To:		ENGINEERING INSTRUCTION *New York State Department of Transportation*	95-024 Supersedes:
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Title: **METRIC BOLT WAIVER POLICY (EXCLUDING §715-14 BOLTS)**

Distribution:	Approved:
X Main Office(30) X Local Gov.(31) X Regions(32) X Contractors/AGC(39) X Consultants(34) ☐ _____( )	P.J. Clark, Director, Design Division — Date: 6/12/95

This Engineering Instruction transmits Department policy on specifying and designing with metric bolts on all metric contracts.

The Department's Metric Coordinating Committee has established a policy to only specify A.S.T.M. metric bolts on plans and in specifications, but allow appropriate English bolt substitutions, according to the attached proposed shelf note, until the full range of A.S.T.M. metric bolts are domestically produced and readily available. **However, no substitution will be allowed for metric bolts used on bridges unless approved by the DCES.**

The attached METRIC/ENGLISH BOLT TABLE provides sufficient information for designers to select appropriate metric bolts, and shows which English bolts are most similar. This table shows which bolts are available in which sizes, and gives the respective proof load and tensile strength of each bolt. (Proof load is the load on a bolt when torqued correctly, and is assumed to be just below yield. Tensile strength is the minimum load that could actually break the bolt.) Each pair of bolts, both shaded or both unshaded, are considered comparable, and will both fit in the specified design hole. **The designer is hereby directed, for design purposes, to assume the lesser strength bolt of any pair will actually be used.** For example, if the required bolt is M8 of F568 Class 4.6, the designer should base the design on a 5/16 inch A307 bolt. If an M12 is required, the design should be based on actually using the M12, since the 1/2" substitute is stronger than the M12. In either case, according to the substitution table, contractors may substitute stronger bolts such as A325 or A449.

The METRIC/ENGLISH BOLT SUBSTITUTION TABLE is a shelf note for inclusion in **all** metric contracts. It shows contractors which English bolts are acceptable substitutes for the specified metric bolts. This shelf note does not allow substitution for the metric bolt sizes domestically manufactured, and will subsequently be updated as additional metric bolt sizes are domestically produced.

Any questions or comments on this material may be addressed to Richard Stempel at (518) 457-5440.

disk22, bolt-ei

METRIC / ENGLISH BOLT TABLE

NOTE: 1 kN=224.8 lbs

				Metric ASTM Bolts			F568 Cl. 4.6		F568 Cl. 8.8,*9.8* A325M: M16-M36		F568Cl.10.9,12.9* A490M: M16-M36	
				English ASTM Bolts			A307 Grade A		A449: ¼" - 3" A325: ½" - 1½"		A354,Gr. BD: ¼"-4" A490: ½" - 1½"	
Bolt		Hole diameter for fit										
SIZE (mm) (in)	DIAM (mm)	DESIGN HOLE (mm)	CLOSE FIT (mm)	NORMAL FIT (mm)	LOOSE FIT (mm)	STRESS AREA (mm^2)	PROOF LOAD (kN)	TENSILE STREN (kN)	PROOF LOAD (kN)	TENSILE STREN (kN)	PROOF LOAD (kN)	TENSILE STREN (kN)
M6	6.0	7.0	6.4	6.6	7.0	20.1	4.5	8.0	*13.1	18.1*	16.7	20.9
1/4	6.4	7.0		7.9	7.9	20.5		8.5	12.0	16.9	17.0	21.2
5/16	7.9	9.0		9.5	9.5	33.8		13.8	19.8	28.0	28.0	35.0
M8	8.0	9.0	8.4	9.0	10.0	36.6	8.2	14.6	*23.8	32.9*	30.4	38.1
3/8	9.5	11.0		11.1	11.1	50.0		20.7	29.4	41.4	41.4	51.7
M10	10.0	11.0	10.5	11.0	12.0	58.0	13.1	23.2	*37.7	52.2*	48.1	60.3
M10	10.0	12.0	10.5	11.0	12.0	58.0	13.1	23.2	*37.7	52.2*	48.1	60.3
7/16	11.1	12.0		12.7	12.7	68.6		28.2	40.3	56.7	56.7	70.9
M12	12.0	14.0	13.0	13.5	14.5	84.3	19.0	33.7	*54.8	75.9*	70.0	87.7
1/2	12.7	14.0	14.3	14.3	15.9	91.5		37.8	53.6	75.8	75.7	94.7
M14	14.0	16.0	15.0	15.5	16.5	115.0	25.9	46.0	*74.8	104*	95.5	120.0
9/16	14.2	16.0		15.9	17.5	117.4		48.9	68.7	97.2	97.1	121.4
5/8	15.9	18.0		17.5	20.6	145.8		60.3	85.4	120.5	120.6	150.8
M16	16.0	18.0	17.0	17.5	18.5	157.0	35.3	62.8	94.2	130.0	130.0	163.0
3/4	19.0	22.0		20.6	23.8	215.5		89.2	126.3	178.4	178.3	222.9
M20	20.0	22.0	21.0	22.0	24.0	245.0	55.1	98.0	147.0	203.0	203.0	255.0
M22	22.0	24.0	24.0	24.0	24.0	303.0			182.0	251.0	251.0	315.0
7/8	22.2	24.0		23.8	27.0	298.1		123.2	174.6	246.7	246.6	308.3
M24	24.0	27.0	25.0	26.0	28.0	353.0	79.4	141.0	212.0	293.0	293.0	367.0
1	25.4	27.0		27.0	31.8	391.0		161.7	229.1	323.4	323.5	404.3
M27	27.0	30.0	30.0	30.0	30.0	459.0			275.0	381.0	381.0	477.0
1 1/8	28.6	30.0		30.2	33.3	492.3		203.7	251.1	356.3	407.3	509.1
M30	30.0	34.0	31.0	33.0	35.0	561.0	126.0	224.0	337.0	466.0	466.0	583.0
1 1/4	31.8	34.0		33.3	39.7	625.2		258.7	318.9	452.4	517.2	646.5
1 3/8	34.9	38.0		36.5	42.9	745.2		308.3	380.1	539.6	616.5	770.7
M36	36.0	38.0	37.0	39.0	42.0	817.0	184.0	327.0	490.0	678.0	678.0	850.0
M36	36.0	40.0	37.0	39.0	42.0	817.0	184.0	327.0	490.0	678.0	678.0	850.0
1 1/2	38.1	40.0		39.7	46.0	906.4		375.0	462.6	656.1	750.0	937.5
M42	42.0	46.0	43.0	45.0	48.0	1120.0	252.0	448.0			930.0	1160.0
1 3/4	44.5	46.0		46.0	52.0	1226.0		507.0	464.8	760.6	1014.0	1268.0
M48	48.0	53.0	50.0	52.0	56.0	1470.0	331.0	588.0			1220.0	1530.0
2	50.8	53.0		52.4	59.0	1613.0		667.2	611.6	1000.0	1334.0	1668.0
M56	56.0	62.0	58.0	62.0	66.0	2030.0	457.0	812.0			1680.0	2110.0
2 1/4	57.2	62.0		59.0	65.0	2097.0		867.4	795.1	1301.0	1730.0	2169.0
2 1/2	63.5	70.0		65.0	71.0	2581.0		1067.6	978.6	1601.0	2135.0	2669.0
M64	64.0	70.0	66.0	70.0	74.0	2680.0	603.0	1070.0			2600*	3270*
2 3/4	70.0	76.0		71.4	77.8	3181.0		1315.8	1207.7	1974.0	2632.0	3289.0
M72	72.0	76.0	74.0	78.0	82.0	3460.0	779.0	1380.0			3360*	4220*
M80	80.0	86.0	82.0	86.0	91.0	4340.0	977.0	1740.0			4210*	5290*
3 1/4	82.6	86.0		84.0	90.0	4581.0		1895.0			3790.0	4737.0
3 1/2	88.9	95.0		90.5	97.0	5374.0		2223.0			4446.0	5558.0
M90	90.0	95.0	93.0	96.0	101.0	5590.0	1260.0	2240.0			5420*	6820*
M100	100.0	107.0	104.0	107.0	112.0	6990.0	1570.0	2800.0			6780*	8530*
4	101.6	107.0		103.0	109.0	7148.0		2957.0			5914.0	7393.0

METRIC / ENGLISH BOLT SUBSTITUTION TABLE

EQUIVALENT BOLT SIZES		HOLE DIAM (MM)	METRIC - ASTM GRADE SPECIFIED						
			F - 568 CLASS 4.6	F - 568 CLASS 8.8	F - 568 CLASS 8.8.3	F - 568 CLASS 9.8	F - 568 CLASS 10.9	A - 325M TYPE 1 OR 2	A - 325M TYPE 3
METRIC (MM)	ENGLISH (INCHES)		ENGLISH BOLT SUBSTITUTION - ASTM GRADE						
M6	1/4	7	A - 307 GRADE A	NOT REQ'D	NOT REQ'D	A - 449 TYPE 1	A - 354 GRADE BD	NOT REQ'D	NOT REQ'D
M8	5/16	9							
M10	7/16	12				A - 325 TYPE 1,3			
M12	1/2	14							
M14	9/16	16							
M16	5/8	18		A - 325 TYPE 1 OR 3 OR A - 449 TYPE 1	A - 325 TYPE 3	NOT REQUIRED	A - 354 GRADE BD OR A - 490 TYPES 1 OR 3	A - 325 TYPE 1 OR 3 OR A - 449 TYPE 1	A - 325 TYPE 3
M20	3/4	22							
M22	7/8	24							
M24	1	27							
M27	1 1/8	30							
M30	1 1/4	34							
M36	1 1/2	40							
M42	1 3/4	46		NOT REQD	NOT REQD		A - 354 GRADE BD NOT REQ'D	NOT REQD	NOT REQD
M48	2	53							
M56	2 1/4	62							
M64	2 1/2	70							
M72	2 3/4	76							
M80	3 1/4	86							
M90	3 1/2	95							
M100	4	107							

ENGLISH BOLT	APPROPRIATE NUTS
A-307 GRADE A	
DIAM < 1.5"	A 563 GRADE A** HEX
DIAM > 1.5"	A 563 GRADE A** HEAVY HEX
A 325 TYPE 1	A 563 - C, C3, D, DH*, DH3 A 194-2, 2H*
A 325 TYPE 3	A 563-C, DH3
A 449 TYPE 1	A 563 GRADE DH* HEAVY HEX
DIAM < 1.5"	A 563 GRADE B HEX
DIAM > 1.5"	A 563 GRADE A HEAVY HEX
A 354 GRADE BD	A 563 GRADE DH** HEAVY HEX
A 490 TYPE 1	A 563 GRADE DH or DH3 or A 194 GRADE 2H

Unless otherwise shown in the contract documents, appropriate English (inch) bolt and nut substitutions will be allowed in accordance with these tables.
However, no substitution will be allowed for M20 or M24 A325M Type 1 bolts unless permitted by the Engineer. Also, no substitution will be allowed for any A325M bolts supplied under §715-14 and used for structural connections on bridges, unless approved by the DCES.

* ZINC COATED AS PER ASTM A153

** PLAIN OR ZINC COATED

WASHERS SHALL BE F-436 WITH SAME FINISH (PLAIN OR ZINC COATED) AS THE BOLT.