Designer's Manual

"PF" brand high strength structural bolting assemblies & DTI washer

(Reference standards IS-3757, ASTM A 325/ASTM A 325 M, ASTM A 490/ASTM A 490M, EN 14399 and ASTM F 959)

PANCHSHEEL FASTENERS

(An ISO 9001:2008 certified company)

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PANCHSHEEL FASTENERS

Over 40 years we, **PANCHSHEEL FASTENERS (An ISO 9001:2008 certified company)** are in the field of fasteners. The main factors of our success story are

1. We are flexible and agile enough to respond to our customer's needs.

2. Quality of the product and service are the backbone of our business.

3. Our manufacturing philosophy differs from our competitors.

So **PANCHSHEEL FASTENERS** has been recognized as one of the quality fastener manufacturer in India. We have over 200 satisfied customers.

PANCHSHEEL FASTENERS has wide range of products.

PANCHSHEEL FASTENERS manufacturers the High Strength Structural fasteners conforming to IS-3757, ASTM A-325, ASTM A-490 and EN-14399 standards.

We assure you that **PANCHSHEEL FASTENERS** product shall meet the technical requirement and your expectations.

HISTORY OF THE HIGH STRENGTH STRUCTURAL BOLTS : Olden days connections were primarily constructed using rivets. In connections where slip was to be prevented, the use of rivets was problematic.

Research on high-strength bolts was performed starting in the 1930s. "The possibility of using high-preload bolts in steel-framed construction was first demonstrated by Mr. Batho and Bateman in their report. In 1947 the Research Council on Riveted and Bolted Structural Joints was formed. They were the main drive for the rapid development of high-strength bolts in the United States.

High-strength bolts are well established as economical and efficient devices for connecting structural steel.

Advantages of using HSFG bolts:

(a) **Greater strength-**High-strength bolts have been found to be stronger than rivets in both shears and tension. This advantage has been observed not only under static loadings but also under fatigue or repeated loadings.

(b) **Economy-**Many applications of high-strength bolting have shown the installed cost of the bolt to be lower than that of the same size of ordinary low-tension bolts.

(c) **Friction gripping-**The forces in bolted structural connections are transmitted by friction between the connected parts rather than direct shear on the bolts.

(d) **Permanent fastening-**Field installations, even under extremely severe loading conditions, have shown that properly installed bolts stay tight and no lock washers or other locking devices are required to maintain this tightness.

(e) **Replacement of bolts-** The bolts can be replaced easily if it becomes necessary.

(f) **Faster erection-**It is found that a two-man bolting crew can fix or install more bolts in a given time than a four-man riveting crew. This not only affects a reduction in cost for the erection of the structure but also results in a structure being erected at a greater speed.

(g) **Less equipment-** Fewer tools and less equipment are required to properly install these high-strength fasteners.

(h) **Less training-**Only an hour or two is needed to train a bolting crew. Furthermore, the bolting crews

can be made up of ordinary steelworkers and need not be trained in the same manner as riveting crews.

(i) **Less inspection-**Because of the more consistent nature of high-strength bolting and the better control possible over the installation procedure, less and improved inspection is required during the erection operations.

Advantages of using **PANCHSHEEL FASTENERS (An ISO 9001:2008 certified company)** make HSS bolt assemblies.

1. PF make fasteners are reliable
2. Quality is built in manufacturing process. We believe in perfection.
3. Products are manufactured by highly skilled technicians and manufacturing process is managed by the experienced professionals.
4. We maintain the delivery commitments.
5. If needed we share our experience with the customer.

REFERENCE STANDARDS FOR HSS BOLTS

- Conforming to national standards IS 3757/ 6623/ 6649.
- Conforming to international standards such as DIN, (6914,6915,6916)
- ASTM (A-325,A-563,F-436), ISO (7412,4775,7415)
- BS EN 14399
- We strongly recommend to refer IS-4000/BS-4604 or relevant standards while installation.

OUR PRODUCT RANGE AND APPLICABLE STANDARDS

Product	Specifications	Size	Threads	Mechanical Properties
High strength structural bolts	IS-3757; ISO 7412; EN 14399-3;ASTM A 325/ASTM 325M	M 16 to M36; ½" to 11/2".	Medium class fit, ANSI B 1.1 "6g" class as per ISO 261, ISO 965, ANSI B 1.13M	Grade 8.8, as per IS 1367(3) or ISO 898-1, EN-14399-3 HR, ASTM A 325/ASTM A 325M
High strength structural bolts	IS-3757; ISO 7412; EN 14399-3 or 4; ASTM A 490/ASTM 490M	M 16 to M 36; ½" to 11/2".	Medium class fit, ANSI B 1.1 "6g" class as per ISO 261, ISO 965, ANSI B 1.13M	Grade 10.9, as per IS 1367(3) or ISO 898-1, EN 14399-3 or 4 HV, ASTM A 490/ASTM A 490M
High strength structural nuts	IS 6623, ISO 4775, ASTM A 563/ASTM A 563M/ EN 14399-3 & 4	M 16 to M 36; ½" to 11/2".	Medium class fit, "6H" as per ISO 261, ISO 965, ANSI B 1.1, ANSI B 1.13M	Grade 8 or 10 as per IS 1367(6), ISO 898-2, ASTM A 563/ ASTM A 563M, EN 14399 3 or 4 HR or HV
High strength structural hardened washers	IS 6649, ISO 7415, ASTM F 436M/ ASTM A 436	M 16 to M 36; ½" to 11/2".		

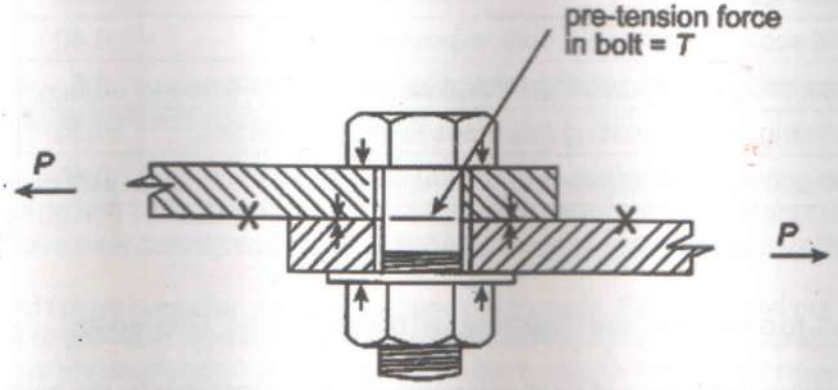
P. F. High Strength Structure Bolts, Nuts and Washers in Friction Grip Joints

High Strength Friction Grip bolts (HSFG) provide extremely efficient connections and perform well under fluctuating/fatigue load conditions.

HSFG bolts, are having high tensile strength, used with high strength nuts and hardened steel washers in structural steelwork. The bolts are tightened to a specified minimum shank tension so that transverse loads are transferred across the joint by friction between the plates and **not through the bolt shank.** The bolt is a loose clearance fit into its hole.

These bolts should be tightened to their proof loads (0.7% of the tensile strength)and require hardened washers to distribute the load under the bolt heads. Taper washers may be used on rolled steel sections.

The tension in the bolt ensures that no slip takes place under working conditions and so the load transmission from plate to the bolt is through friction. (See the figure below)



X–X = friction plane

PF make HSS bolts conforming to BS EN-14399 standard

We are specialize in manufacturing and supplying the PRE LOADED BOLT ASSEMBLIES (Bolts, Nuts, Washers) as per EN-14399 pert 3 and 4, HR and HV system.

We supply these products in black or hot dip Galvanized or in Dacro coated finish suitable to site conditions. The nut threads are coated with proper lubricants.

We also manufacture the high strength Structural bolts, Nuts and washers as per IS or ASTM standard.

Our products are used in various prestigious projects such as Railway Bridges, Steel Structures used in Metro rail projects, Industrial structures etc.

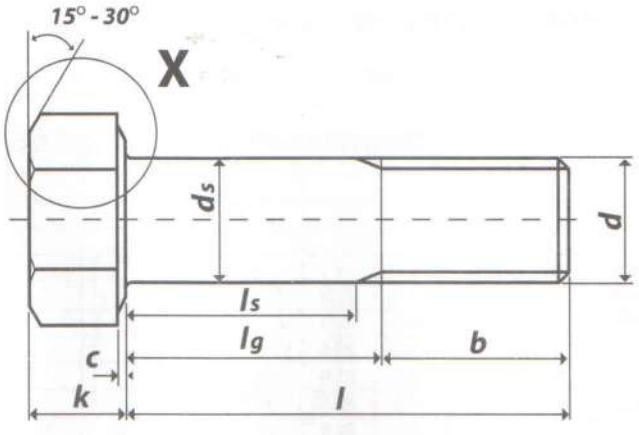
The manufacturing process for both systems HR and HV are closely monitored and controlled. Products are suitably identified at all stages of manufacturing.

Products are marked as per the requirement of the standard.

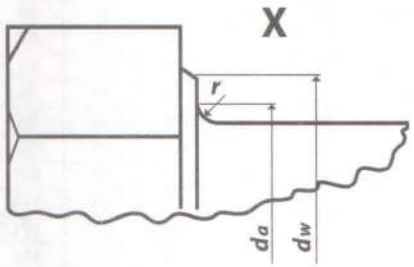
Reference tables for selecting the bolt length.

	ASSEMBLY BOLT, NUT, WASHER HR SYSTEM	ASSEMBLY BOLT, NUT, WASHER HV SYSTEM
General Requirements	As per EN-14399-1	
Bolt and Nut	As per EN-14399 - 3	As per EN-14399 - 4
Marking	HR	HV
Grades	8.8/8 or 10.9/10	10.9/10
Washers	As per En -14399 part 5 or 6	
Marking on washer	H	H
Thread Length	Length varies as per bolt length	Fix length as per standard
Usefulness Testing	As per EN-14399 - 2	
You may specify the "K" factor		
K0	No requirement of "K" factor	
K1	Individual values of "ki" factor	

We make the products in friction class " k1". The "k" factor describes the linear relationship between the tightening torque and the preloading force achieved for the diameter concerned.



BS EN 14399-3 Head Marking



BS EN 14399-3 Mechanical Properties of property class 8.8 bolts

Bolt thread Dia.	Stress Area	Proof Load min	Ultimate Load min	Hardness Rockwell HRC	
	mm²	kN	kN	min	max
M12	84.3	50.7	70	23	34
M16	157	94.5	130	23	34
M20	245	147	203	23	34
M22	303	182	252	23	34
M24	353	212	293	23	34
M27	459	275	381	23	34
M30	561	337	466	23	34
M36	817	490	678	23	34

BS EN 14399-3 Bolt Dimensions

Thread size *d*		M12	M16	M20	M22	M24	M27	M30	M36
P pitch of thread		1.75	2	2.5	2.5	3	3	3.5	4
b	Bolt ≤ 125	30	38	46	50	54	60	66	78
	Bolt > 125 ≤ 200	-	44	52	56	60	66	72	84
	Bolt > 200	-	-	65	69	73	79	85	97
c	max.	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	min.	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
da	max.	15.2	19.2	24.4	26.4	28.4	32.4	35.4	42.4
ds	max.	12.70	16.70	20.84	22.84	24.84	27.84	30.84	37.00
	min.	11.30	15.30	19.16	21.16	23.16	26.16	29.16	35.00
dw[1])	min.	20.1	24.9	29.5	33.3	38.0	42.8	46.6	55.9
e	min.	23.91	29.56	35.03	39.55	45.20	50.85	55.37	66.44
k	max.	7.95	10.75	13.40	14.90	15.90	17.90	19.75	23.55
	min.	7.05	9.25	11.60	13.10	14.10	16.10	17.65	21.45
r	min.	1.2	1.2	1.5	1.5	1.5	2.0	2.0	2.0
s	max.	22	27	32	36	41	46	50	60
	min.	21.16	26.16	31	35	40	45	49	58.8

Dimensions apply prior to coating

Characteristic		Standard
General Requirements		BS EN 14399-1
Materials & Manufacture		BS EN ISO 898-1 Property Class 8.8
Finish / Coatings	Self Colour / Black	BS EN 14399-3 - as processed
	Zinc Electroplated	BS 7371-3 or BS EN ISO 4042
	Hot Dip Galvanized	BS EN ISO 10684
Mechanical Properties		BS EN 14399-3, BS EN ISO 898-1 8.8
Dimensions & Tolerances		BS EN 14399-3
Threads		ISO 261, ISO 965-2
Product Marking		BS EN 14399-3

Important Note

It is a requirement of BS EN 14399 that

The bolt, nut and washer assembly is supplied by one manufacturer who is responsible for the function of the assembly.

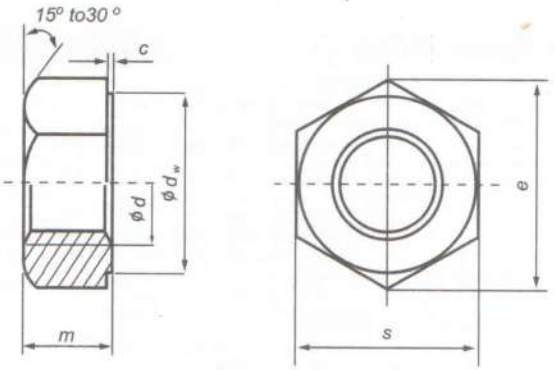
All the components are identified with the manufacturer's mark.

The coating of the assembly is under the control of the manufacturer.

BS EN 14399-3 Bolt length and thread tolerances

Thread d			M12		M16		M20		M22		M24		M27		M30		M36	
l			ls	lg	ls	lg	ls	lg	ls	lg	ls	lg	ls	lg	ls	lg	ls	lg
nom	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
35	33.75	36.25	6	11.25														
40	38.75	41.25	6	11.25	8	14												
45	43.75	46.25	6.25	15	8	14	10	17.5										
50	48.75	51.25	11.25	20	8	14	10	17.5	11	18.5								
55	53.5	56.5	16.25	25	8	14	10	17.5	11	18.5	12	21						
60	58.5	61.5	21.25	30	12	22	10	17.5	11	18.5	12	21	13.5	22.5				
65	63.5	66.5	26.25	35	17	27	10	17.5	11	18.5	12	21	13.5	22.5				
70	68.5	71.5	31.25	40	22	32	11.5	24	11	18.5	12	21	13.5	22.5	15	25.5		
75	73.5	76.5	36.25	45	27	37	16.5	29	12.5	25	12	21	13.5	22.5	15	25.5		
80	78.5	81.5	41.25	50	32	42	21.5	34	17.5	30	12	21	13.5	22.5	15	25.5		
85	83.25	86.75	46.25	55	37	47	26.5	39	22.5	35	16	31	13.5	22.5	15	25.5	18	30
90	88.25	91.75	51.25	60	42	52	31.5	44	27.5	40	21	36	15	30	15	25.5	18	30
95	93.25	96.75	56.25	65	47	57	36.5	49	32.5	45	26	41	20	35	15	25.5	18	30
100	98.25	101.75	61.25	70	52	62	41.5	54	37.5	50	31	46	25	40	16.5	34	18	30
110	108.25	111.75			62	72	51.5	64	47.5	60	41	56	35	50	26.5	44	18	30
120	118.25	121.75			72	82	61.5	74	57.5	70	51	66	45	60	36.5	54	22	42
130	128	132			76	86	65.5	78	61.5	74	55	70	49	64	40.5	58	26	46
140	138	142			86	96	75.5	88	71.5	84	65	80	59	74	50.5	68	36	56
150	148	152			96	106	85.5	98	81.5	94	75	90	69	84	60.5	78	46	66
160	156	164									85	100	79	94	70.5	88	56	76
170	166	174									95	110	89	104	80.5	98	66	86
180	176	184									105	120	99	114	90.5	108	76	96
190	186	194									115	130	109	124	100.5	118	86	106
200	196	204									125	140	119	134	110.5	128	96	116

All dimensions are in millimetres



BS EN 14399-3 Nut Dimensions

Thread size d		M12	M16	M20	M22	M24	M27	M30	M36
P pitch of thread		1.75	2	2.5	2.5	3	3	3.5	4
c	max.	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	min.	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
dw[1])	min.	20.1	24.9	29.5	33.3	38.0	42.8	46.6	55.9
e	min.	23.91	29.56	35.03	39.55	45.20	50.85	55.37	66.44
m	max.	10.8	14.8	18	19.4	21.5	23.8	25.6	31
	min.	10.37	14.1	16.9	18.1	20.2	22.5	24.3	29.4
s	max.	22	27	32	36	41	46	50	60
	min.	21.16	26.16	31	35	40	45	49	58.8
Dimensions apply prior to coating									

All dimensions are in millimetres

Characteristic		Standard
General Requirements		BS EN 14399-1
Materials & Manufacture		BS EN 20898-2 Property Classes 8 & 10
Finish / Coatings	Self Colour / Black	BS EN 14399-3 - as processed
	Zinc Electroplated	BS 7371-3 or BS EN ISO 4042
	Hot Dip Galvanized	BS EN ISO 10684
Mechanical Properties		BS EN 14399-3 BS EN 20898-2 Classes 8 & 10
Dimensions & Tolerances		BS EN 14399-3
Threads		ISO 261 ISO 965-2
Product Marking		BS EN 14399-3

BS EN 14399-3 Proof load values of property classes 8 & 10 nuts

BS EN 14399-3 Nut Marking

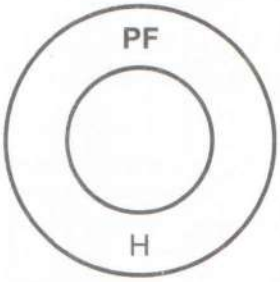
Property Class 8

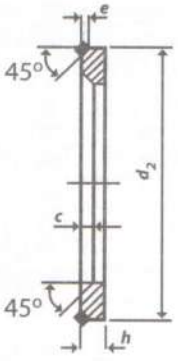
Property Class 10

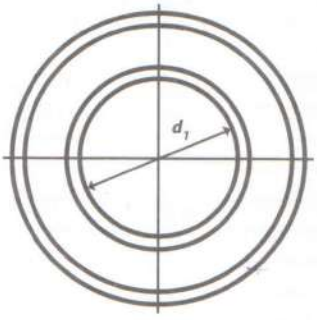
Nut thread Dia.	Stress Area Test Mandrel	Property Class	
		8	10
		Tolerance class 6H[1]) or 6AZ[1])	Tolerance class 6H[1]) or 6AZ[1])
	mm²	Proof Load kN	Proof Load kN
M12	84.3	84.3	97.8
M16	157	157	182.1
M20	245	245	284.2
M22	303	303	351.2
M24	353	353	409.5
M27	459	459	532.4
M30	561	561	650.8
M36	817	817	947.7

[1]) 6H is the tolerance class for self colour nuts and 6AZ is the tolerance class for hot dip galvanized nuts

BS EN 14399-6 Washer Marking







BS EN 14399-3 Chamfered Washer Dimensions

Nominal size *d* [a])		M12	M16	M20	M22	M24	M27	M30	M36
d_1	min	13	17	21	23	25	28	31	37
	max	13.27	17.27	21.33	23.33	25.33	28.52	31.62	37.62
d_2	min	23.48	29.48	36.38	38.38	43.38	49	54.80	64.80
	max	24	30	37	39	44	50	56	66
h	nom	3	4	4	4	4	5	5	6
	min	2.7	3.7	3.7	3.7	3.7	4.4	4.4	5.4
	max	3.3	4.3	4.3	4.3	4.3	5.6	5.6	6.6
e	nom = min	0.5	0.75	0.75	0.75	0.75	1	1	1.25
	max	1.0	1.50	1.50	1.50	1.50	2	2	2.50
c	min	1.6	1.6	2.0	2.0	2.0	2.5	2.5	2.5
	max	1.9	1.9	2.5	2.5	2.5	3.0	3.0	3.0

[a]) Nominal thread diameter of associated bolts

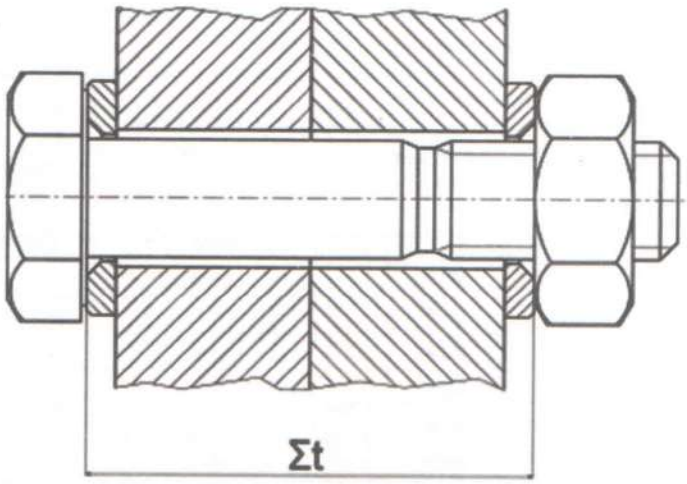
Dimensions apply prior to coating

Characteristic		Standard
General Requirements		BS EN 14399-1
Finish / Coatings	Self Colour / Black	BS EN 14399-6 - as processed
	Zinc Electroplated	BS 7371-3 or BS EN ISO 4042
	Hot Dip Galvanized	BS EN ISO 10684
Mechanical Properties		BS EN 14399-6
Dimensions & Tolerances		BS EN 14399-6
Product Marking		BS EN 14399-6

BS EN 14399-3 Mechanical Properties of chamfered washer

Nominal Size	Vickers Hardness (HV)	
	min	max
M16 to M36 inclusive	300	370

BOLT LENGTH SELECTION CHART BASED ON THE GRIP LENGTH



Diameter of thread	M12	M16	M20	M22	M24	M27	M30	M36*
Nominal length l	HV assemblies - Clamping length Σt							
35	16-21							
40	21-28	17-22						
45	26-31	22-27	18-23					
50	31-36	27-32	23-28	22-27				
55	36-41	32-37	28-33	27-32				
60	41-46	37-42	33-38	32-37	29-34			
65	46-51	42-47	38-43	37-42	34-39			
70	51-56	47-52	43-48	42-47	39-44	36-41		
75	56-61	52-57	48-53	47-52	44-49	41-46	39-44	
80	61-66	57-62	53-58	52-57	49-54	46-51	44-49	
85	66-71	62-67	58-83	57-62	54-59	51-56	49-54	43-48
9	71-76	67-72	63-68	62-67	59-64	56-61	54-59	48-53
95	76-81	72-77	68-73	67-72	64-69	61-66	59-64	53-58
100		77-82	73-78	72-77	69-77	66-71	64-69	58-63
105		82-87	78-83	77-82	74-79	71-76	69-74	63-88
110		87-92	83-88	82-87	79-84	76-81	74-79	68-73
115		92-97	88-93	87-92	84-89	81-86	79-84	73-78
120		97-102	93-98	92-97	89-94	86-91	84-89	78-83
125		102-107	98-103	97-102	94-99	91-96	89-94	83-88
130		107-112	103-108	102-107	99-104	96-101	94-99	88-93
135			108-113	107--112	104-109	101-106	99-104	93-98
140			113-118	112-117	109-114	106-111	104-109	98-103
145			118-123	117-122	114-119	111-116	109-114	103-108
150			123-128	122-127	119-124	116-121	114-119	108-113
155			128-133	127-132	124-129	121-126	119-124	113-118
160				132-137	129-134	126-131	124-129	118-123
165				137-142	134-139	131-136	129-134	123-128
170					139-144	136-141	134-139	128-133
175					144-149	141-146	139-144	133-138
180					149-154	146-151	144-149	138-143
185					154-159	151-156	149-154	143-148
190					159-164	156-161	154-159	148-153
195					164-169	161-166	159-164	153-158
200						166-171	164-169	158-163
*only on request								