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EN 14399-4/6

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HV-sets



Introduction

Publication of prestressed bolting standards for steel construction (EN 14399) as well as the execution standards for steel structures (Eurocode 3 EN 1090-1 and 2) has changed the use of bolts in metal construction.

The European HV-product standards are so called harmonized standards (published in the Official Journal of the European Union) according to the Construction Product Regulation. On this basis, HV-sets are delivered with CE label which is mandatory for structural bolting. Therefore, trading these products within the European Community is free. The distribution of non "CE" structural bolts is forbidden within the European Community market.

HV-sets can be used without restriction for all bolted structural connections common in steel construction according to the European standard DIN EN 1090-2:2011 and also the European standard DIN EN 1993-1-8:2010-12.

HV designation applies to high strength preloaded bolt sets (class 10.9). The "H" stands for high strength. The "V" comes from the German "vorgespannt" and indicates that the bolt is designed to be installed according to the standard in order to obtain a defined prestressing.

When the connections are not calculated with integration of the slip factor, prestress is not necessary. However, it is usual and relevant to prestress the assemblies in order to reduce the backlash, increase the resistance to dynamic stress and limit the deformation of the entire construction.

PGB Hot-dip galvanized HV bolts according to EN 10684 with minimum 50 microns thickness have an excellent corrosion resistance. Corrosion protection is therefore obtained for long years, even in an aggressive atmosphere.

Standards

The EN 14399 standard has been developed for high strength pre-loaded fasteners. Parts 1 and 2 of this standard describe the requirements and the process to get the CE marking. The screws, nuts and washers composing the HV sets can be found in parts 4 and 6 of this standard.

In compliance with the European standard, hot dip galvanized HV nuts are always treated with a special molybdenum disulphide lubricant giving this characteristic black color.

An HV set consists of the following elements:

- 1 HV 10.9 hexagon head screw, hot-dip galvanized, in accordance with EN 14399-4
- 1 hexagonal nut HV 10, hot-dip galvanized, in accordance with standard EN 14399-4
- 2 HV 300-370 HV washers, hot-dip galvanized, in accordance with EN 14399-6

HV bolting assemblies are relevant in the field of metal construction (halls, bridges, wind turbines, pylons, etc.). In the absence of specific indication, HV bolts meet class K1.

Identification

In order to allow a clear identification of the HV sets, each element bears a marking to identify the product and limit the risk of error. In addition, the indication of the manufacturing batch number guarantees traceability before and after assembly. The marking must therefore always remain visible. When mounting the washers and nuts, it is mandatory to ensure that the face bearing the marking is facing outward.



- HV designation
- Resistance class 10.9
- Manufacturer's symbol 'PGB'
- Batch number (eg 15)



- HV designation
- Resistance class 10Z
- Manufacturer's symbol 'PGB'
- Batch number (eg 15)



- Designation H
- Manufacturer's symbol 'PGB'
- Batch number (eg 15)

Standard range

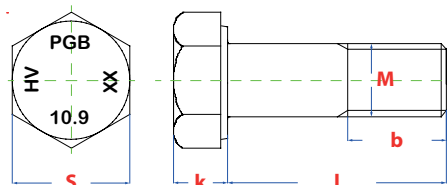
HV 10.9 bolt, EN 14399-4	HV 10 nut, EN 14399-4	HV washer, EN 14399-6
M12 x 30 – 120	M12	M12
M16 x 35 – 150	M16	M16
M20 x 50 – 170	M20	M20
M24 x 55 – 160	M24	M24
M27 x 60 – 160	M27	M27
M30 x 80 – 180	M30	M30
M36 x 90 – 200	M36	M36

Screws, nuts and washers are sold separately.



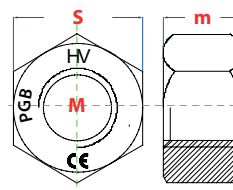
HV combinations

HV hexagonal head screw - 10.9 – Hot dip galvanized – EN 14399-4



Size	M12	M16	M20	M24	M27	M30	M36
Socket wrench (S)	22	27	32	41	46	50	60
Pitch (P)	1,75	2,0	2,5	3,0	3,0	3,5	4,0
Head thickness (k)	8	10	13	15	17	19	23
Thread length (b)	23	28	33	39	41	44	52

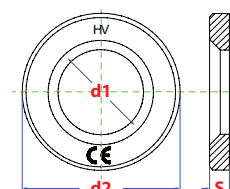
HV nut – classe [10] – Hot dip galvanized + lubricant (MoS2) black – EN 14399-4



Size	M12	M16	M20	M24	M27	M30	M36
Socket wrench (S)	22	27	32	41	46	50	60
Height (m)	10	13	16	19	22	24	29

MoS2 is a common dry or powder lubricant and has a black graphite colour. This explains why the nuts have a black colour after adding this lubricant.

HV washer – 300-370 hv – Hot dip galvanized – EN 14399-6



Size	M12	M16	M20	M24	M27	M30	M36
Inner diameter (d1)	13	17	21	25	28	31	37
Outer diameter (d2)	24	30	37	44	50	56	66
Thickness (S)	3	4	4	4	5	5	6

Choice of length according to clamping capacity

Important remarks about clamping capacity

As the thread length of HV bolts is relatively short, a particular attention should be paid to the choice of length according to clamping capacity. If an HV bolt is too long, the body (non-threaded part) of the bolt may exceed the thickness of the steel structure thickness, preventing the required pre-stressing force to be applied. Conversely, in case the bolt is too short, the available thread length is insufficient to effectively resume the pre-stressing force.

Therefore, the following conditions must be fulfilled:

$$(l_{g_{\max}} + 2 P) < \Sigma t < (l_{\min} - P - m_{\max})$$

- $l_{g_{\max}}$ = maximum body length
- P = screw pitch
- Σt = clamping capacity
- $m_{\max}$ = maximum nut height
- $l_{\min}$ = nominal screw length

In other words:

$$(\text{body length} + 2 \text{ pitch}) < \text{clamping capacity} < (\text{nominal length} - 1 \text{ pitch} - 1 \text{ nut height})$$

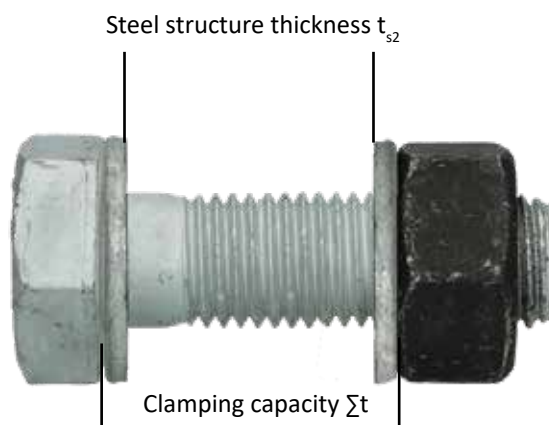
The values indicated in the table on the next page $\Sigma t_{\min}$ and $\Sigma t_{\max}$ are within this perimeter. The values for $\Sigma t_{\max}$ are fixed so that the screw protrudes 1 pitch from the free face of the nut.

Clamping capacity with HV-sets

The definition of the clamping capacity according to EN 14399-4 includes two washers. We must therefore distinguish the tightening capacity of the bolt and the thickness of the steel structure.

Clamping capacity is the distance between the head of the screw and the nut.

Steel structure thickness is the distance between the 2 washers. According to EN 1090-2, to compensate the clamping length, up to three washers of a total thickness not exceeding 12 mm can be installed on the end which is not turned.



Clamping capacity HV-sets

Clamping capacity Σt

Size	M12		M16		M20		M24		M27		M30		M36	
L	min	max	min	max	min	max	min	max	min	max	min	max	min	max
30	11	16												
35	16	21	12	17										
40	21	26	17	22										
45	26	31	22	27										
50	31	36	27	32	23	28								
55	36	41	32	37	28	33	24	29						
60	41	46	37	42	33	38	29	34	26	31				
65	46	51	42	47	38	43	34	39	31	36				
70	51	56	47	52	43	48	39	44	36	41				
75	56	61	52	57	48	53	44	49	41	46				
80	61	66	57	62	53	58	49	54	46	51	44	49		
85	66	71	62	67	58	63	54	59	51	56	49	54		
90	71	76	67	72	63	68	59	64	56	61	54	59	48	53
95	76	81	72	77	68	73	64	69	61	66	59	64	53	58
100	81	86	77	82	73	78	69	74	66	71	64	69	58	63
105	86	91	82	87	78	83	74	79	71	76	69	74	63	68
110	91	96	87	92	83	88	79	84	76	81	74	79	68	73
115	96	101	92	97	88	93	84	89	81	86	79	84	73	78
120	101	106	97	102	93	98	89	94	86	91	84	89	78	83
125			102	107	98	103	94	99	91	96	89	94	83	88
130			107	112	103	108	99	104	96	101	94	99	88	93
135			112	117	108	113	104	109	101	106	99	104	93	98
140			117	122	113	118	109	114	106	111	104	109	98	103
145			122	127	118	123	114	119	111	116	109	114	103	108
150			127	132	123	128	119	124	116	121	114	119	108	113
155					128	133	124	129	121	126	119	124	113	118
160					133	138	129	134	126	131	124	129	118	123
165					138	143					129	134	123	128
170					143	148					134	139	128	133
175											139	144	133	138
180											144	149	138	143
185													143	148
190													148	153
195													153	158
200													158	163

Steel construction thickness HV-sets

Steel construction thickness t_{s2}

Size	M12		M16		M20		M24		M27		M30		M36	
L	min	max	min	max	min	max	min	max	min	max	min	max	min	max
30	5	10												
35	10	15	4	9										
40	15	20	9	14										
45	20	25	14	19										
50	25	30	19	24	15	20								
55	30	35	24	29	20	25	16	21						
60	35	40	29	34	25	30	21	26	16	21				
65	40	45	34	39	30	35	26	31	21	26				
70	45	50	39	44	35	40	31	36	26	31				
75	50	55	44	49	40	45	36	41	31	36				
80	55	60	49	54	45	50	41	46	36	41	34	39		
85	60	65	54	59	50	55	46	51	41	46	39	44		
90	65	70	59	64	55	60	51	56	46	51	44	49	36	41
95	70	75	64	69	60	65	56	61	51	56	49	54	41	46
100	75	80	69	74	65	70	61	66	56	61	54	59	46	51
105	80	85	74	79	70	75	66	71	61	66	59	64	51	56
110	85	90	79	84	75	80	71	76	66	71	64	69	56	61
115	90	95	84	89	80	85	76	81	71	76	69	74	61	66
120	95	100	89	94	85	90	81	86	76	81	74	79	66	71
125			94	99	90	95	86	91	81	86	79	84	71	76
130			99	104	95	100	91	96	86	91	84	89	76	81
135			104	109	100	105	96	101	91	96	89	94	81	86
140			109	114	105	110	101	106	96	101	94	99	86	91
145			114	119	110	115	106	111	101	106	99	104	91	96
150			119	124	115	120	111	116	106	111	104	109	96	101
155					120	125	116	121	111	116	109	114	101	106
160					125	130	121	126	116	121	114	119	106	111
165					130	135					119	124	111	116
170					135	140					124	129	116	121
175											129	134	121	126
180											134	139	126	131
185													131	136
190													136	141
195													141	146
200													146	151

Tightening torque HV-sets

Tightening torque for class K1

Combined method (torque + angle)

	Torque to be applied $M_{r,1}$ [Nm]	Pre-tightening torque $M_{r,i}$ [Nm]	Pre-loading $F_{p,C}$ [kN]
		With $K_t = 0,13$	
M	Class 10.9		
12	92	69	59
16	229	172	110
20	446	335	172
22	607	455	212
24	771	578	247
27	1128	846	321
30	1532	1149	393
36	2676	2007	572

Stage 1 according to EN 1090-2	
$M_{r,i} = 0,75 \times M_{r,1}$	
Met $F_{p,C} = 0,7 \times F_{ub} \times A_s$ $M_{r,1} = K_m \times d \times F_{p,C}$ $K = 0,10 \leq K_t \leq 0,16$	$F_{p,C}$: nominal preload according to EN 1090-2

Stage 2 according to EN 1090-2	
Clamping capacity Σt	Final angle of rotation
d = screw diameter	Class 10.9
$\Sigma t < 2d$	60° or 1/6 of a turn
$2d \leq \Sigma t < 6d$	90° or 1/4 of a turn
$\Sigma t \geq 6d$	120° or 1/3 of a turn

The labels of pgb-fasteners show the recommended torque according to EN 14399 for the HV combinations.



Notes

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