

###### 2.3 - Control instruments and devices of boilers

2.3.1 - Feeding device

2.3.2 - Level view finder

2.3.3 - Level control system

2.3.4 - Pressure indicators

2.3.5 - Safety devices

2.3.6 - Auxiliary devices

2.3.7 - Valves and tubulation

2.3.8 - Smoke draft

###### **3 - BOILER OPERATION**

Length: 12 hours

###### 3.1 - Startup and shutdown

###### 3.2 - Adjust and control

3.2.1 - of temperature

3.2.2 - of pressure

3.2.3 - of energy supply

3.2.4 - of water level

3.2.5 - of contaminants

###### 3.3 - Operation failure, causes and measures

###### 3.4 - Daily inspection schedule

###### 3.5 - Operation of a system of several boilers

###### 3.6 - Procedures in the event of emergency

###### **4 - WATER TREATMENT AND BOILER MAINTENANCE**

Length: 8 hours

4.1 - Water impurities and their consequences

4.2 - Water treatment

4.3 - Boiler maintenance

###### **5 - PREVENTION AGAINST EXPLOSIONS AND OTHER RISKS**

Length: 4 hours

5.1 - General accidental risks and health risks

5.2 - Explosion risks

###### **6 - LEGISLATION AND STANDARDIZATION**

Length: 4 hours

6.1 - Regulation Standards

6.2 - Regulation Standard 13 (NR-13)

#### **APPENDIX I-B**

##### **MINIMUM CURRICULUM TO “SAFETY TRAINING IN PROCESS UNIT OPERATION”**

###### **1 - CONCEPTION ABOUT PHYSICAL MAGNITUDES AND UNITS**

Length: 4 hours

###### 1.1 - Pressure

1.1.1 - Atmospheric pressure

1.1.2 - Internal pressure of a vessel

1.1.3 - Gauge Pressure, relative pressure and absolute pressure

1.1.4 - Pressure units

###### 1.2 - Heat and Temperature

1.2.1 - General knowledge: what’s heat, what’s temperature

1.2.2 - Means of heat exchange

1.2.3 - Specific heat and sensible heat

1.2.4 - Heat exchange at a constant temperature

1.2.5 - Saturated steam and superheated steam

## 2 - PROCESS EQUIPMENT - GENERAL

Length: Established in accordance with the unit complexity, keeping at least 4 hours per item, where applicable.

2.1 - Heat exchangers

2.2 - Tubulation, valves and fittings

2.3 - Pumps

2.4 - Turbines and ejectors

2.5 - Compressors

2.6 - Towers, vessels, tanks and reactors

2.7 - Furnaces

2.8 - Boilers

## 3 - ELECTRICITY

Length: 4 hours

## 4 - INSTRUMENTATION

Length: 8 hours

4.1 - Water impurities and their consequences

4.2 - Water treatment

4.3 - Boiler maintenance

## 5 - UNIT OPERATION

Length: Established in accordance with the unit complexity.

5.1 - Process description

5.2 - Startup and shutdown

5.3 - Emergency procedures

5.4 - Chemical products blowdown and environment preservation

5.5 - Evaluation and control of risks due to the process

5.6 - Prevention against deterioration, explosions and other risks

## 6 - FIRST AID

Length: 8 hours

## 7 - LEGISLATION AND STANDARDIZATION

Length: 4 hours

### APPENDIX II

#### REQUIREMENTS TO CERTIFY THE "OWN SERVICE OF EQUIPMENT INSPECTION"

Prior to put in practice the special periods between inspections, established in 13.5.4 and 13.10.3 herein, the enterprise's "Own Service of Equipment Inspection", arranged in sectors, sections, departments, divisions, or similar, shall be either directly certified by the Brazilian Institute of Metrology, Standardization and Industrial Quality or through "Inspection Organizations" duly authorized by the Institute, which shall verify the following minimum requirements shown from "a" to "g" hereunder. This certification may be canceled always a nonconformity of any of the following requirements is identified:

- a) the existence of enterprise's own personnel where the boiler or pressure vessel is installed, with exclusive dedication to inspection, integrity and residual life evaluation activities, with compatible background, qualification and training with the required activity of ensuring safety;
- b) contracted labor to nondestructive assays, certified in accordance with prevailing regulation, and to other eventual services, selected and evaluated in accordance with similar criteria used with its own labor;
- c) equipment inspection service shall have someone responsible for its management, formally designated for this position;
- d) the existence of at least one "Qualified Professional", in accordance with the provisions of 13.1.2;
- e) the existence of conditions to maintain an updated technical file, necessary to consider this Regulation Standard, as well as means to spread information when required;
- f) the existence of written procedures to the main activities performed.
- g) the existence of equipment proper to perform the proposed activities.

### APPENDIX III

1 - This Regulation Standard shall be used in the following equipment:

- a) any vessel where the product "P.V" is higher than 8 (eight), where "P" is the maximum operational pressure in kPa and "V" is its internal geometric volume in m<sup>3</sup>, including:
  - heat exchangers, evaporators and similar;
  - pressure vessels or parts subjected to direct flame which are neither included in other Regulation Standards nor in 13.1 herein;
  - jacket pressure vessels, including reboilers and reactors;
  - autoclaves and boilers of thermic fluid which do not vaporize;

- b) vessels which contain class “A” fluids, specified in Appendix IV herein, independently of its dimensions and of the product “P.V”.

2 - This Regulation Standard shall not be used in the following equipment:

- a) transportable cylinders, vessels used to transport products, compressed fluid portable reservoirs and fire extinguisher;
- b) the ones used for human occupation;
- c) combustion chamber or vessels which are part of rotative or alternative machines, such as pumps, compressors, turbines, generators, engines, pneumatic and hydraulic cylinders and that can not be considered as independent equipment;
- d) pipes and tubes used to fluid flow;
- e) heating coils;
- f) tanks and reservoirs to store fluids which are not included in design standards and codes related to pressure vessels;
- g) vessels with inside diameter smaller than 150 (one hundred and fifty) mm to fluids of class “B”, “C” and “D”, in accordance with the provisions of Appendix IV.

#### **APPENDIX IV**

##### **PRESSURE VESSEL CLASSIFICATION**

1 - For the accomplishment of this Regulation Standard the pressure vessels are classified in categories accordingly with the type of fluid and the potential risk.

1.1 - The fluids contained in the pressure vessels are classified as described below:

CLASS “A”:

- Inflammable fluids;
- Fuel with temperature at 200°C or higher;
- Toxic fluids with a limit of tolerance at 20 ppm or lower;
- Hydrogen;
- Acetylene.

CLASS “B”:

- Inflammable fluids with temperature lower than 200°C;
- Toxic fluids with a limit of tolerance higher than 20 ppm.

CLASS “C”:

- Steam, simple asphyxiant gases or compressed air.

CLASS “D”:

- Water or other fluids excluded in the Classes “A”, “B” or “C”, with temperature higher than 50°C.

1.1.1. When it is a mixture of fluids, it shall be considered regarding the classification, the fluid which shows the highest risk to the employees and equipment considering its toxicity, inflammability and concentration.

1.2 - The pressure vessels are classified in groups of potential risk in accordance with the product “P.V”, where “P” is the maximum operational pressure in MPa and “V” is its internal geometric volume in m<sup>3</sup>, as follows:

GROUP 1 -  $P.V \geq 100$

GROUP 2 -  $P.V < 100$  and  $P.V \geq 30$

GROUP 3 -  $P.V < 30$  and  $P.V \geq 2.5$

GROUP 4 -  $P.V < 2.5$  and  $P.V \geq 1$

GROUP 5 -  $P.V < 1$

1.2.1. Pressure vessels which operate under a vacuum condition shall be in the following categories:

- category I: for inflammable fluids and fuels;
- category V: for other fluids.

1.3 - The following table classifies pressure vessels in categories in accordance with the groups of potential risk and the fluid class contained.

**PRESSURE VESSEL CATEGORIES**

FLUID CLASS	GROUP OF POTENTIAL RISK				
	1 P.V <sup>≥</sup> 100	2 P.V < 100 P.V <sup>≥</sup> 30	3 P.V < 30 P.V <sup>≥</sup> 2.5	4 P.V < 2.5 P.V <sup>≥</sup> 1	5 P.V < 1
<p align="center">“A”</p> <ul style="list-style-type: none"> <li>- Inflammable fluid with temperature at 200°C or higher</li> <li>- Toxic fluids with a limit of tolerance ≤ 20 ppm or lower</li> <li>- Hydrogen</li> <li>- Acetylene</li> </ul>	<b>I</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>III</b>
<p align="center">“B”</p> <ul style="list-style-type: none"> <li>- Fluids with temperature lower than 200°C</li> <li>- Toxic fluids with a limit of tolerance &gt; 20 ppm</li> </ul>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>IV</b>
<p align="center">“C”</p> <ul style="list-style-type: none"> <li>- Steam</li> <li>- Simple asphyxiant gases</li> <li>- Compressed air</li> </ul>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>
<p align="center">“D”</p> <ul style="list-style-type: none"> <li>- Water or other fluids excluded in the classes “A”, “B” or “C”, with temperature higher than 50° C</li> </ul>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>V</b>

Notes:

- a) Consider the Volume in  $\text{m}^3$  and the Pressure in MPa.
- b) Consider 1 MPa corresponding to  $10.197 \text{ Kg/cm}^2$ .

**TIME LIMITS FOR THE ENTERPRISES TO ADAPT THEMSELVES TO THE NR-13 REGULATION STANDARD**

In a meeting held in Brazil on November 18, 1994, the **WORKING GROUP FOR THE REVIEW OF THIS NR-13 REGULATION STANDARD** established the following time limits for the enterprises to adapt themselves to the requirements of the standard hereto.

**BOILERS**

- 13.1.4 Adjustment of pressure gauges, safety valves, level control systems, etc.  
180 days
- 13.1.5 Adjustment of identification plate and painting or placing additional plates.  
90 days
- 13.1.6 Adjustment of the boiler dossier and complementary documentation.  
120 days
- 13.1.9 Boiler classification in accordance with volume and pressure.  
90 days
- 13.2 Adjustment of the installation to the standard minimum requirements.  
180 days
- 13.3.1 Adjustment of the operation manuals.  
180 days
- 13.3.4 to 13.3.10 Adjustment of the new operators' training.  
90 days
- 13.4.5 Introduction of the preventive maintenance plan in safety control systems.  
90 days
- 13.5 The time limits for the boiler safety inspection shall be immediately adjusted, taking the date of the last periodical/extraordinary inspection as the starting point.

**THE REMAINING ITEMS RELATED TO THE BOILERS SHALL BE IMMEDIATELY ADJUSTED AFTER THE EDITION OF THIS REGULATION.**

**PRESSURE VESSELS**

- 13.6.1 Pressure vessel classification.  
120 days
- 13.6.2 Adjustment of pressure gauges, safety valves, etc.  
270 days
- 13.6.3 and 13.6.3.1 Adjustment of identification plate and painting or placing additional plates with the category.  
180 days
- 13.6.4.a Adjustment of documentation.  
180 days
- 13.6.4.c Elaboration of the installation design.  
180 days
- 13.7 Adjustment of the installation.  
180 days
- 13.8.1 Adjustment of the operation manuals.  
180 days
- 13.8.3 New operators' training.  
180 days
- 13.9.5 Introduction of the preventive maintenance plan in safety control systems.  
120 days
- 13.10 The time limits for the boiler safety inspection shall be immediately adjusted, taking the date of the last periodical inspection or hydrostatic test as the starting point.

**THE REMAINING ITEMS RELATED TO THE BOILERS SHALL BE IMMEDIATELY ADJUSTED AFTER THE EDITION OF THIS REGULATION.**