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A company of
Sundram Fasteners Ltd., India

PEINER

Fasteners for wind turbines

PEINER Umformtechnik

Fastener sets from PEINER link the world
Tried and tested in wind turbines and steel constructions

PEINER Umformtechnik is a company of the Indian Sundram Fasteners Limited (SFL) and a leading supplier of fastening elements for wind turbines. It supplies well-known manufacturers with the full range of fasteners.This includes HV-sets of dimensions up to M64 complying with DIN EN 14399 and DASt guideline 021 typically used in wind turbine systems and also other fasteners made to customer drawings and specifications.

High quality demand
As construction elements performing a safety function, these fasteners must comply with strict quality requirements. Consequently, we have adopted high precision standards and invested heavily in quality assurance. Our quality management system complies with the high demands of the automotive industry and is ISO/TS 16949 and ISO 9001:2008 certified. A part identification code permits back-traceability of the end product through the entire manufacturing process to the batch of the input material. While testifying to our high quality demand, this code makes the process transparent.

Extensive quality controls of materials
Quality assurance starts with the input materials. Samples of every batch received are checked for compliance with the order specifications, test reports and certificates. Surface finish, chemical composition, lattice structure and workability are also tested. We purchase input materials only from validated, well-known suppliers.

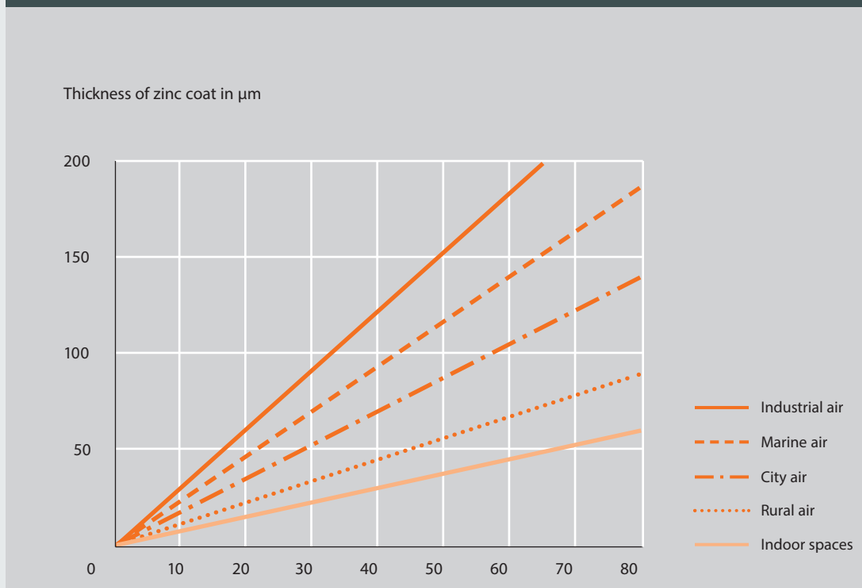
Permanent monitoring of production
Separate from production, quality assurance is practiced throughout the manufacturing process. All measuring results are included and documented in the CAQ system. Possible deviations can be corrected without delay to ensure a uniformly high level of quality.

Effective corrosion protection
Hot dip galvanizing according to DIN EN ISO 10684 ensures efficient, high-quality corrosion protection even in potentially aggressive atmospheres. Depending on the aggressive media, a zinc coat of 50 to 70 µm thickness alloyed with the base material can protect the full function of the bolted connection for many years (Figure 1).

Based on scientific findings and empirical data gained through many years in the industry, hot dip galvanizing is applied under defined conditions according to the manufacturing guideline of Deutscher Schraubenverband and Gemeinschaftsausschuss Verzinken.

Besides as above, any other fastener corrosion protection system can be applied. In addition to hot dip galvanizing, inorganic coating systems defined in DIN EN ISO 10683 have proven to be effective. It goes without saying that no hexavalent chromium is involved anywhere.This is in line with the ecological approach taken in the wind turbine industry.

Global supply
As a member of the global network of Sundram Fasteners Ltd. and in cooperation with logistics partners with worldwide activities we ensure the timely availability of all types of fasteners in customized packaging and specially tailored delivery systems.



Source: Hot dip galvanizing specifications (5.4 Corrosions behaviour of zinc coatings exposed to atmospheric), 3rd edition 1999

Figure 1

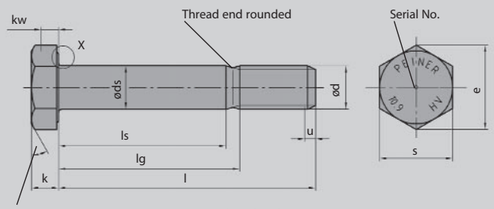
Period of protection of zinc coatings

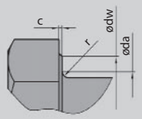
*The period of protection is not a „warranty period."

HV-bolts for wind power (based on DIN EN 14399-4)

Geometry of Peiner HV-bolts with associated HV-nuts and HV-washers

Bolt

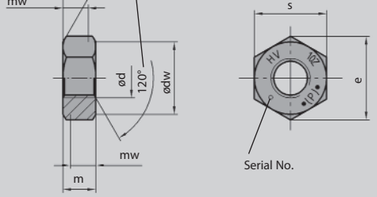




Detail X

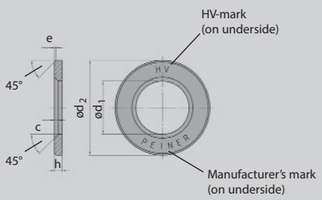
Bolt dimensions* (in millimetres)									
Nominal size		M30	M36	M39 [1]	M42	M45 [1]	M48	M56	M64
P [2]		3,5	4	4	4,5	4,5	5	5,5	6
c	min.	0,4	0,4	0,5	0,5	0,5	0,5	0,5	0,5
	max.	0,8	0,8	1	1	1	1	1	1
d_a	max.	35	41	45	48	52	55	64,2	73,2
d_s	nom.	30	36	39	42	45	48	56	64
	min.	29,16	35	38	41	44	47	54,8	62,8
	max.	30,84	37	40	43	46	49	57,2	65,2
d_w [3]	min.	46,6	55,9	60	64,7	69,45	74,2	83,4	92,9
e	min.	55,37	66,44	71,3	76,95	82,6	88,25	99,2	110,5
k	nom.	19	23	25	26	28	30	35	40
	min.	17,95	21,95	23,95	24,95	26,95	28,95	33,75	38,75
	max.	20,05	24,05	26,05	27,05	29,05	31,05	36,25	41,25
k_w	min.	12,56	15,36	16,76	17,46	18,86	20,26	23,63	27,13
r	min.	2	2	2,5	2,5	3	3	3,5	4
s	max.	50	60	65	70	75	80	90	100
	min.	49	58,8	63,1	68,1	73,1	78,1	87,8	97,8

Nut



Nut dimensions* (in millimetres)									
P [2]		3,5	4	4	4,5	4,5	5	5,5	6
d_a	max.	32,4	38,9	-	-	-	-	-	-
	min.	30	36	-	-	-	-	-	-
d_w [3]	min.	46,6	55,9	60	64,7	69,5	74,2	83,4	92,9
e	min.	55,37	66,44	71,3	76,95	82,6	88,25	99,2	110,5
m	nom. = max.	24	29	31	34	36	38	45	51
	min.	22,7	27,7	29,4	32,4	34,4	36,4	43,4	49,1
m_w	min.	18,16	22,16	23,5	25,9	27,5	29,1	34,7	39,3
s	max.	50	60	65	70	75	80	90	100
	min.	49	58,8	63,1	68,1	73,1	78,1	87,8	97,8

Washer



Washer dimensions* (in millimetres)									
d_1	min. = nom.	31	37	40,4	43,4	46,4	49,4	58	66
	max.	31,62	37,62	41,02	44,02	47,02	50,02	58,74	66,74
d_2	min.	54,8	64,8	70,8	76,8	83,6	90,6	103,6	113,6
	max. = nom.	56	66	72	78	85	92	105	115
h	Nominal size	5	6	6	8	8	8	10	10
	min.	4,4	5,4	5,4	6,8	6,8	6,8	8,8	8,8
	max.	5,6	6,6	6,6	9,2	9,2	9,2	11,2	11,2
c	min. = nom.	2,5	2,5	3	3	3,4	3,4	4	4,5
	max.	3	3	3,5	3,5	4	4	4,5	5
e	Nominal size = min.	1	1,25	1,25	1,5	1,5	1,5	2	2
	max.	2	2,5	2,5	3	3	3	4	4

*The dimensions before galvanization are for hot dip galvanized bolts, nuts and washers

[1] Special sizes; customized production
[2] P =Thread pitch (standard thread)
[3] $d_{w,max.} = s_{act.}$

Note:
Peiner HV-bolts for high-strength and normally preloaded connections in sizes M30 and M36 are specified in DIN EN 14399-4. Larger bolts of M39 to M64 are defined in DASt guideline 021.

PEINER HV-bolts with the associated HV-nuts and HV-washers must only be used as a set from one and the same supplier.

PEINER HV-bolt-sets M30 to M64

Technical features

Technical features

The special technical features of the sets throughout this size range include:
- Large width across flats
- Larger radius at the head-shank transition
- Sufficiently free loaded thread length of the bolt
- Rounded thread-shank transition of the bolt
- Bolt and nut with serial and batch identification
- Washers with sufficiently dimensioned inside chamfer
- Hot dip galvanization according to special conditions, to manufacturer specifications of Deutscher Schraubenverband and Gemeinschaftsausschuss Verzinken, in accordance with DIN EN ISO 10684; the dimensional deviation is included in the nut (tolerance field 6 AZ according to DIN ISO 965-5)
- Defined lubrication of the nut
- Uniform tightening behaviour

Instructions for use

Instructions for use

The execution of the bolted connections is governed by DIN 18800-7 and DIN EN 1090-2, resp. (also see the information in our booklet „PEINER HV-bolt-sets for steel construction").

Table 2

	M30	M36	M39	M42	M45	M48	M56	M64
Preload force F_V [1] $= 0,7 \cdot f_{yb} \cdot A_S$	350	510	610	710	820	930	1280	1680
Tightening torque M_A für F_V	1650	2800	3500	4500	5500	6500	10000	15000
Preload force $F_{p,C} = 0,7 \cdot f_{ub} \cdot A_S$	393	572						
Pretightening torque M_{VA} [2] für $F_{p,C}$	1240	2100						

[1] F_V is equal to $F_{p,C}$* acc. to DIN 1993-1-8
[2] As recommended by manufacturer, Peiner Umformtechnik GmbH, for combined method

	60°	90°	120°
	1/6	1/4	1/3
$\sum t$	$< 2d$	$2d \le \sum t < 6d$	$6d \le \sum t \le 10d$
Further angle of rotation or part turn for total lamping length for the combined method			

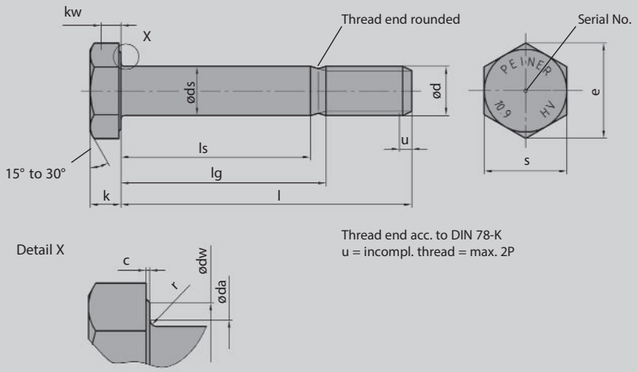
Designation

Size range	Preload	Preload method
M30 and M36 (k-class K1)	F_V acc. to DIN 18800-7	Torque method or combined preload method acc. to DIN 18800-7
	$F_{p,C}$ acc. to DIN EN 1993-1-8 and DIN EN 1090-2	Combined preload method acc. to DIN EN 1090-2
M39 to M64 (hot dip galvanized) [3]	F_V acc. to DASt guideline 021 (based on DIN 18800-7)	Torque method acc. to DASt guideline 021 (based on DIN 18800-7)

[3] Tightening Process verification required for surface condition as processed.

Figure 2

Dimensions of PEINER HV-sets, large size up to M64



Thread end acc. to DIN 78-K
u = incompl. thread = max. 2P

Table 3

Shank lengths l_s and l_g

L	Shank lengths l_s and l_g															
	M30		M36		M39		M42		M45		M48		M56		M64	
Nominal size	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.
70	15,5	26														
80	25,5	36	16	28												
90	35,5	46	26	38												
100	45,5	56	36	48												
110	55,5	66	46	58	30	42										
120	65,5	76	56	68	40	52	32,5	46	30,5	44						
130	75,5	86	66	78	50	62	42,5	56	40,5	54	33	48				
140	85,5	96	76	88	60	72	52,5	66	50,5	64	43	58	33,5	50		
150	95,5	106	86	98	70	82	62,5	76	60,5	74	53	68	43,5	60	32	50
160	105,5	116	96	108	80	92	72,5	86	70,5	84	63	78	53,5	70	42	60
170	115,5	126	106	118	90	102	82,5	96	80,5	94	73	88	63,5	80	52	70
180	125,5	136	116	128	100	112	92,5	106	90,5	104	83	98	73,5	90	62	80
190	135,5	146	126	138	110	122	102,5	116	100,5	114	93	108	83,5	100	72	90
200	145,5	156	136	148	120	132	112,5	126	110,5	124	103	118	93,5	110	82	100
210	155,5	166	146	158	130	142	122,5	136	120,5	134	113	128	103,5	120	92	110
220	165,5	176	156	168	140	152	132,5	146	130,5	144	123	138	113,5	130	102	120
230	175,5	186	166	178	150	162	142,5	156	140,5	154	133	148	123,5	140	112	130
240	185,5	196	176	188	160	172	152,5	166	150,5	164	143	158	133,5	150	122	140
250	195,5	206	186	198	170	182	162,5	176	160,5	174	153	168	143,5	160	132	150
260	205,5	216	196	208	180	192	172,5	186	170,5	184	163	178	153,5	170	142	160
270	215,5	226	206	218	190	202	182,5	196	180,5	194	173	188	163,5	180	152	170
280	225,5	236	216	228	200	212	192,5	206	190,5	204	183	198	173,5	190	162	180
290	235,5	246	226	238	210	222	202,5	216	200,5	214	193	208	183,5	200	172	190
300	245,5	256	236	248	220	232	212,5	226	210,5	224	203	218	193,5	210	182	200
310	255,5	266	246	258	230	242	222,5	236	220,5	234	213	228	203,5	220	192	210
320	265,5	276	256	268	240	252	232,5	246	230,5	244	223	238	213,5	230	202	220
330	275,5	286	266	278	250	262	242,5	256	240,5	254	233	248	223,5	240	212	230
340	285,5	296	276	288	260	272	252,5	266	250,5	264	243	258	233,5	250	222	240
350	295,5	306	286	298	270	282	262,5	276	260,5	274	253	268	243,5	260	232	250
360	305,5	316	296	308	280	292	272,5	286	270,5	284	263	278	253,5	270	242	260
370	315,5	326	306	318	290	302	282,5	296	280,5	294	273	288	263,5	280	252	270
380	325,5	336	316	328	300	312	292,5	306	290,5	304	283	298	273,5	290	262	280
390	335,5	346	326	338	310	322	302,5	316	300,5	314	293	308	283,5	300	272	290
400	345,5	356	336	348	320	332	312,5	326	310,5	324	303	318	293,5	310	282	300
410	355,5	366	346	358	330	342	322,5	336	320,5	334	313	328	303,5	320	292	310
420	365,5	376	356	368	340	352	332,5	346	330,5	344	323	338	313,5	330	302	320
430	375,5	386	366	378	350	362	342,5	356	340,5	354	333	348	323,5	340	312	330
440	385,5	396	376	388	360	372	352,5	366	350,5	364	343	358	333,5	350	322	340
450	395,5	406	386	398	370	382	362,5	376	360,5	374	353	368	343,5	360	332	350
460	405,5	416	396	408	380	392	372,5	386	370,5	384	363	378	353,5	370	342	360
470	415,5	426	406	418	390	402	382,5	396	380,5	394	373	388	363,5	380	352	370
480	425,5	436	416	428	400	412	392,5	406	390,5	404	383	398	373,5	390	362	380
490	435,5	446	426	438	410	422	402,5	416	400,5	414	393	408	383,5	400	372	390
500	445,5	456	436	448	420	432	412,5	426	410,5	424	403	418	393,5	410	382	400

Standardized nominal length range

Additional nominal length range

Figure 3

Clamping pattern with large width across flats

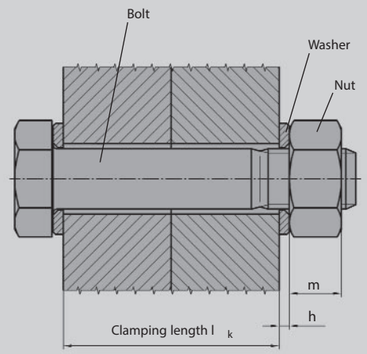


Table 4

Clamping length l_k

Clamping length l	Clamping length l_k							
	M30 [1]	M36 [1]	M39	M42	M45	M48	M56	M64
70	24 - 29							
80	34 - 39	26 - 31						
90	44 - 49	36 - 41						
100	54 - 59	46 - 51						
110	64 - 69	56 - 61	48 - 58					
120	74 - 79	66 - 71	58 - 68	50 - 61	48 - 58			
130	84 - 89	76 - 81	68 - 78	60 - 71	58 - 68	54 - 67		
140	94 - 99	86 - 91	78 - 88	70 - 81	68 - 78	64 - 77	54 - 65,1	
150	104 - 109	96 - 101	88 - 98	80 - 91	78 - 88	74 - 87	64 - 75,1	56 - 69
160	114 - 119	106 - 111	98 - 108	90 - 101	88 - 98	84 - 97	74 - 85,1	66 - 79
170	124 - 129	116 - 121	108 - 118	100 - 111	98 - 108	94 - 107	84 - 95	76 - 89
180	134 - 139	126 - 131	118 - 128	110 - 121	108 - 118	104 - 117	94 - 105	86 - 99
190	144 - 149	136 - 141	128 - 138	120 - 131	118 - 128	114 - 126	104 - 115	96 - 108
200	154 - 159	146 - 151	138 - 148	130 - 141	128 - 138	124 - 136	114 - 125	106 - 118
210	164 - 169	156 - 161	148 - 158	140 - 151	138 - 148	134 - 146	124 - 135	116 - 128
220	174 - 179	166 - 171	158 - 168	150 - 161	148 - 158	144 - 156	134 - 145	126 - 138
230	184 - 189	176 - 181	168 - 178	160 - 171	158 - 168	154 - 166	144 - 155	136 - 148
240	194 - 199	186 - 191	178 - 188	170 - 181	168 - 178	164 - 176	154 - 165	146 - 158
250	204 - 209	196 - 201	188 - 198	180 - 191	178 - 188	174 - 186	164 - 175	156 - 168
260	214 - 219	206 - 211	198 - 208	190 - 201	188 - 198	184 - 196	174 - 185	166 - 178
270	224 - 229	216 - 221	208 - 218	200 - 211	198 - 208	194 - 206	184 - 195	176 - 188
280	234 - 239	226 - 231	218 - 228	210 - 221	208 - 218	204 - 216	194 - 205	186 - 198
290	244 - 249	236 - 241	228 - 238	220 - 231	218 - 228	214 - 226	204 - 215	196 - 208
300	254 - 259	246 - 251	238 - 248	230 - 241	228 - 238	224 - 236	214 - 225	206 - 218
310	264 - 269	256 - 261	248 - 258	240 - 251	238 - 248	234 - 246	224 - 235	216 - 228
320	274 - 279	266 - 271	258 - 268	250 - 260	248 - 258	244 - 256	234 - 244	226 - 238
330	284 - 289	276 - 281	268 - 278	260 - 270	258 - 268	254 - 266	244 - 254	236 - 248
340	294 - 299	286 - 291	278 - 288	270 - 280	268 - 278	264 - 276	254 - 264	246 - 258
350	304 - 309	296 - 301	288 - 298	280 - 290	278 - 288	274 - 286	264 - 274	256 - 268
360	314 - 319	306 - 311	298 - 308	290 - 300	288 - 298	284 - 296	274 - 284	266 - 278
370	324 - 329	316 - 321	308 - 318	300 - 310	298 - 308	294 - 306	284 - 294	276 - 288
380	334 - 339	326 - 331	318 - 328	310 - 320	308 - 318	304 - 316	294 - 304	286 - 298
390	344 - 349	336 - 341	328 - 338	320 - 330	318 - 328	314 - 326	304 - 314	296 - 308
400	354 - 359	346 - 351	338 - 348	330 - 340	328 - 338	324 - 336	314 - 324	306 - 318
410	364 - 369	356 - 361	348 - 358	340 - 350	338 - 348	334 - 345	324 - 334	316 - 327
420	374 - 379	366 - 371	358 - 368	350 - 360	348 - 358	344 - 355	334 - 344	326 - 337
430	384 - 389	376 - 381	368 - 378	360 - 370	358 - 368	354 - 365	344 - 354	336 - 347
440	394 - 399	386 - 391	378 - 388	370 - 380	368 - 378	364 - 375	354 - 364	346 - 357
450	404 - 409	396 - 401	388 - 398	380 - 390	378 - 388	374 - 385	364 - 374	356 - 367
460	414 - 419	406 - 411	398 - 408	390 - 400	388 - 398	384 - 395	374 - 384	366 - 377
470	424 - 429	416 - 421	408 - 418	400 - 410	398 - 408	394 - 405	384 - 394	376 - 387
480	434 - 439	426 - 431	418 - 428	410 - 420	408 - 418	404 - 415	394 - 404	386 - 397
490	444 - 449	436 - 441	428 - 438	420 - 430	418 - 428	414 - 425	404 - 414	396 - 407
500	454 - 459	446 - 451	438 - 448	430 - 440	428 - 438	424 - 435	414 - 424	406 - 417

[1] Unlike in DIN EN 14399-4, the clamping lengths $\sum t$ was converted to l_k for sizes M30 and M36 to obtain a uniform clamping length table in accordance with DASt guideline 021.

Standardized nominal length range

Additional nominal length range

Tabelle 5

Weights of
PEINER HV-bolts

* all data for
guidance only

Thread, d	M30	M36	M39	M42	M45	M48	M56	M64
Nominal length, l	Weight* in kg/100 pcs., with 7.85 kg/dm ³							
70	64,4							
80	69,9	110,5						
90	75,5	118,49						
100	81,0	126,48						
110	86,6	134,5	161,1					
120	92,1	142,5	170,5	200,6	238,6			
130	97,7	150,5	179,9	211,5	251,1	294,7		
140	103,2	158,4	189,3	222,4	263,6	308,9	431,4	
150	108,8	166,4	198,6	233,3	276,1	323,1	450,7	608,0
160	114,3	174,4	208,0	244,1	288,6	337,3	470,1	633,2
170	119,9	182,4	217,4	255,0	301,1	351,5	489,4	658,5
180	125,4	190,4	226,8	265,9	313,5	365,8	508,7	683,7
190	131,0	198,4	236,2	276,8	326,0	380,0	528,1	709,0
200	136,5	206,4	245,5	287,6	338,5	394,2	547,4	734,2
210	142,1	214,4	254,9	298,5	351,0	408,4	566,8	759,5
220	147,6	222,4	264,3	309,4	363,5	422,6	586,1	784,7
230	153,2	230,4	273,7	320,3	376,0	436,8	605,4	810,0
240	158,7	238,3	283,0	331,1	388,5	451,0	624,8	835,3
250	164,3	246,3	292,4	342,0	400,9	465,2	644,1	860,5
260	169,8	254,3	301,8	352,9	413,4	479,4	663,4	885,8
270	175,4	262,3	311,2	363,8	425,9	493,6	682,8	911,0
280	180,9	270,3	320,6	374,6	438,4	507,8	702,1	936,3
290	186,5	278,3	329,9	385,5	450,9	522,0	721,4	961,5
300	192,0	286,3	339,3	396,4	463,4	536,2	740,8	986,8
310	197,6	294,3	348,7	407,3	475,9	550,4	760,1	1012,0
320	203,1	302,3	358,1	418,1	488,3	564,6	779,4	1037,3
330	208,7	310,3	367,4	429,0	500,8	578,8	798,8	1062,5
340	214,2	318,2	376,8	439,9	513,3	593,0	818,1	1087,8
350	219,8	326,2	386,2	450,8	525,8	607,2	837,4	1113,0
360	225,3	334,2	395,6	461,6	538,3	621,4	856,8	1138,3
370	230,9	342,2	404,9	472,5	550,8	635,6	876,1	1163,5
380	236,4	350,2	414,3	483,4	563,2	649,9	895,4	1188,8
390	242,0	358,2	423,7	494,3	575,7	664,1	914,8	1214,1
400	247,5	366,2	433,1	505,1	588,2	678,3	934,1	1239,3
410	253,1	374,2	442,5	516,0	600,7	692,5	953,4	1264,6
420	258,6	382,2	451,8	526,9	613,2	706,7	972,8	1289,8
430	264,2	390,2	461,2	537,8	625,7	720,9	992,1	1315,1
440	269,7	398,2	470,6	548,7	638,2	735,1	1011,4	1340,3
450	275,3	406,1	480,0	559,5	650,6	749,3	1030,8	1365,6
460	280,8	414,1	489,3	570,4	663,1	763,5	1050,1	1390,8
470	286,4	422,1	498,7	581,3	675,6	777,7	1069,5	1416,1
480	291,9	430,1	508,1	592,2	688,1	791,9	1088,8	1441,3
490	297,5	438,1	517,5	603,0	700,6	806,1	1108,1	1466,6
500	303,0	446,1	526,9	613,9	713,1	820,3	1127,5	1491,8

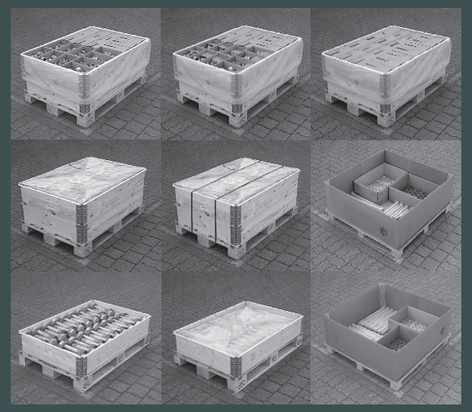
+ 2 HV-washers	12,6	21,2	26,1	41,4	50,0	58,8	94,4	109,4
+ 1 HV-nut	26,2	46,0	69,9	81,8	97,2	116,9	170,4	231,7
Σ	38,8	67,2	96,0	123,2	147,2	175,7	264,8	341,1

Packaging and shipment

General

On request, PEINER fasteners for wind turbines are packed to customer specifications, which ensures additional efficient protection during transportation. Packed in kits or sets, the exact number of parts needed for the assembly of a system or partial system is supplied, preassembled if required, to facilitate final assembly at the customer's place.

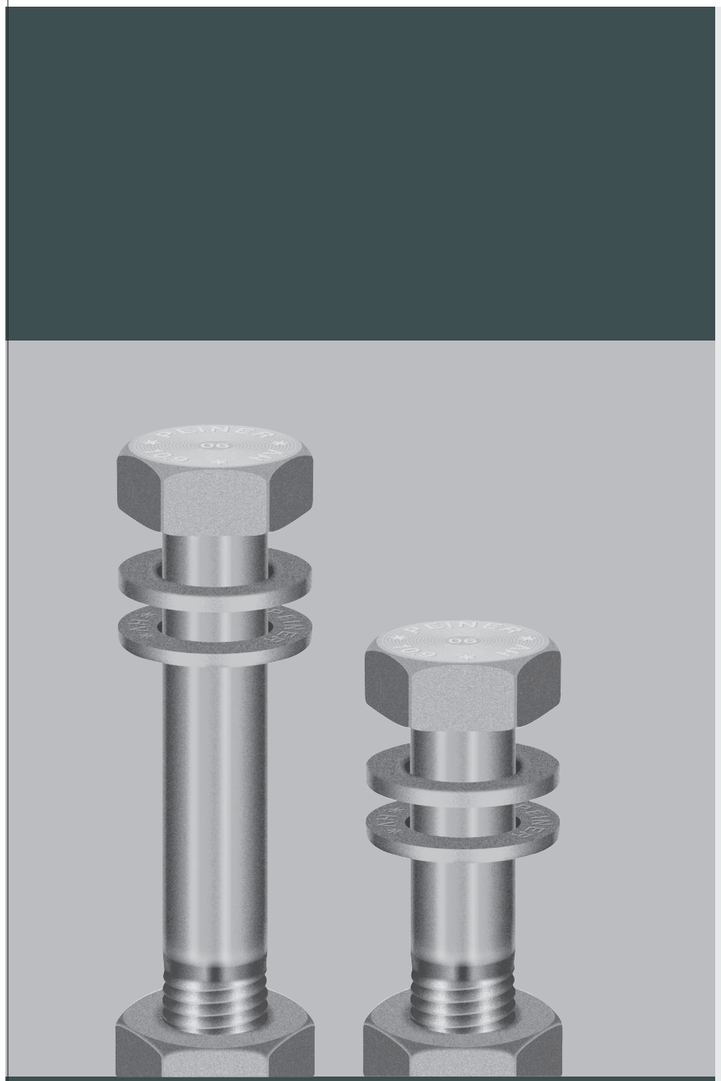
Customized shipping systems



Designation

The production and application of HV-bolt sets are based on the following technical sets of rules:		
Size range	Surface state	Set of rules
M30 and M36	Heat treated and blackened or hot dip galvanized	DIN EN 14399-/1/4/6 BRL B part 1 (sl. No. 1.4.8.1) (CE label) DIN 18800-1 and -7 and DIN EN 1993-1-8 DIN EN 1090-2
M39 to M64	Hot dip galvanized	DASt guideline 021 based on DIN 6914 and on in-house WN 83.120 BRL A part 1 (sl. No. 4.8.71) (Ü label) DIN 18800-1 and -7

Assembly and application rules for HV-bolt-sets



To ensure the standardized tightening performance and, in case of hot dip galvanized fastening elements also the thread fit, PEINER HV-bolts must only be assembled with PEINER HV-nuts and PEINER HV-washers.

Hot dip galvanized PEINER HV-nuts are lubricated ready for assembly. Additional lubrication of the bolts, nuts or washers changes the preload characteristics and is a cause of assembly failure.

All fasteners of the same nominal size can be combined into sets but should have the same surface state (no „mixed applications“ e.g., a „black“ bolt and a hot dip galvanized nut).

Assembly methods
PEINER HV-sets of large size are preferably used for bolting ring flanges in tubular towers and lattice towers. In most such cases, torque controlled tightening with standard tightening torques is applied. Lubrication of the nuts applied in the factory under process conditions ensures that the standard preload is obtained by turning the nut when it is tightened.

In addition to this, over-elastic tightening methods, which reduce the effect of friction and produce a higher preload level, are used in the mechanical equipment of a wind turbine system.
In any such case, the required parameters are defined by us together with the customer's development engineers.The team of the application engineering department of PEINER Umformtechnik consists of highly qualified specialists for such applications.

In addition to this, we cooperate with a partner company for the supply of fasteners permitting ultrasonic control of assembly and documentation of the preload obtained. For details, read pages 14 and 15 of this booklet.

Storage of HV-sets
The parts of a bolt set for systematic preloading should be stored in such a way that their surface conditions and therefore the functional properties cannot be impaired (for example, due to corrosion or dirt/dust).

Arrangement of fastening elements
Washer: Face with the identification code showing towards the part chamfers towards the bolt head and the nut, respectively
Nut: Face with the identification code showing visibly outwards

Bolt projection
In systematically preloaded bolt connections, one full thread should project beyond the nut after it is tightened fully.

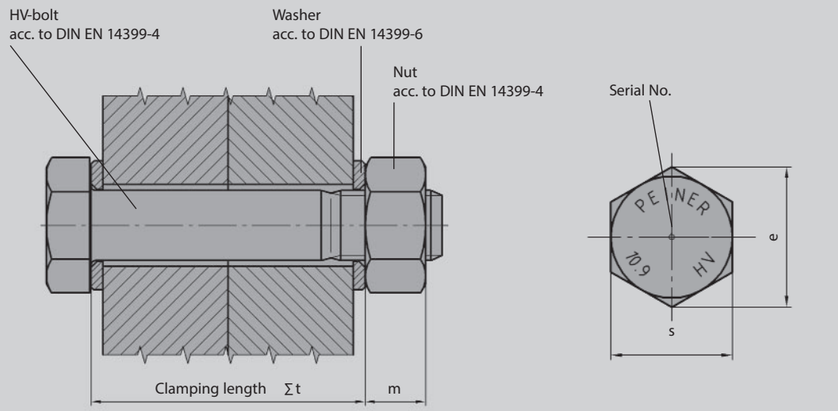


Figure 4

PEINER HV-set in assembled state

Profast
Fastener & Fixing Distributors

Sample products
Double ends and threaded rods

Double ends
and threaded rods

Special design bolt fasteners for wind turbines use double ends/threaded rods for fastening machine houses or hubs and for other applications.

Drive	All drive configurations; front-end external and internal drives are possible
Size range	from M12 to M64
Thread	Metric, other threads on request
Material	Q &T steels
Property class	Preferably 8.8 and 10.9, other grades on request
Surface	Preferably hot dip galvanized, but any other common finish and corrosion protection system is possible

Sample products
Rotor blade fasteners, nuts and special nuts

The rotor blade fasteners, which attach the rotor blade to the rotor hub in wind turbines, are exposed to extremely high dynamic loads due to the wind field.

Bolted connections of this type are subject to strict control, especially if the bolt stress characteristic is non-linear at different material stiffness levels.

Like in the design of bolted connections exposed to vibration stress, to improve the brittle fracture tendency of the cross pin, property class 8.8 and 10.9 materials are normally used, which provides substantially higher ductility.

Rotor blade fasteners

In some cases, special tension nuts ensure improved stress distribution inside the first few stressed threads. Innovative geometries are implemented on customer request, for example, to provide a larger engaged thread lengh for the nut.

Nuts and special nuts

Documentation of the preload force

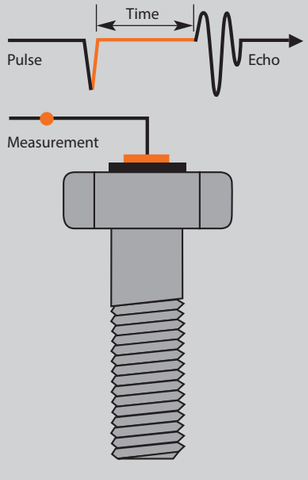
Intellifast ® sensor and 2-D bar code of recessed design

Proof of the preload force of fasteners can be traced back 100 per cent due to the documentation of assembly information.The requirements on high-strength preload fasteners increase constantly and are getting into the focus of the wind power industry and their operators looking for cost effective solutions of with high safety. Innovative hydraulic or electric tightening tools save all bolting process data in a documentation system. Specific parameters are saved on the PMT (permanent mounted transducer). In some applications, a corrosion resistant ultrasonic sensor can be attached by plasma vapour deposition (PVD). Depending on accessibility, the PMT sensor can be attached at the bolt end (face) or to the bolt head. Due to the unique position of the sensor, this innovative technology is distinctly different from any other other measuring method. All strength characteristics of the bolt remain unchanged when the sensor is attached.The preload force is measured by a method similar to echo sounding:The piezoelectric property of the sensor generates ultrasonic waves when a very small voltage is applied.The signal travels through the bolt and is reflected at the far end.The returning signals are received by the transmitter, which acts as transmitter-receiver.The time the ultrasonic wave needs for travelling through the bolt is measured by the pulse-echo method. Any change of this time within the bolt can be determined with plus/minus 3 per cent accuracy.The load factor is determined by means of a calibrated tension machine or on a bolt test rig.
This method is extremely accurate and has successfully been used in aviation/space travel, the automotive industry and for several wind turbine projects.To spare the customer costly and time consuming data handling and make this technology available to users without extensive training, every bolt is provided with a unique data matrix code (DMC).The code identifies the fastening case, contains a unique ID number of the bolt and the reference preload force.The bar code is read out by a reader with robust inspection head. By pressing a button, the user can measure and document the preload force of the bolt with no risk of confusion.This bolt identification (digifast ®) permits 100% traceability for many years.This installation of bolts with no effect on the friction coefficient is ideal especially for demanding and dynamic installations.The time saved due to optimized and simplified processes for inspection, maintenance and documentation fully compensates the costs of this innovative technology.

Hand-held 2-D bar code reader with integrated LED light

Figure 5

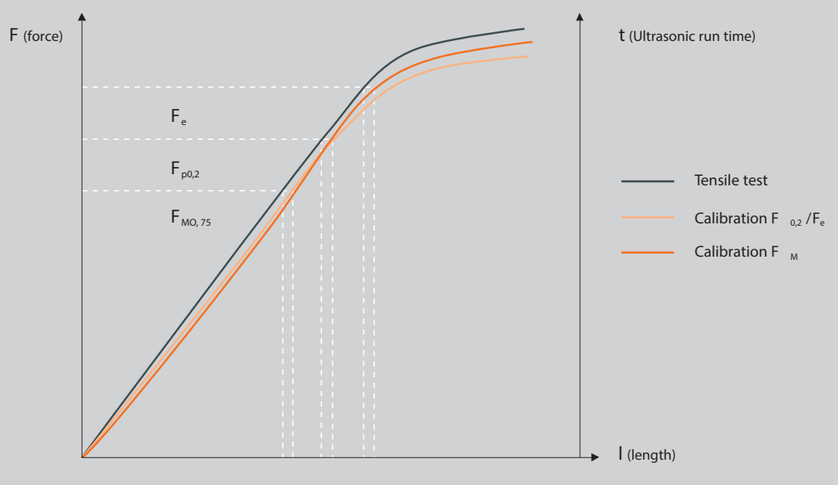
Method of measuring the preload force



The ultrasonic sensor is permanent-adhesion and extremely resistant part of the fastening. Depending on the application, the sensor can be applied to the bolt head or the far end face of the bolt. Direct contact eliminates any fault of handling or coupling.

Figure 6

Comparison of the ultrasonic propagating time between tension test (calibration) and installation monitoring



The ultrasonic propagating time of every fastening application must be measured by a tensile testing machine or load cell.The measured propagating time serves as reference for the real-time propagating time during installation of the fastening elements and can be corrected by the tightening method.The propagating time can be converted directly into extension or elongation with consideration of certain parameters (such as material, temperature, tension).