

Technical Data [ข้อมูลทางเทคนิค] [อ้างอิงจาก ASTM A490M - 14a]

ASTM A490M : Heavy Hex Structural Bolts

1. Materials [วัสดุ]

Type 1: Medium carbon steel, boron steel, or medium carbon alloy steel

Type 3: Weathering steel

Table1 : Chemical Requirements for Bolts

Element	Type : 1				Element	Type : 3	
	Alloy Steel		Alloy Boron Steel			Alloy Boron Steel	
	Heat Analysis, %	Product Analysis, %	Heat Analysis, %	Product Analysis, %		Heat Analysis, %	Product Analysis, %
Carbon For sizes through M30	0.30 - 0.48	0.28 - 0.50	0.30 - 0.48	0.28 - 0.50	Carbon Sizes M20 and smaller	0.20 - 0.53	0.19 - 0.55
For sizes M36	0.35 - 0.53	0.33 - 0.55	0.35 - 0.53	0.35 - 0.55	Sizes larger M20	0.30 - 0.53	0.28 - 0.55
Manganese	0.60min	0.57min	0.60min	0.57min	Manganese	0.40min	0.37min
Phosphorus	0.040max	0.045max	0.040max	0.045max	Phosphorus	0.035max	0.040max
Sulfur	0.040max	0.045max	0.040max	0.045max	Sulfur	0.040max	0.045max
Boron	...	...	0.0005 - 0.003	0.0005 - 0.003	Copper	0.20 - 0.60	0.17 - 0.63
					Chromium	0.45min	0.42min
					Nickel	0.20min	0.17min
					Molybdenum	0.15min	0.14min

*** Recommended Nuts and Washers

Bolt Type and Finish	Nuts Class and Finish Specification	Washer Finish
1, plain	A563M : 10S, 10S3, plain	F436M : plain
1, zinc-coated ^A	A563M : 10S, 10S3 [zinc-coated] ^B	F436M : zinc-coated ^A
3, Weathering Steel	A563M : 10S3, Weathering Steel	F436M : Weathering Steel

^A Zinc-coated =coated in accordance with Specification F1136M(Gr.3) or F2833(Gr.1)

^B Zinc-coated =coated in accordance with Specification F1136M(Gr.5) or F2833(Gr.1)

2. Mechanical Properties [สมบัติทางกล]

2.1 Hardness [ค่าความแข็ง]

Table2 : Hardness Requirements for Bolts

Bolt Size [mm]	Bolt Length [mm]	Brinell		Rockwell C	
		Min	Max	Min	Max
M12 to M24, Inclusive	Less than 2D	311	352	33	38
	2D and over	...	352	...	38
M25 to M36, Inclusive	Less than 3D	311	352	33	38
	3D and over	...	352	...	38

2.2 Tensile Load and Proof Load [ค่าแรงดึงและแรงดึงพิสูจน์]

Table3 : Tensile Load and Proof Load Requirements for Bolts Tested Full-Size

Bolt Size [mm]	Stress Area [mm ²]	Tensile Load, min [MPa]		Proof Load, Length Measurement Method [kN]	Alternative Proof Load, Yield Strength Method [kN]
		min	max		
M12 x 1.75	84.3	87.7	103	70	79.2
M16 x 2.0	157	163	190	130	148
M20 x 2.5	245	255	296	203	230
M22 x 2.5	303	315	366	251	285
M24 x 3.0	353	367	427	293	332
M27 x 3.0	459	477	555	381	431
M30 x 3.5	561	583	679	466	527
M36 x 4.0	817	850	989	678	768

2.3 Tensile Strength [ค่าความแข็งแรงทางแรงดึง]

Table4 : Tensile Strength Requirements for Specimens Machined From Bolts

Bolt Size [mm]	Tensile Strength, min		Yield Strength, min [MPa]	Elongation in 4D, min [%]	Reduction of Area, min [%]
	min	max			
M12 to M36, Inclusive	1040	1210	940	14	40

3. Dimension [รูปร่างและขนาด Bolt A490M] [อ้างอิงจาก ANSI B18.2.6M]

3.1 Body Length, L [ความยาวของ Bolts]

The bolt length shall be the distance measured parallel to the axis of the product from the bearing surface of the head to the extreme end of the bolt including point. Bolts are normally furnished in 5 mm length increments through 100 mm and 10 mm increments over 100 mm.

[ความยาวของ Bolts จะวัดระยะเริ่มจากส่วนหัวด้านในจนถึงปลายสุด โดยระยะที่น้อยกว่าหรือเท่ากับ 100 มิลลิเมตร จะเพิ่มความยาวขึ้นครั้งละ 5 มิลลิเมตร ส่วนระยะที่มากกว่า 100 มิลลิเมตร จะเพิ่มความยาวครั้งละ 10 มิลลิเมตร]

3.2 Basic Body Dimensions [ขนาดทั่วไปของ Bolts A490M]

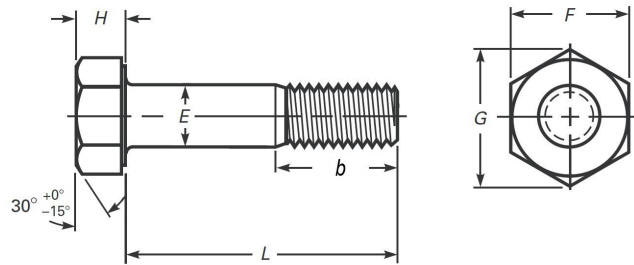


Table6 : Dimensions of Heavy Hex Structural Bolts

Bolt Diameter [mm]	Body Diameter E, [mm]		Width Across Flats F, [mm]		Width Across Corners G, [mm]		Head Height H, [mm]		Thread Length, b, [mm]	
	Max	Min	Max	Min	Max	Min	Max	Min	Bolt Length≤100	Bolt Length>100
M16 x 2.0	16.70	15.30	27.00	26.16	31.18	29.56	10.75	9.25	31	38
M20 x 2.5	20.84	19.16	34.00	33.00	39.26	37.29	13.40	11.60	36	43
M22 x 2.5	22.84	21.16	36.00	35.00	41.57	39.55	14.90	13.10	38	45
M24 x 3.0	24.84	23.16	41.00	40.00	47.34	45.20	15.90	14.10	41	48
M27 x 3.0	27.84	26.16	46.00	45.00	53.12	50.85	17.90	16.10	44	51
M30 x 3.5	30.84	29.16	50.00	49.00	57.74	55.37	19.75	17.65	49	56
M36 x 4.0	37.00	35.00	60.00	58.80	69.28	66.44	23.55	21.45	56	63

3.3 Length Tolerances [ค่าความคลาดเคลื่อนของความยาว]

Bolt length tolerances shall be as tabulated below. [ค่าความคลาดเคลื่อนของความยาว Bolts กำหนดตามตารางด้านล่าง]

Table7 : Tolerance Requirements for Bolts Length

Bolt Length [mm]	M12	M16	M20	M22	M24	M27	M30	M36
Length >150mm.	-4.0	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Length ≤150mm.	-3.0	-3.0	-4.0	-4.0	-4.0	-6.0	-6.0	-6.0

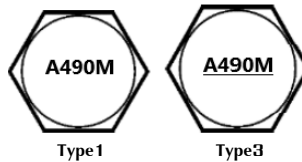
4. Surface and Marking [ผิวและสัญลักษณ์บน Bolts A490M]

4.1 Finish/Coatings

1. Plain / Black
2. Hot-Dip Galvanized [ASTM A153/153M]

4.2 Product Marking

1. Type 1 bolts shall be marked "A490M"
2. Type 3 bolts shall be marked "A490M" [with the A490M underlined]



5. Weight [น้ำหนัก Bolts A490M]

Table8 : Weight [Kg / 100 pcs.] of Heavy Hex Structural Bolts

Body Length [mm]	45	50	55	60	65	70	75	80	85	90	95	100	110	120	130	140
M16x2.0	10.71	11.38	12.04	12.70	13.36	14.02	14.68	15.34	16.00	16.66	17.32	17.98	19.55	21.13	22.71	24.29
M20x2.5		18.85	20.10	21.40	22.60	23.87	25.13	26.40	27.69	28.90	30.15	31.50	34.00	36.44	38.95	41.50
M22x2.5			25.58	26.85	28.12	29.39	30.44	31.39	33.20	34.47	35.74	37.01	39.99	42.97	45.96	48.94
M24x3.0				33.76	35.21	36.66	38.11	39.56	41.01	42.46	43.91	45.36	48.91	52.46	56.01	59.56
M27x3.0					48.40	50.64	52.88	55.12	57.36	59.60	61.84	64.08	68.57	73.06	77.56	82.05
M30x3.5						60.66	63.43	66.21	68.98	71.76	74.53	77.30	82.84	88.39	93.94	99.49
M36x4.0								124.50	128.50	132.50	135.40	141.30	149.29	157.28	165.27	173.26

Table8 : Weight [Kg / 100 pcs.] of Heavy Hex Structural Bolts [Continued]

Body Length [mm]	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
M16x2.0	25.87	27.44	29.02	30.60	32.18	33.76	35.34	36.91	38.49	40.07	41.65	43.23	44.81	46.38	47.96	49.54
M20x2.5	44.00	46.50	49.02	51.53	54.40	56.60	59.10	61.70	64.11	66.65	69.20	71.70	74.20	76.70	79.25	81.90
M22x2.5	51.93	54.91	57.89	60.88	63.86	66.85	69.83	72.81	75.80	78.78	81.77	84.75	87.73	90.72	93.70	96.69
M24x3.0	63.11	66.66	70.21	73.77	77.32	80.87	84.42	87.97	91.52	95.07	98.62	102.18	105.73	109.25	112.83	116.38
M27x3.0	86.55	91.04	95.54	100.03	104.53	109.02	113.52	118.01	122.50	127.00	131.49	135.99	140.48	144.98	149.47	153.97
M30x3.5	105.04	110.59	116.15	121.69	127.23	132.78	138.32	143.87	149.42	154.97	160.52	166.07	171.62	177.17	182.71	188.26
M36x4.0	181.50	189.24	197.23	205.22	213.21	221.20	229.19	237.18	245.17	253.16	261.15	269.14	277.13	285.12	293.11	301.10

ASTM A563M : Heavy Hex Nuts Use With Structural Bolts[A490M]. [อ้างอิงจาก ASTM A563M - 07]

1. Materials [วัสดุ]

Table9 : Chemical Requirements for Nuts

Element	10S		10S3	
	Heat Analysis	Product Analysis	Heat Analysis	Product Analysis
Carbon	0.55max	0.58max	0.20 - 0.53	0.19 - 0.55
Manganese	0.30min	0.27min	0.40min	0.37min
Phosphorus	0.04max	0.048max	0.046max	0.052max
Sulfur	0.05max	0.058max	0.050max	0.055max
Silicon	...	...	...	...
Copper	...	...	0.20min	0.17min
Nickel	...	...	0.20min	0.17min
Chromium	...	...	0.30min	0.25min
Vanadium	...	...	...	...
Molybdenum	...	...	0.15min	0.14min
Titanium	...	...	...	...

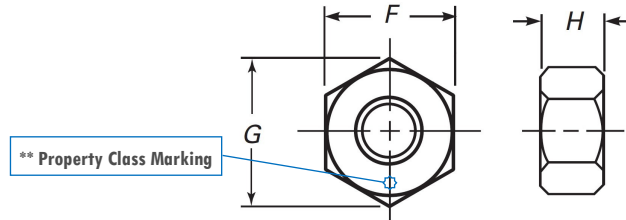
2. Mechanical Properties [สมบัติทางกล]

Table10 : Mechanical Properties Requirements for Nuts

Size [mm]	10S, 10S3		
	Proof Load Values, [kN]	Proof Load Stress, [MPa]	Hardness, [Rockwell]
M12 x 1.75	105		
M16 x 2.0	195		
M20 x 2.5	305		
M22 x 2.5	377		
M24 x 3.0	439	1245 MPa	C26 - C38
M27 x 3.0	571		
M30 x 3.5	698		
M36 x 4.0	1020		

3. Dimension and Weight of Metric Heavy Hex Nuts for Use With Structural Bolts

[รูปร่างและขนาด Nuts A563M + น้ำหนัก] [อ้างอิงจาก ANSI B18.2.6M]



*** Recommended ***
Finish/Coatings : Self Color/Black, HDG

Table11 : Dimension and Weight of Metric Heavy Hex Nuts for Use With Structural Bolts

Size	Width Across Flats F, [mm]		Width Across Corners G, [mm]		Head Height H, [mm]		Weight [Kg./100pcs.]
	Max	Min	Max	Min	Max	Min	
M12 x 1.75	21.00	20.16	24.25	22.78	12.30	11.90	2.80
M16 x 2.0	27.00	26.16	31.18	29.56	17.10	16.40	5.20
M20 x 2.5	34.00	33.00	39.26	37.29	20.70	19.40	7.99
M22 x 2.5	36.00	35.00	41.57	39.55	23.60	22.30	10.64
M24 x 3.0	41.00	40.00	47.34	45.20	24.20	22.90	17.65
M27 x 3.0	46.00	45.00	53.12	50.85	27.60	26.30	22.90
M30 x 3.5	50.00	49.00	57.74	55.37	30.70	29.10	29.39
M36 x 4.0	60.00	58.80	69.28	66.44	36.60	35.00	49.90

ASTM F436M : Metric Hardened Steel Washers. [อ้างอิงจาก ASTM F436M - 11]

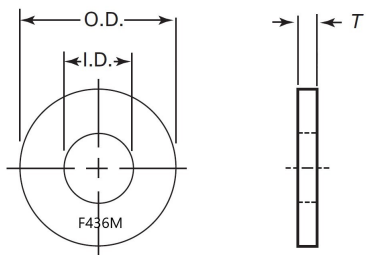


Table12 : Dimension and Weight of Washers for Use With Structural Bolts

Size	I.D., [mm]		O.D., [mm]		T, [mm]		[Kg./100pcs.]
	Max	Min	Max	Min	Max	Min	
M12	14.40	14.00	27.00	25.70	4.60	3.10	1.20
M16	18.40	18.00	34.00	32.40	4.60	3.10	2.15
M20	22.50	22.00	42.00	40.40	4.60	3.10	3.20
M22	24.50	24.00	44.00	42.40	4.60	3.40	4.55
M24	26.50	26.00	50.00	48.40	4.60	3.40	5.90
M27	30.50	30.00	56.00	54.10	4.60	3.40	6.60
M30	33.60	33.00	60.00	58.10	4.60	3.40	7.55
M36	39.60	39.00	72.00	70.10	4.60	3.40	13.30

Table13 : Chemical Requirements for Washers

Element	Composition, %	
	Heat Analysis	Product Analysis
Phosphorus	0.04max	0.05max
Sulfur	0.05max	0.00max

**Hardness for Plain Washers = 38 to 45 HRC. **Hardness for HDG Washers = 26 to 45 HRC.