Based on IS: 1364 (Part 1) - 2018

HEXAGONAL HEAD BOLTS, PRODUCT GRADE A (Property class 8.8)

1.0 SCOPE

1.1 Covers the requirements of Hexagonal Head Bolts in the size range M6 to M16.

2.0 SPECIFICATION AND REFERENCE STANDARDS

Dimensions and Preferred sizes		Table 1 of this standard
Preferred length-size combination		Table 2 of this standard
Tolerance	Product grade	A
	Indian standard	IS: 1367 (part 2)
Thread	Pitch	Coarse
	Tolerance	6g
	Indian standard	IS: 4218 Part 3, IS: 14962 Part 2 & 3
Material		Steel
Mechanical Properties	Property class	8.8
	Indian standard	IS: 1367 Part 3
Sampling and acceptability	Indian standard	IS: 1367 Part 17
General requirements		Bolts shall comply with IS: 1364 Part 1 in respect of requirements not covered in this standard

2.1 Referred standards (only the relevant parts of the current versions are applicable)

IS: 1364 Part 1	Specifications for hexagon head bolts, screws & nuts of product grade A&B - Part 1 – Hexagonal bolts.
IS: 1367	Technical supply conditions for threaded steel fasteners.
IS: 4218	ISO metric screw threads.
IS: 14962	ISO General Purpose Metric Screw Threads - Tolerances

3.0 DESIGNATION

A grade A Hexagon Head Bolt to this standard of thread size M16 and nominal length 60 mm shall be designated as:

3.1 On Drawings:

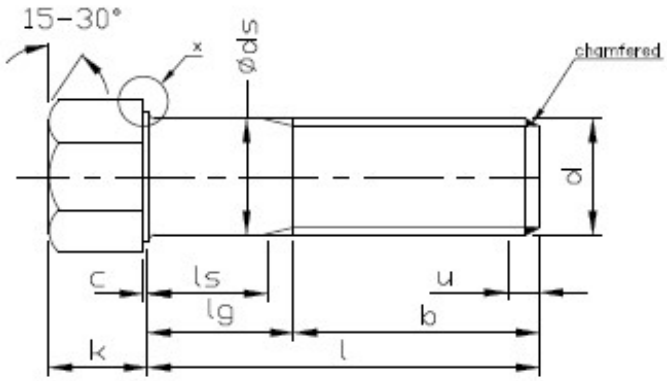
1) Material specification column: IS: 1364
2) Description column : BOLT HEX GR A 8.8 M16x60
3) Drawing number column : 4123716060
4) Material code column : 4123716060

3.2 Ordering Description

For placing indents, issuing enquiries and on purchase order, the ordering description given below shall be followed.

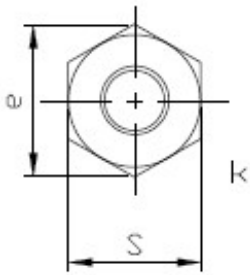
Hexagon Bolt M16x60 IS: 1364 (part-1)-8.8

TABLE 1 DIMENSIONS FOR HEXAGONAL HEAD BOLTS

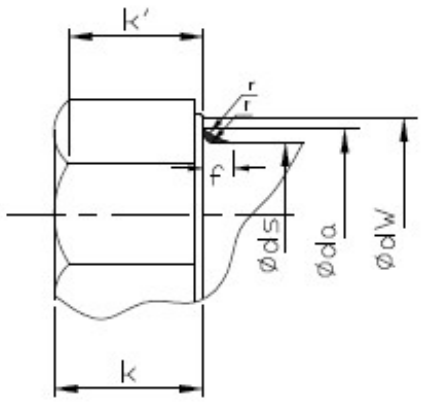


u according to CE of IS:1368 – ' Dimensions of ends of bolts and screws

lg Max=l Nom–b ; ls Min= l Max – 5xpitch



k'=Effective gauging height.



maximum & minimum underhead fillet

(ALL DIMENSIONS ARE IN MILLIMERTERS)

Thread size d	b			C		da	ds		dw Min		e Min		f	k				k'	r	s		
														+		++					Min.	
	1	2	3	Min.	Max.	Max.	Max.	Min.	+	++	+	++	Max.	Min.	Max.	Min.	Max.	Min.	Min.	Max.	+	++
M6	18	–	–	0.15	0.5	6.8	6	5.82	8.9	8.7	11.05	10.89	1.4	3.85	4.15	3.76	4.24	2.63	0.25	10	9.78	9.64
M8	22	28	–	0.15	0.6	9.2	8	7.78	11.6	11.4	14.38	14.20	2	5.15	5.45	5.06	5.54	3.54	0.4	13	12.73	12.57
M10	26	32	–	0.15	0.6	11.2	10	9.78	14.6	14.4	17.77	17.59	2	6.22	6.58	6.11	6.69	4.28	0.4	16	15.73	15.57
M12	30	36	–	0.15	0.6	13.7	12	11.73	16.6	16.4	20.03	19.85	3	7.32	7.68	7.21	7.79	5.05	0.6	18	17.73	17.57
M16	38	44	57	0.2	0.8	17.7	16	15.73	22.5	22	26.75	26.17	3	9.82	10.18	9.71	10.29	6.8	0.6	24	23.67	23.16

1) For Nom length l ≤ 125mm; + for 1 < 10d or 150mm;

2) For Nom length l >125 and ≤ 200mm; ++ for 1 < 10d or 150mm;

3) For Nom length l >200mm

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PLANT STANDARD

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BPS 41237

Rev. No. 01

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TABLE 2– PREFERRED LENGTH–SIZE COMBINATION FOR HEXAGON HEAD BOLTS

(ALL DIMENSIONS ARE IN MILLIMERTERS)

Length 'l'					Thread size d				
	For $l \leq 10\,d$ or 150		For $l > 10\,d$ or 150		M6	M8	M10	M12	M16
Nom	Min	Max	Min	Max					
20	19.58	20.42							
25	24.58	25.42							
30	29.58	30.42							
35	34.5	35.5	33.75	36.25					
40	39.5	40.5	38.75	41.25					
45	44.5	45.5	43.75	46.25	11.8				
50	49.5	50.5	48.75	51.25				58.7	
55	54.4	55.6	53.5	56.5				63.2	
60	59.4	60.6	58.5	61.5		28.2		67.6	123
65	64.4	65.6	63.5	66.5					
70	69.4	70.6	68.5	71.5			53.6		139
75	74.4	75.6	73.5	76.5		35.6			
80	79.4	80.6	78.5	81.5					155
90	89.3	90.7	88.25	91.75					171
100	99.3	100.7	98.25	101.75					
110	109.3	110.7	108.25	111.75					
120	119.3	120.7	118.25	121.75					
130	129.2	130.8	128	132					
140	139.2	140.8	138	142					
150	149.2	150.8	148	152					
160	159.2	160.8	158	162					
180	179.2	180.8	178	182					
200	199.08	200.92	197.7	202.3		WEIGHTS			
220	219.08	220.92	217.7	222.3					
240	239.08	240.92	237.7	242.3					
260	258.95	261.05	257.4	262.6					
280	278.95	281.05	277.4	282.6					
300	298.95	301.05	297.4	302.6					

NOTE:

1. Preferred lengths are in between the stepped bold lines
2. Weights are given in kg per 1000 numbers only

Based on IS: 1364 (part 3)

HEXAGON NUTS, PRODUCT GRADE A
(Property Class 8)

1.0 SCOPE:

Covers the requirement of Hexagon Nuts in the size range M3 to M16.

2.0 SPECIFICATION AND REFERENCE STANDARDS

Dimensions and preferred sizes	Table 1 of this standard	
Tolerance	Product grade	A
	Indian Standard	IS: 1367(part 2)
Thread	Pitch	Coarse
	Tolerance	6H
	Indian Standard	IS: 4218(part 3, 5 & 6)
Material	Steel	
Mechanical properties	Property class	8
	Indian Standard	IS: 1367 (Part 6)
Sampling and Acceptability	Indian Standard	IS: 2614
General requirements	Nuts shall comply with IS: 1364 in respect of requirements not covered in this standard	

2.1 Referred Standards (only the relevant parts of current versions are applicable).

IS: 1364 Specification for Hexagon Head Bolts, Screws & Nuts. (Part 3) of product grade A & B, Part 3 Hexagonal Nuts.

IS: 1367 Technical supply conditions for threaded steel fasteners.

IS: 2614 Method of sampling fasteners.

IS: 4218 ISO metric screw threads.

3.0 DESIGNATION

A Grade–A Hexagonal Nut to this standard of thread size M6 shall be designated as:

3.1 On Drawings

1) Material Specification column : IS: 1364
2) Description Column : NUT HEX GR A 8–M6
3) Drawing Number column : 4132006000
4) Material code Column : 4132000006

3.2 Ordering Description

For placing indents, issuing enquiries and on Purchase order, the Ordering Description given below shall be followed:

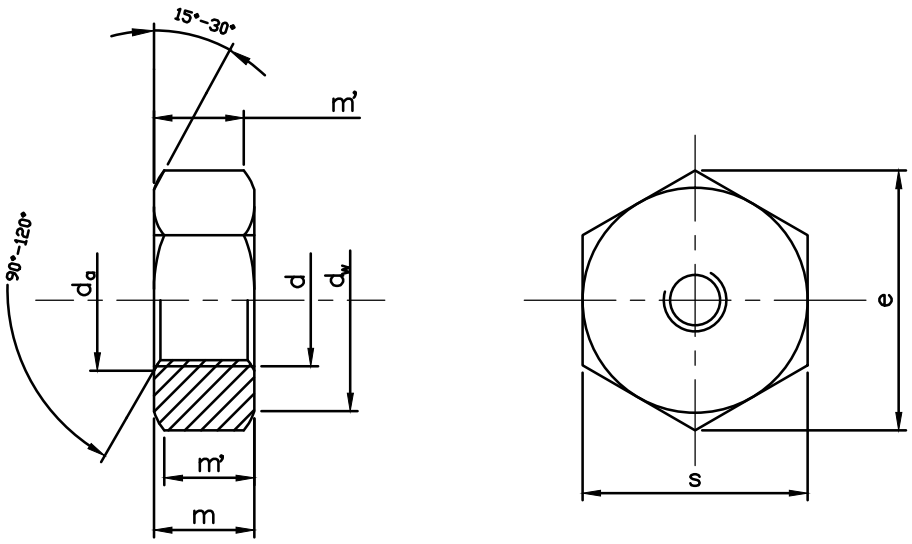
Hex Nut M6 IS: 1364 (part–3) –8

4.0 ADDITIONAL INFORMATION

4.1 For nuts of thread size M20 to M48x3, product grade B, refer BPS: 41301.

4.2 For Cadmium plated nuts, refer BPS: 41360

TABLE 1 DIMENSIONS FOR HEXAGONAL NUTS



m' = Effective guaging height

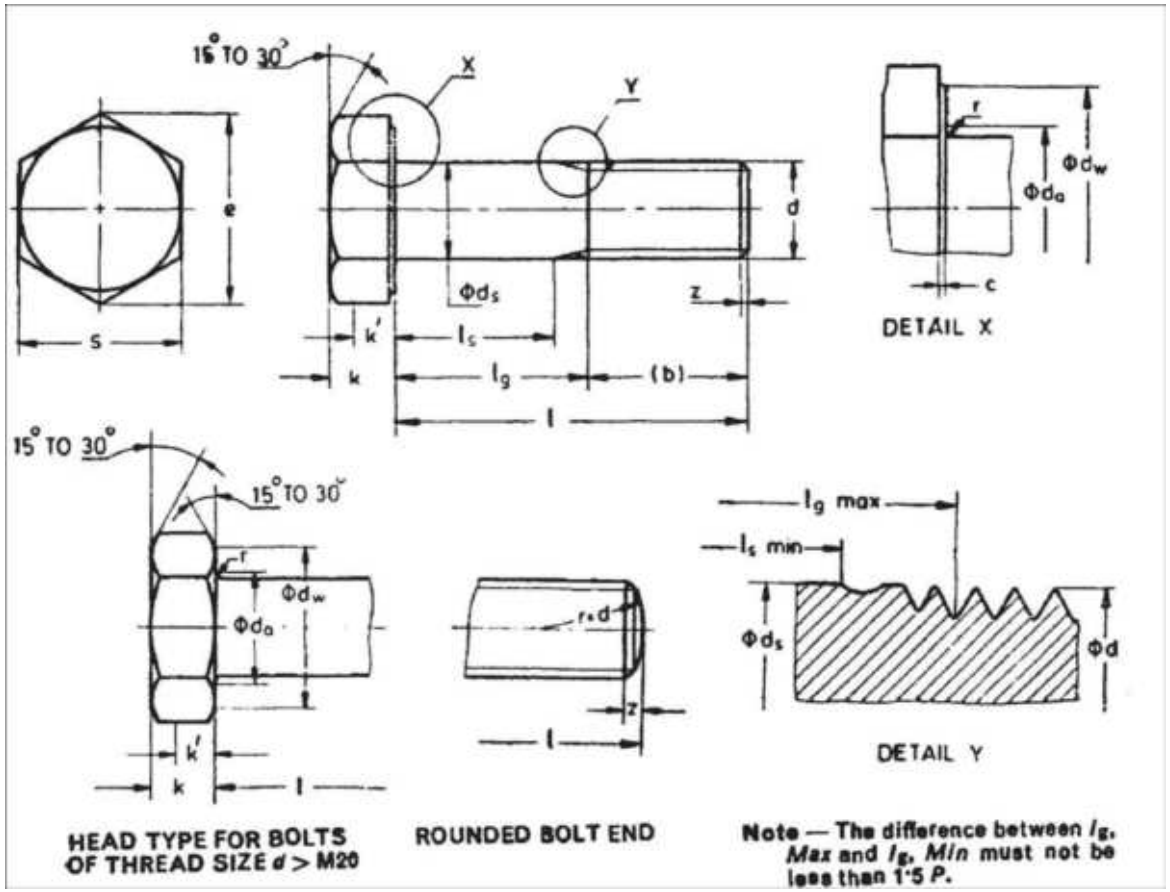
(All dimension are in millimeters)

Thread Size d	d_a		d_w	e	m		m'	s		Weight
	Min	Max	Min	Min	Max	Min	Min	Max	Min	
M3	3	3.45	4.6	6.01	2.4	2.15	1.72	5.5	5.32	0.4
M4	4	4.6	5.9	7.66	3.2	2.9	2.32	7	6.78	0.9
M5	5	5.75	6.9	8.79	4.7	4.4	3.52	8	7.78	
M6	6	6.75	8.9	11.05	5.2	4.9	3.92	10	9.78	2.5
M8	8	8.75	11.6	14.38	6.8	6.44	5.15	13	12.73	6.0
M10	10	10.8	14.6	17.77	8.4	8.04	6.43	16	15.73	11.6
M12	12	13.0	16.6	20.03	10.8	10.37	8.30	18	17.73	17.9
M16	16	17.3	22.5	26.75	14.8	14.1	11.28	24	23.67	33.5

NOTE;

1. Weights are given in kg per 1000 numbers only.
2. For stocked sizes refer BPS components booklet.

DRAWING NO:
3-35-700-09998

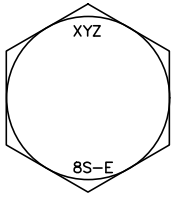


HSFG BOLT FIGURE AS GIVEN IN IS-3757 STANDARD

Sl.No	Bolt Variant	l (mm)	b (mm)	lg (mm)	Bolt head color
1	M20X60-Extended	60	55	5	MAGENTA
2	M20X90-Extended	90	70	20	GREEN
3	M20X130-Extended	130	70	60	ORANGE
4	M20X160-Extended	160	70	90	INDIGO

NOTES:

1. THE THREADED PORTION AND SHANK LENGTH ARE TO BE FOLLOWED AS PER TABLE
2. OTHER DIMENSIONS ARE AS PER IS-3757 STANDARD
3. BOLTS PROPERTY CLASS 8.8.



PROPERTY CLASS IDENTIFICATION SYMBOL
a) 8S STANDS FOR 8.8S
b) E STANDS FOR EXTENDED THREADS

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI – 620014
355-055

	NAME	SIGNATURE	DATE
DRN	S.SETHUPATHI		30.04.2022
CHD	KRG/MPN/VRS/AGN/YUVA		30.04.2022
APPD	K.RAJMOHAN		30.04.2022

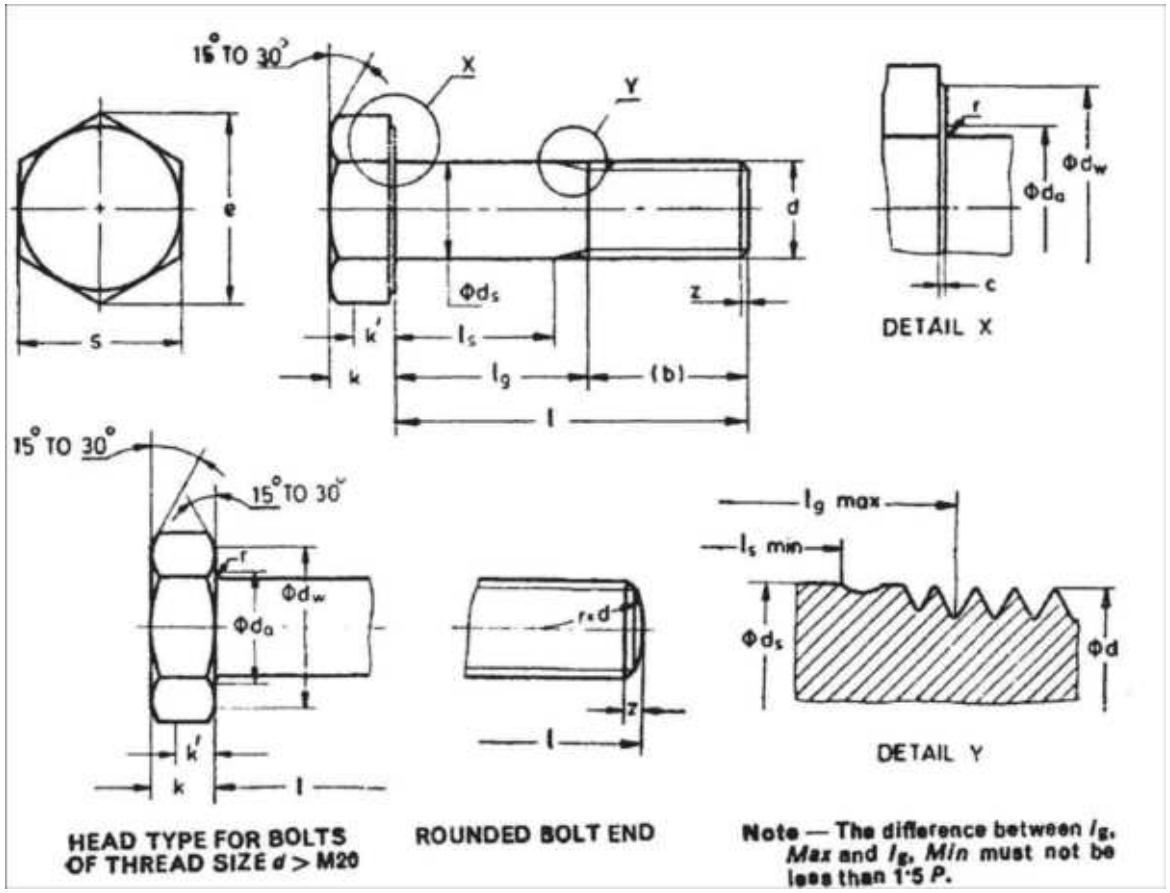
DEPT ST | CODE 122 | ALL DIMENSIONS ARE IN MM | PROJECTION | SCALE | WEIGHT (Kg) | REF TO ASSY / OLD DWG

TITLE: M20X60,90,130&160-EXTENDED THREAD-HSFG BOLTS

DRAWING NO : 3-35-700-09998 | REV 00

REV	DATE	ALTERED :
01		CHD & APPD:

DRAWING NO:
3-35-700-06802

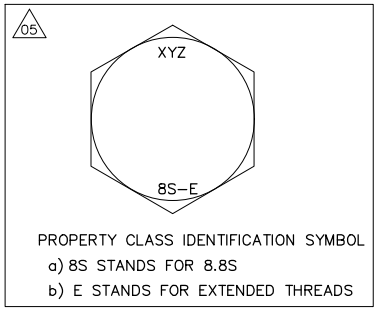


HSFG BOLT FIGURE AS GIVEN IN IS-3757 STANDARD

Sl.No	Bolt Variant	l (mm)	b (mm)	lg (mm)	Bolt head color
1	M24X70-Extended	70	65	5	Red
2	M24X90-Extended	90	70	20	Green
3	M24X130-Extended	130	80	50	Orange
4	M24X170-Extended	170	80	90	Blue
5	M24X200-Extended	200	80	120	Yellow

NOTES:

1. THE THREADED PORTION AND SHANK LENGTH ARE TO BE FOLLOWED AS PER TABLE
2. OTHER DIMENSIONS ARE AS PER IS-3757 STANDARD
3. BOLTS PROPERTY CLASS 8.8.



PROPERTY CLASS IDENTIFICATION SYMBOL
a) 8S STANDS FOR 8.8S
b) E STANDS FOR EXTENDED THREADS

REV	DATE	ALTERED :	REV	DATE	ALTERED :
06	28.10.2023	PRAVEEN CHD & APPD: GANESAN	03	25-04-2019	K.S.PANDIAN CHD & APPD: MUTHU.S
	M24X200 – EXTENDED ADDED.			SKETCH RESIZED	
05	21.10.2022	R.GOVINDASAMY CHD & APPD: S.MUTHU	02	16.08.2018	SHAILESH CHD & APPD: MPN/MUTHU.S
05	PROPERTY CLASS IDENTIFICATION SYMBOL ADDED.			NOTES NO.03 ADDED.	
04	01.11.2019	K.PRAKASH CHD & APPD: YUVARAJ.S	01	21.07.2018	MUTHU CHD & APPD: SARAVANA
	TABLE UPDATED WITH COLOR REQUIREMENT ON BOLT HEAD			DIMENSIONS UPDATED IN FIGURE	

TYPE OF PRODUCT
OR NAME OF
CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI – 620014
355-055

	NAME	SIGNATURE	DATE
DRN	SHAILESH		08.06.18
CHD	MPN/MUTHU		08.06.18
APPD	SHANMUGAM		08.06.18

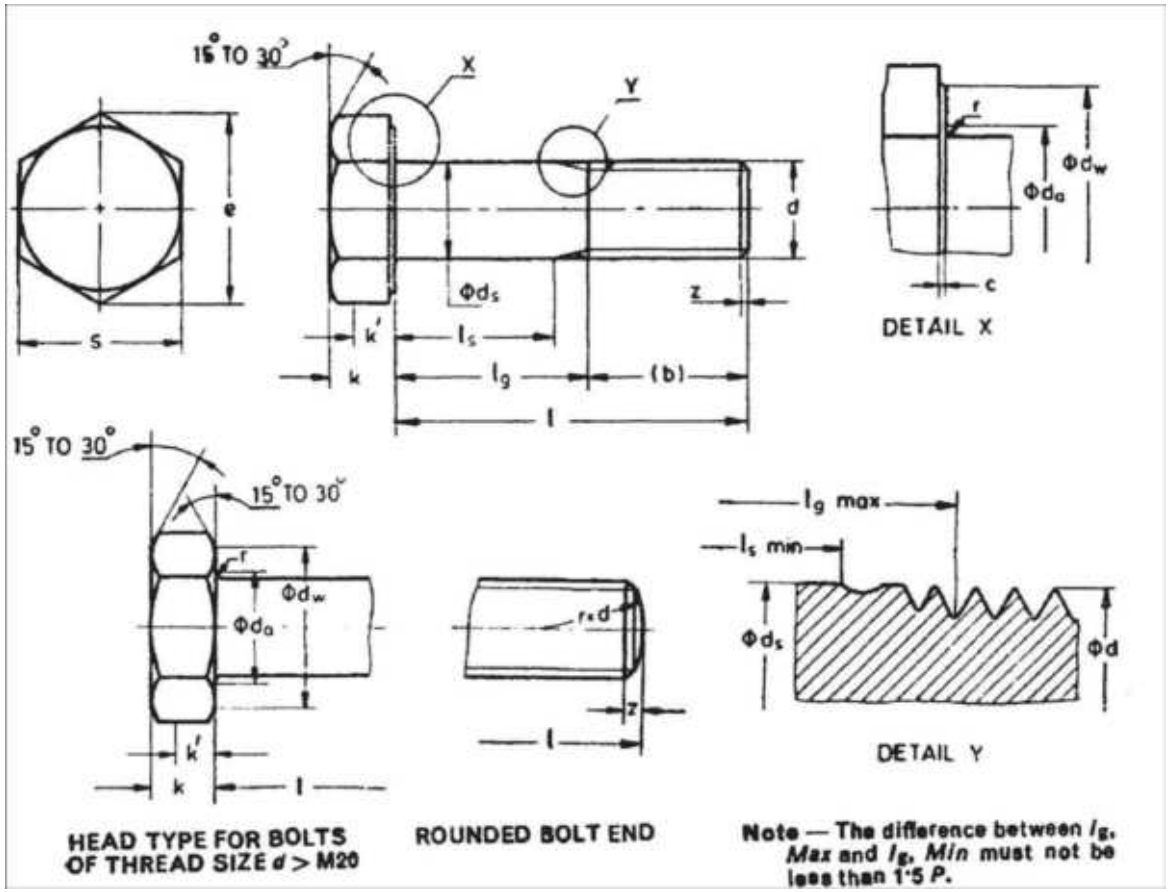
DEPT	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG
ST CODE 122					

TITLE
M24X70,90,130 170-EXTENDED THREAD-HSFG BOLTS

DRAWING NO : 3-35-700-06802

REV 06

DRAWING NO:
3-35-700-09999

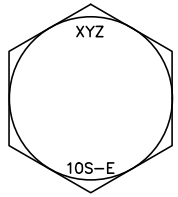


HSFG BOLT FIGURE AS GIVEN IN IS-3757 STANDARD

Sl.No	Bolt Variant	l (mm)	b (mm)	lg (mm)	Bolt head color
1	M30X90-Extended	90	70	20	GREEN
2	M30X130-Extended	130	80	50	ORANGE
3	M30X170-Extended	170	90	80	BLUE
4	M30X200-Extended	200	80	120	YELLOW

NOTES:

1. THE THREADED PORTION AND SHANK LENGTH ARE TO BE FOLLOWED AS PER TABLE
2. OTHER DIMENSIONS ARE AS PER IS-3757 STANDARD
3. BOLTS PROPERTY CLASS 10.9.



PROPERTY CLASS IDENTIFICATION SYMBOL

a) 10S STANDS FOR 10.9S

b) E STANDS FOR EXTENDED THREADS

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI – 620014
355-055

	NAME	SIGNATURE	DATE
DRN	S.SETHUPATHI		30.04.2022
CHD	KRG/MPN/VRS/AGN/YUVA		30.04.2022
APPD	K.RAJMOHAN		30.04.2022

DEPT	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG
ST					
CODE 122					

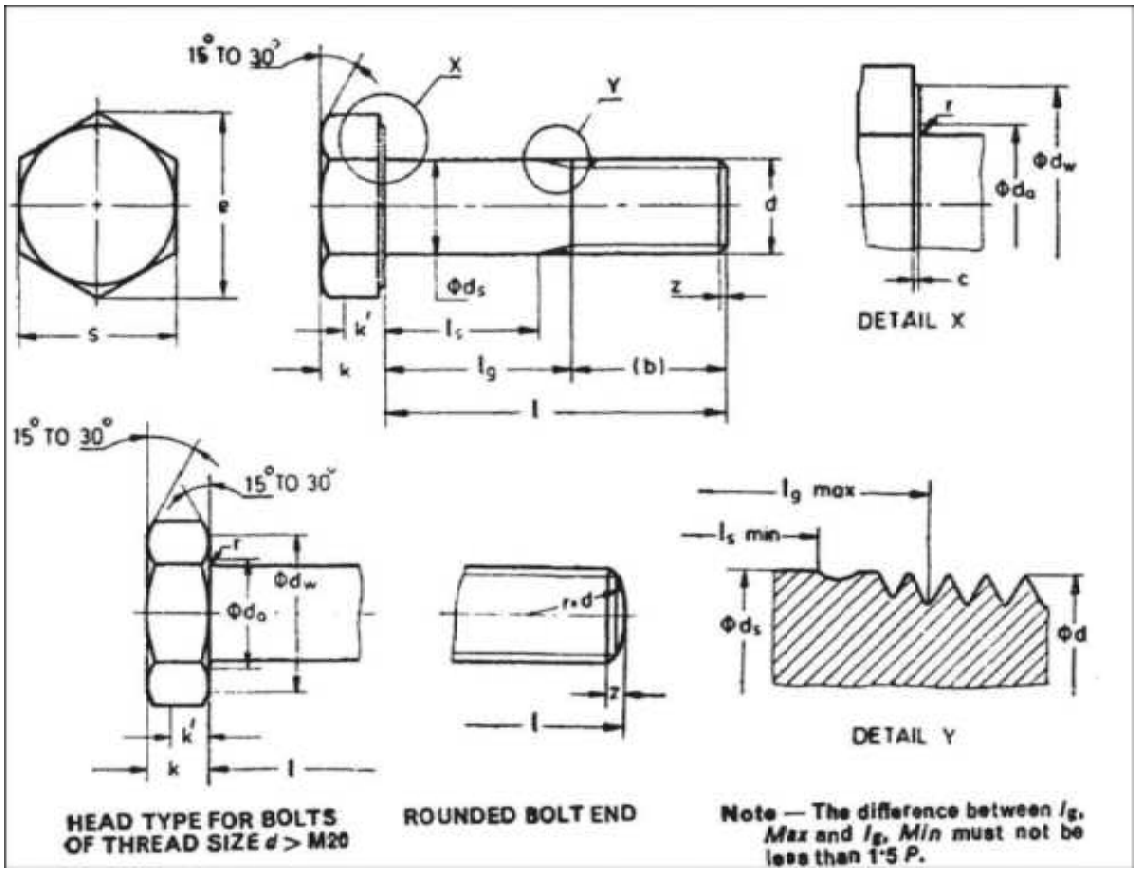
REV	DATE	ALTERED :
01		CHD & APPD:

TITLE
M30X90,130,170&200-EXTENDED THREAD-HSFG BOLTS

DRAWING NO : 3-35-700-09999

REV 00

DRAWING NO:
0-86-700-A0323

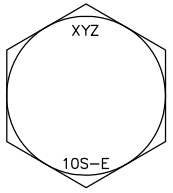


HSFG BOLT FIGURE AS GIVEN IN IS-3757 STANDARD

Sl.No.	Bolt Variant	l(mm)	b(mm)	lg(mm)	Bolt head colour
1	M36X100-Extended	100	85	15	GREEN
2	M36X120-Extended	120	85	35	ORANGE
3	M36X140-Extended	140	95	45	BLUE
4	M36X160-Extended	160	95	65	YELLOW
5	M36X190-Extended	190	105	85	RED

NOTES:

1. THE THREADED PORTION AND SHANK LENGTH ARE TO BE FOLLOWED AS PER TABLE
2. OTHER DIMENSIONS ARE AS PER IS-3757 STANDARD
3. BOLTS PROPERTY CLASS 10.9.



PROPERTY CLASS IDENTIFICATION SYMBOL

a) 10S STANDS FOR 10.9S

b) E STANDS FOR EXTENDED THREADS

REV	DATE	ALTERED :
01		CHD & APPD:

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI – 620014
355-055

	NAME	SIGNATURE	DATE
DRN	JKJ		14.02.2024
CHD	JKJ/PC/KD/NK/AKT/RK		14.02.2024
APPD	TMSR		14.02.2024

DEPT CIVIL
CODE 497
ALL DIMENSIONS ARE IN MM
PROJECTION
SCALE
WEIGHT (Kg)
REF TO ASSY / OLD DWG

TITLE
M36X100,120,140,160&190-EXTENDED THREAD-HSFG BOLTS

DRAWING NO : 0-86-700-A0323

REV 00

Revision record:

Rev 00: 18/10/2011 Fresh Issue released and Test Sampling Plan Rev 00
Rev 01: 19/04/2012 Cl 2: Requirement if the Carbon content is below 0.6% - Added for Bolts; Mn for Nuts: limited to 0.25 min instead of 0.25 max. Cl 5: Hardness of Bolt & Nut: Acceptance values changed. Cl 7: Preservation and Packing added and Test Sampling Plan Rev 01
Rev 02: 28/10/2014 Property class Bolt 10.9 and Nut 10 and its requirements added (for Neyveli 2x500MW Tower boiler) in all clauses and Test Sampling Plan Rev 02

1. SCOPE:

This technical delivery condition covers the requirements for the High strength structural steel bolts, Nuts and Washers applicable for boiler structures and shall be procured from the BHEL approved manufacturers only. The mandatory requirements, test methods and procedures from the applicable IS standards to confirm a product to its relevant latest IS standard shall be met with. TDC is in addition to specification.

Size, Specification and Qty: As per the BHEL Purchase order (PO) / BHEL Drawing. The bolts, nuts and washers shall be supplied in the dull black heat treated condition with residual coating of light oil.

For Bolts: IS: 3757 (Latest) Property class: 8.8 or 10.9. Product Grade C of IS Specification IS: 1367 Part 2 (Latest).
For Nuts: IS: 6623 (Latest) Property class: 8 or 10, Product Grade B
For Washers: IS: 6649 (Latest) Material: 45C8, Type-A: Plain hole Circular Washers. Grade: Ordinary

2. RAW MATERIAL:

- Bolts and Nuts: Rolled/Forged bar of Carbon steel. Washer: as per IS 1571 Part 2 (Latest)
- **Chemical composition**: Shall be checked on receipt of raw material at supplier works for every heat
  Bolts: Plain Carbon Steel, Carbon steel with additives (eg Br, Mn or Cr) – As per Table 2 of IS: 1367 Part 3 (Latest)
  Nuts: As per Table 4 of IS 1367 Part 6 (Latest)
  Washers: As per IS 1570 Part 2 and Sulphur, Phosphorous <0.06% in check analysis

3. DIMENSIONS AND TOLERANCES:

- Process: Cold/Hot Forging with Dies and tools clean of loose scale and sheet particles.
- Threads on the bolts shall be checked with a properly calibrated ring gauge with a tolerance class 6g. Threads on the nuts shall be checked with a properly calibrated plug gauge with tolerance class 6H (in an NABL accredited LAB).
- Dimensions of the Bolts shall be as per the table given in IS 3757 (Latest)
- Dimensions of the Nuts shall be as per the table given in IS: 6623 (Latest)
- Dimensions of the Washers shall be as per the table given in IS 6649 (Latest)

Note: The washers shall be flat with a maximum deviation not exceeding 0.25 mm from the straight edge laid along a line passing through the center of the hole. The hole of the washer shall be concentric with the outside dimensions within 0.50 mm. washers are required to be clipped to provide clearance, the clipped edge shall not be closer to the center of the washer than 0.9 of the bolt diameter.

4. Post Forming Heat Treatment (HT):

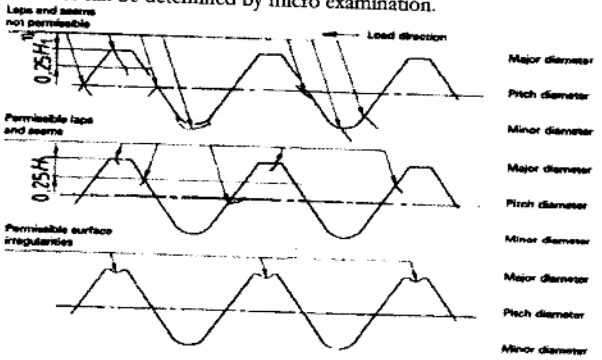
- Bolt: After forming shall be quenched (HT at AC 3 temperature, with soaking time 30minutes per inch followed by quenching) and tempered (at 425°C min, 60 minutes per inch). There should be a sufficient hardenability to ensure a structure consisting of approximately 90 % martensitic in the core of the threaded sections for the fasteners in the as-hardened condition before tempering.
- Nut: Shall be hardened and then tempered (at a temperature of 425°C minimum).
- Washer: Shall be hardened and tempered. Carburized washers are not permitted.

5. CHEMICAL & MECHANICAL & NDE: (on Heat Treated finished product)

Sample Size for Mechanical test: & NDE: As per Sampling Plan

BOLT :

Sl	Test	Test Method - As per Table 3 of IS: 1367 Part 3 (Latest)	Acceptance
1	Chemistry	Spectro / Wet Analysis Method – One sample for every heat Of raw material and One sample/HT batch on product	As per Cl 2.0 of this TDC
2	Hardness Test	Note: Surface hardness shall not be more than 30 Vickers above the measured core Hardness on the product when readings of both surface and core are carried out at HV 0.30. For property class 10.9, any increase in hardness at the surface which indicates that the surface hardness exceeds 390 HV is not acceptable.	8.8 – Min 255 HV Max 335 HV 10.9 – Min 320HV, Max 380HV
3	Minimum Tensile Strength, %Elongation on $5.65\sqrt{A}$, % Reduction in Area after fracture	*if wedge load test is satisfactory the axial tensile test is not required	8.8 – 830N/mm², 12 min, 52% min 10.9 – 1040 N/mm², 9 min, 48% min
4	Proof Load Test	**8.8** – Proof Load of M16(91KN), M20 (147KN), M24 (212KN), M30 (337KN), M36 (490KN); **10.9** – Proof Load of M16(130KN), M20 (203KN), M24 (293KN), M30 (466KN), M36 (678KN) shall be applied axially to the bolt in a calibrated tensile testing machine for 15sec.	Length of the bolt after loading shall be the same as before loading within a tolerance of ± 12.5 µm allowed for measuremnt error.
5	Strength under Wedge load test	IS: 1367 Part 3 (Latest)	8.8 – ≮ 830N/mm2 10.9 – ≮ 1040 N/mm2
6	Decarburization Test at 200X min magnification	Determination of the following by MICROSCOPIC Method a)Minimum Height of non decarburized thread zone – E b)Maximum depth of complete decarburization – G	E = 2/3 H1 G = 0.015 mm
7	Hardness after Retempering	IS: 1367 Part 3 (Latest) # test not mandatory, to be applied in case of dispute only	Reduction of hardness 20 HV max.
8	NDE for Surface Intergrity	**before machining –** For bar Diameter ≥ 40 mm: UT as per ASTM A388. For bar Diameter < 40 mm: MPI as per ASTM E 709 **After machining –** MPI as per ASTM E 709 or as per ISO 6157 Part 3 (Latest)	UT – ASME SEC-VIII. Div-II Part: 3.3.4 (Latest). MPI – Linear indications like cracks, folds & other injurious defects are notacceptable.

9	Micro Examination for Surface Integrity – Laps at threaded region.	If any defectives found in visual and NDE examinations, the extent of defect can be detemined by micro examination. 	Max depth of laps in thread = 0.41 mm Laps of any depth or length are not permitted in the following places: • at the root of the thread • at the loaded flank of screw thread below the pitch diameter, even if they start beyond the pitch diameter. The following laps are permissible : • laps in the crest of the threads of 0.25 H1 max.; • crest of the threads not entirely rolled out, maximum half a turn on one thread; • laps below the pitch diameter, if they run on the non-loaded flank towards the major diameter and not deeper than 0.25 H1 and not longer than half a turn on one thread.

NUT: (on Heat Treated finished product)

Sl	Test	Test Method	Acceptance Value
1.	Chemistry	Spectro / Wet Analysis Method – For every heat Of raw material and, One sample/HT batch on product	As per Cl 2.0 of this TDC
2.	Hardness Test	Hardness of the test mandrel shall be minimum 45 HRC.	8S – Min 188 HV Max 372 HV 10S – Min 272 HV Max 372 HV
3.	Proof Load Test	Proof Load of 8S – M16(168.9KN), M20 (263.4KN), M24 (379.5KN), M30 (603.1KN), M36 (878.3KN) 10S – M16(195.5KN), M20 (305KN), M24 (439.5KN), M30 (698.4KN), M36 (1017.2KN) shall be applied axially to the nut in a tensile testing machine for 15sec.	The nut shall resist the load without failure by stripping or rupture, and shall be removble by the fingers after the load is released.
4.	NDE for Surface Intergrity	Before coating, as per IS 1367 Part 10 Cl 4.2 (Latest)	Linear indications like cracks, folds & Other injurious defects are not acceptable.

WASHER: As per IS 5369. The washers shall be free from cracks, burrs, pits and other defects. All sharp edges shall be removed. **(on Heat Treated finished product)**

Sl	Test	Test Method	Acceptance Value
1.	Chemistry	Spectro / Wet Analysis Method – For every heat Of raw material and One sample/HT batch batch on product.	As per Cl 2.0 of this TDC
2.	Hardness Test	IS 1586 (latest)	Min 35 HRC Max 45 HRC

6. MARKING, PRESERVATION AND PACKING:

The following to be hot stamped or embossed on the top surface of the bolt and nut:
Bolt – Manufacturer's Identification Symbol and 8.8S/10.9S
Nut – Manufacturer's Identification Symbol and 8S/ 10S
Washers – Shall be identified by – the provision of 2 nibs and manufacturers identification symbol being placed as near to the outer edge as possible.
The following details shall be clearly indicated in the tags tied to the bundle:
1) Customer Name 2) Manufacturer's Name 3) Vendor Code 4) Purchase Order No and Supplier internal W.O No 5) Quantum and Weight 6) BHEL Material Code 7) Item Description with diameter, length
Shall be packed in bituminous coated Polythene lined Hessian Cloth/Bag. Each bag shall contain only the same size of bolts/ nuts/ washers respectively and the same shall be indicated in the tags.

7. INSPECTION AND CERTIFICATION:

All the finished components shall be visually and dimensionally inspected as per sampling plan. All the test results shall be documented and maintained. Products to be inspected at works & test certificates (in English) shall be submitted with the following details counter signed by BHEL/BHEL Authorized Inspection agency as indicated in the PO. Manufacturers Test certificate (MTC) shall contain the following:

1) Purchase Order No. (BHEL), TDC No, Specification and Grade.
2) Name of raw material bar supplier.
3) Forming process
4) Dimensional reports for each product.
5) Chemistry including incidental elements on the raw material and final product checked in NABL lab/ suppliers own lab.
6) HT details of materials temperature, soaking time, ROH/ROC medium etc.
7) All Mechanical test result report including hardness.
8) MPI, Micro examination and decarburization test report with the reference & acceptance standard.
9) TC of raw material, UT/MPI report done on raw material shall accompany the MTC.

8. AUDITS AT BHEL:

BHEL reserve the right to reject any item found to be not meeting the requirements during tests at supplier works or during subsequent processing at BHEL.

Haritha.C QA	Venkanna Rupani QA	Kalyanaraman.V QA	Viswanathan.D Engineering	Sekar.S QC	Balachandran.K.S MM	Revisankaran.U QA
Prepared By		Reviewed By				Approved By

BHEL: TRICHY – 14

TEST SAMPLING PLAN FOR HSFG BOLTS, NUTS & WASHERS AS PER BHEL TDC: 5:211 Rev 02

Lot Size (In nos.)	SAMPLE SIZE										Remarks
	Visual (nos.)	Dimensional (nos.)	MPI (nos.)	Physical Tests							
				Total nos.	Hardness (nos.)	Hardness after Re-tempering (nos.)	Proof Load (nos.)	Wedge Load (nos.)	Min Tensile Strength (nos.)	Decarb (nos.)	
Upto 100	20	8	15	5	5	5	2	2	2	1	
101 to 300	32	13	15	5	5	5	2	2	2	1	
301 to 500	50	20	15	5	5	5	2	2	2	1	
501 to 1000	80	32	15	5	5	5	2	2	2	1	
1001 to 3000	125	50	25	8	8	8	2	4	2	1	Upto 1500 nos. 15 nos. for MPI
3001 to 10000	200	80	50	13	13	13	2	6	2	1	Upto 5000 nos. 25 nos. for MPI
10001 to 35000	315	125	75	20	20	20	4	10	4	2	Upto 15000 nos. 50 nos. for MPI
Above 35000	500	200	100	32	32	32	6	15	6	3	Upto 50000 nos. 75 nos. for MPI
Inspection by BHEL/BHEL AIA	W	W	W		W	W	W	W	W	W	

Remarks:

1. Acceptance Number is zero. If the sample is having deviations in Visual, Dimensional and MPI then the entire lot shall be 100% inspected. In case of deviations in Physical tests a second sample of twice the sample size of initial sample shall be taken. The lot will get rejected if the second sample fails.
2. Preservation & Packing: The bolts shall be supplied in the dull black heat treated condition with a residual coating of light oil. Finished products shall be packed in a bituminous coated Polythene lined Hessian cloth/bag. Each bag shall contain only the same size of bolts/nuts/washers respectively and the same shall be indicated in the tags.
3. Inspection by BHEL / BHEL AIA shown as "W" shall be witnessed for the sample size indicated against the lot size.

28/10/14	28/10/2014	28/X/2014	28/10/14	
Haritha.C QA	Venkanna Rupani QA	Kalyanaraman.V QA	Sekar.S QC	Revisankaran.U QA
Prepared By		Reviewed By		Approved By

Revision record:
Rev 00: Dt 14/11/2019 – Fresh issue
Rev01 : Dt 12/08/2022 –In clause 1.0,5.0,6.0, class 10.9 for bolts & 10 for nuts included, Drawing no's removed in Clause 1.0,3.0 &6.0. Weight of bags included in Cl 6.0

1. **SCOPE:**
   This technical delivery condition covers the requirements for the High strength structural steel bolts, Nuts and Washers applicable for boiler structures and shall be procured from the BHEL approved manufacturers only. The mandatory requirements, test methods and procedures from the applicable IS standards to confirm a product to its relevant latest IS standard shall be met with. TDC is in addition to specification.
   Size, Specification and Qty: As per the BHEL Purchase order (PO) / BHEL Drawing. The bolts, nuts and washers shall be supplied in the dull black heat treated condition with residual coating of light oil.
   For Bolts: As per BHEL drawing as indicated in the Purchase order.
   and IS: 3757 (Latest) Property class: 8.8,10.9. Product Grade C of IS Specification IS: 1367 Part 2 (Latest).
   For Nuts: IS: 6623 (Latest) Property class: 8 & 10, Product Grade B
   For Washers: IS: 6649 (Latest) Material: 45C8, Type-A: Plain hole Circular Washers. Grade: Ordinary

2. **RAW MATERIAL:**
   - **Bolts and Nuts**: Rolled/Forged bar of Carbon steel. Washer: as per IS 1571 Part 2 (Latest)
   - **Chemical composition**: Shall be checked on receipt of raw material at supplier works for every heat
     Bolts: Plain Carbon Steel, Carbon steel with additives (e.g. Br, Mn or Cr) – As per Table 2 of IS: 1367 Part 3 (Latest)
     Nuts: As per Table 4 of IS 1367 Part 6 (Latest)
     Washers: As per IS 1570 Part 2 and Sulphur, Phosphorous <0.06% in check analysis

3. **DIMENSIONS AND TOLERANCES:**
   - **Process**: Cold/Hot Forging with Dies and tools clean of loose scale and sheet particles.
   - Threads on the bolts shall be checked with a properly calibrated ring gauge with a tolerance class 6g. Threads on the nuts shall be checked with a properly calibrated plug gauge with tolerance class 6H in an NABL accredited LAB.
   - Dimensions of the Bolts shall be as per BHEL drawing as indicated in the Purchase order.
   - Dimensions of the Nuts shall be as per the table given in IS: 6623 (Latest)
   - Dimensions of the Washers shall be as per the table given in IS 6649 (Latest)

   Note: The washers shall be flat with a maximum deviation not exceeding 0.25 mm from the straight edge laid along a line passing through the center of the hole. The hole of the washer shall be concentric with the outside dimensions within 0.50 mm. washers are required to be clipped to provide clearance, the clipped edge shall not be closer to the center of the washer than 0.9 of the bolt diameter.

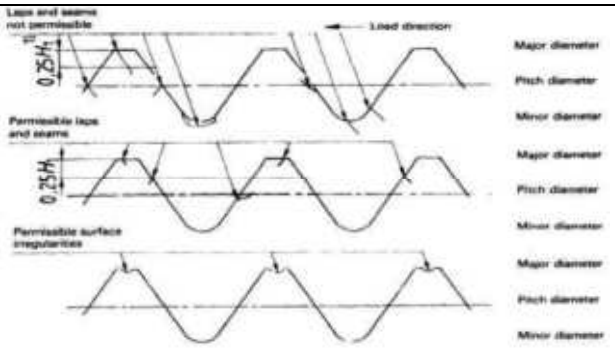
4. **Post Forming Heat Treatment (HT):**
   - **Bolt**: After forming shall be quenched (HT at AC 3 temperature, with soaking time 30minutes per inch followed by quenching) and tempered (at 425°C min, 60 minutes per inch). There should be a sufficient hardenability to ensure a structure consisting of approximately 90 % martensitic in the core of the threaded sections for the fasteners in the as-hardened condition before tempering.
   - **Nut**: Shall be hardened and then tempered (at a temperature of 425°C minimum).
   - **Washer**: Shall be hardened and tempered. Carburized washers are not permitted.

5. CHEMICAL & MECHANICAL & NDE: (on Heat Treated finished product)

Sample Size for Mechanical test: & NDE: As per Sampling Plan

BOLT :

Sl	Test	Test Method - As per Table 3 of IS: 1367 Part 3 (Latest)	Acceptance
1	Chemistry	Spectro / Wet Analysis Method – One sample for every heat Of raw material and One sample/HT batch on product	As per Cl 2.0 of this TDC
2	Hardness Test	Note: Surface hardness shall not be more than 30 Vickers above the measured core Hardness on the product when readings of both surface and core are carried out at HV 0.30.	8.8 – Min 255 HV Max 335 HV 10.9- Min 320 HV Max 380 HV
3	Minimum Tensile Strength, %Elongation on 5.65√A, % Reduction in Area after fracture	if wedge load test is satisfactory the axial tensile test is not required	8.8 – 830N/mm^2 , 12 min, 52% min 10.9-1040N/mm^2 , 9 min, 48% min
4	Proof Load Test	**8.8 –** Proof Load of M20 (147KN), M24 (212KN), M30 (337KN), M36 (490KN) **10.9 –** Proof Load of M20 (203KN), M24 (293KN), M30 (466KN), M36 (678)KN	Length of the bolt after loading shall be the same as before loading within a tolerance of ± 12.5 μm allowed for measurement error.
5	Strength under Wedge load test	IS: 1367 Part 3 (Latest)	8.8 – 830N/mm2 10.9– 1040 N/mm2
6	Decarburization Test at 200X min magnification	Determination of the following by MICROSCOPIC Method a) Minimum Height of non decarburized thread zone – E b) Maximum depth of complete decarburization – G	E = 2/3 H1 G = 0.015 mm
7	Hardness after Retempering	IS: 1367 Part 3 (Latest) test not mandatory, to be applied in case of dispute only	Reduction of hardness 20 HV max.
8	NDE for Surface Intergrity	**before machining –** For bar Diameter ≥ 40 mm: UT as per ASTM A388. For bar Diameter < 40 mm: MPI as per ASTM E 709 **After machining –** MPI as per ASTM E 709 or as per ISO 6157 Part 3 (Latest)	UT – ASME SEC-VIII. Div-II Part: 3.3.4 (Latest). MPI – Linear indications like cracks, folds & other injurious defects are not acceptable.
9	Micro Examination for Surface Integrity – Laps at threaded region.	If any defectives found in visual and NDE examinations, the extent of defect can be detemined by micro examination.	Max depth of laps in thread = 0.41 mm Laps of any depth or length are not permitted in the following places: • at the root of the thread • at the loaded flank of screw thread below the pitch

			diameter, even if they start beyond the pitch diameter. The following laps are permissible : • laps in the crest of the threads of 0.25 H1 max.; • crest of the threads not entirely rolled out, maximum half a turn on one thread; • laps below the pitch diameter, if they run on the non-loaded flank towards the major diameter and not deeper than 0.25 H1 and not longer than half a turn on one thread.

NUT: (on Heat Treated finished product)

Sl	Test	Test Method	Acceptance Value
1.	Chemistry	Spectro / Wet Analysis Method – For every heat of raw material and, One sample/HT batch on product	As per Cl 2.0 of this TDC
2.	Hardness Test	Hardness of the test mandrel shall be minimum 45 HRC.	Min 272 HV Max 372 HV
3.	Proof Load Test	Proof Load of **8S** – Proof Load of M20 (263.4KN), M24 (379.5KN), M30 (603.1KN), M36 (878.3KN) **10S** -M20 (305KN), M24 (439.5KN), M30 (698.4KN), M36 (1017.2KN) shall be applied axially to the nut in a tensile testing machine for 15sec.	The nut shall resist the load without failure by stripping or rupture, and shall be removble by the fingers after the load is released.
4.	NDE for Surface Intergrity	Before coating, as per IS 1367 Part 10 Cl 4.2 (Latest)	Linear indications like cracks, folds & Other injurious defects are not acceptable.

WASHER: As per IS 5369. The washers shall be free from cracks, burrs, pits and other defects. All sharp edges shall be removed.

Sl	Test	Test Method	Acceptance Value
1.	Chemistry	Spectro / Wet Analysis Method – For every heat Of raw material and One sample/HT batch batch on product.	As per Cl 2.0 of this TDC
2.	Hardness Test	IS 1586 (latest)	Min 35 HRC Max 45 HRC

6. MARKING, PRESERVATION AND PACKING:

The following to be hot stamped or embossed on the top surface of the bolt and nut:
Bolt – Manufacturer's Identification Symbol and 8.8S,10.9S
Nut – Manufacturer's Identification Symbol and 8S,10S
Washers – Shall be identified by – the provision of 2 nibs and manufacturers identification symbol being placed as near to the outer edge as possible.

The following details shall be clearly indicated in the tags tied to the bundle:
1) Customer Name 2) Manufacturer's Name 3) Vendor Code 4) Purchase Order No and Supplier Internal W.O No 5) Quantity and Weight 6) BHEL Material Code 7) Item Description with diameter, length

Colour coding: To be done only on bolt head as per BHEL drawing as indicated in the Purchase order.

Shall be packed in bituminous coated Polythene lined Hessian Cloth/Bag. Each bag shall contain only the same size of bolts/ nuts/ washers respectively and the same shall be indicated in the tags. The weight of the bag shall not exceed 30Kgs.

7. INSPECTION AND CERTIFICATION:

All the finished components shall be visually and dimensionally inspected as per sampling plan. All the test results shall be documented and maintained. Products to be inspected at works & test certificates (in English) shall be submitted with the following details counter signed by BHEL/BHEL Authorized Inspection agency as indicated in the PO. Manufacturers Test certificate (MTC) shall contain the following:

1) Purchase Order No. (BHEL), TDC No, Specification and Grade.
2) Name of raw material bar supplier.
3) Forming process
4) Dimensional reports for each product.
5) Chemistry including incidental elements on the raw material and final product checked in NABL lab/ suppliers own lab.
6) HT details of materials temperature, soaking time, ROH/ROC medium etc.
7) All Mechanical test result report including hardness.
8) MPI, Micro examination and decarburization test report with the reference & acceptance standard.
9) TC of raw material, UT/MPI report done on raw material shall accompany the MTC.

8. AUDITS AT BHEL:

BHEL reserve the right to reject any item found to be not meeting the requirements during tests at supplier works or during subsequent processing at BHEL.

TEST SAMPLING PLAN FOR HSFG BOLTS, NUTS & WASHERS FOR BHEL TDC: 5:215

Lot Size (In nos.)	**SAMPLE SIZE**										**Remarks**
	Visual (nos.)	Dimensional (nos.)	MPI (nos.)	Physical Tests							
				Total nos.	Hardness (nos.)	Hardness after Re-tempering (nos.)	Proof Load (nos.)	Wedge Load (nos.)	Min Tensile Strength (nos.)	Decarb (nos.)	
Upto 100	20	8	15	5	5	5	2	2	2	1	
101 to 300	32	13	15	5	5	5	2	2	2	1	
301 to 500	50	20	15	5	5	5	2	2	2	1	
501 to 1000	80	32	15	5	5	5	2	2	2	1	
1001 to 3000	125	50	25	8	8	8	2	4	2	1	Upto 1500 nos. 15 nos. for MPI
3001 to 10000	200	80	50	13	13	13	2	6	2	1	Upto 5000 nos. 25 nos. for MPI
10001 to 35000	315	125	75	20	20	20	4	10	4	2	Upto 15000 nos. 50 nos. for MPI
Above 35000	500	200	100	32	32	32	6	15	6	3	Upto 50000 nos. 75 nos. for MPI
Inspection by BHEL/BHEL AIA	**W**	**W**	**W**		**W**	**W**	**W**	**W**	**W**	**W**	

Inspection by BHEL / BHEL AIA shown as "W" shall be witnessed for the sample size indicated against the lot size

Remarks:

1. Acceptance Number is zero. If the sample is having deviations in Visual, Dimensional and MPI then the entire lot shall be 100% inspected. In case of deviations in Physical tests a second sample of twice the sample size of initial sample shall be taken. The lot will get rejected if the second sample fails.
2. Preservation & Packing: The bolts shall be supplied in the dull black heat treated condition with a residual coating of light oil. Finished products shall be packed in a bituminous coated Polythene lined Hessian cloth/bag. Each bag shall contain only the same size of bolts/nuts/washers respectively and the same shall be indicated in the tags.

M. Jeyaram Manager/QA	S Anand Kumar/SDGM MM	K Rajmohan SDGM/Engg	T Pandian AGM/QC	J.V.V. Aruna Kumar AGM/QA &BE
Prepared	**Reviewed**			**Approved**

	BHEL: IVP Goindwal Quality Assurance	STANDARD QUALITY PLAN Item: HSFG Fasteners (Bolts, Nuts and washers)	QP No	SQP:HSFG:001
			Rev	1
			Date	26.03.2024
			Page	1 of 2

SN	Component & Operation	Characteristics	Type of Check	Quantum of check	Reference Document	Acceptance Norm	Format of Record	Agency		Remarks
								M	B	
1.0	**Raw material**									
1.1	Raw material	Chemical & Mechanical	TC verification	100%	BHEL Specification (TDC & PO)		TC	V	V	
2.0	**In Process**									
2.1	Machining and Heat Treatment: NDE(UT/MPI)	Dimension, Temprature, Time, Medium, HT Chart, NDE	Report Review	100%	DO		R	P	V	NDE in Raw Material
3.0	**Final Inspection (*)**									
3.1	Visual & Dimension (*)	Visual, Dimension, thread & Marking (identification & colour coding)	Measurement/ Thread gauge	Sampling plan (*)	DO		R	P	W	(*) BHEL/BHEL TPIA will witness final inspection in supplier works or NABL approved Lab as per TDC to be followed. (#) For nut only hardness test and Proof load tet. For washers, hardness test only. Hardness after re-tempering in case of dispute
3.2	Mechanical testing (*,#)	Mechanical (Hardness, Strength under wedge load test, Minimum Tensile strength, Proof load test, Decarburization test, Hardness after re-tempering)	Testing	DO	DO		R	P	W	
3.3	Chemical (*)'	Chemical composition (refer note 2))	Testing	DO	DO		R	P	W	
3.4	NDE (*)	Surface quality	Testing (visual & MPI)	DO	DO		R	P	W	
3.5	Preservation	Preservation (rust preventive fluid)	Visual check		DO		TC	P	V	refer BHEL specification no PR:CHEM:09-04 (latest revision)

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Preprated By
Sanju Kohli
Manager, QM

S R KENNY
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Date: 2024.03.29 15:27:35 +05'30'
Reviewed and Approved By
SR Kenny
AGM, QM **E**

	BHEL: IVP Goindwal Quality Assurance	STANDARD QUALITY PLAN Item: HSFG Fasteners (Bolts, Nuts and washers)	QP No	SQP:HSFG:001
			Rev	1
			Date	26.03.2024
			Page	2 of 2

SN	Component & Operation	Characteristics	Type of Check	Quantum of check	Reference Document	Acceptance Norm	Format of Record	Agency		Remarks
3.5	Packing	Packing and Marking	Verification		DO		R	P	V	

Legends:
M-Manufacturer/Sub contractor, B-BHEL/Authorised inspection agency, V-Verification, W-Witness, P-Perform, R-Report, C-Customer, CHP- Customer Hold point, TC- Test Certificates

Note: 1. This QP shall be read along with relevant PO, TDC and applicable standards and drawings. Requirements shall be compiled.
2. Chemical check by spectro/wet method (minimum 1 number to be checked per inspection lot).

Record of Revision		
Rev	**Date**	**Details of Revision**
00	29.01.2021	1. Fresh Release/ Original issue
01	26.03.2024	1. Revised preservation method only

SANJU KOHLI
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Sanju Kohli
Manager, QM

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SR Kenny
AGM, QM **E**

PLANT LABORATORY

TECHNICAL SPECIFICATION FOR TEMPORARY RUST PREVENTIVE FLUID FOR BHEL USE TO IS 1153 (MODIFIED)

REV	DATE	PREPARED BY	REVIEWED AND APPROVED BY
03	01-04-2009	L.Gragori DM/Plant Lab	Dr. G.Ravichandran SDGM/Plant Lab

Controlled Copy No:	Issued to:

Record of Revisions

Rev. No	Date	Details of Revision	Remarks
00	05.11.1992	NEW	----
01	04.04.1995	Sl.No. 1,3 & 5 modified	Quality improvement
02	20.05.2003	Sl.No. 8 Temperature Resistance Newly added	Based on Valves Requirement
03	01.04.2009	Editorial corrections made & new requirements added in Sl.No. 6, 12 & 16. Other Sl. No. Changed accordingly.	SSTP's additional requirements as given in TDC/CHEM/06 added.

REQUIREMENTS FOR TEMPORARY RUST PREVENTIVE FLUID

1	Specific Gravity at ambient temperature	0.85 - 0.95
2	Flash Point °C (min)	40
3	Drying time : Surface Dry (Hours, max)	½
	Tack free (Hours, max)	4
4	Dry film thickness (Microns) per coat-min	20
5	Ford cup Viscosity (No.4) seconds at ambient temperature	25 ± 5
6	Odour	No objectionable Odour
7	Film type Transparent/Translucent	Transparent
8	Application Method	Brush/Spray
9	% Non- Volatiles by mass	55 ± 5
10	Temperature Resistance of RPF film at 50 °C (for 6 hrs)	To pass test.
11	Corrosion Protection under conditions of condensation for 300 hours.	No sign of corrosion.
12	Liebermann –Storch test for the detection of natural resin & its derivatives	No development of pink colour – indicating absence of natural resin.
13	Salt spray test for 72 hours	No sign of corrosion.
14	Outdoor durability	The coating shall not crack or turn opaque when exposed to out door, unsheltered condition for 1 year.
15	Scratch Hardness test (Under load of 1000 g as per IS 101 (Latest)	To pass test
16	Compatibility with Alkyd /Lacquer based paints.	Compatible.
17	Keeping Property – Months (Shelf life) min.	12
18	General conformance to I.S Specification	IS 1153 (Latest)
19	Packing standard/marking	Supply in 200/20/10 Lt. Barrels as per PO indicating the following. Rust Preventive fluid for BHEL use only. Supplier's Name: Batch No: Date Quantity: Shelf Life: BHEL Specn.PR:CHEM:09-04 (latest)
20	Test certificate	The supplier shall furnish test certificate for the above requirements Sl.No.1 to 16 in duplicate.