Contents

Technical Committee on Petroleum and Natural Gas Industry Pipeline Systems and Materials  viii
Subcommittee on Materials  xii

Preface  xiv

1 Scope 1
1.1 General 1
1.2 Size, grade, and category 1
1.2.1 Outside diameter and wall thickness 1
1.2.2 Grade 1
1.2.3 Category 1
1.3 Terminology 1

2 Reference publications 2

3 Definitions 3

4 General requirements 5
4.1 Product ordering requirements 5
4.1.1 Standard requirements 5
4.1.2 Optional requirements 6
4.2 Joinability 6
4.2.1 Weldability 6
4.2.2 Mechanical interference fit method 6
4.3 Rounding procedure 6
4.4 Quality program 6

5 Materials and manufacture 7
5.1 Steelmaking process 7
5.2 Deoxidation practice 7
5.3 Skelp 7
5.4 Pipe manufacture 7

6 Chemical test requirements 8
6.1 General 8
6.2 Heat analysis 8
6.3 Product analysis 8
6.3.1 General 8
6.3.2 Frequency 8
6.3.3 Sampling methods 8
6.3.4 Preparation 8
6.3.5 Retests 8

7 Mechanical test procedures 9
7.1 General 9
7.2 Tension tests 9
7.2.1 General 9
7.2.2 Yield strength 9
7.2.3 Longitudinal tension tests 9
7.2.4 Transverse body tension tests 10
7.2.5 Transverse weld tension tests 10
7.2.6 Retests 11
7.3 Flattening tests — Electric-welded pipe 11
7.3.1 General 11
7.3.2 Electric-welded pipe produced in single lengths 11
7.3.3 Electric-welded pipe produced from coiled skelp 12
7.3.4 Hot reduced electric-welded pipe 12
7.4 Bend tests — Electric-welded pipe 13
7.4.1 Procedure 13
7.4.2 Retests 13
7.5 Guided-bend tests 13
7.5.1 Submerged-arc-welded pipe 13
7.5.2 Electric-welded pipe 14
7.6 Charpy V-notch impact tests 15
7.6.1 General 15
7.6.2 Test specimen size 16
7.6.3 Test specimen type, orientation, and location 16
7.6.4 Retests — Pipe body 16
7.6.5 Retests — Pipe weld 17
7.7 Drop-weight tear tests 17
7.7.1 General 17
7.7.2 Orientation and location 17
7.7.3 Test specimen evaluation 17
7.7.4 Retests 17
7.8 Hardness tests 18

8 Mechanical properties 18
8.1 General 18
8.2 Tensile properties 18
8.2.1 Body tension tests 18
8.2.2 Transverse weld tension tests 18
8.3 Ductility tests 19
8.3.1 General 19
8.3.2 Flattening tests — Electric-welded pipe 19
8.3.3 Guided-bend tests 19
8.3.4 Bend tests 19
8.4 Notch-toughness tests — Pipe body 20
8.4.1 Frequency 20
8.4.2 Test temperature 20
8.4.3 Category I pipe notch-toughness requirements 20
8.4.4 Category II pipe notch-toughness requirements 20
8.4.5 Category III pipe notch-toughness requirements 20
8.5 Notch-toughness tests — Weld 21
8.5.1 Submerged-arc-welded pipe 21
8.5.2 Electric-welded pipe 21
8.6 Hardness tests 21

9 Mill hydrostatic testing 21
9.1 Mill hydrostatic testing requirements 21
9.2 Test duration 22
9.3 Verification of test 22
9.4 Test pressures 22
10 Dimensions, masses, and lengths  22
10.1 General  22
10.2 Outside diameter  22
10.3 Wall thickness  23
10.4 Mass  23
10.5 Nominal length  23
10.6 Mill-jointers  23
10.6.1 General  23
10.6.2 Single-jointers  23
10.6.3 Double-jointers  23
10.6.4 Triple-jointers  23
10.7 Pipe ends  24
10.7.1 Plain end pipe  24
10.7.2 Special end pipe  24

11 Inspection, tolerances, and work quality  25
11.1 Inspection  25
11.2 Inspection notice  25
11.3 Plant access  25
11.4 Tolerances on dimensions and mass  25
11.4.1 Tolerances on outside diameter — Pipe body  25
11.4.2 Tolerances on outside diameter — Pipe ends  25
11.4.3 Tolerances on out-of-roundness  26
11.4.4 Tolerances on wall thickness  26
11.4.5 Tolerances on mass  26
11.4.6 Tolerances on length  26
11.5 Work quality  26
11.5.1 Radial offset at weld seams  26
11.5.2 Tack welds in submerged-arc-welded pipe  27
11.5.3 Misalignment of weld seam of submerged-arc-welded pipe  27
11.5.4 Height of inside and outside weld beads of submerged-arc-welded pipe  27
11.5.5 Trim of outside weld flash of electric-welded pipe  27
11.5.6 Trim of inside weld flash of electric-welded pipe  27
11.5.7 Hard spots  27
11.5.8 Location of weld seams  28
11.5.9 Straightness  28
11.5.10 Geometric deviations  28
11.6 Defects  29
11.7 Residual magnetism  30

12 Nondestructive inspection  31
12.1 General  31
12.2 Methods of inspection  31
12.2.1 Electric-welded pipe  31
12.2.2 Submerged-arc-welded pipe  32
12.2.3 Skelp end welds  32
12.2.4 Circumferential jointer welds  32
12.2.5 Seamless pipe  33
12.3 Qualifications of personnel  33
12.4 Radiological inspection  33
12.4.1 Equipment  33
12.4.2 Procedure  33
12.4.3 Sensitivity  33
12.4.4 Image quality indicators  33
12.4.5 Acceptance limits 34
12.5 Ultrasonic inspection 35
12.5.1 Equipment 35
12.5.2 Reference standards 35
12.5.3 Standardization 36
12.5.4 Acceptance limits 36
12.5.5 Alarm limits 37
12.5.6 Inspection sensitivity checks 37
12.6 Electromagnetic inspection 38
12.6.1 Weld inspection 38
12.6.2 Body inspection 39
12.7 Magnetic particle inspection 41
12.7.1 Procedure 41
12.7.2 Equipment 41
12.7.3 Reference standard 41
12.8 Liquid penetrant inspection 41

13 Repair of pipe containing defects 41
13.1 General 41
13.2 Grinding 41
13.3 Welding 41
13.4 Procedure for repair of defective welds by welding 41
13.5 Repair welding procedure tests 42
13.5.1 General 42
13.5.2 Radiographic test 42
13.5.3 Transverse weld tension test 42
13.5.4 Transverse guided-bend test 42
13.6 Repair welder performance tests 42

14 Procedure for welded mill-jointers 43

15 Markings and coating 44
15.1 General 44
15.2 Required markings 44
15.3 Marking location and method of application 45
15.4 Sequence of required markings 45
15.4.1 Requirements 45
15.4.2 Examples 46
15.4.3 Sequence of markings 46
15.5 Die-stamped markings 46
15.6 Coating 46

16 Sour service 46

17 Certification 47

Annexes
A (informative) — Steel pipe dimensions, weight classes, and schedule numbers 74
B (informative) — Steel line pipe and component size nomenclature 76
C (informative) — Summary of destructive testing requirements 78
Tables
1 — Minimum hydrostatic test pressure 49
2 — Tolerances on length 51
3 — Tolerances on wall thickness 51
4 — Tolerances on mass 52
5 — Chemical composition limits for heat and product analyses 53
6 — Compliance factor (F) — Carbon equivalent formula 54
7 — Charpy test specimen sizes 54
8 — Tensile requirements 55
9 — Body elongation requirements 56
10 — Testing frequency 58
11 — Tolerances on outside diameter — Pipe body 58
12 — Electric-welded pipe — Removal of internal weld flash 59
13 — Image quality indicator sizes 59
14 — Circular slag inclusions and gas pockets 59
15 — Guided-bend test jig dimensions 60
16 — Strain values for guided-bend test 61
17 — Guided-bend test jig dimensions for repair welds 61
18 — Transverse tension tests — Nominal diameter for round specimens 62

Figures
1 — Tension test specimens 63
2 — Guided-bend test specimen 65
3 — Jig for guided-bend test 66
4 — Drop-weight tear test — Specimen orientation and location 67
5 — Examples of circular slag inclusions and gas pockets 68
6 — Reference indicators — Ultrasonic inspection 69
7 — Reference indicators — Electromagnetic inspection 70
8 — Groove configuration 71
9 — Transverse weld tension test specimen 71
10 — Guided-bend test specimen 72
11 — Jig for guided-bend test for repair welds 73