
**Mechanical properties of fasteners
made of carbon steel and alloy steel —**

**Part 3:
Flat washers with specified property
classes**

*Caractéristiques mécaniques des fixations en acier au carbone et en
acier allié —*

Partie 3: Rondelles de forme plane de classes de qualité spécifiées



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Published in Switzerland

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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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 2, *Fasteners*.

A list of all parts in the ISO 898 series can be found on the ISO website.

Introduction

ISO 898 consists of the following parts, under the general title “*Mechanical properties of fasteners made of carbon steel and alloy steel*”:

- *Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread*
- *Part 2: Nuts with specified property classes — Coarse thread and fine pitch thread*
- *Part 5: Set screws and similar threaded fasteners with specified hardness classes — Coarse thread and fine pitch thread*
- *Part 7: Torsional test and minimum torques for bolts and screws with nominal diameters 1 mm to 10 mm*

This document in the ISO 898 series provides a single point of reference for flat washers, in order to standardize market expectations for users, distributors and manufacturers.

This document only deals with flat washers made of carbon steel or alloy steel.

Washers made of stainless steel are not addressed in this document due to their different characteristics and test methods.

Mechanical properties of fasteners made of carbon steel and alloy steel —

Part 3: Flat washers with specified property classes

1 Scope

This document specifies mechanical and physical properties of flat washers, designed to be used in bolted joints in combination with bolts, screws, studs and nuts with a specified property class in accordance with ISO 898-1 and ISO 898-2.

NOTE 1 These types of washers can also be used with other fasteners such as screws forming their own mating thread.

Washers that conform to the requirements of this document are evaluated at an ambient temperature range of 10 °C to 35 °C. They might not retain the specified mechanical and physical properties at elevated temperatures and/or lower temperatures.

NOTE 2 Washers conforming to the requirements of this document are used in applications ranging from -50 °C to +150 °C. Users are advised to consult an experienced fastener expert for temperatures outside this range and up to a maximum temperature of +300 °C when determining appropriate choices, or for critical applications.

This document is applicable to the following flat captive and non-captive washers made of carbon steel or alloy steel, with thickness from 0,2 mm to 12 mm:

- plain washers (with or without knurls, ribs or chamfers);
- square washers;
- square hole washers;
- shaped plates.

It does not specify requirements for the following properties:

- corrosion resistance;
- weldability.

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 1891-4, *Fasteners — Terminology — Part 4: Controls, inspection, delivery, acceptance and quality*

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

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method*

ISO 10644, *Screw and washer assemblies made of steel with plain washers — Washer hardness classes 200 HV and 300 HV*

ISO 10669, *Plain washers for tapping screw and washer assemblies — Normal and large series — Product grade A*

ISO 10673, *Plain washers for screw and washer assemblies — Small, normal and large series — Product grade A*

ISO 10684, *Fasteners — Hot dip galvanized coatings*

3 Terms and definitions

No terms and definitions are listed in this document.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

4 Symbols

For the purposes of this document, the following symbols apply.

d_1	clearance hole, mm
d_2	outside diameter, mm
F	force, N
G	depth of the complete decarburization, mm
r	radius of the supporting part and pressure part for the ductility test, mm
t	nominal thickness of flat washer, mm
t_{eff}	effective thickness of the material measured on the washer, mm
α	angle of the supporting part and pressure part for the ductility test, °

5 Designation system for property classes of washers and combination with property classes of bolts, screws, studs and nuts

The symbol for property classes of washers is composed of two parts:

- the number to the left is the minimum Vickers hardness value in accordance with [Table 3](#);
- the letters HV to the right represent Vickers hardness.

EXAMPLE A steel flat washer with a minimum Vickers hardness of 200 according to [Table 3](#) has the property class designation 200HV.

The designation system of this document may be applied for sizes outside its scope (e.g. for washers with thickness $t > 12$ mm) provided all applicable requirements in accordance with [Tables 2](#) and [3](#) are met.

Although a great number of property classes is specified in this document, this does not mean that all property classes are appropriate for all washers and/or for all bolts/nuts/washers assemblies. The combination of property classes for flat washers with bolts, screws, studs and nuts is specified in [Table 1](#).