

DOD-W-24680
20 July 1977

MILITARY SPECIFICATION
METRIC MACHINERY/EQUIPMENT,
GENERAL REQUIREMENTS FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for machinery/equipment configured to metric dimensions, either wholly or partially (hybrid). (See 6.1 for additional details of intended use.)

1.2 Classification. Metric machinery/equipment shall be of the following classes, as specified (see 6.2):

Class M - Metric design.
Class H - Hybrid metric.

2. APPLICABLE DOCUMENTS

2.1 Government-furnished documents. Not applicable.

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
ASTM E 380 - Metric Practice (IEEE Std 268, ANSI Z210.1).

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Metric units. Metric units, practices, and usages shall be in accordance with ASTM E 380.

3.1.1 Preferred units. Unless otherwise specified (see 6.2), the preferred metric units for the commonly-used quantities shall be in accordance with table I, unless commonly accepted in a particular segment of industry.

3.1.2 Other quantities. Units used for other quantities shall be comparable in size to those in table I and in general accordance with industry practices for the particular item concerned.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Ship Engineering Center, SEC 6124, Department of the Navy, Washington, D.C. 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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DOD-M-24680

TABLE I. Preferred units.

Quantity	SI unit	Other preferred units
length ^{1/}	meter (m)	millimeter (mm), micrometer (μ m)
area	square meter (m^2)	square centimeter (cm^2), square millimeter (mm^2)
volume or capacity ^{2/}	cubic meter (m^3)	cubic centimeter (cm^3), cubic millimeter (mm^3), litre (L), milliliter (mL)
plane angle	radian (rad)	degree ($^\circ$)
angular velocity	radian/second (rad/s)	revolution/minute (r/min), revolution/second (r/s)
mass	kilogram (kg)	metric ton (t), gram (g), milligram (mg), microgram (μ g)
time	second (s)	hour (h), minute (min), milli- second (ms), microsecond (μ s)
current	ampere (A)	kiloampere (kA), milliamper (mA), microampere (μ A)
temperature	kelvin (K)	degree Celsius ($^\circ$ C)
force	newton (N)	meganeutron (MN), kiloneutron (kN), millineutron (mN)
torque	newton-meter (N·m)	
stress	pascal (Pa)	gigapascal (GPa), megapascal (MPa)
fluid pressure	pascal (Pa)	kilopascal (kPa)
energy (including work and quantity of heat)	joule (J)	megajoule (MJ), kilojoule (kJ), kilowatt hour (kWh) (electrical use only)
power	watt (W)	megawatt (MW), kilowatt (kW), milliwatt (mW), microwatt (μ W)
frequency	hertz (Hz)	gigahertz (GHz), megahertz (MHz), kilohertz (kHz), millihertz (mHz)

^{1/} In general, the unit of length for "small" items shall be the millimeter; the meter may be used for "large" items, generally those having linear dimensions above one meter. The centimeter and decimeter shall not be used except where commonly accepted in a particular segment of industry.

^{2/} Liter and its submultiple milliliter are restricted to measurements of fluids (liquids and gases).

DOD-M-24680

3.2 Class requirements.

3.2.1 Class M. Class M machinery/equipment, including assemblies and parts, shall be configured in only metric units. This classification would apply to a metric design or hard-converted product line of machinery/equipment. The following requirements apply:

- (a) The technical requirements for the item, as specified in the actual specification for the machinery/equipment (see 6.1), have been met.
- (b) Interface with any associated machinery/equipment can be achieved.
- (c) A full range of metric spares (parts, assemblies, special tools etc.), as required by contract is available.
- (d) Drawings, technical manuals, and other required technical data use metric units of measurement.

3.2.2 Class H. Class H machinery/equipment, including assemblies and parts, shall be configured in either metric or inch-pound units, or a combination of both; however, the external interfaces shown on the top assembly drawing shall be configured in metric units (see 3.4.1.3.1). In general, this classification would apply to an existing inch-pound product line of machinery/equipment where only the externals have been soft-converted, or to a hard-converted top item composed of either metric or inch-pound assemblies or parts or a combination of both. The following requirements apply:

- (a) The technical requirements for the item, as specified in the actual specification for the machinery/equipment (see 6.1), have been met, either as stated in metric units or in equivalent inch-pound units.
- (b) Interface with any associated machinery/equipment can be achieved.
- (c) A full range of spares (parts, assemblies, special tools etc.), as required by contract, is available, either metric or inch-pound, as applicable.
- (d) Drawings, technical manuals, and other required technical data are available and indicate clearly which parts or assemblies are metric and which are inch-pound.

3.3 Instrumentation. Unless otherwise specified (see 6.2), instrumentation and gaging (temperature, pressure, etc.) for class M or class H machinery/equipment shall show the indications in only metric units. For class H machinery/equipment only, the actual size and construction of the instrumentation and gaging may be in either metric or inch-pound units.

3.4 Technical documentation.

3.4.1 Engineering drawings.

3.4.1.1 General. In general, drawings shall be dimensioned in terms of the unit system in which designed. Unless otherwise specified (see 6.2), dual dimensions (see 6.4(h)) shall not be used on drawing views, except that existing dual-dimensioned drawings are acceptable. Conversion tables on the drawings may be used to translate all shown dimensions (in ascending or descending order) from one system of units to the other.

3.4.1.2 Class M. Drawings for class M items shall be in metric units. For such drawings, conversion tables may be in the form of paste-ons on the master reproducible, which can be peeled off at some future date when no longer required.

3.4.1.3 Class H. Drawings for metric assemblies and parts of class H items shall be in metric units; similarly, the top drawing of the item shall show external interfaces in metric units.

3.4.1.3.1 Unless otherwise specified (see 6.2), drawings delineated in inch-pound units need not contain the conversion table, except for the external interfaces shown on the top assembly drawing (usually first drawing of a set).

3.4.1.3.2 For drawings delineated in metric units, paste-on tables may be used as specified in 3.4.1.2.

3.4.2 Technical manuals, reports, and other technical data. Technical manuals for class M machinery/equipment and for metric parts and assemblies of class H machinery/equipment shall use metric units; the external characteristics (pressure and temperature, for example) of class H machinery/equipment shall be expressed in metric units. Test reports and other technical data shall generally use the terminology of the unit system in which the item was designed. The requirements of 3.4.1 and its subdivisions also apply to drawings and illustrations in technical manuals, reports, and other technical data. Where dual indication is used, the metric unit shall appear first followed by the inch-pound unit in parentheses.

DOD-M-24680

3.4.3 Nonconversion. Conversions shall not be used for items not directly translatable (for example, a number 10 bolt or a number 14 wire are not directly translatable into metric dimensions; similarly, an ISO metric bolt is not directly translatable into inch-pound units). In like manner, temperature associated with electrical machinery/equipment is normally expressed only in °C.

3.4.4 Metric identifier. A metric identifier, that is the word "METRIC", preferably enclosed in a rectangle, shall be placed on the field of a drawing near the title block. On other technical data, it shall be located in the vicinity of the document number. Lettering size shall be approximately the same as the drawing or document number. When nonmetric sheets are included in a metric document, the identifier shall be placed on each metric sheet only.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Technical inspections. Technical inspections shall be in accordance with the requirements of the actual specification for the machinery/equipment being procured (see 6.1 and 6.2).

4.2.1 Qualification. Qualification inspection and verification, if any, shall be in accordance with the qualification requirements of the cited applicable specification.

4.2.1.1 Class H. If merely soft-converted, requalification of the product will normally not be necessary. However, the introduction of metric designed or hard-converted metric parts and assemblies shall follow normal requalification or verification procedures.

4.2.1.2 Class M. A previously-qualified inch-pound product that is hard-converted actually becomes a new item; hence the normal procedures for requalification or verification apply.

4.3 Metric inspections. Compliance with the requirements of section 3 of this specification shall be by visual examination.

5. PACKAGING

5.1 General. Unless metric packaging is specified (see 6.2), the packaging shall be in accordance with the requirements of the actual specification for the machinery/equipment being procured (see 6.1).

6. NOTES

6.1 Intended use. This specification is intended to be cited in procurement contracts for "metric" machinery/equipment, along with the actual nonmetric specification for such machinery/equipment, during the changeover period when the latter specification is still expressed in terms of inch-pound units. Manufacturers and contractors will probably initially be offering an existing product line, but with the external interfaces of the top item soft-converted and expressed in metric units and most internal parts and assemblies retained and still expressed in inch-pound units; this would be class H. Gradually, metric designed or hard-converted parts and assemblies may enter the end item; this would still be class H. Eventually, the product line may be metric designed or hard-converted to a new metric product line (class M). By that time the actual specification for the machinery/equipment may also be completely "converted"; this specification would then no longer have to be cited.

6.1.1 Policy. This specification reflects Department of Defense policy which is designed to avoid specifying metric materiel for metric's sake. Initially, class H machinery/equipment should be considered acceptable. Wholly metric design (class M), including all parts and assemblies, should be specified only where determined to be technically and economically feasible, or otherwise in the best interest of the Department of Defense.

DOD-M-24680

6.1.2 Tailoring. Tailoring of use of this specification in specific contracts is encouraged. For example, if a wholly metric item is actually required, only class M should be cited. If either a wholly or partially metric item is acceptable, both class M and H should be specified (see 6.2). If a partially metric item is desired, but with certain metric features, class H should be specified and the metric features specifically indicated.

6.1.3 New design system. This specification is not intended to define the requirements of a new system design. In such cases, DOD-STD-1476 should be used.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Title, number, and date of the actual specification for the machinery/equipment being procured (see 6.1).
- (c) The class of machinery/equipment to be procured (see 1.2 and 6.1), and if any special metric features are required for class H.
- (d) If other than the preferred metric units are to be used (see 3.1.1).
- (e) If dual indication is required on instruments and gaging (see 3.3).
- (f) If dual dimensioning is required or even permitted (see 3.4.1.1).
- (g) If drawings delineated in inch-pound units require a conversion table (see 3.4.1.3.1).
- (h) If metric packaging is required (see 5.1).

6.3 Data. This specification does not require the preparation or delivery of technical data. Paragraph 3.4 merely specifies the "metric" features necessary for the data required by the specification for the machinery/equipment being procured (see 6.2(b)).

6.4 Definitions. As used herein, certain expressions or terms are defined as follows:

- (a) Metric. The international System of Units (commonly abbreviated as SI), as established by the General Conference of Weights and Measures in 1960 and as interpreted or modified for the United States by the Secretary of Commerce (see 3.1).
- (b) Inch-pound. The customary system formerly and currently used in the United States (for example: foot, inch, pound, p.s.i., B.T.U., horsepower, and degree Fahrenheit).
- (c) Soft-conversion. The process of changing inch-pound measurement units to equivalent metric units, within acceptable measurement tolerances, without changing the physical configuration. In other words, it is the same item both before and after conversion.
- (d) Hard-conversion. The process of changing inch-pound measurement units to nonequivalent metric units which necessitates physical configuration changes outside those permitted by established measurement tolerances. (Although the term is in general use, it is technically incorrect when applied to specific items because no "conversion" takes place; rather, a new metric item, requiring new item identification, is created to replace the inch-pound item.)
- (e) Metric design. Product design using metric dimensions, selected as appropriate, without considering conceptual or physical conversion from inch-pound units.
- (f) Hybrid. A combination or mixture of metric and inch-pound items.
- (g) Dual-indication. The inclusion, in text or on instrumentation and gaging, of a quantity (characteristic or dimension) in both metric and inch-pound units (for example: 700 kPa (100 lbf/in²)).
- (h) Dual-dimensions. The inclusion of linear dimensions in views of a drawing in both metric and inch units.

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