INTERNATIONAL STANDARD

ISO 15463

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Petroleum and natural gas industries — Field inspection of new casing, tubing and plain-end drill pipe

Industries du pétrole et du gaz naturel — Contrôle sur parc ou sur chantier des tubes de cuvelage, des tubes de production et des tiges de forage à extrémités lisses

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15463 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 5, *Casing, tubing and drill pipe*.

Introduction

This International Standard is provided for field inspection and testing of OCTG; it is not intended to restrict the agency or owner from using personal judgement and supplementing the specified inspections with other techniques, extending existing techniques, or re-inspecting certain lengths of OCTG.

Users of this International Standard should be aware that further or differing requirements might be needed for individual applications. This International Standard is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this International Standard and provide details.

Petroleum and natural gas industries — Field inspection of new casing, tubing and plain-end drill pipe

1 Scope

This International Standard specifies requirements and gives recommendations for field inspection and testing of oil country tubular goods (OCTG). This International Standard covers the practices and technology commonly used in field inspection; however, certain practices may also be suitable for mill inspections.

This International Standard covers the qualification of inspection personnel, a description of inspection methods and apparatus calibration and standardization procedures for various inspection methods. The evaluation of imperfections and marking of inspected OCTG are included.

This International Standard is applicable to field inspection of OCTG and is not applicable for use as a basis for acceptance or rejection (for which the relevant purchasing specification is applicable, see 5.4.2).

2 Conformance

2.1 Normative references

In the interests of worldwide application of this International Standard, ISO/TC 67 has decided, after detailed technical analysis, that certain of the normative documents listed in Clause 3 and prepared by ISO/TC 67 or other ISO Technical Committee are interchangeable in the context of the relevant requirement with the relevant document prepared by the American Petroleum Institute (API), the American Society for Testing and Materials (ASTM) or the American National Standards Institute (ANSI). These latter documents are cited in the running text following the ISO reference and preceded by “or”, for example “ISO XXXX or API YYYY”. Application of an alternative normative document cited in this manner may lead to technical results different from the use of the preceding ISO reference. However, both results are acceptable and these documents are thus considered interchangeable in practice.

NOTE ISO 11960 has been back-adopted by API as API Spec 5CT. Therefore, for the purposes of the provisions in this International Standard which cite ISO 11960, API Spec 5CT is equivalent to ISO 11960.

2.2 Units of measurement

In this International Standard, data are expressed in both the International system (SI) of units and the United States Customary (USC) system of units. For specific field inspection and testing, it is intended that only one unit system be used, without combining data expressed in the other system.

Inspection and testing performed using either of these unit systems shall be considered equivalent and totally interchangeable. Consequently, compliance with the requirements of the relevant Product Standard expressed in one of the unit systems provides compliance with the requirements expressed in the other system.

For data expressed in the SI, a comma is used as the decimal separator and a space as the thousands separator. For data expressed in the USC system, a dot (on the line) is used as the decimal separator and a space as the thousands separator.

In the text, data in SI units are followed by data in USC units in brackets.

2.3 Tables and figures

Separate tables for data expressed in SI units and USC units are given in Annex A and Annex C, respectively. For a specific order item, only one unit system shall be used.

In this International Standard, cross-references are made only to the tables in Annex A; if the USC units apply on an order, then any cross-references to tables in Annex A shall be taken to mean the equivalent table in Annex C.

Figures (data expressed in both SI and USC units) are contained in Annex B.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10405:2000, *Petroleum and natural gas industries — Care and use of casing and tubing*

ISO 11960:2001 (including Technical Corrigendum 1:2002), *Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells*

ISO 11961:1996, *Petroleum and natural gas industries — Steel pipes for use as drill pipe — Specification*

ISO 13678, *Petroleum and natural gas industries — Evaluation and testing of thread compounds for use with casing, tubing and line pipe*

API RP 5A3[1)], *Thread compounds for casing, tubing and line pipe*

API Spec 5B, *Threading, gauging and thread inspection of casing, tubing and line pipe threads*

API RP 5B1, *Threading, gauging and inspection of casing, tubing, and line pipe threads*

API RP 5C1:1999, *Care and use of casing and tubing*

API Spec 5D:2001, *Specification for drill pipe*

API Std 5T1, *Imperfection terminology*

4 Terms, definitions, symbols and abbreviated terms

4.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1.1
A-scan
data presentation utilizing a horizontal base line that indicates distance, or time, and a vertical deflection from the base line that indicates amplitude

4.1.2
AC-field
magnetic field induced by alternating current

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1) American Petroleum Institute; 1220 L Street NW, Washington DC, 20005, USA

4.1.3
agency
entity contracted to inspect new OCTG using the methods and criteria specified

4.1.4
ampere-turn
unit of magnetomotive force which is the product of the number of turns in a coil and the quantity of amperes of current flowing through it, representing the magnetizing strength of the coil

EXAMPLE 800 A in a 6-turn coil gives 4 800 ampere-turns.

4.1.5
arc, verb
create intense heat and light by passing an electric current across a gap

4.1.6
back-wall reflection
ultrasonic signal received from the back surface of the pipe wall

4.1.7
black-crested thread
non-full-crested thread whose original (black) mill surface has not been completely removed

4.1.8
black light
long-wave ultraviolet light (UV-A) with a wavelength between 320 nm and 400 nm

4.1.9
borescope
optical instrument with an illuminating lamp, used for inspecting the inside surface of OCTG

4.1.10
box
internally-threaded end of integral-joint OCTG, or the coupling end of threaded-and-coupled OCTG

4.1.11
calibration
comparison of an instrument with, or the adjustment of an instrument to, a known reference(s) standard that is often traceable to a national institute such as the National Institute of Standards and Technology

4.1.12
casing
steel pipe used in oil wells to seal off fluids from the bore hole and to prevent the walls of the hole from sloughing off or caving in

4.1.13
central conductor
conductor that is passed through the bore of OCTG in order to create a circular or circumferential magnetic field in the OCTG

NOTE This does not imply that the current rod is necessarily centred in the bore of the OCTG.

4.1.14
chamfer
conical surface at the end of pipe having round or buttress threads

4.1.15
chatter
wavy surface of the thread flank, root, crest, or chamfer, caused by a vibrating cutter insert

4.1.16
chock
block or wedge used beneath a length of pipe so that it cannot roll

4.1.17
circular magnetic field
circumferential magnetic field
magnetic field in or surrounding a current-carrying conductor, or OCTG, such that the magnetic field is oriented circumferentially within the wall of the OCTG

4.1.18
circular magnetization
circumferential magnetization
production of a magnetic field in a pipe wall or coupling such that the magnetic field is oriented circumferentially

4.1.19
classification
action taken to categorize a length of new OCTG based on conformance with the contracted inspection requirements

4.1.20
contour, verb
taper gradually by filing or grinding to remove abrupt changes in the wall thickness

4.1.21
contour-grind, verb
radius-grind
grind to remove sharp edges and/or abrupt changes in the wall thickness around imperfections or areas of exploratory grinding

4.1.22
couplant
material (usually a liquid) used between an ultrasonic transducer and the test specimen to assist transmission of ultrasonic sound waves between them

4.1.23
crest
top of a thread

4.1.24
cut, noun
gouge or distortion in two or more thread crests in a line, either parallel to the pipe axis or at an angle across the threads

4.1.25
DC-field
residual or active magnetic field induced by direct current

4.1.26
defect
imperfection of sufficient magnitude or properties to warrant rejection of OCTG based on the specified acceptance criteria

4.1.27
demagnetization
process of removing part or all of the residual magnetism from OCTG

4.1.28
detector
detector shoe
scanning shoe carrying one or more transducers, used to protect transducers from mechanical damage

4.1.29
discontinuity
flaw
imperfection
irregularity in the product, such as a lap, seam, pit and lamination

4.1.30
disposition
action taken in accordance with the applicable specification with regard to a defect in a length of OCTG

4.1.31
drift mandrel
cylinder, machined to specified dimensions, that is passed through a pipe to locate obstructions and/or to assess compliance with the appropriate specifications

4.1.32
dual-element transducer
ultrasonic transducer containing two piezoelectric elements, one for transmitting and one for receiving

4.1.33
eddy current
circulating current caused to flow in the OCTG by varying magnetic fields

4.1.34
electromagnetic inspection
EMI
primarily the eddy-current and flux-leakage methods used to detect imperfections

NOTE Field electromagnetic "Inspection Systems" sometimes include equipment for performing additional inspections or services.

4.1.35
evaluation
process of determining the severity of an imperfection which leads to determining whether the OCTG is acceptable or rejectable against the appropriate specification

4.1.36
exploratory grind, noun
probe grind
grind performed to explore or determine the depth of an imperfection

4.1.37
external thread
thread on the outside surface of OCTG

4.1.38
false indication
NDT indication that is interpreted to be caused by a condition other than a discontinuity or imperfection

NOTE False indications are considered non-relevant.

4.1.39
false starting thread
circumferential tool mark on a round-thread chamfer that precedes the actual starting thread

4.1.40
ferromagnetic
term applied to materials that can be magnetized or strongly attracted by a magnetic field

4.1.41
field end
pipe end opposite the internally-threaded end

NOTE Mill identification is at the internally-threaded end.

4.1.42
flank
side
surface of a thread that connects the crest with the root

4.1.43
fluorescent magnetic particle inspection
magnetic particle inspection process employing a finely-divided, fluorescent, ferromagnetic inspection medium that fluoresces when exposed to black light

4.1.44
flux density
strength of a magnetic field

NOTE In the Gaussian system, flux density is expressed in gauss.

4.1.45
flux leakage
magnetic field forced out into the air by a distortion of the field within the OCTG, caused by the presence of a discontinuity

4.1.46
full-body inspection
inspection coverage of the entire surface area of the OCTG within the limitations of the inspection equipment used

4.1.47
furring
build-up or bristling of dry magnetic particles at the ends of a longitudinally-magnetized length of OCTG, i.e. at its poles

4.1.48
gain
sensitivity adjustment produced by an amplifier or circuit

4.1.49
gamma-ray
high-energy, short wavelength, electromagnetic radiation emitted by a nucleus, which is penetrating and is best attenuated by dense material like lead or tungsten

NOTE The energy of gamma-rays is usually between 0,010 MeV and 10 MeV.

4.1.50
gauss meter
electronic magnetometer used to measure flux density

4.1.51
grind, verb
remove material from a surface by abrading, e.g. with a grinding wheel or file

4.1.52
handling damage
damage to the OCTG body, coupling or threads that occurred during loading, unloading, movements in transit, etc.

EXAMPLES cuts, gouges, dents, flattened (mashed) thread crests or similar.

4.1.53
hardness
resistance of a material to indentation, measured by pressing a hardmetal ball or diamond indenter into a smooth surface under standard conditions

4.1.54
hardness value
average of the valid readings taken in the test area for hardness

4.1.55
hydrostatic test
test performed by filling a length of OCTG with water and pressurizing it in order to verify its ability to withstand a specified pressure without leaking or rupturing

NOTE A hydrostatic test is generally considered a method to verify the structural integrity of the pipe but not the threaded connection.

4.1.56
imperfection
flaw
discontinuity or irregularity in the product

NOTE For more detailed definitions and illustrations of specific imperfections, see API Std 5T1.

4.1.57
indication
response or evidence from NDT

4.1.58
indicator
readout
device for displaying a condition, a current or a potential

EXAMPLES Analog and digital galvanometers, A-scan displays, warning lights, alarms.

4.1.59
induction
act of inducing a magnetic field in a ferromagnetic body

4.1.60
inspection
process of examining OCTG for possible defects or for deviation from established standards

4.1.61
inspection job
inspection of one or more lots of OCTG by an agency subject to a single contract or subcontract

4.1.62
inspection system
combination of equipment, procedures and personnel required for the detection of reference indicators

4.1.63
inspector
employee of an agency qualified and responsible for one or more of the inspections or tests specified in the contract

4.1.64
integral joint OCTG
OCTG with one end threaded externally and the other end threaded internally

4.1.65
internal thread
thread on the inside surface of OCTG

4.1.66
interpretation
process of determining the nature or forming an opinion of an indication based on objective data

4.1.67
label 1
dimensionless designation for the size or specified outside diameter, used when ordering OCTG

4.1.68
label 2
dimensionless designation for the mass per unit length or wall thickness, used when ordering OCTG

4.1.69
leakage field
magnetic field forced out of the material into the air by distortion of the field within the material, caused by the presence of a discontinuity

4.1.70
length
joint
complete section of pipe

4.1.71
longitudinal magnetic field
magnetic field which runs substantially parallel to the axis of the OCTG

4.1.72
longitudinal imperfection
imperfection oriented in the longitudinal or approximately longitudinal direction

4.1.73
magnetic particle field indicator
device containing artificial flaws which is used to verify the adequacy or direction, or both, of a magnetic field

4.1.74
magnetic particle
finely-divided ferromagnetic material capable of being individually magnetized and attracted to distortions in a magnetic field

4.1.75
magnetizing force
magnetic field strength

NOTE In the Gaussian system, the symbol is H_S and quantities are expressed in oersteds.

4.1.76
magnetometer
mechanical or electronic instrument used to measure magnetic field strength

4.1.77
manufacturer
entity last responsible for manufacturing compliance with the applicable product specification(s)

4.1.78
marking
assorted marks on tubular products including marks made for inspection with paint sticks and stencils, and ball-point paint tubes

4.1.79
mill end
pipe end having the coupling, box and/or mill identification

4.1.80
mill scale
iron oxide that forms on the surface of hot steel

4.1.81
no-drift
length of pipe through which a drift mandrel of specified diameter will not pass without undue force

4.1.82
non-destructive test
NDT
test used to detect internal, surface and concealed defects or imperfections in materials, using techniques that do not damage or destroy the items being tested

4.1.83
non-full-crested thread
thread that does not have a complete thread crest

EXAMPLE Black-crested thread.

4.1.84
notch
reference indicator with specified geometry

4.1.85
oil country tubular goods
OCTG
casing, tubing, plain-end casing liners, pup joints, couplings, accessories and plain-end drill pipe

4.1.86
operator
person present throughout the inspection or testing process who is responsible for the unit, operates the controls and observes the readout to detect imperfections

4.1.87
owner
entity having ownership of the new OCTG at the time inspection is contracted, specifying the type of inspection or testing to be conducted and authorizing its performance

NOTE The owner might be the purchaser.

4.1.88
perfect thread length
design length from the end of pipe or coupling to a specified location

4.1.89
permeability
measure of the ease with which material can become magnetized

NOTE Permeability is the ratio of flux density and magnetizing force, i.e. B/H.

4.1.90
pin end
externally-threaded end of a pipe without a coupling applied

4.1.91
pipe
oil field casing, tubing, plain-end casing liners, pup joints and plain-end drill pipe

4.1.92
pit
depression or cavity that can be caused by corrosion or removal of rolled-in or extraneous material

4.1.93
plain-end pipe
pipe without threads or tool-joint

4.1.94
planar imperfection
imperfection lying in one geometric plane that is normally parallel to, and within, the outer and inner surfaces

4.1.95
powder-dry
sufficiently dry to allow any type of powder, when applied to the surface, to be blown from the surface without residue remaining

4.1.96
power-tight
threaded connection that has been fully made up by mechanical means, using power tongs or a screw-on machine

4.1.97
prime pipe
pipe meeting all of the specified inspection and testing requirements

4.1.98
pulse
wave of short duration

4.1.99
pulser
electronic device and probe for generating a controlled-magnitude magnetic pulse, used for standardizing transducers

4.1.100
purchaser
entity that has purchased directly from the manufacturer the new OCTG being inspected

NOTE The purchaser might be the owner.

4.1.101
reference indicator
real or artificial discontinuity in a reference standard, which provides reproducible sensitivity levels for inspection equipment

EXAMPLES Artificial reference indicators can be holes, notches, grooves or slots.

4.1.102
reference standard
pipe, or pipe section, containing one or more reference indicators, used as a basis for comparison or for inspection equipment standardization

4.1.103
relevant indication
NDT indication that is caused by a condition or type of discontinuity that requires evaluation

4.1.104
root
bottom of a thread

4.1.105
scanner
detector assembly carrying one or more transducers, used for detecting imperfections and defects in OCTG

NOTE The scanner is often equipped with a magnetizer and is a part of it.

4.1.106
seamless pipe
wrought steel tubular product made without a welded seam

NOTE Seamless pipe is manufactured by hot-working steel and, if necessary, by subsequently cold finishing the hot-worked tubular product to produce the desired shape, dimensions and properties.

4.1.107
sensitivity
size of the smallest discontinuity detectable by an NDT method with a reasonable signal-to-noise ratio

4.1.108
signal
response of electronic NDT equipment to an imperfection or defect

4.1.109
signal-to-noise ratio
ratio of the signal from a significant imperfection or defect to signals generated from surface noise

4.1.110
source
origin of radiation, which is an x-ray tube or radioisotope

4.1.111
standardization
the adjustment of an NDT instrument using an appropriate reference standard, to obtain or establish a known and reproducible response

4.1.112
standardization check
check of the standardization adjustments to ensure that they remain correct

4.1.113
straightness
degree to which the longitudinal axis of a length of OCTG is parallel to a straight line

4.1.114
tally, verb
add up lengths of OCTG to arrive at an aggregate

4.1.15
test
two or more valid hardness test readings that have been made in the same test area

4.1.116
test area
area on OCTG that has been ground or filed smooth and flat to remove the decarburized surface material, on which a hardness test is performed

4.1.117
test block
special precision blocks, used as standards to verify calibration of an inspection instrument

4.1.118
thread form
profile of a thread in an axial (longitudinal) plane for a length of one pitch

4.1.119
thread protector
protection device placed on the end of OCTG to protect threads and seals from damage

4.1.120
threshold
investigation level established during EMI or UT inspection, above which indications are further investigated

4.1.121
tolerance
permissible deviation from the specified value

4.1.122
transducer
device which converts one form of energy to another

EXAMPLES Ultrasonic probes, search coils, eddy-current probes and most other detectors.

4.1.123
transverse
across, usually circumferential or substantially circumferential in direction

4.1.124
tubing
pipe placed within a well and serving as a conduit for produced well fluids or to inject fluids

4.1.125
ultrasonic test
NDT method using high-frequency sound waves

4.1.126
ultrasonic
having a frequency above the audible range, i.e. above 20 kHz

4.1.127
ultrasonic velocity
speed at which ultrasonic sound waves travel through a medium

4.1.128
upset, noun
forged metal end of OCTG with increased wall thickness and diameter, later to be threaded or welded

4.1.129
vanish point
location where the external thread runs out or terminates on the OCTG outside surface

NOTE The vanish point is the point where the lead of the chaser tool makes its final cut.

4.1.130
vernier calliper
dial calliper
measuring device, usually with two legs or jaws, that can be adjusted to measure the thickness, diameter, and distance between surfaces

NOTE Vernier callipers have a vernier scale readout whereas dial callipers have a dial readout.

4.1.131
wetting agent
substance which lowers the surface tension of a liquid

4.1.132
yoke
U-shaped piece of soft magnetic material, either solid or laminated, around which a coil is wound to carry a magnetizing current

4.2 Symbols and abbreviated terms

A_1 length of pin face to base of triangle

D specified outside diameter for pipe

d calculated inside diameter

D_{ou} outside diameter of upset

d_{ou} inside diameter of upset

I electric current, expressed in amperes

J distance from end of pipe to centre of coupling, power-tight make-up

L_{c} minimum length full crest threads

L_{eu} upset external length

L_{iu} upset internal length

L_1 length from end of pipe to hand-tight plane

L_4 total length of threads: end of pipe to vanish point

N coupling length

t specified wall thickness

W specified outside diameter for ISO/API threaded couplings other than special-clearance couplings

W_{c} specified outside diameter of special-clearance couplings

ALTFLD	full-length alternate drifted
BC	buttress thread casing
CPLG	unattached couplings
DC-block	distance calibration block
DSC block	distance sensitivity calibration block
DP	plain end drill pipe
EBW	effective beam width
EMI	electromagnetic inspection
EU	external upset tubing connection
EW	electric-welded casing or tubing (including attached couplings)
FLD	full-length drifted
FLEMI	full-length electromagnetic inspection
FLMPI	full length magnetic particle inspection (wet or dry MPI)
FLVI	full-length visual inspection
IJ	integral joint tubing connection
LC	long round thread casing connection
NDT	non-destructive testing
NU	non-upset tubing connection
OCTG	oil country tubular goods
OD	outside diameter
PD	pulse density
PTL	perfect thread length
SEA	end area inspection (formerly called special end area inspection)
SMLS	seamless casing or tubing (including attached couplings)
STC	short round thread casing connection
T&C	threaded and coupled
TESTED	hydrostatically pressure-tested
UCMPI	unattached coupling magnetic particle inspection
UT	ultrasonic testing
UTFL	full-length ultrasonic inspection

UTW ultrasonic inspection, weld line

VTI Visual thread inspection

5 Application

5.1 Basis for inspection

This International Standard contains practices recommended for use in the inspection of new OCTG subsequent to production by the manufacturer. The basis for performing an inspection has its origin in either ISO 11960, ISO 11961 or API Spec 5D, API Spec 5B, or in a supplemental specification or contract prepared by the owner. The inspections represented by the practices are placed in one of three categories as follows:

a) inspections specified in ISO 11960, ISO 11961 or API Spec 5D, or API Spec 5B;

b) inspections specified as one of several options in ISO 11960, ISO 11961 or API Spec 5D, or API Spec 5B;

c) inspections not specified in ISO 11960, ISO 11961 or API Spec 5D, or API Spec 5B.

5.2 Applicability of inspections

Some of the practices contained in this International Standard are applicable to OCTG regardless of size and type. Other practices typically might have limited applicability. Table A.1 indicates those inspections that are available in the field and covered by this International Standard, in relation to OCTG type. It is the owner's responsibility to specify which inspections shall be used when completing the ordering information (see Clause 6) to accompany an inspection contract.

5.3 Repeatability of results

Every inspection and measurement process is characterized by an inherent variability of results. The NDT methods and measurements included in this International Standard are characterized by additional inherent variability attributable to the following factors.

a) ISO 11960, ISO 11961 or API Spec 5D, or API Spec 5B permits options in the selection of practices to be used in the inspection for specific attributes.

b) Within a single practice, ISO 11960 or ISO 11961 or API Spec 5D, or API Spec 5B permits options in the selection of calibration standards.

c) Each manufacturer of NDT systems uses different mechanical and electronic designs.

d) Certain practices contained in this International Standard are based on operation of the system at high, and even maximum, sensitivity without the use of the reference standards specified in ISO 11960 or ISO 11961 or API Spec 5D.

e) Within the performance capability of a single NDT system installation, there will not be perfect repeatability of results.

5.4 Consequences of variability

5.4.1 Disposition

For any of the reasons given in 5.3, the results of field inspection may not replicate corresponding inspections performed during manufacture. Variability within and among the results of practices contained in this International Standard is to be expected. When field inspection results in the classification of OCTG as other than prime, it shall not be presumed that the material is defective until an evaluation has been performed in accordance with Clause 19 to establish final disposition.

5.4.2 Responsibility for rejections

In some cases, an OCTG inspected using practices described in this International Standard may be classified as a reject even though it was inspected in conformance with ISO 11960, ISO 11961 or API Spec 5D, or API Spec 5B and classified by the manufacturer as an acceptable product in conformance with ISO 11960, ISO 11961 or API Spec 5D, or API Spec 5B. Responsibility for a rejection shall be based on the acceptance criteria contained in ISO 11960, ISO 11961 or API Spec 5D, or API Spec 5B, or an additional or more restrictive criteria previously negotiated with the manufacturer. The results of field NDT shall under no circumstances stand alone as a basis for rejection without corroborating evidence that the material is properly classified as defective based on the evaluation(s) performed in accordance with Clause 19 of this International Standard. If disposition is disputed between the purchaser and the manufacturer, the provisions of ISO 11960:2001, Clause 10, or ISO 11961:1996, Clause 8 or API Spec 5D:2001, Clause 10, or API Spec 5B shall apply.

6 Ordering information

6.1 In specifying the application of this International Standard to an order for the inspection of new OCTG, the owner shall specify, for each size and type of OCTG, the following order information:

a) the inspection(s) to be applied;

b) the frequency of sampling for inspection;

c) the reference standard, if applicable;

d) the acceptance criteria;

e) the permissible disposition of all classifications of OCTG (see Table A.19);

f) the instructions for marking.

6.2 The applicability of methods and procedures contained in this International Standard in accordance with ISO 11960, ISO 11961 or API Spec 5D, or API Spec 5B is indicated in 11.2, 12.2, 13.2, 14.3, 15.2, 16.2, 17.2, 18.2, 19.2 and 20.2. Some procedures in this International Standard are beyond the scope of the inspection requirements of ISO 11960, ISO 11961 or API Spec 5D, and API Spec 5B.

7 Quality assurance

7.1 The agency performing field inspection shall have a quality programme consistent with the provisions of a recognized quality standard. The agency's quality programme shall be documented and shall include written procedures for all inspections performed.

7.2 The agency's quality programme shall include documented procedures for the calibration and verification of the accuracy of all measuring, testing and inspection equipment and materials.

7.3 The agency's quality programme shall include records that verify inspection system capability for detecting the required reference indicators. In order to meet the requirements of ISO 11960, and ISO 11961 or API Spec 5D, the verification of inspection system capability shall address the following.

a) Standardization and operating procedures: The standardization procedures will vary with the different types of equipment, but as a minimum the written procedures shall address the method for assuring coverage (minimum 100 % for longitudinal and transverse flaws), minimum notch response, and maximum signal-to-noise ratio. The written operating procedures shall provide the required steps, control settings and parameter limits, such as use of special electronic circuits, use of special detector array configurations (pig tails), and maximum velocities to be used.

b) Equipment description: The equipment used to conduct the inspection shall be described in sufficient detail to demonstrate that it meets the requirements of ISO 11960, or ISO 11961 or API Spec 5D.

c) Personnel qualification: documentation of qualification of inspection personnel shall meet the requirements of Clause 8.

d) Dynamic test data demonstrating the system capabilities for detecting the reference indicators: there are many methods of verifying system capability, two of which are as follows:

   1) Inspection system capability is established by using statistical techniques for assessment of inspection performance. By establishing inspection system setup parameters and response amplitude of the applicable reference flaws, data points are established to determine the distribution of response amplitudes. These data then become the basis for establishing the capability of the inspection system.

   2) Inspection system capability is demonstrated for each inspection order by use of a reference standard with the required reference notches. After the system is standardized according to the written procedures, the test standard is inspected at a number of positions to establish the reliability in all quadrants.

e) Reports: reports shall include all system settings, strip charts (if applicable), traceability of calibration, standardization and setup procedure, and a map of the test standard.

7.4 The agency's quality programme shall include provisions for the education, training and qualification of personnel performing inspections in accordance with this International Standard.

8 Qualification of inspection personnel

8.1 General

This clause sets forth the minimum requirements for qualification and certification (where applicable) of personnel performing field inspection of OCTG.

8.2 Written procedure

Agencies performing inspection of OCTG in accordance with this International Standard shall have a written procedure for education, training and qualification of personnel. The written procedure shall include the following:

a) establish administrative duties and responsibilities for execution of the written procedure;

b) establish personnel qualification requirements;

c) require documentation verifying all qualifications.

8.3 Qualification of inspection personnel

The qualification inspection personnel shall be the responsibility of the agency. ISO 11484 or ASNT SNT-TC-1A may be used as a guideline.

The requirements for each applicable qualification shall include the following as a minimum:

a) training and experience commensurate with the inspector's level of qualification;

b) written and practical examinations with acceptable grades;

c) a vision examination;

d) knowledge of the related sections of the applicable ISO/API standards and this document.

8.4 Training programmes

8.4.1 All qualified personnel shall have completed a documented training programme designed for that level of qualification. The programme shall include the following:

a) principles of each applicable inspection method;

b) procedures for each applicable inspection method, including calibration and operation of inspection equipment;

c) related sections of the applicable ISO/API standards.

8.4.2 Training may be given by the agency or an outside agent.

8.5 Examinations

8.5.1 All inspection personnel shall have successfully completed the following examinations.

a) Written examinations addressing the general and specific principles of the applicable inspection method, the inspection procedures, and the applicable ISO/API standards.

b) A practical examination that shall include apparatus assembly, standardization, inspection techniques, operating procedures, interpretation of results for appropriate levels, and related report preparation.

c) Natural or corrected vision to read J-2 letters on a Jaeger number-2 test chart at a distance of 304,8 mm to 381,0 mm (12 in to 15 in). Equivalent tests, such as the ability to perceive a Titmus number-8 target, a Snellen fraction 20/25, or vision examinations with optical apparatus administered by physicians, are also acceptable.

8.5.2 Examinations shall be given by the agency or an outside agent.

8.6 Experience

All candidates for qualification shall have the experience required by the written procedure.

8.7 Requalification

8.7.1 Requalification requirements shall be defined in the written procedure.

8.7.2 Requalification is required at least every five years for all personnel.

8.7.3 Requalification of personnel is required if an individual has not performed defined functions within the previous 12 months, or if an individual changes employers.

8.7.4 As a minimum requirement for requalification, all personnel shall achieve an acceptable grade on a written examination addressing the current applicable OCTG inspection procedures, and the applicable ISO/API documents.

8.8 Documentation

8.8.1 Record retention and documentation are required for all qualification programmes. The following are minimum requirements:

a) all qualified personnel shall receive an attestation of qualification stating their level of qualification;

b) the records of all qualified personnel showing training program completion, experience, and examinations shall be maintained by the agency for a minimum period of 5 years and made available for review upon request.

8.8.2 All qualifications and related documents shall be approved by authorized agency personnel.

8.9 NDT personnel certification

8.9.1 A programme for certification of NDT personnel shall be developed by the agency. ISO 11484 or ASNT-TC-1A may be used as a guideline.

8.9.2 The administration of the NDT personnel certification programme shall be the responsibility of the agency.

8.9.3 ISO and API are neither responsible for administering the NDT certification programme nor acting as a certifying agent in the programme.

9 General inspection procedures

9.1 General

This clause covers general procedures applicable to all inspection methods contained in this International Standard.

9.2 Documents at job site

The following inspection-related documents shall be available at the job site:

a) applicable ISO standards listed in Clause 3;

b) additionally, when ISO/API thread gauging is being conducted, a copy of API RP 5B1;

c) all applicable agency-controlled and qualified inspection procedure documents;

d) the field inspection contract or agency inspection order based on the contract.

9.3 Pre-inspection procedures

9.3.1 Each inspection shall start with the correct equipment available and in good working condition.

9.3.2 Prior to equipment setup, the agency shall assure that the OCTG to be inspected is the OCTG the owner has ordered to be inspected by comparing the information on the job order with the OCTG markings, i.e. diameter, nominal mass, grade, manufacturer, and whether seamless or welded.

9.3.3 All inspection shall begin by uniquely numbering or renumbering each length with a paint marker. Place the sequence number on the outside surface, preferably on the coupling end, box end, or identified end and printed in white paint so that it can be read from the end of the length. Do not place numbers over mill paint stencils. Unique numbering of unattached couplings is not required, however rejected couplings shall be identified and segregated from prime couplings. If a defect is found on a length of OCTG, complete all specified inspections on that length unless otherwise stipulated in the inspection contract.

9.4 Records and notification

As inspection progresses, maintain a record of the classification of the OCTG inspected. If at any time after 50 lengths or couplings have been inspected or tested, the reject rate exceeds 10 % of the OCTG inspected, notify the owner or his/her representative. If appropriate, it is suggested that the manufacturer, or his/her representative, be notified in turn through the purchaser.

9.5 Post-inspection procedures

9.5.1 Classification

Classify each length of pipe or coupling into one of the categories listed below (see Clause 21 for details):

a) prime pipe with good connections, or prime unattached couplings;

b) prime pipe with defective connections;

c) pipe that contains conditionable defects;

d) pipe that contains non-conditionable defects;

e) non-conditionable unattached couplings (rejects);

f) unattached couplings requiring conditioning;

g) pipe or unattached couplings not meeting special owner-specified tests.

9.5.2 Marking

Mark the classification of each pipe and coupling with paint markings and apply all applicable inspection markings as described in Clause 21.

9.5.3 Cleaning

Remove all magnetic powder and cleaning material from the pipe and coupling surfaces. Do not contaminate nearby pipe during this process.

Material Safety Data Sheets should be read and the precautions observed when handling products of this type. Consideration should be given to the storage, transport, use and disposal of excess materials and containers. Observe appropriate regulations relative to disposal of used solvents and generated waste materials.

NOTE Solvents and other cleaning agents might contain hazardous materials. Solvents are normally volatile and can build up pressure in containers.

9.5.4 Count and tally lengths

Count and tally the lengths in each of the classification categories. Be sure to verify the totals after the initial count. Segregate the prime OCTG from all other OCTG if practical. Tally each length of casing and tubing using the overall length (including pin threads and coupling). By agreement between the owner and the agency, a “makeup” tally as described in ISO 10405:2000, 4.1.7 c) or API RP 5C1:1999, 4.1.7 c) shall be substituted on acceptable OCTG. An overall tally shall be used on rejected OCTG.

9.5.5 Thread protection

After inspection, ensure that the threads are clean and dry. Lubricate the threads with a thread compound that meets the performance objectives of ISO 13678 or API RP 5A3 or with a specific thread compound if specified by the owner. Lubricate the entire threaded area, including seals and thread roots, for the full thread circumference. In very cold climates, it might be necessary to warm the thread compound in order to apply it.

The Material Safety Data Sheets for thread compounds should be read and observed. Storage and disposal of containers and unused compound should be in accordance with appropriate regulations.

9.5.6 Thread protectors

Reinstall clean thread protectors and tighten them wrench-tight.

9.6 Job site checklist

Before leaving the job site, the agency shall ensure that the following items have been accomplished.

a) Pipe racking. The agency shall ensure that each row of pipe has been properly secured (e.g. with chocks) for safety, and that no loose or unsecured pipe is left free to roll or fall from the racks. No pipe shall be left on the ground. Ensure that the pipe has been properly racked, and that all pipe has stripping between layers. Stripping shall be placed directly over the centreline of each sill.

b) Unattached couplings. Unattached couplings shall be stored for protection against the environment. Unless otherwise specified by the owner, they shall be returned to their original shipping container.

c) Debris removal. The job site shall be left neatly arranged and clean of all job-related debris.

d) Solvent disposal. Cleaning solvents used at the job site shall be disposed of properly.

9.7 Documentation

A field copy of the completed inspection report and supporting documents shall be delivered to the customer or specified representative upon completion of the job. Terminology for defects shall comply with API Std 5T1, where applicable.

10 Acceptance criteria, disposition and responsibility

10.1 General

This clause sets forth the principles for determining acceptance criteria, disposition, and responsibility for OCTG inspected in accordance with this International Standard.

10.2 Basis for acceptance

ISO 11960, ISO 11961 or API Spec 5D, or API Spec 5B constitute the basis for acceptance of OCTG inspected in accordance with this International Standard, except that additional or more restrictive criteria may be contracted between the owner and the agency.

10.3 Responsibility for rejections

10.3.1 The manufacturer shall be responsible for rejects which, after evaluation, are demonstrated to be nonconforming to the requirements of ISO 11960, ISO 11961 or API Spec 5D, or API Spec 5B. Manufacturer responsibility for defects attributable to handling or shipping damage shall be limited to those conditions reported to the manufacturer at, or prior to, delivery to the purchaser. Rejection shall not be based solely on unevaluated imperfections or indications (see 10.3.3).

10.3.2 In an identical manner to 10.3.1, the manufacturer shall be responsible for rejects that, after evaluation, are demonstrated to be conforming to the requirements of ISO 11960, ISO 11961 or API Spec 5D, or API Spec 5B but nonconforming to additional or more restrictive criteria for which the manufacturer is contractually liable (see 10.3.3).

10.3.3 In the event the manufacturer may be responsible for the rejection, but the purchaser and manufacturer are unable to agree that the OCTG is defective, a destructive test may be performed. If tests that require the destruction of material are made, any product that is proven to have not met the requirements of the specification shall be rejected. Disposition of rejected product shall be a matter of agreement between the manufacturer and purchaser.

10.3.4 Disposition of defects shall be in compliance with the applicable specification. Dispositions shall be recorded and shall be traceable to the OCTG inspection number (see 9.3.3).

11 Visual and dimensional inspection

11.1 General

This clause provides descriptions, mechanical equipment requirements, and procedures for visual and dimensional inspection of OCTG.

11.2 Application

The inspections described in this clause are applicable to all sizes and all types of OCTG.

11.3 Drift mandrels

The diameter of the drift mandrel shall be measured with a vernier calliper or micrometer having flat contacts.

The instrument used shall be calibrated using a known precision setting standard at least once every 4 months.

The calibration check shall be recorded on the instrument, and in a log book, giving the date of the calibration check, the due date, and the initials of the person who performed the check. Length measurements may be made using one of the devices listed in 11.5.

11.4 Precision callipers (micrometer, vernier calliper or dial calliper)

The instrument shall be calibrated using a known precision reference standard at least once every 4 months. The calibration check shall be recorded on the calliper, and in a log book, giving the date of the calibration check, the due date, and the initials of the person who performed the check.

11.5 Length- and diameter-measuring devices (steel rules, steel length- or diameter-measuring tapes, and other non-adjustable measuring devices)

Accuracy verification shall be defined as a visual check of the legibility of the markings and the general wear of fixed reference points. The verification procedure of these devices shall be documented.

11.6 Depth gauges

11.6.1 General

The following conditions and checks apply to gauges used for imperfection evaluation in Clause 19.

11.6.2 External depth gauges

For external depth gauges the following shall apply.

a) Set the gauge to zero on a flat surface.

b) Check measuring accuracy of the gauge over a range of standard depths, at least once every 4 months or after repair or replacement.

c) Accuracy shall be within 0,025 mm (0.001 in) of actual depths of the reference standard.

d) The calibration check shall be recorded on the gauge, and in a log book, giving the date of the calibration check, the due date, and the initials of the person who performed the check.

11.6.3 Internal depth gauges

For internal depth gauges and wall thickness callipers the following shall apply.

a) Set the gauge to read zero or a specified thickness when the contact points touch or when a standard thickness is placed between the contacts.

b) Check the measuring accuracy of the gauge over a range of standard thicknesses, different from those used in 11.6.2.b), at least once every 4 months or after repair.

c) Accuracy of readings shall be within 2 % of the actual wall thickness of the thickest standard used.

d) The calibration check shall be recorded on the gauge, and in a log book, giving the date of the calibration check, the due date, and the initials of the person who performed the check.

11.7 External surface illumination

11.7.1 Direct daylight

Direct daylight conditions do not require a check for surface illumination.

11.7.2 Night and enclosed-facility lighting

The diffused light level at the surfaces being inspected shall be at least 500 lx (50 fc). Illumination shall be checked once every 4 months. The check shall be recorded in a log book, giving the date, the reading, and the initials of the person who performed the check. This record shall be available on site. Illumination shall be checked whenever lighting fixtures change position or intensity, relative to surfaces being inspected.

11.7.3 Night-lighting with portable equipment

The diffused light level at the surfaces being inspected shall be at least 500 lx (50 fc). Proper illumination shall be verified at the beginning of the job to assure that portable lighting is directed effectively for surfaces being inspected. Illumination shall be checked during the job whenever lighting fixtures change positions or intensity relative to the surfaces being inspected.

11.7.4 Light-meter calibration

Light-meters used to verify illumination shall be calibrated at least once a year. The calibration check shall be recorded on the meter, and in a log book, giving the date of the calibration check, the due date, and the initials of the person who performed the check.

11.8 Internal surface illumination

11.8.1 Mirrors for illumination

The reflecting surface shall be a non-tinted mirror that provides a non-distorted image. The reflecting surface shall be flat and clean.

11.8.2 Spotlights

A light source having documented, demonstrated capability shall be used for illumination of inside surfaces. A spotlight producing an illumination greater than 1 000 lx (100 fc) at the maximum inspection distance may be used for this. The lens of the light source shall be kept clean.

11.8.3 Borescope equipment

The borescope lamp shall meet the requirements shown in Table A.2. The resolution of the borescope shall be checked at the start of a job, and whenever all or part of the borescope is assembled or re-assembled during a job. The date on a coin [not to exceed 1,02 mm (0.040 in) in height] or Jaeger J-4 letters placed within 101,60 mm (4 in) of the objective lens, shall be readable through the assembled borescope.

11.9 Full-length visual inspection (FLVI) of new OCTG

11.9.1 Description

A full-length visual inspection of the entire outside and inside surfaces, excluding the threads, shall be conducted to detect gouges, cuts, pits, dents, grinds, mechanical damage, lack of straightness, and other visually detectable imperfections. On electric-welded pipe, special attention should be given to weld flash and trim. Each length shall be rolled and the entire surface viewed. The entire inside surface shall be inspected using a high intensity light, mirror or borescope (depending on size) meeting the requirements of 11.8.

11.9.2 External visual inspection procedure

Inspect lengths in groups by first rolling them together. Observe the pipe while rolling to detect straightness problems. Evaluate bent or bowed pipe in accordance with Clause 19.

Use the following procedure for external visual inspection:

a) identify the upper one-third of each length with a chalk mark;

b) examine each pipe surface by walking the length of each pipe from one end to the other. The number of lengths inspected on each pass will depend on the diameter. As each imperfection is found, mark it and evaluate it in accordance with Clause 19;

c) after the top one-third of this group has been inspected, roll each length one-third of a turn and mark with chalk;

d) repeat b) and c) until the entire outside surface of the pipe has been inspected.

11.9.3 Internal visual inspection procedures

Inspect the entire inside surface, excluding the threads, for imperfections. Pipe sizes Label 1: 10-3/4 and larger shall be visually inspected from each end using an illumination source meeting the requirements of 11.8.1, 11.8.2 or 11.8.3. For pipe sizes smaller than Label 1: 10-3/4, the best quality inspections are done with a borescope; see 11.8.3 for resolution requirements.

11.10 Outside diameter verification

11.10.1 If requested by the owner, the diameter of each length shall be verified to assure compliance with ISO 11960 and with ISO 11961 or API Spec 5D.

11.10.2 Verification of minimum and maximum diameter may be performed with snap gauges.

11.10.3 Micrometers or mechanical callipers that display the readout in hundredths of a millimetre (thousandths of an inch) shall be used to measure actual diameter.

11.10.4 Diameter tapes shall be used to measure average diameter.

11.11 Straightness

11.11.1 A visual inspection shall be performed to detect hooked ends or bowed pipe. Pipe to be examined shall be placed on a rack or joists where it can be rolled while visually examining for straightness.

11.11.2 Pipe sizes Label 1: 4-1/2 and larger shall be measured to determine the amount of straightness deviation whenever a visual examination has shown them to have hooked ends or to be bowed. This measurement shall be performed using a straight edge or taut string (wire) and a steel scale or rule.

11.11.3 Straightness shall be evaluated in accordance with Clause 19.

11.12 Drift testing

11.12.1 General

Casing or tubing shall be drifted throughout its entire length to detect reduction in inside diameter. Group 1 external upset drill pipe, except sizes Label 1: 3-1/2 to Label 2: 13.30, shall be drifted throughout the length of the end upsets. Drift mandrels manufactured in accordance with ISO 11960, ISO 11961 or API Spec 5D, or this International Standard shall be used for this test.

11.12.2 Drift mandrel specifications

Drift mandrel specifications are as follows.

a) The minimum diameter of the cylindrical portion of a drift mandrel for bare casing, tubing, and drill pipe shall be in accordance with Table A.4, Table A.5 and Table A.8. Diameters for sizes and masses not included in these tables shall be calculated in accordance with Table A.3. A drift mandrel for internally-coated pipe shall be made of plastic, or hardwood such as oak and, as a guide, should meet the dimensions specified in Table A.6 and Table A.7. Because of the extra thickness added by the coating, a “no-drift” coated length might not need to be classified as a reject.

b) The drift mandrel shall be cylindrical in shape and may have attachments on one or both ends. Disk and barbell-shaped mandrels shall not be used. The ends of the drift mandrel extending beyond the specified cylindrical portion shall be shaped to permit easy entry into the pipe.

Sometimes pipe is drifted in the field to allow drilling with commonly used bit sizes. Drift sizes that are in use to allow passage of these commonly used bit sizes are shown in Table A.4. Pipe through which this specified drift passes should be marked as recommended in Clause 21.

NOTE Pipe rejected for failure to pass this specified or alternative drift is not the responsibility of the manufacturer unless the pipe was ordered that way.

11.12.3 Drift mandrel verification procedures

The following drift mandrel verification procedures shall be followed.

a) The length of the cylindrical portion of the drift mandrel shall be measured (a steel scale may be used for this measurement). Specified drift mandrel lengths are tabulated in Table A.3.

b) The mandrel diameter shall be measured using a micrometer or mechanical calliper that displays the readout in hundredths of a millimetre (thousandths of an inch). These measurements shall be made with the drift mandrel and micrometer at the same temperature. Measurements shall be made at each end of the drift mandrel. Each measurement shall be made in two locations, 90° apart. The allowable mandrel tolerance shall be 0,000 mm to +0,013 mm (0.000 in to +0.005 in) from the specified ISO/API dimensions. Drift mandrels larger than the upper tolerance of +0,013 mm (+0.005 in) may be used for acceptance but not for rejection. In case of dispute, a precision steel drift mandrel made to the appropriate ISO/API dimensions shall be used to resolve whether the lengths are acceptable or rejectable.

11.12.4 Drifting procedures

The following drifting procedures shall be followed.

a) Select and measure the correct drift mandrel prior to starting the inspection job, and re-measure the mandrel at least once for every 500 lengths thereafter.

b) The drift mandrel shall be at approximately the same temperature as the pipe being inspected.

c) Pass the drift mandrel through the entire length of each casing and tubing and through the upset length of drill pipe. The drift mandrel shall pass through the pipe or upset freely using a reasonably exerted force that does not exceed the weight of the drift mandrel. The drift should be inserted and removed carefully so that neither the threads nor the seals are scratched or damaged.

d) If the drift does not pass through the entire length of casing or tubing or the drill pipe upset, remove and clean the drift mandrel. Clean out the pipe if necessary. Check the pipe for sagging and provide additional support if needed.

e) Attempt the drift test again from the other end of the pipe. If the drift mandrel does not pass through the entire length on the second attempt, the length shall be considered a reject and identified immediately as a “no-drift.”

11.13 Visual thread inspection (VTI)

11.13.1 General

Visual thread inspection is a method for locating thread imperfections without the use of magnetic particle inspection or thread gauges other than a profile gauge. This inspection applies to exposed round threads on casing and tubing and exposed buttress threads on casing. Visually evident manufacturing defects or mechanical damage to the threads are detected by this inspection method.

NOTE Extreme-line threads are excluded from these inspection procedures. For extreme-line threads, refer to API Spec 5B.

11.13.2 Evaluation tools

Though imperfections can be visually located during this inspection, the following tools shall be used to evaluate the magnitude of the imperfections found:

a) a steel scale for accurately determining the L_c area on the pin and the perfect thread length of internal threads [see 11.13.4c)];

b) mirror for inspection of load flanks and roots of internal threads;

c) bright light, meeting the requirements of 11.8.2, for inspection of internal threads;

d) profile gauge, for detection of thread profile errors;

e) flexible steel measuring tape for measuring circumferential nonfull-crested or black-crested thread length on buttress threads.

A copy of API Spec 5B and this International Standard shall be available on location.

11.13.3 Thread repair

Repair of threads is not a part of this inspection. However, by agreement between the owner and the agency, cosmetic (minor) repair of threads may be made.

11.13.4 Visual thread inspection procedures

Proceed as follows.

a) Remove the thread protectors and stack them out of the way so that they will not be a work hazard. From this step, until the thread protectors are reinstalled, great care shall be taken to ensure that two lengths of pipe do not strike each other and damage the unprotected threads. Pipe shall never be loaded, unloaded, or removed to another rack without thread protectors installed. Never leave threads unprotected from moisture or condensation overnight. Use of a light corrosion inhibitor is recommended.

NOTE 1 Martensitic chromium steels (ISO 11960, grades L80-9Cr and L80-13Cr) are sensitive to galling. Special precautions might be necessary for thread surface treatment and/or lubrication to minimize galling.

b) Clean all exposed threads thoroughly. Ensure that no thread compound, dirt, or cleaning material remains on the threads.

c) Determine the L_c length of pin end threads and record this number. Refer to Table A.9 and Table A.10 of this International Standard, or to API Spec 5B from which these tables were taken.

Internal threads do not have an L_c area. All of the threads within the interval from the counterbore to a plane located at a distance J plus one thread turn from the centre of the coupling or small end of integral joint OCTG shall be inspected to the L_c area requirements. This area is defined as the internal perfect thread length (PTL). The calculated perfect threads are listed in the Table A.9 and Table A.10.

NOTE 2 Thread classification depends on the location of an imperfection. Imperfections located in the L_c area of external threads or in the PTL of internal threads have different criteria for acceptance and rejection than those outside these regions. Measurement might be required to determine if imperfections are in the L_c or box PTL.

d) Slowly roll individual lengths at least one full revolution while examining the threads.

e) For external threads, inspect for imperfections on the face, chamfer, L_c area and non-L_c area. The thread profile gauge shall be applied to the threads to detect machining errors.

f) For internal threads, inspect for imperfections in the counterbore, PTL, and threaded area beyond the PTL. Seal-ring grooves shall be inspected for fins, wickers, and ribbons that are loose, or could become loose, on each side of the groove. The profile gauge shall be applied to the threads to detect machining errors. Caution shall be exercised when applying the profile gauge to avoid damaging thread coating. Exploratory grinding or filing to determine the depth of an imperfection is not permitted in the L_c area of external threads or the total length of internal threads.

11.13.5 Categories of imperfections

Types of imperfections that may cause thread rejection are listed below. Refer to 19.12 or API Spec 5B for dimensional data for acceptance and rejection.

a) Threaded area imperfections:

1) broken threads;

2) cuts;

3) grinds;

4) shoulders or steps;

5) seams;

6) non-full-crested threads (including black-crested threads);

7) laps;

8) pits;

9) dents;

10) tool marks;

11) fins;

12) dings;

13) burrs;

14) torn threads (tears);

15) handling damage;

16) thick threads;

17) narrow threads (shaved threads);

18) galls;

19) improper thread height;

20) wicker (or whisker);

21) cracks;

22) chattered threads;

23) wavy or drunken threads;

24) improper thread form;

25) arc burns;

26) threads not extending to the centre of the coupling (threads within the J-area may not be perfect);

27) imperfections, other than those listed above, that break the continuity of the thread.

NOTE 1 Non-full-crested threads have historically been, and continue to be, referred to as black-crested threads because the original mill surface has not been removed. The term black-crested thread is a useful descriptive term, however, it should be understood that there can also be non-full-crested threads that are not black.

b) Conventional chamfer area:

1) not present 360°;

2) thread running out on the face;

3) razor edge;

4) feather edge;

5) burrs;

6) false starting thread engaging actual starting thread;

7) mashes;

8) cuts.

NOTE 2 The surfaces of the chamfers need not be perfectly smooth. Chamfers on the pipe ends have no effect on the sealing capability of the threads.

c) Round or bullet nose for tubing:

   1) radius transition not smooth;

   2) sharp corners;

   3) burrs;

   4) slivers;

   5) false starting thread engaging actual starting thread;

   6) mashes;

   7) cuts.

NOTE 3 Dimensions are not subject to measurement to determine acceptance or rejection of the product.

d) Pipe end imperfections (inside and outside):

   1) burrs;

   2) fins;

   3) dents/mashes.

e) Box face and counterbore imperfections:

   1) tool marks;

   2) mashes;

   3) burrs;

   4) arc burns.

f) Mill end makeup: Coupling makeup measurement is not part of visual thread inspection. However, if visual inspection reveals obvious makeup errors, evaluate in accordance with Clause 19.

All imperfections listed in a) through e), if detected, shall be evaluated in accordance with 19.12.

12 Hardness testing

12.1 General

This clause covers methods for hardness testing under field conditions. This test may also be used to determine compliance with contractual hardness specifications.

NOTE Brinell-type testing using visually measured impression diameters is outside the scope of this International Standard.

12.2 Application

ISO 11960, and ISO 11961 or API Spec 5D, contain no direct provision for surface hardness testing. The owner shall specify the test locations and acceptance criteria (hardness range).

NOTE The steel grade cannot be reliably determined by hardness testing alone.

12.3 Equipment

A wide variety of portable hardness testing equipment is available. Some types of hardness testers are suitable only for general information and vary in accuracy (as explained in ASTM E 110:2002, Note 2). Other types of hardness testers as described in ASTM E 110 may also be employed.

12.4 Calibration

12.4.1 Annual calibration

Hardness testers shall be calibrated at least once a year and after each repair. The calibration shall be conducted by a certified agency issuing a certificate showing traceability to a statutory authority. The certificate shall identify the date of the check, the specified values of each certified hardness test block, the mean value of the tester readings on each block, and the initials of the person performing the check.

12.4.2 Four-month verification

The accuracy of hardness testers that were used during any four-month period shall be verified at the end of that four-month period. This shall be accomplished by taking five readings on each of two certified hardness test blocks of different hardness values on the scale to be used. The mean of the five readings on any certified hardness test block shall be within the specified range of that block for the tester to be acceptable for use. Certified hardness test blocks shall never be used on both sides. One of the test blocks shall be within ±5 hardness numbers at the low end of the range of values specified for the OCTG being tested. The other test block shall be within ±5 hardness numbers at the high end of the specified range of values for the OCTG being tested. Each Rockwell Hardness C-scale (HRC) certified hardness test block shall have a mean value of not less than 20 HRC. Each Rockwell Hardness B-scale (HRB) certified hardness test block shall have a mean value of not more than 100 HRB.

12.5 Standardization

12.5.1 Standardization shall be performed prior to each job or when the hardness range changes for the OCTG being tested. The hardness tester instructions supplied by the tester manufacturer shall be followed. For all types of testers, the procedure for checking the tester prior to performing tests is the same except for attaching the tester to the OCTG or the certified hardness test block.

12.5.2 The hardness testing equipment shall be checked to determine if the proper load cell has been installed and if the correct indenter is being used for the hardness range specified.

12.5.3 The indenter shall be examined prior to use. If it is chipped, spalled, distorted or deformed, it is defective and requires replacement, in accordance with the manufacturer’s instructions.

12.5.4 The test block shall have a hardness within the specified range of the OCTG to be tested.

12.5.5 The hardness test block shall be placed onto the anvil with the calibration (indented) side up. If both sides of the test block show use, the test block is not suitable for further use.

12.5.6 Indentations shall be spaced no closer than 2 ½ diameters from their centre to the edge of the test block or 3 diameters from another indentation, measured centre-to-centre.

12.5.7 Contact surfaces and/or shoulders of a hardness test block, anvil, or indenter shall be clean and free from oil film.

12.5.8 Three readings shall be made on the certified hardness test block. The average of these readings shall be within the specified range of the test block. Any single reading shall not vary more than two Rockwell numbers from the specified mean value of the test block. No more than the first two readings may be discarded, in order to reduce the probability of errors, before the next three readings are used for averaging.

12.6 Procedures

12.6.1 The acceptable hardness range, number of readings made on each prepared test area, and the location of the test areas are by agreement between the owner and the agency. Unless otherwise specified, grind, machine or file the OCTG surface approximately 0,25 mm (0.010 in) deep, for a length of approximately 50 mm (2 in) to remove any possible decarburized layer. Before grinding, machining or filing, the wall thickness shall be determined to prevent reducing the wall thickness below that allowable. If the wall thickness is at, or close to, the allowable minimum, an alternative location shall be selected. Ensure that the area is smooth and flat so that accurate readings can be obtained. Caution shall be taken during grinding to avoid overheating the test area. A blue colour indicates grinding practices are causing excessive heating. Contact surfaces of the test area and indenter shall be clean and free from oil film.

12.6.2 Attach the tester to the OCTG and test the OCTG according to the instrument operating procedures as specified by the hardness tester manufacturer.

12.6.3 Indentations shall be more than 3 diameters from each other and in the prepared area, no closer than 6,35 mm (1/4 in) from the edge of the prepared area.

12.6.4 A test shall consist of two or more valid readings that have been made in the same test area. Readings are valid when they are within two Rockwell C numbers (HRC) of one another or four Rockwell B numbers (HRB) of one another. The readings, to the nearest whole number, shall be recorded on the OCTG surface adjacent to the test area using chalk or paint.

12.6.5 The hardness value shall be the average of the valid readings taken in the test area. The hardness value and/or the readings shall be recorded to the nearest whole number on the appropriate report form.

12.6.6 Standardization checks shall be performed periodically on the tester, using a certified hardness test block as defined in 12.5.4, taking two or more readings on the test block in accordance with 12.5. The tester shall be checked at the following times:

a) after every 100 readings;

b) whenever the hardness tester is subjected to abnormal mechanical shock;

c) at the end of the inspection job;

d) prior to rejection of any OCTG.

12.6.7 All tests that have been made between the last acceptable periodic check and an unacceptable check shall be repeated.

12.6.8 Rockwell readings that are below 20 HRC require that the readings be made again using the Rockwell B scale, unless readings below 20 HRC are permitted by an agreement between the inspection agency and the owner.

12.6.9 Rockwell readings above 100 HRB require that the readings be made again using the Rockwell C scale, unless readings above 100 HRB are permitted by agreement between the inspection agency and the owner. To prevent indenter damage, caution shall be taken when readings above 100 HRB are encountered. Re-standardization shall be done after such readings.

13 Magnetic particle inspection (MPI)

13.1 General

This clause provides material requirements, equipment requirements, descriptions and procedures for wet fluorescent and dry magnetic particle inspection of new ferromagnetic OCTG.

OCTG subjected to MPI may retain significant residual magnetism. See Clause 15 for measurement of residual magnetism and for demagnetization.

The magnetizing of OCTG may be accomplished in a number of ways that may limit the application of the method.

Clause 19 describes the use of MPI for evaluation of imperfections.

13.2 Application

13.2.1 End area inspection (SEA)

SEA is used principally to detect transverse and longitudinal defects on the inside and outside surfaces of the end areas. This includes the pins, couplings, exposed threads, upsets, special upsets, integral connections, and ends of pipe. In addition to magnetic particle inspection (MPI), the exposed threads and end areas shall be visually inspected.

NOTE This inspection was formerly called special end area inspection.

13.2.2 Unattached couplings magnetic particle inspection (UCMPI)

Inside and outside surfaces shall be inspected for longitudinal defects using magnetic particle inspection. In addition, both surfaces shall be visually inspected.

13.2.3 Full-length magnetic particle inspection (FLMPI)

The length of casing, tubing, pup joints, or plain-end drill pipe shall be inspected full length including upsets and attached couplings for longitudinal defects using magnetic particle inspection. Threads are excluded from this procedure. The owner may specify that the inspections be performed only from one surface or from both surfaces.

13.3 Equipment and materials

13.3.1 Internal conductors

A circumferential magnetic field is induced in OCTG by inserting an insulated conductor inside the product, completing the circuit to the power supply, and energizing the current to the appropriate value given in 13.8.1.

The power supply includes an ammeter for indicating the applied current. An audible or visible annunciator may be used to indicate inadequate current.

The conductor shall be insulated from the OCTG surface to prevent electrical contact or arcing.

NOTE For OCTG sizes Label 1: 16 or larger, the centre of the conductor shall be positioned within 152,4 mm (6 in) of the centre of the product.

13.3.2 Coils

A longitudinal magnetic field is induced by a coil placed around the product, and applying current to achieve the requirements of 13.8.2.

The power supply requirements of 13.3.1 shall apply.

The number of turns of the coil shall be clearly marked on the coil.

Flexible coils made up of conductor cable shall be tied or taped to keep the turns close together.

13.3.3 Yokes

Yokes are hand-held magnetizing devices used to detect imperfections in any orientation on the same surface to which the yoke is applied.

Yokes have either fixed or articulated legs and may be energized by either alternating current (AC) or direct current (DC). For some applications, adjustable legs are preferred for OCTG because the legs can be adjusted to maintain contact on the inspection surface, regardless of contour.

13.3.4 Magnetic particle field indicators

Acceptable field indicators (e.g. slotted shims, strips, pie field indicators) shall be able to hold magnetic particles in a field of approximately 5 Gs.

To verify longitudinal external magnetic fields, the indicator shall be positioned on the outside surface with the artificial imperfection aligned in the transverse direction.

To verify circumferential or transverse external magnetic fields, the indicator shall be positioned on the outside surface with the artificial imperfection aligned in a longitudinal direction.

The external magnetic particle field indicators show the presence and orientation of a magnetic field. Because magnetic flux might not leave a ferromagnetic material containing a uniform residual circular field, indications on a magnetic particle field strength indicator are not always possible. This is particularly true with couplings and EW pipe. Magnetometers may be used to indicate the relative strength of a magnetic field, and these are covered in 15.3.2.

13.4 Magnetic particles

13.4.1 General

Magnetic particles are used to indicate imperfections that cause magnetic flux leakage. Particles may be applied either dry or in suspension (wet).

13.4.2 Dry magnetic particles

The colour of dry magnetic particles shall contrast with the product surface. The mixture shall consist of different size particles with at least 75 % by mass being finer than 150 µm (100 ASTM sieve size) and a minimum of 15 % by mass being finer than 45 µm (325 ASTM sieve size). The particle mixture shall not contain contaminants such as moisture, dirt, sand, etc.

As a supplementary practice, there should be a particle manufacturer’s batch or lot check of the magnetic particles for high permeability and low retentivity.

13.4.3 Wet fluorescent magnetic particles

Fluorescent magnetic particles are suspended in a solution. The solution should be low viscosity [5 mm^2/s (5 cSt)], nonfluorescent, flash point above 93 °C (200 °F) and able to wet the surface completely. Particles glow when exposed to black light.

Wet fluorescent particles shall be applied with low velocity flow to prevent washing away weakly-held indications. Recirculating systems, spray containers or other means shall be used to obtain complete and uniform coverage.

13.5 Illumination equipment and optical aids

13.5.1 These devices are used to provide illumination and visual aid for surface examination of OCTG.

13.5.2 For visible light inspection refer to 11.7, 11.8.1, and 11.8.2. Borescopes are optical aids that may be used to view the inside surfaces beyond the end area. Refer to 11.8.3 for equipment details.

13.5.3 Black light is employed to illuminate the accumulation of fluorescent-dyed magnetic particles. Black light shall be provided by an appropriately-filtered mercury arc lamp or other source. It shall be capable of providing wavelengths at or near 365 nm and a minimum intensity of 1 000 $\mu W/cm^2$ at the inspection surface under working conditions. Intensity shall be measured with the black light sensor on the inspection surface and directed toward the black light source.

13.5.4 The ambient illuminance during black light inspection, measured at the inspection surface, shall not exceed 20 lx (2 fc).

13.6 General procedures

13.6.1 When capacitor-discharge units are used as magnetizing sources, the OCTG shall be insulated from metal racks and adjacent OCTG to prevent arc burns.

NOTE Partial demagnetization might occur in a magnetized length of OCTG if it is not sufficiently separated prior to magnetizing the next adjacent length.

13.6.2 The OCTG surface shall be clean and free from all dirt, grease, loose scale, or other substances that have detrimental effects on particle mobility. It shall be free of coatings that are sticky or have a thickness that hinders the effectiveness of the inspection.

13.6.3 In addition to the procedures in 13.6.2, dry magnetic particle inspection shall be conducted in accordance with the following.

a) The surface shall be dry.

b) Dry particles shall be applied with a blower, bulb, or suitable sprinkler to provide a light uniform distribution over the external surface, and the internal surface as size permits. A non-ferromagnetic trough shall be used to place particles on the internal surface of small diameter OCTG. Dry magnetic particles shall not be re-used.

Dry magnetic particle inspection should not be attempted when uniform application of the magnetic particles over the surface is not possible.

NOTE Wind or other inclement weather may be detrimental to the uniform application of magnetic particles to the surface. Dampness of the inspection surface reduces the mobility of the magnetic particles.

13.6.4 A separate white-light visual inspection is required when doing magnetic particle inspection using black light.

13.6.5 After inspection, the magnetic particles (either dry or suspended in solution) shall be removed from the surfaces with suitable means that will not damage the OCTG.

13.6.6 When using a residual magnetic field for inspection, magnetize only enough lengths to maintain the work load for the current workday. Any lengths not inspected on the day that they are magnetized shall be re-magnetized prior to MPI.

13.6.7 All imperfections that accumulate magnetic particles shall be evaluated and dispositioned as described in Clause 19.

13.7 Calibration

13.7.1 Ammeters

Ammeters shall be calibrated at least once every 4 months, after repair, and whenever an erratic response is indicated. The calibration check shall be recorded on the meter, and in a log book, giving the date of the calibration check, the due date, and the initials of the person who performed the check.

13.7.2 Light meters

Refer to 11.7.4 for calibration requirements.

13.7.3 Coils

Prefabricated coils (excluding flexible coils) shall be verified at least once every 4 months, by comparing resistance or magnetic flux values to those initially established.

The calibration check shall be recorded on the coil, and in a log book, giving the date of the calibration check, the due date, and the initials of the person who performed the check.

13.7.4 Yokes

AC yokes shall be capable of lifting 4,5 kg (10 lb) at the maximum pole spacing that would be used for inspection.

DC yokes shall be capable of lifting 18 kg (40 lb) at the maximum pole spacing that would be used for inspection.

Yokes shall be tested for lifting power every 4 months using a steel bar or plate of the appropriate mass or a calibrated magnetic mass lift test bar. The calibration check shall be recorded on the yoke, and in a log book, giving the date of the calibration check, the due date, and the initials of the person who performed the check.

13.8 Standardization

13.8.1 Internal conductor systems

For battery or rectified-AC power supply, a minimum magnetizing current of 11,8 A/mm (300 A/in) of specified OCTG outside diameter shall be used.

For capacitor-discharge units, see Table A.11 for magnetizing current recommendation.

13.8.2 Coils

The number of coil turns and current required are imprecise but shall not be less than 20 ampere-turns per millimetre (500 ampere-turns per inch) of specified OCTG outside diameter. The current shall be set as high as possible, but not so high as to cause furring of dry magnetic particles or immobility of wet magnetic particles.

13.9 Periodic checks

13.9.1 Ammeters indicating the magnetizing current shall be monitored with each application of current. For internal conductor systems, the current shall be as recommended in 13.8.1. For coils, the current shall not vary by more than 10 % of the selected value in 13.8.2.

13.9.2 The strength and direction of magnetic fields shall be confirmed with equipment as described in 13.3.4 at the start of each day, after meal breaks, whenever an element of the inspection equipment is repaired or replaced, and after every 50 lengths of OCTG are inspected, or at least once in every 4 h of continuous operations (see 13.4.3).

13.9.3 All OCTG inspected between an unacceptable check and the most recent acceptable check shall be re-inspected.

13.9.4 Wet fluorescent magnetic particle solution shall be mixed according to the manufacturer’s instructions and agitated either continuously or periodically. The volume fraction (concentration) shall be between 0,1 % and 0,4 %. The settling test time shall be 1 h for oil-based carriers and 30 min for water-based carriers.

Settling tests shall be done in a vibration-free, non-magnetic environment.

The concentration of the solution shall be checked prior to use.

The concentration of the solution in recirculating systems shall be verified at least once during each shift.

The black and ambient light-intensity levels shall be verified at least once during each shift.

13.10 End area inspection (SEA)

13.10.1 General

SEA performed in accordance with this International Standard may be beyond the inspection requirements for end areas as defined in ISO 11960, and ISO 11961 or API Spec 5D. This inspection is performed primarily to detect seams, laps, forging laps, upset cracks, pits and underfill, thread imperfections, quench cracks, rolled-in slugs, and mechanical damage.

13.10.2 Inspection areas

If SEA is done in conjunction with an automated inspection system, the inspection area shall be at least equal to the area not covered by the automated inspection system. If done as a separate inspection, the end areas shown in Figure B.1 shall be cleaned of all grease, thread compound, dirt, and any other foreign matter and inspected as defined in Table A.12. When using dry magnetic particle techniques, all surfaces to be inspected shall be powder-dry.

13.10.3 Sandblasting or other methods

By agreement between the owner and the agency and when environmental conditions permit, the outside surface may be sand-blasted or other effective methods used to remove mill varnish and mill scale. Threads shall not be sand-blasted.

13.10.4 Inspection procedure

The steps for inspection are the minimum requirements and may vary depending on the OCTG condition and the options agreed to between the owner and the agency. Visual thread inspection shall meet the requirements outlined in Clause 11. The recommended procedure is as follows.

a) Remove the thread protectors and clean the ends and threads, as required. After removal of thread protectors, take great care to avoid damaging threads.

b) Magnetize the ends with a circular magnetic field in accordance with 13.3.1. As an alternative, an active transverse DC-field may be applied if its strength and direction have been verified with equipment as described in 13.3.4, and its strength at both the inside and outside surfaces have been demonstrated to be at least equal to that of a circular field induced in accordance with 13.3.1. Make multiple revolutions of the OCTG in the magnetic field.

c) Inspect the outside and inside surfaces, including threads, using MPI. The illumination requirements of 13.5.2 for visible light, and 13.5.3 for black light, apply.

d) Inspect the outside surfaces on each end with either an active or residual longitudinal DC-field or an active longitudinal AC-field.

NOTE Excessive ampere-turns can cause furring of dry magnetic particles and lack of mobility of fluorescent particles on the outside surface, which might conceal indications.

e) Inspect the inside surface on each end with either an active or residual longitudinal DC-field.

f) Evaluate all imperfections in accordance with Clause 19.

g) Do not leave magnetic particles or cleaning materials on the threads or OCTG overnight.

h) Threads shall be covered as soon as possible and shall not be left unprotected overnight.

i) Apply thread compound and protectors in accordance with Clause 9.

13.11 Inspection of unattached couplings (UCMPI)

This inspection is performed to detect seams, cracks, laps, pits, thread imperfections, rolled-in slugs, and mechanical damage. Visual thread inspection shall meet the requirements outlined in Clause 11. The recommended procedure is as follows.

a) Use either wet or dry magnetic particles. Clean the threads as required.

b) Magnetize the couplings with a circular magnetic field. For battery or rectified-AC power supplies, see 13.8.1. For capacitor-discharge units, see Table A.13 for magnetizing current recommendations. As an alternative, an active transverse DC-field may be applied if its strength and direction has been verified with equipment as described in 13.3.4, and its strength at both the inside and outside surfaces have been demonstrated to be at least equal to that of a circular field induced in accordance with 13.3.1. Make multiple revolutions of the OCTG in the magnetic field.

c) Inspect the outside and inside surfaces, including threads, using MPI. The illumination requirements of 13.5.2 for visible light, and 13.5.3 for black light, apply.

d) Inspect the outside surface with either an active or residual longitudinal DC-field.

e) Longitudinal magnetization is achieved by using the magnetizing current recommended in Table A.14, or may be calculated from the following formulas:

for $\frac{L_{\text{cpg}}}{D_{\text{cpg}}} < 2{,}0$

SI units: $$\left(N \times I\right) = \left[1\ 200 - \left(130 L_{\text{cpg}} / D_{\text{cpg}}\right)\right] \times \left(D_{\text{coil}} / 25{,}4\right) \quad (1)$$

US customary units: $$\left(N \times I\right) = \left[1\ 200 - \left(130 L_{\text{cpg}} / D_{\text{cpg}}\right)\right] \times D_{\text{coil}} \quad (2)$$

for $\frac{L_{\text{cpg}}}{D_{\text{cpg}}} > 2{,}0$

SI units: $$\left(N \times I\right) = 37\, D_{\text{coil}} \quad (3)$$

US customary units: $$\left(N \times I\right) = 940\, D_{\text{coil}} \quad (4)$$

where

L_{cpg} is the specified length of coupling, expressed in millimetres (inches);

D_{cpg} is the specified diameter of coupling, expressed in millimetres (inches);

D_{coil} is the inside diameter of coil, expressed in millimetres (inches);

$(N \times I)$ is the required magnetomotive force, expressed in ampere-turns;

N is the number of turns;

I is the electric current, expressed in amperes.

NOTE Excessive ampere-turns $(N \times I)$ can cause furring of dry magnetic particles and lack of mobility of fluorescent particles on the outside coupling surface, which can conceal indications.

If the coil size used is not listed in Table A.14, either calculate the correct ampere-turn requirement using Equations (1) to (4) as appropriate, or use the next higher ampere-turn value from Table A.14.

f) Inspect the outside and inside surfaces of each coupling.

g) Evaluate all imperfections in accordance with Clause 19.

h) Do not leave magnetic particles or cleaning materials on the threads or coupling overnight.

13.12 Full-length magnetic particle inspection (FLMPI)

13.12.1 General

This inspection is performed to detect cracks, laps, seams, rolled-in slugs, mechanical damage, and other imperfections in the pipe body and weld.

13.12.2 Magnetization

Induce a circular magnetic field in accordance with 13.3.1.

13.12.3 Internal full-length inspection

If FLMPI of the inside surface (threads excluded) is specified, the following procedure shall be used.

a) Distribute dry magnetic particles on the inside surface to obtain complete coverage (360°), by rolling the pipe a minimum of one and one-half turns.

b) Use a borescope for inspection. The borescope requirements of 11.8.3 apply.

c) After the initial internal inspection, roll the pipe sufficiently to expose the area previously covered with particles and re-inspect as outlined above.

13.12.4 External full-length inspection

The following procedure shall be used when inspecting an outside surface full length.

a) Use a marking method to assure 100 % of the surface area is inspected.

b) Inspect each pipe surface by walking the length of each pipe from one end to the other. The number of lengths inspected on each pass will depend on the pipe diameter.

c) It might be necessary to inspect the entire surface in segments by incrementally rotating the pipe, in which case follow a suitable procedure to ensure complete coverage.

d) Apply dry or wet magnetic particles to the segments that are inspected on each length, with sufficient overlap to ensure complete surface coverage. The illumination requirements of 13.5.2 for visible light, and 13.5.3 for black light, apply.

13.12.5 Evaluation of imperfections

Evaluate all imperfections in accordance with Clause 19.

14 Electromagnetic inspection (EMI)

14.1 General

This clause describes the EMI equipment and methods for detecting longitudinal and transverse imperfections in the tube body (excluding the ends) of ferromagnetic OCTG.

Pipe subjected to EMI might retain significant residual magnetism. See Clause 15 regarding residual magnetism and demagnetization.

14.2 Equipment

14.2.1 EMI systems shall be of the flux-leakage or eddy-current type.

14.2.2 In flux-leakage equipment, a strong magnetic field is applied to the region of the pipe under the sensors. The sensors detect magnetic flux fields that leak from the pipe at the location of imperfections.

14.2.3 In eddy-current equipment, an electric field is induced in the OCTG by one or more exciter coils. One or more sensor coils detect a change in the normal flow of current due to the presence of imperfections.

14.2.4 Flux-leakage is the most commonly used technique in field applications; therefore, the remainder of this clause does not address eddy-current systems.

NOTE Most field EMI inspection systems contain electromagnetic scanners for the detection of longitudinal, transverse, and volumetric imperfections, a method for wall thickness and eccentricity inspection and might also contain equipment for making a grade comparison. Typically, these systems incorporate these four inspection stages in one unit that is field-portable or permanently mounted in a facility. This clause addresses only the electromagnetic inspection portion of EMI systems. Equipment and procedures for wall thickness and grade comparison portions of EMI systems are addressed in Clause 16 and Clause 17, respectively.

14.2.5 Longitudinal imperfections are detected by passing the magnetized pipe through a rotating scanner. A combination of the longitudinal velocity and the rotating speed of the scanner and/or pipe shall result in overlapping coverage of paths of adjacent detectors.

14.2.6 Transverse imperfections are detected by passing the magnetized pipe through a fixed encircling scanner.

14.2.7 Volumetric imperfections can be detected by either longitudinal or transverse scanners.

14.3 Application

14.3.1 ISO 11960, and ISO 11961 or API Spec 5D, provide EMI as one of the alternative methods for pipe body inspection (except for H-40, J-55, K-55, or N-80 Type 1) and inspection of the EW weld seam (except for the weld seam of P-110 and Q-125 grade pipe). All other EMI inspections performed in accordance with this International Standard are beyond the inspection requirements of ISO 11960, and ISO 11961 or API Spec 5D.

14.3.2 EMI systems may be used for the inspection of all sizes of pipe within the size range of the equipment.

14.3.3 EMI systems as defined in this International Standard are not capable of full coverage inspection to the pipe ends. Full coverage inspection of the end areas requires use of magnetic particle inspection or other inspection method(s) with demonstrated capability of detecting defects as defined in ISO 11960, and ISO 11961 or API Spec 5D.

14.4 Calibration

14.4.1 General

This clause specifies the minimum requirements necessary to ensure that inspection equipment is operating to its intended capability. Practices shall be stipulated by agreement between the owner and agency prior to commencement of the inspection service.

14.4.2 Active field systems

Ammeters (reading magnetizing current) shall be calibrated at least once every 4 months, after repair, and whenever erratic response is indicated. The calibration check shall be recorded on the meter, and in a log book, giving the date of the calibration check, the due date, and the initials of the person who performed the check.

14.4.3 Dual coil systems

The polarity of the magnetic fields shall be non-opposing. This shall be checked with a compass or magnetometer at least once every 4 months and after any repairs are performed on the assembly or magnetizing circuit.

14.4.4 Residual field systems (central conductor method for EMI)

Ammeters shall be calibrated at least once every 4 months, after repair, and whenever erratic response is indicated. The calibration check shall be recorded on the meter, and in a log book, giving the date of the calibration check, the due date, and the initials of the person who performed the check.

14.4.5 Magnetic pulsers

If used to establish sensitivity levels, the output signal from a magnetic pulser shall be calibrated every 4 months and after any repairs. The pulser shall produce reproducible pulses. The calibration shall be recorded on the pulser or power supply, and in a log book, giving the date of the calibration, the due date, and the initials of the person performing the calibration.

14.4.6 Instrumentation

Instrument readouts for determining rotational and linear speed shall be calibrated once every 6 months.

14.5 Standardization

14.5.1 General standardization of EMI equipment shall be performed at the beginning of each job. A reference standard of the same specified thickness and curvature as the material being inspected shall be used. The material of the standard shall have magnetic properties similar to those of the OCTG being inspected. Using a piece of the material to be inspected is the best way to assure similar magnetic properties. The reference standard shall be of a length sufficient for dynamic standardization checks. If the standard is to be a piece of the material to be inspected, it shall be provided by the owner. Additional standardization checks shall be performed as follows:

a) at the beginning of each inspection shift and after meal breaks;

b) at least once every 4 h of continuous operation or every 50 lengths inspected, whichever occurs first;

c) after any power interruption;

d) prior to equipment shutdown during a job;

e) prior to resuming operation after repair or change to a system component that would affect system performance.

All OCTG inspected between an unacceptable check and the most recent acceptable check shall be re-inspected.

14.5.2 For the inspection standardization, the reference notch length, width and location shall be in accordance with ISO 11960:2001, Clause 10, or ISO 11961:1996, Clause 8 or API Spec 5D:2001, Clause 10. The notch depth shall not exceed the depth required by ISO 11960:2001, Clause 10, or ISO 11961:1996, Clause 8 or API Spec 5D:2001, Clause 10. Notches, including those having depths less than the requirements of the ISO/API standards, are used to establish equipment sensitivity. Reference signal amplitude shall not be used to determine acceptance or rejection. See Clause 19 for evaluation procedures.

Notch widths used in field inspection are typically 0,5 mm (0.020 in) or less. Notch depth for field inspection to 12 ½ % acceptance criteria is typically 10 % of the specified pipe wall thickness. Notch depth for field inspection to 5 % acceptance criteria shall be as specified by ISO 11960, or ISO 11961 or API Spec 5D.

14.5.3 As an alternative to the above notches, with the owner's permission, a drilled hole may be used. The hole diameter shall be in accordance with the requirements of ISO 11960:2001, Clause 10 or ISO 11961:1996, Clause 8 or API Spec 5D:2001, Clause 10. When standardizing EMI equipment using drilled holes, the inspection system shall have the demonstrated capability of meeting the notch requirements of ISO 11960:2001, Clause 10 or ISO 11961:1996, Clause 8 or API Spec 5D:2001, Clause 10. Reference signal amplitude shall not be used to determine acceptance or rejection. See Clause 19 of this International Standard for evaluation procedures.

14.5.4 Reference notches shall be cut so they can be removed without reducing the wall thickness to less than the minimum allowable thickness. A reference standard that contains a drilled hole shall be clearly identified as a reject. Drilled holes shall be positioned so that the section containing them can be cut off with minimal loss of acceptable pipe.

14.5.5 Notches or holes shall be separated such that each indication is distinct and separate from each other and from other anomalies or end-effects. Equipment shall provide a suitable signal-to-noise ratio.

NOTE Typically, a signal-to-noise ratio of at least 3-to-1 for external notches and 2-to-1 for internal notches is considered suitable.

14.5.6 The longitudinal notch shall be positioned under each appropriate sensor of each longitudinal detector. The instrumentation shall be adjusted to produce an indication having an amplitude equal to or greater than 1/4 of full scale and clearly identifiable above background noise. This adjustment applies to the inside surface notch when both inside and outside surface notches are used.

14.5.7 If a transverse notch is required, it shall be passed through the inspection system at production speed under a selected detector. The instrumentation shall be adjusted to produce an indication having an amplitude at least equal to 1/4 of full scale and clearly identifiable above background noise. This adjustment applies to the inside surface notch when both inside and outside surface notches are used. Each indication shall be clearly identified above background noise. The other detectors shall be adjusted by repeating the above process or by another system with demonstrated capability to establish the same sensitivity for the remaining detectors.

14.5.8 The threshold alarms, if available, should be adjusted to activate based on reference notch response from each detector.

14.5.9 For the final dynamic standardization check, the standard shall be passed through the inspection system four times at production speed, once with a notch or hole at each of the following positions: 0°, 90°, 180° and 270°. The height of the principal indication from each notch or hole shall not vary more than 20 % from its average indication level. Each indication shall be clearly identified above background noise, and shall be at least 1/4 of full scale.

14.5.10 By agreement between the owner and agency, the following standardization procedure shall be used.

a) Adjust the gain settings to provide discernible imperfection signals or a suitable signal-to-noise ratio for the material being inspected.

b) For at least the first five lengths inspected, use a gain setting that produces background noise amplitudes of no more than 1/8 of full scale.

c) If investigation of signals above the background noise indicates excessive gain, reduce the gain until minor (less than 5 % of specified wall thickness) imperfection signals are at least 1/8 of full scale.

d) A magnetic pulser may be used for standardizing flux-leakage inspection equipment. The magnetic pulser head is placed adjacent to each sensor in each detector. The overall system gain of each readout channel is then standardized to produce optimum system performance.

14.6 Equipment requirements and periodic checks

The following periodic checks shall be made at the same frequency as stated in 14.5.1, unless otherwise specified.

a) Check that the central conductor (current rod) used for residual circular magnetization is completely insulated from the OCTG surface so that no arcing is possible. Check that the connections of the conductor are tight, and the rod-to-cable contacts are clean. Check that the magnetizing system is free of internal shorts.

b) Use and observe an ammeter indicating the magnetizing current with each application of current. Alternatively, use an ammeter indicating the magnetizing current in conjunction with a low-current indicator and alarm. The magnetizing current shall be at least the minimum value stated in the agency's standard operating procedure.

c) Check the magnetizing coils of active field-type magnetizers to ensure that the proper current or magnetizing force is used, and that no magnetizing coils are open-circuited or short-circuited. Check that the current or magnetizing force is within 10 % of the correct value for the equipment being used.

d) Check manual and/or automatic circuits to ensure sensor continuity. Make continuity checks with a device that produces a change in flux density or generates a current in each sensor, to provide reliable detection of an open circuit.

e) Make periodic checks throughout the inspection job to ensure that the detectors carrying the EMI sensors are riding smoothly on the surface, since lift-off of detectors substantially impairs the sensitivity to detect imperfections.

All EMI equipment shall be standardized, calibrated, or adjusted to proper sensitivity levels as described in 14.4 and 14.5.

14.7 Inspection procedure

Proceed as follows.

a) Pass each length through the EMI inspection unit. The sequence of inspecting the OCTG by the various scanners is not specified, but each one shall perform its respective function effectively and without detrimental interaction with other scanners.

b) Establish a threshold in accordance with the agency's standard operating procedure, but not greater than the reference level if reference indicators are used.

c) Locate and mark electronic readout indications on the outside surface of the pipe, for the full extent of each indication. Evaluate all marked indications in accordance with Clause 19.

d) Make an identifiable record of the inspection, including a readout of imperfection indications detected. These documents shall be retained by the agency for at least 6 months.

e) Verify that the first length inspected, and one of each 25 lengths thereafter, has been demagnetized in accordance with Clause 15.

15 Residual magnetism and demagnetization

15.1 General

This clause describes the equipment and methods used for the measurement and reduction of residual longitudinal magnetic fields.

Magnetic particle inspection (MPI) and electromagnetic inspection (EMI) are accomplished by inducing a magnetic field into the OCTG. It shall be ensured that the residual longitudinal magnetic field is less than the defined acceptance level after inspection.

15.2 Application

ISO 11960, and ISO 11961 or API Spec 5D, do not contain references or criteria for the measurement or reduction of residual magnetism. Restrictions regarding residual magnetism are normally applied only to OCTG that have been subjected to MPI or EMI. The reduction of residual longitudinal magnetism is required to prevent difficulty during subsequent processing, handling, and removal of magnetic particles. Circumferential magnetic fields do not cause difficulty and are not addressed in this International Standard.

15.3 Services

15.3.1 Measuring flux density

Measurements are made on the ends using a magnetometer in contact with the end. The OCTG being checked shall be separated from other OCTG in all directions. A residual longitudinal field of more than 30 Gs, measured with an electronic magnetometer (gauss meter), shall be reduced. A mechanical magnetometer may be used if the user has established the equivalence to the electronic magnetometer. In case of dispute, the electronic magnetometer shall govern.

15.3.2 Flux density measuring equipment, including calibration

Electronic magnetometers (gauss meters) shall be calibrated at least once a year and after repair. The calibration shall be recorded on the instrument, and in a log book, giving the date of the calibration, the due date, and the initials of the person performing the calibration.

If a reference magnet is used to adjust gauss meters, the reference magnet shall be calibrated at least once a year. The calibration shall be recorded on the reference magnet, and in a log book, giving the date of the calibration, the due date, and the initials of the person performing the calibration.

Mechanical magnetometers shall be checked for accuracy at least once every 4 months and after repair. They shall be repaired if the zero position deviates by more than 10 % of the full-scale value. The accuracy shall be within 10 % of a calibrated variable reference magnetizing force over the entire range of the readout. The accuracy check shall be recorded on the instrument, and in a log book, giving the date of the calibration, the due date and the initials of the person performing the calibration.

15.3.3 Methods for reducing residual longitudinal magnetism

One or more of the following methods shall be used:

a) Reduce the residual longitudinal field to acceptable limits by inducing a circular magnetic field, using an internal conductor system in accordance with 13.3.1.

b) Reduce the residual longitudinal field to acceptable limits by passing it through a circular coil energized with alternating current or direct current. More current will be needed as the pipe diameter and thickness increase. Approximately 6 000 ampere-turns to 10 000 ampere-turns are sufficient to reduce the longitudinal field to acceptable limits for OCTG up to 254 mm (10 in). Larger sizes may require more current, depending on the system.

c) Use an EMI system which contains a demagnetizing DC-coil as part of the inspection system. Adjust and monitor the demagnetizing unit to reduce the residual longitudinal field to the acceptable level. If this system is used, the gauss level shall be measured for compliance with 15.3.1 after every 25 lengths inspected.

16 Gamma-ray wall thickness inspection

16.1 General

This clause describes the gamma-ray equipment and procedures used for the inspection of pipe wall thickness. This equipment is typically an integral component of an EMI inspection system and might not be available separately.

16.2 Application

16.2.1 Wall thickness measurement of EW pipe performed in accordance with this International Standard is beyond the inspection requirements of ISO 11960.

16.2.2 Wall thickness measurement systems may be used for the inspection of all sizes of pipe within the size range of the equipment.

16.3 Equipment

The equipment typically consists of a gamma-ray source, a sensor and a readout. Measurements are normally made on a helical path along the length. Surface coverage is typically not 100 %. Rotation of the pipe, the source, the sensor, or any combination thereof, may be used to accomplish this scan.

16.4 Calibration and standardization

16.4.1 General

This clause specifies the minimum requirements necessary to ensure that inspection equipment is operating to its intended capability. Practices shall be stipulated by agreement between the owner and agency prior to commencement of the inspection service.

16.4.2 Periodic checks

General standardization of inspection equipment shall be performed at the beginning of each job. Periodic standardization checks shall be performed as follows:

a) at the beginning of each inspection shift and after meal breaks;

b) at least once every 4 h of continuous operation or every 50 lengths inspected, whichever occurs first;

c) after any power interruption;

d) prior to equipment shutdown during a job;

e) prior to resuming operation after repair or change to a system component that would affect system performance.

All pipe inspected between an unacceptable check and the most recent acceptable check shall be re-inspected.

16.4.3 Standardization procedure

The standardization of the gamma-ray system shall be accomplished using one or more of the following methods.

a) Adjust the gain of the system so that the readout corresponds with two known thicknesses of a reference standard.

b) Adjust the gain of the system so that the readout corresponds with the measured thickness values on a selected circumferential ring of a reference standard having the same specified diameter and specified wall thickness as the pipe being inspected. Measure a minimum and maximum thickness on the ring using a micrometer or properly standardized ultrasonic thickness gauge. The readout of the wall thickness measuring system shall be standardized to a specific scale. The readout's minimum thickness value shall be adjusted to be within ±0,25 mm (±0.010 in) of the minimum thickness selected on the reference standard. The maximum thickness of the standard shall be clearly distinguishable on the readout.

c) If a reference standard is not available, verify a minimum wall thickness reading for at least one out of every 50 lengths inspected, using a micrometer or a properly standardized ultrasonic gauge.

16.5 Inspection procedure

16.5.1 Pass each length of pipe through the system and establish a threshold in accordance with the agency's documented operating procedure and specification requirements.

16.5.2 Mark the area of the suspected wall variation on the pipe surface. Evaluate all marked indications in accordance with Clause 19.

16.5.3 Make an identifiable record of the inspection, including a readout of indications detected. These documents shall be retained by the agency for at least 6 months.

17 Electromagnetic grade comparison

17.1 General

This clause describes grade comparison equipment and procedures using principles based on differences in the electromagnetic characteristics of grades of OCTG. This equipment is typically an integral component of an EMI inspection system and might not be available separately.

NOTE Grade comparators might not be capable of distinguishing between OCTG grades that have similar properties.

17.2 Application

ISO 11960, and ISO 11961 or API Spec 5D, do not provide for grade comparison based on OCTG electromagnetic characteristics. This method is applicable to all types and diameters of OCTG within the size range of the inspection equipment.

17.3 Equipment

Grade comparators that categorize based on electromagnetic characteristics are either comparator-bridge or transformer-type systems.

A grade comparator, when used, shall be equipped with a visible or audible alarm, or otherwise alert the operator, when a coil circuit opens.

With either type of equipment, absolute calibration is not possible. A comparison may be made between a known standard and each length inspected.

17.4 Calibration and standardization

17.4.1 Periodic checks

General standardization of inspection equipment shall be performed at the beginning of each job. Periodic standardization checks shall be performed as follows:

a) at the beginning of each inspection shift, and after meal break;

b) at least once every 4 h of continuous operation or every 50 lengths inspected, whichever occurs first;

c) after any power interruption;

d) prior to equipment shutdown during a job;

e) prior to resuming operation after repair or change to a system component that would affect system performance.

The mill grade markings shall be verified on all OCTG inspected between an unacceptable check and the most recent acceptable check.

17.4.2 Standardization procedure

The standardization procedure depends on the type of system being used, as follows.

a) For the comparator-bridge system, confirm the grade of the first length of OCTG to be inspected, by visual examination of the markings, and place the OCTG in the comparator coil in the inspection line. Balance the bridge and set the gain control at a selected position. After several lengths are inspected, readjust the gain to an optimum level based on the normal variations in the OCTG being inspected.

b) For the transformer system, confirm that the grade of the first five lengths of OCTG to be inspected are the same grade, by visual examination of the markings. Run each of the first five lengths through the inspection line and record the readout voltage. Determine the average voltage and set the upper and lower warning limits.

c) For a supplementary performance test, use a reference signal from a secondary reference standard of different magnetic or conductive properties than the material being inspected, to verify the sorting capability of the system.

17.5 Inspection procedure

a) Pass each length of OCTG through the inspection system.

b) The readout of the grade comparison equipment shall provide a distinct indication, level, or threshold, to indicate OCTG with properties dissimilar to that being inspected.

c) If a significant grade comparator indication is detected, the proper mass, grade, and manufacturer of the length of OCTG shall be investigated prior to its disposition. This investigation shall include a review of the mill markings and dimensions.

18 Ultrasonic inspection

18.1 General

This clause describes the equipment and procedures used to perform ultrasonic inspection. The five categories are as follows:

a) inspection of the pipe body for longitudinal and transverse imperfections (and, possibly, oblique imperfections);

b) inspection of the pipe body for wall thickness;

c) inspection of the longitudinal weld;

d) manual ultrasonic thickness gauging;

e) manual ultrasonic shear-wave inspection.

18.2 Application

18.2.1 For grades E-75 (Q&T), M-65, N-80Q, L-80 and C-95, ISO 11960, and ISO 11961 or API Spec 5D, specify UT as one of the pipe body inspection methods to detect longitudinal imperfections and, for seamless pipe, to verify wall thickness.

18.2.2 For grades X-95, G-105, P-110 and S-135, ISO 11960, and ISO 11961 or API Spec 5D, specify UT as one of the pipe body inspection methods to detect longitudinal and transverse imperfections and, for seamless pipe, to verify wall thickness.

18.2.3 For grades C-90, T-95 and Q-125, ISO 11960 specifies UT for pipe body inspection to detect longitudinal and transverse imperfections and, for seamless pipe, to verify wall thickness.

18.2.4 ISO 11960, and ISO 11961 or API Spec 5D, do not require 100 % coverage for wall thickness verification.

18.2.5 All other UT inspections performed in accordance with this International Standard are beyond the inspection requirements of ISO 11960, and ISO 11961 or API Spec 5D.

18.2.6 In principle, ultrasonic inspection in all five categories can be performed using either manual or mechanized equipment. In practice, inspection of the body (see 18.1 a) and 18.1 b)) is typically performed only using mechanized equipment and is therefore limited to the size range that can be processed through the equipment.

18.2.7 Full-body UT systems, as defined in this International Standard, normally are not capable of full coverage inspection to the ends of the pipe. Full coverage inspection of the end areas requires use of magnetic particle inspection, manual ultrasonic inspection or other inspection method(s) with demonstrated capability of detecting defects as defined in ISO 11960, and ISO 11961 or API Spec 5D.

18.3 General procedures for calibration, standardization, and inspection

18.3.1 The following applies to all categories of ultrasonic inspection except as noted.

18.3.2 The horizontal and vertical linearity of the A-scan display shall be calibrated after any repairs to related circuitry, or at least once every 6 months, whichever is more frequent. The vertical and horizontal linearity between 25 % and 75 % of full scale of either display shall be within ±5 % of its full-scale value. If a recorder display is used, the linearity of its scale shall also be calibrated once every 6 months. Instrument readouts for determining rotational speed and linear or inspection mechanism speed shall also be calibrated once every 6 months. The calibration shall be recorded on the instrument or recorder, and in a log book, giving the date of calibration, the due date, and the initials of the person performing the calibration.

18.3.3 Standardization of ultrasonic inspection equipment shall be performed at the beginning of each job. A reference standard of the same specified thickness and curvature as the material being inspected shall be used, except as noted in 18.9.4. The material of the standard shall have ultrasonic velocity and attenuation properties similar to those of the pipe being inspected. If the standard is to be a piece of the material to be inspected, it shall be provided by the owner. Additional standardization checks shall be performed as follows:

a) at the beginning of each inspection shift;

b) for mechanized units, at least once every 4 h of continuous operation, or every 50 lengths inspected, whichever occurs first;

c) for manual methods, at least every 25 areas measured or inspected in a continuous operation;

d) after any power interruption or change in power supply (battery to charger);

e) for manual methods, whenever there is a change of operator (inspector);

f) prior to equipment shutdown during a job;

g) prior to resuming operation after repair or change to a system component that would affect system performance;

h) whenever the transducer, cable, wedge or type of couplant is changed.

All OCTG inspected between an unacceptable check and the most recent acceptable check shall be re-inspected.

18.3.4 All OCTG surfaces shall be clean and free of loose scale, dirt, grease or any other material that may interfere with the sensitivity of the inspection or the interpretation of the readout.

18.3.5 A liquid couplant shall be used to wet the surface of the pipe and assist transmission of ultrasonic sound waves from the transducers into the pipe being tested. The couplant shall be free of contaminants that may interfere with the sensitivity of the inspection or the interpretation of the readout. Rust inhibitors, water softeners, glycerine, antifreeze or wetting agents may be added to the couplant provided they are not detrimental to the pipe surface.

18.3.6 Mechanized ultrasonic inspection systems may be configured to perform more than one category of inspection in the same operation.

18.4 Inspection for longitudinal, transverse, and oblique imperfections

18.4.1 General

The entire surface shall be scanned. Separate ultrasonic beams shall be used for the detection of transverse, longitudinal and oblique imperfections. The combination of linear and rotational speed of the material and/or scanner shall provide 100 % full-body coverage based upon the effective beam width (EBW) of the transducer and the distance between successive pulses [pulse density (PD)] for each instrument channel. The material may be pre-wet, or submerged, in part or totally for scanning. The couplant shall provide an effective acoustic contact between the transducer beams and the pipe surface.

The EBW and PD shall be defined by the agency.

18.4.2 Inspection for longitudinal imperfections

Shear-wave ultrasonic beams are propagated clock-wise and counter-clockwise by two or more transducers. The sensitivity of the system shall enable it to detect, display and record imperfections oriented parallel to the major axis such as, but not limited to, seams, laps and cracks.

The angle of sound beam chosen for OCTG inspection shall ensure the sound wave will intersect the inside surface of the OCTG.

18.4.3 Inspection for transverse imperfections

Shear-wave sound beams are propagated in each longitudinal direction to provide for the detection of imperfections oriented transverse to the major axis. The sensitivity of the system shall enable it to detect, display and record transversely-oriented imperfections and three-dimensional imperfections such as, but not limited to, cracks, cuts, rolled-in slugs and pits.

18.4.4 Optional inspection for oblique or angular imperfections

Shear-wave sound beams propagating at one or more designated angles to the longitudinal axis may be used to detect imperfections oriented oblique to the major axis. The sensitivity of the system shall enable it to detect, display and record obliquely-oriented imperfections.

The angle of sound beam chosen for OCTG inspection shall ensure the sound wave will intersect the inside surface of the OCTG.

18.5 Standardization

18.5.1 A reference standard shall be of a length sufficient for dynamic periodic checks and shall be provided by the owner.

18.5.2 For standardization, the reference notch length, width and location shall be in accordance with the requirements of the applicable specification. The notch depth shall not exceed the depth required by ISO 11960:2001, Clause 10 or ISO 11961:1996, Clause 8 or API Spec 5D:2001, Clause 10. Notches, including those having depths less than the requirements of the ISO/API standards, are used to establish equipment sensitivity. Reference signal amplitude shall not be used to determine acceptance or rejection. See Clause 19 of this International Standard for evaluation procedures. Notch widths used in field inspection are typically 0,5 mm (0.020 in) or less. Notch depths for field inspection to 12 ½ % acceptance criteria are typically 10 % of the specified wall thickness. Notch depths for field inspection to 5 % acceptance criteria shall be as specified by ISO 11960, and ISO 11961 or API Spec 5D.

18.5.3 As an alternative to the above notches, with the owner's permission, a drilled hole may be used. The hole diameter shall be in accordance with the requirements of the applicable specification. Reference signal amplitude shall not be used to determine acceptance or rejection. See Clause 19 for evaluation procedures.

18.5.4 Reference notches shall be cut so they can be removed without reducing the wall thickness to less than the minimum allowable thickness. A reference standard that contains a drilled hole shall be clearly identified as a reject. Drilled holes shall be positioned so that the section containing them can be cut off with minimal loss of acceptable pipe.

18.5.5 Notches or holes shall be separated such that the indication from each is distinct and separate from each other and from other anomalies or end-effects. Equipment gain and threshold adjustments shall be set for a minimum signal-to-noise ratio of 3-to-1.

18.5.6 Instrumentation shall be adjusted to produce reference signal amplitudes of at least 50 % of full scale of the readout for each transducer. A threshold shall be established in accordance with the agency's standard operating procedures and shall not be greater than the reference level. A dynamic standardization check shall be performed at the intervals defined in 18.3.3, to ensure repeatability by inspecting the reference standard at production speeds two consecutive times.

18.5.7 As a supplementary practice, by agreement between the owner and the agency, the effect of the shape and radial direction of a reference reflector (on signal amplitude) shall be verified. This is done by comparing the peak amplitudes from both sides of the reflector. If one amplitude is less than 80 % of the other (2 dB), the use of the reference reflector for standardization sensitivity is questionable.

18.6 Procedure for the detection of longitudinal, transverse and oblique imperfections

Inspect each length with the ultrasonic inspection system. The sequence of inspecting the OCTG by the various scanners is not specified, but each one may perform its respective function effectively and without detrimental interaction with other scanners.

Locate and mark electronic readout indications on the outside surface of the pipe, for the full extent of each indication. Evaluate all marked indications in accordance with Clause 19.

Make an identifiable record of the inspection, including a readout of imperfection indications detected. These documents shall be retained by the agency for at least 6 months.

18.7 Inspection of the body wall for wall thinning

18.7.1 Equipment

Sound beams propagated normal to the material's surface are used to measure wall thickness throughout the length of the tube covered by the automated system. The combination of linear and rotational speeds of the material and/or scanner normally produces 100 % full-body coverage based upon the effective beam width (EBW) of the transducer and the distance between successive pulses [pulse density (PD)] for each instrument channel. The material may be pre-wet or submerged in part or totally for scanning. Couplant shall provide an effective acoustic contact between the transducer beams and the pipe surface. A means of monitoring effective acoustic coupling shall also be used.

The EBW and PD shall be defined by the agency.

NOTE Ultrasonic wall thickness verification coverage may not be 100 % when used in conjunction with EMI units.

18.7.2 Standardization

a) The standard shall contain at least two thicknesses that will allow adjustment of the readout over an appropriate range of thickness values for the material being inspected. The reference thicknesses shall be verified by measurement with a micrometer or standardized ultrasonic thickness gauge (see 18.9). One thickness shall be equal to or greater than the specified wall thickness of the OCTG being inspected. The other thickness shall be less than the specified thickness. The difference in the thicknesses shall be equal to or greater than 10 % of the specified wall thickness for seamless material.

b) The equipment's readout of wall thickness shall be adjusted to read the reference thickness nearest the minimum allowable thickness of the material being inspected within 0,25 mm (0.010 in) or 2 % of the specified wall thickness, whichever is the smaller. These adjustments are to be done for each transducer used for wall thickness measurements.

As a supplementary practice, by agreement between the owner and the agency, the thinnest reference thickness used in 18.7.2a) shall be equal to or less than the minimum allowable thickness for the pipe being inspected. This standard shall be provided by the owner. Equipment adjustment shall be the same as described in 18.7.2b).

18.7.3 Procedure for measurement of wall thickness

Inspect each length with the ultrasonic inspection system.

Verify a minimum wall thickness reading for at least one length out of every 50 inspected, using a precision deep-throated calliper or a properly standardized manual ultrasonic thickness gauge.

Locate and mark electronic readout indications on the outside surface of the pipe, for the full extent of each indication. Evaluate all marked indications in accordance with Clause 19.

Make an identifiable record of the inspection, including a readout of imperfection indications detected. These documents shall be retained by the agency for at least 6 months.

18.8 Ultrasonic inspection of longitudinal welds

18.8.1 Equipment

The longitudinal weld area is automatically or manually scanned along its entire length for imperfections. Shear-wave sound beams are propagated through the weld in opposing circumferential directions for detection of weld imperfections such as, but not limited to, lack of fusion, pin holes, lack of penetration, longitudinal cracks, porosity and inclusions. Equipment shall be capable of inspecting 1,6 mm (1/16 in) on either side of weld line throughout the entire thickness of the weld.

18.8.2 Standardization for weld inspection

The reference standard shall contain reference indicators in accordance with ISO 11960:2001, 10.15.3.

Reference indicators should be separated so that the indication from each is distinct and separate from each other and from other anomalies or end-effects. Equipment adjustments such as gain, threshold and signal filtering should be set for a minimum signal-to-noise ratio of 3-to-1.

Distance amplitude compensation may be used when it is required to detect and gauge reflectors over a significant distance.

The angle of sound beam chosen for OCTG inspection shall ensure the sound wave will intersect the inside surface of the OCTG.

Reference signal amplitudes shall be produced by simulation of the scanning method on the pipe to be inspected. Reference reflector signal amplitude shall be adjusted to at least 50 % of full scale of the readout for each transducer. A threshold shall be established in accordance with the agency's standard operating procedures and shall not be greater than the reference level. A dynamic standardization check shall be performed at the intervals defined in 18.3.3, to ensure repeatability by inspecting the reference standard at production speeds two consecutive times. Coverage of scanning on both sides of the centreline of the weld shall be verified by demonstrating signal amplitude from a reflector positioned offset from the reference line for the weld.

By agreement between the owner and the agency, one or more of the following supplementary practices shall apply.

a) Supplementary Practice A, in which specific reference standards and reference reflectors are used to do the following:

   1) check each transducer angle;

   2) check proper adjustment of gates and inspection coverage by the equipment. This includes the use of multiple internal and external surface reflectors and a longitudinally-drilled hole at mid-wall of the material. Longitudinal notches for radial holes are separated by a minimum transverse distance of 1,6 mm (1/16 in) on both sides of the reference line, and the longitudinal hole is placed along a line midway between them. In addition, a radial hole through the reference line may be used for setting the reference signal amplitude (see Figure B.2). The offset reflectors, as well as the longitudinal hole, are used to verify sensitivity of coverage on both sides of the centreline of the weld and through the thickness of the weld. By agreement between the owner and the agency, the reference line shall coincide with the weld line. Signal repeatability shall be the same as stated earlier in this clause.

b) Supplementary Practice B, in which the effect of the shape and radial direction of a reference reflector (on signal amplitude) are verified. This is done by comparing the peak amplitudes from both sides of the reflector. If one amplitude is less than 80 % of the other (2 dB), the use of the reference reflector for standardization sensitivity is questionable.

18.8.3 Procedure for ultrasonic inspection of longitudinal welds

The inspection shall cover the entire length of the weld excluding upsets and threads. A method of tracking the weld in a consistent manner shall be employed. By agreement between the owner and agency, inspection for thin wall and planar imperfections shall be included, in which case the operation of the equipment includes a normal beam inspection along the edge of the weld in accordance with 18.7. Proceed in accordance with the following.

a) Propel the transducer assembly along the weld at the scanning speed used in 18.8.2.

b) Locate and mark electronic readout indications on the outside surface of the pipe, for the full extent of each indication. Evaluate all marked indications in accordance with Clause 19.

c) Make an identifiable record of the inspection, including a readout of imperfection indications detected. These documents shall be retained by the agency for at least 6 months.

18.9 Manual ultrasonic thickness gauging

18.9.1 Equipment

The ultrasonic thickness gauge is used to measure wall thickness from the outside surface. The gauge typically consists of an ultrasonic transducer, a connecting cable, and a battery-powered instrument package with a digital, scope or meter readout. The transducer element diameter shall not exceed 9,5 mm (0.375 in) and shall be capable of reading the thickness of a parallel surface test block within ±0,025 mm (0.001 in) of the actual thickness.

18.9.2 Surface conditions

Surface roughness might cause an ultrasonic thickness reading to be different from a mechanical calliper reading at the same spot. Generally, ultrasonic readings are a response to the average thickness between the peaks and valleys of surface roughness. Therefore, ultrasonics will give a slightly thinner reading than a mechanical calliper (as specified in ISO 11960:2001, 10.13.4 or ISO 11961:1996, 8.4.2 or API Spec 5D:2001, 7.4.2), which measures on the peaks of surfaces. Slightly nonparallel surfaces may cause differences between ultrasonic measurements and mechanical measurements. The type of difference depends mainly on the type of transducer used and the application of the mechanical calliper.

18.9.3 Calibration

The linearity of the gauge’s readout shall be calibrated over an interval of 2,5 mm (0.100 in) to 51 mm (2.000 in) after any repair of the instrument, or at least once every 6 months, whichever is more frequent.

If the UT gauge is used to evaluate an imperfection on the inside surface of the pipe, it shall be able to detect a 0,8 mm (1/32 in) flat-bottom hole at least 9,5 mm (3/8 in) from the front surface of a parallel-surface test block. The remaining wall thickness measurement accuracy shall be ± 0,25 mm (0.010 in) and shall be checked after any repair of the instrument, or at least once every 6 months, whichever is more frequent.

The calibration shall be recorded on the instrument, and in a log book, giving the date of the calibration, due date, and the initials of the person performing the calibration.

18.9.4 Standardization

All standards used for standardization shall have velocity and attenuation properties similar to the material being inspected. Prior to use, to minimize error due to temperature differences, the standard(s) shall be exposed to the same ambient temperature as the material for 30 min or more (this may be reduced to 10 min if the standard is placed on the pipe surface and its contact area maximized).

The gauge shall be standardized according to the gauge manufacturer’s instructions on a standard thickness that is at least 1,3 mm (0.050 in) thinner than the specified wall thickness of the material being inspected and on a second standard thickness that is at least 1,3 mm (0.050 in) thicker than the specified wall thickness. The thicknesses shall be verified by measuring with a micrometer. The gauge accuracy shall be within ±0,025 mm (0.001 in) of the standard’s thickness.

The standards specified above shall have the same outside surface curvature as the outside diameter of the material being measured, except that a flat standard may be used for specified diameters larger than 88,90 mm (3 ½ in).

The following shall apply.

a) If practical, take a micrometer measurement of a properly prepared area of the material to be inspected and use this for final standardization of the gauge. If the thickness reading of the standardized gauge is not the same as that measured by the micrometer [within a tolerance of ±0,05 mm (0.002 in)], determine the source of the error. If the error is due to transducer curvature, adjust the zero control. If the error is due to material velocity, adjust the velocity control. To prepare the external surface, remove varnish, paint and loose material. To prepare the internal surface at the same point, remove loose material, scale and varnish to allow proper contact of the micrometer anvil.

b) In addition to the requirements stated in 18.3.3, the following shall be done:

   1) verify standardization whenever a reject reading is encountered or whenever a reading within 0,13 mm (0.005 in) of the minimum permissible thickness is encountered;

   2) re-adjust the gauge reading during a standardization check when there is a variance of more than 0,05 mm (0.002 in) from the original setup value.

18.9.5 Procedure

Proceed as follows.

a) For battery-powered UT gauges, check the battery charge indication with the gauge switched ON. If the battery is low, recharge or replace it before proceeding.

b) Select the appropriate scale for the wall thickness to be measured, and standardize the gauge as described in 18.9.4.

c) When measuring the wall thickness, remove all dirt and loose material from the external surface and apply a couplant, which is non-injurious to the material being inspected, to the area to be gauged. Place the transducer firmly onto the surface. When measuring the wall thickness after contour-grinding, allow the OCTG surface to cool to the same ambient temperature as the surrounding material surface.

d) If a dual-element transducer is employed, ensure that the parting line between the transmitting and receiving transducer is perpendicular to the pipe axis.

   NOTE If the parting line of a dual-element transducer is applied at an angle other than perpendicular to the longitudinal axis, the resulting ultrasonic readings might be greater than the actual pipe thickness; the smaller the pipe diameter, the larger the error.

e) Allow the reading to stabilize, then compare the reading with the minimum allowable wall thickness. A stable reading is one that maintains the same value [within ± 0,025 mm (0.001 in)] for at least 3 s.

f) When a reading is made that would classify the material as a reject, scrape all surface coating and loose scale to clean the surface, without removing any base metal. Verify the gauge standardization and re-check the thickness measurement.

g) When using a highly sensitive gauge, take care to ensure that detection of an inclusion or lamination is not interpreted as a reduction in wall thickness. Refer to Clause 19 for imperfection evaluation details.

h) After a significant amount of use, examine the ultrasonic transducer face for wear. When a worn transducer face results in inaccurate readings, it shall be replaced.

   NOTE A concave transducer face causes pipe wall to appear thinner than actual if the ultrasonic gauge has been standardized on material with a radius of curvature greater than that of the material being inspected.

i) If the readout does not remain stable when the transducer is being held securely on the test block, the gauge could be malfunctioning, and it shall be repaired or replaced.

NOTE Achieving the accuracy on standardization thicknesses as described in 18.9.4 does not necessarily assure the same accuracy for wall thickness measurements. The material's surface condition (both entry- and back-wall reflection surfaces) is not necessarily the same as a test block. Digital readouts normally round off the least significant digit, causing a small amount of error.

18.10 Manual ultrasonic shear-wave inspection

18.10.1 Equipment

The ultrasonic instrumentation shall be the pulse-echo type with an A-scan presentation. For the amplitude-based inspection technique, a transducer frequency between 2,25 MHz and 10,0 MHz shall be used. Wedges shall be used to generate shear-waves in the material to be inspected.

The use of a 45° refracted angle is typical. The angle of sound beam chosen for OCTG inspection shall ensure the sound wave will intersect the inside surface of the OCTG

18.10.2 Inspection for longitudinal imperfections

A shear-wave sound beam is propagated clock-wise and anti-clockwise in the inspection area. The sensitivity of the system shall enable it to detect and display imperfections oriented parallel to the major axis, e.g. seams, laps and cracks. Wedges shall be machine-contoured to fit the external curvature of the material and maintain the refracted sound path angle; manually-contoured wedges will not give reproducible results.

18.10.3 Inspection for transverse imperfections

A shear-wave sound beam is propagated in each longitudinal direction in the inspection area. The sensitivity of the system shall enable it to detect and display transversely oriented imperfections (e.g. cracks) and three-dimensional imperfections (e.g. cuts, pits and rolled-in slugs).

18.10.4 Optional inspection for oblique or angular imperfections

A shear-wave sound beam is propagated clock-wise and anti-clockwise at the anticipated angle to the longitudinal axis in the inspection area. The sensitivity of the system shall enable it to detect and display obliquely-oriented imperfections.

18.10.5 Standardization

The following shall apply.

a) A reference standard shall contain internal and external, longitudinal and transverse notches that meet the requirements of 18.5.2 and 18.5.5.

b) The effect on signal amplitude of the shape and radial direction of a reference notch(es) shall be verified. This shall be done by comparing the peak amplitudes from both sides of the reflector. If one amplitude is less than 89 % of the other (1 dB), the use of the reference reflector for standardization sensitivity is questionable. For oblique notches, 18.5.7 may apply.

c) To eliminate parallax error during standardization and inspection, the A-scan presentation shall be viewed perpendicular at all times.

d) To locate imperfections accurately, a distance standardization is recommended. Typically, a DSC-block, miniature angle-beam block or a DC-block is used to perform a distance standardization of the A-scan presentation. The distance used shall be established in the agency's standard operating procedures but shall not be less than the shear-wave metal-path distance equivalent of one-and-one-half skips. When applicable, the digital sound-path display shall also be standardized for distance.

e) Instrumentation shall be adjusted to produce reference signal amplitudes of at least 50 % of full scale of the readout.

NOTE For amplitude-based methods, standardization should be performed beyond the near-field.

18.10.6 Frequency of standardization checks

In addition to 18.3.3, standardization checks shall be performed as follows:

a) whenever an indication is within ± 20 % of the reference amplitude;

b) before classifying a shear-wave indication as rejectable.

18.10.7 Unacceptable standardization result

The following conditions constitute an unacceptable standardization result:

a) if a standardization check indicates a ± 10 % full screen height (FSH) change in reference level;

b) if a standardization check shows that any reference point has moved more than 5 % of its sweep reading.

All material evaluated since the last acceptable standardization check shall be re-evaluated.

18.10.8 Procedure for inspection of longitudinal, transverse and oblique imperfections

To aid in locating imperfections, scanning may be performed with additional gain. Inspect required areas in the appropriate orientation using the ultrasonic equipment. Locate and mark on the outside surface the indications noted on the readout, for the full extent of each indication. Evaluate all marked indications in accordance with Clause 19.

19 Evaluation of imperfections and deviations

19.1 General

This clause describes the procedures for the evaluation of imperfections and deviations detected using the methods contained in this International Standard. Acceptance and rejection principles are contained in Clause 10.

19.2 Application

The evaluation procedures contained in this clause are applicable to all OCTG except those classified as prime as the result of inspection in accordance with this International Standard.

19.3 Equipment

Equipment used in conjunction with evaluation procedures includes, but is not limited to,

a) depth gauges,

b) wall thickness callipers,

c) straight edges,

d) rigid and flexible rules,

e) thread profile gauges,

f) portable ultrasonic inspection equipment,

g) magnetic particle inspection equipment.

19.4 Calibration and standardization procedures

All equipment and materials used to evaluate imperfections shall be calibrated on a regular basis in accordance with the provisions of the agency's quality assurance program. In addition, the following standardizations shall be performed.

a) For hardness testing, the standardization procedure shall be in accordance with 12.5.

b) For ultrasonic thickness measurement, the standardization procedure shall be in accordance with 18.9.4.

c) For shear-wave ultrasonic equipment, the standardization procedure shall be in accordance with 18.10.5.

d) For MPI equipment and materials, the standardization procedure shall be in accordance with 13.8.

19.5 Procedure for evaluating outside-surface-breaking pipe body imperfections

19.5.1 General

This procedure shall be followed when inspecting pipe to imperfection and wall thickness tolerances specified in ISO 11960:2001, 8.4, or ISO 11961:1996, 8.4 or API Spec 5D:2001, 7.4.

NOTE An imperfection is a discontinuity or irregularity in the wall or in the pipe surface that can be detected by an NDT method included in the applicable International Standard.

NOTE A defect is an imperfection of sufficient magnitude to warrant rejection of the product based on the stipulations of the applicable specifications.

If an imperfection of any size in the pipe or upset extends under the coupling where it is inaccessible for exploration, the imperfection shall be classified as a defect.

Quench cracks shall be considered defects.

Grinds that run under the coupling shall not be considered defects if the grind is well-contoured with the circumference of the pipe and displays a high degree of workmanship. Because of the difficulty in defining "well-contoured" and "high degree of workmanship", the owner's discretion shall govern (only with respect to the contour of the grind).

19.5.2 Exploration

When imperfections such as seams, laps, or cracks are found in a length of pipe, the following procedure applies.

a) Explore the imperfection with a file or grinder. Exploratory grinding shall be round-bottomed.

b) To avoid over-grinding, it is good practice, though not required, to leave some trace of the imperfection at or near the bottom of the grind.

c) If a length is determined to be rejectable, a trace of the defect shall be left for verification by the manufacturer or the manufacturer's representative.

d) Pits, cuts and gouges do not normally require exploratory grinding for depth measurement.

19.5.3 Measurement of imperfection depth

Adjust the depth gauge to zero on a flat surface. Measure the depth of the imperfection using a depth gauge. Verify the measurement before rejection by scraping away the varnish and loose scale and removing metal protrusions using a flat file. Read the depth of the imperfection directly from the dial. Reconfirm the "zero point" after a reading that would result in rejection. If the normal pipe contour is irregular or has a dent, set the depth gauge to zero adjacent to the imperfection.

19.5.4 Determination of remaining wall thickness

Proceed as follows.

a) For imperfections penetrating the wall approximately radially, measure the wall thickness on each side of the imperfection adjacent to its deepest penetration. Subtract the depth of the imperfection from the average of these wall thickness readings.

b) For imperfections penetrating the wall at an angle (e.g. a lap or a hook crack), measure the wall thickness on each side of the exploratory grind at the point of maximum penetration of the imperfection. Subtract the depth of the imperfection from the average of these wall thickness readings.

c) If practical, callipers shall be used to measure the wall thickness near the ends of the OCTG.

19.5.5 Further exploration

If an electromagnetic or ultrasonic inspection indication is displayed and a magnetic particle build-up exists but no imperfection is readily identifiable, refer to 19.6.4 for the procedure for further exploration.

19.5.6 Linear defects — Group 1 and Group 2 (except C-90 and T-95) materials

Any linear imperfection that is deeper than 12,5 % of the specified wall thickness, as measured from the surface, or that reduces the wall thickness remaining at the root of the imperfection to less than 87,5% of the specified wall thickness shall be considered a defect.

NOTE Linear imperfections include, but are not limited to, cracks, seams, laps, plug scores, cuts and gouges.

19.5.7 Linear defects — Group 3 and Group 4, C-90 and T-95 materials

Any linear imperfection that is deeper than 5 % of the specified wall thickness, as measured from the surface, or that reduces the wall thickness remaining at the root of the imperfection to less than 87,5 % of the specified wall thickness shall be considered a defect.

19.5.8 Non-linear defects—All grades

Any non-linear imperfection, such as a pit, that results in a wall thickness above or below the imperfection with a value less than 87,5 % of specified wall thickness shall be considered a defect.

19.5.9 Disposition

Pipe containing defects shall be given one of the following dispositions.

a) Disposition A. The defect may be removed by grinding, providing the remaining wall thickness is not less than 87,5% of the specified wall thickness. If the depth of a grind exceeds 10 % of the specified wall thickness, the remaining wall thickness shall be verified. Removal of defects by grinding may be performed only by agreement between the owner and the agency.

b) Disposition B. Reject the length. The defect shall not be contoured or removed but shall be left in the pipe for confirmation by the manufacturer.

c) Disposition C. The section of pipe containing the defect may be cut off within the limits of requirements on length, if agreed upon between the owner and the manufacturer.

19.5.10 Radius grinding

Contour all exploratory grinds and file marks with generous radii in acceptable pipe. Coat all outside surface grinds in acceptable pipe with a rust inhibitor.

19.6 Procedure for evaluating inside-surface-breaking pipe body imperfections

19.6.1 Imperfections near pipe ends

If the inside surface-breaking imperfection is near the end of the pipe, but not in the threads, an attempt shall be made to explore and measure the imperfection if the diameter permits, see 19.5.1 through 19.5.4.

19.6.2 Ultrasonic evaluation

If the inside surface imperfection is not accessible from the pipe end, it shall be evaluated using shear- and/or compression-wave UT. API RP 5UE should be used as a guide to performing shear-wave standardization and evaluation of imperfections. Specific evaluation procedures should be agreed upon between the owner and the agency. The following shall apply.

a) The area to be evaluated shall have been located and marked when applying the NDT method that originally detected the indication.

b) Manual ultrasonic thickness gauging may also be used to aid in locating the imperfection. Manual ultrasonic thickness gauges shall be standardized prior to use in accordance with 18.9.4.

c) An ultrasonic thickness gauge may be used to measure the wall thickness above the imperfection to determine if 87,5 % of the specified wall thickness is present, provided it can be demonstrated that the imperfection breaks the inside surface.

19.6.3 Defects and disposition

The requirements of 19.5.5 through 19.5.9 apply.

19.6.4 Further exploration

If an electromagnetic or ultrasonic inspection indication is displayed and/or a magnetic powder build-up exists but no imperfection is readily identifiable, supplementary tools and techniques shall be used to evaluate these imperfections as either acceptable or rejectable, as follows.

a) Inspect the inside surface using a high intensity light source or a borescope;

b) Perform an internal MPI in the area of interest in accordance with 13.12.3.

19.6.5 Defects and disposition

The requirements of 19.5.5 through 19.5.9 apply.

19.6.6 Radius grinding

In acceptable pipe, contour all exploratory grinds and file marks with generous radii.

19.7 Procedure for evaluating welds

19.7.1 Surface-penetrating imperfections

Evaluate in accordance with 19.5 or 19.6.

19.7.2 Non-surface-breaking imperfections

Non-surface-breaking imperfections shall be evaluated by the procedure in 18.8. Any weld seam imperfection within 1,6 mm (1/16 in) of either side of the weld line, not breaking the inside or outside surface, that is proven to reduce the net effective wall thickness below 87,5 % of the specified wall thickness shall be considered a defect.

19.7.3 Flash height

Flash in electric-welded OCTG is considered a defect if its height exceeds the limits described in ISO 11960:2001, 8.8.

19.7.4 Excessive trim

Excessive trim in electric-welded pipe is considered a defect if the depth of the groove exceeds the limits described in ISO 11960:2001, 8.8. The depth of the groove is the difference between wall thickness measurements taken approximately 25,4 mm (1 in) away from the groove and in the groove in the same transverse plane.

19.7.5 Disposition

The disposition of pipe containing defects shall be according to 19.5.9.

19.7.6 Radius grinding

In acceptable pipe, contour all exploratory grinds and file marks with generous radii. Also, coat all grinds on the outside surface of acceptable pipe with a rust inhibitor.

19.8 Procedure for evaluating grinds

19.8.1 Inspection

Inspect the area using MPI to ensure complete removal of the imperfection. If the imperfection is not completely removed, use the procedure in 18.7 or 18.8 to evaluate the imperfection.

19.8.2 Wall thickness measurement

If no further imperfection is found, measure the wall thickness in several places in the grind area to ensure that a wall thickness of 87,5 % or greater of the specified wall thickness remains. If not, the length shall be rejected. Refer to 19.9 for procedures related to determining rejection.

19.8.3 Defects and disposition

The requirements of 19.5.5 through 19.5.9 apply.

19.9 Procedure for evaluating large-area wall reduction

19.9.1 Wall thickness measurement

Determine the wall thickness using an acceptable measuring device such as an ultrasonic wall thickness gauge or mechanical calliper.

Mechanical callipers shall meet the construction requirements of ISO 11960:2001, 10.13.4 or ISO 11961:1996, 8.4.2 or API Spec 5D:2001, 7.4.2.

When using an ultrasonic thickness gauge, if the minimum reading is borderline on 87,5 % of the specified wall thickness, multiple readings shall be taken to determine the lowest measured wall thickness. The "measured" wall thickness is then defined as the average of at least three ultrasonic readings within a circle of approximately 6,3 mm (1/4 in) diameter. Each reading shall be no closer than 3,2 mm (1/8 in) to any other. Readings shall not be used for averaging if they differ by more than 0,25 mm (0.010 in). No single reading shall be a basis for rejection.

19.9.2 Disposition

If the "measured" wall thickness is less than 87,5 % of the specified wall thickness, it shall be considered a defect and dispositioned according to 19.5.9.

In case of disputed wall thickness measurements, direct measurement by mechanical calliper shall govern, as stated in ISO 11960:2001, 10.13.4, or ISO 11961:1996, 8.4.2 or API Spec 5D:2001, 7.4.2.

19.10 Procedure for evaluating imperfections in upsets

19.10.1 Surface-penetrating imperfections

The maximum permissible depth of imperfections measured from the surface of the upset portion of the pipe shall be in accordance with ISO 11960:2001, Table C.34 or Table E.34, or ISO 11961:1996, 8.5.2 or API Spec 5D:2001, Table 10.

The internal upset configuration on all upset products shall exhibit no sharp corners or drastic changes of sections and shall permit a 90° hook-type tool to be pulled through without snagging (hanging-up).

If an imperfection in the upset extends under the coupling, where it is inaccessible for exploration, the imperfection shall be classified as a defect. Grinds that run under the coupling are not considered defects provided the grind is well-contoured with the circumference of the pipe and displays a high degree of workmanship. Because of the difficulty in defining "well-contoured" and "high degree of workmanship", the owner's discretion shall govern (only with respect to the contour of the grind).

When practical, evaluation shall be done in accordance with 19.5.1 and 19.5.2.

19.10.2 Internal inaccessible imperfections

If the imperfection is inaccessible for direct depth measurements, a substantial effort shall be made to determine its depth using a mechanical calliper and/or ultrasonic thickness measurements.

The following procedures shall be used.

a) Measure the wall thickness on each side of the imperfection adjacent to its deepest penetration.

b) Measure the remaining wall thickness at the deepest penetration of the imperfection. Subtract the value from the average of the adjacent wall thickness measurements.

c) Evaluate with UT in accordance with 19.6.1.

19.10.3 Additional requirements for plain-end drill pipe

The maximum permissible depth of a visible imperfection in the L_{eu} or L_{iu} areas of the upsets of plain-end drill pipe is determined from respective ISO/API diameter allowances. The minimum allowable value of D_{ou} is used for outside surface imperfections. The maximum allowable value of d_{ou} is used for inside surface imperfections.

19.10.4 Disposition

An imperfection that has a depth exceeding the maximum allowable depth shall be considered a defect. A wall thickness that is less than the allowable minimum shall be considered a defect. In the case of disputed wall thickness measurements, direct measurement by mechanical calliper shall govern, as stated in ISO 11960:2001, 10.13.4 or ISO 11961:1996, 8.4.2 or API Spec 5D:2001, 7.4.2.

Pipe containing a defect in the upset portion shall be rejected unless the defect can be removed by grinding. Grinding shall not be done in areas for which wall thickness or diameter tolerances are not specified. Removal of defects by grinding may be performed only by agreement between the owner and the agency. Grinding shall not produce any of the following:

a) a wall thickness less than 87,5 % of the specified body wall thickness in the upset runout area;

b) an outside diameter less than the applicable minimum allowable;

c) an inside diameter greater than the applicable maximum allowable.

19.11 Procedure for evaluation of outside surface imperfections on couplings

19.11.1 Pits, round-bottom gouges, and similar imperfections are not considered defects unless the depth of the imperfection exceeds that listed in Table A.15.

19.11.2 Grip marks, sharp-bottom gouges, and similar imperfections are not defects unless the depth of the imperfection exceeds that listed in Table A.15. If a gouge has an adjacent metal protrusion, the protrusion shall be removed prior to making a depth measurement.

19.11.3 For Group 1, Grades J-55 and K-55 impact tested above 0 °C (32 °F) and Grade H-40, the following shall apply:

Finished couplings shall be free of all visible seams, cracks and porosity as specified in ISO 11960.

NOTE Visible seams or cracks are those that can be seen without the aid of magnetic particle inspection or other NDT methods on uncoated couplings or if the coating is removed.

19.11.4 For Group 1, Grade J-55 and K-55 couplings that comply with the requirements of ISO 11960:2001, 9.14.6 and are marked as required in ISO 11960:2001, Table C.67 or Table E.67, the following shall apply:

Linear imperfections, such as seams or cracks on the outside surface are not defects unless their depth exceeds that listed in Table A.16.

19.11.5 For Group 1 (N80) and Groups 2, 3, and 4, the following shall apply:

Linear imperfections such as seams or cracks on the outside surface are not defects unless their depth exceeds that listed in Table A.16. Indications of nonmetallic inclusions are not defects unless their depth exceeds 0,89 mm (0,035 in).

19.11.6 The depth of the imperfection shall be measured from the normal surface or contour of the coupling extended over the imperfection. All depth measurements shall be done in accordance with 19.5.3. Evaluation of linear imperfections such as seams or cracks shall be done in accordance with 19.5.6 or 19.5.7, depending on the material.

19.11.7 All seams, cracks or pits may be removed, and all other defects or imperfections may be removed or reduced to acceptable limits, by machining or grinding on the outer surface, provided that the resulting diameter is within the tolerances specified in Table A.17 or Table A.18, as applicable. The outside diameter of the finished coupling shall be measured across the finished surface or contour of the coupling (i.e. initial surface or grind contour resulting from the removal of a defect or imperfection). The outside diameter shall not be measured at the base of an acceptable imperfection. Grinding or machining shall not be performed by the agency except at the specific direction of the owner. The grinding shall be approximately faired into the outer contour of the coupling.

19.11.8 The minimum OD resulting from grinding or machining shall be measured with an OD micrometer or other suitable instrument capable of being read in hundredths of a millimetre (thousandths of an inch).

19.12 Procedure for evaluation of visually-located thread imperfections

19.12.1 General

Good judgment and discretion shall be exercised in field examination of exposed threads on casing and tubing. Some surface irregularities will not affect the joint strength or the pressure-seal performance unless they are large enough to act as a leak path. Recognizing that the crest of a round thread does not engage the root of the mating round thread, minor chatter, tears, cuts or other surface irregularities on the crests or roots of round threads are not cause for rejection.

NOTE Some surface roughness may even assist proper makeup, by holding thread compound in place as the thread is engaged.

Superficial scratches, minor dings, and surface irregularities on the threads are occasionally encountered and may not necessarily be detrimental. Because of the difficulty in defining superficial scratches, minor dings and surface irregularities, and because of the degree to which they can affect thread performance, no blanket acceptance criteria for such imperfections can be established. The thread flanks in the L_c area of round threads are the critical sealing elements.

Minor (cosmetic) field repair of threads and other repairs stated in 19.12 may only be performed by agreement between the owner and the agency.

Arc burns are rejectable anywhere in the threaded areas.

Refer to Table A.9 and Table A.10 to determine the length of specific thread areas (for example, L_c and PTL).

19.12.2 Rejection criteria outside the L_c area

The following shall apply.

a) Pits, seams, laps, cuts and other imperfections are rejectable if they penetrate through the root of the thread, or if they exceed 12,5 % of the specified body wall thickness as measured from the projected pipe surface, whichever is greater.

b) Detectable protrusions on the threads are rejectable if they could peel off the protective coatings on the coupling threads or score mating surfaces.

19.12.3 Rejection criteria within the L_c area

The following shall apply.

a) Threads shall be free of any visible imperfections as listed in 11.13.5.a) that break the continuity of the threads.

b) Detectable protrusions on the threads are rejectable if they could peel off the protective coatings on the coupling threads or score mating surfaces.

c) On round threads, all threads within the L_c area shall have full crests, otherwise they are rejectable.

d) In buttress casing, a single thread showing the original outside surface of the pipe for more than 25 % of the circumference is cause for rejection. More than two threads showing the original outside surface of the pipe is cause for rejection.

e) Minor pitting and thread discolouration may also be encountered and may not necessarily be detrimental. Because of the difficulty in defining pitting and discolouration and the degree to which they affect thread performance, no blanket acceptance criteria for such imperfections can be established. As a guide to acceptance, the most critical considerations are that any corrosion products protruding above the surface of the threads be removed and that no leak path exists. Filing or grinding shall not be performed to remove pits.

f) In field inspection, heat-tinting on threads might indicate localized hardening of the threads as a result of thermal cutting when removing couplings or protectors. This may be cause for rejection by agreement between the agency and the owner.

19.12.4 Rejection criteria in the chamfer area

The following shall apply.

a) A chamfer not present for a full 360° circumference is cause for rejection.

b) A thread root that runs out on the face of the pipe or produces a feather edge (and not on the chamfer) is cause for rejection. See Figure B.4.

c) Excessive chamfer that produces a knife edge (razor edge) on the face of the pipe is cause for rejection. See Figure B.5.

d) A burr on the starting thread within the chamfer is not cause for rejection unless the burr is loose or protrudes into the mating thread form. The burr shall be removed if either of these possibilities exist.

e) A false starting thread is not cause for rejection if it does not extend into the true starting thread. An interrupted starting thread is not cause for rejection but may indicate chamfer or thread misalignment, which shall then be evaluated.

f) Dents or mashes that cause out-of-tolerance thread dimensions are cause for rejection.

19.12.5 Rejection criteria for pipe ends

a) Pipe ends with burrs or fins that cannot be removed by grinding shall be rejected.

b) Dents or mashes that cause out-of-tolerance thread dimensions are cause for rejection.

19.12.6 Rejection criteria for round or bullet nose tubing

a) Ends with sharp corners or abrupt radius changes are cause for rejection. See Figure B.6.

b) For other rejection criteria, refer to 19.12.8.

19.12.7 Other criteria

Other visually evident imperfections that are not specifically covered in the preceding sections, whether in the L_c area or not, that may be detrimental to the makeup, strength, or sealing capacity of the thread, or that could result in galling, shall be reported to the owner.

19.12.8 Rejection criteria for the PTL area of box or coupling threads

The threads in the PTL area have the same rejection criteria as for the L_c area (see 19.12.3). The PTL area is described in 11.13.4 c).

19.12.9 Rejection criteria for threads beyond the PTL area of box or coupling threads

Threads not extending to the centre of the coupling, or to a distance of L_4 plus 12,7 mm (0.500 in) from the box face of an integral joint, shall be cause for rejection. Threads in this area need not be full-crested.

NOTE Tapping machines might not produce uniform threads in the J area since they tap from each side using multi-toothed chasers. During the tapping of the second side, the lead side of the chaser taps the threads in the J area of the first side that has been tapped.

19.12.10 Rejection criteria for coupling faces, box faces and counterbores

The following shall apply.

a) Faces with burrs or fins that cannot be removed by grinding or filing shall be rejected.

b) Dents or mashes that cause counterbore diameter reduction or out-of-tolerance thread dimensions are cause for rejection.

c) Tool marks on the counterbore are not cause for rejection but may indicate incorrect counterbore diameter, counterbore misalignment, or thread misalignment, which shall then be evaluated.

19.12.11 Rejection criteria for seal-ring grooves

Fins, wickers and ribbons that are loose, or could become loose, and fold into the thread form are cause for rejection unless removed.

19.13 Procedure for triangle location and coupling makeup position

19.13.1 Buttress thread

Proceed as follows.

a) Verify the location of the triangle stamp on the field end of each length of buttress thread casing. Using a metal scale, measure from the end of the pin to the base of the triangle, holding the scale parallel to the longitudinal axis of the pipe. If the triangle cannot be located or is in the wrong position [i.e. more than 0,8 mm (1/32 in) from the A_1 position], it is cause for rejection.

b) Determine the distance ($N - A_4$), where N is the measured coupling length. This is the nominal position of the end of the pin in the coupling. Measure the distance from the end of the coupling to the end of the pin inside the coupling. If the measured distance is different from the nominal distance by more than +5 mm (0.200 in) or –9,5 mm (–0.375 in), the condition is cause for rejection.

19.13.2 Round thread

a) Verify the location of the triangle stamp on the field end of each length of Label 1: 16, 18-5/8, 20. round thread casing. Using a metal scale, measure from the end of the pin to the base of the triangle. Hold the scale parallel to the longitudinal axis of the pipe. If the triangle stamp cannot be located or if the triangle is in the wrong position [i.e. more than 0,8 mm (1/32 in) from the A_1 position], it shall be reported to the owner. The base of the triangle will aid in locating the vanishing point for basic power-tight makeup; however, the position of the coupling with respect to the base of the triangle shall not be a basis for acceptance or rejection of the product. As a guide, makeup of the couplings shall be measured as described below.

b) For all sizes, determine the distance ($N - L_4$), where N is the measured coupling length. This is the nominal position of the end of the pin in the coupling. Measure the distance from the end of the coupling to the end of the pin inside the coupling. If the measured distance is different from the nominal distance by more than ± 6 mm (± 0.250 in), the condition shall be reported to the owner.

19.14 Procedure for evaluating straightness

19.14.1 All pipe shall be reasonably straight. This criterion requires judgement; it applies to all sizes and is the only straightness requirement for sizes Label 1: below 4-1/2. If the pipe is not reasonably straight, it is cause for rejection.

19.14.2 For pipe sizes Label 1: 4-1/2 and larger, follow the following procedure.

a) Chock the pipe so it cannot roll, with the major arc or bow oriented in the horizontal plane.

b) Measure and record the total length of the pipe from one end to the other. Calculate the maximum allowable chord height, as follows.

1) In SI units

$$h_{c,\,max} = L \times 0{,}05 \quad (5)$$

where

$h_{c,\,max}$ is the maximum allowable chord height, expressed in millimetres;

L is the total pipe length, expressed in millimetres.

2) In USC units

$$h_{c,\,max} = L \times 0{,}002 \tag{6}$$

where

$h_{c,\,max}$ is the maximum allowable chord height, expressed in inches;

L is the total pipe length, expressed in inches.

c) Stretch a taut string or wire across the arc or bow from one end to the other. The taut string or wire shall be extended between, and not over, couplings, upsets, or protectors. See Figure B.6. Measure and record the maximum distance (chord height) from the taut string or wire to the pipe body (see Figure B.6). If the measured value exceeds the calculated maximum chord height, $h_{c,max}$, the pipe shall be dispositioned in accordance with 19.14.4.

19.14.3 For plain-end pipe sizes Label 1: 4-1/2 and larger, the deviation from a straight line shall not exceed 3,2 mm (0.125 in) in a 1,8 m (6 ft) length at each end (see Figure B.6 for the method of measurement). If the measured value is greater than this amount, the pipe shall be dispositioned in accordance with 19.14.4.

19.14.4 Pipe not meeting straightness requirements shall be given one of the following dispositions:

a) the pipe is rejected;

b) hooked ends may be cut off within the limits of requirements on length if agreed upon between the owner and the manufacturer; or

c) the pipe may be straightened if agreed upon between the owner and the manufacturer.

19.15 Procedure for evaluating pipe diameter

19.15.1 Determination of outside diameter

Determine either the minimum or maximum outside diameter, at the point of interest, in accordance with ISO 11960:2001, 10.13.2.

19.15.2 Rejection criteria for pipe diameter

If the pipe has a diameter exceeding the tolerances of ISO 11960, it shall be dispositioned as follows.

a) Disposition A. The section of pipe containing an unacceptable diameter may be cut off within the limits of requirements on length if agreed between the owner and the manufacturer.

b) Disposition B. Reject the length.

c) Disposition C. By agreement between the owner and the manufacturer, pipe with an unacceptable diameter may be repaired.

20 Hydrostatic pressure testing

20.1 General

This clause describes the equipment and procedures used to hydrostatically pressurize OCTG for the purpose of detecting leaks in the body, couplings, mill end connections, or pin-end threads. This clause applies to rack-testing only.

Typically, field pressure testing is conducted using a pressure that produces a fibre stress in the OCTG which is in accordance with the formulas and applicable referenced tables in ISO 11960:2001, 10.12.

NOTE For environmental reasons, it might be desirable to use fresh water for hydrotesting.

20.2 Application

20.2.1 ISO 11960:2001, 10.12.1 requires that all OCTG shall comply with the test requirements for the particular designation, grade and end finish shown in referenced tables.

20.2.2 The OCTG body, upset, coupling or box (excluding threads) shall be free of leakage.

20.2.3 The connection between the coupling and mating mill end shall be free of leakage.

20.2.4 ISO 11960 contains no criteria for leakage of the threaded connections engaged by the pressure test plugs.

20.3 Equipment, safety and general procedures

20.3.1 Pressure gauge

The pressure test unit shall be equipped with an indicating pressure gauge that shall directly indicate the full hydrostatic pressure being applied. The indicating pressure gauge shall have a graduated dial for the entire pressure range, and its range will exceed the test pressure by a minimum of 25 %. The gauge shall be located in a position that will be convenient for the operator to observe throughout the test. The gauge shall have sufficient accuracy, scale divisions and damping so that it can be easily read to within 5 % of the applied pressure throughout the pressure cycle. Gauges shall not be over-pressurized.

20.3.2 Pressure recording

In addition to the indicating pressure gauge, each hydrostatic pressure test unit shall have a recording-type pressure gauge connected to read the full applied pressure throughout each pressure cycle. The recording gauge reading shall be compared with the indicating pressure gauge a minimum of once per hour to ensure reliability.

20.3.3 Test plugs

Documentation shall be provided to assure the test plugs are fabricated from material sufficient to withstand the pressure to which they may be subjected. Test plugs shall have effective anti-gall (see note) protection on the threads. Round thread pin-end test plugs shall be manufactured so that they cover the threads to the plane L_1 plus four threads (minimum). Buttress pin-end test plugs shall completely cover the L_4 area (minimum).

NOTE Martensitic chromium steels (ISO 11960, grades L80-9Cr and L80-13Cr) are sensitive to galling. Special precautions might be necessary for thread surface treatment and/or lubrication to minimize galling during hydrostatic testing (plug application and removal).

20.3.4 Safety

The following shall apply.

a) Pressure testing of OCTG is a dangerous operation, and appropriate safety precautions shall be taken.

b) Care shall be taken to protect both the testing personnel and others from moving OCTG, test plugs, and test fluids in the event of failure of threads, pressure plugs, supply lines (e.g. hoses) or connections. If air is entrapped in the OCTG, the movement may be sudden, quick and without warning.

c) The pressure shall be under proper control at all times so that the required test pressure is never exceeded by more than 5 %.

20.3.5 General procedures

Proceed as follows.

a) The pressure-hold time shall be a minimum of five seconds after the gauge indicator has reached its maximum stable pressure value.

b) Care shall be taken when handling OCTG while the thread protectors are removed, to ensure that two lengths of pipe do not strike each other and damage the unprotected threads or sealing surfaces. Also, care shall be used in installing threaded pressure plugs onto the OCTG to ensure that no cross threading or other damage occurs to the threads.

c) Seal rings (if supplied) should be removed prior to testing.

d) The water or other liquid used for pressure testing, and the OCTG being tested, shall be at approximately the same temperature during the pressure-hold cycle. If testing is done at an ambient temperature below 4 °C (40 °F), the temperature of the water shall be by agreement between the owner and the agency.

e) Test plugs shall be visually inspected before each use for thread imperfections and damage that would affect the integrity of the mating product threads. Damaged test plugs shall be repaired or replaced. At regular intervals established by the responsible parties performing the testing, test plugs shall be inspected visually for wear and damage, and non-destructively for cracks using the wet fluorescent magnetic particle or liquid penetrant method of inspection. Prior to the start of each job, test plugs shall be thread-gauged with all thread element (lead, height and taper) readings recorded.

20.4 Equipment calibration

20.4.1 Calibration check

The indicating pressure gauge, recording gauge or reference gauge shall be checked for accuracy, over the entire range of the gauge, whenever:

a) there is a failure to respond smoothly and repeatably to slowly increasing pressures;

b) it is over pressurized, in which case it shall also be re-calibrated prior to further use;

c) gauge repairs have been made;

d) four (4) months or more have passed since the previous calibration check;

e) the indicating pressure gauge and recording gauge, or reference gauge, are in disagreement by more than 5 % of the applied pressure.

20.4.2 Calibration tag

A calibration tag shall be attached to each pressure gauge. Each tag shall indicate the calibration check date, due date, accuracy and the name of the person or organization performing the calibration.

20.4.3 Time control

When a time-delay controller or indicator is used to ensure proper test time, the controller shall be checked once every inspection shift; a stop-watch may be used for this.

20.5 Operating procedure

The following procedure shall apply.

a) After removing the thread protectors, examine the threaded areas. If the threads are dry and/or dirty, then the threads shall be cleaned of all old thread compound and/or dirt and fresh thread compound applied. If cleaned, examine the threads before reapplying compound. Lengths with damaged threads shall be repaired before testing or shall be rejected. The compound applied shall be clean and undiluted thread compound that meets the performance objectives of ISO 13678; however, the owner may direct a specific compound be used.

NOTE For the purpose of this provision, API RP 5A3 is equivalent to ISO 13678.

b) Raise the end of the OCTG that is opposite the filling end in order to remove all air prior to starting the pressure cycle. Screw pressure test plugs onto each end of the OCTG and torque them to ensure a good seal.

c) Connect the lines and begin filling the OCTG with water. Allow all air and air-water mixture to exit through the high-pressure valve on the raised end of the OCTG. When all air has been purged, close the high-pressure valve on the raised end.

d) Bring the OCTG up to the required pressure, then stop applying pressure, and hold so that the hydrostatic pressure can be closely observed. The cause for any observable pressure drop during the hold cycle shall be identified through observation of the OCTG, connections and plugs. If the cause of the pressure drop is not discovered, or if a leak is discovered between the pipe and pressure cap or between the coupling and the pressure test plug, clean and examine the pipe and/or coupling threads to check for a condition that might cause a leak. If no cause is found, then clean and examine the pressure test plug and/or cap. If no cause for the leak is found, re-lubricate the thread and pressure test a second time.

e) If the pressure drops perceptibly during the second test, the length shall receive one of the following dispositions.

   1) If the OCTG body, upset, coupling or box (excluding threads) bursts, leaks, seeps or weeps, the length is unacceptable and shall be rejected.

   2) If the connection between the coupling and the threads at the mating mill end leaks, the length shall be rejected and marked for repair.

   3) If the threaded connections engaged by the pressure test plugs have a large leak (i.e. a pressure drop of more than 10 % of the test pressure in five seconds), the threads shall receive additional inspection to determine their acceptability.

   4) If the OCTG holds pressure and the plugs seal or leak only slightly, the length is acceptable.

f) If a large leak is discovered in two successive lengths of OCTG on the same end, remove the pressure test plug on the leaking end of the lengths. Clean and dry the plug threads, and carefully examine them for possible mechanical damage. If thread damage is found, replace the plug or repair it.

g) After pressure testing each acceptable length of OCTG, release the hydrostatic pressure and remove the water from the length. Remove the test plugs from the OCTG. Examine product threads for damage such as cuts and galls. Clean and inspect the connections on at least each tenth length.

h) Apply thread compound and protectors in accordance with Clause 9.

i) Mark all tested OCTG in accordance with Clause 21.

21 Marking

21.1 General

This clause sets forth the recommended practice for the uniform inspection marking of OCTG.

21.2 Authority

The classification of each inspected length shall be performed only by a qualified inspector. However, any crew-member may be directed to paint the length with the appropriate descriptions and paint bands.

21.3 Guidelines

21.3.1 Legibility

No inspection markings shall be placed over the mill markings (except the paint stripe identifying the location of the buttress thread triangle) that reduce the legibility of the manufacturer's markings, unless an imperfection exists under such marking.

21.3.2 Paint bands

All paint bands or stripes shall be approximately 25 mm (1 in) wide and applied neatly on the OCTG. They shall be placed as close as possible to the coupling, box or identified end of the OCTG (but not on threads).

Inspection markings on rejected OCTG should be kept to a minimum to facilitate salvage.

21.3.3 Exploratory areas

All exploratory marks and grinds except those on rejected lengths shall be coated with a rust inhibitor.

21.3.4 Sequence number

Each length of inspected OCTG shall have a unique number printed in white paint in accordance with ISO 11960.

21.3.5 Marking

For Label 1: 2-3/8 and larger OCTG, white paint markings shall be placed adjacent to the inspection paint band or stripe, or following the mill markings. These markings shall identify the agency, work order number, type of inspection and date (month and year) of the inspection. On each rejected length, the type and depth (if applicable) of defect shall be printed in white paint, and the word "REJECT" shall be printed after the type of inspection in white paint. The format illustrated in Figure B.7 is presented as an example only. On small diameter OCTG, it might be necessary to place the markings in a single line along the longitudinal axis. On couplings, connectors and OCTG smaller than size Label 1: below 2-3/8, an alternative marking method may be used by agreement between the owner and the agency. Inspection techniques shall be indicated using either descriptive wording or the following abbreviations (by agreement between the owner and the agency, a trade name may be substituted for a specific inspection).

a) FLEMI: full-length EMI;

b) SEA: end area inspection;

c) FLVI: full-length visual inspection;

d) FLD: full-length drifting;

e) VTI: clean and visual thread inspection;

f) FLMPI: full-length magnetic particle inspection;

g) HRC or HRB: Rockwell hardness (C-scale or B-scale) test;

h) TESTED: hydrostatically tested xxx MPa (psi);

i) UTFL: ultrasonic full-length inspection;

j) UTW: ultrasonic weld inspection only;

k) ALTFLD: alternative full-length drifting;

l) API TG: API thread gauging (thread element measuring).

21.3.6 Drill pipe without tool-joints

All inspection paint bands and stencils normally placed on the identified end shall be placed at least 1 m (3 ft) from this end.

21.4 Marking of prime OCTG

21.4.1 Requirements

Each length of OCTG that meets the requirements of the applicable specification for the specific inspections being performed is classified as prime.

Each coupling shall carry its own classification. If the length has integral connections, the length and the connections together shall be given one classification.

21.4.2 Markings

One white paint band or white stripe shall be placed on the OCTG as close as possible to the identified end, and other markings as described in 21.3.5.

21.5 Marking of no-drift OCTG

21.5.1 Requirements

Each length of OCTG that will not pass the specified drift mandrel will be classified as no-drift.

21.5.2 Markings

All of the following are required:

a) one red paint band around the OCTG as close as possible to the coupling, box or identified end;

b) one red paint band around the OCTG on each side of the location where the drift will not pass;

c) “no drift to xx.xxx” printed in white paint over the location where the drift mandrel will not pass;

d) markings as described in 21.3.5.

21.6 Marking of conditioned OCTG

21.6.1 Requirements

Each length of OCTG that had a defect according to ISO 11960, or ISO 11961 or API Spec 5D, that was subsequently properly conditioned, shall be classified as prime.

21.6.2 Markings

The same as for prime pipe, see 21.3.5.

21.7 Marking of conditionable OCTG (still to be conditioned)

21.7.1 Requirements

Each length of OCTG that has a defect according to ISO 11960, or ISO 11961 or API Spec 5D, and has not yet been conditioned, shall be classified as a conditionable length.

If a length of OCTG has integral connections, the length and the connections together shall be given one classification.

21.7.2 Markings

All of the following are required:

a) one yellow paint band around the OCTG as close as possible to the identified end;

b) yellow paint outlining the total length and width of the defect on the outside surface;

c) type and depth of the defect printed in white paint adjacent to the defect;

d) other markings as described in 21.3.5.

21.8 Marking of non-conditionable OCTG (rejects)

21.8.1 Requirements

Each length of non-conditionable OCTG containing a defect, as defined in ISO 11960 and API Spec 5B, or ISO 11961 or API Spec 5D, shall be classified as a reject. If an OCTG has a defective pin connection or integral box connection, the entire length shall be rejected.

21.8.2 Markings

All of the following are required:

a) one red paint band around the OCTG as close as possible to the coupling, box or identified end;

b) red paint outlining the total length and width of the defect on the outside surface;

c) one red paint band around the OCTG at each end of the defect. In the case of a defective pin connection, the red paint band shall be placed adjacent to the last scratch of the threads (but not on the threads);

d) type and depth of the defect printed in white paint adjacent to the defect;

e) markings as described in 21.3.5.

If more than one defect is present in a length then, by agreement between the owner and the agency, all of the defects should be outlined in red paint, but only the deepest defect need be measured and recorded.

21.9 Marking of OCTG not meeting ISO/API standards for hardness

21.9.1 Requirements

Each length of OCTG that does not meet ISO/API standards for hardness shall be identified with red paint.

21.9.2 Markings

All of the following are required:

a) one red paint band as close as possible to the coupling, box or identified end;

b) one red paint circle around the test area and one red paint band around the OCTG at the test area, the ends of which connect with the paint circle;

c) the hardness value printed in white paint on the OCTG adjacent to the test area;

d) markings as described in 21.3.5.

21.10 Marking of prime couplings and connectors

21.10.1 Requirements

Couplings and connectors that are found to have no defects are classified as prime.

21.10.2 Markings

If the coupling is installed on OCTG, no identifying colour band is required.

For couplings not installed on OCTG and connectors, one white paint band is placed around the coupling or connector at one end and the name of the agency is printed in white paint in full (if space permits) or else in abbreviated form.

21.11 Marking of conditioned couplings and connectors

All couplings and connectors that contain imperfections that have been conditioned and meet the requirements for couplings and connectors in ISO 11960 are considered prime and shall be identified as described in 21.9.2.

21.12 Marking of conditionable couplings and connectors (still to be conditioned)

21.12.1 Requirements

If a length of OCTG has a removable coupling with imperfections that require conditioning by grinding, the coupling shall carry its own identification, independent of the pipe.

21.12.2 Markings

All of the following are required:

a) one yellow paint band around the coupling or connector;

b) yellow paint outlining the defect on the outside surface of the coupling or connector;

c) white paint on an attached coupling that indicates the OCTG sequence number with a “C” after it and the type and depth of the defect;

d) white paint on a connector or unattached coupling that indicates a reject number and the type and depth of the defect.

21.13 Marking of non-conditionable couplings and connectors (rejects)

21.13.1 Requirements

If a length of OCTG has a coupling with defects, the coupling shall carry its own identification, independent of the pipe.

21.13.2 Markings

All of the following are required:

a) one red paint band around the coupling or connector;

b) red paint outlining the defect on the outside surface of the coupling or connector;

c) white paint on an installed coupling that indicates the OCTG sequence number with a “C” after it and the type and depth of the defect;

d) white paint on a connector or unattached coupling that indicates a reject number and the type and depth of the defect.

Annex A
(normative)

Tables in SI units

Table A.1 — Field inspections available

Inspection [a]	**Product type** [b]			
	SMLS	EW	DP	CPLG
	Applicability [c]			
FLEMI [d]	EQ	EQ	EQ	N.A.
FLMPI	All	All	All	N.A.
FLVI	All	All	All	All
UTFL	EQ	EQ	EQ	N.A.
UTW	N.A.	All	N.A.	N.A.
SEA	All	All	All	N.A.
UCMPI	N.A.	N.A.	N.A.	All
TESTED	All	All	N	N.A.
FLD	All	All	N.A.	N.A.
ALTFLD	All	All	N	N.A.
HRC or HRB	All	All	All	All
VTI	All	All	N.A.	All
API TG [e]	All	All	N.A.	All

[a] **Key to inspection abbreviations**:

FLEMI	Full-length EMI
FLMPI	Full-length magnetic particle inspection (wet or dry MPI)
FLVI	Full-length visual inspection
UTFL	Full-length ultrasonic inspection
UTW	Ultrasonic inspection, weld line
SEA	End area inspection (wet or dry MPI)
UCMPI	Magnetic particle inspection of unattached couplings
TESTED	Hydrostatically pressure tested
FLD	Full-length drifted
ALTFLD	Full-length alternative drifted
HRC or HRB	Hardness tested, Rockwell C or B
VTI	Visual thread inspection
API TG	API thread gauging

[b] **Key to product type:**

SMLS	Seamless casing or tubing (including attached couplings)
EW	Electric welded casing or tubing (including attached couplings)
DP	Plain-end drill pipe
CPLG	Unattached couplings

[c] **Key to inspection applicability:**

All	Inspection method can be applied throughout the diameter range.
EQ	Inspection method can be applied throughout the diameter range, subject to equipment limitations.
N	Inspection method not usually applicable for this product.
N.A.	Not applicable.

[d] For field inspections, typically includes wall thickness inspection and grade comparison.

[e] Procedures for API/ISO thread gauging are provided in API RP 5B1 and not in this International Standard.

Table A.2 — Minimum lamp power for borescope

Pipe inside diameter mm	Minimum lamp power W
< 25,4	10
⩽ 25,4 to 76,2	30
> 76,2 to 127	100
> 127	250

Table A.3 — Drift mandrel dimensions

Dimensions in millimetres

Label 1 product	Minimum length	Drift cylindrical portion minimum diameter [a]
Casing and liners:		
< 9-5/8	152	d – 3,18
9-5/8 to 13-3/8, inclusive	305	d – 3,97
> 13-3/8	305	d – 4,76
Tubing:		
= 2-7/8	1 067	d – 2,38
> 2-7/8	1 067	d – 3,18
Casing used in tubing service:		
= 8-5/8	1 067	d – 3,18
> 8-5/8	1 067	d – 3,97
Drill pipe:		
Group 1, all sizes of external upset, except size Label 1: 3-1/2 Label 2: 13.30	102	d – 4,76

[a] Minimum diameter does not apply to extreme-line casing or pin upset of integral-joint tubing. "d" is the tabulated inside diameter for the specified size and mass-per-metre. For casing, liners, tubing and plain-end drill pipe, "d" is equivalent to the outside diameter minus two times the specified wall thickness.

Table A.4 — Drift information for casing

Dimensions in millimetres

Label		Outside diameter	Wall thickness	Inside diameter	Plain-end and T & C	Extreme-line		Alternative drift[a]
						Finished bored members	Full-length drifting	
1	2	*D*	*t*	*d*				
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
4-1/2	9.50	114,30	5,21	103,88	100,71	—	—	—
4-1/2	10.50	114,30	5,69	102,92	99,75	—	—	—
4-1/2	11.60	114,30	6,35	101,60	98,43	—	—	—
4-1/2	13.50	114,30	7,37	99,56	96,39	—	—	—
4-1/2	15.10	114,30	8,56	97,18	94,01	—	—	95,25
5	11.50	127,00	5,59	115,82	112,65	—	—	—
5	13.00	127,00	6,43	114,14	110,97	—	—	—
5	15.00	127,00	7,52	111,96	108,79	106,25	105,44	—
5	18.00	127,00	9,19	108,62	105,45	106,25	105,44	—
5	21.40	127,00	11,10	104,80	101,63	—	—	—
5	23.20	127,00	12,14	102,72	99,55	—	—	—
5	24.10	127,00	12,70	101,60	98,43	—	—	—
5-1/2	14.00	139,70	6,20	127,3	124,13	—	—	—
5-1/2	15.50	139,70	6,99	125,72	122,55	119,91	118,19	—
5-1/2	17.00	139,70	7,72	124,26	121,09	119,02	118,19	—
5-1/2	20.00	139,70	9,17	121,36	118,19	119,02	118,19	—
5-1/2	23.00	139,70	10,54	118,62	115,45	116,71	115,44	—
5-1/2	26.80	139,70	12,70	114,3	111,13	—	—	—
5-1/2	29.70	139,70	14,27	111,16	107,99	—	—	—
5-1/2	32.60	139,70	15,88	107,94	104,77	—	—	—
5-1/2	35.30	139,70	17,45	104,80	101,63	—	—	—
5-1/2	38.00	139,70	19,05	101,60	98,43	—	—	—
5-1/2	40.50	139,70	20,62	98,46	95,29	—	—	—
5-1/2	43.10	139,70	22,23	95,24	92,07	—	—	—
6-5/8	20.00	168,28	7,32	153,64	150,47	—	—	—
6-5/8	24.00	168,28	8,94	150,40	147,23	146,46	145,54	—
6-5/8	28.00	168,28	10,59	147,10	143,93	145,19	143,92	—
6-5/8	32.00	168,28	12,07	144,14	140,97	142,24	140,97	—
7	17.00	177,80	5,87	166,06	162,89	—	—	—
7	20.00	177,80	6,91	163,98	160,81	—	—	—
7	23.00	177,80	8,05	161,70	158,53	156,36	156,24	—
7	23.00	177,80	8,05	161,70	158,75 [b]	—	—	—
7	26.00	177,80	9,19	159,42	156,25	156,36	156,24	—
7	29.00	177,80	10,36	157,08	153,91	155,14	153,90	—
7	32.00	177,80	11,51	154,78	151,61	152,83	151,61	—

Table A.4 — Drift information for casing *(continued)*

Dimensions in millimetres

Label		Outside diameter	Wall thickness	Inside diameter	Plain-end and T & C	Extreme-line		Alternative drift[a]
						Finished bored members	Full-length drifting	
1	2	*D*	*t*	*d*				
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
7	32.00	177,80	11,51	154,78	152,40 [b]	—	—	—
7	35.00	177,80	12,65	152,50	149,33	150,50	149,33	—
7	38.00	177,80	13,72	150,36	147,19	148,46	147,19	—
7	42.70	177,80	15,88	146,04	142,87	—	—	—
7	46.40	177,80	17,46	142,88	139,71	—	—	—
7	50.10	177,80	19,05	139,70	136,53	—	—	—
7	53.60	177,80	20,62	136,56	133,39	—	—	—
7	57.10	177,80	22,23	133,34	130,17	—	—	—
7-5/8	24.00	193,68	7,62	178,44	175,27	—	—	—
7-5/8	26.40	193,68	8,33	177,02	173,85	171,58	171,45	—
7-5/8	29.70	193,68	9,53	174,62	171,45	171,58	171,45	—
7-5/8	33.70	193,68	10,92	171,84	168,67	169,93	168,66	—
7-5/8	39.00	193,68	12,70	168,28	165,11	166,37	165,10	—
7-5/8	42.80	193,68	14,27	165,14	161,97	—	—	—
7-5/8	45.30	193,68	15,11	163,46	160,29	—	—	—
7-5/8	47.10	193,68	15,88	161,92	158,75	—	—	—
7-5/8	51.20	193,68	17,45	158,78	155,61	—	—	—
7-5/8	53.30	193,68	19,05	155,58	152,41	—	—	—
7-3/4	46.10	196,85	15,11	166,63	165,10 [b]	—	—	—
7-3/4	46.10	196,85	15,11	166,63	163,46	—	—	—
8-5/8	24.00	219,08	6,71	205,66	202,49	—	—	—
8-5/8	28.00	219,08	7,72	203,64	200,47	—	—	—
8-5/8	32.00	219,08	8,94	201,20	200,03 [b]	—	—	—
8-5/8	32.00	219,08	8,94	201,20	198,03	195,83	195,58	—
8-5/8	36.00	219,08	10,16	198,76	195,59	195,83	195,58	—
8-5/8	40.00	219,08	11,43	196,22	193,68 [b]	—	—	—
8-5/8	40.00	219,08	11,43	196,22	193,05	194,26	193,04	—
8-5/8	44.00	219,08	12,70	193,68	190,51	191,77	190,50	—
8-5/8	49.00	219,08	14,15	190,78	187,61	188,87	187,60	—
9-5/8	32.30	244,48	7,92	228,64	224,67	—	—	—
9-5/8	36.00	244,48	8,94	226,60	222,63	—	—	—
9-5/8	40.00	244,48	10,03	224,42	220,45	219,71	218,41	—
9-5/8	40.00	244,48	10,03	224,42	222,25 [b]	—	—	—

Table A.4 — Drift information for casing *(continued)*

Dimensions in millimetres

Label		Outside diameter	Wall thickness	Inside diameter	Plain-end and T & C	Extreme-line		Alternative drift[a]
						Finished bored members	Full-length drifting	
1	2	*D*	*t*	*d*				
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
9-5/8	43.50	244,48	11,05	222,38	218,41	219,71	218,41	219,08
9-5/8	47.00	244,48	11,99	220,50	216,53	218,59	216,54	219,08
9-5/8	53.50	244,48	13,84	216,80	215,90 [b]	—	—	—
9-5/8	53.50	244,48	13,84	216,80	212,83	214,88	212,83	—
9-5/8	58.40	244,48	15,11	214,26	212,73 [b]	—	—	—
9-5/8	58.40	244,48	15,11	214,26	210,29	—	—	—
9-5/8	59.40	244,48	15,47	213,54	209,57	—	—	—
9-5/8	64.90	244,48	17,07	210,34	206,37	—	—	—
9-5/8	70.30	244,48	18,64	207,20	203,23	—	—	—
9-5/8	75.60	244,48	20,24	204.00	200,03	—	—	—
10-3/4	32.75	273,05	7,09	258,87	254,90	—	—	—
10-3/4	40.50	273,05	8,89	255,27	251,30	—	—	—
10-3/4	45.50	273,05	10,16	252,73	250,83 [b]	—	—	—
10-3/4	45.50	273,05	10,16	252,73	248,77 [b]	249,02	248,77	—
10-3/4	51.00	273,05	11,43	250,19	246,22	246,48	246,23	—
10-3/4	55.50	273,05	12,57	247,91	243,94	244,20	243,94	—
10-3/4	55.50	273,05	12,57	247,91	244,48 [b]	—	—	—
10-3/4	60.70	273,05	13,84	245,37	241,40	241,66	241,40	—
10-3/4	65.70	273,05	15,11	242,83	238,86	—	—	241,30
10-3/4	73.20	273,05	17,07	238,91	234,94	—	—	—
10-3/4	79.20	273,05	18,64	235,77	231,80	—	—	—
10-3/4	85.30	273,05	20,24	232,57	228,60	—	—	—
11-3/4	42.00	298,45	8,46	281,53	279,40 [b]	—	—	—
11-3/4	42.00	298,45	8,46	281,53	277,56	—	—	—
11-3/4	47.00	298,45	9,53	279,39	275,42	—	—	—
11-3/4	54.00	298,45	11,05	276,35	272,38	—	—	—
11-3/4	60.00	298,45	12,42	273,61	269,64	—	—	—
11-3/4	60.00	298,45	12,42	273,61	269,88 [b]	—	—	—
11-3/4	65.00	298,45	13,56	271,33	269,88 [b]	—	—	—
11-3/4	65.00	298,45	13,56	271,33	267,36	—	—	—
11-3/4	71.00	298,45	14,78	268,89	264,92	—	—	—
13-3/8	48.00	339,73	8,38	322,97	319,00	—	—	—
13-3/8	54.50	339,73	9,65	320,43	316,46	—	—	—

Table A.4 — Drift information for casing *(continued)*

Dimensions in millimetres

Label		Outside diameter	Wall thickness	Inside diameter	Plain-end and T & C	Extreme-line		Alternative drift[a]
						Finished bored members	Full-length drifting	
1	2	D	t	d				
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
13-3/8	61.00	339,73	10,92	317,89	313,92	—	—	—
13-3/8	68.00	339,73	12,19	315,35	311,38	—	—	—
13-3/8	72.00	339,73	13,06	313,61	311,15[b]	—	—	—
13-3/8	72.00	339,73	13,06	313,61	309,64	—	—	—
16	65.00	406,40	9,53	387,34	382,58	—	—	—
16	75.00	406,40	11,13	384,14	379,38	—	—	—
16	84.00	406,40	12,57	381,26	376,50	—	—	—
16	109.00	406,40	16,66	373,08	368,32	—	—	—
18-5/8	87.50	473,08	11,05	450,98	446,22	—	—	—
20	94.00	508,00	11,13	485,74	480,98	—	—	—
20	106.50	508,00	12,70	482,60	477,84	—	—	—
20	133.00	508,00	16,13	475,74	470,98	—	—	—

[a] The alternative drift is not a requirement of the ISO/API product specifications.

[b] Drift diameter for most common bit size. Drift diameter shall be marked on the pipe.

Table A.5 — Drift information for tubing

Dimensions in millimetres

Label				Outside diameter	Wall thickness	Inside diameter	Drift diameter		
1	2						T & C	IJ	
	NU T&C	EU T&C	IJ	*D*	*t*	*d*		Drifting before upsetting	Drifting after upsetting
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1.05	1.14	1.20	—	26,67	2,87	20,93	18,55	—	—
	1.48	1.54	—	26,67	3,91	18,85	16,47	—	—
1.315	1.70	1.80	1.72	33,40	3,38	26,64	24,26	24.26	24.26
	2.19	2.24	—	33,40	4,55	24,30	21,92	—	—
1.660	—	—	2.10	42,16	3,18	35,80	33,42	33.43	32.66
	2.30	2.40	2.33	42,16	3,56	35,04	32,66	32.66	32.66
	3.03	3.07	—	42,16	4,85	32,46	30,08	—	—
1.900	—	—	2.40	48,26	3,18	41,90	39,52	39.52	38.51
	2.75	2.90	2.76	48,26	3,68	40,90	38,52	38.51	38.51
	3.65	3.73	—	48,26	5,08	38,10	35,72	—	—
	4.42	—	—	48,26	6,35	35,56	33,18	—	—
	5.15	—	—	48,26	7,62	33,02	30,64	—	—
2-1/16	—	—	3.25	52,40	3,96	44,48	42,10	42.09	42.09
	4.50	—	—	52,40	5,72	40,96	38,58	—	—
2-3/8	4.00	—	—	60,33	4,24	51,85	49,47	—	—
	4.60	4.70	—	60,33	4,83	50,67	48,29	—	—
	5.80	5.95	—	60,33	6,45	47,43	45,05	—	—
	6.60	—	—	60,33	7,49	45,35	42,97	—	—
	7.35	7.45	—	60,33	8,53	43,27	40,89	—	—
2-7/8	6.40	6.50	—	73,03	5,51	62,01	59,63	—	—
	7.80	7.90	—	73,03	7,01	59,01	56,63	—	—
	8.60	8.70	—	73,03	7,82	57,39	55,01	—	—
	9.35	9.45	—	73,03	8,64	55,75	53,37	—	—
	10.50	—	—	73,03	9,96	53,11	50,73	—	—
	11.50	—	—	73,03	11,18	50,67	48,29	—	—
3-1/2	7.70	—	—	88,90	5,49	77,92	74,75	—	—
	9.20	9.30	—	88,90	6,45	76,00	72,83	—	—
	10.20	—	—	88,90	7,34	74,22	71,05	—	—
	12.70	12.95	—	88,90	9,53	69,84	66,67	—	—
	14.30	—	—	88,90	10,92	67,06	63,89	—	—
	15.50	—	—	88,90	12,09	64,72	61,55	—	—
	17.00	—	—	88,90	13,46	61,98	58,81	—	—

Table A.5 — Drift information for tubing *(continued)*

Dimensions in millimetres

Label				Outside diameter	Wall thickness	Inside diameter	Drift diameter		
1	2						T & C	IJ	
	NU T&C	EU T&C	IJ	*D*	*t*	*d*		Drifting before upsetting	Drifting after upsetting
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
4	9.50	—	—	101,60	5,74	90,12	86,95	—	—
	—	11.00	—	101,60	6,65	88,30	85,13	—	—
	13.20	—	—	101,60	8,38	84,84	81,67	—	—
	16.10	—	—	101,60	10,54	80,52	77,35	—	—
	18.90	—	—	101,60	12,70	76,20	73,03	—	—
	22.20	—	—	101,60	15,49	70,62	67,45	—	—
4-1/2	12.60	12.75	—	114,30	6,88	100,54	97,37	—	—
	15.20	—	—	114,30	8,56	97,18	94,01	—	—
	17.00	—	—	114,30	9,65	95,00	91,83	—	—
	18.90	—	—	114,30	10,92	92,46	89,29	—	—
	21.50	—	—	114,30	12,70	88,90	85,73	—	—
	23.70	—	—	114,30	14,22	85,86	82,69	—	—
	26.10	—	—	114,30	16,00	82,30	79,13	—	—

Table A.6 — Drift sizes for bare and coated tubing

Dimensions in millimetres

Label		Inside diameter	API drift (bare pipe)		Plastic drift for coated pipe	
			Outside diameter	Length	Thin film drift size	Thick film drift size [a]
1	2	*d*	*D*			
1	*2*	*3*	*4*	*5*	*6*	*7*
1.315	1.70	26,64	24,26	1 066,80	23,75	23,37
1.315	1.72	—	—	—	—	—
1.315	1.80	—	—	—	—	—
1.660	2.10	35,81	32,67	1 066,80	32,16	31,78
1.660	2.30	35,05	32,67	1 066,80	32,16	31,78
1.660	2.33	—	—	—	—	—
1.660	2.40	—	—	—	—	—
1.900	2.40	41,91	38,51	1 066,80	38,00	37,62
1.900	2.75	40,89	38,51	1 066,80	38,00	37,62
1.900	2.76	—	—	—	—	—
1.900	2.90	—	—	—	—	—
2-1/16	3.25	44,46	42,08	1 066,80	41,58	41,2
2-3/8	4.00	51,84	49,46	1 066,80	48,95	48,56
2-3/8	4.60	50,67	48,29	1 066,80	47,78	47,40
2-3/8	4.70	—	—	—	—	—
2-3/8	5.80	47,42	45,04	1 066,80	44,53	44,15
2-3/8	5.95	—	—	—	—	—
2-7/8	6.40	62,00	59,62	1 066,80	59,11	58,72
2-7/8	6.50	—	—	—	—	—
2-7/8	8.60	57,38	55,00	1 066,80	54,48	54,10
2-7/8	8.70	—	—	—	—	—
3-1/2	7.70	77,93	74,76	1 066,80	74,24	73,86
3-1/2	9.20	76,00	72,83	1 066,80	72,31	71,93
3-1/2	9.30	—	—	—	—	—
3-1/2	10.20	74,22	71,05	1 066,80	70,54	70,15
3-1/2	12.70	69,85	66,68	1 066,80	66,17	65,79
3-1/2	12.95	—	—	—	—	—
4	9.50	90,12	86,95	1 066,80	86,44	86,06
4	11.00	88,29	85,12	1 066,80	84,61	84,23
4-1/2	12.60	100,53	97,36	1 066,80	71,45	96,47
4-1/2	12.75	—	—	—	—	—

[a] Tolerance for plastic drifts shall be $^{0}_{-0,25}$ mm.

Table A.7 — Drift sizes for bare and coated casing

Dimensions in millimetres

Label		Inside diameter	API drift (bare pipe)		Plastic drift for coated pipe	
			Outside diameter	Length	Thin film drift [a]	Thick film drift [b]
1	2	*d*	*D*			
1	*2*	*3*	*4*	*5*	*6*	*7*
4-1/2	9.50	103,89	100,72	152,40	100,20	99,82
4-1/2	10.50	102,92	99,75	152,40	99,24	98,86
4-1/2	11.60	101,60	98,43	152,40	97,92	97,54
4-1/2	13.50	99,57	96,40	152,40	95,89	95,50
4-1/2	15.10	97,18	94,01	152,40	93,50	93,12
5	11.50	115,82	112,65	152,40	112,14	111,76
5	13.00	114,15	110,98	152,40	110,46	110,08
5	15.00	111,96	108,79	152,40	108,28	107,90
5	18.00	108,61	105,44	152,40	104,93	104,55
5	21.40	104,80	101,63	152,40	101,12	100,74
5	24.10	101,60	98,43	152,40	97,92	97,54
5-1/2	14.00	127,30	124,13	152,40	123,62	123,24
5-1/2	15.50	125,73	122,56	152,40	122,05	121,67
5-1/2	17.00	124,26	121,09	152,40	120,57	120,19
5-1/2	20.00	121,36	118,19	152,40	117,68	117,30
5-1/2	23.00	118,62	115,45	152,40	114,94	114,55

[a] From API Bulletin 5C2.

[b] Tolerance for plastic drifts shall be $^{0}_{-0,25}$ mm.

Table A.8 — Drift information for Group 1 external upset drill pipe

Dimensions in millimetres

Label		Outside diameter	Inside diameter	Drift diameter
1	2	D	d	
1	*2*	*3*	*4*	*5*
2-3/8	6.65	60,33	46,10	41,34
2-7/8	10.40	73,03	54,64	49,88
3-1/2	9.50	88,90	76,00	71,24
3-1/2	15.50	88,90	66,09	61,33
4	11.85	101,60	88,29	83,53
4	14.00	101,60	84,84	80,08
4-1/2	13.75	114,30	100,53	95,77
4-1/2	16.60	114,30	97,18	92,42
4-1/2	20.00	114,30	92,46	87,70

Table A.9 — Tubing pin L_c and box PTL

Dimensions in millimetres

Label 1	NU		EU		IJ	
	Pin L_c	Box PTL	Pin L_c	Box PTL	Pin L_c	Box PTL
1	*3*	*4*	*5*	*6*	*7*	*8*
1.050	7,62	25,25	7,62	26,04	—	—
1.315	7,62	26,04	8,89	29,21	5,72	26,04
1.660	8,89	29,21	12,07	32,39	8,89	29,21
1.900	12,07	32,39	13,67	33,99	12,07	32,39
2-1/16	—	—	—	—	13,67	33,99
2-3/8	18,42	38,74	23,83	46,05	—	—
2-7/8	29,54	49,86	28,58	50,80	—	—
3-1/2	35,89	56,21	34,93	57,15	—	—
4	34,93	57,15	38,10	60,33	—	—
4-1/2	39,70	61,93	41,28	63,50	—	—

Table A.10 — Casing pin L_c and coupling PTL

Dimensions in millimetres

Label		Outside diameter	STC		LC		BC	
			Pin	Box	Pin	Box	Pin	Box
1	2	D	L_c	*PTL*	L_c	PTL	L_c	PTL
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
4-1/2	9.50	114,30	22,23	63,50	—	—	—	—
4-1/2	Others	114,30	38,10	63,50	47,63	73,03	31,84	94,93
5	11.50	127,00	34,93	66,68	—	—	—	—
5	Others	127,00	41,28	66,68	57,15	82,55	35,01	98,09
5-1/2	All	139,70	44,45	69,85	60,33	85,73	36,60	99,70
6-5/8	All	168,28	50,80	76,20	69,85	95,25	41,36	104,46
7	17.00	177,80	31,75	76,20	—	—	—	—
7	Others	177,80	50,80	76,20	73,03	98,43	46,13	109,22
7-5/8	All	193,68	53,98	79,38	76,20	101,6	50,89	113,98
8-5/8	24.00	219,08	47,63	82,55	—	—	—	—
8-5/8	Others	219,08	57,15	82,55	85,73	111,13	54,06	117,16
9-5/8	All	244,48	57,15	82,55	92,08	117,48	54,06	117,16
10-3/4	32.75	273,05	41,28	85,73	—	—	—	—
10-3/4	Others	273,05	60,33	85,73	—	—	54,06	117,16
11-3/4	All	298,45	60,33	85,73	—	—	54,06	117,16
13-3/8	All	339,73	60,33	85,73	—	—	54,06	117,16
16	All	406,40	73,03	98,43	—	—	69,20	117,16
18-5/8	87.50	473,08	73,03	98,43	—	—	69,20	117,16
20	All	508,00	73,03	98,43	104,78	130,18	69,20	117,16

Table A.11 — Recommended capacitor discharge minimum current

Number of pulses	Length of pulse duration ms	
	$\leqslant 40$	> 40
	Current A	
One pulse	240 times specified pipe nominal mass	110 times specified pipe nominal mass
Two pulses	180 times specified pipe nominal mass	not applicable
Three pulses	145 times specified pipe nominal mass	not applicable

Table A.12 — End area inspection (SEA) coverage

Surface	Distance (measured from end of the pipe)
Outside (all sizes)	457 mm
Inside (non-upset products)	2,5 times the outside diameter (OD) or 457 mm, whichever is less
Inside (upset products)	Length of upset including runout interval

Table A.13 — Recommended capacitor discharge minimum current for circular magnetization of unattached couplings (based on the coupling equivalent nominal mass)

Label 1	Size mm	Number of pulses		
		1	2	3
		Current A		
1.050	26,67	784	588	473
1.315	33,40	1 086	814	656
1.660	42,16	1 206	904	728
1.900	48,26	1 447	1 085	874
2-3/8	60,33	2 125	1 593	1 284
2-7/8	73,03	3 037	2 278	1 835
3-1/2	88,90	4 708	3 531	2 845
4	101,6	5 332	3 999	3 221
4-1/2	114,3	6 407	4 805	3 871
5	127,0	5 196	3 897	3 139
5-1/2	139,7	5 644	4 233	3 410
6-5/8	174,6	8 961	6 721	5 414
7	177,8	8 450	6 338	5 105
7-5/8	193,7	11 642	8 732	7 034
8-5/8	219,1	14 889	11 167	8 995
9-5/8	244,5	16 786	12 590	10 142
10-3/4	273,1	17 634	13 225	10 654
11-3/4	298,5	19 218	14 413	11 611
13-3/8	339,7	21 792	16 344	13 166
16	406,4	27 924	20 943	16 871
18-5/8	473,1	41 910	31 433	25 321
20	508,0	35 065	26 299	21 185

Table A.14 — Recommended longitudinal magnetomotive force (ampere-turns) for unattached couplings

Label 1	Coupling outside diameter mm	Coil inside diameter [a] mm					
		152,4	215,9	254	330,2	406,4	609,6
		Magnetomotive force ampere-turns					
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1.050 to 4	All	5 640	7 990	9 400	12 220	15 040	22 560
4-1/2	127,00	6 225	8 819	10 375	13 488	16 600	24 900
5	141,30	6 289	8 909	10 481	13 625	16 770	25 154
5-1/2	153,67		8 967	10 550	13 714	16 879	25 319
6-5/8	187,71		9 116	10 725	13 942	17 159	25 739
7	194,46		9 154	10 769	14 000	17 230	25 845
7-5/8	215,90			10 853	14 109	17 365	26 047
8-5/8	244,48			10 953	14 239	17 525	26 288
9-5/8	269,88				14 367	17 683	26 524
10-3/4	298,45				14 449	17 784	26 676
11-3/4	323,85					17 895	26 842
13-3/8	365,13					18 042	27 064
16	431,80						27 148
18-5/8	508,00						27 396
20	533,40						27 463

[a] If the coil size used is not listed, either use the value for the next bigger coil size or calculate the correct ampere-turn requirement using the equations in 13.11 e).

Table A.15 — Permissible depth of imperfections

Dimensions in millimetres

Label Coupling for pipe sizes 1	Group 1, 2 (L-80 and C-95) and Group 3		Group 2 (C-90 and T-95) and Group 4
	Pits and round-bottom gouges	Grip marks and sharp-bottom gouges	All
1	*2*	*3*	*4*
Tubing:			
Smaller than 3-1/2	0,76	0,64	0,76
3-1/2 and larger	1,14	0,76	0,89
Casing:			
Smaller than 6-5/8	0,89	0,76	0,76
6-5/8 to 7-5/8, incl.	1,14	1,02	0,89
Larger than 7-5/8	1,52	1,02	0,89

Table A.16 — Linear imperfections on the outside surface of couplings (all groups except grades J-55 and K-55 impact tested above 0 °C and H-40)

Dimensions in millimetres

Label [a]	Outside diameter	Permissible depth [b]						
		NU	EU	EU [c]	BC [c]	BC	LC	STC
1	*D*							
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1.050	26,67	0,23	0,28	—	—	—	—	—
1.315	33,40	0,28	0,33	—	—	—	—	—
1.660	42,16	0,30	0,30	—	—	—	—	—
1.900	48,26	0,25	0,33	—	—	—	—	—
2-3/8	60,33	0,38	0,38	0,28	—	—	—	—
2-7/8	73,03	0,48	0,46	0,33	—	—	—	—
3-1/2	88,90	0,58	0,58	0,38	—	—	—	—
4	101,60	0,58	0,58	—	—	—	—	—
4-1/2	114,30	0,56	0,64	—	0,33	0,41	0,43	0,43
5	127,00	—	—	—	0,33	0,46	0,51	0,48
5-1/2	139,70	—	—	—	0,33	0,46	0,51	0,48
6-5/8	168,28	—	—	—	0,36	0,58	0,66	0,61
7	177,80	—	—	—	0,36	0,53	0,58	0,56
7-5/8	193,68	—	—	—	0,43	0,69	0,74	0,69
8-5/8	219,08	—	—	—	0,46	0,76	0,81	0,79
9-5/8	244,48	—	—	—	0,46	0,76	0,84	0,79
10-3/4	273,05	—	—	—	0,46	0,76	—	0,79
11-3/4	298,45	—	—	—	—	0,76	—	0,79
13-3/8	339,73	—	—	—	—	0,76	—	0,79
16	406,40	—	—	—	—	0,84	—	0,81
18-5/8	473,08	—	—	—	—	1,09	—	1,04
20	508,00	—	—	—	—	0,84	0,86	0,81

[a] The size of the coupling is the same as the corresponding pipe size.

[b] 5 % of the critical thickness defined in ISO 11960:2001, Table C.8 or E.8.

[c] Special clearance only.

Table A.17 — Casing coupling outside diameters and tolerances

Dimensions in millimetres

Label [a]	Outside diameter	Round thread			Buttress thread outside diameter					
		Outside diameter, W			Regular, W			Special clearance, W_c		
1	D	Minimum	Specified	Maximum	Minimum[b]	Specified	Maximum	Minimum[b]	Specified	Maximum
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
4-1/2	114,30	125,73	127,00	128,27	125,73	127,00	128,27	123,42	123,83	124,61
5	127,00	139,88	141,30	142,72	139,88	141,30	142,72	136,12	136,53	137,31
5-1/2	139,70	152,12	153,67	155,22	152,12	152,67	155,22	148,82	149,23	150,01
6-5/8	168,28	185,83	187,71	189,59	185,83	187,71	189,59	177,39	177,80	178,59
7	177,80	192,51	194,46	196,42	192,51	194,46	196,42	186,92	187,33	188,11
7-5/8	193,68	213,74	215,90	218,06	213,74	215,90	218,06	205,97	206,38	207,16
8-5/8	219,08	242,04	244,48	246,91	242,04	244,48	246,91	231,37	231,78	232,56
9-5/8	244,48	267,18	269,88	272,57	267,18	269,88	272,57	256,77	257,18	257,96
10-3/4	273,05	295,45	298,45	301,45	295,45	298,45	301,45	285,34	285,75	286,54
11-3/4	298,45	320,68	323,85	327,03	320,68	323,85	327,03	—	—	—
13-3/8	339,73	361,95	365,13	368,30	361,95	365,13	368,30	—	—	—
16	406,40	428,63	431,80	434,98	428,63	431,80	434,98	—	—	—
18-5/8	473,08	504,83	508,00	511,18	504,83	508,00	511,18	—	—	—
20	508,00	530,23	533,40	536,58	530,23	533,40	536,58	—	—	—

NOTE Dimensions taken from ISO 11960:2001, Table C.35 or E.35 and Table C.36 or E.36.

[a] The size of the coupling is the same as the corresponding pipe size.

[b] Does not apply to Q-125 casing sizes 6 and larger. For Q-125 casing sizes 6 and larger, use (W – 1,6) mm for the minimum.

Table A.18 — Tubing coupling outside diameters and tolerances

Dimensions in millimetres

Label [a]	Outside diameter	NU outside diameter			EU outside diameter					
		Regular, W			Regular and special bevel , W			Special clearance, W_c		
1	D	Minimum	Specified	Maximum	Minimum	Specified	Maximum	Minimum	Specified	Maximum
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1.050	26,67	33,02	33,35	33,68	41,73	42,16	42,60	—	—	—
1.315	33,40	41,73	42,16	42,60	47,78	48,26	48,74	—	—	—
1.660	42,16	51,64	52,17	52,71	55,32	55,88	56,44	—	—	—
1.900	48,26	55,32	55,88	56,44	62,87	63,50	64,14	—	—	—
2-3/8	60,33	72,29	73,03	73,76	77,01	77,80	78,59	73,53	73,91	74,30
2-7/8	73,03	88,01	88,90	89,79	92,23	93,17	94,11	87,50	87,88	88,27
3-1/2	88,90	106,86	107,95	109,04	113,16	114,30	115,44	105,79	106,17	106,55
4	101,60	119,43	120,65	121,87	125,73	127,00	128,27	—	—	—
4-1/2	114,30	130,76	132,08	133,40	139,88	141,30	142,72	—	—	—

NOTE Dimensions taken from ISO 11960:2001, Table C.37 or E.37 and Table C.38 or E.38.

[a] The size of the coupling is the same as the corresponding pipe size.

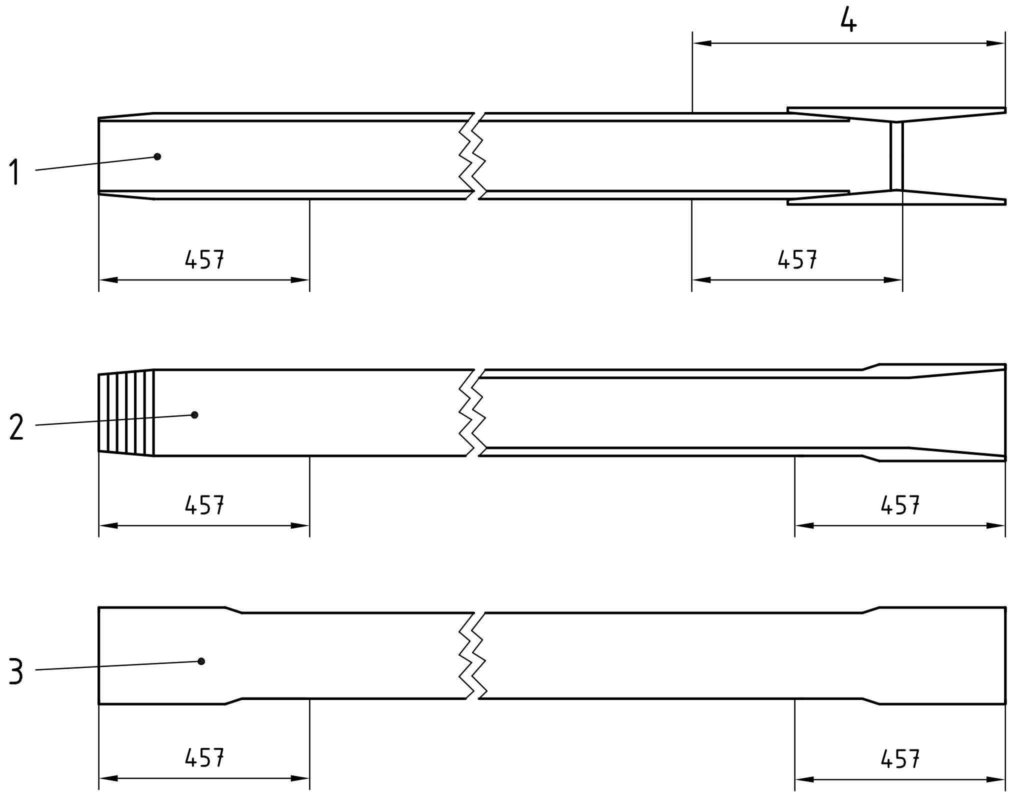
Table A.19 — Inspection identification band colours for new OCTG

Classification	Band colour
Prime OCTG	White
Acceptable conditioned OCTG	White
OCTG requiring conditioning	Yellow
Non-conditionable (reject) OCTG	Red
OCTG failing API/ISO drift tests	Red
OCTG failing API/ISO hardness specifications	Red
Prime connector or unattached coupling	White
Acceptable conditioned connector or unattached coupling	White
Couplings or connectors requiring conditioning	Yellow
Non-conditionable (reject) coupling or connector	Red
OCTG failing special owner-specified tests	Green

Annex B
(normative)

Figures

Dimensions in millimetres

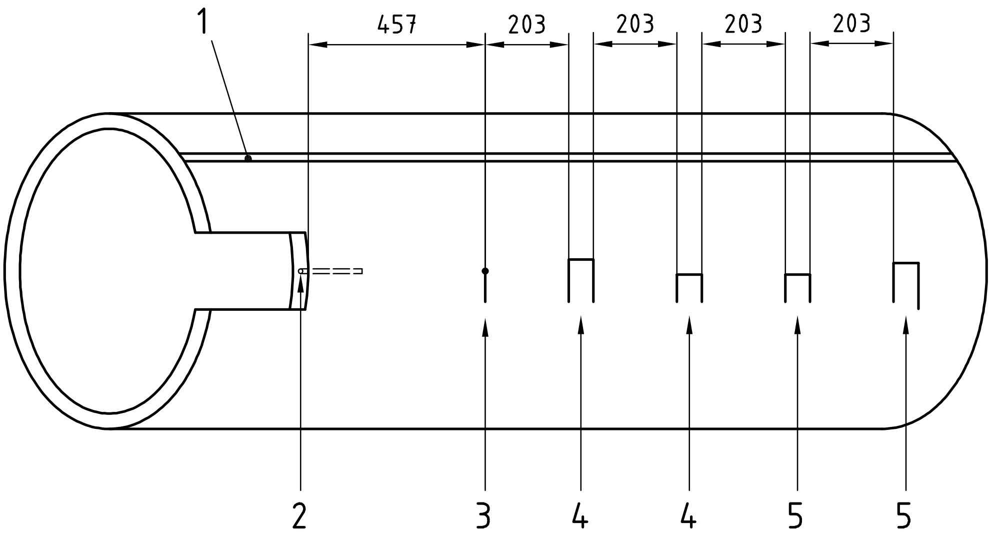


Key

1 tubing or casing with coupling
2 tubing or casing with integral connections
3 plain-end drill pipe
4 inspected area

Figure B.1 — Inspection distances for different types and combinations of tubes and connections

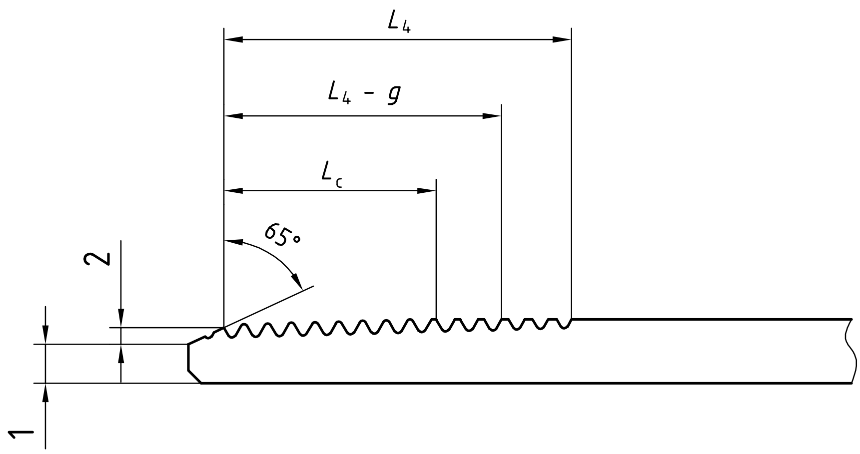
Dimensions in millimetres



Key

1 weld line
2 2,38 mm diameter longitudinal hole
3 2,38 mm diameter through hole
4 outside notch
5 inside notch

Figure B.2 — Ultrasonic reference standard example for Supplementary Practice A

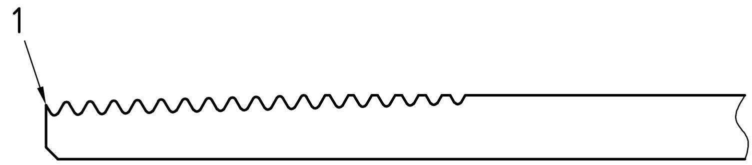


Key

1 pipe face
2 chamfer

NOTE Eccentricity and ovality limitations are not currently specified by the ISO/API product specifications.

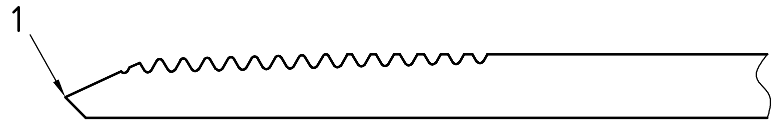
Figure B.3 — External thread inspection parameters



Key

1 feather-edge (no chamfer)

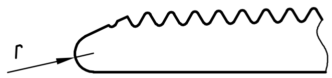
Figure B.4 — Feather-edge (no chamfer)



Key

1 razor-edge (no face)

Figure B.5 — Razor-edge (no face)

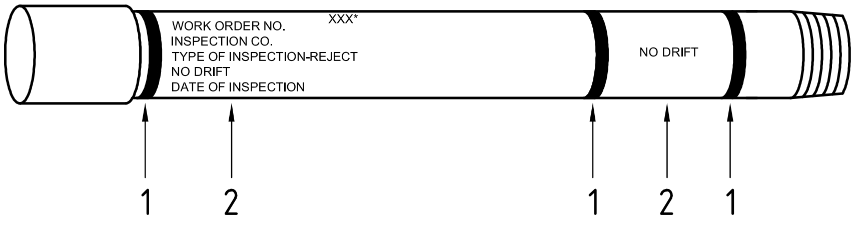


Size	Radius, *r*[a]
2-3/8	2,4 mm (3/32 in)
2-7/8	2,4 mm (3/32 in)
3-1/2	3,2 mm (1/8 in)
4-1/2	3,2 mm (1/8 in)

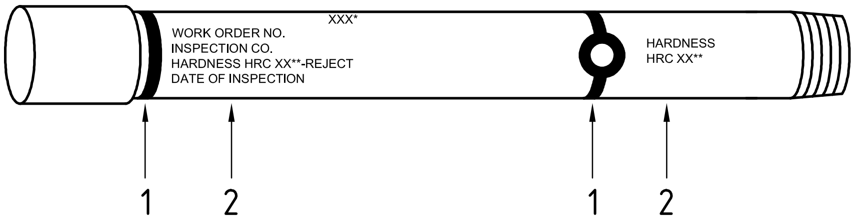
NOTE See API Spec 5B for details.

[a] These dimensions are for reference only and are not subject to measurement for determining product acceptance.

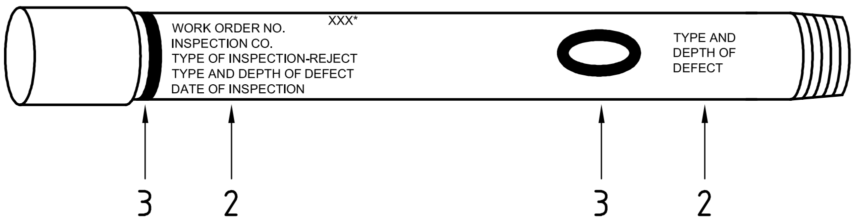
Figure B.6 — Rounded nose for external-upset tubing



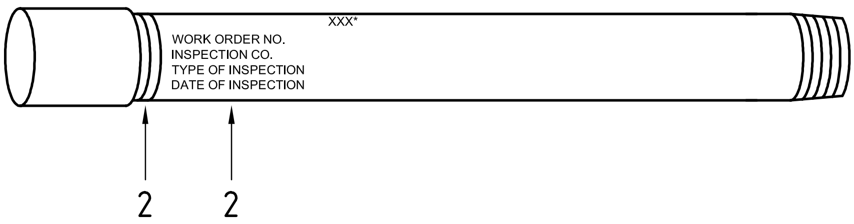
a) No-drift



b) Improper hardness



c) Repairable defect not repaired



d) Prime length

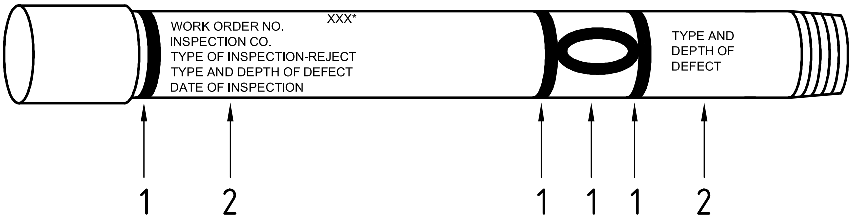
Key

1 red

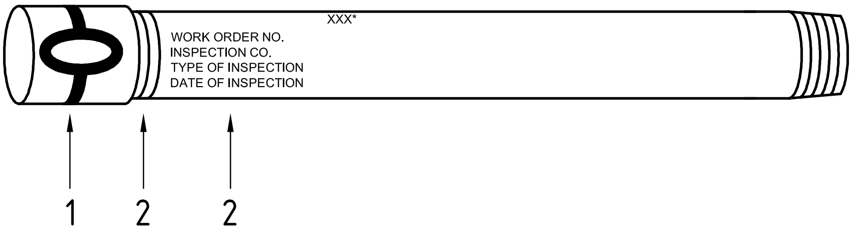
2 white

3 yellow

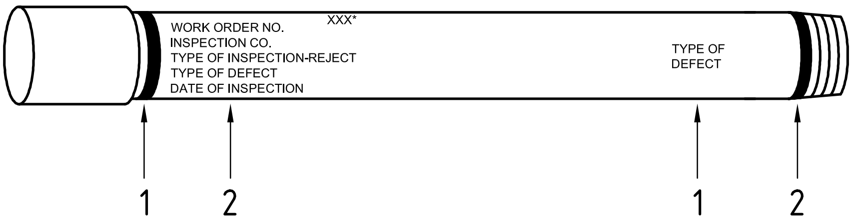
Figure B.7 — Identification of inspected new tubular goods and couplings (*continued*)



e) Defective length



f) Defective coupling



g) Defective pin

Key

1 red

2 white

3 yellow

* XXX = length number.

** HRC XX = hardness number on Rockwell C scale.

Figure B.7 — Identification of inspected new tubular goods and couplings

Annex C
(normative)

Tables in USC units

Table C.1 — Field inspections available

Inspection [a]	**Product type** [b]			
	SMLS	EW	DP	CPLG
	Applicability [c]			
FLEMI [d]	EQ	EQ	EQ	N.A.
FLMPI	All	All	All	N.A.
FLVI	All	All	All	All
UTFL	EQ	EQ	EQ	N.A.
UTW	N.A.	All	N.A.	N.A.
SEA	All	All	All	N.A.
UCMPI	N.A.	N.A.	N.A.	All
TESTED	All	All	N	N.A.
FLD	All	All	N.A.	N.A.
ALTFLD	All	All	N	N.A.
HRC or HRB	All	All	All	All
VTI	All	All	N.A.	All
API TG [e]	All	All	N.A.	All

[a] **Key to inspection abbreviations**:

FLEMI	Full-length EMI
FLMPI	Full-length magnetic particle Inspection (wet or dry MPI)
FLVI	Full-length visual inspection
UTFL	Full-length ultrasonic inspection
UTW	Ultrasonic inspection, weld line
SEA	End area inspection (wet or dry MPI)
UCMPI	Magnetic particle inspection of unattached couplings
TESTED	Hydrostatically pressure tested
FLD	Full-length drifted
ALTFLD	Full-length alternative drifted
HRC or HRB	Hardness tested, Rockwell C or B
VTI	Visual thread inspection
API TG	API thread gauging

[b] **Key to product type:**

SMLS	Seamless casing or tubing (including attached couplings)
EW	Electric welded casing or tubing (including attached couplings)
DP	Plain-end drill pipe
CPLG	Unattached couplings

[c] **Key to inspection applicability:**

All	Inspection method can be applied throughout the diameter range.
EQ	Inspection method can be applied throughout the diameter range, subject to equipment limitations.
N	Inspection method not usually applicable for this product.
N.A.	Not applicable.

[d] For field inspections, typically includes wall thickness inspection and grade comparison.

[e] Procedures for API/ISO thread gauging are provided in API RP 5B1 and not in this International Standard.

Table C.2 — Minimum lamp power for borescope

Pipe inside diameter in	Minimum lamp power W
< 1	10
⩾ 1 to 3	30
> 3 to 5	100
> 5	250

Table C.3 — Drift mandrel dimensions

Dimensions in inches

Label 1 product	Minimum length	Drift cylindrical portion minimum diameter [a]
Casing and liners:		
< 9-5/8	6	d – 1/8
9-5/8 to 13-3/8, inclusive	12	d – 5/32
> 13-3/8	12	d – 3/16
Tubing:		
= 2-7/8	42	d – 3/32
> 2-7/8	42	d – 1/8
Casing used in tubing service:		
= 8-5/8	42	d – 1/8
> 8-5/8	42	d – 5/32
Drill pipe: Group 1, all sizes of external upset, except Label 1: 3-1/2 and Label 2: 13.30	4	d – 3/16

[a] Minimum diameter does not apply to extreme-line casing or pin upset of integral-joint tubing. "d" is the tabulated inside diameter for the specified size and weight-per-foot. For casing, liners, tubing, and plain-end drill pipe, "d" is equivalent to the outside diameter minus two times the specified wall thickness.

Table C.4 — Drift information for casing

Dimensions in inches

Label 1	Label 2	Inside diameter *d*	Plain-end and T & C	Extreme-line: Finished bored members	Extreme-line: Full-length drifting	Alternative drift [a]
1	*2*	*3*	*4*	*5*	*6*	*7*
4-1/2	9.50	4.090	3.965	—	—	—
4-1/2	10.50	4.052	3.927	—	—	—
4-1/2	11.60	4.000	3.875	—	—	—
4-1/2	13.50	3.920	3.795	—	—	—
4-1/2	15.10	3.826	3.701	—	—	3.750
5	11.50	4.560	4.435	—	—	—
5	13.00	4.494	4.369	—	—	—
5	15.00	4.408	4.283	4.183	4.151	—
5	18.00	4.276	4.151	4.183	4.151	—
5	21.40	4.126	4.001	—	—	—
5	23.20	4.044	3.919	—	—	—
5	24.10	4.000	3.875	—	—	—
5-1/2	14.00	5.012	4.887	—	—	—
5-1/2	15.50	4.950	4.825	4.721	4.653	—
5-1/2	17.00	4.892	4.767	4.686	4.653	—
5-1/2	20.00	4.778	4.653	4.686	4.653	—
5-1/2	23.00	4.670	4.545	4.595	4.545	—
5-1/2	26.80	4.500	4.375	—	—	—
5-1/2	29.70	4.376	4.251	—	—	—
5-1/2	32.60	4.250	4.125	—	—	—
5-1/2	35.30	4.126	4.001	—	—	—
5-1/2	38.00	4.000	3.875	—	—	—
5-1/2	40.50	3.876	3.751	—	—	—
5-1/2	43.10	3.750	3.625	—	—	—
6-5/8	20.00	6.049	5.924	—	—	—
6-5/8	24.00	5.921	5.796	5.766	5.730	—
6-5/8	28.00	5.791	5.666	5.716	5.666	—
6-5/8	32.00	5.675	5.550	5.600	5.550	—
7	17.00	6.538	6.413	—	—	—
7	20.00	6.456	6.331	—	—	—
7	23.00	6.366	6.241	6.156	6.151	—
7	23.00	6.366	6.250	—	—	—
7	26.00	6.276	6.151	6.156	6.151	—
7	29.00	6.184	6.059	6.108	6.059	—
7	32.00	6.094	5.969	6.017	5.969	—
7	32.00	6.094	6.000 [b]	—	—	—
7	35.00	6.004	5.879	5.925	5.879	—
7	38.00	5.920	5.795	5.845	5.795	—
7	42.70	5.750	5.625	—	—	—
7	46.40	5.625	5.500	—	—	—

Table C.4 — Drift information for casing *(continued)*

Dimensions in inches

Label		Inside diameter	Plain-end and T & C	Extreme-line		Alternative drift [a]
				Finished bored members	Full-length drifting	
1	2	*d*				
1	*2*	*3*	*4*	*5*	*6*	*7*
7	50.10	5.500	5.375	—	—	—
7	53.60	5.376	5.251	—	—	—
7	57.10	5.250	5.125	—	—	—
7-5/8	24.00	7.025	6.900	—	—	—
7-5/8	26.40	6.969	6.844	6.755	6.750	—
7-5/8	29.70	6.875	6.750	6.755	6.750	—
7-5/8	33.70	6.765	6.640	6.690	6.640	—
7-5/8	39.00	6.625	6.500	6.550	6.500	—
7-5/8	42.80	6.501	6.376	—	—	—
7-5/8	45.30	6.435	6.310	—	—	—
7-5/8	47.10	6.375	6.250	—	—	—
7-5/8	51.20	6.251	6.127	—	—	—
7-5/8	53.30	6.125	6.000	—	—	—
7-3/4	46.10	6.560	6.500 [b]	—	—	—
7-3/4	46.10	6.560	6.435	—	—	—
8-5/8	24.00	8.097	7.972	—	—	—
8-5/8	28.00	8.017	7.892	—	—	—
8-5/8	32.00	7.921	7.875 [b]	—	—	—
8-5/8	32.00	7.921	7.796	7.710	7.700	—
8-5/8	36.00	7.825	7.700	7.710	7.700	—
8-5/8	40.00	7.725	7.625 [b]	—	—	—
8-5/8	40.00	7.725	7.600	7.648	7.600	—
8-5/8	44.00	7.625	7.500	7.550	7.500	—
8-5/8	49.00	7.511	7.386	7.436	7.386	—
9-5/8	32.30	9.001	8.845	—	—	—
9-5/8	36.00	8.921	8.765	—	—	—
9-5/8	40.00	8.835	8.679	8.650	8.599	—
9-5/8	40.00	8.835	8.750 [b]	—	—	—
9-5/8	43.50	8.755	8.599	8.650	8.599	8.625
9-5/8	47.00	8.681	8.525	8.606	8.525	8.625
9-5/8	53.50	8.535	8.500 [b]	—	—	—
9-5/8	53.50	8.535	8.379	8.460	8.379	—
9-5/8	58.40	8.435	8.375 [b]	—	—	—
9-5/8	58.40	8.435	8.279	—	—	—
9-5/8	59.40	8.407	8.251	—	—	—
9-5/8	64.90	8.281	8.125	—	—	—
9-5/8	70.30	8.157	8.001	—	—	—
9-5/8	75.60	8.031	7.875	—	—	—

Table C.4 — Drift information for casing *(continued)*

Dimensions in inches

Label		Inside diameter	Plain-end and T & C	Extreme-line		Alternative drift [a]
				Finished bored members	Full-length drifting	
1	2	*d*				
1	*2*	*3*	*4*	*5*	*6*	*7*
10-3/4	32.75	10.192	10.036	—	—	—
10-3/4	40.50	10.050	9.894	—	—	—
10-3/4	45.50	9.950	9.875 [b]	—	—	—
10-3/4	45.50	9.950	9.794 [b]	9.804	9.794	—
10-3/4	51.00	9.850	9.694	9.704	9.694	—
10-3/4	55.50	9.760	9.604	9.614	9.604	—
10-3/4	55.50	9.760	9.625 [b]	—	—	—
10-3/4	60.70	9.660	9.504	9.514	9.504	—
10-3/4	65.70	9.560	9.404	—	—	9.500
10-3/4	73.20	9.406	9.250	—	—	—
10-3/4	79.20	9.282	9.126	—	—	—
10-3/4	85.30	9.156	9.000	—	—	—
11-3/4	42.00	11.084	11.000 [b]	—	—	—
11-3/4	42.00	11.084	10.928	—	—	—
11-3/4	47.00	11.000	10.844	—	—	—
11-3/4	54.00	10.880	10.724	—	—	—
11-3/4	60.00	10.772	10.616	—	—	—
11-3/4	60.00	10.772	10.625 [b]	—	—	—
11-3/4	65.00	10.682	10.625 [b]	—	—	—
11-3/4	65.00	10.682	10.526	—	—	—
11-3/4	71.00	10.586	10.430	—	—	—
13-3/8	48.00	12.715	12.559	—	—	—
13-3/8	54.50	12.615	12.459	—	—	—
13-3/8	61.00	12.515	12.359	—	—	—
13-3/8	68.00	12.415	12.259	—	—	—
13-3/8	72.00	12.347	12.250 [b]	—	—	—
13-3/8	72.00	12.347	12.191	—	—	—
16	65.00	15.250	15.062	—	—	—
16	75.00	15.124	14.936	—	—	—
16	84.00	15.010	14.822	—	—	—
16	109.00	14.688	14.500	—	—	—
18-5/8	87.50	17.755	17.567	—	—	—
20	94.00	19.124	18.936	—	—	—
20	106.50	19.000	18.812	—	—	—
20	133.00	18.730	18.542	—	—	—

a The alternative drift is not a requirement of the ISO/API product specifications.

b Drift diameter for most common bit size. Drift diameter shall be marked on the pipe.

Table C.5 — Drift information for tubing

Dimensions in inches

Label				Inside diameter	Drift diameter		
	2				T & C	IJ	
	NU	EU	IJ			Drifting before upsetting	Drifting after upsetting
1	T&C	T&C		*d*			
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1.050	1.14	1.20	—	0.824	0.730	—	—
1.050	1.48	1.54	—	0.742	0.648	—	—
1.315	1.70	1.80	1.72	1.049	0.955	0.955	0.955
1.315	2.19	2.24	—	0.957	0.863	—	—
1.660	—	—	2.10	1.410	—	1.316	1.286
1.660	2.30	2.40	2.33	1.380	1.286	1.286	1.286
1.660	3.03	3.07	—	1.278	1.184	—	—
1.900	—	—	2.40	1.650	—	1.556	1.516
1.900	2.75	2.90	2.76	1.610	1.516	1.516	1.516
1.900	3.65	3.73	—	1.500	1.406	—	—
1.900	4.42	—	—	1.400	1.306	—	—
1.900	5.15	—	—	1.300	1.206	—	—
2.063	—	—	3.25	1.751	—	1.657	1.657
2.063	4.50	—	—	1.613	1.519	—	—
2-3/8	4.00	—	—	2.041	1.947	—	—
2-3/8	4.60	4.70	—	1.995	1.901	—	—
2-3/8	5.80	5.95	—	1.867	1.773	—	—
2-3/8	6.60	—	—	1.785	1.691	—	—
2-3/8	7.35	7.45	—	1.703	1.609	—	—
2-7/8	6.40	6.50	—	2.441	2.347	—	—
2-7/8	7.80	7.90	—	2.323	2.229	—	—
2-7/8	8.60	8.70	—	2.259	2.165	—	—
2-7/8	9.35	9.45	—	2.195	2.101	—	—
2-7/8	10.50	—	—	2.091	1.997	—	—
2-7/8	11.50	—	—	1.995	1.901	—	—
3-1/2	7.70	—	—	3.068	2.943	—	—
3-1/2	9.20	9.30	—	2.992	2.867	—	—
3-1/2	10.20	—	—	2.922	2.797	—	—
3-1/2	12.70	12.95	—	2.750	2.625	—	—
3-1/2	14.30	—	—	2.640	2.515	—	—
3-1/2	15.50	—	—	2.548	2.423	—	—
3-1/2	17.00	—	—	2.440	2.315	—	—
4	9.50	—	—	3.548	3.423	—	—
4	—	11.00	—	3.476	3.351	—	—
4	13.20	—	—	3.340	3.215	—	—
4	16.10	—	—	3.170	3.045	—	—
4	18.90	—	—	3.000	2.875	—	—
4	22.20	—	—	2.780	2.655	—	—

Table C.5 — Drift information for tubing *(continued)*

Dimensions in inches

Label				Inside diameter	Drift diameter		
	2				T & C	IJ	
	NU	EU	IJ			Drifting before upsetting	Drifting after upsetting
1	T&C	T&C		*d*			
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
4-1/2	12.60	12.75	—	3.958	3.833	—	—
4-1/2	15.20	—	—	3.826	3.701	—	—
4-1/2	17.00	—	—	3.740	3.615	—	—
4-1/2	18.90	—	—	3.640	3.515	—	—
4-1/2	21.50	—	—	3.500	3.375	—	—
4-1/2	23.70	—	—	3.380	3.255	—	—
4-1/2	26.10	—	—	3.240	3.115	—	—

Table C.6 — Drift sizes for bare and coated tubing

Dimensions in inches

Label		Inside diameter	API drift (bare pipe)		Plastic drift for coated pipe	
			Outside diameter	Length	Thin film drift size	Thick film drift size[a]
1	2	*d*	*D*			
1	*2*	*3*	*4*	*5*	*6*	*7*
1.315	1.70	1.049	0.955	42	0.935	0.920
1.315	1.72	—	—	—	—	—
1.315	1.80	—	—	—	—	—
1.660	2.10	1.410	1.286	42	1.266	1.251
1.660	2.30	1.380	1.286	42	1.266	1.251
1.660	2.33	—	—	—	—	—
1.660	2.40	—	—	—	—	—
1.900	2.40	1.610	1.516	42	1.496	1.481
1.900	2.75	1.610	1.516	42	1.496	1.481
1.900	2.76	—	—	—	—	—
1.900	2.90	—	—	—	—	—
2-1/16	3.25	1.751	1.657	42	1.637	1.622
2-3/8	4.00	2.041	1.947	42	1.927	1.912
2-3/8	4.60	1.995	1.901	42	1.881	1.866
2-3/8	4.70	—	—	—	—	—
2-3/8	5.80	1.867	1.773	42	1.753	1.738
2-3/8	5.95	—	—	—	—	—
2-7/8	6.40	2.441	2.347	42	2.327	2.312
2-7/8	6.50	—	—	—	—	—
2-7/8	8.60	2.259	2.165	42	2.145	2.130
2-7/8	8.70	—	—	—	—	—
3-1/2	7.70	3.068	2.943	42	2.923	2.908
3-1/2	9.20	2.992	2.867	42	2.847	2.832
3-1/2	9.30	—	—	—	—	—
3-1/2	10.20	2.922	2.797	42	2.777	2.762
3-1/2	12.70	2.750	2.625	42	2.605	2.590
3-1/2	12.95	—	—	—	—	—
4	9.50	3.548	3.423	42	3.403	3.388
4	11.00	3.476	3.351	42	3.331	3.316
4-1/2	12.60	3.958	3.833	42	2.813	3.798
4-1/2	12.75	—	—	—	—	—

[a] Tolerance for plastic drifts shall be $^{0}_{-0.010}$ in.

Table C.7 — Drift sizes for bare and coated casing

Dimensions in inches

Label		Inside diameter	API drift (bare pipe)		Plastic drift for coated pipe	
			Outside diameter	Length	Thin film drift [a]	Thick film drift [b] [b]
1	2	*d*	*D*			
1	*2*	*3*	*4*	*5*	*6*	*7*
4-1/2	9.50	4.090	3.965	6	3.945	3.930
4-1/2	10.50	4.052	3.927	6	3.907	3.892
4-1/2	11.60	4.000	3.875	6	3.855	3.840
4-1/2	13.50	3.920	3.795	6	3.775	3.760
4-1/2	15.10	3.826	3.701	6	3.681	3.666
5	11.50	4.560	4.435	6	4.415	4.400
5	13.00	4.494	4.369	6	4.349	4.334
5	15.00	4.408	4.283	6	4.263	4.248
5	18.00	4.276	4.151	6	4.131	4.116
5	21.40	4.126	4.001	6	3.981	3.966
5	24.10	4.000	3.875	6	3.855	3.840
5-1/2	14.00	5.012	4.887	6	4.867	4.852
5-1/2	15.50	4.950	4.825	6	4.805	4.790
5-1/2	17.00	4.892	4.767	6	4.747	4.732
5-1/2	20.00	4.778	4.653	6	4.633	4.618
5-1/2	23.00	4.670	4.545	6	4.525	4.510

[a] From API Bulletin 5C2.

[b] Tolerance for plastic drifts shall be $^{0}_{-0.010}$ in.

Table C.8 — Drift information for Group 1 external upset drill pipe

Dimensions in inches

Label		Inside diameter	Drift diameter
1	2	*d*	
1	*2*	*3*	*4*
2-3/8	6.65	1.815	1.628
2-7/8	10.40	2.151	1.964
3-1/2	9.50	2.992	2.805
3-1/2	15.50	2.602	2.415
4	11.85	3.476	3.289
4	14.00	3.340	3.153
4-1/2	13.75	3.958	3.771
4-1/2	16.60	3.826	3.639
4-1/2	20.00	3.640	3.453

Table C.9 — Tubing pin L_c and box PTL

Dimensions in inches

Label	NU		EU		IJ	
1	Pin L_c	Box PTL	Pin L_c	Box PTL	Pin L_c	Box PTL
1	*2*	*3*	*4*	*5*	*6*	*7*
1.050	0.300	0.994	0.300	1.025	—	—
1.315	0.300	1.025	0.350	1.150	0.225	1.025
1.660	0.350	1.150	0.475	1.275	0.350	1.150
1.900	0.475	1.275	0.538	1.338	0.475	1.275
2-1/16	—	—	—	—	0.538	1.338
2-3/8	0.725	1.525	0.938	1.813	—	—
2-7/8	1.163	1.963	1.125	2.000	—	—
3-1/2	1.413	2.213	1.375	2.250	—	—
4	1.375	2.250	1.500	2.375	—	—
4-1/2	1.563	2.438	1.625	2.500	—	—

Table C.10 — Casing pin L_c and coupling PTL

Dimensions in inches

Label		STC		LC		BC	
		Pin	Box	Pin	Box	Pin	Box
1	2	L_c	PTL	L_c	PTL	L_c	PTL
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
4-1/2	9.50	0.875	2.500	—	—	—	—
4-1/2	Others	1.500	2.500	1.875	2.875	1.254	3.738
5	11.50	1.375	2.625	—	—	—	—
5	Others	1.625	2.625	2.250	3.250	1.379	3.862
5-1/2	All	1.750	2.750	2.375	3.375	1.441	3.925
6-5/8	All	2.000	3.000	2.750	3.750	1.629	4.113
7	17.00	1.250	3.000	—	—	—	—
7	Others	2.000	3.000	2.875	3.875	1.816	4.300
7-5/8	All	2.125	3.125	3.000	4.000	2.004	4.488
8-5/8	24.00	1.875	3.250	—	—	—	—
8-5/8	Others	2.250	3.250	3.375	4.375	2.129	4.613
9-5/8	All	2.250	3.250	3.625	4.625	2.129	4.613
10-3/4	32.75	1.625	3.375	—	—	—	—
10-3/4	Others	2.375	3.375	—	—	2.129	4.613
11-3/4	All	2.375	3.375	—	—	2.129	4.613
13-3/8	All	2.375	3.375	—	—	2.129	4.613
16	All	2.875	3.875	—	—	2.725	4.613
18-5/8	87.50	2.875	3.875	—	—	2.725	4.613
20	All	2.875	3.875	4.125	5.125	2.725	4.613

Table C.11 — Recommended capacitor discharge minimum current

Number of pulses	Length of pulse duration ms	
	$\leqslant 40$	> 40
	Current A	
One pulse	240 times specified pipe nominal mass	110 times specified pipe nominal mass
Two pulses	180 times specified pipe nominal mass	not applicable
Three pulses	145 times specified pipe nominal mass	not applicable

Table C.12 — End area inspection (SEA) coverage

Surface	Distance (measured from end of the pipe)
Outside (all sizes)	11 in
Inside (non-upset products)	2,5 times the outside diameter (OD) or 18 in, whichever is less
Inside (upset products)	Length of upset including runout interval

Table C.13 — Recommended capacitor discharge minimum current for circular magnetization of unattached couplings (based on the coupling equivalent nominal mass)

Label 1	Number of pulses		
	1	2	3
	Current A		
1.050	784	588	473
1.315	1 086	814	656
1.660	1 206	904	728
1.900	1 447	1 085	874
2-3/8	2 125	1 593	1 284
2-7/8	3 037	2 278	1 835
3-1/2	4 708	3 531	2 845
4	5 332	3 999	3 221
4-1/2	6 407	4 805	3 871
5	5 196	3 897	3 139
5-1/2	5 644	4 233	3 410
6-5/8	8 961	6 721	5 414
7	8 450	6 338	5 105
7-5/8	11 642	8 732	7 034
8-5/8	14 889	11 167	8 995
9-5/8	16 786	12 590	10 142
10-3/4	17 634	13 225	10 654
11-3/4	19 218	14 413	11 611
13-3/8	21 792	16 344	13 166
16	27 924	20 943	16 871
18-5/8	41 910	31 433	25 321
20	35 065	26 299	21 185

Table C.14 — Recommended longitudinal magnetomotive force (ampere-turns) for unattached couplings

Label 1	Coupling outside diameter (in)	Coil inside diameter [a] in					
		6	8.5	10	13	16	24
		Magnetomotive force ampere-turns					
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1.050 to 4	All	5 640	7 990	9 400	12 220	15 040	22 560
4-1/2	5.000	6 225	8 819	10 375	13 488	16 600	24 900
5	5.563	6 289	8 909	10 481	13 625	16 770	25 154
5-1/2	6.050		8 967	10 550	13 714	16 879	25 319
6-5/8	7.390		9 116	10 725	13 942	17 159	25 739
7	7.656		9 154	10 769	14 000	17 230	25 845
7-5/8	8.500			10 853	14 109	17 365	26 047
8-5/8	9.625			10 953	14 239	17 525	26 288
9-5/8	10.625				14 367	17 683	26 524
10-3/4	11.750				14 449	17 784	26 676
11-3/4	12.750					17 895	26 842
13-3/8	14.375					18 042	27 064
16	17.000						27 148
18-5/8	20.000						27 396
20	21.000						27 463

[a] If the coil size used is not listed, either use the value for the next bigger coil size or calculate the correct ampere-turn requirement using the equations in 13.11 e).

Table C.15 — Permissible depth of imperfections

Dimensions in inches

Label Coupling for pipe sizes	Group 1, 2 (L-80 and C-95) and Group 3		Group 2 (C-90 and T-95) and Group 4
1	Pits and round-bottom gouges	Grip marks and sharp-bottom gouges	All
1	*2*	*3*	*4*
Tubing:			
Smaller than 3-1/2	0.030	0.025	0.030
3-1/2 and larger	0.045	0.030	0.035
Casing:			
Smaller than 6-5/8	0.035	0.030	0.030
6-5/8 to 7-5/8, incl.	0.045	0.040	0.035
Larger than 7-5/8	0.060	0.040	0.035

Table C.16 — Linear imperfections on the outside surface of couplings (all groups except Grade J-55 and Grade K-55 impact tested above 32 °F and H-40)

Dimensions in inches

Label [a]	Permissible depth [b]						
1	NU	EU	EU [c]	BC [c]	BC	LC	STC
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1.050	0.009	0.011	—	—	—	—	—
1.315	0.011	0.013	—	—	—	—	—
1.660	0.012	0.012	—	—	—	—	—
1.900	0.01	0.013	—	—	—	—	—
2-3/8	0.015	0.015	0.011	—	—	—	—
2-7/8	0.019	0.018	0.013	—	—	—	—
3-1/2	0.023	0.023	0.015	—	—	—	—
4	0.023	0.023	—	—	—	—	—
4-1/2	0.022	0.025	—	0.013	0.016	0.017	0.017
5	—	—	—	0.013	0.018	0.020	0.019
5-1/2	—	—	—	0.013	0.018	0.020	0.019
6-5/8	—	—	—	0.014	0.023	0.026	0.024
7	—	—	—	0.014	0.021	0.023	0.022
7-5/8	—	—	—	0.017	0.027	0.029	0.027
8-5/8	—	—	—	0.018	0.030	0.032	0.031
9-5/8	—	—	—	0.018	0.030	0.033	0.031
10-3/4	—	—	—	0.018	0.030	—	0.031
11-3/4	—	—	—	—	0.030	—	0.031
13-3/8	—	—	—	—	0.030	—	0.031
16	—	—	—	—	0.033	—	0.032
18-5/8	—	—	—	—	0.043	—	0.041
20	—	—	—	—	0.033	0.034	0.032

[a] The size of the coupling is the same as the corresponding pipe size.

[b] 5 % of the critical thickness defined in ISO 11960:2001, Table C.8 or E.8.

[c] Special clearance only.

Table C.17 — Casing coupling outside diameters and tolerances

Dimensions in inches

Label [a]	Round thread			Buttress thread outside diameter					
1	Outside diameter, W			Regular, W			Special Clearance, W_c		
	Minimum	Specified	Maximum	Minimum [b]	Specified	Maximum	Minimum [b]	Specified	Maximum
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
4-1/2	4.950	5.000	5.050	4.950	5.000	5.050	4.859	4.875	4.906
5	5.507	5.563	5.619	5.507	5.563	5.619	5.359	5.375	5.406
5-1/2	5.989	6.050	6.111	5.989	6.050	6.111	5.859	5.875	5.906
6-5/8	7.316	7.390	7.464	7.316	7.390	7.464	6.984	7.000	7.031
7	7.579	7.656	7.733	7.579	7.656	7.733	7.359	7.375	7.406
7-5/8	8.415	8.500	8.585	8.415	8.500	8.585	8.109	8.125	8.156
8-5/8	9.529	9.625	9.721	9.529	9.625	9.721	9.109	9.125	9.156
9-5/8	10.519	10.625	10.731	10.519	10.625	10.731	10.109	10.125	10.156
10-3/4	11.632	11.750	11.868	11.632	11.750	11.868	11.234	11.250	11.281
11-3/4	12.625	12.750	12.875	12.625	12.750	12.875	—	—	—
13-3/8	14.250	14.375	14.500	14.250	14.375	14.500	—	—	—
16	16.875	17.000	17.125	16.875	17.000	17.125	—	—	—
18-5/8	19.875	20.000	20.125	19.875	20.000	20.125	—	—	—
20	20.875	21.000	21.125	20.875	21.000	21.125	—	—	—

NOTE Dimensions taken from ISO 11960:2002, Table C.35 or E.35 and Table C.36 or E.36.

[a] The size of the coupling is the same as the corresponding pipe size.

[b] Does not apply to Q-125 casing sizes 6 and larger. For Q-125, casing sizes 6 and larger, use (W – 1/16) in for the minimum.

Table C.18 — Tubing coupling outside diameters and tolerances

Dimensions in inches

Label 1 [a]	NU Outside diameter			EU Outside diameter					
	Regular, W			Regular and special bevel, W			Special Clearance, W_c		
	Minimum	Specified	Maximum	Minimum	Specified	Maximum	Minimum	Specified	Maximum
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1.050	1.300	1.313	1.326	1.643	1.660	1.677	—	—	—
1.315	1.643	1.660	1.677	1.881	1.900	1.919	—	—	—
1.660	2.033	2.054	2.075	2.178	2.200	2.222	—	—	—
1.900	2.178	2.200	2.222	2.475	2.500	2.525	—	—	—
2-3/8	2.846	2.875	2.904	3.032	3.063	3.094	2.895	2.910	2.925
2-7/8	3.465	3.500	3.535	3.631	3.668	3.705	3.445	3.460	3.475
3-1/2	4.207	4.250	4.293	4.455	4.500	4.545	4.165	4.180	4.195
4	4.702	4.750	4.798	4.950	5.000	5.050	—	—	—
4-1/2	5.148	5.200	5.252	5.507	5.563	5.619	—	—	—

NOTE Dimensions taken from ISO 11960:2002, Table C.37 or E.37 and Table C.38 or E.38.

[a] The size of the coupling is the same as the corresponding pipe size.

Table C.19 — Inspection identification band colours for new OCTG

Classification	Band colour
Prime OCTG	White
Acceptable conditioned OCTG	White
OCTG requiring conditioning	Yellow
Non-conditionable (reject) OCTG	Red
OCTG failing API/ISO drift tests	Red
OCTG failing API/ISO hardness specifications	Red
Prime connector or unattached coupling	White
Acceptable conditioned connector or unattached coupling	White
Couplings or connectors requiring conditioning	Yellow
Non-conditionable (reject) coupling or connector	Red
OCTG failing special owner-specified tests	Green

Bibliography

[1] ISO 11484, *Steel tubes for pressure purposes — Qualification and certification of non-destructive testing (NDT) personnel*

[2] API Bull 5C2, *Performance properties of casing, tubing, and drill pipe*

[3] API Spec 5CT, *Specification for casing and tubing*

[4] API RP 5UE, *Recommended practice for ultrasonic evaluation of pipe imperfections*

[5] ASNT SNT-TC-1A [2)], *Personnel qualifications and certification in non-destructive testing*

[6] ASTM E 18 [3)], *Standard test methods for Rockwell hardness and Rockwell superficial hardness of metallic materials*

[7] ASTM E 110, *Standard test method for indentation hardness of metallic materials by portable hardness testers*

2) American Society for Nondestructive Testing; 1711 Arlingate Lane, P. O. Box 28518, Columbus, Ohio 43228-0518

3) ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, USA

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