RULES

PUBLICATION 23/P

PIPELINES PREFABRICATION

August
2004

Publications P (Additional Rule Requirements) issued by Polski Rejestr Statków
complete or extend the Rules and are mandatory where applicable.

GDAŃSK

Publication 23/P – Pipelines Prefabrication – August 2004 (based on the IACS Unified Requirements P2, Rev. Nov. 2001, Chapters 2.5, 2.6), is an extension of the requirements contained in *Rules for the Classification and Construction of Sea-going Ships*.

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The present *Publication* replaces *Publication 23/P – Pipelines Prefabrication*, 1997.

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1 INTRODUCTION

The present requirements apply to class I, II and III piping systems made of carbon, carbon-manganese and alloy steels.

2 WELDING

2.1 General

The welding joints belonging to Class I or II piping systems shall be effected by approved procedures. Consumables shall meet the requirements of PRS *Rules* and welders are to be granted PRS certificates issued according to PRS *Publication 30/P – Principles for Certification of Welders*. Joint preparation and tolerance shall be appropriate to the welding process, in accordance with the PRS Rules or recognized standards.

The following requirements apply to the fabrication of Classes I and II piping systems operating at ambient or high temperatures and made of steel of the types given hereunder:
- carbon and carbon-manganese steels having minimum tensile strength (R_m) 320, 360, 410, 460 and 490 MPa;
- low alloy carbon-molybdenum, chromium-molybdenum, chromium-molybdenum-vanadium steels having chemical composition: 0.3Mo; 1Cr-0.5Mo; 2.25Cr-1Mo; 0.5Cr-0.5Mo-0.25V.

At the discretion of PRS these requirements may be applied also to the class III piping systems and to repair welding of pipelines.

Refrigerated cargo installations piping systems operating at temperatures lower than –40°C will be given special consideration by PRS.

2.2 Agreeing of Welding Procedures

Welding procedures for class I and II piping systems are subject to PRS agreement.

The welding procedure is to detail all of the parameters necessary to effect sound welds. Prior to commencement of welding, the Works should be granted with the recognition for welding on the basis of appropriate tests. The tests should include:
- welding processes,
- parent materials,
- welding consumables,
- edge preparation,
- welding position.

The procedure tests should be performed in conditions adequately representative of those actually used in the production welding.

Scope of non-destructive testing is to be given in item 3.

The following tests are required from each test assembly:
- transverse tensile tests,
- bend tests (1 – face bend and 1 – root bend or 1 – side bend).

Macro section with hardness survey, Charpy V-notch impact tests in weld metal and heat affected zone, chemical analysis of the deposited metal in case of alloy steels may also be required at the discretion of PRS.

Unless otherwise specified the results of tensile tests are to comply with the parent material requirements.

Bend specimens are to be bent around a mandrel having a diameter 4 times the thickness of the specimen with an angle of 180°. Superficial cracks less than 3 mm in length should not be taken into consideration.

PRS may wholly or partially dispense with procedure approval test where the required weld properties are demonstrated by other means to the PRS satisfaction.

2.3 Welding Facilities and Personnel

Piping systems are to be manufactured by Works having the necessary equipment, qualified personnel and implemented technological process for the construction of welded piping.

2.4 Edge Preparation for Welded Joints

Edge preparation is to be in accordance with recognized standards and/or approved drawings.

The preparation of the edges shall be preferably carried out by mechanical means. When flame cutting is used, care should be taken to remove the oxide scales and any notch due to irregular cutting by matching grinding or chipping back to sound metal.

2.5 Alignment and Assembling

Unless otherwise agreed by PRS, the tolerances on the alignment of the pipes to be welded are to be as given in Table 1.

Table 1

Pipe inside diameter [mm]	Pipe wall thickness t [mm]	Tolerance on the alignment of the pipes [mm]
Pipes of all diameters and thicknesses welded with permanently fitted backing ring		0.5
< 150	≤ 6	1.0 or $t/4$ whichever is less
< 300	≤ 9.	1.5 or $t/4$ whichever is less
≥ 300	> 9.5	2.0

Note:
For class III piping systems, the requirements for alignment tolerances may be waived at the discretion of PRS.

Tack welds should be made with an electrode suitable for the base material; tack welds which from part of the finished weld should be made using approved procedures.

When welding procedure requires preheating, the same preheating should be applied during tack welding.

2.6 Preheating

Preheating of the different types of steels will be dependent upon their thickness and chemical composition as indicated in Table 2.

In any case, dryness is to be ensured using, in necessary suitable preheating.

Table 2 values are based on use of low hydrogen processes; consideration should be given to using higher preheating temperatures when low hydrogen processes are not used.

Table 2

Type of steel		Thickness of thicker part [mm]	Minimum preheating temperature [°C]
C and C-Mn with carbon equivalent	C + Mn/6 ≤ 0.4	≥ 20[2)]	50
	C + Mn/6 > 0.4	≥ 20[2)]	100
0.3Mo		> 13[2)]	100
1Cr-0.5 Mo		< 13 ≥ 13	100 150
2.25Cr-1Mo and 0.5Cr-0.5Mo-0.25V[1)]		< 13 ≥ 13	150 200

Notes:

1) For these materials, preheating may be omitted for thicknesses up to 6 mm if the results of hardness tests carried out on welding procedure qualification are considered acceptable by PRS.

2) For welding in ambient temperature below 0°C, the minimum preheating temperature is required independent of the thickness unless specifically approved by PRS.

2.7 Heat Treatment after Forming and Welding

The heat treatments are not to impair the specified properties of the materials; verifications, may be required to this effect as necessary. The heat treatments are preferably to be carried out in suitable furnaces provided with temperature recording equipment. However, also localized heat treatments on a sufficient portion of the length way of the welded joint, carried out with approved procedures, can be accepted by PRS.

Hot forming is to be generally carried out in the temperature range 850°C – 1000°C, for all grades however, the temperature may decrease to 750°C during the forming process.

When the hot forming is carried out within the temperature range, the following generally applies:
- for C, C-Mn and C-Mo steels, no subsequent heat treatment is required;
- for Cr-Mo and C-Mo-V steels, a subsequent stress relieving heat treatment in accordance with Table 3 is required.

When the hot forming is carried outside the above temperature range, a subsequent new heat treatment in accordance with Table 4 is generally required for all steel grades.

After cold forming, when $r \leq 4D$ (where r is the mean bending radius and D is the outside diameter of pipe) consideration is to be given to a complete heat treatment in accordance with Table 4; in any case a stress relieving heat treatment in accordance with Table 3 is required for all grades other than carbon and carbon-manganese steels with R_m 320, 360 and 410 MPa.

Stress relieving heat treatment after welding for other than oxy-acetylene welding process is required as indicated in Table 3 depending on the type of steel and thickness.

The temperature ranges given in the Table are in accordance with common practice. Other values for upper and lower temperature limits may be stipulated by the PRS.

The stress relieving heat treatment is to consist in heating the piping slowly and uniformly to a temperature within the range indicated in the Table 3, soaking at this temperature for a suitable period, in general one hour per 25 mm of thickness, minimum half an hour, cooling slowly and uniformly in the furnace to a temperature not exceeding 400°C and subsequently cooling in a still atmosphere.

In any case, the heat temperature is not to be higher than t_T – 20 [°C], where t_T is the temperature of the final tempering treatment of the material.

Table 3

Type of steel	Thickness of thicker part [mm]	Stress relief heat treatment temperature [°C]
C and C-Mn	≥ 15 [1), 3)]	550 to 620
0.3 Mn	≥ 15 [1)]	580 to 640
1Cr-0.5 Mo	> 8	620 to 680
2.25Cr-1Mo and 0.5Cr-0.5Mo-0.25V	any [2)]	650 to 720

Notes:

1) When steels with specified Charpy V notch impact properties at low temperature are used, the thickness above which postweld heat treatment shall be applied may be increased by special agreement with PRS.

2) Heat treatment may be omitted for pipes having thickness ≤ 8 mm, diameter ≤ 100 mm and minimum service temperature 450°C.

3) For C and C-Mn steels, stress relieving heat treatment may be omitted up to 30 mm thickness by special agreement with PRS.

Unless otherwise specified, for oxy-acetylene welding, the heat treatment indicated in Table 4 depending on the type of steel is required.

The temperature ranges given in Table are in accordance with common practice. Different values for upper and lower temperature limits may be stipulated by the PRS.

Table 4

Type of steel	Heat treatment and temperature [°C]
C and C-Mn	Normalizing 880 to 940
0.3 Mo	Normalizing 900 to 940
1Cr-0.5Mo	Normalizing 900 to 960 Tempering 640 to 720
2.25Cr-1 Mo	Normalizing 900 to 960 Tempering 650 to 780
0.5Cr-0.5Mo-0.25V	Normalizing 930 to 980 Tempering 670 to 720

3 NON-DESTRUCTIVE TESTING OF WELDS AND ACCEPTANCE CRITERIA

In general, the welded joints including the inside wherever possible shall be visually examined and non-destructive tests will be required depending on the class of pipes and type of joint as hereunder indicated.

Table 5
Extent of non-destructive testing of pipelines welded joints

Class of pipelines	Outside diameter of pipe [mm]	Extent of testing, in percentage, of welded joints	
		visual testing [1)]	radiographic or ultrasonic
I	≤ 75	100	10 [2)]
	> 75		100
II	≤ 100		at random
	> 100		10 [2)]
III	irrespective of diameter		at random

Notes:

1) In places indicated by the PRS Surveyor, visual inspection is to be supplemented by penetrant or magnetic.
2) However, not less than 1 welded joint made by a welder.

More stringent requirements may be applied at the PRS discretion depending on the kind of materials, welding procedure and controls during the fabrication.

An approved ultrasonic procedure may be accepted, at the PRS discretion, in lieu of radiographic testing when the conditions are such that a comparable level weld quality is assured.

Fillet welds of flange pipe connections are to be examined by magnetic particle method or by other appropriate non-destructive methods, in case of Class I pipes.

In other cases, magnetic testing or equivalent non-destructive testing may be required at the discretion of the Surveyor.

Radiographic and ultrasonic testing is to be performed with an appropriate technique by trained operators (acc. PN-EN 473 standard).

At the request of the PRS, complete details of radiographic or ultrasonic technique is to be submitted for approval.

Magnetic testing is to be performed with suitable equipment and procedures, and with a magnetic flux output sufficient for defect detection. The equipment may be required to be checked against standard samples.

The welds are to meet the acceptable standard level as required by the PRS. Unacceptable defects are to be removed and repaired according to the satisfaction of the PRS.