



WA 950 Material Requirements and Mechanical Properties of Bolts, Studs, and Bolt & Washer Assemblies.

1. SCOPE.

This standard specifies the design information relating to material requirements and mechanical properties for bolts, studs, and bolt & washer assemblies when tested at room temperature (ISO 1).

NOTE: All requirements of ISO 898/1 apply unless otherwise specified in this standard.

2. REFERENCES.

ISO 1	Standard reference temperature for industrial length measurements.
ISO 898/1	Mechanical properties of fasteners - Part 1: Bolts, screws and studs.
SAE/USCAR-8	Grain Flow Pattern for Bolts and Screws.
WA 990	Surface discontinuities of bolts and studs.
WF 900	Dimensional, material, heat treatment, hardness and performance requirements for flat, toothed, conical, bowed and wavy washers.

3. MECHANICAL PROPERTIES.

Bolts, studs, and bolt & washer assemblies shall have the mechanical properties as specified in ISO 898 Part 1.

Bolt & washer assemblies shall be tested in the assembled washer form wherever possible. Where the conditions of a given test so dictate, the washer component may require removal.

4. MINIMUM ULTIMATE TENSILE LOADS AND PROOF LOADS.

The minimum tensile loads and proof load tables in the standard have been provided to assist Design Engineers. The tables show property classes 4.8, 8.8 and 10.9, and are the only property classes permitted for through hardened Ford worldwide fasteners. Property class 10.9 (10.9 underlined) fasteners are unacceptable. Property class 10.9 fasteners specify a minimum tempering temperature of 340°C and a 0.15-0.35% carbon content. For information regarding property classes and thread diameters not included in Table 1, refer to ISO 898 Part 1.

5. SURFACE INTEGRITY.

For referee purposes, surface integrity shall be in accordance with WA 990.

6. MATERIAL, HEAT TREATMENT, HARDNESS AND PERFORMANCE REQUIREMENTS FOR THE WASHER COMPONENT OF BOLT & WASHER ASSEMBLIES.

The material, heat treatment, hardness and performance requirements of the washer component of bolt & washer assemblies shall be in accordance with WF 900.

7. GRAIN FLOW.

Grain flow shall be verified in accordance with SAE/USCAR-8. This verification should be conducted at job setup, or whenever tooling or raw material changes are made that affect grain flow. The sample size and frequency should be identified in the manufacturer's Control Plan. All records, test specimens or photographs for this requirement shall conform to QS9000 record retention requirements.



Table 1 - Ultimate Tensile Loads and Proof Loads for ISO Metric Coarse Threads. These tables have been provided to assist Design Engineers. For all other requirements ISO 898/1 shall be referenced.

Table 1

Nominal Thread Diameter d (mm)	Pitch of the Thread p (mm)	Nominal Stress Area A _s nom. (mm ²)	Property Class					
			4.8	8.8	10.9	4.8	8.8	10.9
			Minimum Ultimate Tensile Load N			Proof Load N		
4	0.7	8.78	3690	7020	9130	2720	5100	7290
5	0.8	14.2	5960	11350	14800	4400	8230	11800
6	1	20.1	8440	16100	20900	6230	11600	16700
7	1	28.9	12100	23100	30100	8960	16800	24000
8	1.25	36.6	15400	29200	38100	11400	21200	30400
10	1.5	58.0	24400	46400	60300	18000	33700	48100
12	1.75	84.3	35400	67400	87700	26100	48900	70000
14	2	115	48300	92000	120000	35600	66700	95500
16	2	157	65900	125000	163000	48700	91000	130000
18	2.5	192	80600	159000	200000	59500	115000	159000
20	2.5	245	103000	203000	255000	76000	147000	203000
22	2.5	303	127000	252000	315000	93900	182000	252000
24	3	353	148000	293000	367000	109000	212000	293000