INTERNATIONAL STANDARD

ISO 18418-2

Second edition
2022-11

Gasoline engines — High pressure liquid fuel supply connections —

Part 2: Pipe assemblies

Moteurs à essence — Connexions pour des lignes de combustible liquide à haute pression —

Partie 2: Lignes assemblées

Reference number
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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.

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).

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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 Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 34, *Propulsion, powertrain and powertrain fluids.*

This second edition cancels and replaces the first edition (ISO 18418-2:2014), which has been technically revised.

The main changes are as follows:

— high-strength steel tubes are required as fuel pressure increases;

— additional specification of tubes, already in use worldwide, are added.

A list of all parts in the ISO 18418 series can be found on the ISO website.

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.

Introduction

Some spark ignition (SI) engines use direct injection (DI) fuel systems which supply gasoline under pressure to a rail and to the injectors via pipe assemblies with a 60° concave cone connector. Such components are similar to ISO 2974 and ISO 13296 for the diesel injection systems except for the relationship between the outside and inside diameters of the pipes due to the lower pressure range.

GDI fuel systems typically operate in a pressure range of around 35 MPa and are labelled “high pressure”. In the context of all injections systems, including diesel, this same pressure range is considered as medium pressure, as diesel injection operates at much higher pressures, however the term “high pressure” is used in this document.

Gasoline engines — High pressure liquid fuel supply connections —

Part 2: Pipe assemblies

1 Scope

This document specifies dimensions and requirements for high-pressure fuel pipe assemblies and assembled pipe sets made of seamless stainless steel or surface-treated steel tubing to be used with 60°concave cone connectors on gasoline (spark-ignition) engines.

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.

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

ISO 8535-1:2016, *Diesel engines — Steel tubes for high-pressure fuel injection pipes — Part 1: Requirements for seamless cold-drawn single-wall tubes*

ISO 9329-4:1997, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 4: Austenitic stainless steels*

ISO 15510:2014, *Stainless steels — Chemical composition*

ISO 19724, *Gasoline engines with direct injection — Cleanliness assessment of fuel injection equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7876-4 apply.

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

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

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

4 Material properties

Material properties of stainless-steel tubing are specified in ISO 9329-4:1997, Table 1 or ISO 15510:2014, Table 1.

Material properties of surface-treated steel tube are specified in ISO 8535-1:2016, Table 3.

5 Dimensions and tolerances

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

a) an indication of compliance with this document;

b) the thread and the hexagon size of the connector nuts according to Tables 1 and 2;

c) the type of the connection ends as specified in 8.2;

d) a graphic representation of the centreline of the pipe with the connection ends and each bend intersection labelled as a point, with each point listed in a table with Cartesian coordinates x, y, and z with the orthogonal distance from the axis and the bend radius (the beginning and end points are given as the "S" dimension for the defined configuration);

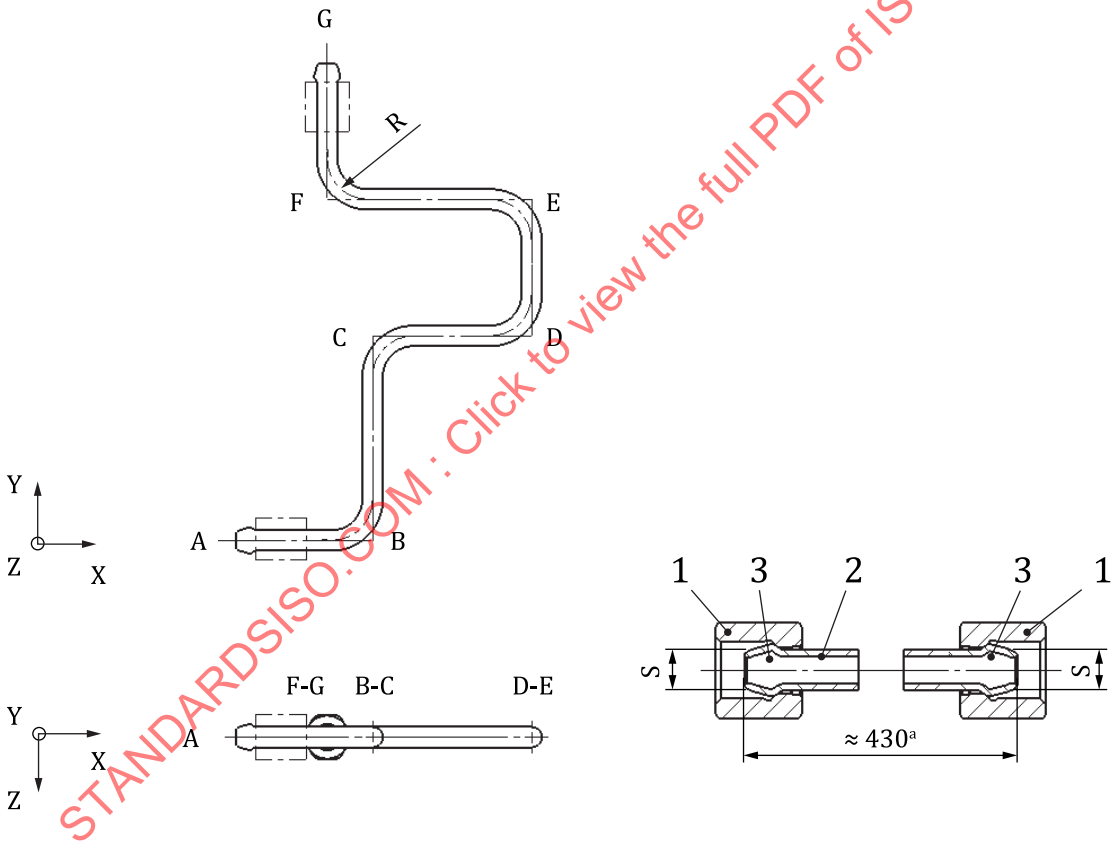
NOTE The coordinates are used to specify the theoretical exact centreline of the pipe. See the example given in Figure 1.

e) the developed length of the pipe as an approximated value;

f) the material and 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 specified maximum outside contour and the variance of the actual pipe connection end from specified position, as agreed between supplier and customer.

Dimensions in millimetres



Key

1 connector nuts: thread M14; hexagon across flats 17

2 pipe: tube outside diameter 8 mm

3 pipe connection ends

[a] Developed length.

NOTE For dimension *S*, see Table 1.

Figure 1 — Example of a requirement and configuration drawing

6 Cleanliness

The bore of a pipe assembly shall be clean, and this shall be assessed in accordance with ISO 19724. Unless otherwise agreed between supplier and customer, cleanliness of pipe assemblies shall be designated using the component cleanliness code (CCC), as defined in ISO 19724.

7 Minimum bend radii

The radius of any bend made in fabricating pipe assemblies shall be not less than two and one-eighth times (2,125×) the outside diameter of the pipe as measured from the pipe centreline. Bends shall be at a sufficient distance from the end-connections so as to allow easy fitting of the pipe assembly for its intended use. Bends shall be at a sufficient distance from one another so as not to impair fabrication. Bend radii shall be of uniform size in each pipe assembly whenever possible.

8 Pipe end connections

8.1 General

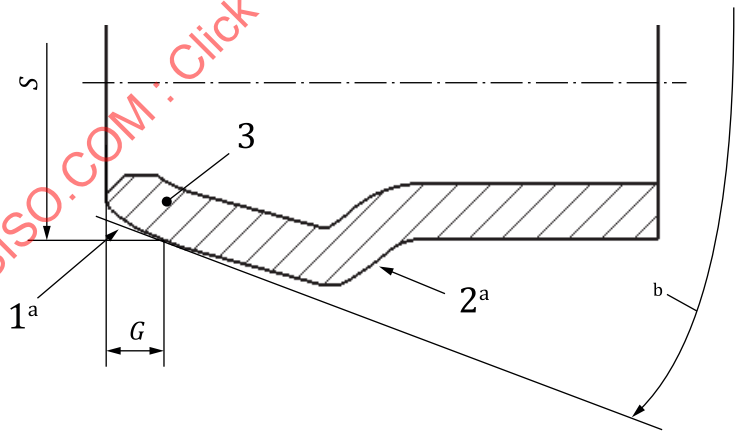
The relationships of connection ends to the connector nut and with the dimensions *G* and *S* are shown in Table 1 for the 60° concave cone.

The design of the shoulders of the connection end and of the related connector nut shall be agreed between supplier and customer.

The dimensional characteristics of 60°concave cones are described in ISO 18418-1.

8.2 Type of connection ends

In Figure 2, the design of connector end with a spherical sealing face for pipe assemblies is shown.



Key

1 connection end sealing face (spherical)

2 shoulder of connection end

3 connection end of pipe

a Spherical shape of the connection end sealing face and of the shoulder in order to allow an inclined position of the pipe connection end to the matching concave cone.

b Spherical connection end to fit into the 60° concave cone is specified in ISO 18418-1.

NOTE For dimensions *G* and *S*, see Table 1.

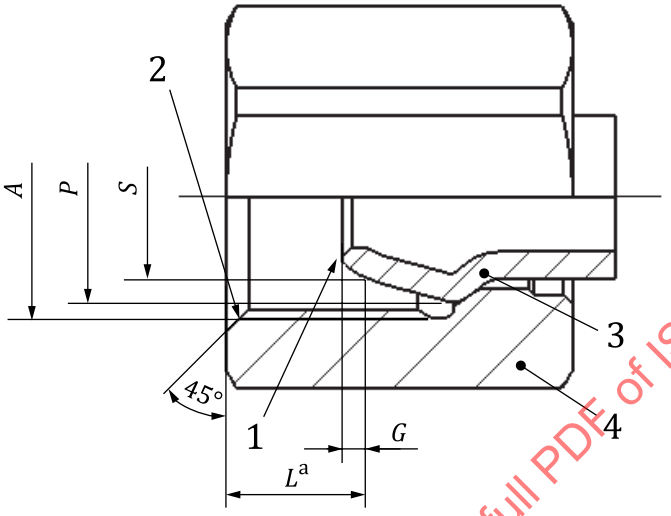
Figure 2 — Connector end

8.3 Pipe end assembly for 60° concave cones

Figure 3 shows the basic requirements and relationships of a connection end assembled to the related connector nut.

For dimensions, see Table 1.

NOTE The dimensions of Table 1 correspond to the values specified in ISO 18418-1.



Key

1 connection end sealing face (spherical)

2 chamfer to root of thread

3 connection end of pipe (according to Figure 2)

4 connector nut (according to Table 2)

[a] When defining dimension *L*, there shall be clearance between the base of the connector nut and the surface of the mating component (defined in ISO 18418-1) to ensure correct sealing force, taking into account material deformation after tightening while maintaining a minimum thread engagement of 3x pitch.

Figure 3 — Pipe end assembly for 60° concave cones (schematically)

Table 1 — Dimensions of pipe end connections for 60°concave cones

Dimensions in millimetres

Tube outside diameter	Thread[a] *A*	Reference diameter *S*[b]	*P* ±0,5	*G*[b] ±0,4	*L* max.	Tube inside diameter
8	M14 × 1,5	7,5	10,5 to 12	0,8	10	5,0
		8,2 or 8,5	10,5 to 12	0,8	10	5,6
		9,4	10,5 to 12	1,4	10	6,0
9	M14 × 1,5	8,5	11,5 to 13	0,8	10	5,6
		9,4	11,5 to 13	1,4	10	6,0 6,4
10	M16 × 1,5	8,5	12 to 13,5	0,8	10	6,4
		9,4	12 to 13,5	1,4	10	7,0

[a] Tolerance classes of threads: 6H for connector nuts.

[b] The intersection of *S* and *G* represents a typical contact line with the concave cone.

Table 2 — Connector nut wrench size for 60° concave cones

Dimensions in millimetres

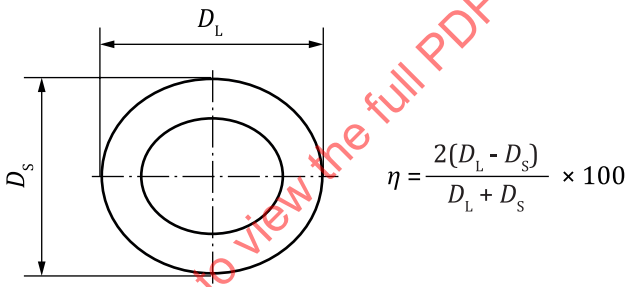
Tube outside diameter	Thread	Wrench size
8	M14 × 1,5	17[a] or 19
9	M14 × 1,5	17[a] or 19
10	M16 × 1,5	24
[a] Preferred.		

9 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 supplier and customer.

10 Ovality of bending portion

The ovality of any bending portion made in fabricating pipe assemblies shall be not more than 15 %. The ovality of bending portion is affected by material physical properties, inside/outside diameter ratio, bend radius, and type of fabrication. The definition of ovality is shown in Figure 4.



Key

η percent ovality
D_L major axis
D_S minor axis

Figure 4 — Definition of ovality

11 Tightening torque and sealing performance

The tightening torque to connect the connection ends of the pipe assemblies with a pump and a rail shall be determined carefully so that no fuel leakage from the sealing faces, rotational movement of the mating components, or unfavourable deformation of the sealing faces, threads, or pipe connection ends will occur.

The adequate tightening torque for the connection ends varies according to the combination of size and material of the tube, size and material of connector nut, design of the shoulder of the connection end and the connector nut, etc. The design should reflect the thread engagement requirements specified in ISO 18418-1:2016, Figure 1. The required tightening torque shall be determined empirically between the supplier and the customer.

The sealing performance shall be tested by fitting the pipe assembly to 60° concave cone connectors and by applying the lower limit of the determined tightening torque. For the test, the same type of fuel as for actual operation and the maximum fuel pressure encountered in actual operation shall be used.