INTERNATIONAL STANDARD

ISO 13296

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Diesel engines — High-pressure fuel injection pipe assemblies — General requirements and dimensions

Moteurs diesels — Lignes assemblées d'injection de carburant haute pression — Exigences générales et dimensions

Foreword

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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.

International Standard ISO 13296 was prepared by Technical Committee ISO/TC 22, *Road vehicles,* Subcommittee SC 7, *Injection equipment and filters for use on road vehicles*.

Annexes A and B form an integral part of this International Standard. Annex C is for information only.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

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Introduction

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this International Standard may involve the use of a patent concerning an apparatus to measure the inside diameter of the pipe assembly as described in annex B.

ISO takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured ISO that he is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO. Information may be obtained from:

Daimler-Benz AG
70322 Stuttgart
Germany

This information is given for the convenience of the users of this International Standard and does not constitute an endorsement of the apparatus for which a patent is held by the above-mentioned company. Other apparatus may be used if it can be shown to lead to the same results.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights other than those identified above. ISO shall not be held responsible for identifying any or all such patent rights.

Diesel engines — High-pressure fuel injection pipe assemblies — General requirements and dimensions

1 Scope

This International Standard specifies dimensions and requirements for high-pressure fuel injection pipe assemblies and assembled pipe sets used on a compression-ignition (diesel) engines.

High-pressure pipes for use on test benches are specified in ISO 4093.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2974:1994, *Diesel engines — High-pressure fuel injection pipe end-connections with 60° female cone.*

ISO 7876-4:1994, *Fuel injection equipment — Vocabulary — Part 4: High-pressure pipes and end-connections.*

ISO 8535-1:1996, *Compression-ignition engines — Steel tubes for high-pressure fuel injection pipes — Part 1: Requirements for seamless cold-drawn single-wall tubes.*

ISO 8535-2:1993, *Compression-ignition engines — Steel tubes for high-pressure fuel injection pipes — Part 2: Requirements for composite tubes.*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 7876-4 apply.

4 Dimensions and tolerances

The requirement and configuration drawing for a pipe assembly shall include at least the following:

a) indication of compliance with this International Standard;

b) the outside diameter and inside diameter of the pipe and indication of compliance with ISO 8535-1 or ISO 8535-2;

c) a graphic representation of the centreline of the pipe with the connection ends and each bend intersection labeled as a point; each point shall be listed in a table with Cartesian co-ordinates *x*, *y* and *z* with the orthogonal distance from the axis and the bend radii;

NOTE — The co-ordinates are used to establish the theoretical exact centreline of the tube. See the example given in figure 1.

d) the developed length of the pipe as an approximate value;

e) the surface finish requirements of the pipe and connector nuts.

The dimensional tolerance of a pipe assembly shall be stated in terms of the actual outside contour of the tube in relation to the theoretical maximum outside contour and the variance of the actual connection ends from theoretical position as agreed upon between the supplier and customer.

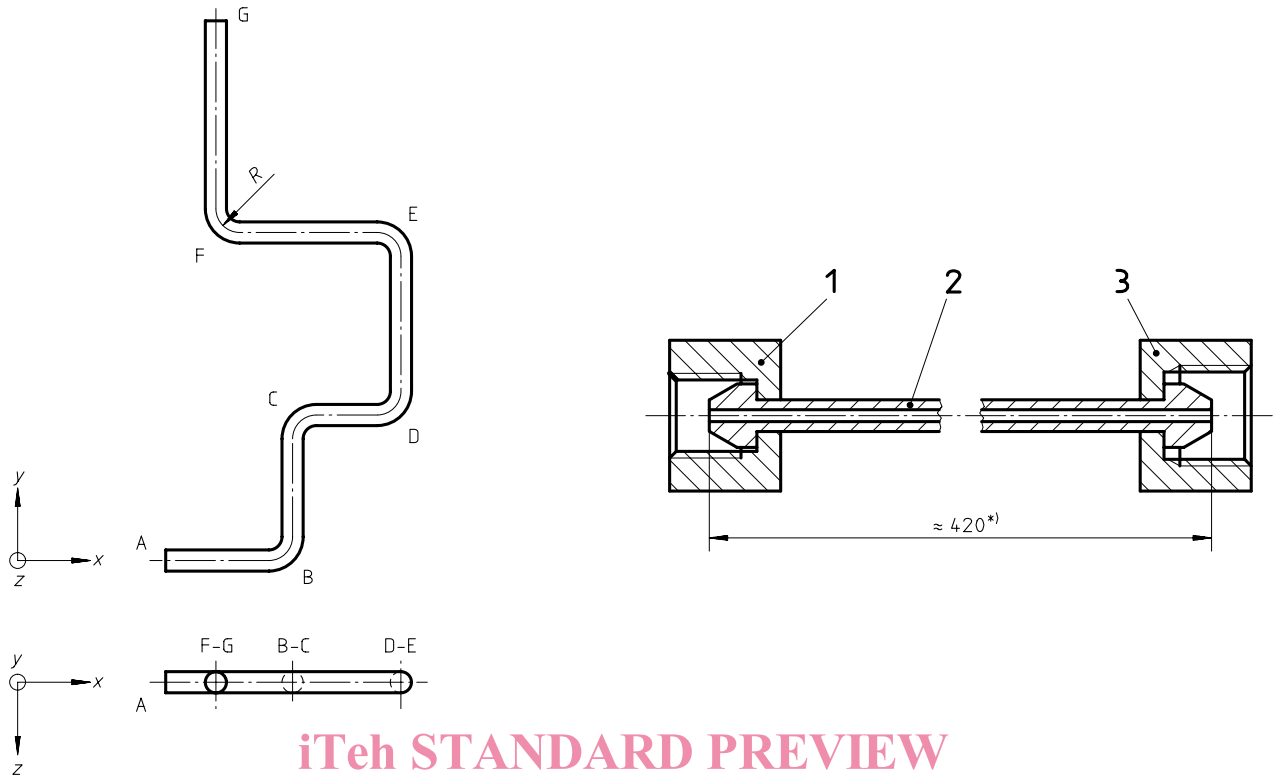
5 Cleanliness

The bore of a high-pressure fuel injection pipe assembly shall be clean and shall be assessed using a method which has been agreed upon by the supplier and customer.

6 Minimum bend radii

The radius of any bend made in fabricating high-pressure pipe assemblies shall be not less than two and one-half times (2,5 ×) the outside diameter of the pipe as measured from the pipe centreline. Bends shall be a sufficient distance from the end-connections so as to allow easy fitting of the pipe assembly for its intended used. Bends shall be of a sufficient distance from one another and from the end-connections so as not to impair fabrication. Bend radii shall be of uniform size in each pipe assembly whenever possible.

Dimensions in millimetres



Key

1 Connector nut M12
2 Pipe
3 Connector nut M14

*) Developed length

	x	*y*	*z*	**Radius**
A	0	0	0	0
B	65	0	0	15,75
C	65	100	0	15,75
E	140	150	0	15,75
F	40	150	0	15,75
G	40	150	0	0

Figure 1 — Example of a requirement and configuration drawing

7 End connections

The dimensional characteristics of the high-pressure pipe end-connections with 60° female cone are specified in ISO 2974. The preferred hexagon size for the connector nusts are listed in table 1.

Table 1 — Connector nut hexagon size

Dimensions in millimetres

Tube outside diameter	Thread	Hexagon across flats (preferred)
4,5	M10 × 1,25	14
	M12 × 1,5	17
6	M12 × 1,5	17
	M14 × 1,5	19
8	M16 × 1,5	24
	M18 × 1,5	24
	M22 × 1,5	32
10	M20 × 1,5	30
	M22 × 1,5	32
	M24 × 1,5	36
12	M22 × 1,5	32
	M26 × 1,5	36

The tube-connection end and bore configuration shall be chosen such that, after final assembly, the inside diameter of the tube is not less than that which is shown in figure 2. After manufacture, the connection ends of the pipe shall comply with the dimensional characteristics given in figure 2. This figure also determines any internal distortion limits. If, by agreement between supplier and customer, a chamfer is to be put in the bore, the maximum tolerance of d_1 at the front of the male sealing face may be increased.

8 Assembly clamps

Pipe assemblies may be formed in such a manner as to be held to the engine and/or to one another with a form of assembly clamp. Clamp placement should be such that it will prevent damage from engine-induced vibration. It is recommended that the assembly clamps hold the pipes at a centre-to-centre distance of 1,42 *D*, where *D* is the pipe outside diameter.

9 External coatings

The outside surfaces of high-pressure pipe assemblies, assembled pipe sets, or pipe components may be plated or left in an untreated condition. If an untreated condition is specified a temporary preservative shall be applied to external surfaces. The outside surface specification of metallic components shall be in accordance with the specifications for tubes as given in table 3 of ISO 8535-1:1996 or ISO 8535-2:1993.

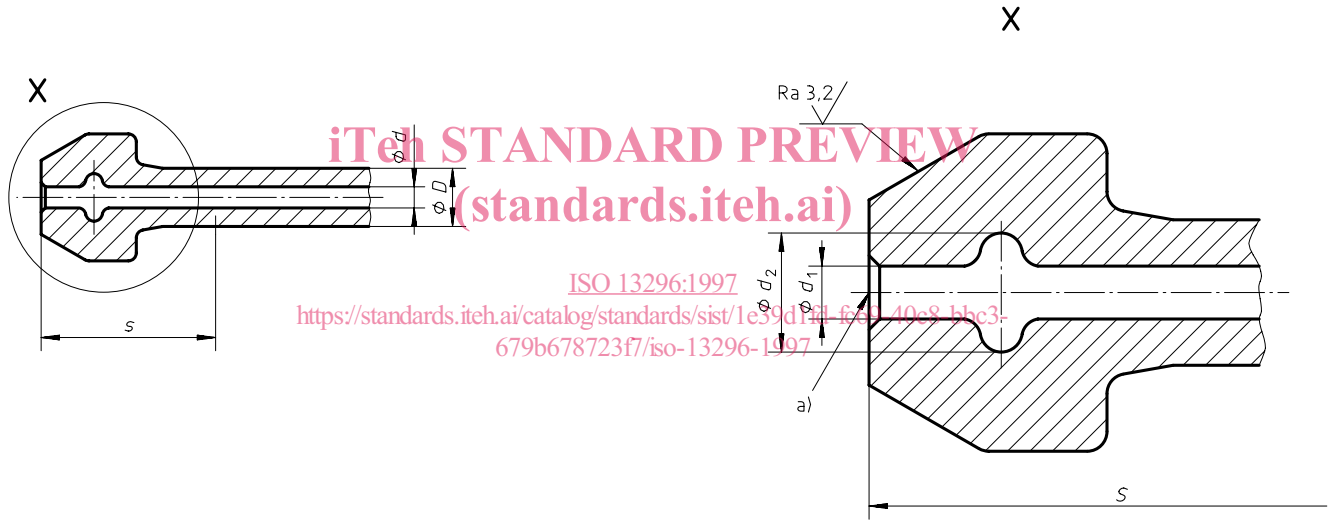
10 Operating pressure

The permissible operating pressure shall be specified with an adequate safety margin below the fatigue strength under pulsating internal pressure and shall be agreed upon between customer and supplier. See annex A for additional information.

11 Pipe inside diameter

The pipe inside diameter shall not exhibit any permanent deformation due to bending other than a 3 % maximum reduction in the cross-sectional area of the bore through the length of a bend when compared with an adjacent straight portion. The cross-sectional area reduction is affected by material physical properties, inside/outside diameter ratio, bend radius, and type of fabrication. A method to measure the diameter of the cross-sectional area of the bore of the pipe assembly, in which a ball on a wire is passed through the pipe and the clearance between the ball and the inside wall at each point is determined by pneumatic flow, is given in annex B.

Surface roughness values in micrometres



$d_1 = d \pm 0{,}1$

$d_2 = 1{,}5\ d_{max}$

$s = 3D_{max}$

Key

D Nominal outside diameter of the pipe
d Nominal inside diameter of the pipe
d_1 Inside diameter at length s, excluding inside bulge
d_2 Inside diameter at the inside bulge
s Length over which internal distortion is permitted (see d_1)

a) In this area, tube bore transition to tube end face made by uniform widening of inside diameter with rounded run-out. No sharp edges permitted.

Figure 2 — Tube-connection end and bore configuration