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Aerospace — Metric series pipe coupling 8°30' up to 28 000 kPa dynamic beam seal — Technical specification

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by the Aerospace and Defence Industries Association of Europe – Standardization (ASD-STAN) as EN 3275:2019 and drafted in accordance with its editorial rules. It was assigned to Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 10, *Aerospace fluid systems and components*, and adopted, without modification other than those given below, under the "fast-track procedure".

The main changes compared to EN 3275:2019 are as follows:

— the title was changed to have no more than three elements;

— Clause 2, normative references, was updated to only list references cited normatively in the text;

— Clause 3, terms and definitions, was updated to follow the rules of ISO/IEC Directives, Part 2, 2018;

— the tables were renumbered to follow the rules of ISO/IEC Directives, Part 2, 2018;

— Example 3 in A.1.3 was changed to normal body text as it contains a requirement;

— Figure 4 and Figure 7 were changed to be language neutral.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Aerospace — Metric series pipe coupling 8°30' up to 28 000 kPa dynamic beam seal — Technical specification

1 Scope

This document specifies the required characteristics, inspection and test methods, quality assurance and procurement requirements for metric series 8°30’ dynamic beam seal pipe couplings, for temperature ranges type II and III according to ISO 6771 and nominal pressure up to 28 000 kPa.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 2813, *Aerospace series — Aluminium alloy AL-P-6061- — T6 — Drawn tube for pressure applications — 0,6 mm ≤ a ≤ 12,5 mm*

EN 3120, *Aerospace series — Titanium alloy TI-P64003 — Cold worked and stress relieved — Seamless tube for pressure systems — 4 mm ≤ D ≤ 51 mm, 690 MPa ≤ R_m ≤ 1 030 MPa*

EN 10204, *Metallic products — Types of inspection documents*

ISO 1302, *Geometrical Product Specifications (GPS) — Indication of surface texture in technical product documentation*

ISO 2685, *Aircraft — Environmental test procedure for airborne equipment — Resistance to fire in designated fire zones*

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 5855 (all parts), *Aerospace — MJ threads*

ISO 6771, *Aerospace — Fluid systems and components — Pressure and temperature classifications*

ISO 6772, *Aerospace — Fluid systems — Impulse testing of hydraulic hose, tubing and fitting assemblies*

ISO 7137, *Aircraft — Environmental conditions and test procedures for airborne equipment*

ISO 7257, *Aircraft — Hydraulic tubing joints and fittings — Rotary flexure test*

ISO 8625-1, *Aerospace — Fluid systems — Vocabulary — Part 1: General terms and definitions related to pressure*

ISO 9538, *Aerospace series — Hydraulic tubing joints and fittings — Planar flexure test*

TR 2674,[1)] Design and construction of pipeline for fluids in liquid or gaseous condition — Rigid lines, installation

1) Published as ASD-STAN Technical Report at the date of publication of this standard by AeroSpace and Defence industries Association of Europe – Standardization (ASD-STAN) (www.asd-stan.org).

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8625-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

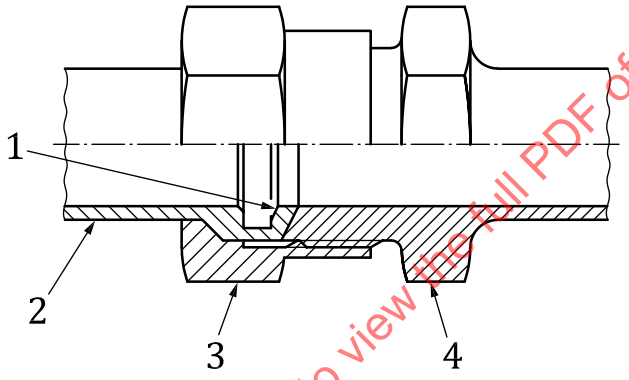
— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1 Coupling

3.1.1
coupling assembly
assembled and torque-tightened nut, ferrule and pipe mating with e.g. unions, tees or elbows

Note 1 to entry: See Figure 1.



Key
1 dynamic beam seal
2 ferrule
3 nut
4 union end

Figure 1 — Example of coupling assembly

3.1.2
shaped part
forged part
coupling machined out of individual forging blank

Note 1 to entry: For crosses, tees and elbows machined out of bar or plate stock the term “shaped” may be used.

3.2 Surface defects

3.2.1
surface irregularity
nonconformity with general surface appearance, possible defect

3.2.2
crack
clean (crystalline) fracture passing through or across the grain boundaries that possibly follows inclusions of foreign elements

Note 1 to entry: Cracks are normally caused by overstressing the metal during forging or other forming operations, or during heat treatment. Where parts are subject to significant reheating, cracks are usually discoloured by scale.

3.2.3
fold
doubling over of metal, which can occur during the forging operation

Note 1 to entry: Folds can occur at or near the intersection of diameter changes and are especially prevalent with non-circular necks, shoulders and heads.

3.2.4
lap
fold (3.2.3) -like machining defect

3.2.5
seam
surface opening or *crack* (3.2.2) or extraneous material resulting from a defect obtained during e.g. casting or forging

3.2.6
pit
void or hole in the surface as caused, for example, by corrosion

3.3 Quality assurance

3.3.1
production batch
definite quantity of some commodity or service produced at one time under conditions that are presumed uniform

3.3.2
delivery batch
batch consisting of couplings with the same identity block which may come from different *production batches* (3.3.1)

3.3.3
acceptable quality level
AQL
quality level which for the purposes of sampling inspection is the limit of a satisfactory process average, when a continuing series of lots is considered

3.3.4
qualification
testing required to demonstrate successful performance of the *coupling assembly* (3.1.1) in simulated service (overload, destructive and fatigue tests)

3.3.5
major defect
defect other than critical, that is likely to result in a failure or to reduce materially the usability of the considered product for its intended purpose

3.3.6
minor defect
defect that is not likely to reduce materially the usability of the considered product for its intended purpose, or that is a departure from established specification having little bearing on the effective use or operation of this product

4 Symbols

A	Elongation, in percent [%]
D_0	Actual outside diameter of pipe, in millimetres [mm]
D_1	Actual inside diameter of pipe, in millimetres [mm]
DN	Nominal outside diameter of pipe
P	Working pressure, in megapascals [MPa]
R_m	Tensile strength, in megapascals [MPa]
$R_{p0,2}$	0,2 % proof stress, in megapascals [MPa]
σ_x	Axial stress due to pressure, in megapascals [MPa]

5 Requirements, inspection and test methods

5.1 Test conditions and preparation of specimens for qualification

5.1.1 General

For requirements, inspection and test methods see Table 1.

5.1.2 Tests fluids

Unless otherwise specified, tests shall be carried out using e.g. a petroleum base hydraulic fluid according to MIL-H-5606 for coupling assemblies of type II temperature range and a silicate ester base hydraulic fluid according to MIL-H-8446 for those of type III temperature range. Water may be used, whenever practical, for proof, burst, stress corrosion and re-use capability testing. For other than hydraulic system applications, it is preferable to use system fluid for leakage (gaseous pressure) and proof testing. When specified in the test method, the test fluid is used as a lubricant.

5.1.3 Specimen preparation

Shaped parts shall be machined with the grain flow of the bar or plate in the direction of the fluid. Specimens shall be assembled as illustrated in Table 3. Installations on the pipe end shall be in accordance with TR 2674. Prior to testing, all couplings shall be assembled using the maximum specified torque. Except, when specified in Table 3, the coupling shall be assembled using the minimum installation torque for at least half of the specimens, and maximum torques for the remainder.

5.1.4 Pipe assembly

The method of joining the pipe to the coupling end (brazing, welding, mechanical attachment, etc.) shall not be detrimental to the properties, strength or geometry of the pipe and the coupling end. The joint shall be in accordance with the design instructions and shall be inspected by direct measurement, X-ray or other non-destructive methods.

Table 1 — Requirements, inspection and test methods

Sub-clause	Characteristic	Requirement	Inspection and test method	Q	A
5.2[a]	Materials	Conformity with the product standards	Chemical analysis or certificate of compliance according to EN 10204 issued by the semi-finished product manufacturer.	X 100 %	X 100 %
5.3[a]	Dimensions	Conformity with the product standards	Suitable measuring instruments	X 100 %	X 50 %
	Fluid passages	Conformity with the product standards	A ball with a diameter 0,5 mm less than the minimum diameter specified for the passage shall pass through the coupling.	X 100 %	X 20 %
5.4[a]	Product identification	Marking shall be according to product standards and definition documents including batch identification of Annex A. It shall be legible and shall not adversely affect the material or the functioning of the products.	Visual examination	X 100 %	X 100 %
5.5[a]	Surface roughness	Conformity with the product standards Interpreted in accordance with ISO 1302	Suitable measuring instruments or visual-tactile samples	X 100 %	X 100 %
5.6[a]	Surface treatment	Conformity with the product standards	Visual examination The thread shall be tested using a gauge with a tolerance class of 4h6h.	X 100 %	X 100 %

Key

Q qualification

A acceptance

[a] Applicable to parts prior to assembly.

Table 1 *(continued)*

Sub-clause	Characteristic	Requirement	Inspection and test method	Q	A
5.7[a]	Surface defects	Parts shall be free from surface defects indicated in 3.3 liable to have an adverse effect on their characteristics and endurance.	Visual inspection using suitable methods	X 100 %	X 100 %
			Visual examination	X 100 %	X 100 %
	Threads	Threads may be cut, rolled or ground, except titanium alloys which shall be cut or rolled. The external threads of couplings should be rolled and, if machined, shall have an arithmetical mean deviation, Ra, of the profile of 3,2 µm or smoother in accordance with ISO 1302. The grain flow in rolled threads shall be continuous and follow the general thread contour with the maximum density at the thread root. Laps, cracks, surface irregularities and seams (see 3.2) are not acceptable on any part of the pressure thread flank, in the thread root or on the non-pressure thread flank. Laps and seams, depths of which are within the limits of Table 2, are acceptable on the crest and the non-pressure thread flank above the pitch diameter.	Thread flanks in rolled threads shall be examined by micro-examination. Specimens shall be taken from the finished part by sectioning on a longitudinal plane across the threaded area. The specimens shall be polished and etched to reveal the surface defects.	X 10 %	X 5 %
5.8	Proof pressure	The coupling assembly shall withstand a pressure equal to twice the nominal pressure of the fluid system for 5 min at ambient temperature without leakage and shall not show any evidence of permanent deformation or other malfunction when using the specified torque values.	The coupling assembly shall be connected to a pressure source with one end free to move. Rate of pressure increase shall be (150 000 ± 37 500) kPa/min.	X	
5.9	Gaseous pressure	The coupling assembly shall withstand a gaseous pressure equal to the nominal pressure for 5 min, at ambient temperature. There shall be no visible formation of bubbles after 1 min at pressure or other malfunction that would affect assembly or disassembly when using the torque values specified.	The coupling assembly shall be solvent cleaned and air dried prior to testing. It shall be assembled and tightened to the minimum torques specified in Table 4. It shall then be pressurized with nitrogen to the nominal pressure. This pressure shall be maintained for 5 min while the specimens are immersed in water or suitable oil (see Figure 2).	X	
5.10	Hydraulic impulse resistance	The coupling assembly shall withstand 200 000 impulse pressure cycles without leakage.	The coupling assembly shall be impulse tested at the temperatures and in the sequence specified in ISO 6772.	X	

Key

Q qualification

A acceptance

[a] Applicable to parts prior to assembly.

Table 1 *(continued)*

Sub-clause	Characteristic	Requirement	Inspection and test method	Q	A
5.11	Minimum burst pressure	The coupling assembly shall withstand a pressure equal to four times the nominal pressure of the fluid system for 5 min, when tested at ambient temperature. There shall be no leakage or burst. Pipe expansion is permissible. The coupling assemblies need not meet any disassembly or assemblies requirements after this test.	The coupling assembly shall be connected to a pressure source with one end free to move. Rate of pressure increase shall be (150 000 ± 37 500) kPa/min.	X	
5.12	Flexure fatigue resistance	Coupling assembly welded to pipes shall achieve a target minimum flexure fatigue stress of 130 MPa for 10^7 cycles. For other methods of joining the coupling to the pipe the minimum flexure fatigue levels for each DN size shall be as shown in Table 5 or Table 6. Specimens according to Figure 3 shall pass this test without leakage from the coupling assembly or the pipe/coupling interface. Recorded S/N curves shall show characteristics equal to or greater than those of Figure 4. Thrust wire coupling assemblies shall achieve the flexure fatigue stress of 130 MPa for 10^7 cycles, measured at the pipe/coupling joint.	Shall be in accordance with either ISO 7257 or ISO 9538. The bending stress shall be determined prior to the application of internal pressure. In order to obtain the true bending stress, it is always necessary to measure the strain dynamically at the flexure test frequency. The tolerance for the specified bending stress shall be from 0 % to 10 %. NOTE If it is desired to express the stress in terms of combined pressure and bending stress, the axial pressure stress is calculated by the formula: $\sigma_x = P \cdot \frac{D_1^2}{D_0^2 - D_1^2}$	X	
5.13	Stress corrosion resistance	The coupling assembly shall withstand salt spray exposure without any of the following defects:	The coupling assembly shall be installed in a test apparatus (see Figure 5) which imposes a bending stress level equal to (85 ± 5) % of $R_{p0,2}$ of the pipe material at the beam seal interface.	X	

Key

Q qualification

A acceptance

[a] Applicable to parts prior to assembly.

Table 1 *(continued)*

Sub-clause	Characteristic	Requirement	Inspection and test method	Q	A
		a) indications of cracking or pitting of the exposed surfaces when visually examined at 10 times magnification; b) indications of inter- or transgranular corrosive attack during metallurgical examination of longitudinal and transverse sections of the coupling assembly.	Internal pressure equal to the nominal pressure of the hydraulic system shall be applied without removing the bending stress. The coupling assembly shall then be subjected to the salt spray test in accordance with ISO 7137. After exposure, the coupling assembly shall be subjected to the minimum burst pressure test. The coupling assembly shall then be cleaned and subjected to micro-examination by sectioning.		
5.14	Re-use capability	The coupling assembly shall withstand 25 repeated assemblies, without any of the following defects: a) leakage at any of the proof pressure tests; b) inability to tighten the coupling by hand; c) nut deformation; d) excessive galling or damage to any surfaces of the coupling assembly which prevents the specified tightening torques from being applied smoothly; e) gaseous leakage after the final tightening operation.	The coupling assembly shall be tested according to Figure 6 with one end torqued to the maximum and the other to the minimum value of the tightening torque with no additional lubricant permitted for the first tightening. Each coupling assembly shall then be disassembled, and the sealing face rotated 60° to 90°; the coupling assembly shall then be lubricated with the test fluid on threads only and retorqued to the original value to a minimum of 25 times. After each fifth and the final tightening operation, the coupling shall be subjected to the gaseous pressure test according to 5.9.	X	
		The torque to damage shall also be determined and the values recorded. For couplings in titanium alloy it shall not be less than two times the maximum torque, according to Table 4 up to DN 18 or 202 Nm starting from DN 20. For other materials values to be specified. Damage is defined as one or more of the following defects: a) distortion or cracking of the dynamic beam seal; b) plastic deformation of any part of the nut or ferrule; c) leakage.	Every sixth tightening, the union on the test fixture shall be replaced. The test fixture shall be designed to ensure that all assembly forces are induced into the dynamic beam seal. The torque to damage shall be determined as follows: Using one specimen, the curve torque/angular rotation of the nut shall be established using a calibrated torque wrench and a means of measuring the angular rotation of the nut. The nut and ferrule thread and contact faces shall be lubricated with the test fluid, but none is allowed on the sealing face or dynamic beam seal. The torque shall be increased until plastic deformation occurs (see Figure 7).		

Key

Q qualification

A acceptance

[a] Applicable to parts prior to assembly.

Table 1 *(continued)*

Sub-clause	Characteristic	Requirement	Inspection and test method	Q	A
			The specimen shall then be subjected to the gaseous pressure test according to 5.9. If no leakage occurs, the specimen shall be disassembled and the dynamic beam seal examined for cracks or distortion. If the dynamic beam seal is not damaged, the torque to damage shall be determined in accordance with Figure 7. If leakage or cracking of the dynamic beam seal is observed, a second specimen shall be tested. This specimen shall be torqued to the maximum value and subjected to a gaseous pressure test according to 5.9 and the dynamic beam seal examined for cracks or distortion. The coupling assembly shall then be progressively torqued in increments equal to 20 % of the difference between the deformation torque of the first specimen and the maximum torque of Table 4 for couplings in titanium alloy. For other materials values to be specified. After each increment the specimen shall be subjected to the gaseous pressure test according to 5.9 and the dynamic beam seal examined for cracks or distortion. Any leakage, cracking or distortion shall be noted. The torque value at which no damage was found shall be considered as the torque to damage.		
5.15	Tensile strength (coupling assembly with welded ferrule only)	The coupling assembly shall withstand a tensile load that is equal to or greater than the product of the burst pressure and the cross sectional area of the pipe. It shall be demonstrated that the coupling assembly is at least as strong as the associated pipe.	The coupling assembly shall be mounted in a tensile test machine with no internal fluid or pressure. The tensile load shall be applied at a constant speed at a rate of (4 ± 2,5) mm/min until rupture of the associated pipe.	X	
5.16	Thermal shock resistance	The coupling assembly shall not leak during the test.	The coupling assembly shall be mounted in a low temperature test chamber and connected to a pressure source of test fluid which can be heated to maximum temperature ±5 °C. The coupling assembly shall be cooled to −55 °C ± 2 °C for a minimum of 2 h. At the end of this period, test fluid at the maximum temperature shall be introduced at a minimum pressure of 350 kPa. Within 15 s of the fluid entering the coupling assembly the pressure shall be raised to proof pressure and held for 15 min.	X	

Key

Q qualification

A acceptance

[a] Applicable to parts prior to assembly.

Table 1 *(continued)*

Sub-clause	Characteristic	Requirement	Inspection and test method	Q	A
5.17	Resistance to fire (if required)	The coupling assembly shall be fireproof for 15 min without leakage.	Shall be in accordance with ISO 2685.	X	
Key Q qualification A acceptance [a] Applicable to parts prior to assembly.					

Table 2 — Acceptable limits of depths of laps and cracks

DN	Depth mm
05	0,15
06	0,18
08	0,18
10	0,20
12	0,23
14 to 32	0,25

Table 3 — Inspection, testing and specimens for qualification of coupling assemblies

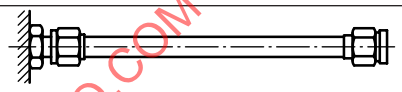
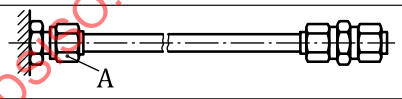
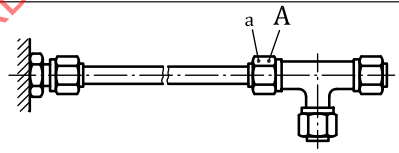
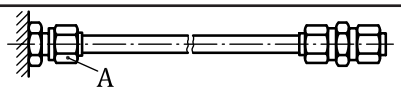
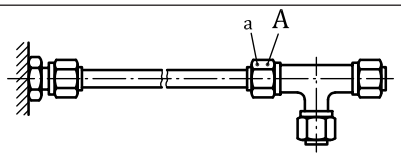
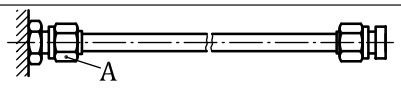
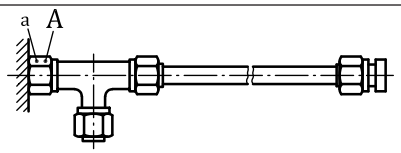
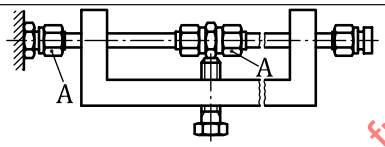
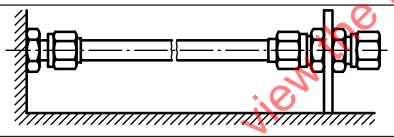
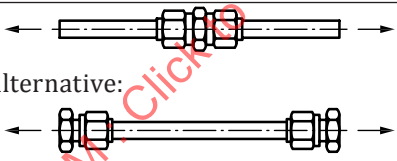
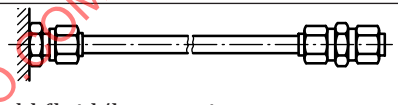
Test	Sub-clause	Specimen	Quantity		Specimen number	Sizes	Remarks
			each	total			
Proof pressure	5.8	coupling assemblies prior to the following tests	all				
Gaseous pressure	5.9		6		1 to 6	all	
Hydraulic impulse resistance	5.10		3	6	7 to 9	all	b
			3		10 to 12		
Side A of the specimens illustrated in clauses 5.10, 5.11, 5.12 and 5.13 shall be tightened to the minimum value of the tightening torque and the other side to the maximum value of the tightening torque. [a] This is a thrust wire nut configuration. [b] Same specimens may be tested as those used for the re-use capability test. [c] Same specimens may be tested as those used for the hydraulic impulse test. [d] When rotary testing is performed, the number of specimens is reduced from 10 to 6. NOTE See also Table 5 and Table 6 for cycles/stress levels.							

Table 3 *(continued)*

Test	Sub-clause	Specimen	Quantity each	Quantity total	Specimen number	Sizes	Remarks
Minimum burst pressure	5.11		3	6	13 to 15	all	b, c
							
Flexure fatigue resistance	5.12		10	12	19 to 28	all	d
			2		29 and 30		
Stress corrosion resistance	5.13		3		31 to 33	DN16	
Re-use capability	5.14		3		34 to 36	all	
Tensile strength	5.15		2		37 and 38	all	
Thermal shock resistance	5.16	 cold fluid/hot specimen	2		39 to 42	DN10	
		hot fluid/cold specimen	2			DN16	
Resistance to fire	5.17		2		43 and 44	DN16	

Side A of the specimens illustrated in clauses 5.10, 5.11, 5.12 and 5.13 shall be tightened to the minimum value of the tightening torque and the other side to the maximum value of the tightening torque.

[a] This is a thrust wire nut configuration.

[b] Same specimens may be tested as those used for the re-use capability test.

[c] Same specimens may be tested as those used for the hydraulic impulse test.

[d] When rotary testing is performed, the number of specimens is reduced from 10 to 6.

NOTE See also Table 5 and Table 6 for cycles/stress levels.

Table 4 — Torques values and change in angle of nut rotation for couplings in titanium alloy

DN	Thread size[a]	Torque		Minimum change[c] (for information only)
		minimum	maximum	
		Nm		Degrees
05	MJ10 × 1,0	8	11	7
06	MJ12 × 1,25	15	18	7
08	MJ14 × 1,5	18	22	6
10	MJ16 × 1,5	25	37	6
12	MJ18 × 1,5	30	51	8
14	MJ20 × 1,5	45	64	10
16	MJ22 × 1,5	50	76	9
18	MJ24 × 1,5	63	88	[b]
20	MJ27 × 1,5	75	101	10
22	MJ30 × 1,5	85	114	4
25	MJ33 × 1,5	88	141	[b]
28	MJ36 × 1,5	120	167	6
32	MJ39 × 1,5	143	202	[b]

[a] The thread size shall be in accordance with ISO 5855 (all parts).

[b] Values not available at present.

[c] Minimum change in angle of nut rotation during torque tightening between the minimum specified value and the maximum specified value after 25 repeated assemblies.

Table 5 — Flexure fatigue resistance requirements

Type II (–55 °C to 135 °C) (according to ISO 6771)									
	Class B 14 000 kPa		Class D 21 000 kPa		Class E 28 000 kPa				
Pipe material									
	Cold worked titanium alloy stress relieved	AL-P 6061-T6	Cold worked corrosion resistant steel	Cold worked titanium alloy stress relieved	Cold worked titanium alloy stress relieved	Joining method			
						welded min.			other min.
	according to EN 3120	according to EN 2813	725/515/20[a]	according to EN 3120	according to EN 3120	1×10^7 cycles 6[b] specimens	5×10^5 cycles 2 specimens	5×10^4 cycles 2 specimens	1×10^7 cycles 2[b] specimens

[a] R_m min/$R_{p0,2}$ min/A_{min}

[b] Only two specimens need to be tested if rotary flexure test method is used. Six specimens if planar flexure test method is used.

[c] Nominal diameter/wall thickness combinations not covered by this table shall be tested, if required, on the basis of an agreement between the manufacturer and purchaser (user).

[d] For special application.

Table 5 *(continued)*

Type II (−55 °C to 135 °C) (according to ISO 6771)									
DN	Nominal wall thickness[c] mm		Nominal wall thickness[c] mm		Nominal wall thickness[c] mm	Minimum bending stress according to 5.12 MPa			
05	0,4 0,5		0,4 0,5	0,4 0,5	0,4 0,5	130	172	240	138
06			0,4 0,5	0,5	0,5	130	172	240	131
08	0,5		0,5 0,6	0,5	0,6	130	172	240	124
10		1,0	0,6 0,7 0,8 1,0	0,5	0,8	130	172	240	124
12	0,5	1,0	0,8	0,6 0,7[d]	0,9	130	172	240	117
14			1,0	0,8	1,0	130	172	240	117
16	0,5 0,6	1,0	1,0	0,8[d] 1,0	1,2	130	172	240	117
18	0,7			1,0	1,3[d]	130	172	240	110
20	0,7	1,0	1,5	1,2	1,5	130	172	240	110
22	0,8			1,2	1,6	130	172	240	90
25	0,9		1,6	1,4	1,8	130	172	240	90
28	1,0			1,6	2,0	130	172	240	90
32	1,2		2,2			130	172	240	90

[a] R_m min/$R_{p0,2}$ min/A_{min}

[b] Only two specimens need to be tested if rotary flexure test method is used. Six specimens if planar flexure test method is used.

[c] Nominal diameter/wall thickness combinations not covered by this table shall be tested, if required, on the basis of an agreement between the manufacturer and purchaser (user).

[d] For special application.

Table 6 — Flexure fatigue resistance requirements

Type III (−55 °C to 200 °C) (according to ISO 6771)									
Pressure (according to ISO 6771)									
	Class B 14 000 kPa		Class D 21 000 kPa		Class E 28 000 kPa				
Pipe material									
	Cold worked titanium alloy stress relieved	AL-P 6061-T6	Cold worked corrosion resistant steel	Cold worked titanium alloy stress relieved	Cold worked titanium alloy stress relieved	Joining method			
						welded min.			other min.
	according to EN 3120	according to EN 2813	725/515/20[a]	according to EN 3120	according to EN 3120	1×10^7 cycles 6[b] specimens	5×10^5 cycles 2 specimens	5×10^4 cycles 2 specimens	1×10^7 cycles 2[b] specimens
DN	Nominal wall thickness[c] mm		Nominal wall thickness[c] mm		Nominal wall thickness[c] mm	Minimum bending stress according to 5.12 MPa			
05	0,4 0,5			0,4 0,5	0,4 0,5	130	172	240	138
06				0,5	0,5	130	172	240	131
08	0,5	1,0	0,5	0,5	0,6	130	172	240	124
10			0,5	0,5	0,8	130	172	240	124
12	0,5	1,0	0,6 0,7	0,6 0,7[d]	0,9	130	172	240	117
14			0,8	0,8	1,0	130	172	240	117
16	0,5 0,6	1,0	1,0	0,8[d] 1,0	1,2	130	172	240	117
18	0,7		1,0	1,0	1,3[d]	130	172	240	110
20	0,7	1,0	1,2	1,2	1,5	130	172	240	110
22	0,8		1,2	1,2	1,6	130	172	240	90
25	0,9		1,4	1,4	1,8	130	172	240	90
28	1,0		1,6	1,6	2,0	130	172	240	90
32	1,2					130	172	240	90

a R_m min/$R_{p0,2}$ min/A_{min}

b Only two specimens need to be tested if rotary flexure test method is used. Six specimens if planar flexure test method is used.

c Nominal diameter/wall thickness combinations not covered by this table shall be tested, if required, on the basis of an agreement between the manufacturer and purchaser (user).

d For special application.

Table 7 — Acceptance criteria

Union			Tee, elbow, cross		
Class of defect	AQL	Nonconformity on	Class of defect	AQL	Nonconformity on
Major	1,5	— thread length, size and form — overall length — surface treatment — surface finish, radii, chamfer — bore diameter — seal diameter — seal angle — circular run-out inner diameter of the weld end to thread diameter	Major	1,5	— holes (incomplete or missing) — depth of bore — bore diameters — leg length — overall length — angle between legs — surface treatment — surface finish, radii, chamfer — thread length, size and form — assembly of components — seal diameter — seal angle — internal radius at bore junctions
Minor	4,0	— hexagon dimension — marking	Minor	4,0	— marking
Thread end			**Ferrule**		
Class of defect	AQL	Nonconformity on	Class of defect	AQL	Nonconformity on
Major	1,5	— seal diameter — perpendicularity of bearing surface to thread diameter — coaxiality of inner diameter to the outside diameter of pipe — seal angle — bore diameter — thread length, size and form — surface treatment — surface finish, radii, chamfer	Major	1,5	— surface finish, radii, chamfer — bore diameter — outside diameters — coaxiality diameters to outside diameter of pipe — lengths — width of shoulder — seal diameter — seal angle — circular run-out of bearing surfaces for the pipe to outside diameter
Minor	4,0	— hexagon dimension — symmetry of the across flats	Minor	4,0	— marking

Table 7 *(continued)*

Nut			Preparation for delivery		
Class of defect	AQL	Nonconformity on	Class of defect	AQL	Nonconformity on
Major	1,5	— coaxiality diameters to thread diameter — thread length, size and form — bore diameter — thrust-wire hole diameter — overall length — surface treatment — surface finish, radii, chamfer — circular run-out seal area to thread diameter	Major	1,5	— any component (component missing, damaged, or otherwise defective)
Minor	4,0	— hexagon dimension — marking — countersink dimension — symmetry of the across flats	Minor	4,0	— marking (missing, incorrect incomplete, illegible, of improper size, location, sequence or method of application) — number per container (more or less than stipulated) — gross or net weight (exceeds the requirement)

6 Quality assurance

6.1 Product qualification

The qualification procedure for aerospace standard products (e.g. according to EN 9133 or another in aerospace accepted and established qualification procedure) shall be used and documented according to the specified tests if not otherwise agreed between customer and supplier.

The manufacturer's operations shall be an approved production organisation for aerospace products and shall demonstrate that it has implemented and is able to maintain a quality management system (e.g. according to EN 9100 or another in aerospace accepted and established quality management system).

Qualification obtained for tees also covers that of elbows and crosses.

6.2 Quality control records

The manufacturer shall maintain a record of inspection applied to each production batch for a minimum of 5 years. Records of chemical composition analysis, mechanical property tests showing conformance with the applicable material specification and metallurgical tests shall be made available to the purchaser (user) of each delivery batch of coupling parts upon request.

Each delivery batch shall be traceable to its production batch.

6.3 Acceptance conditions

The acceptance of a delivery batch shall be in accordance with 5.2 to 5.7.

Non-destructive tests for inspection of threads, finish, dimensions, marking, surface defects shall be conducted on a sampling basis in accordance with ISO 2859-1.

a) Classification of defects

Defects are classified in Table 7 according to the effect they have on safety and usability. Definition of classes shall be in accordance with ISO 2859-1.

b) Level of inspection

The following acceptable quality levels (AQL) shall apply to the defect classifications shown in Table 7.

Failure class major: AQL 1,5

Failure class minor: AQL 4,0

All defects not identified in Table 7 shall be inspected in accordance with the "minor defect" classification, AQL 4,0.

6.4 Rejection

Parts subjected to non-destructive tests and failing to conform to the requirements of these tests shall be rejected. Parts identified as having major defects during acceptance test require a rejection of all parts as above. Parts identified as having minor defects require the definition of a procedure by the quality assurance department of the purchaser (user).

6.5 Purchaser's (user's) quality control

The purchaser (user) may, on receiving of a delivery batch, proceed to inspect it by using the methods specified in 5.2 to 5.7, in full or in part, to ensure that the items conform to the required quality level, and to determine whether the delivery batch is acceptable.

This inspection may be carried out in the purchaser's (user's) factory, or by special agreement with the manufacturer, in the manufacturer's factory.

7 Preparation for delivery

7.1 Cleaning

Before packaging, all parts shall be free from grease, oil, dirt or other foreign matter. No preservative compound shall be applied.

7.2 Preservation and packaging

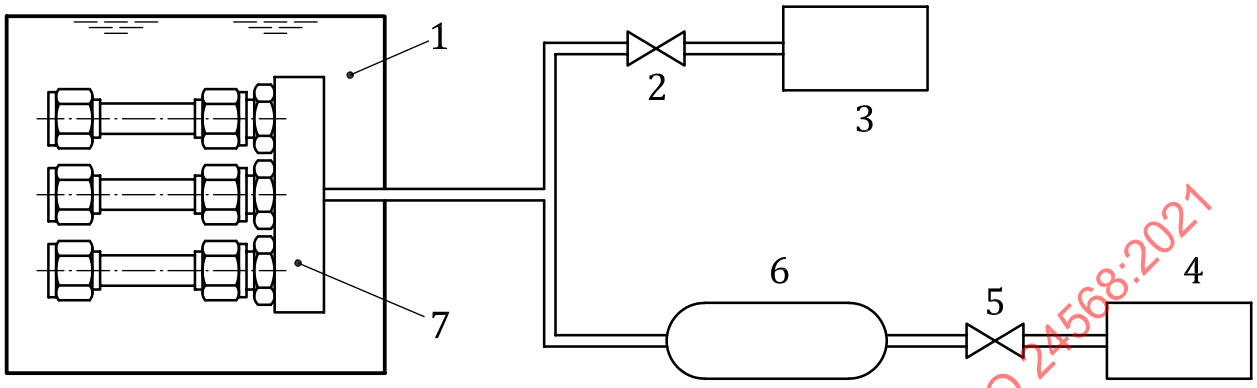
Prior to packaging, couplings or their assembled components shall be protected by capping all threaded ends and pipe attachment ends with caps or plugs to avoid the introduction of foreign matter. Appropriate choice of plastic material, thread tolerances and design of caps/plugs shall prohibit contamination and damage to the dynamic beam seal during transportation or storage.

The parts shall be packed on cardboard flats tightly enclosed by a transparent bag (skin package) to ensure protection from damage. Each flat shall be pre-printed or a label affixed for identification. As an alternative, the parts may be packaged in polyethylene bags with enclosed identification labels or the bags may be pre-printed with the identification.

Unless otherwise agreed, nuts, ferrules and caps of one type and size shall be unit packaged in the quantity per unit as specified in Table 8.

Table 8 — Quantity per unit

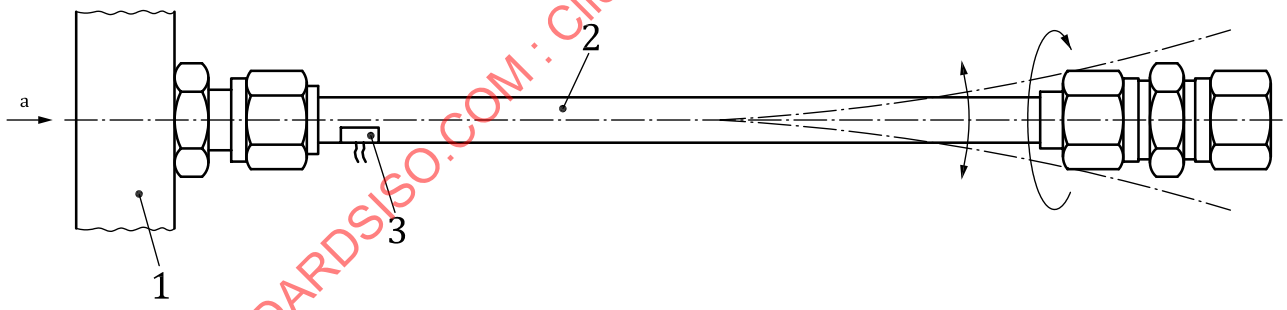
DN	Quantity
05 to 14	100
16 to 32	25



Key

1 water
2 valve for precharging
3 nitrogen source
4 hydraulic pressure source
5 valve
6 accumulator
7 manifold with specimens

Figure 2 — Schematic diagram for gaseous pressure test



Key

1 fixed frame
2 pipe
3 strain gauge
a Nominal pressure.

Figure 3 — Configuration of coupling assemblies for flexure fatigue resistance test