



HSE

**Health & Safety
Executive**

**TPSR – Technical Code for Refillable
Transportable Pressure Receptacles for Oil Well
Samples**

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Introduction

This Technical Code is recognised by HSE as meeting the requirements of section 6.2.3 of ADR2003. There is no standard listed in 6.2.2 or 6.2.5 of ADR2003 that covers the scope required for this type of transportable pressure equipment.

This Technical Code is a specification for seamless nickel alloy and precipitation-hardened stainless steel transportable pressure receptacles, for the transportation of oil well pressurised fluids and or gases, up to 5.0 litre capacity. It is intended that this specification be used to describe the design and construction requirements that provide the basis for a type examination submission and subsequent batch production.

1 Scope

This technical code specifies the materials, design, construction and testing of seamless pressure receptacles for the conveyance of oil well gases and or liquids and combinations thereof. The pressure receptacles are also suitable for the storage of such fluids under pressure. This technical code has been prepared in accordance with the requirements of ADR, clause 6.2.3 in the absence of a suitable design standard listed in section 6.2.2 for use as pressure receptacles manufactured from seamless nickel alloy and precipitation-hardened stainless steels.

The maximum service pressure of the pressure receptacles shall be 2068 bar

The temperature range for the operation of the pressure receptacles shall be limited to between -40°C and 200°C.

The maximum water capacity contained in the pressure receptacle shall be 5.0 litres.

2 Normative References

ADR, European Agreement Concerning the International carriage of Dangerous Goods by Road, Volume II, Chapter 6.2.

ASTM A-370 Standard Methods and Definitions for Mechanical Testing of Steel Products

ASTM A479 Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

ASTM A564 Standard Specification for Hot-rolled and Cold-finished Age-Hardening Stainless Steel Bars and Shapes

ASTM B150 Standard Specification for Aluminum Bronze Rod, Bar, and Shapes

ASTM B166 Standard Specification for Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, and N06045)* and Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) Rod, Bar, and Wire

ASTM B196/B196M Standard Specification for Copper-Beryllium Alloy Rod and Bar

ASTM B637 Standard Specification for Precipitation-Hardening Nickel Alloy Bars, Forgings, and Forging Stock for High-Temperature Service

ASTM B865 Standard Specification for Precipitation Hardening Nickel-Copper-Aluminium Alloy (UNS N05500) Bar, Rod, Wire, Forgings, and Forging Stock

ASTM E8 Standard Test Methods for Tension Testing of Metallic Materials

ASTM B-805 Standard Specification for Precipitation Hardening Nickel Alloys, Bar and Wire

AMS 4596 Copper Nickel Tin Alloy, Bars, Rods and Tubes, 77Cu 15Ni 8Sn, Solution Annealed and Spinodal Hardened (Tx 00)

AMS 5844 Alloy, Corrosion-Resistant, Round Bars 20Cr 35Ni 35Co 10Mo Vacuum Induction Plus Vacuum Consumable Electrode Melted Solution Heat Treated and Work Strengthened

BS EN 10204 Metallic products. Types of inspection documents

BS 1104 Specification for general-purpose Acme screw threads

BS 1580 pt 1&2 Specification for Unified screw threads. Diameters 1/4 in and larger

BS 3643-1 ISO Metric screw threads, 1 to 300mm Diameter. Specification

BS EN ISO 10423 Petroleum And Natural Gas Industries - Drilling And Production Equipment - Wellhead And Christmas Tree Equipment

EN ISO 11114-1 Transportable gas – Compatibility of cylinder and valve materials with gas contents – Part 1: Metallic materials (ISO 11114-1)

NACE MR 0175 ISO 15156-1 Petroleum And Natural Gas Industries - Materials For Use In H₂S-Containing Environments In Oil And Gas Production - Part 1: General Principles For Selection Of Cracking-Resistant Materials

CGA C-14, Procedures for Fire Testing of DOT Cylinder Pressure Relief Device Systems

3 Terms, definitions and symbols

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

3.1 Terms and definitions

3.1.1 Yield Stress

The value corresponding to the lower yield stress $R_{p0.2}$ the 0.2% proof stress.

3.1.2 Burst Pressure

Highest pressure reached in a pressure receptacle during a burst test. The pressure receptacle may not in fact burst during this test.

3.1.3 Batch

A batch is defined as a quantity of pressure receptacles not exceeding 200 of the same nominal diameter, thickness and design. The batch must also be manufactured from the same materials and heat numbers.

3.1.4 Service Pressure

The service pressure (or maximum working pressure) P shall be the maximum internal pressure that the pressure receptacle can contain while in transit, measured in bar, at a settled temperatures of 15°C.

3.1.5 Volumetric Test Pressure

The volumetric test pressure, p_v shall be equal to 5/3 times the service pressure, P .

3.1.6 Hydraulic test Pressure

The hydraulic test pressure, p_h shall be equal to 3/2 times service pressure, P .

3.1.7 Thick-walled Pressure receptacles

All pressure receptacles designed to this specification shall be thick-walled cylinders. Thick-walled cylinders are defined by the ratio of internal diameter to wall thickness, and this ratio shall be less than 10 in all cases.

3.1.8 Well Fluids

Pressure receptacles shall be designed to contain fluids of the following classifications

- UN 1267 Petroleum Crude Oil
- UN 1953 Compressed Gas, Toxic, Flammable NOS
- UN 1954 Compressed Gas, Flammable NOS
- UN 1964 Hydrocarbon Gas Mixture, Compressed, NOS
- UN 1965 Hydrocarbon Gas Mixture, Liquefied, NOS
- UN 1971 Methane, Compressed or Natural Gas, compressed
- UN 1075 Petroleum Gases, Liquefied or Liquefied Petroleum Gas

3.1.9 Verification

“Verification” is defined as either witnessing of tests or procedures, or otherwise, checking documentation of tests or procedures to be agreed between the manufacturer and the selected Notified Body prior to manufacture of a design of receptacle.

3.2 Symbols

a	Calculated minimum wall thickness, in millimetres, of the cylindrical shell
A	Percentage elongation
d	Inside diameter of the pressure receptacle, in millimetres
D	Outside diameter of the pressure receptacle, in millimetres
L_0	Original gauge length, in millimetres, according to ASTM A-370
p_b	Actual burst pressure, in bar, above atmospheric pressure
p_h	Hydraulic test pressure, in bar, above atmospheric pressure
p_{lc}	Lower cyclic pressure, in bar, above atmospheric pressure
p_y	Observed pressure when pressure receptacle starts to yield during hydraulic bursting test, in bar, above atmospheric pressure
p_v	Volumetric test pressure, in bar, above atmospheric pressure
P	Service pressure, or Maximum working pressure, in bar, above atmospheric pressure
R_e	Minimum guaranteed value of yield stress, in megapascals
R_{ea}	Value of the actual yield stress, in megapascals, determined by the tensile test
R_g	Minimum guaranteed value of tensile stress, in megapascals
R_m	Value of the actual tensile stress, in megapascals, determined by the tensile test
S	Wall stress in pressure receptacle, at volumetric test pressure (p_v), in megapascals
S_o	Original cross-sectional area of tensile test piece, in square millimetres, according to ASTM A-370
t	Actual thickness of the test specimen in millimetres
w	Width of the tensile test piece, in millimetres

4 Permissible Materials

There shall be no heat treatment of materials subsequent to receipt from maker. Maker shall supply certification to at least 3.1B of BS EN 10204.

Materials shall be considered for service in low temperatures down to -40°C and shall not be susceptible to brittle fracture etc at these temperatures.

Permanent joining techniques of any kind on pressure retaining components shall not be permitted, nor shall any subsequent hot work of the raw materials after receipt from the manufacturer to affect any repair or rebuild.

All materials exposed to well fluids, for pressure retaining parts, shall be qualified in accordance with NACE MR-0175 and/or ISO 15156.

Materials for the pressure containing components of transportable pressure receptacles shall be selected from the following:

4.1 Precipitation-hardening Stainless Steel

Shall conform to ASTM A-564.

4.2 Precipitation-hardening Nickel Alloy

Shall conform to ASTM B-637

4.3 Precipitation-hardening Nickel-Copper Alloy

Shall conform to ASTM B-865

4.4 Cobalt-Nickel Alloy

Shall conform to AMS 5844

4.5 Age-hardenable Nickel-Chromium-Molybdenum-Niobium Alloy

Shall conform to ASTM B-805

4.6 Precipitation-hardening Nickel Iron-Chromium Alloy

Shall conform to ASTM A-370

4.7 Chemical composition of materials

The chemical composition of materials shall conform to the relevant standard listed and should not exceed the values in Table 1.

Element	Precipitation-hardening Stainless Steel	Precipitation-hardening Nickel Alloy	Precipitation-hardening Nickel Copper Alloy	Nickel Cobalt Alloy	Nickel Chromium Molybdenum Niobium alloy	Precipitation-hardening Nickel Iron-Chromium Alloy
Aluminium %	-	-	2.3-3.15	-	0.35 Max	0.1-0.5
Beryllium %	-	-	-	-	-	-
Carbon %	0.07 Max	0.8 Max	0.25 Max	-	0.03 Max	0.03 Max
Chromium %	15-17.5	17-21	-	19-21	19-22.5	19.5-23.50
Copper %	3-5	-	BAL	-	-	1.5-3.0
Cobalt %	-	1.0 Max	-	35(BAL)	-	-
Hydrogen %					-	-
Iron %	73 (BAL)	BAL	2.0 Max	1.0 Max	BAL	22 Min
Nickel %	3-5	50-55	63-70 (+Co)	33-37	55-59	38.00-46.00
Niobium %					2.75-4.0	-
Nitrogen %					-	-
Manganese %	0.7 Max	0.35 Max	1.5 Max	-	0.35 Max	1.0 Max
Molybdenum %	-	2.8-3.30	-	9-10.5	7-9.5	2.50-3.50
Oxygen %						-
Titanium %	-	0.65-1.15	0.35-0.85	-	1.0-1.7	1.9-2.4
Tin %	-	-	-	-	-	-
Vanadium %					-	-
Zirconium %	-	-	-	-	-	-

Table 1 Chemical Composition of materials

5 Design

5.1 General provisions

5.1.1

The calculation of the wall thickness of the pressure-containing parts shall be related to the tensile stress (R_g) of the material and the test pressure P_v . The minimum calculation pressure shall not be lower than the test pressure from P200 of ADR for the products to be carried.

5.1.2

a) At volumetric test pressure p_v the wall stress S in the pressure receptacle shall not exceed 67% of the guaranteed tensile stress (R_g).

b) At hydraulic test pressure p_h the stress in the metal at the most severely stressed point of the pressure receptacle shall not exceed 77% of the guaranteed yield stress (R_e).

5.1.3

The internal pressure upon which the calculation of wall thickness is based shall be the volumetric test pressure (p_v).

5.1.4

The design of pressure receptacles shall be such that adequate venting of contents in event of exposure to fire shall be effected by the failure of the elastomeric seals fitted to end closures before any rupture of the pressure receptacle occurs.

5.2 Calculation of wall thickness

Wall thickness shall be determined by the following calculations. The ratio of internal diameter to wall thickness shall be less than 10 in all cases. This calculated wall thickness shall not include any corrosion allowances, or coating allowances.

Two calculations shall be made. First method in 5.2.1 shall ensure wall stress meets the criteria of 5.1.2a.

The second calculation in 5.2.2 shall ensure the wall thickness meets the criteria of 5.1.2b

5.2.1 Wall thickness at volumetric test pressure

The wall stress (S) at volumetric test pressure (p_v) shall be calculated by the following:

$$S := \frac{p_v \cdot (1.3 \cdot D^2 + 0.4 \cdot d^2)}{(D^2 - d^2)}$$

5.2.2 Stress Analysis Derivation.

The calculated values for Longitudinal, Circumferential and Radial stress at hydraulic test pressure P_h ,

σ_1 , σ_2 , and σ_3 shall be related to an Equivalent Stress, σ_y , by the “Theory of Constant Energy of Distortion”, Von Mises formula page 26 of Roark’s Formula for Stress and Strain, 6th edition.

Longitudinal Stress – calculated using appropriate loading and cross-sectional area.

$$\sigma_1 = P_h \times \left(\frac{b^2}{a^2 - b^2} \right)$$

Circumferential or Hoop Stress

$$\sigma_2 = P_h \times \left(\frac{a^2 + b^2}{a^2 - b^2} \right)$$

Radial Stress

$$\sigma_3 = -P_h$$

Where,

Ph= Test Pressure

a= Outside radius of pressure receptacle

b= Inside radius of pressure receptacle

Equivalent stress

$$\sigma_y = \frac{\sqrt{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2}}{2}$$

σ_y shall never exceed 77% of the guaranteed yield stress R_e for the material selected from clause 4.

5.3 Design of Ends

End closure of pressure receptacles shall be affected by a combination of threaded closure and a blind end or two threaded closures. Where a blind is fitted this shall be known as the base. Threads shall either be trapezoidal or “v” form, parallel, uniform and conform to BS EN 1104, BS 3643-1, or BS 1580 part 1&2.

The base thickness and the transition from the base to the wall shall be designed to meet the requirements of the hydraulic burst testing in 7.3.1 and pressure cyclic testing in 7.3.2, and also to allow the fitment of suitable valves and ported connections to the pressure receptacle. In no case shall the base thickness be less than the minimum calculated wall thickness, **a**.

The threaded closure shall be designed such that maximum shear stress of the thread shall not exceed 48% of the guaranteed yield stress R_e for the material selected in clause 4 at volumetric test pressure (p_v).

Materials for end closures may be selected from the following list. Additional mechanical testing as in clause 8.2 is required for end closures, and the material selected must have material certification to at least 3.1.B of EN 10204. Copper alloys do not exhibit low temperature embrittlement, therefore these materials are not required to have impact strengths as specified in 8.2.

Materials may also be selected for end closures from the list of permissible materials in clause 4, and additional mechanical testing as in clause 8.2 is required

5.3.1 UNS C63000 Aluminium Bronze, ASTM B150

5.3.2 UNS C72900 Copper Nickel Alloy AMS 4596

5.3.3 UNS C17200 Beryllium Copper ASTM B 196

5.4 Valve Connections

Valves and ported connections to the pressure receptacle shall not be made in the cylindrical shell of the pressure receptacle at which the minimum calculated wall thickness, **a** applies, but may be fitted to the blind end closure beyond this section. Valve and ported connections may also be made in the threaded closure. Integral valves where fitted shall form part of the design, and shall be subject to EC-type examination. External valves where fitted shall conform to BSEN 849 and be pi marked, or must meet the requirements of the Pressure Equipment Directive and, pursuant to that directive, be subject to a category II, III, or IV conformity assessment procedure according to whether the receptacle belongs to category 1,2, or 3 of the Transportable Pressure Equipment directive. Valves must also be marked in compliance with the TPED by a TPED qualified Notified Body by the affixing of the CE mark.

Parallel threads must have at least 4 engaged threads and the calculated maximum shear stress of the thread shall not exceed 48% of the guaranteed yield stress R_e for the material selected, in clause 4, at volumetric test pressure (p_v).

The pressure receptacle valve port threads shall be “V” form, parallel, or tapered, conforming to a recognized standard agreed between the Notified Body and manufacturer to permit the use of a corresponding valve, thus minimising valve port stresses following the valve torquing operation. Internal threads shall be checked using gauges corresponding to the agreed valve port thread or by an alternative method agreed between the Notified Body and manufacturer. Particular care shall be taken to ensure that internal threads are accurately cut, are of full form and free from sharp profiles, e.g. burrs.

Materials for integral valve components may be selected from the following list. Additional mechanical testing as in clause 8.2 is not required for integral valve components, provided the material selected has material certification to at least 3.1.B of EN 10204.

Materials may also be selected for integral valve components from the list of permissible materials in clause 4 without the requirement for additional mechanical testing as in clause 8.2

Materials for integral valve components:-

5.4.1 UNS C63000 Aluminium Bronze, ASTM B150

5.4.2 UNS S31600 Austenitic Stainless Steel, ASTM A182

5.4.3 UNS S31600 Austenitic Stainless Steel, ASTM A276

5.4.4 UNS S31600 Austenitic Stainless Steel, ASTM A479

5.4.5 UNS S31803 Duplex Stainless Steel ASTM A479

5.4.6 UNS S21800 Austenitic Stainless Steel, ASTM A479

5.4.7 UNS N06600 Nickel Chromium Alloy, ASTM B166

5.4.8 UNS C72400 High Strength Copper Nickel, DIN 2 1504, DTD 900/4805

5.4.9 UNS N08825 Nickel Iron Chromium Alloy, ASTM B425

5.4.10 UNS N10276 Hastelloy C 276, ASTM B-574

5.5 Technical Documentation

A fully dimensioned drawing and quality assurance plan shall be produced by the manufacturer and shall include specification of materials, inspection, test and production requirements. The Notified Body shall approve the drawings and quality assurance plan.

6 Construction and Workmanship

6.1 General

Processes for manufacture shall be limited to machine cutting only, the use of thermal processes are not permitted. Permanent joining techniques and heat treatment of materials after receipt from manufacturer are not permitted.

A manufacturing plan shall be created for each design of pressure receptacle and shall be approved by a Notified Body. Deviations from the plan shall not be allowed unless permitted by 7.1.1.

6.2 Surface Defects

Post machining non-destructive examination in accordance with BS EN ISO 10423 Level PSL-3 for pressure retaining parts shall be carried out. Surface defects on internal and external surfaces of the pressure receptacle shall not be permitted. Threads shall be checked to gauge, and shall conform to BS 1104, BS1580 part 1&2 or BS3643-1 or as required by thread type and classification.

6.3 Thickness checks

Wall thickness shall be within the specifications of the pressure receptacle as detailed within the dimensional drawings supplied as part of the requirement of 5.5.

7 New Design Tests

7.1 General Requirements

7.1.1 Prototype Tests

The following testing shall be carried out for each new design of pressure receptacle under the supervision of a Notified Body. A design shall be considered to be a new design when any of the following conditions apply.

- It is manufactured in a different factory, or
- It is manufactured by a different process, or
- It is manufactured from a different grade of material, or
- The base profile has changed or if there is a change in the base thickness/pressure receptacle diameter ratio, or
- The nominal outside diameter has changed, or
- Change in calculated wall thickness, or
- The test pressure has increased, or
- The minimum guaranteed material mechanical properties have reduced.

In cases where an approved design has a combination of threaded closure and blind end, substitution of an additional threaded closure identical to that already approved for the blind end does not constitute a new design, provided that the above conditions have not been infringed. Similarly, the length of a receptacle may be increased up to the maximum capacity of 5 Litres, provided that the above conditions are met.

7.1.2 Technical Specification

A technical specification of each new design of pressure receptacle, including design drawing, design calculation and material specifications shall be prepared by the manufacturer and approved by the Notified Body. Sufficient pressure receptacles shall be made available to the Notified Body to complete all verification tests.

7.2 Verifications and Tests

7.2.1 Verifications

The Notified Body shall verify that:

- The design of pressure receptacle conforms to clause 5
- The construction of pressure receptacle conforms to clause 6

7.2.2 List of tests

The Notified body shall verify the following tests:

- Mechanical tests as specified in 8.2
- Hydraulic burst test on 3 pressure receptacles as specified in 7.3.1
- Pressure cycling tests on 3 pressure receptacles as specified in 7.3.2
- Pool fire test on 3 pressure receptacles as specified in 7.3.3

7.3 Description of tests

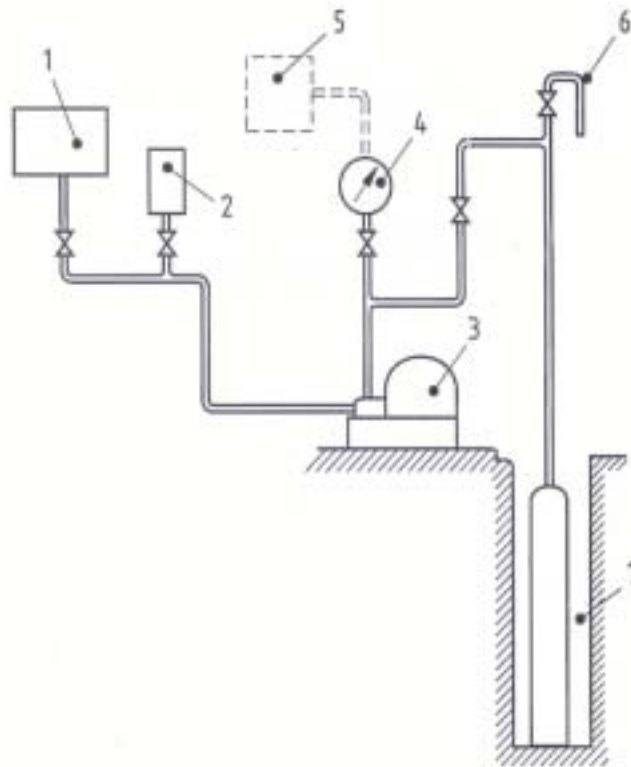
7.3.1 Hydraulic burst test

7.3.1.1 Procedure

The test method used shall be hydraulic, using suitable equipment. An example is shown in figure 1.

The average rate of pressure increase shall not exceed 50 bar/ second. It is important that no air is present during the test.

The pressure gauge used to monitor the burst pressure shall be calibrated to a reference every batch and a record made. The reference gauge shall be calibrated to a national reference at least every six months and a certificate kept until the time of the next calibration.



Key

- 1 Feed tank or other device for containing either water or another suitable hydraulic fluid
- 2 Tank for measurement of water or hydraulic fluid required for each test (the feed tank may be used as the measuring tank)
- 3 High pressure pump
- 4 Pressure gauge
- 5 Device for plotting the pressure/time curve
- 6 Pipe-line with an air vent or release valve at the extreme top for connecting the fixed installation to the cylinder under test. With certain installations it may be necessary to install more than one air vent to ensure that no air is trapped in the circuit
- 7 Safety device to prevent injury to personnel during the test

Figure 1 Burst Test Arrangement (typical)

7.3.1.2 Interpretation of results

The following procedures shall be used for the interpretation of results:

Determination of the burst pressure (p_b) and the yield pressure (p_y) attained during the test.

7.3.1.3 Acceptance criteria

For the results of a burst test to be considered satisfactory, the following requirements shall be met:

- The actual burst pressure (p_b) shall not be less than 2 times the pressure receptacle service pressure (P). If the receptacle has not burst at $2.48 \times$ service pressure P , then the receptacle will be considered as having passed the test.
- If the pressure receptacle burst then the body shall not fragment, fail in the forged areas or connection between adapter and body.
- Any burst shall only occur in the cylindrical part of the pressure receptacle body as a single vertical ductile fracture without any branching.
- The actual yield pressure p_y shall not be less than $1.94 \times$ service pressure P

7.3.2 Pressure cycling test

Pressure receptacles subjected to this test shall bear the markings as described in clause 12. This test shall be carried out with a non-corrosive liquid subjecting the pressure receptacles to successive reversals at an upper cyclic pressure, which is equal to the hydraulic test pressure (p_h). The value of the lower cyclic pressure (p_{lc}) shall not exceed 10% of the upper cyclic pressure, but shall have an absolute maximum value of 30bar.

The frequency of reversals shall not exceed 10 cycles/min. the temperature measured on the surface of the pressure receptacle shall not exceed 40°C during the test.

7.3.2.1 Acceptance

The pressure receptacle shall withstand 12 000 cycles without failure.

The test shall be considered satisfactory if the pressure receptacle attains the required number of cycles without developing a leak. The receptacles shall be sectioned after successful pressure cycling test to check that the base and wall thickness does not exceed that specified in the technical specification. The sectioned pressure receptacles shall also be examined for damage to or near the internal surfaces, particularly at the junction of the cylindrical wall and base

7.3.3 Pool fire test

Pressure receptacles shall be tested in accordance with the Compressed Gas Association publication C-14, Procedures for Fire Testing of DOT Cylinder Pressure Relief Device Systems

7.3.3.1 Acceptance

The test shall be considered satisfactory when the contents of the pressure receptacle are adequately vented when the pressure receptacle is exposed to fire, and no rupture occurs.

7.4 EC Type Examination Certificate

If the results of the tests and verifications in 7.3 are satisfactory, a EC Type Examination Certificate shall be issued by the Notified Body, an example of which is given in A.1 Annex A.

8 Batch tests

8.1 General

The following tests shall be verified by the Notified Body for each batch of pressure receptacles.

8.1.1 Information

For the purpose of batch testing, the manufacturer shall provide:

- The EC type-examination certificate
- Material certification to at least 3.1B of EN 10204 for each material used.
- Serial numbers and stamp markings of the pressure receptacles.

8.1.2 Checks and verifications

Batch testing shall include:

- Verification that a EC type-examination certificate has been obtained and that the pressure receptacles conform to it
- Checking the material certification
- Checking that the requirements of clauses 4, 6, 8.2, 9 and 11 have been met.

8.2 Mechanical tests

The Notified Body shall verify that for each heat number of material used in the manufacture of a batch of pressure receptacles, samples shall be taken from the billet, verified and marked accordingly with the heat number, material grade and certificate number, and then sent to an independent laboratory for verification of the material properties and chemical composition as specified in clause 4. These tests are to be carried out in accordance with ASTM E8 and verified by Notified Body. The results shall be recorded in the batch test certificate, an example of which is given in A.3.

Mechanical testing shall be performed on two samples taken from the outer edges of the billet, approximately 180° apart removed in the longitudinal direction. Test specimens shall be 4D bars with 1"(25.4mm) gauge length in accordance with ASTM E8. Charpy Impact testing shall be performed on three samples equally spaced from around the billet near the outer edges.

The minimum bending rupture energy shall be 42J @ -40°C. A longitudinal ISO V-notch 10mm x 10mm test piece shall be used for impact testing. A minimum of three tests shall be carried out. The average value of the three tests shall be used as the minimum bending rupture energy. Only one result below 42J is acceptable. The minimum acceptable value is 28J.

9 Tests on Every Pressure Receptacle

9.1 General

The following tests shall be verified by the Notified Body for each pressure receptacle

9.2 Dimensional Checks

Each pressure receptacle shall have a full dimension check on critical dimensions as indicated in the quality plan, the wall thickness shall be verified and the threads shall be checked against gauges.

9.3 Check Weighing

Each pressure receptacle shall be weighed dry and weighed full of water and the results recorded on an appropriate record sheet, an example of which is shown in A.4

9.4 Volumetric Expansion Test

Each pressure receptacle must successfully withstand a hydrostatic test as follows

The test must be by the water-jacket method, figure 2 gives a typical arrangement. The pressure gauge shall permit reading to an accuracy of 1% in the range 80-120% of the test pressure (p_v). The pressure gauge used to monitor the pressure shall be calibrated to a reference every batch and a record made. The reference gauge shall be calibrated to a national reference at least every six months and a certificate kept until the time of the next calibration.

The expansion-measuring device shall permit reading to an accuracy of 1% or 0.1mL whichever is greater, of the total expansion.

A calibration pressure receptacle, capable of verifying the equipment accuracy to 1% for the material, size and test pressure of the pressure receptacles to be tested, shall be used to verify the accuracy of the equipment at the beginning of each testing day.

Each pressure receptacle shall be tested to $5/3$ of the service pressure (P), .

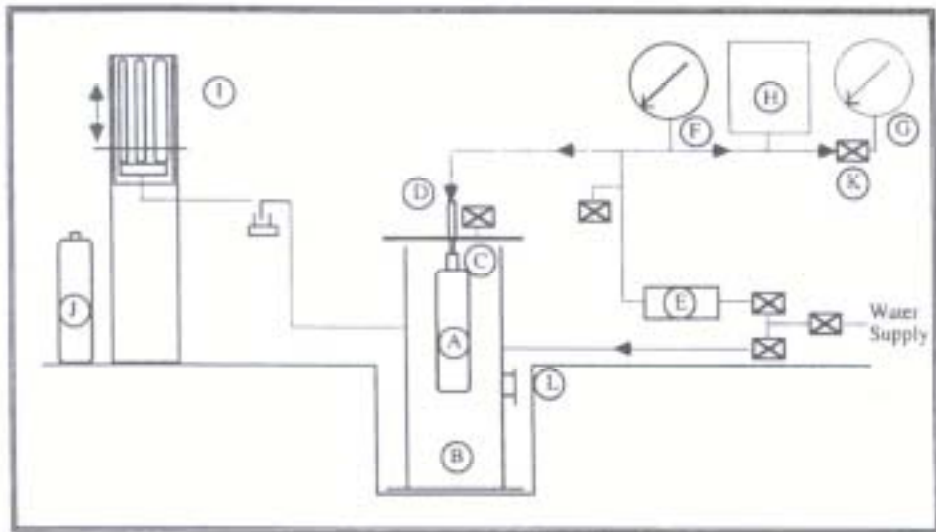
If due to the failure of the test apparatus, the test pressure (p_v) cannot be maintained, the test may be repeated at a pressure increased by 10% or 6.89bar, whichever is lower.

The results of the test shall be recorded on an appropriate record sheet, an example of which is shown in A.4.

9.4.1 Acceptance Criteria

Test pressure (p_v) shall be maintained for at least 30 seconds and sufficiently long to allow complete expansion. Any internal pressure applied prior to the official test shall not exceed 90% of the test pressure (p_v).

The permanent expansion shall not exceed 10% of the total expansion at test pressure (p_v).




KEY	DESCRIPTION
A	Cylinder
B	Water Jacket with relief non. sealed lid & high/low pressure connections
C	Test Adapter
D	Pressure Connection
E	Pump/manual - shop air - electric - motor driven
F	Pressure Indicating Device (PID)
G	Master Gauge (optional)
H	Pressure Recording Graph (optional)
I	Expansion Measuring (Indicating) Device (Burettes or Digital Balance)
J	Calibrated Cylinder
K	Isolation Valve
L	Safety Rupture Port
	Water/Electric/Air Control Valves: operated manually and/or automatically via PLC/Computer Control

Fig 2 Water jacket test apparatus (typical)

9.5 Leak test

After successful completion of tests 9.2, 9.3 and 9.4, each receptacle shall be assembled with appropriate component parts as per the approved manufacturing/assembly drawing, and a hydrostatic leak test to hydraulic test pressure p_h conducted. Valves should be opened and ports should be plugged to test integrity of the valve gland. Test duration shall be at least 10 minutes at hydraulic test pressure p_h .

A chart recording of the test shall be made on a calibrated chart-recording device. The recording device should have a full-scale pressure rating at least 25% higher than the hydraulic test pressure p_h .

9.4.1 Acceptance Criteria

During the test no weeps or leaks shall be visible from the receptacle or closures. The recorded pressure shall not reduce by more than 5% of hydraulic test pressure p_h over the test duration.

10 Failure to meet test requirements

The following procedure shall be used for both design testing and batch testing. In the event of a failure to meet test requirements, retesting or repair then retesting shall be carried out as follows:

- a) If there is evidence of a fault in carrying out the test, or an error of measurement a further test shall be performed. If the result of this test is satisfactory, the first test shall be ignored.
- b) If the test has been carried out in a satisfactory manner, the cause shall be identified. If the failure can be identified and repaired within the requirements of this standard, a further test can be performed. Otherwise the pressure receptacle shall be rejected by permanently rendering the pressure receptacle inoperable in accordance with clause 10.1.

10.1 Failure of tests

Any pressure receptacle failing to meet acceptance criteria shall be rejected. Pressure receptacles shall be rejected by permanently rendering the pressure receptacle inoperable, by mechanically cutting the pressure receptacle into at least 3 parts.

11 Identification marks

The pressure receptacle shall be marked clearly and legibly with certification marks. These marks shall be permanently affixed (stamped, engraved or etched), at least 2.5mm high on the pressure receptacle, in a position detailed in the manufacturing drawings of the pressure receptacle, as per the following:

- The manufacturer's mark registered with competent authority.
- The serial number of the pressure receptacle.
- The hydrostatic test pressure, (p_h) preceded by the letters "PH" and the word "BAR".
- The empty mass of the pressure receptacle including valves in Kilograms, followed by the letters "KG". The mass shall be expressed to three significant figures, rounded up to the last digit.
- The type approval number followed by TPSR.
- The characters identifying the country of approval as indicated by the distinguishing signs of motor vehicles in international traffic.
- The identity mark of the inspection body, registered with the competent authority.
- The date of the initial inspection, the year (four digits) followed by the month (two digits) separated by a slash (i.e. "/").
- The Transportable Pressure Equipment Directive conformity mark, (π) minimum height of mark shall be 5mm.
- The wall thickness.
- The service pressure P, preceded by the letters "PW" followed by the word "BAR".
- The water capacity followed by the letter "L".
- The letter "H".

Annex A
(Informative)

Examples of design test and batch test certificates

A.1 EC Type Examination Certificate

Issued byon behalf of

.....

applying XXXX

concerning **TPSR Technical Code for Refillable Transportable Pressure Receptacles for Oil Well Samples**

Certificate No Date

Type of pressure receptacle
(Description of the family of pressure receptacles to which the certificate applies)

p_n D_{min} D_{max} a^1

L_{min} L_{max} V_{min} V_{max}

.

Manufacturer or agent
(Name and address of manufacturer or its agent)

.....

.....

Details of the results of design testing of the pressure receptacle

And the main features of the design are annexed.

All information may be obtained from
(Name and address of the certificate issuer)

.....

Date Place

.....(signature)

A.2 Comments for use with EC Type Examination Certificate

- a) Results of design testing with pressure receptacle design details should be attached.
- b) Main features of the pressure receptacle design should be shown, in particular:
 - Longitudinal cross-section of the pressure receptacle which has been design tested, showing:
 - the minimum and maximum nominal external diameter, D_{\min} and D_{\max} with an indication of the design tolerances laid down by the manufacturer;
 - the guaranteed minimum thickness of the pressure receptacle wall (a);
 - the water capacity or capacities V_{\min} V_{\max} ;
 - the hydraulic test pressure, p_h
 - the name of the manufacturer/No. of the drawing and date;
 - the name of the pressure receptacle design;
 - the material in accordance with clause 4 (method of manufacture, guaranteed mechanical characteristics (tensile strength – yield stress)).

Table A.1 – Batch tests – Measurements of sample pressure receptacles

Test No.	Batch covering Nos..... To Nos.....	Water Capacity	Mass (empty) kg	Maximum measured thickness of the wall mm

Table A.2 - Mechanical tests carried out on sample pressure receptacles

Test No.	Heat No.	Tensile test				Hydraulic burst test bar	Description of the fracture
		Test piece	Yield Point R _{ea} MPa	Tensile Strength R _m MPa	Elongation A (%)		
Minimum values specified							

I, the undersigned hereby declare that I have checked that the requirements of clauses 8 and 9 of TPSR have been carried out successfully.

Special remarks

.....

General remarks

Certified on (date) Place

.....

(signature of issuer)

On behalf of

A.3 Batch test certificate

Application of Standard No. TPSR

Issuer

.....

Date

Design certificate No

Description of pressure receptacles

Manufacturing serial No to

Manufacturer

(Name and address)

.....

Country Mark

Owner

(Name and address)

.....

.....

Customer

(Name and address)

.....

.....