

DIN EN ISO 11960:2011-09 (E)

Petroleum and natural gas industries - Steel pipes for use as casing or tubing for wells (ISO 11960:2011); English version EN ISO 11960:2011, only on CD-ROM

| Inhalt | Seite |
|--|-------|
| Foreword | 13 |
| Introduction..... | 14 |
| 1 Scope..... | 15 |
| 2 Conformance | 16 |
| 2.1 Dual referencing of normative references..... | 16 |
| 2.2 Units of measurement | 16 |
| 3 Normative references | 16 |
| 4 Terms, definitions, symbols and abbreviated terms | 19 |
| 4.1 Terms and definitions..... | 19 |
| 4.2 Symbols and abbreviated terms..... | 23 |
| 5 Information to be supplied by the purchaser..... | 24 |
| 5.1 Grades C90, T95 and C110 | 24 |
| 5.2 Casing | 24 |
| 5.3 Tubing | 26 |
| 5.4 Coupling stock, coupling material and accessory material | 27 |
| 6 Process of manufacture | 28 |
| 6.1 General..... | 28 |
| 6.2 Heat treatment | 28 |
| 6.2.1 General | 28 |
| 6.2.2 Group 1 (except H40)..... | 28 |
| 6.2.3 Group 2..... | 28 |
| 6.3 Straightening | 29 |
| 6.3.1 Groups 1 (except Grade R95) and 3 | 29 |
| 6.3.2 Grade R95 | 29 |
| 6.3.3 Grades M65 and L80 | 29 |
| 6.3.4 Grades C90 and T95..... | 29 |
| 6.3.5 Grade C110 | 29 |
| 6.3.6 Grade Q125 | 29 |
| 6.4 Traceability | 30 |
| 6.4.1 General..... | 30 |
| 6.4.2 Serialization of Grades C90, T95, C110 and Q125 | 30 |
| 6.5 Processes requiring validation..... | 30 |
| 7 Material requirements..... | 30 |
| 7.1 Chemical composition..... | 30 |
| 7.2 Tensile properties | 31 |
| 7.2.1 General | 31 |
| 7.2.2 Elongation — All groups | 31 |
| 7.2.3 Yield strength | 31 |
| 7.2.4 Statistical tensile testing – Grades C90, T95 and C110 | 31 |
| 7.3 Charpy V-notch test — General requirements | 32 |
| 7.3.1 Evaluation of test results | 32 |
| 7.3.2 Critical thickness | 32 |
| 7.3.3 Specimen size and orientation | 32 |
| 7.3.4 Hierarchy of test specimens | 32 |
| 7.3.5 Alternative size impact test specimens | 33 |
| 7.3.6 Sub-size test specimens | 33 |
| 7.3.7 Test temperature | 33 |

| | | |
|--------|---|----|
| 7.3.8 | Statistical impact testing | 33 |
| 7.3.9 | Reference information | 33 |
| 7.4 | Charpy V-notch — Absorbed energy requirements for coupling stock, coupling material, coupling blanks and couplings..... | 33 |
| 7.4.1 | General | 33 |
| 7.4.2 | Grade H40..... | 33 |
| 7.4.3 | Grades J55 and K55 for API threads | 33 |
| 7.4.4 | Grade M65 for API threads | 34 |
| 7.4.5 | Grades N80 Type 1, N80Q and R95, Groups 2 (except Grades M65 and C110), 3 and 4 for API threads..... | 34 |
| 7.4.6 | Special end-finish..... | 34 |
| 7.5 | Charpy V-notch — Absorbed energy requirements for pipe | 34 |
| 7.5.1 | Grades H40, J55, K55 and N80 Type 1 | 34 |
| 7.5.2 | Grade M65 | 34 |
| 7.5.3 | Grades N80Q, R95, L80, C90, T95 and P110 | 35 |
| 7.5.4 | Grades C110 and Q125 | 35 |
| 7.5.5 | Test specimen..... | 36 |
| 7.5.6 | Testing conditions..... | 36 |
| 7.6 | Charpy V-notch — Absorbed energy requirements for accessory material | 36 |
| 7.6.1 | Accessory material — General | 36 |
| 7.6.2 | Accessory material for accessories with internal API threads except integral tubing connections | 36 |
| 7.6.3 | Accessory material for accessories with internal special end-finish tapered interference- type threads | 36 |
| 7.6.4 | Accessory material for accessories with external threads..... | 36 |
| 7.6.5 | Accessory material for accessories with either integral tubing connections or internal special end-finish connections that do not have thread interference | 36 |
| 7.6.6 | Critical thickness for accessory material and special end-finish material | 36 |
| 7.7 | Maximum hardness | 37 |
| 7.7.1 | Group 2 — All product | 37 |
| 7.7.2 | Grade Q125 — All products..... | 37 |
| 7.8 | Hardness variation — Grades C90, T95, C110 and Q125 | 37 |
| 7.9 | Process control — Grades C90, T95, C110 and Q125 | 37 |
| 7.10 | Hardenability — Minimum percentage martensite for quenched and tempered products | 38 |
| 7.10.1 | Grades C90 and T95..... | 38 |
| 7.10.2 | Grade C110..... | 38 |
| 7.10.3 | All grades except Grades C90, T95 and C110 | 38 |
| 7.11 | Grain size — Grades C90, T95 and C110 | 38 |
| 7.12 | Surface condition — Grades L80 9Cr and L80 13Cr | 38 |
| 7.13 | Flattening — Electric-welded pipe..... | 39 |
| 7.14 | Sulfide stress cracking test — Grades C90, T95 and C110..... | 39 |
| 7.14.1 | General guidance | 39 |
| 7.14.2 | Test and re-test requirements..... | 39 |
| 7.14.3 | Test sample selection and location..... | 39 |
| 7.14.4 | Test solution for Grades C90, T95 and C110..... | 40 |
| 7.14.5 | Minimum SSC requirements | 40 |
| 7.14.6 | Invalidation of tests..... | 41 |
| 7.14.7 | Additional testing provisions for ANSI-NACE TM0177-2005 Method D..... | 41 |
| 8 | Dimensions, masses, tolerances, pipe ends and defects..... | 41 |
| 8.1 | Labels and sizes | 41 |
| 8.2 | Dimensions and masses | 41 |
| 8.3 | Diameter | 42 |
| 8.3.1 | Measurement and design | 42 |
| 8.3.2 | Requirements..... | 42 |
| 8.4 | Wall thickness..... | 42 |
| 8.5 | Mass..... | 43 |
| 8.6 | Length..... | 43 |
| 8.7 | Casing jointers..... | 43 |
| 8.8 | Height and trim of electric-weld flash | 43 |
| 8.8.1 | Trimming electric-weld flash..... | 43 |

| | | |
|--------|--|----|
| 8.8.2 | Groups 1 and 2 | 44 |
| 8.8.3 | Groups 3 and 4 | 44 |
| 8.8.4 | Disposition..... | 44 |
| 8.9 | Straightness | 44 |
| 8.9.1 | Pipe..... | 44 |
| 8.9.2 | Coupling stock, coupling material and accessory material | 44 |
| 8.10 | Drift requirements | 44 |
| 8.11 | Tolerances on dimensions and masses | 45 |
| 8.11.1 | Outside diameter..... | 45 |
| 8.11.2 | Wall thickness | 45 |
| 8.11.3 | Mass | 45 |
| 8.11.4 | Inside diameter..... | 46 |
| 8.11.5 | Upset dimensions | 46 |
| 8.11.6 | Extended length upsets..... | 46 |
| 8.12 | Product ends | 46 |
| 8.12.1 | Plain-end pipe..... | 46 |
| 8.12.2 | Product with API threads | 46 |
| 8.12.3 | Rounded nose | 46 |
| 8.12.4 | Threading | 47 |
| 8.12.5 | Workmanship of ends..... | 47 |
| 8.12.6 | Special end-finish | 47 |
| 8.13 | Defects | 47 |
| 8.13.1 | Pipe and accessory made from pipe..... | 47 |
| 8.13.2 | Accessory material not made from pipe, coupling stock and coupling material..... | 48 |
| 8.13.3 | Process control plan..... | 48 |
| 8.14 | Coupling make-up and thread protection..... | 48 |
| 8.14.1 | Groups 1, 2 and 3 | 48 |
| 8.14.2 | Group 4..... | 48 |
| 9 | Couplings..... | 49 |
| 9.1 | General requirements | 49 |
| 9.2 | Alternative grades or heat treatments | 49 |
| 9.3 | Mechanical properties | 50 |
| 9.4 | Dimensions and tolerances | 50 |
| 9.4.1 | Groups 1, 2 and 3 | 50 |
| 9.4.2 | Group 4..... | 50 |
| 9.5 | Regular couplings..... | 50 |
| 9.6 | Special-clearance couplings — Groups 1, 2 and 3..... | 50 |
| 9.7 | Combination couplings | 50 |
| 9.8 | Reducing couplings — Groups 1, 2 and 3..... | 50 |
| 9.9 | Seal-ring couplings..... | 51 |
| 9.10 | Special-bevel tubing regular couplings — Groups 1, 2 and 3..... | 51 |
| 9.11 | Threading | 51 |
| 9.11.1 | General requirements | 51 |
| 9.11.2 | Couplings..... | 51 |
| 9.12 | Surface inspection | 51 |
| 9.13 | Measurement of imperfections..... | 52 |
| 9.14 | Repair and removal of imperfections and defects | 52 |
| 9.15 | Thread surface treatment — Grade Q125..... | 52 |
| 9.16 | Couplings and coupling blank protection — Grades C90, T95, C110 and Q125 | 52 |
| 10 | Inspection and testing | 53 |
| 10.1 | Test equipment..... | 53 |
| 10.2 | Lot definition for testing of mechanical properties | 53 |
| 10.2.1 | Groups 1, 2 (Grades M65 and L80 Type 1 only) and 3 — Coupling stock, coupling material and pipe (except pup joints heat-treated after cutting to blank or individual length) | 53 |
| 10.2.2 | Grades L80 9Cr, L80 13Cr, C90, T95, C110 and Q125 — Coupling stock, coupling material and pipe (except pup joints heat-treated after cutting to blank or individual length) | 53 |
| 10.2.3 | Coupling blanks, pup joints or accessory material heat-treated after cutting to blank or individual length..... | 53 |
| 10.3 | Testing of chemical composition | 53 |
| 10.3.1 | Heat analyses | 53 |

| | | |
|---------|--|----|
| 10.3.2 | Product analyses | 54 |
| 10.3.3 | Test method | 54 |
| 10.3.4 | Re-check of product analyses — All groups | 54 |
| 10.4 | Tensile tests | 54 |
| 10.4.1 | Stress-relief temperature — All grades except C110 | 54 |
| 10.4.2 | Heat-control tensile tests — Groups 1, 2 and 3 | 54 |
| 10.4.3 | Frequency of testing and location of test specimen — Casing and tubing | 55 |
| 10.4.4 | Frequency of testing and test specimen location — Coupling stock, coupling material, coupling blanks, pup joints and accessory material | 55 |
| 10.4.5 | Test specimens — General | 55 |
| 10.4.6 | Test specimens — Additional requirements for coupling blanks, coupling stock coupling material and pup joint and accessory materials — Grades C110 and Q125 | 56 |
| 10.4.7 | Test method | 56 |
| 10.4.8 | Invalidation of tests | 56 |
| 10.4.9 | Re-tests — All products (except coupling blanks, coupling stock, coupling material, pup joints or accessory material) — Grades C90, T95, C110 and Q125) | 56 |
| 10.4.10 | Re-tests — Coupling blanks, coupling stock, coupling material, pup joints or accessory material in Grades C90, T95, C110 and Q125 | 56 |
| 10.5 | Flattening test | 57 |
| 10.5.1 | General requirement for testing | 57 |
| 10.5.2 | Frequency of testing | 57 |
| 10.5.3 | Test specimens | 57 |
| 10.5.4 | Test method for Groups 1 and 2 | 57 |
| 10.5.5 | Test method for Grade P110 pipe and Grade Q125 casing | 57 |
| 10.5.6 | Invalidation of tests | 57 |
| 10.5.7 | Re-tests | 58 |
| 10.6 | Hardness test | 58 |
| 10.6.1 | PSL requirements | 58 |
| 10.6.2 | Frequency of testing — General | 58 |
| 10.6.3 | Frequency of testing — Heat-control tests — Grades M65 and L80 | 58 |
| 10.6.4 | Frequency of testing — Grades M65 and L80 | 58 |
| 10.6.5 | Frequency of testing and test specimen location — Non-upset pipe — Grades C90, T95 and C110 | 58 |
| 10.6.6 | Frequency of testing and test specimen location — Upset pipe — Grades C90 and T95 | 59 |
| 10.6.7 | Frequency of testing and test specimen location — Coupling blanks, coupling stock, coupling material, pup joints and accessory material — Grades C90, T95 and C110 | 59 |
| 10.6.8 | Frequency of testing — Grade Q125 | 59 |
| 10.6.9 | Test specimens | 59 |
| 10.6.10 | Test method | 59 |
| 10.6.11 | Invalidation of tests | 61 |
| 10.6.12 | Periodic checks of hardness-testing machines | 61 |
| 10.6.13 | Verification of hardness-testing machines and indenters | 62 |
| 10.6.14 | Re-tests — Grades M65 and L80 | 63 |
| 10.6.15 | Re-tests — Grades C90, T95 and C110 products except for coupling blanks, pup joints or accessory material heat-treated after cutting to individual lengths | 63 |
| 10.6.16 | Re-tests — Grades C90, T95 and C110 coupling blanks, pup joints or accessory material heat-treated after cutting to individual lengths | 63 |
| 10.6.17 | Re-tests — Grade Q125 — General | 63 |
| 10.6.18 | Re-tests — Grade Q125 — Casing, coupling stock and coupling material | 64 |
| 10.6.19 | Re-tests — Grade Q125 — Coupling blanks, pup joints and accessory material | 64 |
| 10.6.20 | Rejected lots — Groups 2 and 4 | 64 |
| 10.7 | Impact test | 64 |
| 10.7.1 | Sampling — Grades J55, K55 and N80 Type 1 | 64 |
| 10.7.2 | Sampling — Grade M65 | 64 |
| 10.7.3 | Sampling — Grades N80Q, R95, L80, C90, T95, C110 and P110 | 64 |
| 10.7.4 | Sampling and test specimen location — Grade Q125 | 64 |
| 10.7.5 | Test specimens | 65 |
| 10.7.6 | Test method | 65 |
| 10.7.7 | Invalidation of tests | 65 |
| 10.7.8 | Re-test of a length — All groups | 65 |
| 10.7.9 | Replacement of a reject length — All groups | 65 |

| | | |
|----------|--|----|
| 10.7.10 | Multiple length rejection — Grade Q125..... | 65 |
| 10.8 | Grain size determination — Grades C90, T95 and C110..... | 66 |
| 10.8.1 | Sampling..... | 66 |
| 10.8.2 | Test method..... | 66 |
| 10.9 | Hardenability — Grades C90, T95 and C110..... | 66 |
| 10.10 | Sulfide stress-cracking test — Grades C90, T95 and C110..... | 66 |
| 10.11 | Metallographic evaluation — EW Grades P110 and Q125..... | 66 |
| 10.12 | Hydrostatic tests..... | 66 |
| 10.12.1 | Hydrostatic test procedures..... | 66 |
| 10.12.2 | Hydrostatic test requirements..... | 67 |
| 10.12.3 | Test pressure calculation..... | 68 |
| 10.13 | Dimensional testing..... | 68 |
| 10.13.1 | General..... | 68 |
| 10.13.2 | Diameter measurement..... | 69 |
| 10.13.3 | Diameter re-tests..... | 69 |
| 10.13.4 | Wall thickness measurement..... | 69 |
| 10.13.5 | Drift test..... | 70 |
| 10.13.6 | Length measurement..... | 70 |
| 10.13.7 | Mass (weight) determination..... | 70 |
| 10.13.8 | Straightness evaluation..... | 71 |
| 10.13.9 | Internal upset inspection..... | 71 |
| 10.14 | Visual inspection..... | 71 |
| 10.14.1 | General..... | 71 |
| 10.14.2 | Pipe body, coupling stock and coupling material (excluding pipe ends)..... | 71 |
| 10.14.3 | Pipe ends..... | 71 |
| 10.14.4 | Disposition..... | 72 |
| 10.15 | Non-destructive examination (NDE)..... | 72 |
| 10.15.1 | General..... | 72 |
| 10.15.2 | NDE personnel..... | 72 |
| 10.15.3 | Reference standards..... | 72 |
| 10.15.4 | NDE system capability records..... | 73 |
| 10.15.5 | Pipe body or coupling stock inspection — General..... | 73 |
| 10.15.6 | Full-body, full-length NDE of casing and tubing — Grades N80Q, M65, L80 and R95..... | 74 |
| 10.15.7 | Full-body, full-length NDE of casing and tubing — Grade P110 to A.10 SR16..... | 74 |
| 10.15.8 | Full-body, full-length NDE of casing and tubing — Grade P110 and Grade P110 to A.10 SR16 and A.3 SR2..... | 74 |
| 10.15.9 | Full-body, full-length NDE of casing and tubing — Grades C90, T95, C110 and Q125..... | 75 |
| 10.15.10 | NDE of the weld seam of welded pipe..... | 75 |
| 10.15.11 | Coupling stock (except Grade C110) and pup joints..... | 75 |
| 10.15.12 | NDE of coupling stock and accessory material – Grade C110..... | 76 |
| 10.15.13 | Un-tested pipe ends, coupling stock ends and accessory material ends..... | 77 |
| 10.15.14 | Pipe upsets..... | 77 |
| 10.15.15 | Pipe, coupling stock and accessory material requiring further evaluation..... | 77 |
| 10.15.16 | Evaluation of indications (prove-up)..... | 77 |
| 10.15.17 | Disposition of pipe containing defects..... | 78 |
| 10.15.18 | Disposition of coupling stock and accessory material containing defects..... | 79 |
| 11 | Marking..... | 80 |
| 11.1 | General..... | 80 |
| 11.2 | Stamp marking requirements..... | 81 |
| 11.2.1 | Methods..... | 81 |
| 11.2.2 | Size..... | 81 |
| 11.2.3 | Location..... | 81 |
| 11.2.4 | Group 1 (except R95) and Group 3..... | 81 |
| 11.2.5 | Grade R95 and Groups 2 and 4..... | 81 |
| 11.2.6 | Make-up triangle marking..... | 82 |
| 11.3 | Stencil marking requirements..... | 82 |
| 11.4 | Colour identification..... | 82 |
| 11.4.1 | Colour coding..... | 82 |
| 11.4.2 | Product 1,8 m (6 ft) and longer..... | 82 |
| 11.4.3 | Loose couplings..... | 83 |

| | | |
|---------|---|----|
| 11.4.4 | Special-clearance couplings | 83 |
| 11.4.5 | Pup joints shorter than 1,8 m (6 ft) in length | 83 |
| 11.4.6 | Grade colour-codes | 83 |
| 11.5 | Thread and end-finish marking — All groups | 83 |
| 11.5.1 | API thread marking | 83 |
| 11.5.2 | Plain-end and special end-finish markings | 83 |
| 11.6 | Pipe-threader marking requirements — All groups | 83 |
| 12 | Coating and protection | 84 |
| 12.1 | Coatings — All groups | 84 |
| 12.1.1 | Coatings for protection during transit | 84 |
| 12.1.2 | Coatings for long-term storage | 84 |
| 12.2 | Thread protectors | 85 |
| 12.2.1 | General | 85 |
| 12.2.2 | Grade L80 Types 9Cr and 13Cr | 85 |
| 12.2.3 | Driftable thread protectors | 85 |
| 13 | Documents | 85 |
| 13.1 | Electronic media — All groups | 85 |
| 13.2 | Certification — Groups 1, 2 (except Grade C110) and 3 | 85 |
| 13.3 | Certification requirements — Grades C110 and Q125 | 86 |
| 13.4 | Retention of records | 86 |
| 14 | Minimum facility requirements for various categories of manufacturer | 86 |
| 14.1 | Pipe mill | 86 |
| 14.2 | Processor | 86 |
| 14.3 | Pipe threader | 86 |
| 14.4 | Coupling, pup-joint or accessory manufacturer | 87 |
| Annex A | (normative) Supplementary requirements | 88 |
| A.1 | General | 88 |
| A.2 | SR1 Supplementary non-destructive examination for Grades H40, J55, K55 and N80 Type 1 | 88 |
| A.3 | SR2 Supplementary non-destructive examination for Grades H40, J55, K55, N80 Type 1, N80Q, M65, L80, R95 and P110 to A.10 SR16 | 88 |
| A.4 | SR9 Coupling blanks — Grades C110 and Q125 | 88 |
| A.4.1 | SR9.1 Coupling blank size | 88 |
| A.4.2 | SR9.2 Dimensional tolerances | 88 |
| A.4.3 | SR9.3 Imperfections | 89 |
| A.4.4 | SR9.4 Marking | 89 |
| A.5 | SR10 Upset casing — Grade Q125 only | 89 |
| A.5.1 | SR10.1 Dimensions | 89 |
| A.5.2 | SR10.2 Material properties | 89 |
| A.5.3 | SR10.3 Heat treatment | 89 |
| A.5.4 | SR10.4 Other testing considerations | 89 |
| A.5.5 | SR10.5 End area inspection | 89 |
| A.6 | SR11 Electric-welded Grades P110 and Q125 pipe | 89 |
| A.6.1 | SR11.1 General | 89 |
| A.6.2 | SR11.2 Flattening test frequency | 90 |
| A.6.3 | SR11.3 Flattening test procedures | 90 |
| A.6.4 | SR11.4 Other material properties | 90 |
| A.6.5 | SR11.5 Inspection and rejection | 90 |
| A.7 | SR12 Statistical impact testing | 91 |
| A.7.1 | SR12.1 General | 91 |
| A.7.2 | SR12.2 Frequency of testing | 92 |
| A.7.3 | SR12.3 Re-test | 92 |
| A.7.4 | SR12.4 Acceptable impact energy for any lot of product | 92 |
| A.7.5 | SR12.5 Lot acceptance/rejection | 92 |
| A.8 | SR13 Seal-ring couplings | 93 |
| A.8.1 | SR13.1 Seal-ring groove | 93 |
| A.8.2 | SR13.2 Non-metallic ring | 93 |
| A.8.3 | SR13.3 Marking | 94 |
| A.9 | SR15 Test certificates | 94 |
| A.9.1 | SR15.1 | 94 |

| | | |
|---------|--|-----|
| A.9.2 | SR15.2 | 95 |
| A.10 | SR16 Impact testing (Charpy V-notch) | 96 |
| A.10.1 | SR16.1 Testing requirements..... | 96 |
| A.10.2 | SR16.2 Charpy V-notch test — General requirements..... | 96 |
| A.10.3 | SR16.3 Charpy V-notch test — Impact requirements for pipe and for accessory material for externally threaded accessories..... | 97 |
| A.10.4 | SR16.4 Accessory material for accessories with integral joint API tubing connections | 97 |
| A.10.5 | SR16.5 Accessory material for accessories with internal special end-finish connections that do not have thread interference..... | 98 |
| A.10.6 | SR16.6 Impact test procedures | 98 |
| A.10.7 | SR16.7 Reporting | 99 |
| A.10.8 | SR16.8 Marking | 99 |
| A.11 | SR22 Enhanced leak resistance, LC | 99 |
| A.11.1 | General..... | 99 |
| A.11.2 | SR22 Enhanced leak resistance | 100 |
| A.12 | SR38 Statistical tensile testing — Grades C90, T95 and C110..... | 101 |
| A.12.1 | SR38.1 General..... | 101 |
| A.12.2 | SR 38.2 Frequency of testing..... | 102 |
| A.12.3 | SR38.3 Yield strength determination | 102 |
| A.12.4 | SR38.4 Additional testing to qualify a lot | 102 |
| A.12.5 | SR38.5 Retests to qualify a pipe..... | 102 |
| A.13 | SR39 Alternative ANSI-NACE TM0177-2005 Method D Sulfide stress cracking (SSC) tests — Grade C110..... | 102 |
| A.13.1 | SR39.1 Test requirements | 102 |
| A.13.2 | SR39.2 Test sample selection and location | 103 |
| A.13.3 | SR39.3 Alternative test solution | 103 |
| A.13.4 | SR39.4 Test conditions..... | 103 |
| A.13.5 | SR39.5 Invalidation of tests | 103 |
| A.13.6 | SR39.6 Additional testing provisions | 103 |
| A.14 | SR40 Electric-welded casing, tubing and pup joints, Groups 1 & 2..... | 104 |
| A.14.1 | SR40.1 Height and trim of electric-weld flash..... | 104 |
| A.14.2 | SR40.2 Non-destructive examination of weld seam | 104 |
| Annex B | (normative) Purchaser inspection..... | 105 |
| B.1 | Inspection notice..... | 105 |
| B.2 | Plant access | 105 |
| B.3 | Compliance | 105 |
| B.4 | Rejection | 105 |
| Annex C | (normative) Tables in SI units | 106 |
| Annex D | (normative) Figures in SI (USC) units | 157 |
| Annex E | (normative) Tables in USC units | 185 |
| Annex F | (informative) Use of the API Monogram by Licensees..... | 235 |
| F.1 | General | 235 |
| F.2 | References | 235 |
| F.3 | API monogram programme — Licensee responsibilities | 235 |
| F.3.1 | Maintaining a license to use the API monogram | 235 |
| F.3.2 | Monogrammed product — Conformance with API Spec Q1 | 236 |
| F.3.3 | Application of the API monogram | 236 |
| F.3.4 | Records | 236 |
| F.3.5 | Quality program changes..... | 236 |
| F.3.6 | Use of the API Monogram in advertising..... | 237 |
| F.4 | Marking requirements for products | 237 |
| F.4.1 | General..... | 237 |
| F.4.2 | Stamp marking requirements | 238 |
| F.4.3 | Stencil marking requirements..... | 239 |
| F.4.4 | Colour identification | 239 |
| F.4.5 | Thread and end-finish marking — All groups | 240 |
| F.4.6 | Pipe threader marking requirements — All groups..... | 240 |
| F.5 | API Monogram Program — API responsibilities..... | 241 |

| | |
|--|------------|
| Annex G (informative) Procedures used to convert from USC units to SI units | 242 |
| G.1 Background..... | 242 |
| G.2 General | 242 |
| G.2.1 Rounding..... | 242 |
| G.2.2 Fractions | 242 |
| G.2.3 Tolerances..... | 242 |
| G.3 Pipe dimensions | 243 |
| G.3.1 Outside diameter | 243 |
| G.3.2 Wall thickness..... | 243 |
| G.3.3 Inside diameter | 243 |
| G.3.4 Diameters and lengths of upsets..... | 243 |
| G.4 Drift diameters | 244 |
| G.4.1 Drift diameter, standard drift size, Table C.28..... | 244 |
| G.4.2 Drift diameter, alternative drift size, Table C.29 | 244 |
| G.5 Coupling dimensions | 245 |
| G.5.1 Length of couplings | 245 |
| G.5.2 Diameter of coupling recess | 245 |
| G.5.3 Width of the coupling bearing face | 245 |
| G.5.4 Diameter at the root of the coupling thread at the end of the pipe in the power-tight position..... | 245 |
| G.6 Linear mass..... | 246 |
| G.6.1 Nominal threaded and coupled linear mass | 246 |
| G.6.2 Plain-end linear mass..... | 246 |
| G.6.3 Coupling masses | 246 |
| G.6.4 Mass gain or loss due to end finish | 247 |
| G.7 Tensile and flattening tests | 247 |
| G.7.1 Yield strength..... | 247 |
| G.7.2 Tensile strength..... | 247 |
| G.7.3 Elongation | 247 |
| G.7.4 Flattening test formula..... | 248 |
| G.8 Charpy impact energy requirements..... | 248 |
| G.8.1 Critical thickness for couplings with API threads, Table C.7 | 248 |
| G.8.2 Charpy impact energy..... | 248 |
| G.8.3 Minimum absorbed energy requirements for couplings, Tables C.11 to C.17..... | 249 |
| G.8.4 Absorbed energy requirements for pipe..... | 249 |
| G.8.5 Calculated wall thickness required to machine transverse and longitudinal Charpy impact specimens from pipe and couplings, Tables C.20 and C.21 | 250 |
| G.9 Hydrostatic testing | 251 |
| G.9.1 Hydrostatic test pressure for plain-end pipe..... | 251 |
| G.9.2 Hydrostatic test pressure for couplings | 251 |
| G.9.3 Internal pressure leak-resistance at E1 or E7 plane | 252 |
| G.9.4 Hydrostatic test pressure for threaded and coupled pipe | 252 |
| G.10 Other | 252 |
| G.10.1 Temperature..... | 252 |
| G.10.2 Torque..... | 253 |
| Annex H (normative) Product Specification Levels..... | 254 |
| H.1 General | 254 |
| H.2 Heat treatment | 254 |
| H.2.1 Grade J55 and K55, PSL-2 (6.2.2) | 254 |
| H.2.2 Grade N80Q, PSL-3 (6.2.2) | 254 |
| H.3 Straightening, PSL-2 | 254 |
| H.3.1 Grades C90 and T95 (6.3.4) | 254 |
| H.3.2 Grades R95 and P110 (6.3.1, 6.3.3) | 254 |
| H.4 Chemical composition Grades C90 and T95, PSL-3 (7.1)..... | 255 |
| H.5 Yield strength — Grade Q125, PSL-3 (7.2.3)..... | 255 |
| H.6 Charpy V-notch tests | 255 |
| H.6.1 Charpy V-notch test properties — General requirements, Grades N80 Type 1, N80Q, L80 Type 1, C90, R95, T95, P110 and Q125, PSL-2 (7.3.1)..... | 255 |
| H.6.2 Charpy V-notch — Absorbed energy requirements for pipe, PSL-2..... | 255 |
| H.7 Hardenability — Minimum percentage martensite required for quenched and tempered products | 255 |

| | | |
|--|--|------------|
| H.7.1 | Grade L80 Type 1, PSL-2 (7.10.3) | 255 |
| H.7.2 | Grades C90 AND T95, PSL-3 (7.10.1) | 256 |
| H.8 | Inside surface preparation — Grade L80 13Cr, PSL-2 (7.12) | 256 |
| H.9 | Sulfide stress-cracking (SSC) test — PSL-3 | 256 |
| H.9.1 | Grades C90 and T95 (7.14) | 256 |
| H.9.2 | Grade L80 13Cr..... | 256 |
| H.10 | Processing of pin ends — All groups, PSL-2 (8.12.5) | 256 |
| H.11 | Seal-ring couplings — All groups, PSL-2 (9.9)..... | 256 |
| H.12 | Processing of box ends — All groups, PSL-2 (9.11.1) | 257 |
| H.13 | Frequency of tensile testing — Casing and tubing, Grades N80 Type 1, and N80Q, PSL-2 (10.4.3) | 257 |
| H.14 | Hardness testing, PSL-3..... | 257 |
| H.14.1 | Hardness test — Grades N80Q, L80 Type 1, R95, P110 and Q125 (10.6.1, 10.6.4 and 10.6.8) | 257 |
| H.14.2 | Sampling and test specimen location — Non-upset pipe, Grades C90 and T95 (10.6.5) | 257 |
| H.15 | Metallographic evaluation for EW pipe — Grades J55, K55, M65, N80 Type 1, N80Q, L80 Type 1, and R95, PSL-2 (10.11) | 257 |
| H.16 | Hydrostatic test — Grades J55 and K55, PSL-2 (10.12.2) | 257 |
| H.17 | Wall thickness (10.13.4)..... | 257 |
| H.17.1 | All groups, PSL-2 | 257 |
| H.17.2 | All groups, PSL-3 | 258 |
| H.18 | Non-destructive examination (NDE)..... | 258 |
| H.18.1 | Full-body, full-length NDE — Casing and tubing..... | 258 |
| H.18.2 | NDE of the weld seam of welded pipe — Grades K55 and M65, PSL-2 (10.15.10) | 258 |
| H.18.3 | NDE of pipe ends — All groups, PSL-3 (10.15.13) | 258 |
| H.18.4 | NDE of coupling stock — Groups 1 (Grade R95 only), 2, 3 and 4, PSL-2 (10.15.11) | 259 |
| H.18.5 | NDE of coupling stock — Groups 1 (Grade R95 only), 2, 3 and 4, PSL-3 (10.15.11) | 259 |
| H.19 | Certification requirements — Groups 1, 2 and 3, PSL-2 (13.2)..... | 259 |
| H.20 | Non-metallic seal ring — All groups, PSL-2 (A.8.2)..... | 259 |
| Annex I (normative) Requirements for thread protector design validation | | 261 |
| I.1 | General | 261 |
| I.2 | Validation procedure | 261 |
| I.3 | Sample identification | 262 |
| I.4 | Dimensional stability tests | 262 |
| I.5 | Torque and vibration tests | 262 |
| I.6 | Axial impact tests..... | 262 |
| I.7 | Angular impact test..... | 263 |
| I.8 | Corrosion test..... | 263 |
| I.9 | Stripping test (pin end protector only) | 264 |
| I.10 | Hookability (liftability) test | 264 |
| Annex J (informative) Summary of Product Specification Level (PSL) requirements | | 265 |
| J.1 | General | 265 |
| J.2 | Grades J55 and K55..... | 265 |
| J.2.1 | PSL-2 | 265 |
| J.2.2 | PSL-3 | 265 |
| J.3 | Grade M65..... | 266 |
| J.3.1 | PSL-2 | 266 |
| J.3.2 | PSL-3 | 266 |
| J.4 | Grades N80 Type 1 and N80Q..... | 266 |
| J.4.1 | PSL-2 | 266 |
| J.4.2 | PSL-3 | 267 |
| J.5 | Grade L80 Type 1 | 267 |
| J.5.1 | PSL-2 | 267 |
| J.5.2 | PSL-3 | 268 |
| J.6 | Grade L80 13Cr..... | 268 |
| J.6.1 | PSL-2 | 268 |
| J.6.2 | PSL-3 | 268 |
| J.7 | Grades C90 and T95..... | 269 |
| J.7.1 | PSL-2 | 269 |
| J.7.2 | PSL-3 | 269 |

| | | |
|---|--|------------|
| J.8 | Grade R95..... | 269 |
| J.8.1 | PSL-2..... | 269 |
| J.8.2 | PSL-3..... | 270 |
| J.9 | Grade P110..... | 270 |
| J.9.1 | PSL-2..... | 270 |
| J.9.2 | PSL-3..... | 271 |
| J.10 | Grade Q125..... | 271 |
| J.10.1 | PSL-2..... | 271 |
| J.10.2 | PSL-3..... | 271 |
| Annex K (normative) Modification of the hydrogen sulfide titration procedures in ANSI-NACE | | |
| | TM0284-2003, Appendix C..... | 272 |
| K.1 | Solution preparation for low hydrogen sulfide (H ₂ S) analyses..... | 272 |
| K.2 | Titration procedures..... | 272 |
| K.3 | Titration of H ₂ S in solution..... | 272 |
| Annex L (informative) Technical changes from the previous edition..... | | |
| L.1 | Introduction..... | 273 |
| L.2 | Requirements for Group 2, Grade C110..... | 273 |
| L.3 | Changes to non-destructive examination requirements..... | 275 |
| L.4 | Changes to sulfide stress cracking requirements for Group 2, Grades C90 and T95..... | 275 |
| L.5 | Changing Group 2, Grade C95 to Group 1, Grade R95..... | 276 |
| L.6 | Change to Label-1: 7 coupling outside diameter..... | 277 |
| L.7 | Introduction of "product test block" and "standardised test block"..... | 277 |
| L.8 | Change to requirements for NDE of weld seams..... | 277 |
| L.9 | Change to requirements for weight tolerances..... | 277 |
| L.10 | Requirements for imperfections in threaded sections..... | 277 |
| L.11 | Requirements for marking seal ring couplings..... | 278 |
| L.12 | Requirements for paint marking Grades L80 9Cr and L80 13Cr..... | 278 |
| L.13 | Requirements for arc burns..... | 278 |
| L.14 | Introduction of "coupling material"..... | 278 |
| L.15 | Deletion of plain-end liners..... | 279 |
| L.16 | Deletion of extreme-line casing..... | 280 |
| L.17 | Elimination of grade types for Grades C90, T95 and Q125..... | 281 |
| L.18 | Changes to requirements for thread protector design validation..... | 281 |
| Bibliography..... | | 282 |