JIS G 4903 Seamless nickel-chromium-iron alloy pipes

1. Scope

This Japanese Industrial Standard specifies the seamless nickel-chromium-iron alloy pipes (hereafter referred to as pipes) intended for the use of piplings of corrosion-resisting and high temperature service.

Remarks

1. The purchaser may specify, in addition to the items given in this text, part of the supplementary quality requirements of Z 2 to 4 in Annex 1 by prior agreement with the manufacturer.

Annex 1 Z 2 High temperature yield point or proof stress

Annex 1 Z 3 Ultrasonic examination

Annex 1 Z 4 Eddy current examination

2. Applicable standards in this Standard are shown as follows

JIS Z 8401 Rules for Rounding Off of Numerical Values

JIS Z 2201 Test Pieces for Tensile Test for Metallic Materials

JIS Z 2241 Method of Tensile Test for Metallic Materials

JIS G 0303 General Rules for Inspection of Steel

JIS G 0567 Method of High Temperature Tensile Test for Steels and Heat-Resisting Alloys

JIS G 0551 Methods of Austenite Grain Size Test for Steel

JIS G 0582 Ultrasonic Examination of Steel Pipes and Tubes

JIS G 0583 Eddy Current Examination of steel Pipes and Tubes

JIS G 1256 Method for X-Ray Fluorescent Spectrometric Analysis of Iron and Steel

JIS G 1257 Methods for Atomic Absorption Petrochemical Analysis of Iron and steel

JIS G 1281 Methods for Chemical Analysis of Nickel-Chromium-Iron Alloys

2. Grade and symbol

Pipes shall be classified into 6 grades and their symbols shall be as given in Table 1.

Table 1 Symbol of grade

Symbol of grade
NCF600TP
NCF625TP
NCF690TP

NCF800TP NCF800HTP NCF825TP

World standard Comferens Table

	Grade number	Designation of Grade
ASTM	B167	N06600 N06601 N06690 N6025 N06045
	B407	N08800 N08810 N08811
	B423	N08825 N08821
JIS	G4903	NCF600TP NCF625TP NCF690TP NCF800TP NCF800HTP NCF825TP

3. Manufacturing method

3.1 Pipes shall be manufactured shall be as follows.

3.2 The inside and outside surfaces of the pipes shall be finished excellently and free from defects detrimental to practical use.

Table 2 Heat treatment

Symbol of grade	Heat treatment ℃	
	Solution treatment	Annealing
NCF600TP	-	900 or higher rapid cooling
NCF625TP	1090 or higher rapid colling	870 or higher rapid cooling
NCF690TP	-	900 or higher rapid colling
NCF800TP	-	950 or higher rapid colling
NCF800HTP	1100 or higher rapid colling	-
NCF825TP	-	930 or higher rapid cooling

3.3 Symbols expressing manufacturing methods shall be as given in Table 3.

Table 3 Symbols expressing manufacturing methods

Classification	Symbols
Hot finished seamless pipe	- S - H
Cold finished seamless pipe	- S - C

Remarks

The symbol - may be replaced by a bland.

4. Chemical composition

Pipes shall be subjected to the test of 10.1, and their cast analysis shall be as given in Table 4.

Table 4.Chemical composition Unit: %

Symbol of grade	C	Si	Mn	P	S	Ni	Cr	Fe	Mo	Cu	Al	Ti	Nb+Ta
NCF600TP	0.15 max.	0.50 max.	1.00 max.	0.030 max.	0.015 max.	72.00 min.	14.00~ 17.00	6.00~ 10.00	-	0.50 max.	-	-	-
NCF625TP	0.10 max.	0.50 max.	0.50 max.	0.015 max.	0.015 max.	58.00 min.	20.00~ 23.00	5.00 max.	8.00~ 10.00	-	0.40 max.	0.40 max.	3.15~ 4.15
NCF690TP	0.05 max.	0.50 max.	0.50 max.	0.030 max.	0.015 max.	58.00 min.	27.00~ 31.00	7.00~ 11.00	-	0.50 max.	-	-	-
NCF800TP	0.10 max.	1.00 max.	1.50 max.	0.030 max.	0.015 max.	30.00~ 35.00	19.00~ 23.00	Remainder	-	0.75 max.	0.15~ 0.60	0.15~ 0.60	-
NCF800HTP	0.05 ~0.10	1.00 max.	1.50 max.	0.030 max.	0.015 max.	30.00~ 35.00	19.00~ 23.00	Remainder	-	0.75 max.	0.15~ 0.60	0.15~ 0.60	-
NCF825TP	0.05 max.	0.50 max.	1.00 max.	0.030 max.	0.015 max.	38.00~ 46.00	19.50~ 23.50	Remainder	2.50~ 3.50	1.50~ 3.00	0.20 max.	0.60~ 1.20	-

Remarks

1. Analysis value for Ni may contain Co.

2. When requested by the purchaser, product analysis may be conducted. In this case, the permissible variation of chemical composition shall be as agreed upon between the parties concerned with delivery

5. Mechanical properties

5.1 Tensile strength, proof stress and elongation Pipes shall be tested in accordance with 10.2 and the resulting tensile strength, proof stress and elongation of pipes shall conform to Table 5.

Table 5 Mechanical properties

Symbol of grade	Heat treatment	Dimensions			
			Tensile strength kgf/П {N/П}	Proof stress kgf/П {N/П}	Elongation %
NCF600TP	Annealing after hot finishing	127mm or under in outside diameter	550 min.	205 min.	35 min.
		Over 127mm in outside diameter	520 min.	175 min.	35 min.
	Annealing after cold finishing	127mm or under in outside diameter	550 min.	245 min.	30 min.
		Over 127mm in outside diameter	550 min.	205 min.	30 min.
NCF625TP	Annealing after cold finishing	-	820 min.	401 min.	30 min.
	Solution treatment after cold finishing	-	690 min.	275 min.	30 min.
NCF690TP	Annealing after hot finishing	127mm or under in outside diameter	590 min.	205 min.	35 min.
		Over 127mm in outside diameter	520 min.	175 min.	35 min.
	Annealing after cold finishing	127mm or under in outside diameter	590 min.	245 min.	30 min.
		Over 127mm in outside diameter	590 min.	205 min.	30 min.
NCF800TP	Annealing after hot finishing	-	450 min.	175 min.	30 min.
	Annealing after cold finishing	-	520 min.	205 min.	30 min.
NCF800HTP	Solution treatment after hot finishing or after cold finishing	-	450 min.	175 min.	30 min.
NCF825TP	Annealing after hot finishing	-	520 min.	175 min.	30 min.
	Annealing after cold finishing	-	580 min.	235 min.	30 min.

Remarks

1. The elongation value indicates the value obtained from the tensile test on No.11 or No.12 test piece.

2. When tensile test is conducted on No. 12 test piece for the pipes of under 8mm in wall thickness, the minimum value of elongation shall be reduced at the rate of 1.5% from the elongation value given in Table 3 for each 1mm decrease in wall thickness from 8mm, and be rounded off to an integer in accordance with JIS Z 8401.

3. To pipes of under 20mm in outside diameter, the values in the above table shall not be applied, though the values shall be noted.

5.2 Flattening resistance Pipes shall be tested in accordance with 10.3 and shall be free from flaws or cracks on their wall surfaces.

H = (1 + e) t / (e + t/D)

Where H: distance between flattening plates (mm)

T: wall thickness of pipe (mm)

D: outside diameter of pipe (mm)

e: 0.09(constant)

6. Austenitic grain size

The pipes of NCF800HTP shall be tested in accordance with 10.4 and the resulting average austenitic grain size number shall be equal to or coarser than No. 5

7. Hydrostatic characteristic

When hydrostatic pressure P (this is 7 MPa if the value P exceeds 7 MPa) calculated from the following formula is applied, the pipes shall withstand it without leakage. In the case where the hydrostatic test is conducted by the specification of the purchaser and the test pressure exceeds the value P calculated from the following formula, the test pressure shall be agreed upon by the purchaser and the manufacturer. The designated hydrostatic pressure shall be graduated in 0.5 MPa for under 10 MPa and in 1 MPa for 10 MPa or over. In calculation, the value P in the following formula shall be obtained and likewise rounded off to 0.5 MPa or 1 MPa.

$P = 200st/D$

Where P: test pressure

t: wall thickness of pipe(mm)

D: Outside diameter of pipe(mm)

s: 1/4 of minimum value of tensile strength specified in Table 5 (MPa)

Table 5 Mechanical properties

Symbol of grade	Heat treatment	Dimensions			
			Tensile strength kgf/П {N/П}	Proof stress kgf/П {N/П}	Elongation %
NCF600TP	Annealing after hot finishing	127mm or under in outside diameter	550 min.	205 min.	35 min.
		Over 127mm in outside diameter	520 min.	175 min.	35 min.
	Annealing after cold finishing	127mm or under in outside diameter	550 min.	245 min.	30 min.
		Over 127mm in outside diameter	550 min.	205 min.	30 min.

NCF625TP	Annealing after cold finishing	-	820 min.	410 min.	30 min.
	Solution treatment after cold finishing	-	690 min.	275 min.	30 min.
NCF690TP	Annealing after hot finishing	127mm or under in outside diameter	590 min.	205 min.	35 min.
		Over 127mm in outside diameter	520 min.	175 min.	35 min.
	Annealing after cold finishing	127mm or under in outside diameter	590 min.	245 min.	30 min.
		Over 127mm in outside diameter	590 min.	205 min.	30 min.
NCF800TP	Annealing after hot finishing	-	450 min.	175 min.	30 min.
	Annealing after cold finishing	-	520 min.	205 min.	30 min.
NCF800HTP	Soultion treatment after hot finishing or after cold finishing	-	450 min.	175 min.	30 min.
NCF825TP	Annealing after hot finishing	-	520 min.	175 min.	30 min.
	Annealing after cold finishing	-	580 min.	235 min.	30 min.

Remarks

1. The elongation value indicates the value obtained from the tensile test on No. 11 or No.12 test piece.
2. When tensile test is conducted on No. 12 test piece for the pipes of under 8mm in wall thickness, the minimum value of elongation shall be reduced at the rate of 1.5 % from the elongation value given in Table 3 for each 1mm decrease in wall thickness from 8mm, and be rounded off to an integer in accordance with JIS Z 8401.
3. To pipes of under 20mm in outside diameter, the values in the above table shall not be applied, though the values shall be noted.

8. Appearance

(1) The pipes shall be straight for practical purposes, and their both ends shall be at right angles to the axes.

(2) The inside and outside surfaces of the pipes shall be finished excellently and free from defects detrimental to practical use.

9. Tolerances on dimension

(1) The tolerances on outside diameter, wall thickness and wall thickness disparity for the pipes shall be as specified in Table 6.

Table 6 Tolerances on outside diameter, wall thickness and wall thickness disparity

Division	Tolerances on outside diameter	Tolerances on wall thickness	Tolerances on wall thickness disparity
Hot finished seamless pipe	Up to 50mm, ± 0.5mm 50mm and over, ± 1%	Up to 4mm, ± 0.5mm 4mm and over, ± 12.5%	Within 20% of thickness
Cold finished seamless pipe	30mm ±0.3mm 30mm ±1%	Up to 2mm, ± 0.2mm 2mm and over, ± 10%	-

Remarks

The tolerances on wall thickness disparity is defined as the ratio of the difference between the largest and the smallest values of wall thickness measured in the same cross section to the ordered wall thickness. This shall not be applied to the pipes of under 5.6mm in wall thickness.

(2) When the length of a pipe is designated, the tolerances on length shall be on the plus side.

10. Test

10.1 Analytical test

10.1.1 Analytical test

General matters for analytical tests and sampling of an analytical sample shall be in accordance with 3. (chemical composition) of JIS G 0303.

10.1.2 Analytical method

The analytical method shall be in accordance with any one of the following standards. However, when those standards can not be applied, the analytical method shall be agreed upon between the parties concerned with delivery.

JIS G 1256, JIS G 1257, JIS G 1281

10.2 Tensile test

10.2.1 Test piece

The test piece shall be any one of No. 11, No. 12 A, No.12 B, or No.12 C test piece specified in JIS Z 2201 and shall be cut off from a pipe.

10.2.2 Test method

The test method shall be as specified in JIS Z 2241.

10.3 Flattening test

10.3.1 Test piece

A test piece of 50mm or over in length shall be cut off from one end of a pipe.

10.3.2 Test method

The test piece shall be placed between two flat plates at ordinary temperature as it is and flattened by compression until a distance between the plates becomes a specified value, and shall be checked for flows and cracks on the wall surface of the pipe.

10.4 Austenitic grain size test

10.4.1 Test piece

A part of approximately 20mm in length shall be cut off from one end of a pipe to serve as a test piece.

10.4.2 Test method

The test method shall be as specified in JIS G 0551

10.5 Hydrostatic test or nondestructive test

(1) When hydrostatic pressure is applied to a pipe and is kept at specified pressure, whether the pipe withstands said pressure and whether a leak is generated or not is examined.

(2) The test method for nondestructive inspection shall be in accordance with either JIS G 0582 or JIS G 0583.

11. Inspection

11.1 General matters for inspection shall be as specified in JIS G 0303.

11.2 The chemical composition shall conform to the requirements specified in 3.

11.3 The mechanical properties shall conform to the requirements specified in 4.

11.4 NCF800HTP pipes shall be subjected to the austenitic grain size test and the result shall conform to the requirements specified in 5.

11.5 Either hydrostatic test characteristics or nondestructive test characteristics shall conform to the requirements specified in 6. However, the hydrostatic test may be replaced by a suitable nondestructive inspection other than those specified in 10.5 (2) as agreed upon between the parties concerned with delivery.

11.6 The dimensions shall conform to the requirements specified in 7.

11.7 The appearance shall conform to the requirements specified in 8.

11.8 In the case where supplementary quality requirements of Annex 1 are specified as agreed upon between the parties concerned with delivery, the obtained results shall conform to the said requirements specified in Z 2 to 4.

11.9 Either the hydrostatic test or the nondestructive test shall be conducted on each pipe.

11.10 A number of product analysis samples shall be agreed upon between the parties concerned with delivery.

11.11 The method of sampling test specimens and the number of test pieces for tensile test, flattening test and austenitic grain size test shall be as specified below. Take two specimens for each lot of 100 pipes or its fraction of the same cast, heat treatment, and dimensions. Take one test piece for tensile test from each of the test specimens, and then take one test piece for flattening test from both ends of one of the two test specimens.

Further, take one test piece for austenitic grain size test from either of the two test specimens.

12. Marking

Each pipes having passed the inspection shall be legibly marked with the following peculiarities. However, small pipes may be bundled together and marked for each bundle by a suitable means. The order of arranging the peculiarities is not specified.

Further, a part of the peculiarities may be omitted as agreed upon between the parties concerned with delivery.

(1) Symbol of grade

(2) Dimensions (external shape X thickness

(3) Symbol expressing manufacturing method

(4) Manufacturer's name or its abbreviation

(5) symbol Z expressing the specification for supplementary quality requirements.

13. Report

The manufacturer, as required, shall submit to the purchaser a report on the test results, manufacturing method, ordered dimensions, quantity and work lot number indicating the history of manufacture.

Annex 1 Supplementary quality requirements

The supplementary quality requirements shall be applied only when designated by the purchaser, and the designated item or items as given below shall be executed by the manufacturer.

Z 2. High temperature yield point or proof stress

(1) The values of the high temperature yield point or proof stress and test temperatures shall be agreed upon by the purchaser and the manufacturer.

(2) The test piece and test method shall be as specified in JIS G 0567.

When it is difficult to take the test piece specified in JIS G 0567, the profile of the test piece shall be agreed upon by the purchaser and the manufacturer.

(3) Pertaining to the sampling of test specimens and the number of test pieces, one test specimen shall be taken from a lot of the same cast, and from the test specimen one test piece shall be taken for each test temperature.

Z 3. Ultrasonic examination

(1) The criteria of the ultrasonic examination shall be the test sensitivity UB for cold finished pipes and UC for hot finished pipes specified in JIS G 0582, and there shall be no signal at least equal to the signals produced by the artificial flaws of the reference test piece in performance.

(2) The test method of the ultrasonic examination shall be as specified in JIS G 0582.

(3) The ultrasonic examination shall be performed for each pipe and the results shall conform to the requirements of (1).

Z 4. Eddy current examination

(1)The criteria of the eddy current examination shall be the test sensitivity EV for cold finished pipes and EX for hot finished pipes specified in JIS G 0583, and there shall be no signal at least equal to the signals produced by the artificial flaws of the reference test piece in performance.

(2) The test method of eddy current examination shall be as specified in JIS G 0583.

(3) The eddy current examination shall be performed for each pipe and the results shall conform to the requirements of (1).

JIS Number and Corresponding Foreign Standards

JIS			ASTM			BS			DIN			NF			ISO			Index Number
Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade	Type	
G4903	NCF600TP	A	B167	NO6600	A													C011
	NCF800TP	A	B407	NO8800	A													
	NCF825TP	A	B423	NO8825	A													