INTERNATIONAL STANDARD

**ISO 28741**

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# Road vehicles — Spark-plugs and their cylinder head housings — Basic characteristics and dimensions

*Véhicules routiers — Bougies d'allumage et leur logement dans la culasse — Caractéristiques élémentaires et dimensions*



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# Foreword

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The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 1, *Ignition equipment*.



This second edition cancels and replaces the first edition (ISO 28741:2009), which has been technically revised. It also incorporates the Technical Corrigendum ISO 28741:2009/Cor1:2009.

# Introduction

The purpose of this International Standard is to provide a compact and concise specification on spark-plugs and their cylinder head housings, which replaces the large number of existing individual International Standards on each type of spark-plug.

It is intended to specify the main properties, the design requirements, and the dimensions of most of the existing types of spark-plugs and their cylinder head housings. In this way, the user can work with one comprehensive International Standard valid for most types of spark-plugs, instead of a number of International Standards, each of which is specified for one type only.

The testing of spark-plugs is covered in ISO 11565.

# Road vehicles — Spark-plugs and their cylinder head housings — Basic characteristics and dimensions

## 1 Scope

This International Standard specifies the main properties and dimensions of spark-plugs, including the terminals and the dimensions of their cylinder head housings, for use with spark-ignition engines.

This International Standard does not cover screened and waterproof spark-plugs (see ISO 3412, ISO 3895, and ISO 3896).

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 68-1, *ISO general purpose screw threads — Basic profile — Part 1: Metric screw threads*

ISO 261, *ISO general purpose metric screw threads — General plan*



ISO 965-1, *ISO general-purpose metric screw threads — Tolerances — Part 1: Principles and basic data*

ISO 965-3, *ISO general purpose metric screw threads — Tolerances — Part 3: Deviations for constructional screw threads*



ISO 4095, *Aerospace — Bihexagonal drives — Wrenching configuration — Metric series*

ISO 6518-1, *Road vehicles — Ignition systems — Part 1: Vocabulary*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6518-1 and the following apply.

**3.1**
**installed height**
*l*
distance from the contact point of the cylinder head to the top of the spark-plug terminal, including the compressed gasket thickness with the spark-plug installed at the specified installation torque

Note 1 to entry: For conical seating, the contact point is defined from the gauge point of the seat.

**3.2**
**spark-plug thread size**
nominal size of the spark-plug thread used to interface between the spark-plug and the cylinder head thread

Note 1 to entry: These are standard metric threads, with the exception of the M14 × 1,25 thread.

**3.3**
**hexagon/bi-hexagon**
feature of the spark-plug shell that is used to install the spark-plug into the cylinder head, interfacing with the installation socket while the spark-plug is installed into the cylinder head

Note 1 to entry: A bi-hexagon is a 12-point installation feature, which requires that a 12-point socket wrench be used to install the spark-plug.

**3.4**
**conical seating**
conical section of the spark-plug shell on some spark-plug types, which is used for the seal interface between the spark-plug and the cylinder head

Note 1 to entry: There is typically no gasket used between the conical mating surfaces.

**3.5**
**flat seating**
flat surface of some spark-plug types which is perpendicular to the spark-plug axis and is used for the seal interface between the spark-plug and the cylinder head

Note 1 to entry: This seal typically uses a gasket between the flat seat of the spark-plug and the mating flat surface of the cylinder head.

**3.6**
**insulator diameter**
*e*
nominal diameter of the insulator in a defined region of the insulator between the top of the shell and the terminal of the spark-plug, which interfaces with a corresponding region of the high-voltage boot of the ignition lead or ignition coil

Note 1 to entry: The fit is the key to suppression of high-voltage leakage around the spark-plug insulator (flashover).

**3.7**
**high-voltage terminal**
part of the spark-plug that is used as the contact point between the high-voltage ignition source and the spark-plug



Note 1 to entry: The connection between the high-voltage ignition source and the spark-plug terminal can be made with a threaded fastener, with a snap clip that interfaces with the solid terminal or by spring-loaded mechanical contact.



**3.8**
**installation tightening torque**
rotational force applied to the spark-plug hexagon to ensure proper seating and sealing of the spark-plug to the cylinder head

Note 1 to entry: The value of the correct installation tightening torque can vary from conditions that affect the friction between the spark-plug threads and the cylinder head threads. These include cylinder head material, spark-plug shell plating, thread lubrication, and contamination from combustion deposits. It is advisable to ensure that spark-plugs are not over-torqued during installation, as this can damage spark-plug integrity and can result in engine damage. Spark-plugs with smaller thread sizes require a lower installation tightening torque.

**3.9**
**spark-plug reach**
*a*
distance from the spark-plug seating surface (flat seat) or from the gauge diameter (conical seat) to the point on the shell designed to be aligned with the combustion chamber surface on the cylinder head with the spark-plug properly installed

Note 1 to entry: It is advisable to design the spark-plug reach and the cylinder head housing in such a way that they match, so as to ensure correct fit of the spark-plug into the combustion chamber.

**3.10**
**spark-plug projection**
*b-a*
distance that any part of the spark-plug projects past the spark-plug reach into the combustion chamber

Note 1 to entry: It is important to consider this dimension for possible interference with the engine piston at top dead centre.

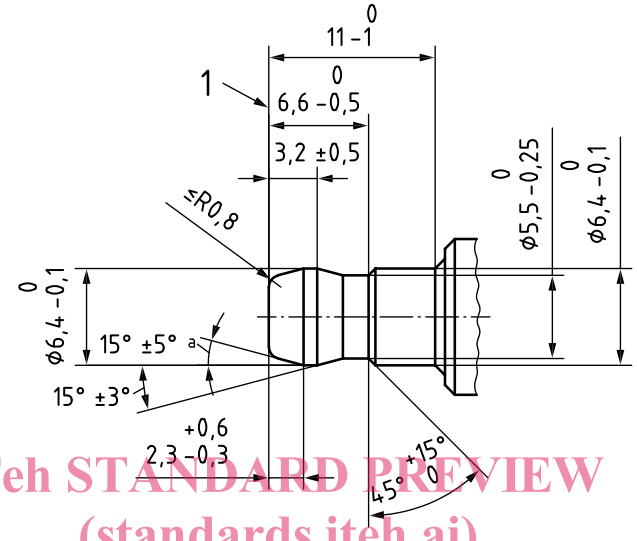
# 4 Terminals

## 4.1 Solid post terminal dimensions

The dimensions of solid post terminals shall be in accordance with Figures 1 and 2.

Nuts for use with threaded terminals shall have the same external dimensions as those of the solid post terminal, and shall have internal threads to 6H tolerance prior to assembly on the threaded terminals.

Dimensions in millimetres






**Key**

1 reference plane

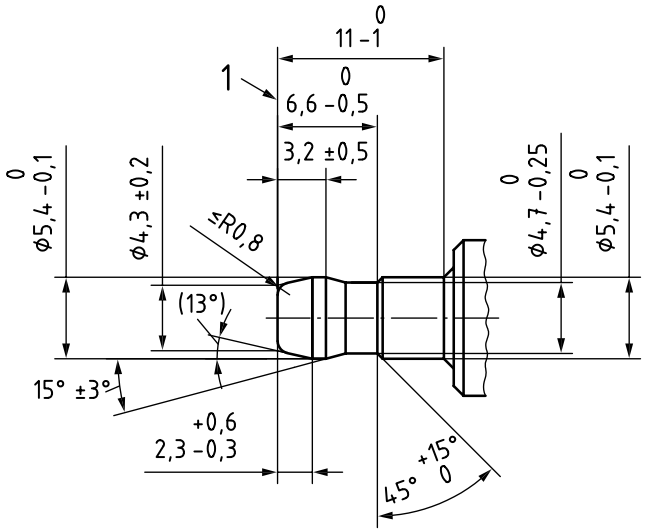
a For existing products, values between 7° and 30° are allowed.



**Figure 1 — Solid post terminal**

The measurement of the minimum diameter of 6,3 mm shall be taken at any or all points around the post circumference. A ring gauge shall be used for measuring the maximum diameter of 6,4 mm.

Dimensions in millimetres




**Key**

1 reference plane

**Figure 2 — Solid post terminal for M10 × 1 bi-hex 12 mm spark-plugs**



The measurement of the minimum diameter of 5,3 mm shall be taken at any or all points around the post circumference. A ring gauge shall be used for measuring the maximum diameter of 5,4 mm.

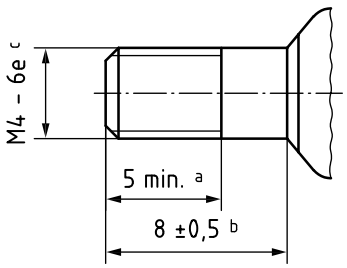


## 4.2 Threaded terminal dimensions



The dimensions of threaded terminals shall be in accordance with Figure 3.

Dimensions in millimetres




**Key**

a Length of usable thread.

b Cylindrical part.

c Depending on manufacturing process, tolerance class 7e is acceptable on finished product.

**Figure 3 — Threaded terminal**

# 5 Dimensions, threads, and related items

## 5.1 Spark-plug reach

The spark-plug reach shall be in accordance with Table 5 or 7 (see also Figures 4 to 15).

The following basic types of spark-plug reach are defined:

— Short: S

— Medium: M

— Long: L

— Extended long: EL

— Extra long: XL

— Extended extra long: EXL

## 5.2 Gasket

When unused spark-plugs with flat seating have been tightened once with a torque, as specified in Clause 7 and Table 3, on threads that are clean, smooth, and dry, the gasket thickness shall be as specified in Table 3. Non-captive gaskets may be used in special cases.

## 5.3 Threads, limiting dimensions, and tolerances

The threads of spark-plugs and the corresponding tapped holes in the cylinder heads shall conform to ISO 68-1, ISO 261, ISO 965-1, and ISO 965-3. Their limiting dimensions, minor diameters, basic profiles, and initial clearances are specified in Tables 1 and 2, respectively.



**Table 1 — Limiting dimensions**

Dimensions in millimetres

| Thread size | Tolerance class | Dimension | Major diameter | | Pitch diameter | | Minor diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | max. | min. | max. | min. | max. | min. |
| M18 × 1,5 | 6e | Plug thread (on finished plug) | 17,933 | 17,697 | 16,959 | 16,819 | 16,092 | 15,845[a] |
| | 6H | Tapped hole in the cylinder head | not specified | 18,000 | 17,216 | 17,026 | 16,676 | 16,376 |
| M14 × 1,25 | 6e | Plug thread (on finished plug) | 13,937 | 13,725 | 13,125 | 12,993 | 12,404 | 12,181[b] |
| | 6H | Tapped hole in the cylinder head | not specified | 14,000 | 13,368 | 13,188 | 12,912 | 12,647 |
| M12 × 1,25 | 6e | Plug thread (on finished plug) | 11,937 | 11,725 | 11,125 | 10,993 | 10,404 | 10,181[b] |
| | 6H | Tapped hole in the cylinder head | not specified | 12,000 | 11,368 | 11,188 | 10,912 | 10,647 |
| M10 × 1 | 6g | Plug thread (on finished plug) | 9,974 | 9,794 | 9,324 | 9,212 | 8,747 | 8,563[c] |
| | 6H | Tapped hole in the cylinder head | not specified | 10,000 | 9,500 | 9,350 | 9,153 | 8,917 |

[a] With a root radius ≥ 0,150 mm (0,1 *P*).

[b] With a root radius ≥ 0,125 mm (0,1 *P*).

[c] With a root radius ≥ 0,1 mm (0,1 *P*).

**Table 2 — Minor diameters, basic profiles, and initial clearances for threads used**

Dimensions in millimetres

| Thread size | Minor diameter[a] $d_{3max}$ | Fundamental deviation[b] $es$ |
|---|---|---|
| M18 × 1,5 – 6e | $d_{3max}$ = (16,376 – 0,067 – 0, 217) = 16,092 | 0,067 |
| M14 × 1,25 – 6e | $d_{3max}$ = (12,647 – 0,063 – 0,180) = 12,404 | 0,063 |
| M12 × 1,25 – 6e | $d_{3max}$ = (10,647 – 0,063 – 0,180) = 10,404 | 0,063 |
| M10 × 1 – 6g | $d_{3max}$ = (8,917 – 0,026 – 0,144) = 8,747 | 0,026 |

[a] The maximum value of the minor diameter, $d_{3max}$, is calculated according to ISO 965-1:1998, Clause 11 with a truncation of H/6, in accordance with the following equation: $d_{3max} = D_1 - es - 2(H/4 - H/6)$.

[b] The fundamental deviation (term used in ISO 965-1 instead of "initial clearance"), *es*, between the pitch diameters of the thread and of the tapped hole is intended to prevent the possibility of seizure, as a result of combustion deposits on the bare threads, when removing the spark-plugs. This clearance is also intended to enable spark-plugs with threads in accordance with this International Standard to be fitted in existing tapped holes.

## 6 Other dimensions of spark-plugs and their cylinder head housings



The other dimensions of spark-plugs and their cylinder head housings shall be as indicated in Figures 4 to 17, Tables 5 to 10, and Figures A.1, A.2, and C.1.

The installed height, *l*, shall be measured when the spark-plug has been tightened, as specified in Table 3 or 4.



The contour of the insulator is optional; however, between the reference planes defined by the dimensions *c* and *d*, its diameter shall be *e*, as specified in Table 5 or 7.

The non-ribbed insulator design is preferred because it provides superior protection to dielectric tracking between the spark-plug insulator and the cover.

The lengths of the cylinder head housing, $Z$ and $Z'$ (see Figures 16, 17, A.2, and C.1), shall be sufficient to ensure that the end of the spark-plug thread does not project into the combustion chamber at any point when the spark-plug is tightened to its maximum specified torque.

Alternative cylinder head housing with a combination of conical and flat seating is possible (see Annex C).

## 7 Installation tightening torque

The installation tightening torque values in Tables 3 and 4 apply to new spark-plugs without lubricant on the threads (production-related remains of lubricants are permitted). If threads are lubricated, the torque value in the table shall be reduced by approximately one-third to avoid overstressing.

Engine manufacturers may specify a different torque for the first spark-plug installation.

The torque values for measuring the gasket thickness and the installed height are also given in Table 3.