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EAD **200345-00-0103**

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European Assessment Document for

Connectors for tubular sections

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD covers connectors for tubular sections to connect tubular sections (steel pipes) to transfer static loads (in the following referred to as “connector”). The connector is made of steel or stainless steel. The connector is uncoated or treated with an inorganic coating, but not with an organic coating.

The connector consists of 2 steel components that are welded on tubular sections and plugged into each other to connect the tubular sections mechanically. The plugged connection can be fixed by optional components, e.g., bolts, screws, steel pins, steel blocks (possibly ring-shaped). A schematic example of a joint is shown in the following figure.

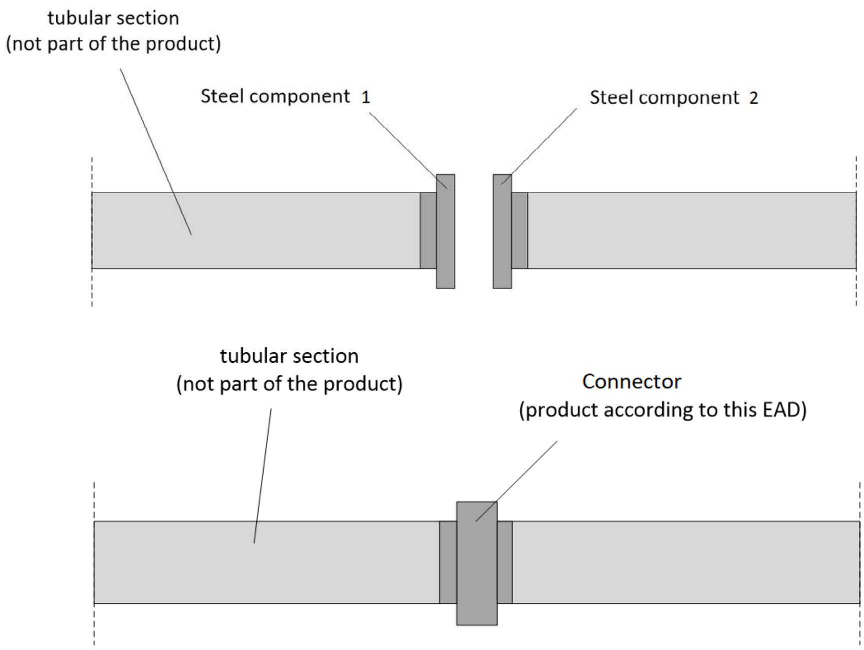


Figure 1.1.1 - Schematic example of a mechanical joint using a connector

The connector transmits forces such as tensile and compressive forces, shear forces, bending moments and torsional moments between the tubular cross sections.

This EAD applies to products whose material properties comply to the relevant European Standards in accordance with EN 1090-2[1], clause 5.1 (constituent products), or the properties of the materials are specified accordingly

For all components of the product the following parameters with the associated test methods are considered material properties:

- Tensile strength properties in analogy to EN ISO 6892-1, clauses 11 to 21, and
- Charpy v-notch impact properties in analogy to EN ISO 148-1.

And for components to be welded (components 1 and 2), the following additional material properties are considered:

- Chemical composition (CEV) (weldability) in accordance with EN 10025-1, clause 7.2.3The product is not covered by a harmonised European standard (hEN).

1 All undated references to standards in this EAD are to be understood as references to the dated versions listed in chapter 4.

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations, e.g., with regard to the intended end use conditions, having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA as long as the details of the assessment methods as laid down in this EAD are respected.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The intended use of the connector is to connect two tubular sections to each other to transfer static and quasi-static loads. The loads can comprise, compression forces (in longitudinal direction), tension forces (in longitudinal direction), shear forces, bending moments and torsional moments.

The intended use comprises connected tubular sections that are designed following EN 1993-1-1 and EN 1993-1-6.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the connector for the intended use of 100 years when installed in the works (provided that the connector is subject to appropriate installation). These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[2].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

2 The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

1.3 Specific terms used in this EAD

1.3.1 Symbols

A_{gt}	[%]	Elongation at fracture
CEV	[-]	Carbon equivalent (weldability)
d_t	[mm]	Outer nominal diameter of a tubular section
F	[kN]	Force applied to the test specimens in tests and increased
F_C	[kN]	Maximum linear elastic load-bearing capacity of the joint in compression, defined as force at a deformation of 0,05 u_{Fmax} in compression tests
$F_{C,Rk}$	[kN]	Compression resistance of the joint
$F_{int,joint}$	[kN]	maximum linear elastic load-bearing capacity of the joint to bending, defined as bending moment at a deformation of 0,05 u_{Fmax} in combined acting load tests (interacting)
F_{max}	[kN]	Maximum test force achieved in a test
F_T	[kN]	Maximum linear elastic load-bearing capacity of the joint in tension, defined as force at a deformation of 0,05 u_{Fmax} in tension tests
$F_{T,Rk}$	[kN]	Tension resistance of the joint
$\overline{KV}$	[J; °C]	Charpy impact strength with v-notch
L, L_1, L_2	[mm]	Distances and lengths of the test specimens defined as a function of the outer diameter of the adjoining tubular sections
M_{Rk}	[kNm]	Bending resistance of the joint
$M_{T,Rk}$	[kNm]	Torsional resistance of the joint
$M_{int,Rk}$	[kNm]	Bending resistance interaction forces
M_{joint}	[kNm]	maximum linear elastic load-bearing capacity of the joint to bending, defined as bending moment at a deformation of 0,05 u_{Fmax} in bending tests
$M_{joint,max}$	[kNm]	maximum bending moment achieved in a test
$M_{T,joint}$	[kNm]	maximum linear elastic load-bearing capacity to torsion of the joint, defined as torsional moment at a deformation angle of 0,05 α_{Fmax}
$M_{T,max}$	[kNm]	maximum torsion moment achieved in a test
$M_{int,joint}$	[kNm]	maximum linear elastic load-bearing capacity of the joint to bending, defined as bending moment at a deformation of 0,05 u_{Fmax} in combined acting load tests (interacting)
$R_{p0.2}$	[N/mm²]	Yield strength
R_m	[N/mm²]	Tensile strength
t_t	[mm]	Wall thickness of a tubular section
b	[mm]	Pipe segment length in tensile and compression tests
u, u_1, u_2	[mm]	Measured deformations in tests

u_{Fmax}	[mm]	Measured deformation when reaching maximum internal forces F_{max}, $V_{joint,max}$ or $M_{joint,max}$ in tests
V_{Rk}	[kN]	Shear resistance of the joint
$V_{int,Rk}$	[kN]	Shear resistance interaction forces
V_{joint}	[kN]	Maximum linear elastic load-bearing capacity of the joint to shear stress, defined as force at a deformation of 0,05 u_{Fmax} in shear tests
$V_{int,join}$	[kN]	Maximum linear elastic load-bearing capacity of the joint to shear stress, defined as force at a deformation of 0,05 u_{Fmax} in combined acting load tests (interacting)
$V_{joint,max}$	[kN]	maximum shear stress achieved in a test
w	[mm]	Spacing between two measuring points on which the determination of a strain measurement is based in tests
w_{ini}	[mm]	initial distance w before the test
$w_{measured}$	[mm]	measured distance w during the test
α, α_1, α_2	[°]	Measured rotation angles in tests
α_{Fmax}	[°]	Measured rotation angle when reaching maximum torsion moment $M_{T,max}$ in tests

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1.1 shows how the performance of connector is assessed in relation to the essential characteristics.

Table 2.1.1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability			
Material properties of steel component 1 and steel component 2			
1	Carbon equivalent (weldability)	2.2.1	Level CEV [-]
2	Charpy impact strength with v-notch	2.2.2	Level $\overline{KV}$ [J; °C]
3	Yield strength, tensile strength, elongation at fracture	2.2.3	Level $R_{p0.2}$ [N/mm²], R_m [N/mm²], A_{gt} [%]
Resistance of the connection			
4	Tension resistance of the joint	2.2.4	Level $F_{T,Rk}$ [kN]
5	Compression resistance of the joint	2.2.5	Level $F_{C,Rk}$ [kN]
6	Shear resistance of the joint	2.2.6	Level V_{Rk} [kN]
7	Bending resistance of the joint	2.2.7	Level M_{Rk} [kNm]
8	Torsional resistance of the joint	2.2.8	Level $M_{T,Rk}$ [kNm]
9	Resistance for combined acting shear forces and bending moments (interaction)	2.2.9	Level $M_{R,i,k}$ [kNm], $V_{R,i,k}$ [kN]
Basic Works Requirement 2: Safety in case of fire			
10	Reaction to fire	2.2.10	Class

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

If for any components covered by harmonised standards or European Technical Assessments the manufacturer of the component has included the performance regarding the relevant essential characteristic in the Declaration of Performance, retesting of that component for issuing the ETA under the current EAD is not required.

The conditions regarding the tubular sections which were applied for the assessment of the connector, such as material properties, chemical composition, yield strength, weldability, etc., shall be specified in the ETA.

In the tests according to this EAD, the tubular sections can be reinforced by stiffening plates to prevent premature failure (such as buckling) and ensure mechanical joint assessment. Stiffening plates are round steel plates with a thickness that is at least equal to the wall thickness of the pipe. Their tensile strength is at least equal to that of the pipe. The outer diameter of the steel plate is slightly smaller (for installation less than or equal to 5 mm) than the inner diameter of the pipe, and they are rigidly welded to the pipe.

2.2.1 Carbon equivalent (weldability)

Purpose of the assessment

The assessment in this clause refers to the carbon equivalent CEV (weldability) of steel components 1 and 2 which are welded to tubular sections.

Assessment method

In a chemical analysis, the chemical constituents C (carbon), Mn (manganese), Cr (chromium), Mo (molybdenum), V (vanadium), Ni (nickel) and Cu (copper) shall be determined in accordance with EN ISO 15350 for Carbon (C) and in accordance with EN 10315 for Mn (manganese), Cr (chromium), Mo (molybdenum), V (vanadium), Ni (nickel) and Cu (copper). The respective method used (A, B or C) in accordance with EN ISO 15350 shall be given in the ETA.

At least 3 specimens shall be tested.

If components are made of the same material, one value is sufficient (CEV). If they are made of different materials, testing and assessment shall be carried out and the results given separately for each component (CEV_1 and CEV_2).

Expression of results

The mean values of the above-mentioned chemical components shall be determined from the test results and the carbon equivalent CEV [-] shall be calculated in accordance with EN 10025-1, clause 7.2.3, and given in the ETA.

2.2.2 Charpy impact strength with v-notch

Purpose of the assessment

The assessment in this clause refers to the charpy impact strength with v-notch $\overline{KV}$ of steel components 1 and 2.

Assessment method

The test is carried out on specimens manufactured specifically for the test from the same materials as the component.

The charpy impact strength $\overline{KV}$ shall be assessed in accordance with EN ISO 148-1 using the v-notch and a 2,0 mm Hammer-nose. At least 3 specimens shall be tested.If components are made of the same material, one value is sufficient ($\overline{KV}$). If they are made of different materials, testing and assessment shall be carried out and the results given separately for each component ($\overline{KV}_1$ and $\overline{KV}_2$).

Expression of results

The charpy impact strength with v-notch - $\overline{KV}$ [J; °C] shall be calculated as the mean value of the test results and shall be given in the ETA.

2.2.3 Yield strength, tensile strength, elongation at fracture

Purpose of the assessment

The assessment in this clause refers to the yield strength $R_{p0.2}$[3], tensile strength R_m and the elongation at fracture A_{gt} of steel components 1 and 2.

Assessment method

The test is carried out on specimens manufactured specifically for the test from the same materials as the component.

The yield strength $R_{p0.2}$, the tensile strength R_m, and the elongation at fracture A_{gt} shall be assessed in accordance with EN ISO 6892-1, clause 10.3.2, using a round specimen. The method used (closed loop or open loop) shall be given in the ETA.

By default, test-specimens B 10 x 50 in accordance with Annex A, Figure A.7 shall be used. Deviating test specimens can be used if the following boundary conditions are met:

- The test specimen shall be a roundspecimen.
- The diameter of the round specimen shall be minimum 30% of the thickness of the testing steel component.

Deviating tests specimens shall be stated in the ETA.

At least 3 specimens shall be tested.

If components are made of the same material, one value is sufficient ($R_{p0.2}$, R_m, A_{gt}). If they are made of different materials, testing and assessment shall be carried out and the results given separately for each component ($R_{m,1}$, $R_{m,2}$, $R_{p0.2,1}$, $R_{p0.2,2}$, $A_{gt,1}$ and $A_{gt,2}$).

Expression of results

The yield strength $R_{p0.2}$ [N/mm²], tensile strength R_m [N/mm²] and elongation at fracture A_{gt} [%] shall be calculated by the averaging of the test results and shall be given in the ETA.

3 with Rp (yield strength at plastic extensometer strain) and ep (specified plastic extensometer strain) =0,2 %

2.2.4 Tension resistance of the joint

Purpose of the assessment

Assessment of the tensile resistance $F_{T,Rk}$ of the mechanical joint.

Assessment method

The tension resistance of the mechanical joint shall be assessed by tension tests including segments of the connected steel tubular sections. The test set-up is shown in Annex A, Figure A.1.

The tubular section is not part of the product; nevertheless, it is an indispensable part of the assessment method. The tubular section shall be welded to the product.A default tubular section with the following properties shall be used:

- The outer and inner diameter are identical to the diameters of the product.
- The material to be used is S235 in accordance with EN 10025-1.
- The default length of each tubular section is 1*d_t.

In addition, based on the wish of the manufacturer other deviating tubular sections can be used. The used tubular section shall be stated in the ETA including the material properties, dimensions and the free length between grips.

To introduce the loading, a front plate shall be welded to the tubular section. The welding is not part of the assessment.

At least 3 tests shall be performed.

The testing speed shall be d_t [mm]/1000 / min +- 1 mm/min. The deformation measurement u shall be based on:

$$u = w_{ini} - w_{measured}$$

During the test, the ultimate loads, the load-deformation curves and the failure mode shall be recorded. The test load shall be increased until failure of the specimen occurs.

The maximum linear elastic load-bearing capacity F_T of the joint is defined as force at a deformation of 0,05 u_{Fmax}, where u_{Fmax} corresponds to the deformation, when the maximum force F_{max} is reached in the tensile test, as shown in Figure 2.2.4.1.

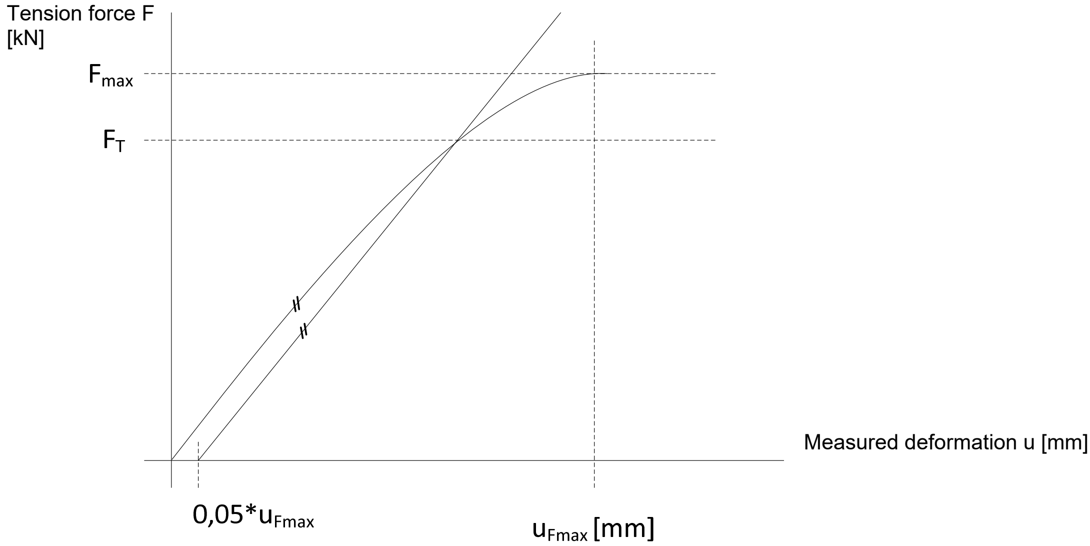


Figure 2.2.4.1: Force-deformation diagram and definition of F_T (at u = 5% of u_{Fmax})

If failure occurred due to failure of a tubular section, the failure is defined as failure of the product.

If failure occurred to the welded plate for load introduction and/or its welding to the tubular section, the plate and/or its welding shall be enlarged and the test repeated until failure occurs in the connector or in a tubular section.

Expression of results

The statistical evaluation of the test series shall be done in accordance with EN 1990, Annex D. The statistically calculated result (5% fractile) $F_{T,Rk}$ shall be determined in accordance with EN 1990, clause D.7.2, assuming a normal distribution of the results.

The tension resistance $F_{T,Rk}$ shall be given in the ETA.

2.2.5 Compression resistance of the joint

Purpose of the assessment

Assessment of the compression resistance $F_{C,Rk}$ of the mechanical joint.

Assessment method

The compression resistance of the connector shall be assessed by compression tests including segments of the connected steel tubular sections. The test set-up is shown in Annex A, Figure A.2.

At least 3 tests shall be performed.

The total testing time shall not be below 5 minutes. The deformation measurement shall be based on a distance of $w = 2d_t$. During the test, the ultimate loads, the load-deformation curves and the failure mode shall be recorded.

The maximum linear elastic load-bearing capacity F_C of the joint is defined as force at a deformation of 0,05 u_{Fmax}, where u_{Fmax} corresponds to the deformation, when the maximum force F_{max} is reached in the compression test, as shown in Figure 2.2.5.1.

If no further load increase is achieved or if a deformation u ≥ 0.2 b is reached, the test shall be finished and assessed with the measured values.

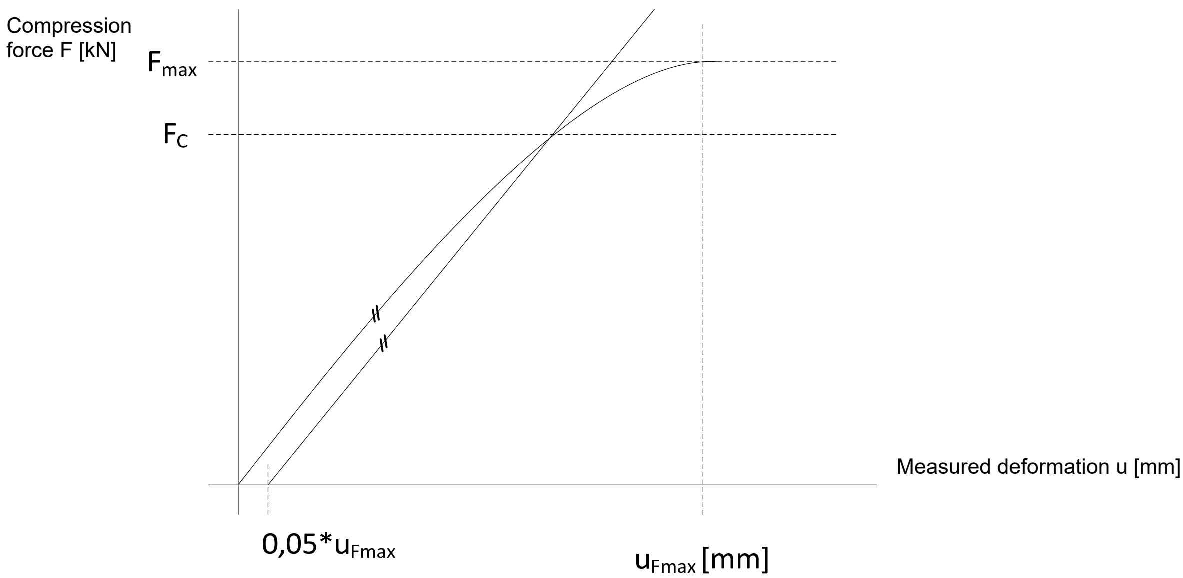


Figure 2.2.5.1: Force-deformation diagram and definition of F_C (at u = 5% of u_{Fmax})

The tubular section is not part of the product; nevertheless, it is an indispensable part of the assessment method.

A default tubular section with the following properties shall be used:

- The outer and inner diameter are identical to the product.
- The material to be used is S235 in accordance with EN 10025-1.
- The default length of each tubular section is $1*d_t$.

In addition, based on the wish of the manufacturer other deviating tubular sections can be used.

The used tubular section shall be stated in the ETA including the material properties, dimensions and the free length between grips.

To introduce the loading, a front plate shall be welded to the tubular section. The welding is not part of the assessment.

The tubular section shall be welded to the product.

If failure occurred due to failure of a tubular section, the failure is defined as failure of the product.

If failure occurred to the welded plate for load introduction and/or its welding to a tubular section, the plate and/or its welding shall be enlarged and the test repeated until failure occurs in the connector.

The testing speed shall be d_t [mm]/1000 / min +- 1 mm/min.

To avoid buckling of the tubular section, additional stiffeners can be used. The stiffeners shall have the same thickness and be made of the same material as the tubular section. The used stiffeners shall be stated in the ETA.

Expression of results

The statistical evaluation of the test series shall be done according EN 1990, Annex D. The statistically calculated result (5% fractile) $F_{C,Rk}$ shall be determined according to EN 1990, clause D.7.2, assuming a normal distribution of the results.

The compression resistance $F_{C,Rk}$ shall be given in the ETA.

2.2.6 Shear resistance of the joint

Purpose of the assessment

Assessment of the shear resistance V_{Rk} of the mechanical joint.

Assessment method

The shear resistance of the mechanical joint shall be assessed by shear tests including segments of the connected steel tubular sections. The test set-up is shown in Annex A, Figure A.3.

At least 3 tests shall be performed.

The total testing time shall not be below 5 minutes. The deformation measurement results fromu = max {u1; u2} in accordance with Annex A, Figure A.3. During the test, the ultimate loads, the load-deformation curves and the failure mode shall be recorded.

The load shall be introduced uniformly using semi-circular sections that fit the tubular sections.

The maximum linear elastic load-bearing capacity to shear stress V_{joint} of the joint is defined as force at a deformation of 0,05 u_{Fmax}, where u_{Fmax} corresponds to the deformation, when the maximum shear stress $V_{joint,max}$ is reached in the shear test, as shown in Figure 2.2.6.1.

If no further load increase is achieved or if a deformation u of 10% of the length L_1 is reached, the test shall be finished and assessed with the measured values.

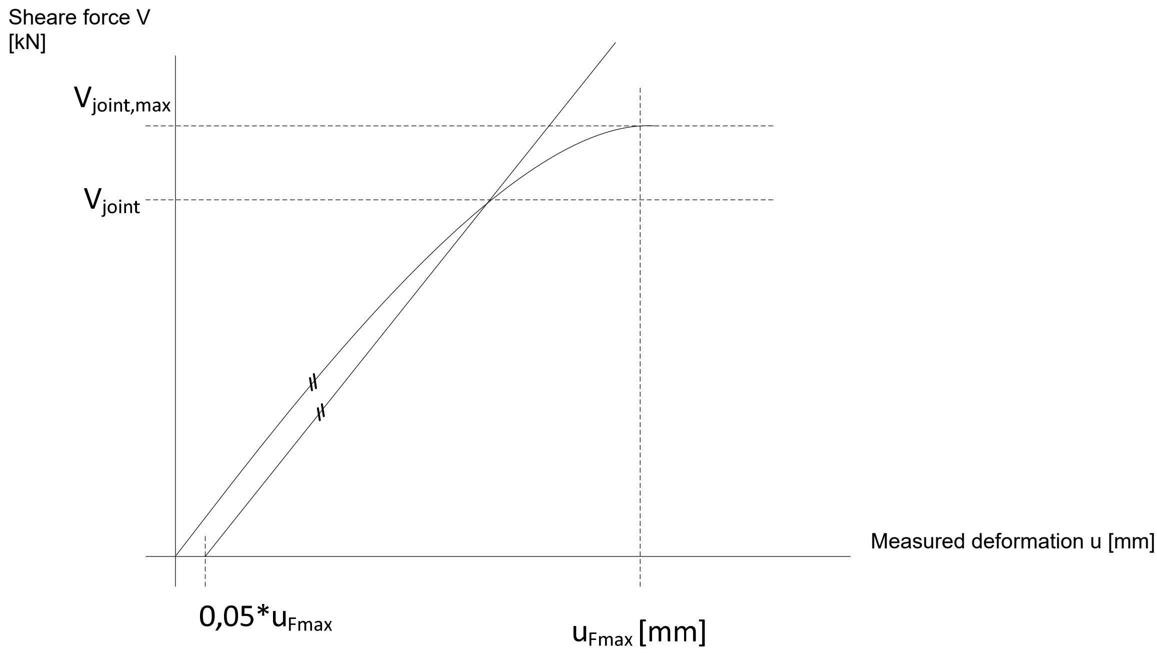


Figure 2.2.6.1: Force-deformation diagram and definition of V_{joint} (at u = 5% of u_{Fmax})

The shear force in the joint shall be calculated from the test force F and its geometric distances L_1 and L_2 (see Annex A, Figure A.3) as follows.

$$V_{joint} = \frac{F \cdot L_2}{L_1 + L_2} \qquad (2.2.6.1)$$

with

V_{joint} Shear loading in the joint

F Measured force introduced to the test setup

L_1 Distance in accordance with Annex 3

L_2 Distance in accordance with Annex 3

Expression of results

The statistical evaluation of the test series shall be done in accordance with EN 1990, Annex D. The statistically calculated result (5% fractile) V_{Rk} shall be determined in accordance with EN 1990, clause D.7.2, assuming a normal distribution of the results.

The shear resistance V_{Rk} shall be given in the ETA.

2.2.7 Bending resistance of the joint

Purpose of the assessment

Assessment of the bending resistance M_{Rk} of the mechanical joint.

Assessment method

The bending resistance of the mechanical joint shall be assessed by bending tests including segments of the connected steel tubular sections. The test set-up is shown in Annex A, Figure A.4.

At least 3 tests shall be performed.

The total testing time shall not be below 5 minutes. The deformation measurement results from u = max {u_1; u_2} in accordance with Annex A, Figure A.4. During the test, the ultimate loads, the load-deformation curves and the failure mode shall be recorded. The test load shall be increased until failure of the specimen occurs.

The maximum linear elastic load-bearing capacity to bending M_{joint} of the joint is defined as bending moment at a deformation of 0,05 u_{Fmax}, where u_{Fmax} corresponds to the deformation, when the maximum bending moment $M_{joint,max}$ is reached in the bending test, as shown in Figure 2.2.7.1.

If no further load increase is achieved or if a deformation u of 10% of the length L_1 is reached, the test shall be finished and assessed with the measured values.

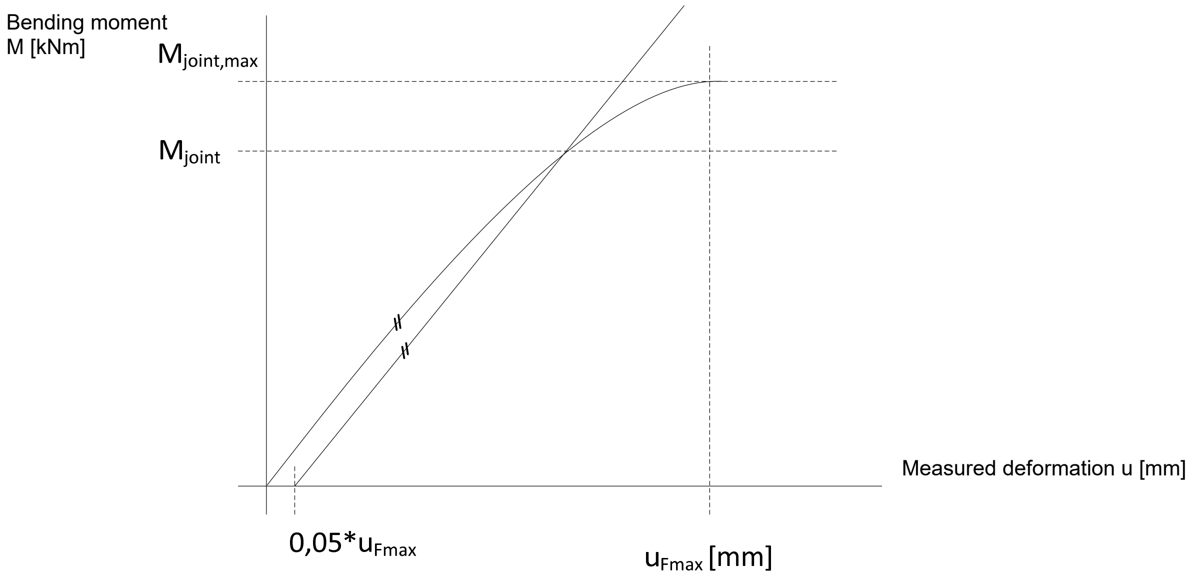


Figure 2.2.7.1: Force-deformation diagram and definition of M_{joint} (at u = 5% of u_{Fmax})

The bending moment in the joint shall be calculated from the test force F and its geometric distance L_2 (see Annex A, Figure A.4) as follows:

$$M_{joint} = \frac{F \cdot L_2}{2} \qquad (2.2.7.1)$$

with

M_{joint} Bending loading in the joint

F Measured force introduced to the test setup

L_2 Distance in accordance with Annex A, Figure A.4

Expression of results

The statistical evaluation of the test series shall be done in accordance with EN 1990, Annex D. The statistically calculated result (5% fractile) M_{Rk} shall be determined in accordance with EN 1990, clause D.7.2, assuming a normal distribution of the results.

The bending resistance M_{Rk} shall be given in the ETA.

2.2.8 Torsional resistance of the joint

Purpose of the assessment

Assessment of the torsional resistance $M_{T,Rk}$ of the mechanical joint.

Assessment method

The torsional resistance of the mechanical joint shall be assessed by torsional tests including segments of the connected steel tubular sections. The test set-up is shown in Annex A, Figure A.5.

At least 3 tests shall be performed.

The total testing time shall not be below 5 minutes. The deformation measurement of the rotation angle is $\alpha = \max \{ |\alpha_1|, |\alpha_2| \}$ measured in a distance of d_t to the joint. The measurement of the rotation angle shall be performed in relation to the initial position. During the test, the ultimate load, the load-deformation curve and the failure mode shall be recorded.

If no further load increase is achieved or if a total rotation angle of 10° is reached, the test shall be finished and assessed with the measured values.

The load shall be introduced uniformly.

The maximum linear elastic load-bearing capacity to torsion $M_{T,joint}$ of the joint is defined as torsional moment at a deformation angle of 0,05 α_{Fmax} where α_{Fmax} corresponds to the deformation angle, when the maximum torsional moment $M_{T,max}$ is reached in the torsional test, as shown in Figure 2.2.8.1.

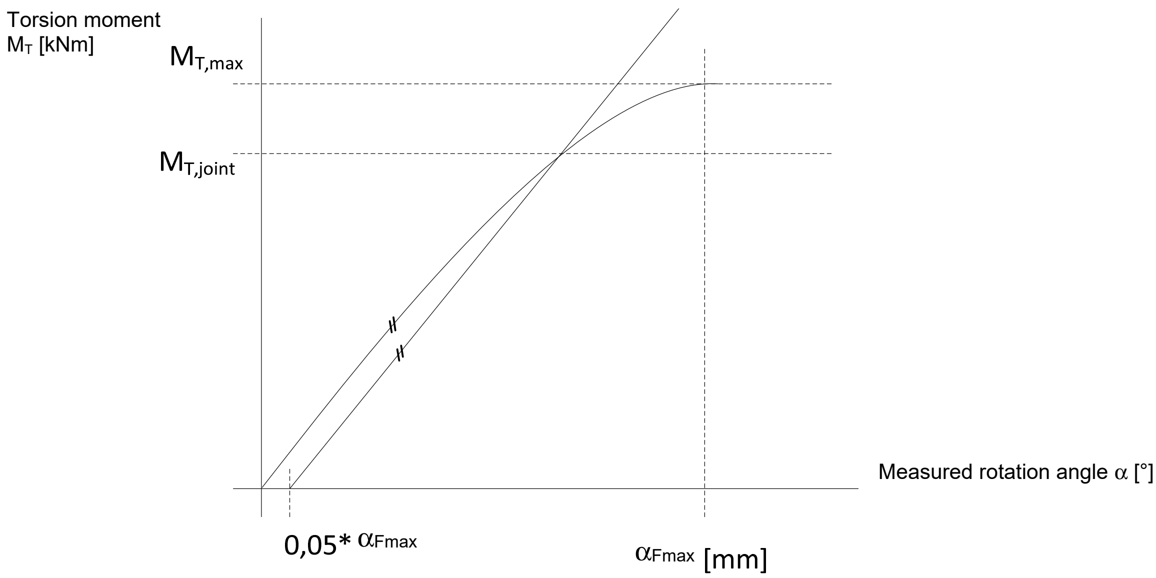


Figure 2.2.8.1: Force-deformation diagram and definition of $M_{T,joint}$ (at α = 5%of α_{Fmax})

The torsional moment in the joint shall be calculated from the test force F and its geometric distance L (see Annex A, Figure A.5) as follows:

$$M_{T,joint} = F \cdot L \qquad (2.2.8.1)$$

with

$M_{T,joint}$ Torsional moment in the joint

F Measured force introduced to the test setup

L Distance according to Annex A, Figure A.5

Expression of results

The statistical evaluation of the test series shall be done in accordance with EN 1990, Annex D. The statistically calculated result (5% fractile) $M_{T,Rk}$ shall be determined in accordance with EN 1990, clause D.7.2, assuming a normal distribution of the results.

The torsional resistance $M_{T,Rk}$ shall be given in the ETA.

2.2.9 Resistance for combined acting shear forces and bending moments (interaction)

Purpose of the assessment

Assessment of the resistance of combined acting shear forces $V_{int,joint}$ and bending moments $M_{int,joint}$ of the mechanical joint.

Assessment method

The resistance of combined acting shear forces and bending moments of the mechanical joint shall be assessed by bending tests including segments of the connected steel tubular sections where the joint is subjected to both shear and bending loads. The test set-up is shown in Annex A, Figure A.6.

At least 3 tests shall be performed.

The total testing time shall not be below 5 minutes. The deformation measurement results from u = max {u_1; u_2} in accordance with Annex A, Figure A.6. During the test, the ultimate load, the load-deformation curve and the failure mode shall be recorded.

The load shall be introduced uniformly.

The maximum linear elastic load-bearing capacity to combined shear and bending $F_{int,joint}$ ($M_{int,joint}$ and $V_{int,joint}$) of the joint is defined as bending moment and shear stress at a deformation of 0,05 u_{Fmax}, where u_{Fmax} corresponds to the deformation, when the maximum force $F_{int,max}$ is reached in the combined acting test, as shown in Figure 2.2.9.1.

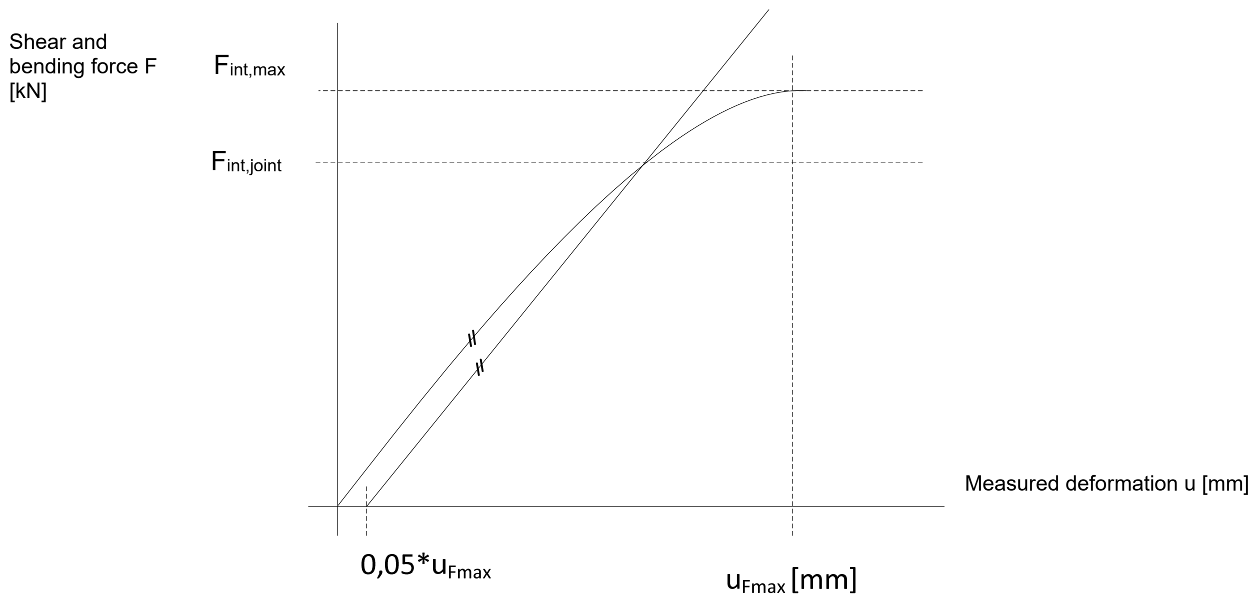


Figure 2.2.9.1 - Force-deformation diagram and definition of $F_{int,joint}$ (at u = 5% of u_{Fmax})

The bending moment $M_{int,joint}$ in the joint under combined acting load shall be calculated from the test force F and its geometric distances L_1 and L_2 (see Annex A, Figure A.6) as follows:

$$M_{int,joint} = \frac{F \cdot (L_2 - L_1)}{2} \quad (2.2.9.1)$$

with

$M_{int,joint}$	Bending moment in the joint in the combined acting test
F	Measured force introduced to the test setup
L_1	Distance in accordance with Annex A, Figure A.6
L_2	Distance in accordance with Annex A, Figure A.6

The shear stress $V_{int,joint}$ in the joint under combined acting load shall be calculated from the test force F (see Annex A, Figure A.6) as follows:

$$V_{int,joint}=\frac{F}{2} \qquad (2.2.9.2)$$

with:

$V_{int,joint}$	Shear stress in the joint in the combined acting test
F	Measured force introduced to the test setup

Expression of results

The statistical evaluation of the test series shall be done in accordance with EN 1990, Annex D. The statistically calculated results (5% fractile) $V_{int,Rk}$ and $M_{int,Rk}$ shall be determined in accordance with EN 1990, clause D.7.2, assuming a normal distribution of the results.

The resistance for combined acting shear forces and bending moments $V_{int,Rk}$ and $M_{int,Rk}$ shall be given in the ETA.

2.2.10 Reaction to fire

The connector for tubular sections is considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire in accordance with the Commission Decision 96/603/EC, as amended by Commission Decisions 2000/605/EC and 2003/424/EC, without the need for testing on the basis of it fulfilling the conditions set out in that Decision and its intended use being covered by that Decision.

Therefore, when the conditions referred to above are fulfilled, the performance of the product is class A1 which shall be given in the ETA.

3 SYSTEM(S) OF ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE TO BE APPLIED

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is Commission Decision 98/214/EC, as amended by 2001/596/EC.

The system is **2+**.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.2.1.

For kits: The manufacturer (regarding the components he buys from the market with DoP) shall take into account the Declaration of Performance issued by the manufacturer of that component. No retesting is necessary.

Table 3.2.1 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
1	Check of material properties and chemical composition	Inspection document 3.1. in accordance with to EN 10204	According to the control plan	-	Every batch
2	Geometry and Dimensions	Check of Geometry, Dimensions and Tolerances	According to the control plan	10	Every batch

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for the connector are laid down in Table 3.3.1.

Table 3.3.1 Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control *(for systems 1+, 1 and 2+ only)*					
1	Notified Body will ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the connector	Verification of the complete FPC as described in the control plan agreed between the TAB and the manufacturer	According to Control plan	According to Control plan	When starting the production or a new line
Continuous surveillance, assessment and evaluation of factory production control *(for systems 1+, 1 and 2+ only)*					
2	The Notified Body will ascertain that the system of factory production control and the specified manufacturing process are maintained taking account of the control plan.	Verification of the controls carried out by the manufacturer as described in the control plan agreed between the TAB and the manufacturer with reference to the raw materials, to the process and to the product as indicated in Table 3.2.1	According to Control plan	According to Control plan	1/year

4 REFERENCE DOCUMENTS

EN 1090-2:2018+A1:2024	Execution of steel structures and aluminium structures – Part 2: Technical requirements for steel structures
EN 1990:2023	Eurocode: Basis of structural and geotechnical design
EN 1993-1-1:2022	Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings
EN 1993-1-6:2025	Eurocode 3 - Design of steel structures - Part 1-6: Strength and stability of shell structures
EN 10025-1:2004	Hot rolled products of structural steels - Part 1: General technical delivery conditions
EN 10204:2004	Metallic products - Types of inspection documents
EN 10315:2006	Routine method for analysis of high alloy steel by X-ray Fluorescence Spectrometry (XRF) by using a near by technique
EN 13501-1:2018	Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests
EN ISO 148-1:2016	Metallic materials – Charpy pendulum impact test – Part 1: Test method (ISO 148-1:2016)
EN ISO 6892-1:2019	Metallic materials – Tensile testing – Part 1: Method of test at room temperature (ISO 6892-1:2019)
EN ISO 15350:2010	Steel and iron - Determination of total carbon and sulfur content - Infrared absorption method after combustion in an induction furnace (routine method) (ISO 15350:2000)

ANNEX A TEST STANDS DESCRIPTION AND DETAILING

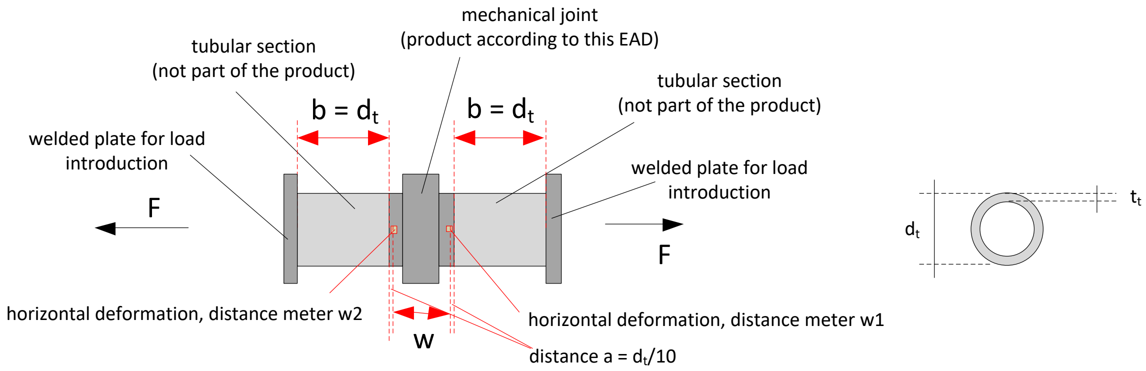


Figure A.1: Schematic diagram of test stand for tensile tests

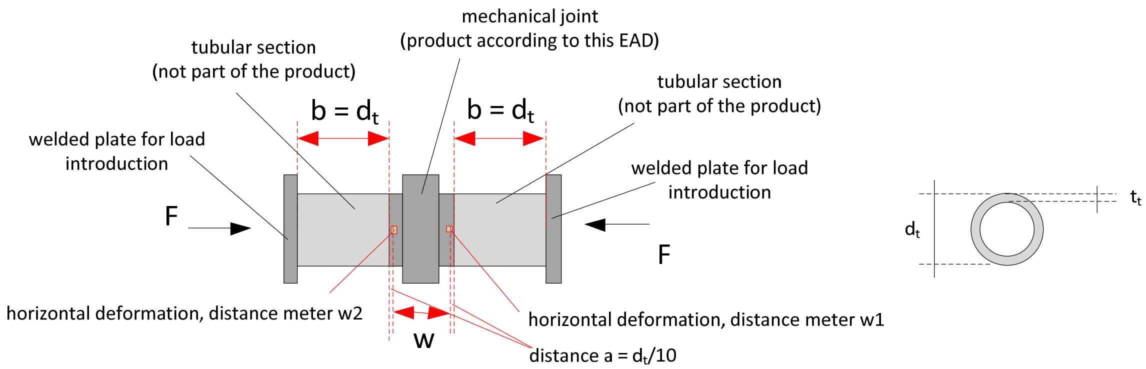


Figure A.2: Schematic diagram of test stand for compression tests

t_t

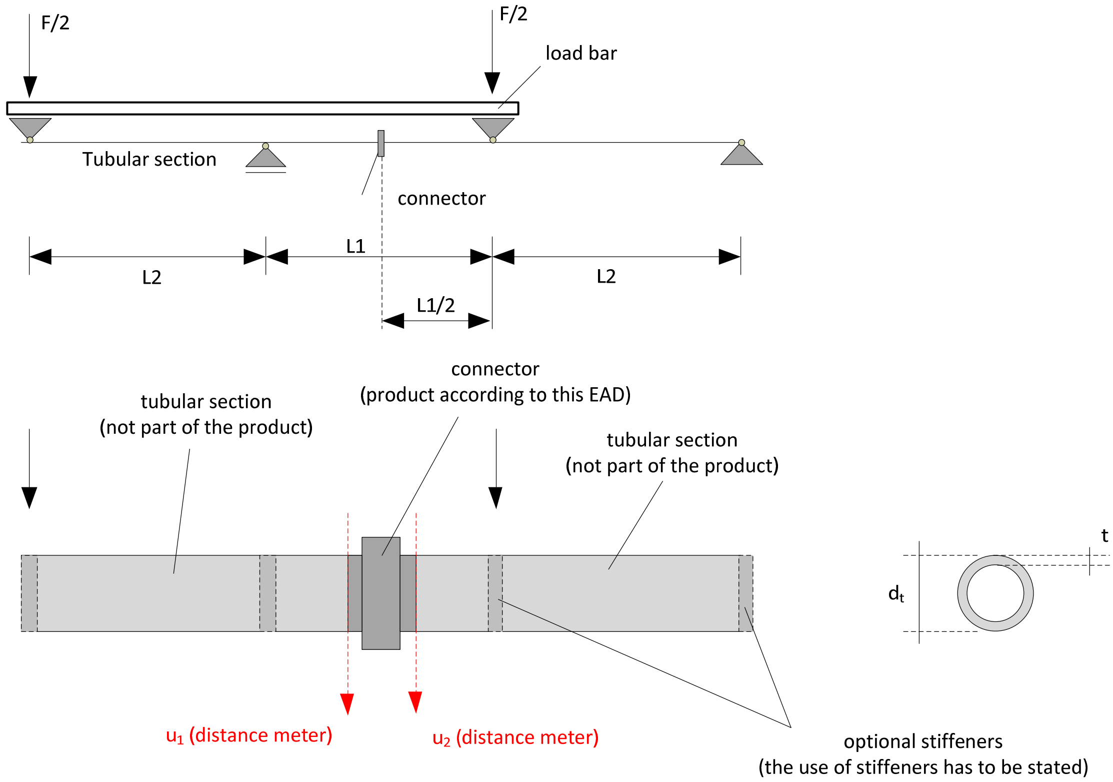


Figure A.3: Schematic diagram of test stand for shear tests

To avoid buckling of the tubular section, optional stiffeners can be used at the load introduction points. The stiffeners shall have the same thickness and be made of the same material as the tubular section. The use of stiffeners shall be stated in the ETA.

with

common default value $L_1 = 1{,}5d_t$ (recommended range: $L_1 \leq 3d_t$)

common default value $L_2 = 4{,}5d_t$ (recommended range: $2d_t \leq L_2 \leq 7d_t$)

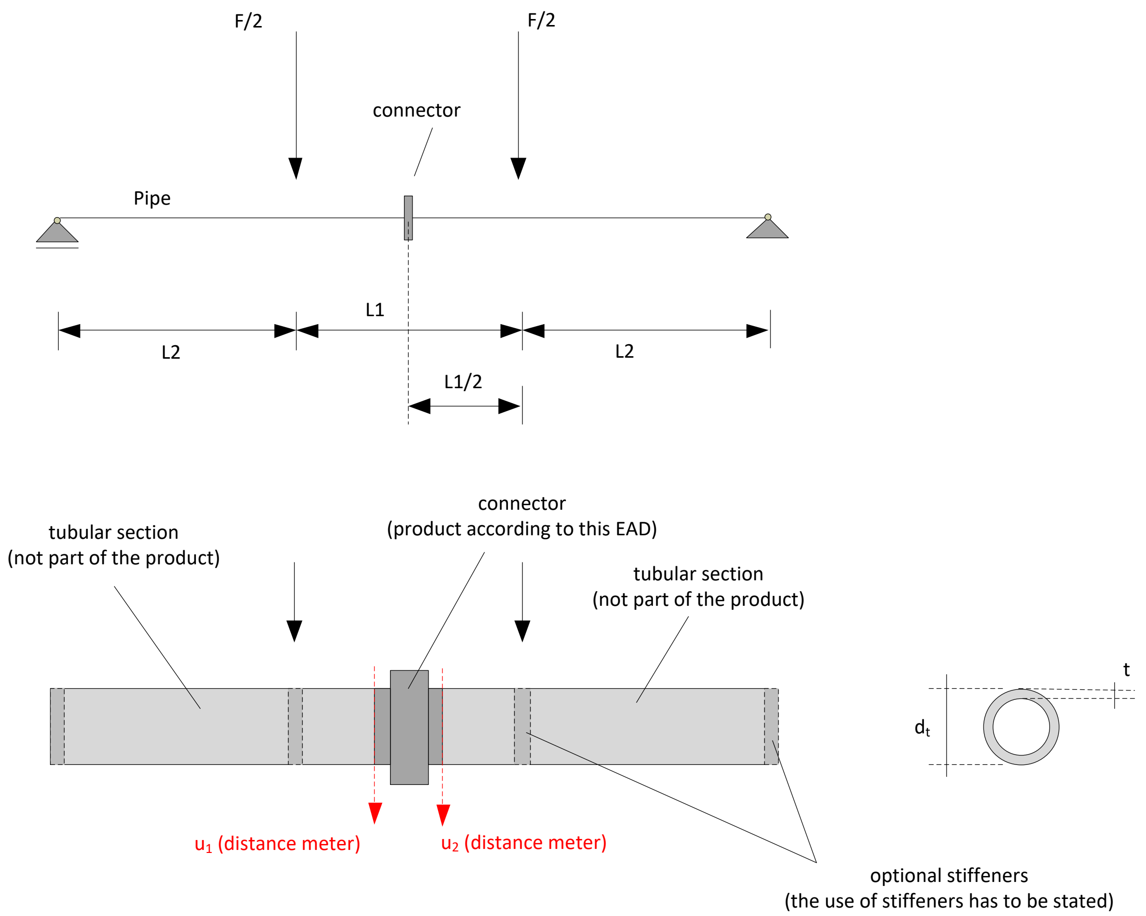


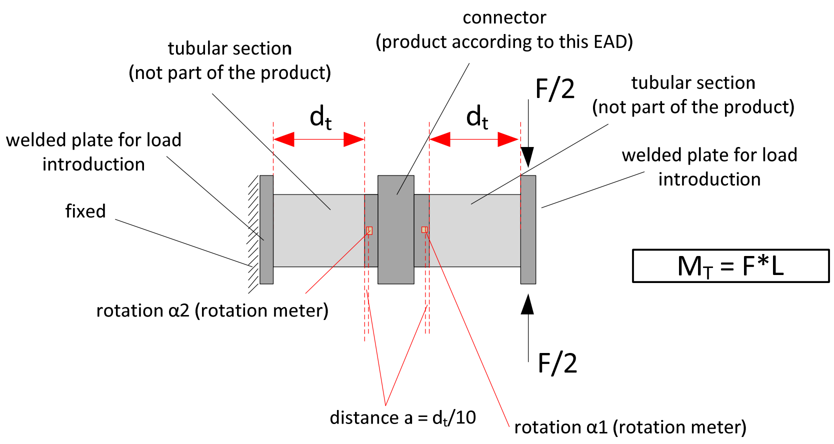
Figure A.4: Schematic diagram of test stand for bending tests

To avoid buckling of the tubular section, optional stiffeners can be used at the load introduction points. The stiffeners shall have the same thickness and be made of the same material as the tubular section. The use of stiffeners shall be stated in the ETA.

with

common default value $L_1 = 1{,}5d_t$ (recommended range $L_1 \leq 3d_t$)

common default value $L_2 = 5{,}5d_t$ (recommended range $3d_t \leq L_2 \leq 8d_t$)



α illustrate the measurement of angles α_1 and α_2. For the location of the measurement, see the figure left.

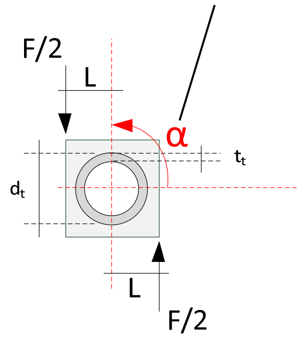


Figure A.5: Schematic diagram of test stand for torsional tests

with

$M_T = F \cdot L$ (A.1)

common default value $L = 2d_t$ (recommended range $1d_t \leq L \leq 3d_t$)

α_1 and α_2 are the measuring points and at the same time the angle of twist measured on the tube in relation to the initial position. The total rotation angle α shall be calculated from $\alpha = \alpha_1 + \alpha_2$.

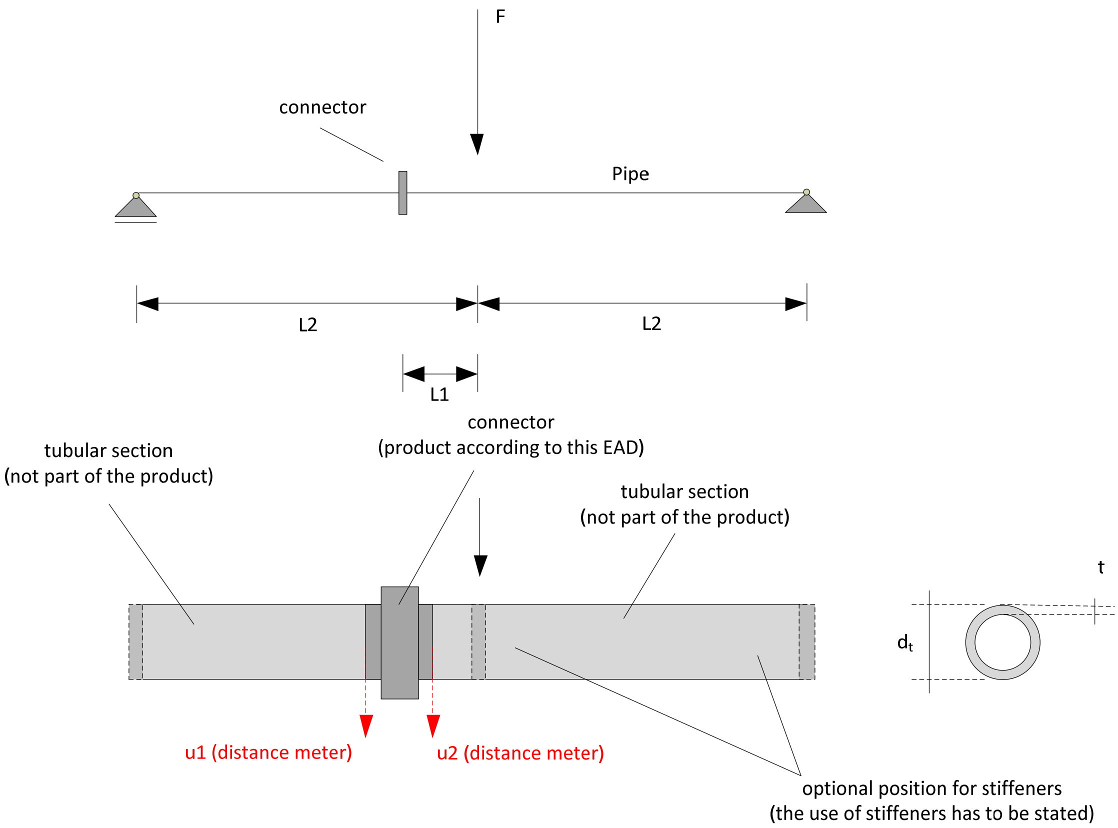


Figure A.6: Schematic diagram of test stand for bending tests where the joint is subjected to both shear and bending loads

To avoid buckling of the tubular section, optional stiffeners can be used at the load introduction points. The stiffeners shall have the same thickness and be made of the same material as the tubular section. The use of stiffeners shall be stated in the ETA.

with

common default value $L_1 = 0{,}75d_t$ (recommended range $L_1 \leq L_2$)

common default value $L_2 = 1{,}5d_t$ (recommended range $1d_t \leq L_2 \leq 2d_t$)

Specimens for tensile tests according to clause 2.2.3

By default, specimens B 10 x 50 shall be used:

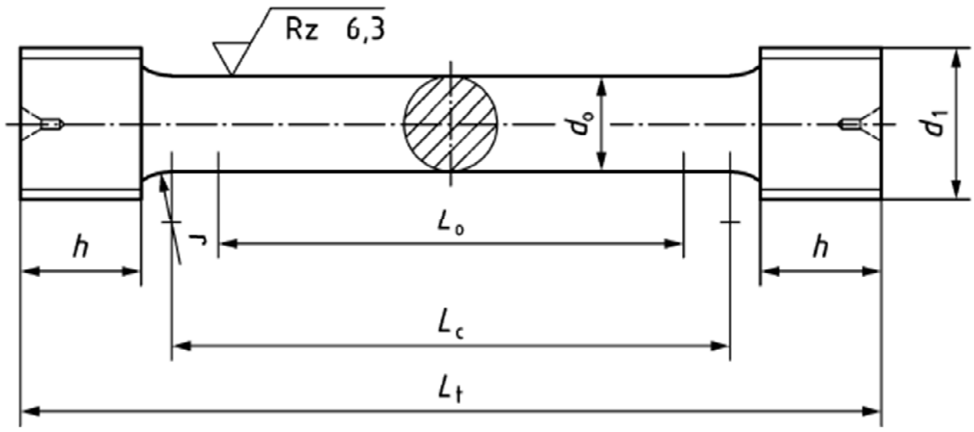


Figure A.7: Specimens for tensile tests

d_0	10 mm
L_0	50 mm
d_1	M16
r	8 mm (minimum)
h	12 mm (minimum)
L_c	60 mm (minimum)
L_t	97 mm(minimum)