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**Erdöl- und Erdgasindustrie –
Drehende Bohrausrüstungsteile –
Teil 1: Drehende Bohrgestänge-Elemente (ISO 10424-1:2004);
Englische Fassung EN ISO 10424-1:2004**

Petroleum and natural gas industries –
Rotary drilling equipment –
Part 1: Rotary drill stem elements (ISO 10424-1:2004);
English version EN ISO 10424-1:2004

Industries du pétrole et du gaz naturel –
Équipements de forage rotary –
Partie 1: Éléments de forage rotary (ISO 10424-1:2004);
Version anglaise EN ISO 10424-1:2004

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Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) im DIN

Nationales Vorwort

Diese Europäische Norm wurde vom Technischen Komitee CEN/TC 12 „*Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie*“ (Sekretariat: Frankreich) erstellt. Es handelt sich dabei um die unveränderte Übernahme von ISO 10424-1:2004, erarbeitet vom ISO/TC 67 „*Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*“, Subkomitee SC 4 „*Drilling and production equipment*“.

Für Deutschland war der Normenausschuss Erdöl- und Erdgasgewinnung (NÖG), Arbeitskreis NÖG 12/67/AK4 „*Bohr- und Fördereinrichtungen*“, beteiligt.

Diese Europäische Norm enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 13/1983 nur die englische Originalfassung der ISO-Norm.

English version

**Petroleum and natural gas industries – Rotary drilling equipment
– Part 1: Rotary drill stem elements (ISO 10424-1:2004)**

Industries du pétrole et du gaz naturel – Équipements de
forage rotatif – Partie 1: Éléments de forage rotatif
(ISO 10424-1:2004)

Erdöl- und Erdgasindustrie – Drehende
Bohrausrüstungsteile – Teil 1: Drehende Bohrgestänge-
Elemente (ISO 10424-1:2004);

This European Standard was approved by CEN on 2 August 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Foreword

This document (EN ISO 10424-1:2004) has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum and natural gas industries" in collaboration with Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2005, and conflicting national standards shall be withdrawn at the latest by March 2005.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Endorsement notice

The text of ISO 10424-1:2004 has been approved by CEN as EN ISO 10424-1:2004 without any modifications.

Introduction

The function of this part of ISO 10424 is to define the design and the mechanical properties of the material required for rotary drill stem elements. It also defines the testing required to verify compliance with these requirements. As rotary drill stem elements are very mobile, moving from rig to rig, design control is an important element required to ensure the interchangeability and performance of product manufactured by different sources.

A major portion of this part of ISO 10424 is based upon API Spec 7, 40th edition, November 2001. However, API Spec 7 does not define the nondestructive testing requirements of materials used to manufacture the drill stem components covered by this part of ISO 10424. This part of ISO 10424 does address these requirements.

Users of this part of ISO 10424 should be aware that further or differing requirements may be needed for individual applications. This part of ISO 10424 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 part of ISO 10424 and provide details.

In this part of ISO 10424, certain ISO and non-ISO standards provide the same technical result for a particular provision, however there is a market need to retain the traditional non-ISO reference.

In the running text the provision is written in the form “..... in accordance with ISO xxx.

NOTE For the purposes of this provision, non-ISO Ref yyy is equivalent to ISO xxx.”

Application of a non-ISO reference cited in this manner will lead to the same results as the use of the preceding ISO reference. These documents are thus considered interchangeable in practice. In recognition of the migration of global standardization towards the use of ISO standards, it is intended that references to these alternative documents be removed at the time of the first full revision of this part of ISO 10424.

1 Scope

This part of ISO 10424 specifies requirements for the following drill stem elements: upper and lower kelly valves; square and hexagonal kellys; drill stem subs; standard steel and non-magnetic drill collars; drilling and coring bits.

This part of 10424 is not applicable to drill pipe and tool joints, rotary shouldered connection designs, thread gauging practice, or grand master, reference master and working gauges.

A typical drill stem assembly to which this part of 10424 is applicable is shown in Figure 1.

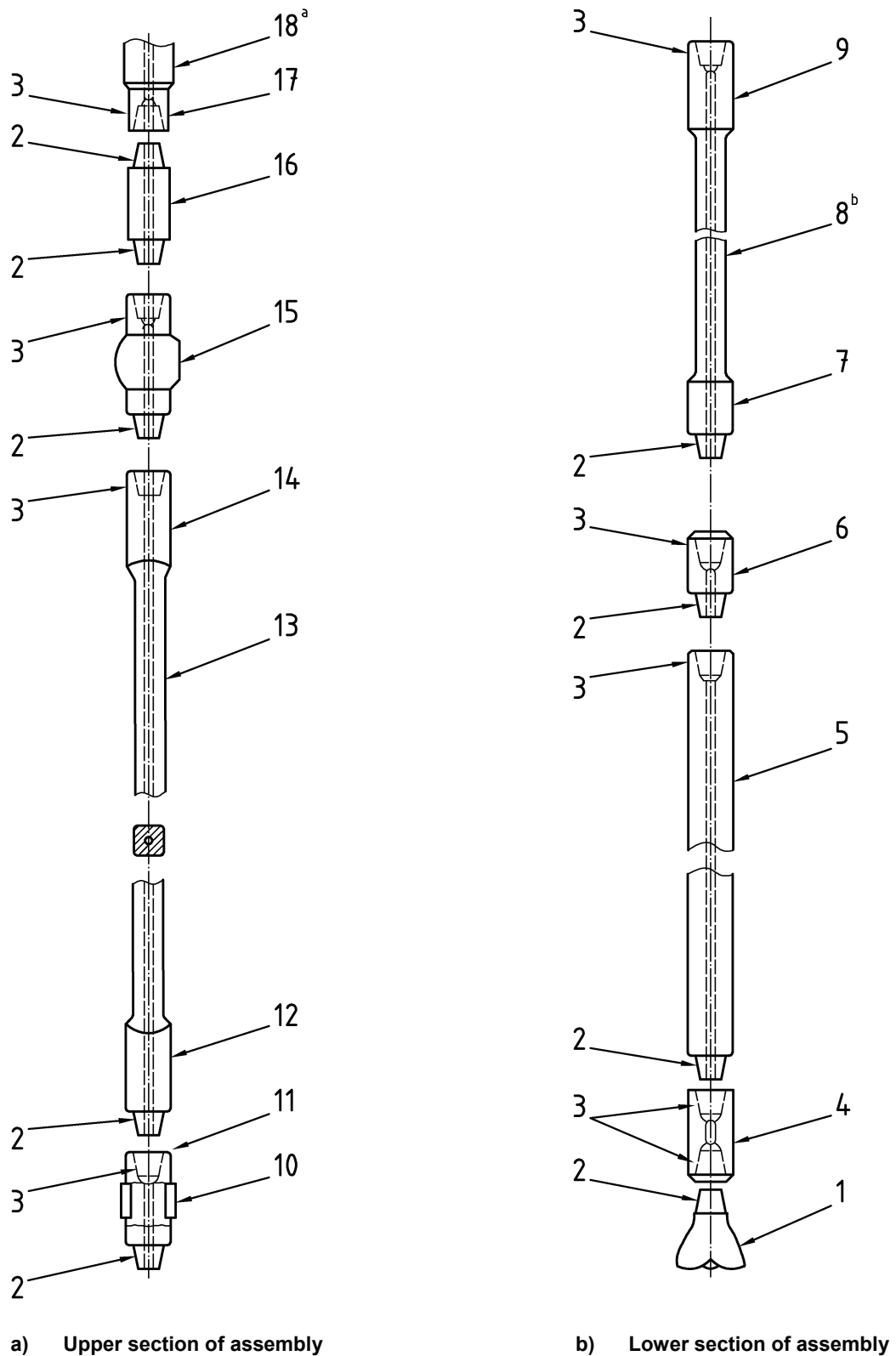


Figure 1 — Typical drill stem assembly

Key

1 bit	7 pin tool joint	13 kelly drive section
2 rotary pin connection	8 drill pipe	14 upper kelly upset
3 rotary box connection	9 box tool joint	15 upper kelly valve
4 bit sub	10 protector rubber	16 swivel sub
5 drill collar	11 lower kelly valve or kelly saver sub	17 swivel stem
6 crossover sub	12 lower kelly upset	18 swivel

^a Requirements on swivels can be found in ISO 13535.

^b Requirements on drill pipe with weld-on tool joints can be found in ISO 11961.

NOTE 1 For the purposes of the provision in footnote a, API Specs 8A and 8C are equivalent to ISO 13535.

NOTE 2 For the purposes of the provision in footnote b, API Specs 5D and 7 are equivalent to ISO 11961.

NOTE 3 All connections between lower kelly upset and the bit are RH.

NOTE 4 All connections between upper kelly upset and swivel are LH.

Figure 1 — Typical drill stem assembly *(continued)*

2 Conformance

2.1 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 a specific order item, it is intended that only one system of units be used, without combining data expressed in the other system.

Products manufactured to specifications expressed in either of these unit systems shall be considered equivalent and totally interchangeable. Consequently, compliance with the requirements of this International Standard as expressed in one system provides compliance with requirements 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 is used as the decimal separator and a space as the thousands separator.

Data within the text of this International Standard are expressed in SI units followed by data in USC units in parentheses.

2.2 Tables and figures

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

Figures are contained in the text of the clause concerning the particular product, and express data in both SI and USC units.

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 148, *Steel — Charpy impact test (V notch)*

ISO 3452, *Non-destructive testing — Penetrant inspection — General principles*

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6892, *Metallic materials — Tensile testing at ambient temperature*

ISO 9303, *Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes — Full peripheral ultrasonic testing for the detection of longitudinal imperfections*

ISO 9934-1, *Non-destructive testing — Magnetic particle testing — Part 1: General principles*

ISO 9712, *Non-destructive testing — Qualification and certification of personnel*

ISO 13665, *Seamless and welded steel tubes for pressure purposes — Magnetic particle inspection of the tube body for the detection of surface imperfections*

ISO 15156-1, *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production — Part 1: General principles for selection of cracking-resistant materials*

ISO 15156-2, *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production — Part 2: Cracking-resistant carbon and low alloy steels, and the use of cast irons*

ISO 15156-3, *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production — Part 3: Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys*

API¹⁾ RP 7G, *Drill Stem Design and Operating Limits*

API Spec 7, *Rotary Drill Stem Elements*

ASTM²⁾ A 262, *Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels*

ASTM A 434, *Standard Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered*

ASTM E 587, *Standard Practice for Ultrasonic Angle-Beam Examination by the Contact Method*

1) American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005, USA

2) American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428, USA

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

amplitude

vertical height of the A-scan received signal, measured from base to peak or peak to peak

4.1.2

A-scan display

ultrasonic instrument display in which the received signal is displayed as a vertical height or “pip” from the horizontal-sweep time trace, while the horizontal distance between two signals represents the material distance for time of travel between the two conditions causing the signals

4.1.3

back reflection

signal received from the back surface of a surface test object

4.1.4

bevel diameter

outer diameter of the contact face of the rotary shouldered connection

4.1.5

bit sub

sub, usually with two box connections, that is used to connect the bit to the drill stem

4.1.6

box connection

threaded connection on oilfield tubular goods (OCTG) that has internal (female) threads

4.1.7

bending strength ratio

BSR

ratio of the section modulus of a rotary shouldered box at the point in the box where the pin ends when made up, to the section modulus of the rotary shouldered pin at the last engaged thread

4.1.8

calibration system

documented system of gauge calibration and control

4.1.9

cold working

plastic deformation of the thread roots of a rotary shouldered connection, of radii and of cylindrical sections at a temperature low enough to ensure or cause permanent strain of the metal

4.1.10

decarburization

loss of carbon from the surface of a ferrous alloy as a result of heating in a medium that reacts with the carbon at the surface

4.1.11

depth prove-up

act of grinding a narrow notch across a surface-breaking indication until the bottom of the indication is located and then measuring the depth of the indication with a depth gauge for comparison to acceptance criteria

4.1.12**drift**

gauge used to check minimum internal diameter of drill stem components

4.1.13**drill collar**

thick-walled pipe used to provide stiffness and concentration of mass at or near the bit

4.1.14**drill pipe**

length of tube, usually steel, to which special threaded connections called tool joints are attached

4.1.15**forge**, verb

⟨hammer⟩ plastically deform metal, usually hot, into desired shapes by the use of compressive force, with or without dies

4.1.16**forging**, noun

⟨product⟩ shaped metal part formed by the forging method

4.1.17**full-depth thread**

thread in which the thread root lies on the minor cone of an external thread or on the major cone of an internal thread

4.1.18**gauge point**

plane perpendicular to the thread axis in API rotary shouldered connections

NOTE The gauge point is located 15,9 mm (0.625 in) from the shoulder of the product pin.

4.1.19**gas-tight**

capable of holding gas without leaking under the specified pressure for the specified length of time

4.1.20**heat**, noun

metal produced by a single cycle of a batch melting process

4.1.21**H₂S trim**

all components, except external valve body, meeting the H₂S service requirements of ISO 15156-2 and ISO 15156-3

NOTE For the purposes of this provision, NACE MR0175 is equivalent to ISO 15156-2 and ISO 15156-3.

4.1.22**kelly**

square or hexagonally shaped steel pipe connecting the swivel to the drill pipe that moves through the rotary table and transmits torque to the drill stem

4.1.23**kelly saver sub**

short rotary sub that is made up onto the bottom of the kelly to protect the pin end of the kelly from wear during make-up and break-out operations

4.1.24

label

dimensionless designation for the size and style of a rotary shouldered connection

4.1.25

length of box thread

LBT

length of threads in the box measured from the make-up shoulder to the intersection of the non-pressure flank and crest of the last thread with full thread depth

4.1.26

lot

pieces of steel, with the same nominal dimensions and from a single heat, which are subsequently heat-treated as part of the same continuous operation (or batch)

4.1.27

low-stress steel stamps

steel stamps that do not contain any sharp protrusions on the marking face

4.1.28

lower kelly valve

kelly cock

essentially full-opening valve installed immediately below the kelly, with outside diameter equal to the tool joint outside diameter, that can be closed to remove the kelly under pressure and can be stripped in the hole for snubbing operations

4.1.29

make-up shoulder

sealing shoulder on a rotary shouldered connection

4.1.30

non-pressure flank – box

thread flank closest to the make-up shoulder where no axial load is induced from make-up of the connection or from tensile load on the drill stem member

4.1.31

non-pressure flank – pin

thread flank farthest from the make-up shoulder where no axial load is induced from make-up of the connection or from tensile load on the drill stem member

4.1.32

out-of-roundness

difference between the maximum and minimum diameters of the bar or tube, measured in the same cross-section, and not including surface finish tolerances outlined in 8.1.4

4.1.33

pin end

external (male) threads of a threaded connection

4.1.34

process of quenching

hardening of a ferrous alloy by austenitizing and then cooling rapidly enough so that some or all of the austenite transforms to martensite

4.1.35

process of tempering

reheating a quench-hardened or normalized ferrous alloy to a temperature below the transformation range and then cooling to soften and remove stress

4.1.36**reference dimension**

dimension that is a result of two or more other dimensions

4.1.37**rotary shouldered connection**

connection used on drill stem elements, which has coarse, tapered threads and sealing shoulders

4.1.38**stress-relief features**

modification performed on rotary shouldered connections by removing the unengaged threads on the pin or box to make the joint more flexible and to reduce the likelihood of fatigue-cracking in highly stressed areas

4.1.39**sub**

short drill stem members with different rotary shouldered connections at each end for the purposes of joining unlike members of the drill stem

4.1.40**swivel**

device at the top of the drill stem that permits simultaneous circulation and rotation

4.1.41**tensile strength**

maximum tensile stress that a material is capable of sustaining that is calculated from the maximum load during a tensile test carried to rupture and the original cross-sectional area of the specimen

4.1.42**tensile test**

mechanical test used to determine the behaviour of material under axial loading

4.1.43**test pressure**

pressure above working pressure used to demonstrate structural integrity of a pressure vessel

4.1.44**thread form**

thread profile in an axial plane for a length of one pitch

4.1.45**tolerance**

amount of variation permitted

4.1.46**tool joint**

heavy coupling element for drill pipe having coarse, tapered threads and sealing shoulders

4.1.47**upper kelly valve****kelly cock**

valve immediately above the kelly that can be closed to confine pressures inside the drill stem

4.1.48**working pressure**

pressure to which a particular piece of equipment is subjected during normal operation

4.1.49**working temperature**

temperature to which a particular piece of equipment is subjected during normal operation

4.2 Symbols and abbreviated terms

D	outside diameter
D_{BP}	diameter baffle plate recess
D_C	distance across corners, forged kellys
D_{CC}	distance across corners, machined kellys
D_F	bevel diameter
D_{FL}	distance across flats on kellys
D_{FR}	diameter float valve recess
D_E	diameter elevator groove
D_L	outside diameter lift shoulder
D_{LR}	outside diameter, kelly lower upset
D_P	elevator recess diameter
D_R	outside diameter, reduced section
D_S	diameter slip groove
D_U	outside diameter, upper kelly upper upset
d	inside diameter
d_b	inside bevel
L	overall length
L_D	length kelly drive section
L_{FV}	length float valve assembly
L_G	minimum length kelly sleeve gauge
L_L	lower upset length kellys
L_R	depth of float valve recess
L_U	upper upset length kellys
l_E	elevator groove recess depth
l_S	slip recess groove depth
R	radius

R_c	corner radius forged kelly
R_{cc}	corner radius machined kelly
R_H	maximum fillet radius hexagonal kelly sleeve gauge
R_S	maximum fillet radius square kelly sleeve gauge
T	diameter of baffle plate recess
t	minimum wall thickness
$\angle \alpha$	angle of run-out of elevator recess
$\angle \beta$	angle of run-out of slip recess
AMMT	American macaroni tubing style of thread design
AMT	alternative abbreviation for the American macaroni tubing style of thread design
BSR	bending strength ratio
dB	decibel
FH	API full-hole style of thread design
HBW	Brinell hardness
LH	left hand
MT	magnetic particle testing
MT	macaroni tubing style of thread design
NC	API number style of thread design
NDT	non-destructive testing
PT	liquid penetrant testing
REG	API regular style of thread design
RH	right hand
UT	ultrasonic testing

5 Upper and lower kelly valves

5.1 General

This part of ISO 10424 specifies the minimum design, material, inspection and testing requirements for upper and lower kelly valves. This part of ISO 10424 also applies to drill-stem safety valves used with overhead drilling systems. It applies to valves of all sizes with rated working pressures of 34,5 MPa through 103,5 MPa (5 000 psi through 15 000 psi) used in normal service conditions (H_2S service conditions are addressed as a supplemental requirement, see 5.7). Rated working temperatures are $-20\text{ }^{\circ}\text{C}$ ($-4\text{ }^{\circ}\text{F}$) and above for valve bodies; sealing system components may have other temperature limitations.

5.2 Design criteria

5.2.1 General

The manufacturer shall document the design criteria and analysis for each type of valve produced under this part of ISO 10424. This documentation shall include loading conditions that will initiate material yield for the valve body with minimum material properties and tolerances under combined loading, including tension, internal pressure and torsion. Body material yield loading conditions shall be documented in either tabular form or in graphical form. The minimum design yield safety factor shall be 1,0 at the shell test pressure found in Table 1.

For the valve to have a useful fatigue life, loading conditions should be monitored to ensure they remain well below manufacturer-supplied valve body material yield conditions. Endurance load conditions, below which fatigue does not accumulate, will depend on the service conditions, primarily determined by the temperature and corrosive nature of the fluids in contact with the valve.

Table 1 — Hydrostatic testing pressures

Maximum working pressure rating	Hydrostatic shell test pressure (new valves only)
MPa	MPa
34,5	68,9
68,9	103,4
103,4	155,1

5.2.2 Material requirements

Where material requirements are not otherwise specified, material for equipment supplied to this part of ISO 10424 may vary depending on the application but shall comply with the manufacturer's written specifications. Manufacturer specifications shall define the following:

- a) chemical composition limits;
- b) heat treatment conditions;
- c) limits for the following mechanical properties:
 - 1) tensile strength;
 - 2) yield strength;
 - 3) elongation;
 - 4) hardness.

Minimum values for mechanical properties shall conform to material requirements for drill collars as specified in Clause 8.

5.2.3 Impact strength

5.2.3.1 Test specimen

Three longitudinal impact test specimens per heat per heat treatment lot shall be tested in accordance with ISO 148. Qualification test coupons may be integral with the components they represent, separate from the components or a sacrificial production part. In all cases, test coupons shall be from the same heat as the components which they qualify and shall be heat-treated with the components.

NOTE For the purposes of this provision, ASTM A 370 and ASTM E 23 are equivalent to ISO 148.

Test specimens shall be removed from integral or separate qualification test coupons such that their longitudinal centreline axis is wholly within the centre 1/4-thickness envelope for a solid test coupon or within 3 mm (1/8 in) of the mid-thickness of the thickest section of a hollow test coupon.

Test specimens taken from sacrificial production parts shall be removed from the centre 1/4-thickness envelope location of the thickest section of the part.

If the test coupon is obtained from a trepanned core or other portion removed from a production part, the test coupon shall only qualify production parts that are identical in size and shape to the production part from which it was removed.

5.2.3.2 Requirements

The average impact value of the three specimens shall not be less than 42 J (31 ft-lbs), with no single value below 32 J (24 ft-lbs) when tested at $-20\text{ }^{\circ}\text{C}$ ($-4\text{ }^{\circ}\text{F}$).

5.2.3.3 Subsize specimens

If it is necessary for subsize impact test specimens to be used, the acceptance criteria shall be multiplied by the appropriate adjustment factor listed in Table 2. Subsize test specimens of width less than 5 mm (0.197 in) shall not be permitted.

Table 2 — Adjustment factors for impact specimens

Specimen dimensions mm × mm	Adjustment factor
10 × 10	1,00
10 × 7,5	0,833
10 × 5	0,667

5.2.4 Pressure sealing performance requirements

Kelly valve and other drill-string safety valves (regardless of closure mechanism) shall be designed for either surface-only or for surface and/or downhole service. Lower kelly valves and lower safety valves used with overhead drilling systems should be designed for downhole service. The design performance requirements for pressure sealing for each service class are shown in Table 3.

Table 3 — Service class definitions

Class number	Service type	Design performance requirements for pressure sealing
Class 1 ^a	Surface only	Body and any stem seal shall hold <i>internal</i> pressure equal to the shell test pressure ^b Closure seal shall hold pressure from <i>below</i> at a low pressure of 1,7 MPa and at a high pressure equal to the maximum rated working pressure
Class 2	Surface and downhole	Body and any stem seal shall hold <i>internal</i> pressure equal to the shell test pressure ^b Stem seal shall hold <i>external</i> pressure at a low pressure of 1,7 MPa and at a minimum high pressure of 13,8 MPa ^c Closure seal shall hold pressure from <i>below</i> at a low pressure of 1,7 MPa and at a high pressure equal to the maximum rated working pressure Closure seal shall hold pressure from <i>above</i> at a low pressure of 1,7 MPa and at a high pressure equal to the maximum rated working pressure ^d Sealing temperature range verified by testing ^e
^a Valves manufactured to the 39th and earlier editions of API Spec 7 qualify as Class 1 valves. To re-classify existing valves as Class 2 shall require testing in accordance with the requirements of 5.4.3, 5.4.4 and 5.4.5. ^b Shell test only performed once, in accordance with the values given in Table 1, for each valve manufactured. ^c Stem seal performance verified once for each valve design, not for each valve manufactured. ^d Only applies to ball-type valves. ^e Sealing temperature range verified once for each valve design, not for each valve manufactured.		

5.2.5 Basic performance requirements

Kelly valves and other drill-string safety valves (regardless of closure mechanism) shall be designed to be capable of the following basic performance requirements:

- a) repeated operation in drilling mud;
- b) closing to shut off a mud flow from the drill string;
- c) sealing over the design range of temperature and tension load conditions.

5.3 Connections

5.3.1 Size and type

For all valves covered by this part of ISO 10424, end connections shall be stated on the purchase order and the corresponding bevel diameters specified for such connections shall be used.

In the case of upper and lower kelly valves, connections shall be of the size and type shown in Clause 6, Table 5 or Table 7 unless otherwise stated on the purchase order. If such connections are employed, the corresponding bevel diameters specified for such connections shall be used.

A gall-resistant treatment of zinc or manganese phosphate shall be applied to the threads and sealing shoulders of all end connections of valves manufactured from standard steel. Application of the treatment shall be after completion of all gauging. The treatment type shall be the option of the manufacturer.

Gall-resistant treatments are not readily available for non-magnetic drill collars, therefore are not required.

Cold working of threads is optional. But purchaser should consider specifying cold working of threads after thread gauging. See 8.1.7.3 for further details.

Consult manufacturer for recommended make-up torques and combined load rating of end connections and any service connections supplied (see API RP 7G Appendix A for combined loading calculations for API connections).

5.3.2 Non-destructive examination

5.3.2.1 Coverage

End connections and any service connection shall be subjected to non-destructive examination for both transverse and longitudinal defects.

5.3.2.2 Connections from standard steel

Connections manufactured from standard steel shall be examined by the wet magnetic-particle method. The examination shall be performed according to a written procedure developed by the manufacturer. The procedure shall be in accordance with ISO 9934-1 and shall be made available to the purchaser on request.

NOTE For the purposes of this provision, ASTM E 709 is equivalent to ISO 9934-1.

5.3.2.3 Connections from non-magnetic steel

Connections manufactured from non-magnetic steel shall be examined by liquid penetrant, using the visible or fluorescent solvent-removable or water-washable method. The examination shall be performed according to a written procedure developed by the manufacturer. The procedure shall be in accordance with ISO 3452 and shall be made available to the purchaser on request.

NOTE For the purposes of this provision, ASTM E 1209, ASTM E 1219, ASTM E 1220 and ASTM E 1418 are equivalent to ISO 3452.

5.4 Hydrostatic testing

5.4.1 General

Hydrostatic testing shall be conducted to the pressures as shown in Table 1. Testing shall be conducted at ambient temperature with a suitable non-corrosive, low-viscosity, low-compressibility fluid. During the pressure-holding period, timing shall start when pressure stabilization is achieved. During the test period, no visually detectable leakage is permitted, and pressure drop shall be within manufacturer's tolerance for a zero leak rate.

5.4.2 Hydrostatic shell testing

Each new valve body shall be tested to the hydrostatic test pressure by the method outlined below. Hydrostatic shell testing shall be conducted with the valve in the half-closed position. If there is a stem seal in the valve body, a low pressure test to 1,7 MPa (250 psi) shall also be conducted. Both the low pressure and high pressure tests shall be conducted in three parts:

- a) initial pressure-holding period of 3 min;
- b) reduction of pressure to zero;
- c) final pressure-holding period of not less than 10 min.

5.4.3 Tests at working pressure

5.4.3.1 General

Each valve shall have appropriate working-pressure testing, depending on the class of service defined in Table 3. This testing shall apply to all new valves and shall be conducted as specified in 5.4.3.2 and 5.4.3.3.

Working pressure test period shall be for a minimum of 5 min.

5.4.3.2 Tests at pressure from below

This testing applies to both Class 1 and Class 2 type valves.

Pressure shall be applied to the functional lower end of the valve (normally the pin end) with the valve in the closed position. Low and high pressure tests shall be conducted. The low pressure test shall be at 1,7 MPa (250 psi) and the high pressure test shall be at the maximum working-pressure rating. Open and close the valve after the high pressure test to release any trapped pressure in cavities of valve.

5.4.3.3 Tests at pressure from above

This testing applies to Class 2 type valves only.

This testing applies to valves with ball-type closure mechanisms only.

Pressure shall be applied to the functional upper end of the valve (normally the box end) with the valve in the closed position. Low and high pressure tests shall be conducted. The low pressure test shall be at 1,7 MPa (250 psi) and the high pressure test shall be at the maximum working-pressure rating. Open and close the valve after the high pressure test to release any trapped pressure in cavities of the valve, and then repeat the low pressure test.

CAUTION — After working pressure tests are completed, check to ensure that the alignment of the ball or flapper in the indicated “open position” is still within manufacturing tolerances, as misalignment can cause fluid erosion problems in field applications.

5.4.4 Design verification test for stem-seal external pressure

Each Class 2 service valve design shall have appropriate stem-seal external pressure testing as outlined below.

The test period shall be for a minimum of 5 min.

The stem-seal external pressure test applies to Class 2 type valves only, and is only required for design verification purposes. Pressure shall be applied to the outside of the valve (e.g. through a high pressure sleeve mounted over the stem seal area) with the valve in the half-open position. Low and high pressure stem-seal tests shall be conducted. The low pressure test shall be at 1,7 MPa (250 psi) and the high pressure test shall be a minimum of 13,8 MPa (2 000 psi) but may be higher, up to the rated working pressure, at the manufacturer's discretion.

5.4.5 Design verification test for sealing temperature range

This applies to Class 2 type valves only and is only required for design verification purposes.

Standard non-metallic seal systems are typically valid over the range $-10\text{ }^{\circ}\text{C}$ ($14\text{ }^{\circ}\text{F}$) to $90\text{ }^{\circ}\text{C}$ ($194\text{ }^{\circ}\text{F}$), so design verification testing shall be conducted with the valve and the test fluid at these temperature extremes, unless the purchaser specifies otherwise. Pressure testing shall be performed in accordance with 5.4.3 and 5.4.4 at both low and high temperatures, using suitable testing fluids for extreme temperature conditions.