ASTM A928/A928M 2205 (S32205) Engineering Datasheet

Prepared from ASTM A928/A928M-13

1. Basic designation

Standard	UNS	Common grade / name	Product type	Scope
ASTM A928/A928M-13	S32205	2205	Electric-fusion-welded duplex stainless steel pipe with addition of filler metal	Suitable for corrosive service

2. Grade, plate, and filler metal specification table (ASTM A928 Table 1)

UNS	Common	Plate material	A5.4 Class	A5.4 UNS	A5.9 Class	A5.9 UNS	A5.11 Class	A5.11 UNS	A5.14 Class	A5.14 UNS	A5.22 Class	A5.22 UNS	A5.30 Class	A5.30 UNS
S32205	2205	A240/A240M S32205	E2209	W39209	ER2209	S39209	—	—	—	—	E2209TOX	W39239	—	—

Note: "—" means an AWS standard filler metal is not yet available for inclusion in ASTM A928 Table 1.

3. Chemical composition requirements

Requirement	Details
Plate chemistry basis	The plate material chemistry shall conform to the applicable ASTM A240/A240M grade listed in Table 1.
Welding material chemistry	Unless otherwise specified in the purchase order, welding material shall conform to the applicable AWS specification for the corresponding grade in Table 1, or conform to the chemical composition specified for the plate, or, subject to purchaser approval, be a filler metal more highly alloyed than the base metal when needed for corrosion resistance or other properties.
Nitrogen analysis	When nitrogen is a specified element for the ordered grade, the method of analysis shall be a matter of agreement between purchaser and manufacturer.
Heat analysis	The chemical analysis of the steel shall be determined by the plate manufacturer and shall conform to A240/A240M.
Product analysis lot size	One length of flat-rolled stock from each heat, or base metal and weld deposit from two pipes from each lot. Pipe lot size: under NPS 2 = 400 lengths; NPS 2 to 5 incl. = 200 lengths; NPS 6 and over = 100 lengths.
Product analysis acceptance	Results shall conform to Section 7, subject to product analysis tolerances of Table 1 in A480/A480M.

4. Heat treatment / annealing requirements (ASTM A928 Table 2)

UNS	Common grade / name	Heat treatment temperature	Quench / cooling requirement
S32205	2205	1870–2010 °F [1020–1100 °C]	Rapid cooling in air or water

Unless otherwise stated in the order, heat treatment shall be performed after welding and in accordance with Table 2. If desired by the purchaser, pipe fabricated from plate already heat treated may be supplied without final heat treatment and marked HT-O.

5. Pipe class and weld construction requirements

Class	Requirement
Class 1	Pipe shall be double welded by processes using filler metal in all passes and shall be radiographed completely.
Class 2	Pipe shall be double welded by processes using filler metal in all passes. No radiograph is required.
Class 3	Pipe shall be single welded by processes using filler metal in all passes and shall be radiographed completely.
Class 4	Same as Class 3, except that the weld pass exposed to the inside pipe surface is permitted to be made without the addition of filler metal.
Class 5	Pipe shall be double welded by processes using filler metal in all passes and shall be spot radiographed.

Joints shall be full-penetration single- or double-welded butt joints using fusion welding processes. Backing rings or strips, if used, shall be removed completely after welding and before required radiography. Welding procedures and welding operators shall be qualified to ASME BPVC Section IX.

6. Mechanical test requirements

Requirement	Details
Plate tensile properties	The plate used in making the pipe shall conform to the tensile requirements of the applicable A240/A240M grade listed in Table 1. Tension tests made by the plate manufacturer qualify the plate material.
Transverse tension test across welded joint	Tensile strength shall be not less than the specified minimum tensile strength of the plate.
Guided-bend weld tests	Two bend specimens shall be taken transversely from the pipe. One face guided-bend and one root guided-bend test are required unless side bends are permitted by wall thickness.
Wall thickness > 3/8 in. to < 3/4 in.	Side-bend tests may be made instead of face and root bends.
Wall thickness ≥ 3/4 in.	Both bend specimens shall be side-bend tests.
Bend acceptance	No cracks or defects exceeding 1/8 in. [3 mm] in any direction in weld metal or between weld and pipe metal after bending; edge cracks less than 1/4 in. [6.5 mm] are disregarded.

Test specimens shall be taken from the end of finished pipe, flattened cold before final machining to size, or may be taken from a welded test plate prolongation as permitted by Section 14.2.

7. Nondestructive examination and pressure test requirements

Requirement	Details
Hydrostatic or NDE requirement	Each length of pipe shall be subjected to a hydrostatic test or, with purchaser approval, each length of pipe having wall thickness up through 0.165 in. [4.2 mm] shall be subjected to a nondestructive electric test.
Hydrostatic test	Per A999/A999M. Pressure shall be held long enough for inspection of the entire welded seam.
System pressure test option	With manufacturer agreement, purchaser may complete the hydrostatic requirement by system pressure test; test pressure may be lower or higher than specification test pressure, but never below system design pressure. Pipe furnished without completed manufacturer hydro shall be marked NH.
Nondestructive electric test	Per Practice E426.
Eddy-current scope	For pipe through NPS 4, eddy-current test shall be applied to the total pipe area. For pipe larger than NPS 4, the producer may apply eddy-current testing to the weld area only instead of the total pipe area.
Radiography Classes 1, 3, 4	All welded joints shall be examined completely by radiography.
Radiography Class 5	Spot radiography not less than 12 in. [300 mm] of radiograph per 50 ft [15 m] of weld.
Radiography code basis	Classes 1, 3, and 4: ASME BPVC Section VIII, latest edition, Paragraph UW-51. Class 5: Section VIII Division 1, latest edition, Paragraph UW-52.
Radiography timing	Radiographic examination is permitted to be performed prior to heat treatment.

8. Permitted variations in dimensions

Characteristic	Requirement
General dimensions	A999/A999M dimensional tolerances apply unless modified below.
Thin-wall definition	Thin-wall pipe is defined as wall thickness of 3% or less of the specified outside diameter.
Diameter tolerance for thin-wall pipe	The A999/A999M outside diameter tolerance applies only to the mean of the extreme maximum and minimum OD readings in any one cross section.
Ovality for thin-wall pipe	Difference in extreme outside diameter readings in any one section shall not exceed twice the permissible variations in outside diameter for the specified diameter listed in A999/A999M.

9. Workmanship, finish, and appearance

Item	Requirement
Weld surface contour	Weld surface may be flush or have a reasonably uniform crown not exceeding 1/8 in. [3 mm]. Reinforcement may be removed by manufacturer option or agreement.
Concavity	No concavity of contour is permitted unless resulting weld metal thickness is equal to or greater than the minimum thickness of adjacent base metal.
Repair of weld defects	Weld defects shall be repaired by removal to sound metal and rewelding; subsequent heat treatment and examination (visual, radiographic, dye penetrant) shall be as required on the original welds.
Repair of plate defects by machining or grinding	Permitted provided the wall thickness is not reduced below the specified minimum wall thickness; followed by supplementary visual inspection.
Repair of plate defects by welding	Permitted only with purchaser approval. Repaired lengths with repair depth > 1/4 of thickness shall be pressure tested or repressure tested after repair and heat treatment (if any); repair welds shall be examined by suitable NDE techniques, including any required on the primary weld.
Surface condition	Finished pipe shall have a workmanlike finish and be free of scale and contaminating iron particles.
Pickling / passivation	Pickling, blasting, or surface finishing is not mandatory when bright annealed; purchaser may require passivating treatment in the PO.

10. Supplementary requirements

Supplementary requirement	Summary

S1 Product Analysis	Product analysis shall be made on each length of pipe. Individual lengths failing to conform to the chemical requirements shall be rejected.
S2 Tension and Bend Tests	Tension tests and bend tests shall be made on specimens to represent each length of pipe. Failure of any test specimen to meet the requirements shall be cause for rejection of the represented pipe length.
S3 Penetrant Oil and Powder Examination	All welded joints shall be subjected to examination by a penetrant oil and powder method. Details and disposition of flaws are by agreement between purchaser and manufacturer.
S4 Ferrite Control in Weld Deposits	Ferrite content of the deposited weld metal may be determined. Procedural details, chemistry, equipment, method, number and location of test sites, and ferrite limits are by agreement.

11. Ordering information checklist

PO item	What to specify
Quantity	Feet, metres, or number of lengths
Name of material	Electric-fusion-welded pipe
Grade	See Table 1
Class	See 1.3
Size	Outside diameter and nominal wall thickness
Length	Specific or random
End finish	Per A999/A999M
Authorization for repair of plate defects	By welding and subsequent heat treatment without prior approval, if intended
Specification designation	ASTM A928/A928M
Special requirements	As applicable
Invoke 13.4	If passivating treatment is required
Circumferential weld permissibility	See Section 17
Supplementary requirements	S1 through S4, if required
Applicable ASME Code	If known
ASME Section III service classification	If applicable
Certification requirements	Per A999/A999M

12. Purchase order description example

Example wording
ASTM A928/A928M, electric-fusion-welded duplex stainless steel pipe, UNS S32205 (2205), Class 1 (or Class 2 / 3 / 4 / 5), plate material A240/A240M S32205, OD 323.9 mm × WT 9.53 mm, length 6000 mm, heat treated after welding per Table 2, hydrostatic test or purchaser-approved NDE when applicable, radiography per class requirement, certification per A999/A999M, supplementary requirements as specified.

13. Notes

• ASTM A928 directly governs welded duplex pipe construction, class, heat treatment, radiography, pressure / electric testing, workmanship, and supplementary requirements.

• Numerical plate chemistry and plate tensile values are governed by the referenced ASTM A240/A240M grade listed in Table 1; ASTM A928 does not restate those numeric chemistry values in a separate chemistry table.

• Circumferentially welded joints of the same quality as the longitudinal joint are permitted by agreement between manufacturer and purchaser.