
**Compression-ignition engines — Steel
tubes for high-pressure fuel injection
pipes —**

Part 2:

Requirements for composite tubes

iTeh STANDARD PREVIEW

(standard only)

*Moteurs à allumage par compression — Tubes en acier pour lignes
d'injection à haute pression*

Partie 2: Caractéristiques des tubes composites

ISO 8535-2:2003

<https://standards.iteh.ai/catalog/standards/sist/92829166-cdec-48e9-9bc3-2c83d5bfe176/iso-8535-2-2003>



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Contents

Page

Foreword	iv
1 Scope	1
2 Normative references	1
3 Dimensions and tolerances	1
4 Material processing	3
5 Testing	5
6 Designation	7
7 Identification and marking	8
8 Packing	8
Bibliography	9

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Foreword

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

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

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

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

ISO 8535-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 7, *Injection equipment and filters for use on road vehicles*.

This second edition cancels and replaces the first edition (ISO 8535-2:1993), which has been technically revised.

ISO 8535 consists of the following parts, under the general title *Compression-ignition engines — Steel tubes for high-pressure fuel injection pipes*:

— *Part 1: Requirements for seamless cold-drawn single-wall tubes*

— *Part 2: Requirements for composite tubes*

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Compression-ignition engines — Steel tubes for high-pressure fuel injection pipes —

Part 2: Requirements for composite tubes

1 Scope

This part of ISO 8535 specifies the dimensions of, and gives requirements for, composite steel tubes for high-pressure fuel injection pipes used on diesel (compression-ignition) engines (Class 2) and for fuel injection pump testing (Class 1).

2 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 404, *Steel and steel products — General technical delivery requirements*

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 6892, *Metallic materials — Tensile testing*

3 Dimensions and tolerances

3.1 Diameters

Recommended inside and outside diameters are given in Table 1. Other sizes may be used by agreement between supplier and purchaser.

Tolerances on inside and outside diameters shall be as follows.

a) Inside diameter, d

± 0,05 mm for Class 2

± 0,025 mm for Class 1¹⁾

b) Outside diameter, D

± 0,06 mm for Classes 1 and 2

1) Tolerance in accordance with ISO 4093.

c) Concentricity of the tube outside diameter relative to the inside diameter shall be proportional to the wall thickness, as shown in Figure 1.

3.2 Length

Length and tolerances on length shall be by agreement between supplier and purchaser.

Table 1 — Recommended inside and outside diameters

Dimensions in millimetres

Inside diameter fin ^a		Outside diameter fin ^b		
<i>d</i>		<i>D</i>		
Preferred	Non-preferred	4,5	6	7
1,12		(cross-hatched region)		
1,25				
1,4				
	1,5			
1,6				
	1,7			
1,8				
	1,9			
2				
	2,12			
2,24		(cross-hatched region)		
	2,36			
2,5				
	2,65			
2,8				
	3			
3,15				
	3,35			

NOTE The diameter sizes have been established with the ratio of outside to inside diameter within the range of 2 to 4.

^a Based on ISO 3.

^b Size combinations to be used are those falling within the cross-hatched region.

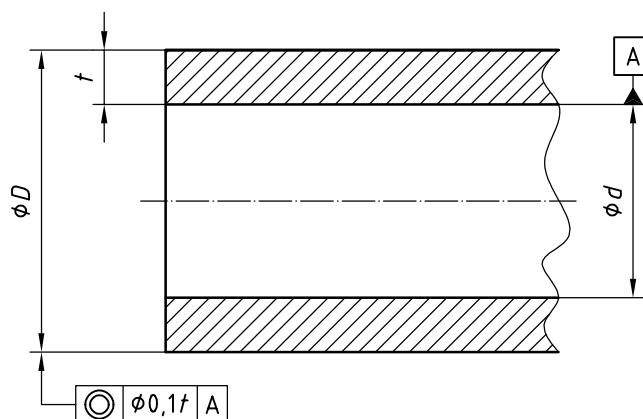


Figure 1 — Tube diameters

4 Material processing

4.1 Steel manufacturing process

The tubes shall be manufactured from an unalloyed quality steel or an equivalent quality steel produced by a steel-making process that ensures a very homogeneous structure.

The composite structure can be produced in various ways:

— a seamless inner (liner) tube is indicated by “CA”;

— a seamed inner tube is indicated by “CB”;

4.2 Surface quality

4.2.1 General

The outside and inside surfaces of finished tubes shall be free from scale, rust, grooves, laps, laminations, deep pits or other injurious defects.

4.2.2 Minimum surface quality of bore (Grade S)

The inside of the tubes of bore Grade S shall be finished to ensure a smooth bore of accurate size with no more than five imperfections (fissures, crevices, etc.) over 0,08 mm to 0,13 mm maximum depth per tube cross-section, using 50× magnification for examination (see Table 2). This does not apply to tube type CB.

4.2.3 Higher surface quality of bore (Grades O, P, Q and R)

If closer control over the depth of imperfections is required, bore grades O, P, Q or R, assessed under the magnification indicated (see Table 2), may be specified in the tube designation (see Clause 6). This does not apply to tube type CB.

Table 2 — Bore grades

Code	Permitted imperfections	Magnification ×
S	As in 4.2.2	50
R	No imperfections over 0,08 mm deep are permitted; no more than five imperfections over 0,05 mm deep are permitted	100
Q	A maximum of five imperfections over 0,02 mm to 0,05 mm deep	100
P	A maximum of five imperfections over 0,01 mm to 0,02 mm deep	200
O	No imperfections over 0,01 mm deep are permitted	500

4.3 Surface finish

The outside surface of the tube may be coated by metal plating or galvanizing, or may be submitted to a chemical surface treatment (see Table 3).

The inside surface of a CA tube shall remain uncoated.

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Table 3 — Surface finish

Code	Outside surface condition	Application remarks
0	Not specified (at manufacturer's choice)	May have additional finish at manufacturer's choice
1	Outside surface as-processed, without any additional finish. Tubes annealed or normalized in a controlled atmosphere may be discoloured, but shall be free from loose scale.	Condition preferred for further surface processing
2	Zinc electroplated with a coating layer thickness of 8 µm minimum and an additional colourless chromating ^a	When minimum corrosion-resistance is required. Not recommended for use with light alcohol-based fuels such as methanol.
3	Zinc electroplated with a coating layer thickness of 8 µm minimum and an additional yellow chromating ^a	
(4, 5, 6, 7, 8)	Reserved	
9	As specified, subject to agreement	

^a Chromating as described in ISO 2080 and ISO 4520.

4.4 Minimum mechanical properties of tube

The tubes shall comply with one of the classes of mechanical properties (Codes 1 to 2) resulting from the steel type and composite structure as listed in Table 4.

Table 4 — Mechanical properties

Code	Tube type	Minimum tensile strength	Minimum upper yield stress	Minimum elongation A5	Maximum hardness	
		Rm N/mm ²	ReH N/mm ²	%	HV 5 ^a	HV1 ^b
1	CB	310	205	30	130	
2	CA	310	205	23	130	170

NOTE The mechanical properties apply when the tube is tested in accordance with ISO 6892 and ISO 6507-1.

^a As measured on the tube outside diameter.

^b As measured on the cross-section of the inner (liner) tube.

4.5 Cleanliness

The bore shall be clean and free from any contamination or coating which would impair the processing and serviceability of the tubes. Any special requirements shall be agreed at the time of enquiry or order between supplier and purchaser.

4.6 Straightness

Unless otherwise agreed between supplier and purchaser, the tubes shall be straight within a maximum error of 1 in 400 with no localised deformation.

4.7 Corrosion-resistance

The outside and inside surfaces shall be protected against corrosion for transportation and storage in closed areas. A permanent coating may be used on the outside surface when agreed between supplier and purchaser. Any temporary coating used shall not be injurious to the injection and combustion systems of engines and shall be removable with diesel fuel.

5 Testing

5.1 General

Unless otherwise specified, tests shall be carried out in accordance with 5.2 to 5.8.

5.2 Scope of tests

Tubes shall be tested by lots of the same processing during composite construction, structure, dimensions and surface finish.

For the test in 5.4, a test inspector shall select one tube from each lot and for the test in 5.6, three tubes. The tests in 5.3, 5.7.1 and 5.8 shall be performed on all selected tubes.

For the test in 5.7.3, lot size, number of samples and acceptance limit shall be agreed upon between supplier and purchaser in the order.