IHF

FASTENER SYSTEMS

Standard Fasteners

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Business and Products

The company IHF develops, produces and sells high-strength and high quality fastening elements in the form of bolts, nuts and washers.

The product range consists of:
- Strength Classes: 8.8, 10.9, 12.9, 13.9
- Bolt Diameter: M12 – M64
- Corrosion Protection: Dacromet, Deltaton, Galvanized

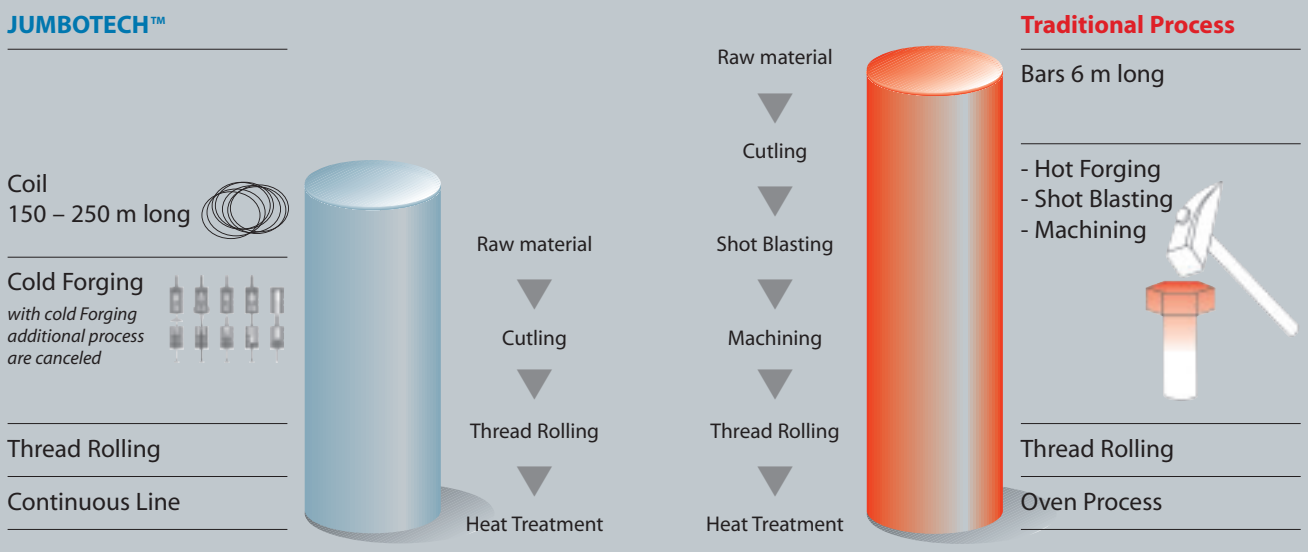
70,000 tons a year: One of the biggest producers of bolts in Europe
IHF relies on the capacities and knowledge of its partner SBE. With more than 70,000 tons a year SBE is one of the biggest producers of bolts in Europe. The product range of IHF reaches from batch productions to various custom productions, like the HV-stretch-bolt for the wind power industry.

IHF stands out with:
- ✓ Customer focus – Company procedures are focused on customer service
- ✓ High quality standards by steadily improving production reliability as a certified supplier
- ✓ Complete traceability from the wire to the finished product
- ✓ Constant and controlled heat treatment of the product
- ✓ In house nut production
- ✓ Innovative cold metal forming process JUMBOTECH™
- ✓ Complete system supplier, engineering, tools, fastening elements, service

JUMBOTECH™ Production Process

The IHF-bolts are produced by the patented JUMBOTECH™ production process.

This is the only cold metal forming process that allows for tight production tolerances of 0.05 mm on bolt sizes up to M69. In contrast to hot metal forming the JUMBOTECH™ process allows for the modern extrusion of the bolt directly from the drawn coil with a length of 150 to 200 metres. With cold metal forming you can eliminate the other expensive and time consuming manufacturing processes like sandblasting, machining and heat treating. All production steps are documented throughout the process. This makes complete traceability from the bolt to the basic material possible.



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Engineering

The engineering department provides complete technical support to meet the customer requirements. This includes detailed assembly conditions, load measurements, and surface condition requirements.

With this support the customer receives a technical solution with a commercial bolt connection.

Material Selection

The quality of the products begins with the selection of certificated suppliers. The materials used meet the requirements according to ISO 898-1 (bolts) and ISO 898-2 (nuts) regarding the chemical composition. Only carbon steel with additives or alloyed steel with suitable degrees of purity are used.

Regarding surface defects the product class D according to DIN EN 10221 is used. The surface finish, chemical composition, microstructure and formability are controlled in the lab. Special material requirements, such as thread forms and surface finishes can be supplied upon the customer's request.

Manufacturer Qualification

The production of the IHF-fastening elements is licensed and certified according to the following quality systems ISO 9001:200, ISO TS 16949:2002 and UNI EN ISO 14001 for the environment management system.

The HV-sets fulfill the requirements of the German Building Rules List A, Part 1 and have compliance certificates, issued by an accepted corporation. Each product has a control plan and process run with detailed instructions for every step of manufacturing. In addition there are quality control plans with all valid quality processes and instructions.

Documented control results are kept for 15 years.
The quality certificates according to DIN 10204, torque certificates according to DIN 18800-7 and hydrogen certificates can be shown upon customer's request.

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The Manufacturing Process

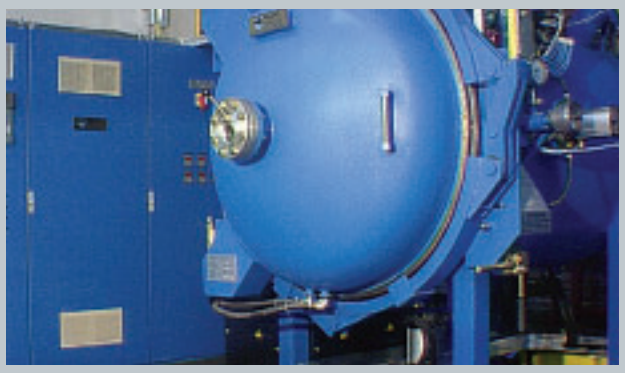
1. Wire rod stock yard
Incoming wire coil is checked prior to acceptance on the basis of IHF's quality requirements and stored in specific areas to ensure error-free collection.

2. Wire coil heat treatment
Computer controlled spheroid annealing is done in bell furnaces.

3. Wire rod pickling and phosphating
A completely automated system renders the surface of the wire rod chemically homogeneous ready for the forging operation.

4. Wire drawing
This operation ensures uniform diameter of the wire coil.

5. Tool making
Fundamental for a flexible manufacturing system, the tool making department is equipped with the machine tools needed to make the dies that are designed and drawn by our own Engineering Services department.



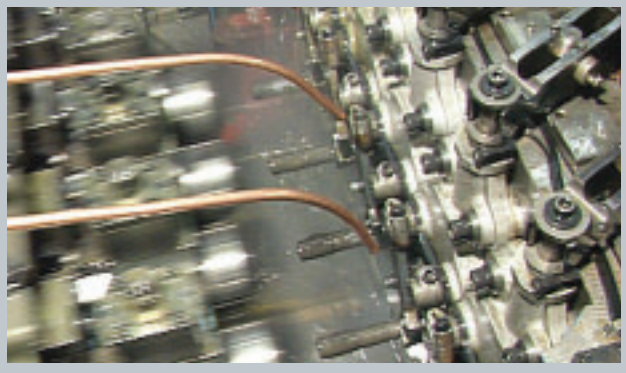
6. Tool heat treatment
An important feature of the tool making process is vacuum heat treatment.

7. Thread rolling and tapping
These recently updated and enlarged departments have facilities for threading every type of forging produced.

8. Heat treatment
Continuous furnaces of different capacities (kg/h) with a controlled and constantly monitored atmosphere are used to achieve the mechanical strength properties specified for the various fasteners.

9. Toolstock
With an inventory of over 35,000 tooling components for forging equipment, IHF owns and manages an engineering heritage hard to equal.

10. Packaging
This department has been completely refurbished, and is capable of packaging all current production items automatically.



11. Forging
It is at this stage of the process, using multi-station bolt makers and parts formers (cold forming up to 300 pcs/min), that parts are given their final shape.

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Tightening procedure

Tightening procedure of preloaded Hv assemblies according to DIN 18800 part 7, 11/2008

Table 1 shows the preload and tightening torques for steel structural assemblies. The preload should be achieved by tightening the nuts. If the tightening is only possible by turning the bolt head it is necessary to use an approved and accepted tightening procedure with a suitable lubrication on the bearing face of the head of the bolt. The thread does not need further lubrication as this is already provided by the manufacturer through the built-in lubrication of the nut.
The following procedures are available for applying preload, usually by turning the nut:

- **Torque procedure:**
  A torque M_A taken from the table 1, column 3, shall be applied to achieve the specified preload F_V according to table 1, column 2. This procedure allows a gradual tightening when a joint has many bolts. Furthermore it is possible to inspect the bolts as well as to apply a second round of tightening after some days, to assure that the specified preload is achieved in each bolt;

- **Impact procedure**
  Nut is turned relative to the bolt by impact rotating through an air driven impact wrench. The wrench shall be set to preload $F_{V, DI}$ according to column 4 of table 1 which is 10 % higher that that for the torque procedure;

- **Rotation angle procedure**
  To use this procedure all mating parts shall be flat and in a good firm contact with each other. After having achieved a pre-tightening torque $M_{VA, DW}$ according to column 5 of table 1, an additional rotation of the nut shall be applied to achieve the minimum specified preload indicated in table 1, column 2. The angle of nut rotation must be evaluated by an approved procedure on the original assembly. The elongation of the bolt under full preload might be a suitable measure;

- **Combined procedure**
  This procedure consists of two steps. Firstly a pre-tightening torque $M_{VA, KV}$ according to the table 1, column 6, has to be applied. After that, if the plates lie firmly together without any gap, a further angle of nut rotation according to table 2 shall be applied.

Contact surfaces of the joints in preloaded bearing connections with normal HV bolts or with HV fit bolts should be treated as per DIN 18800 part 7. To prevent loss of preload it is necessary to tighten up all bolts in a further round. Retightening of fully preloading HV bolts after dismantling shall be avoided. The complete bolt assembly (bolt, nut and washers) must be replaced by a new one.

Table 1: Preload and tightening torques for 10.9 assemblies (abstract from DIN 18800-7: 2008)

	1	2	3	4	5	6
			Torque	Impact	Rotation angle	Combined procedure
	Size	Specified preload F_v kN	Tightening torque M_A to be applied Nm	Preload to be applied $F_{V, DI}$ kN	Pre-tightening torque $M_{VA, DW}$ Nm	Pre-tightening torque $M_{VA, KV}$ Nm
		Surface condition: hot-dip galvanized and lubricated and as delivered and lubricated [a]				
1	M 12	50	100	60	10	75
2	M16	100	250	110	50	190
3	M20	160	450	175	50	190
4	M22	190	650	210	100	490
5	M24	220	800	240	100	600
6	M27	290	1250	320	200	940
7	M30	350	1650	390	200	1240
8	M36	510	2800	560	200	210
a) Nuts treated with molybdenum disulphide or equivalent lubricant						

DIN 18800-7 includes diameters up to M36 – larger diameters M39, M42, M45, M48, M56, M64 can be produced according to DASt-Richtlinie 021 or customer specifications

Application rules for connections with HV bolt assembly according to DIN 29900 part 1, 11/2008 and DIN 18800 part 7, 11/2008

Preloaded bolted assemblies are very sensitive to differences in manufacture and lubrication. Therefore, according to EN 14399-1 and DIN 18800-7, SBE bolts shall only be used together with SBE nuts and SBE washers.

Please note that SBE HV nuts do not need additional lubrication. This could modify the original and approved torque-preloaded-relationship.

Independently from the date of production, in case k-class K1 is required, SBE bolts, SBE nuts and SBE washers of the same diameter may be combined, but mixing bolts nut washers of different surface treatments is to be avoided.

During the installation, the plain face of the washer with the marking should show to the joint. The face with the bevel should be shown to the bolt head or the nut. The nut face with the marking should be visible after assembly.

In the preloaded connection the installed HV bolts must show a minimum one full thread protruding from the nut.

To adjust the bolt length and the thread length with the thickness of the joint, packing up to washers or shims with 12 mm thickness maximum may be used on the side not turned.

The parallelism of the two outside planes of the joint must be less or equal to 4 % (ca. 2°) for steel constructions with no oscillating loads and if the assembly is tightened by the nut. In constructions under oscillating loads the parallelism must be less or equal to 2 % (ca. 1°), if the skewness is more than the values mentioned then chamfered washers of sufficient hardness shall be applied. Bolted connections in U-profiles or in I-profiles of older size with sloped inside flanges need chamfered washers according DIN 6917 or DIN 6918. HV bolts tightened up to the specified preload need measures to prevent loosening of the preload. Short and long slotted holes possibly need enlarged washers or additional shims. They shall not be applied without the agreement of the design engineer. They are usually subjected to separate checks by the constructor.

To calculate the torque, tension and the friction coefficient of the assemblies, two test benches are available in the Laboratory, with a maximum torque of 18.000 Nm and a clamping load up to 1.800 kN.

Inspection of the specified preload of the bolt assembly

Bolt assemblies shall be inspected to determine whether the inspected bolt is correctly tightened. Table 3 shows how to inspect the assemblies and measures to be taken on the basis of the inspection results. A minimum of 10 % of all HV bolts shall be inspected in steel constructions subjected to oscillating loads, while in steel constructions of buildings or industrial buildings it´s only 5 %. In joints with less than 20 HV bolts a minimum of 2 bolts shall be inspected.

Before the inspection begins the position of the bolt, nut, washers and joint shall be marked on that side of the connection where the tightening has taken place. An inspection tool of the same type as the tightening tool shall be used as follows: adjustable hand tools and machine tools such as used in the torque control method shall be set to an inspection torque which is 10 % higher than it is listed in table 1, column 3; air driven impact wrenches shall be set to the preload listed in table 1, column 4.

Tightening procedure must be revised and complete connections shall be checked again if tightening procedure parameters cannot be met.

Table 2: Required additional angle of rotation σ and value of rotation V for the combined tightening method for 10.9 bolts

	1	2	3
	Clamping length Σ t of the package (incl. shims and washers)	Additional angle of rotation δ	Value of rotation V
1	$\Sigma t < 2\,d$	45	1/8
2	$2\,d \leq \Sigma t < 6\,d$	60	1/6
3	$6\,d \leq \Sigma t < 10d$	90	1/4
4	$10\,d < \Sigma t$	No recommendation	No recommendation

Table 3: Inspection of the specified bolt preload

Additional angle of rotation	Conclusion	Measure to be taken
< 30°	Preload was sufficient	Non
30° to 60°	Preload was only partly sufficient	Leave the inspected assembly but inspect two more bolts in the same connection
> 60°	Preload was not sufficient	Replace the inspected bolt by a new[a)] and inspect two more bolts in the same connection

a) In case of statically loaded bearing type connection with HV bolts or HV fit bolts without axial forces the inspected bolts may remain in the construction

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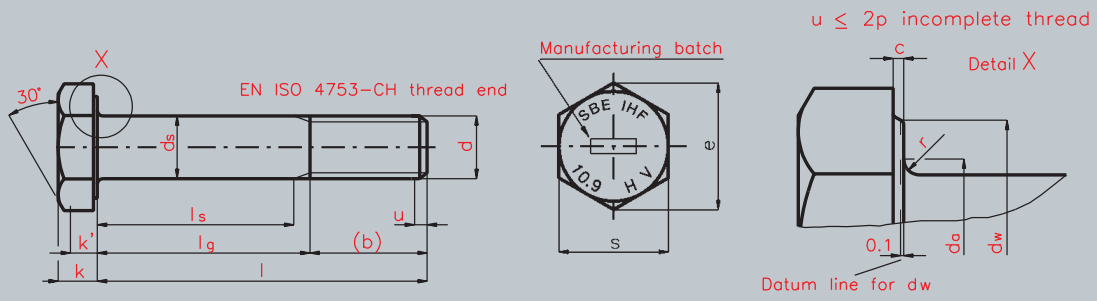


Dimensions HV-Strenght hexagon head bolts, EN 14399-4

Table 4: Dimensions of high-strength hexagon head bolts with large width across flats for structural steel bolting according to DIN 6914

Thread size (d)		M 12	M 16	M 20	M 22	M 24	M 27	M 30	M 36
P [1]		1.75	2	2.5	2.5	3	3	3.5	4
b	[2]	21	26	31	32	34	37	40	48
	[3]	23	28	33	34	37	39	42	50
c	min.	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	max.	0.6	0.6	0.8	0.8	0.8	0.8	0.8	0.8
d_a	max.	15.2	19.2	24	26	28	32	35	41
d_s	Nom. size	12	16	20	22	24	27	30	36
	min.	11.3	15.3	19.16	21.16	23.16	26.16	29.16	35
	max.	12.7	16.7	20.84	22.84	24.84	27.84	30.84	37
d_w [4]	min.	20	25	30	34	39	43.5	47.5	57
e	min.	23.91	29.56	35.03	39.55	45.20	50.85	55.37	66.44
k	Nom. size	8	10	13	14	15	17	19	23
	min.	7.55	9.25	12.1	13.1	14.1	16.1	17.95	21.95
	max.	8.45	10.75	13.9	14.9	15.9	17.9	20.05	24.05
k'	min.	5.28	6.47	8.47	9.17	9.87	11.27	12.56	15.36
r	min.	1.2	1.2	1.5	1.5	1.5	2	2	2
s	max.= nom. size	22	27	32	36	41	46	50	60
	min.	21.16	26.16	31	35	40	45	49	58.8

Nominal length, l	Shank lengths, l_s *) and l_g**)															
	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
30	3.75	9														
35	8.75	14	3	9												
40	13.75	19	8	14	15	9										
45	16.75	22	13	19	6.5	14										
50	21.75	27	18	24	11.5	19	10.5	18	7	16						
55	26.75	32	23	29	16.5	24	15.5	23	12	21						
60	31.75	37	28	34	21.5	29	20.5	28	17	26	14	23				
65	36.75	42	33	39	26.5	34	25.5	33	22	31	19	28				
70	41.75	47	38	44	31.5	39	30.5	38	27	36	24	33	19.5	30		
75	46.75	52	41	47	36.5	44	35.5	43	32	41	29	38	24.5	35		
80	51.75	57	46	52	41.5	49	40.5	48	37	46	34	43	29.5	40		
85	56.75	62	51	57	46.5	54	45.5	53	42	51	39	48	34.5	45	25	37
90	61.75	67	56	62	49.5	57	48.5	56	44	53	44	53	39.5	5 0	30	42
95	66.75	72	61	67	54.5	62	53.5	61	49	58	49	58	44.5	55	35	47
100	71.75	77	66	72	59.5	67	58.5	66	54	63	52	61	47.5	58	40	52
105	76.75	82	71	77	64.5	72	63.5	71	59	68	57	66	52.5	63	43	55

Table 4: (Continued)

Thread size (d)	M 12		M 16		M 20		M 22		M 24		M 27		M 30		M 36	
Nominal length, l	Shank lengths, l_s *) and l_g **)															
	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
110	81.75	87	76	82	69.5	77	68.5	76	64	73	62	71	57.5	68	48	60
115	86.75	92	81	87	74.5	82	73.5	81	69	78	67	76	62.5	73	53	65
120	91.75	97	86	92	79.5	87	78.5	86	74	83	72	81	67.5	78	58	70
125			91	97	84.5	92	83.5	91	79	88	77	86	72.5	83	63	75
130			96	102	89.5	97	88.5	96	84	93	82	91	77.5	88	68	80
135			101	107	94.5	102	93.5	101	89	98	87	96	82.5	93	73	85
140			106	112	99.5	107	98.5	106	94	103	92	101	87.5	98	78	90
145			111	117	104.5	112	103.5	111	99	108	97	106	92.5	103	83	95
150			116	122	109.5	117	108.5	116	104	113	102	111	97.5	108	88	100
155			121	127	114.5	122	113.5	121	109	118	107	116	102.5	113	93	105
160			126	132	119.5	127	118.5	126	114	123	112	121	107.5	118	98	110
165			131	137	124.5	132	123.5	131	119	128	117	126	112.5	123	103	115
170			136	142	129.5	137	128.5	136	124	133	122	131	117.5	128	108	120
175			141	147	134.5	142	133.5	141	129	138	127	136	122.5	133	113	125
180			146	152	139.5	147	138.5	146	134	143	132	141	127.5	138	118	130
185			151	157	144.5	152	143.5	151	139	148	137	146	132.5	143	123	135
190			156	162	149.5	157	148.5	156	144	153	142	151	137.5	148	128	140
195			161	167	154.5	162	153.5	161	149	158	147	156	142.5	153	133	145
200			166	172	159.5	167	158.5	166	154	163	152	161	147.5	158	138	150
210			176	182	169.5	177	168.5	176	164	173	162	171	157.5	168	148	160
220			186	192	179.5	187	178.5	186	174	183	172	181	167.5	178	158	170
230					189.5	197	188.5	196	184	193	182	191	177.5	188	168	180
240					199.5	207	198.5	206	194	203	192	201	187.5	198	178	190
250					209.5	217	208.5	216	204	213	202	211	197.5	208	188	200
260					219.5	227	218.5	226	214	223	212	221	207.5	218	198	210

Figure = standardized range of bolt lengths

Figure = additional range of bolt lengths

On customer request different lengths can be produced.

* $l_{s\,min.} = l_{g\,max.} - 3\,P$

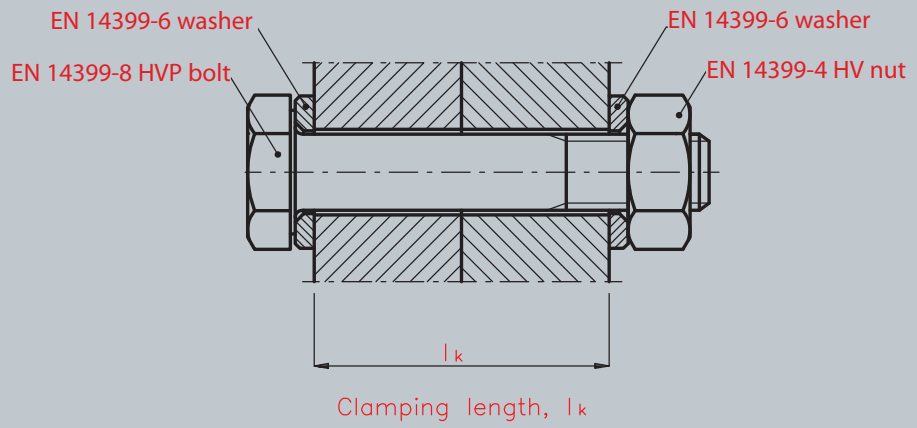
** $l_{g\,max.} = l_{nominal\,size} - b$

1) P = pitch of thread (coarse thread)

2) For lengths above the continuous step line

3) For lengths below the continuous step line

4) The maximum value of d_w shall not exceed the actual width across flats



Flangethickness HV-Standard Fasteners

Table 5: Clamping lengths

	M 12	M 16	M 20	M 22	M 24	M 27	M 30	M 36
Nominal length l	Clamping lengths l_k in mm							
30	6 to 10							
35	11 to 15	5 to 9						
40	16 to 20	10 to 14	5 to 9					
45	21 to 23	15 to 19	10 to 14					
50	24 to 28	20 to 24	15 to 19	14 to 18	12 to 16			
55	29 to 33	25 to 29	20 to 24	19 to 23	17 to 21			
60	34 to 38	30 to 34	25 to 29	24 to 28	22 to 26	18 to 22		
65	39 to 43	35 to 39	30 to 34	29 to 33	27 to 31	23 to 27		
70	44 to 48	40 to 44	35 to 39	34 to 38	32 to 36	28 to 32	24 to 28	
75	49 to 53	45 to 47	40 to 44	39 to 43	37 to 41	33 to 37	29 to 33	
80	54 to 58	48 to 52	45 to 49	44 to 48	42 to 46	38 to 42	34 to 38	
85	59 to 63	53 to 57	50 to 54	49 to 53	47 to 51	43 to 47	39 to 43	31 to 35
90	64 to 68	58 to 62	55 to 57	54 to 56	52 to 53	48 to 52	44 to 48	36 to 40
95	69 to 73	63 to 67	58 to 62	57 to 61	54 to 58	53 to 57	49 to 53	41 to 45
100	74 to 78	68 to 72	63 to 67	62 to 66	59 to 63	58 to 60	54 to 56	46 to 48
105		73 to 77	68 to 72	67 to 71	64 to 68	61 to 65	57 to 61	49 to 53
110	84 to 88	78 to 82	73 to 77	72 to 76	69 to 73	66 to 70	62 to 66	54 to 58
115		83 to 87	78 to 82	77 to 81	74 to 78	71 to 75	67 to 71	59 to 63
120	94 to 98	88 to 92	83 to 87	82 to 86	79 to 83	76 to 80	72 to 76	64 to 68
125		93 to 97	88 to 92	87 to 91	84 to 88	81 to 85	77 to 81	69 to 73
130		98 to 102	93 to 97	92 to 96	89 to 93	86 to 90	82 to 86	74 to 78
135			98 to 102	97 to 101	94 to 98	91 to 95	87 to 91	79 to 83
140		108 to 112	103 to 107	102 to 106	99 to 103	96 to 100	92 to 96	84 to 88

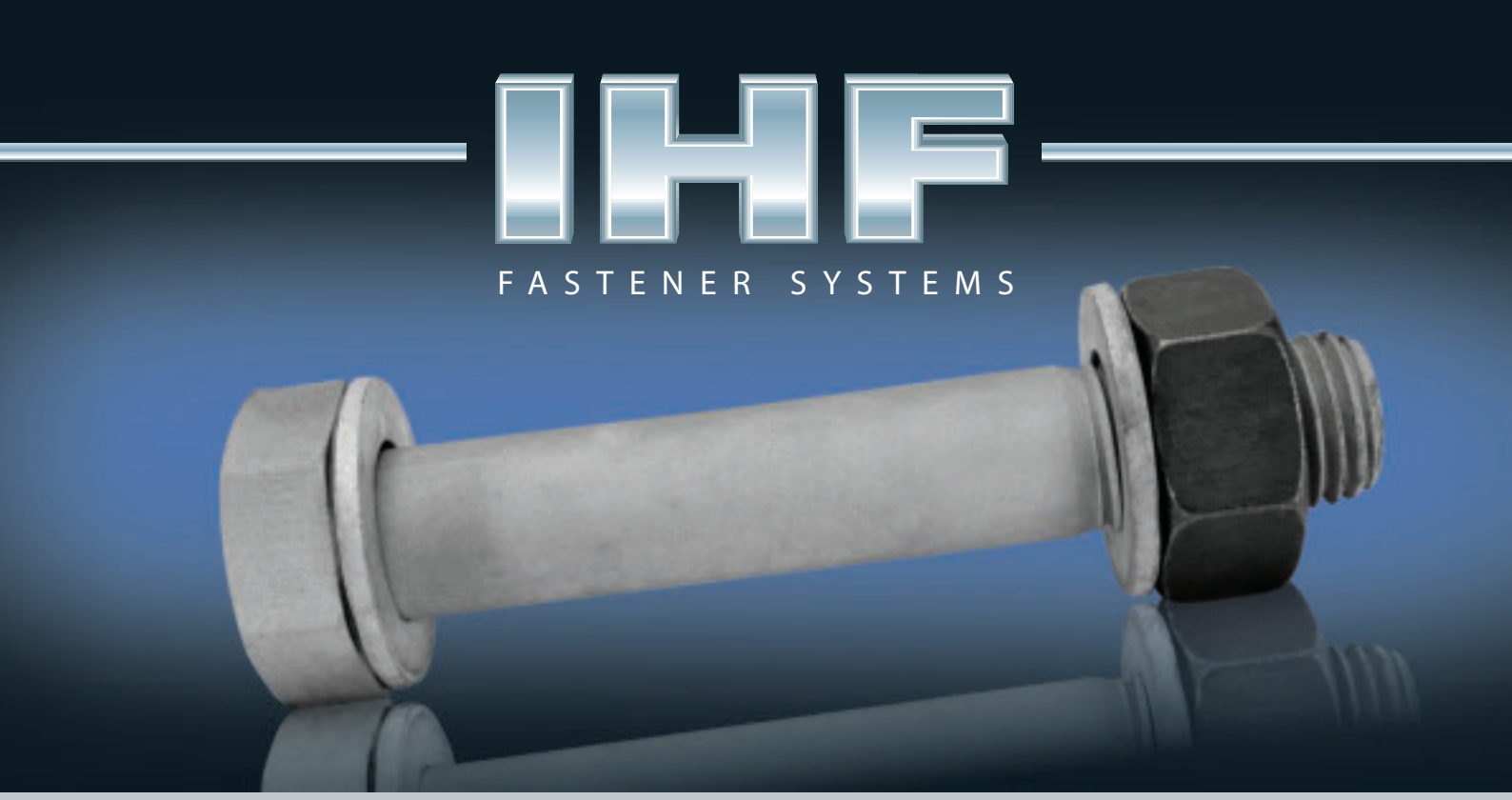


Table 5: (Continued)

	M 12	M 16	M 20	M 22	M 24	M 27	M 30	M 36
Nominal length, l	**Clamping lengths Σ t in mm**							
145		122 to 127	118 to 123	117 to 122	114 to 119	111 to 116	109 to 114	103 to 108
150		127 to 132	123 to 128	122 to 127	119 to 124	116 to 121	114 to 119	108 to 113
155		132 to 137	128 to 133	127 to 132	124 to 129	121 to 126	119 to 124	113 to 118
160		137 to 142	133 to 138	132 to 137	129 to 134	126 to 131	124 to 129	118 to 123
165		142 to 147	138 to 143	137 to 142	134 to 139	131 to 136	129 to 134	123 to 128
170		147 to 152	143 to 148	142 to 147	139 to 144	136 to 141	134 to 139	128 to 133
175		152 to 157	148 to 153	147 to 152	144 to 149	141 to 146	139 to 144	133 to 138
180		157 to 162	153 to 158	152 to 157	149 to 154	146 to 151	144 to 149	138 to 143
185		162 to 167	158 to 163	157 to 162	154 to 159	151 to 156	149 to 154	143 to 148
190		167 to 172	163 to 168	162 to 167	159 to 164	156 to 161	154 to 159	148 to 153
195		172 to 177	168 to 173	167 to 172	164 to 169	161 to 166	159 to 164	153 to 158
200		177 to 182	173 to 178	172 to 177	169 to 174	166 to 171	164 to 169	158 to 163
210		187 to 192	183 to 188	182 to 187	179 to 184	176 to 181	174 to 179	168 to 173
220		197 to 202	193 to 198	192 to 197	189 to 194	186 to 191	184 to 189	178 to 183
230			203 to 208	202 to 207	199 to 204	196 to 201	194 to 199	188 to 193
240			213 to 218	212 to 217	209 to 214	206 to 211	204 to 209	198 to 203
250			223 to 228	222 to 227	219 to 224	216 to 221	214 to 219	208 to 213
300							264 to 269	258 to 263
350							314 to 319	308 to 313

Figure = standardized range of bolt lengths **Figure = additional range of bolt lengths**

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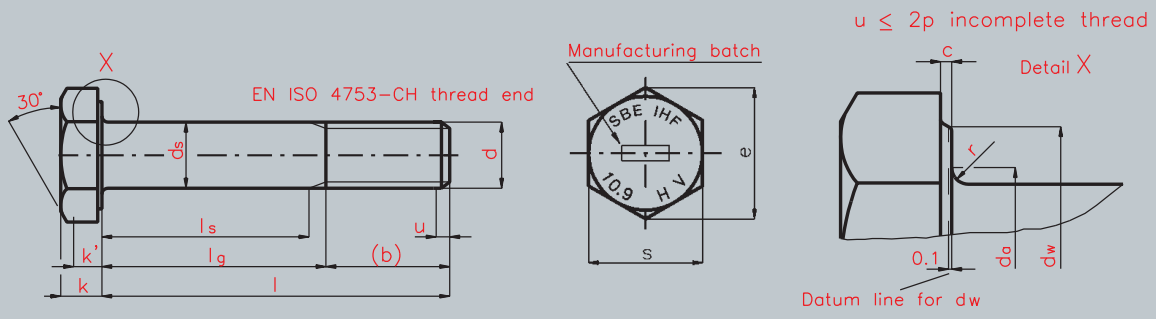


Dimensions HV-Strenght hexagon head bolts, JUMBOTECH™ line

Table 6: Dimensions of high-strength hexagon head bolts with large width across flats for structural steel bolting M39 to M64 according to DASt-Richtlinie 021

Thread size (d)		M 39	M 42	M 45	M 48	M 56	M 64
P [1]		4	4.5	4.5	5	5.5	6
b		68	74	76	82	90	100
c	min.	0.5	0.5	0.5	0.5	0.5	0.5
	max.	1	1	1	1	1	1
d_a	max.	45	48	52	55	64.2	73.2
d_s	nom. size	39	42	45	48	56	64
	min.	38	41	44	47	54.8	62.8
	max.	40	43	46	49	57.2	65.2
d_w [2]	min.	60	64.7	69.45	74.2	83.4	92.9
e	min.	71.3	76.95	82.6	88.25	99.2	110.5
k	nom. size	25	26	28	30	35	40
	min.	23.95	24.95	26.95	28.95	33.75	38.75
	max.	26.05	27.05	29.05	31.05	36.25	41.25
k'	min.	16.76	17.46	18.86	20.26	23.63	27.13
r	min.	2.5	2.5	3	3	3.5	4
s	max.= nom. size	65	70	75	80	90	100
	min.	63.1	68.1	73.1	78.1	87.8	97.8

Nominal length, l	Shank lengths, l_s [*] and l_g [**]											
	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
110	30	42										
115	35	47										
120	40	52	32.5	46	30.5	44						
125	45	57	37.5	51	35.5	49						
130	50	62	42.5	56	40.5	54	33	48				
135	55	67	47.5	61	45.5	59	38	53				
140	60	72	52.5	66	50.5	64	43	58	33.5	50		
145	65	77	57.5	71	55.5	69	48	63	38.5	55		
150	70	82	62.5	76	60.5	74	53	68	43.5	60	32	50
155	75	87	67.5	81	65.5	79	58	73	48.5	65	37	55
160	80	92	72.5	86	70.5	84	63	78	53.5	70	42	60
165	85	97	77.5	91	75.5	89	68	83	58.5	75	47	65

Table 6: (Continued)

Thread size (d)	M 39		M 42		M 45		M 48		M 56		M 64	
Nominal length, l	Shank lengths, l_s *) and l_g **)											
	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
170	90	102	82.5	96	80.5	94	73	88	63.5	80	52	70
175	95	107	87.5	101	85.5	99	78	93	68.5	85	57	75
180	100	112	92.5	106	90.5	104	83	98	73.5	90	62	80
185	105	117	97.5	111	95.5	109	88	103	78.5	95	67	85
190	110	122	102.5	116	100.5	114	93	108	83.5	100	72	90
195	115	127	107.5	121	105.5	119	98	113	88.5	105	77	95
200	120	132	112.5	126	110.5	124	103	118	93.5	110	82	100
205	125	137	117.5	131	115.5	129	108	123	98.5	115	87	105
210	130	142	122.5	136	120.5	134	113	128	103.5	120	92	110
215	135	147	127.5	141	125.5	139	118	133	108.5	125	97	115
220	140	152	132.5	146	130.5	144	123	138	113.5	130	102	120
225	145	157	137.5	151	135.5	149	128	143	118.5	135	107	125
230	150	162	142.5	156	140.5	154	133	148	123.5	140	112	130
235	155	167	147.5	161	145.5	159	138	153	128.5	145	117	135
240	160	172	152.5	166	150.5	164	143	158	133.5	150	122	140
245	165	177	157.5	171	155.5	169	148	163	138.5	155	127	145
250	170	182	162.5	176	160.5	174	153	168	143.5	160	132	150
255	175	187	167.5	181	165.5	179	158	173	148.5	165	137	155
260	180	192	172.5	186	170.5	184	163	178	153.5	170	142	160
265	185	197	177.5	191	175.5	189	168	183	158.5	175	147	165
270	190	202	182.5	196	180.5	194	173	188	163.5	180	152	170
275	195	207	187.5	201	185.5	199	178	193	168.5	185	157	175
280	200	212	192.5	206	190.5	204	183	198	173.5	190	162	180
285	205	217	197.5	211	195.5	209	188	203	178.5	195	167	185
290	210	222	202.5	216	200.5	214	193	208	183.5	200	172	190
295	215	227	207.5	221	205.5	219	198	213	188.5	205	177	195
300	220	232	212.5	226	210.5	224	203	218	193.5	210	182	200
305	225	237	217.5	231	215.5	229	208	223	198.5	215	187	205
310	230	242	222.5	236	220.5	234	213	228	203.5	220	192	210
315	235	247	227.5	241	225.5	239	218	233	208.5	225	197	215
320	240	252	232.5	246	230.5	244	223	238	213.5	230	202	220
325	245	257	237.5	251	235.5	249	228	243	218.5	235	207	225
330	250	262	242.5	256	240.5	254	233	248	223.5	240	212	230
335	255	267	247.5	261	245.5	259	238	253	228.5	245	217	235
340	260	272	252.5	266	250.5	264	243	258	233.5	250	222	240
345	265	277	257.5	271	255.5	269	248	263	238.5	255	227	245
350	270	282	262.5	276	260.5	274	253	268	243.5	260	232	250

FASTENER SYSTEMS

Dimensions HV-Strenght hexagon head bolts, JUMBOTECH™ line

Table 6: (Continued)

Thread size (d)	M 39		M 42		M 45		M 48		M 56		M 64	
Nominal length, l	Shank lengths, l_s *) and l_g **)											
	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
360	280	292	272.5	286	270.5	284	263	278	253.5	270	242	260
370	290	302	282.5	296	280.5	294	273	288	263.5	280	252	270
380	300	312	292.5	306	290.5	304	283	298	273.5	290	262	280
390	310	322	302.5	316	300.5	314	293	308	283.5	300	272	290
400	320	332	312.5	326	310.5	324	303	318	293.5	310	282	300
410	330	342	322.5	336	320.5	334	313	328	303.5	320	292	310
420	340	352	332.5	346	330.5	344	323	338	313.5	330	302	320
430	350	362	342.5	356	340.5	354	333	348	323.5	340	312	330
440	360	372	352.5	366	350.5	364	343	358	333.5	350	322	340
450	370	382	362.5	376	360.5	374	353	368	343.5	360	332	350
460	380	392	372.5	386	370.5	384	363	378	353.5	370	342	360
470	390	402	382.5	396	380.5	394	373	388	363.5	380	352	370
480	400	412	392.5	406	390.5	404	383	398	373.5	390	362	380
490	410	422	402.5	416	400.5	414	393	408	383.5	400	372	390
500	420	432	412.5	426	410.5	424	403	418	393.5	410	382	400
550	470	482	462.5	476	460.5	474	453	468	443.5	460	432	450
600	520	532	512.5	526	510.5	524	503	518	493.5	510	482	500
650	570	582	562.5	576	560.5	574	553	568	543.5	560	532	550
700	620	632	612.5	626	610.5	624	603	618	593.5	610	582	600
750	670	682	662.5	676	660.5	674	653	668	643.5	660	632	650

* $l_{s\,min.} = l_{g\,max.} - 3\,P$

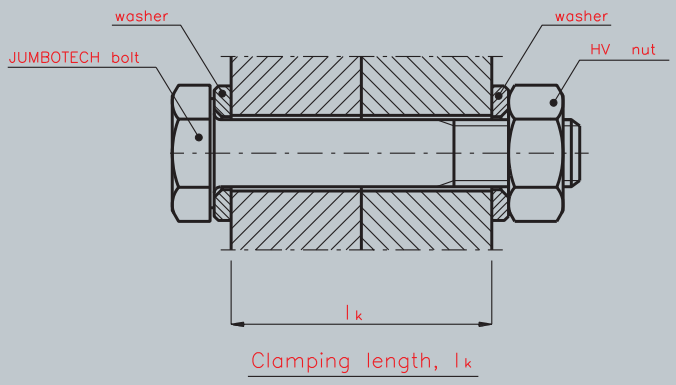
** $l_{g\,max.} = l_{nominal\,size} - b$

1) *P = pitch of thread (coarse thread)*

2) *The maximum value of d_w shall not exceed the actual width across flats*

On customer request different diameters can be produced.

FASTENER SYSTEMS



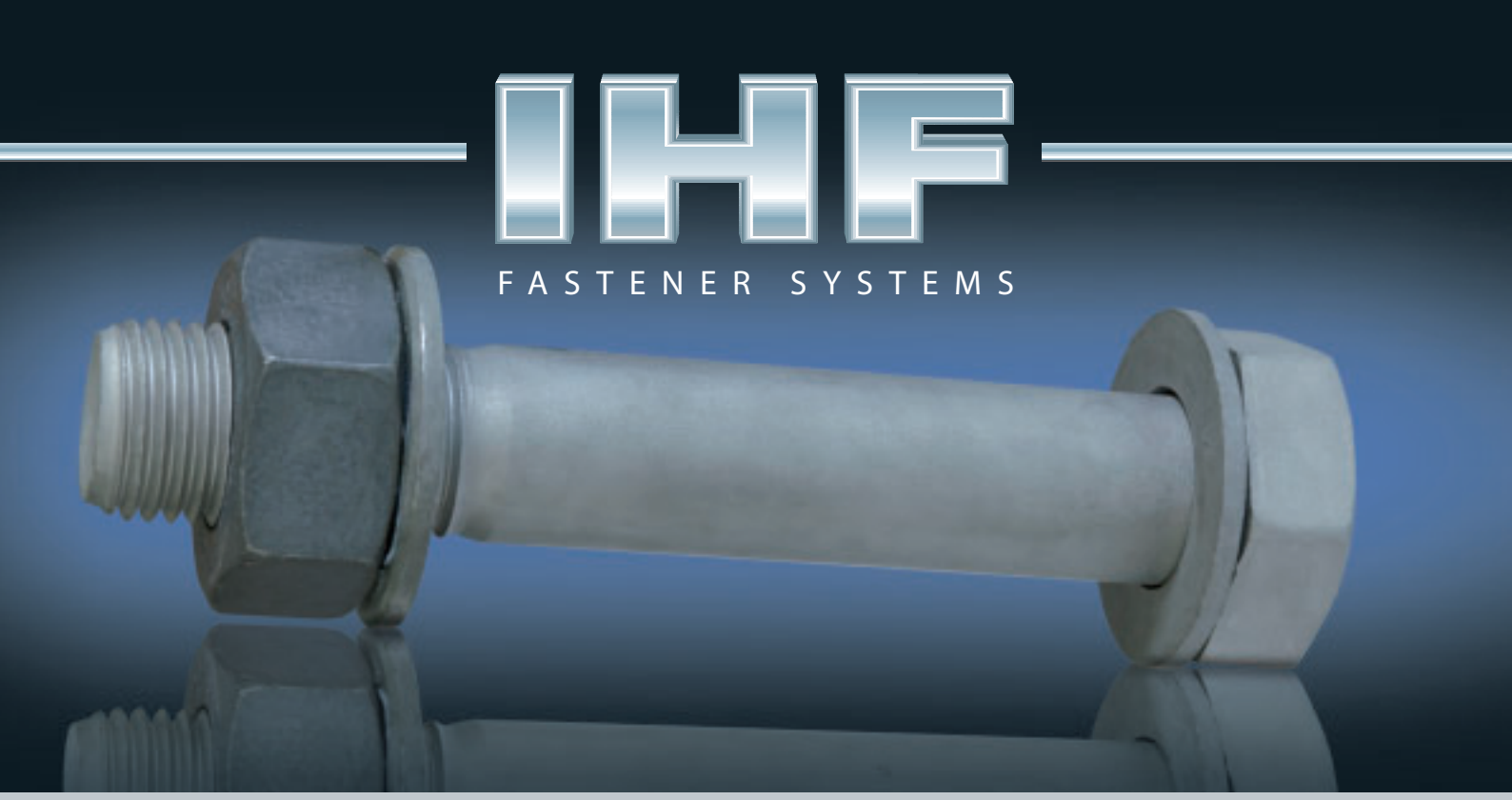
Flangethickness HV-Standard, JUMBOTECH™ line

Table 7: Clamping lengths

	M 39	M 42	M 45	M 48	M 56	M 64
Nominal length l	**Clamping lengths l_k in mm**					
110	48 to 58					
115	53 to 63					
120	58 to 68	50 to 61	48 to 58			
125	63 to 73	55 to 66	53 to 63			
130	68 to 78	60 to 71	58 to 68	54 to 67		
135	73 to 83	65 to 76	63 to 73	59 to 72		
140	78 to 88	70 to 81	68 to 78	64 to 77	54 to 65.1	
145	83 to 93	75 to 86	73 to 83	69 to 82	59 to 70.1	
150	88 to 98	80 to 91	78 to 88	74 to 87	64 to 75.1	56 to 69
155	93 to 103	85 to 96	83 to 93	79 to 92	69 to 80.1	61 to 74
160	98 to 108	90 to 101	88 to 98	84 to 97	74 to 85.1	66 to 79
165	103 to 113	95 to 106	93 to 103	89 to 102	79 to 90	71 to 84
170	108 to 118	100 to 111	98 to 108	94 to 107	84 to 95	76 to 89
175	113 to 123	105 to 116	103 to 113	99 to 112	89 to 100	81 to 94
180	118 to 128	110 to 121	108 to 118	104 to 117	94 to 105	86 to 99
185	123 to 133	115 to 126	113 to 123	109 to 121	99 to 110	91 to 103
190	128 to 138	120 to 131	118 to 128	114 to 126	104 to 115	96 to 108
195	133 to 143	125 to 136	123 to 133	119 to 131	109 to 120	101 to 113
200	138 to 148	130 to 141	128 to 138	124 to 136	114 to 125	106 to 118
205	143 to 153	135 to 146	133 to 143	129 to 141	119 to 130	111 to 123
210	148 to 158	140 to 151	138 to 148	134 to 146	124 to 135	116 to 128
215	153 to 163	145 to 156	143 to 153	139 to 151	129 to 140	121 to 133
220	158 to 168	150 to 161	148 to 158	144 to 156	134 to 145	126 to 138
225	163 to 173	155 to 166	153 to 163	149 to 161	139 to 150	131 to 143
230	168 to 178	160 to 171	158 to 168	154 to 166	144 to 155	136 to 148
235	173 to 183	165 to 176	163 to 173	159 to 171	149 to 160	141 to 153
240	178 to 188	170 to 181	168 to 178	164 to 176	154 to 165	146 to 158
245	183 to 193	175 to 186	173 to 183	169 to 181	159 to 170	151 to 163
250	188 to 198	180 to 191	178 to 188	174 to 186	164 to 175	156 to 168
255	193 to 203	185 to 196	183 to 193	179 to 191	169 to 180	161 to 173
260	198 to 208	190 to 201	188 to 198	184 to 196	174 to 185	166 to 178

Table 7: (Continued)

	M 39	M 42	M 45	M 48	M 56	M 64
Nominal length l	**Clamping lengths l_k in mm**					
265	203 to 213	195 to 206	193 to 203	189 to 201	179 to 190	171 to 183
270	208 to 218	200 to 211	198 to 208	194 to 206	184 to 195	176 to 188
275	213 to 223	205 to 216	203 to 213	199 to 211	189 to 200	181 to 193
280	218 to 228	210 to 221	208 to 218	204 to 216	194 to 205	186 to 198
285	223 to 233	215 to 226	213 to 223	209 to 221	199 to 210	191 to 203
290	228 to 238	220 to 231	218 to 228	214 to 226	204 to 215	196 to 208
295	233 to 243	225 to 236	223 to 233	219 to 231	209 to 220	201 to 213
300	238 to 248	230 to 241	228 to 238	224 to 236	214 to 225	206 to 218
305	243 to 253	235 to 246	233 to 243	229 to 241	219 to 230	211 to 223
310	248 to 258	240 to 251	238 to 248	234 to 246	224 to 235	216 to 228
315	253 to 263	245 to 256	243 to 253	239 to 251	229 to 240	221 to 233
320	258 to 268	250 to 260	248 to 258	244 to 256	234 to 244	226 to 238
325	263 to 273	255 to 265	253 to 263	249 to 261	239 to 249	231 to 243
330	268 to 278	260 to 270	258 to 268	254 to 266	244 to 254	236 to 248
335	273 to 283	265 to 275	263 to 273	259 to 271	249 to 259	241 to 253
340	278 to 288	270 to 280	268 to 278	264 to 276	254 to 264	246 to 258
345	283 to 293	275 to 285	273 to 283	269 to 281	259 to 269	251 to 263
350	288 to 298	280 to 290	278 to 288	274 to 286	264 to 274	256 to 268
360	298 to 308	290 to 300	288 to 298	284 to 296	274 to 284	266 to 278
370	308 to 318	300 to 310	298 to 308	294 to 306	284 to 294	276 to 288
380	318 to 328	310 to 320	308 to 318	304 to 316	294 to 304	286 to 298
390	328 to 338	320 to 330	318 to 328	314 to 326	304 to 314	296 to 308
400	338 to 348	330 to 340	328 to 338	324 to 336	314 to 324	306 to 318
410	348 to 358	340 to 350	338 to 348	334 to 345	324 to 334	316 to 327
420	358 to 368	350 to 360	348 to 358	344 to 355	334 to 344	326 to 337
430	368 to 378	360 to 370	358 to 368	354 to 365	344 to 354	336 to 347
440	378 to 388	370 to 380	368 to 378	364 to 375	354 to 364	346 to 357
450	388 to 398	380 to 390	378 to 388	374 to 385	364 to 374	356 to 367
460	398 to 408	390 to 400	388 to 398	384 to 395	374 to 384	366 to 377
470	408 to 418	400 to 410	398 to 408	394 to 405	384 to 394	376 to 387
480	418 to 428	410 to 420	408 to 418	404 to 415	394 to 404	386 to 397
490	428 to 438	420 to 430	418 to 428	414 to 425	404 to 414	396 to 407
500	438 to 448	430 to 440	428 to 438	424 to 435	414 to 424	406 to 417
550	488 to 498	480 to 490	478 to 488	474 to 485	464 to 474	456 to 467
600	538 to 548	530 to 540	528 to 538	524 to 535	514 to 524	506 to 517
650	588 to 598	580 to 590	578 to 588	574 to 585	564 to 574	556 to 567
700	638 to 648	630 to 640	628 to 638	624 to 635	614 to 624	606 to 617
750	688 to 698	680 to 690	678 to 688	674 to 685	664 to 674	656 to 667



Technical delivery conditions EN 14399, JUMBOTECH™ line

Table 7: Technical delivery conditions

Size		M12 ÷ M64
Material		Steel
General requirements		EN 14399-1
Thread	Tolerance	6g
	As specified in	ISO 261, ISO 965-2
Mechanical properties	Property class	10.9
	As specified in	ISO 898 Part 1
Tolerances	Product grade	C [1)]
	As specified in	ISO 4759 Part 1
Surface finish		As processed (black) ISO 10684 shall apply with regard to hot dip galvanizing
Acceptance inspection		As specified in ISO 3269

1) For M39 to M64 exceptional tolerance for the nominal length (= js 17)

FASTENER SYSTEMS

Picture: JUMBOTECH™ Productionprocess, hexagon nut bolt M36

Total reliability and quality

- High Quality System
- Reliable and Qualified Suppliers
- Traceability from raw material to the final product
- Constant and Controlled heat treatment of the product
- Complete Product Certification
- Nut former manufacturing division
- Supporting customers with new technical solutions

SBE has developed an innovative production process JUMBOTECH™ that has moved the upper limit of cold forging for bolts to M64 mm, with a maximum weight up to 25 Kg and a manufacturing accuracy that allows us to keep a very narrow range of tolerances as little as 0,05 mm.

Thanks to international patent JUMBOTECH™ – nº PCT/IT2003/000106 - we are even more competitive: contrary to the traditional hot forging process using six meter bars, SBE can start production directly from wire rod, with variations in length from 100 to 250 meters depending on the diameter.

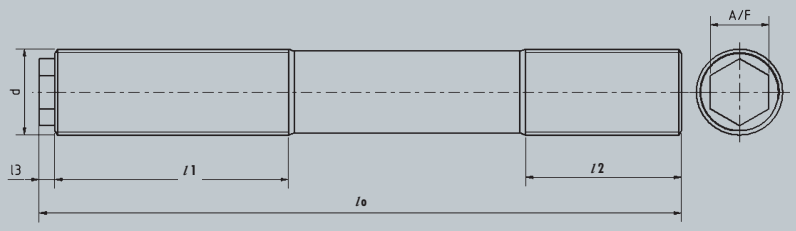
Secondly all the additional processes before thread rolling, such as shot blasting and machining can now be eliminated.

With our German heat treatment supplier we have developed a bespoke continuous belt furnace with a capacity that covers the full range of the fasteners we forge with the new JUMBOTECH™ production process.

IHF

FASTENER SYSTEMS

IHF Stud Bolt



threadsize (d)												
M 20		M 24		M 30		M 36		M 42		M 48		
l1	l2	l1	l2	l1	l2	l1	l2	l1	l2	l1	l2	
30	55	35	65	45	80	55	95	65	110	75	125	
total length, lo												
130												
140												
150												
160		160										
170		170										
180		180										
190		190		190								
200		200		200								
210		210		210								
220		220		220								
230		230		230		230						
240		240		240		240						
250		250		250		250						
260		260		260		260						
270		270		270		270		270				
280		280		280		280		280				
290		290		290		290		290		290		
300		300		300		300		300		300		
		310		310		310		310		310		
		320		320		320		320		320		
		330		330		330		330		330		
				340		340		340		340		
				350		350		350		350		
				360		360		360		360		
						370		370		370		
						380		380		380		
						390		390		390		
						400		400		400		
								410		410		
								420		420		
								430		430		
								440		440		
										450		
										460		
										470		
										480		

All dimensions in mm, other total length or thread length after arrangement, the standard material is according to ISO 898, Surface protection according to customer specification, Thread and Form tolerances according to customer sprecificatior standard IHF specification

IHF

FASTENER SYSTEMS

Applications

Hot-dip galvanized stud-bolts for blade bearings on wind turbines, with ITH-Round-Nut RMS and ITH-Bolt-Tensioning Cylinder.

HV-Fasteners-Set for wind turbine towers, according to EN 14399-, hot-dip galvanized.

Stud-bolts M36 with hexagon nuts ISO 4032 and spacer for blade bearings on wind turbines, Xylan-Surface Protection.

Worldwide Service Facilities

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