

# High-strength structural bolting assemblies for preloading —

## Part 5: Plain washers

The European Standard EN 14399-5:2005 has the status of a  
British Standard

ICS 21.060.30

# National foreword

This British Standard is the official English language version of EN 14399-5:2005. Together with BS EN 14399-1:2005, BS EN 14399-2:2005, BS EN 14399-3:2005, BS EN 14399-4:2005 and BS EN 14399-6:2005, it supersedes BS 4395-1:1969 and BS 4395-2:1969, which are planned to be declared obsolescent in September 2007<sup>1)</sup>, and then, together with BS 449 and BS 5950, will be withdrawn upon publication of Eurocode 3. (BS 4395-1:1969 and BS 4395-2:1969 currently support BS 449 and BS 5950.)

The UK participation in the preparation of EN 14399-5 was entrusted by Technical Committee FME/9, Nuts, bolts and accessories/Steering Committee, to its Subcommittee, FME/9/1, Materials, which has the responsibility to:

- aid enquirers to understand the text;
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This part of BS EN 14399 is one of several parts that comprise the BS EN 14399 series of standards. BS EN 14399-1 provides the general requirements to which the other parts, which provide specific requirements regarding manufacture, materials and testing, relate.

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<sup>1)</sup> CEN/TC 185/WG 6 has applied for a two-year extended co-existence period, to “September 2007”, and for a corrigendum to amend the second “September 2005” date in the Foreword to EN 14399-5:2005 to “September 2007”.

### Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 8, an inside back cover and a back cover.

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English version

## High-strength structural bolting assemblies for preloading - Part 5: Plain washers

Boulonnerie de construction métallique à haute résistance  
apte à la précontrainte - Partie 5 : Rondelles plates

Hochfeste planmäßig vorspannbare  
Schraubenverbindungen für den Metallbau - Teil 5: Flache  
Scheiben

This European Standard was approved by CEN on 30 April 2004.

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Contents		page
Foreword.....		3
Introduction .....		4
1	Scope .....	5
2	Normative references .....	5
3	Dimensions.....	6
4	Specifications and reference standards .....	7
5	Designation .....	7
6	Marking .....	7
Bibliography .....		8

## Foreword

This document (EN 14399-5:2005) has been prepared by Technical Committee CEN /TC 185, "Threaded and non-threaded mechanical fasteners and accessories", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2005, and conflicting national standards shall be withdrawn at the latest by September 2005.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

## Introduction

This document on structural bolting reflects the situation in Europe where two technical solutions exist to achieve the necessary ductility of bolt/nut/washer assemblies. These solutions utilize different systems (HR and HV) of bolt/nut/washer assemblies, see Table 1. Both systems are well proved and it is up to the experts responsible for structural bolting whether they use the one or the other system.

It is, however, important for the performance of the assembly to avoid mixing up the components of both systems. Therefore, bolts and nuts for both systems are standardized in one single part of this European Standard each and the marking of the components of the same system is uniform.

**Table 1 — Systems of bolt/nut/washer assemblies**

	<b>Bolt/nut/washer assembly System HR</b>		<b>Bolt/nut/washer assembly System HV</b>
<b>General requirements</b>	EN 14399-1		
<b>Bolt/nut assembly</b>	EN 14399-3		EN 14399-4
Marking	HR		HV
Property classes	8.8/8	10.9/10	10.9/10
<b>Washer(s)</b>	EN 14399-5 or EN 14399-6		EN 14399-5 or EN 14399-6
Marking	H		H
<b>Suitability test for preloading</b>	EN 14399-2		EN 14399-2

Preloaded bolted assemblies are very sensitive to differences in manufacture and lubrication. Therefore it is important that the assembly is supplied by one manufacturer who is always responsible for the function of the assembly.

For the same reason it is important that coating of the assembly is under the control of one manufacturer.

Beside the mechanical properties of the components the functionality of the assembly requires that the specified preload can be achieved if the assembly is tightened with a suitable procedure. For this purpose a test method for the suitability of the components for preloading was created which will demonstrate whether the function of the assembly is fulfilled.

It should be pointed out that compared to ISO 272 the widths across flats (large series) for M12 and M20 have been changed to 22 mm and 32 mm respectively. These changes are justified by the following reasons.

Under the specific conditions of structural bolting the compressive stresses under the bolt head or nut for the sizes M12 may become too large with the width across flats of 21 mm, especially if the washer is fitted excentrically to the bolt axis.

For the size M20, the width across flats of 34 mm is very difficult to be produced. The change to 32 mm is primarily motivated by economics but it should also be pointed out that the width across flats of 32 mm is already common practice in Europe.

For the time being, the product standards EN 14399-3 to EN 14399-6 are the only European Standards which have regard to the general requirements of EN 14399-1. However, further product standards on

- fit bolts,
- countersunk head bolts, and
- load indicating washers

for the use in high strength structural bolting for preloading are under preparation.

## 1 Scope

This document specifies, together with EN 14399-1, hardened and tempered plain washers intended for assembly with large series hexagon high-strength structural bolts and nuts with threads from M12 to M36 inclusive. Washers according to this standard can be applied under the nut only.

NOTE Attention is drawn to the importance of ensuring that the washers are correctly used if satisfactory results are to be obtained. For recommendations concerning proper application, reference to ENV 1090-1 is made.

## 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.

EN 14399-1, *High-strength structural bolting assemblies for preloading — Part 1: General requirements*.

EN ISO 3269, *Fasteners — Acceptance inspection (ISO 3269:2000)*.

EN ISO 4759-3, *Tolerances for fasteners — Part 3: Plain washers for bolts, screws and nuts — Products grades A and C (ISO 4759-3:2000)*.

EN ISO 10684, *Fasteners — Hot dip galvanized coatings (ISO 10684:2004)*.

3 Dimensions

See Figure 1 and Table 2.

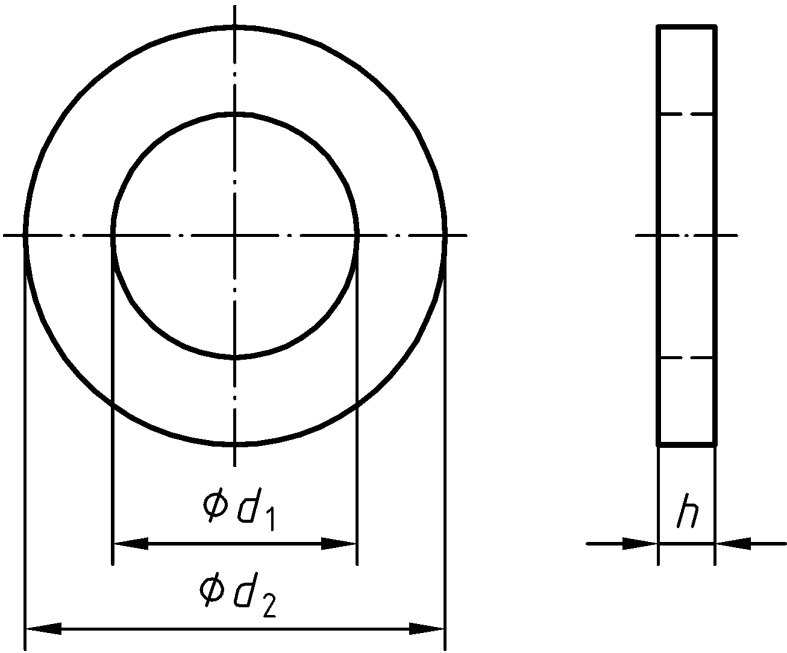


Figure 1 — Dimensions

Table 2 — Dimensions

Dimensions in millimetres

Nominal size <i>d</i> (nominal thread diameter of associated bolt)		12	(14) <sup>a</sup>	16	(18) <sup>a</sup>	20	22	24	27	30	36
<i>d</i> <sub>1</sub>	min.	13	15	17	19	21	23	25	28	31	37
	max.	13,27	15,27	17,27	19,33	21,33	23,33	25,33	28,52	31,62	37,62
<i>d</i> <sub>2</sub>	min.	23,48	27,48	29,48	33,38	36,38	38,38	43,38	49	54,80	64,80
	max.	24	28	30	34	37	39	44	50	56	66
<i>h</i>	nom.	3	3	4	4	4	4	4	5	5	6
	min.	2,7	2,7	3,7	3,7	3,7	3,7	3,7	4,4	4,4	5,4
	max.	3,3	3,3	4,3	4,3	4,3	4,3	4,3	5,6	5,6	6,6
NOTE For hot dip galvanized washers the above dimensions apply prior to galvanizing.											
<sup>a</sup> Sizes in brackets are non-preferred sizes.											



## 4 Specifications and reference standards

Table 3 — Specifications and reference standards

Material		Steel
General requirements		EN 14399-1
Mechanical properties	Hardness range	300 HV to 370 HV
Tolerances	Product grade	A
	International Standard	EN ISO 4759-3
Surface finish <sup>a</sup>	normal	as processed <sup>b</sup>
	hot dip galvanized	EN ISO 10684
	others	to be agreed <sup>c</sup>
Workmanship		Parts shall be uniform and free of irregularities or detrimental defects. No protruding burrs shall appear on the washer.
Acceptability		For acceptance procedure, see EN ISO 3269.

<sup>a</sup> Attention is drawn to the need to consider the risk of hydrogen embrittlement when selecting an appropriate surface treatment process (e.g. cleaning and coating), see relevant coating standards.

<sup>b</sup> "As processed" means the normal finish resulting from heat treatment with a residual coating of light oil.

<sup>c</sup> Other coatings may be negotiated between the purchaser and the manufacturer provided they do not impair the mechanical properties or the functional characteristics. Coatings of cadmium or cadmium alloys are not permitted.

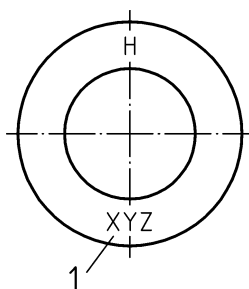
## 5 Designation

EXAMPLE A hardened and tempered plain washer, nominal size  $d = 16$  mm, for high-strength structural bolting for preloading is designated as follows:

Washer EN 14399-5 — 16

## 6 Marking

Hardened and tempered plain washers shall be marked with the manufacturer's identification mark and letter H. The marking shall be indented on one of the bearing faces.



### Key

1 Identification mark of the manufacturer of the assembly

Figure 2 — Marking

## Bibliography

- [1] ENV 1090-1, *Execution of steel structures — Part 1: General rules and rules for buildings*.
- [2] ISO 272, *Fasteners — Hexagon products - Widths across flats*.



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