
METRIC DESIGN GUIDE

(PBS-PQ260)

September 1995

**Public Buildings Service
U.S. General Services Administration**

TABLE OF CONTENTS

General Information	1
Introduction.....	1
Benefits Of Metric	3
International Acceptance.....	3
Simplicity.....	3
Product Variations.....	3
One Unit For Each Property.....	3
Pressure.....	4
Power.....	4
Standards.....	4
Summary.....	4
Metric Project Definition	5
Dual Dimensions.....	5
Summary.....	5
Round Metric Dimensions	6
Architectural.....	6
Civil.....	7
Structural.....	7
Mechanical.....	7
Electrical.....	7
Custom Products.....	8
Modular Products.....	8
Drawings	9
Space Between Groups.....	9
Scales.....	9
Sheet Sizes.....	9
Specifications	10
Millimeters (mm).....	10
Meters (m).....	10

Centimeters (cm).....	10
Rounding and Conversion.....	11
Simple Mathematical Rounding.....	11
Professional Rounding.....	11
Architectural/General.....	13
Module	13
Drywall.....	13
Doors	13
Ceiling Systems.....	13
Architectural/Masonry	14
Brick.....	14
Block	14
Architectural/Sheet Metal.....	15
Civil/Surveying.....	16
Civil/Concrete.....	17
Civil/Reinforcement.....	18
Structural/General.....	19
Metric Projects	19
Fasteners.....	19
Structural/Floorload.....	20
Mechanical/General.....	21
Temperature	21
Air Distribution	21
Ductwork.....	21
Units.....	21
Mechanical/Pipe.....	22
Electrical/General.....	23
Wire Size.....	23
Lighting Fixtures.....	24

Product Information	25
Air Diffusers and Grilles.....	25
Carpet.....	27
Curtainwall Systems.....	27
Doors.....	27
Drywall.....	28
Elevators.....	29
HVAC Controls.....	29
Lighting Fixtures.....	29
Masonry.....	31
Plywood.....	33
Raised Access Flooring.....	34
Reinforcing Steel.....	34
Steel Fabrication.....	35
Structural Bolts.....	35
Suspended Ceiling Systems.....	36
Systems Furniture.....	37
Tools.....	37
Windows.....	37
 General Information	 39
Executive Order 12770 of July 25, 1991.....	39
AGC Letter to Metrication Operating Committee.....	42
 Recommended Preparation	 43
Governmental Organizations.....	43
Private Design Firms.....	43
Product Manufacturers.....	43
Metric Projects.....	44
Small Projects.....	44
A/E-CM CBD Guidance.....	44
Construction CBD Guidance.....	45
A/E-CM Scope Guidance.....	45
Metric Measurement.....	46
Specification Guidance.....	46

General Information

Introduction

Pub. L. 100-418 designated the metric system as the *preferred* system of weights and measures for U.S. trade and commerce. This law also directed all Federal procurement, grants, and other business-related activities to be metric by September 1992, unless this was impractical or likely to cause loss of markets to U.S. firms. Presidential Executive Order 12770, July 29, 1991, designated the Secretary of Commerce to direct and coordinate metric conversion efforts by all Federal departments and agencies, and authorized the development of specific dates for metric conversion in industries where September 1992 was impractical.

Executive Order 12770 also authorized the Secretary to create an Interagency Council on Metric Policy (ICMP) to assist the effort. The ICMP established 10 working subcommittees, each responsible for the conversion of Federal procurement in a major industry. The Construction Subcommittee was established to oversee metric conversion in the Federal construction industry.

In industries where a September 1992 conversion deadline was not feasible, the Executive order authorized a department or agency to consult the Secretary of Commerce to establish a more feasible date. The Construction Subcommittee evaluated the construction industry and proposed an alternate conversion date of January 1, 1994. This date allowed time to revise standards after some experience with pilot projects. The Subcommittee requested this time because, in the spirit of the law, it was going to propose using as many modular *hard*-dimension products as are made at any given time.

The General Services Administration (GSA) order, GSA Metric Program (ADM 8000.1B), dated November 11, 1992, required that all procurement be in the metric system of measurement by October 1992 or waivers be issued, supported by an assessment. This order established the alternative date of January 1, 1994, for construction.

Cooperation between Government and the private sector has been vigorously pursued as required by the Executive order. The Construction Subcommittee established a Construction Metrication Council in the National Institute of Buildings Sciences. The meetings of the Construction Metrication Council are attended by Federal agencies involved in construction, professional societies, trade organizations, product manufacturers, labor representatives, code organizations, and design firms. Attendance at the Council is extended to other parties interested in monitoring and assisting the metric conversion of the Federal construction community.

All GSA designs for renovation and new construction started after January 1, 1994, are being done in the metric system. Most Federal agencies involved in construction have already committed significant projects to be designed and built in metric.

Many private firms and governmental agencies involved with international construction have provided input and feedback to the material presented here. This document was coordinated with available private sector and professional society metric design guidance. Whenever possible, existing guidance has simply been adopted. Where private guidance did not exist, the most feasible direction has been developed and presented.

There are several "metric" systems in use in the world. The U.S. Government has adopted the International System of Units, abbreviated SI, from the French *Système international d'unités*. SI is used by major professional and code organizations.

An objective of the development of this document has been to minimize the impact on design firms, contractors, and product manufacturers, while still complying with the national directive of increasing U.S. competitiveness

Due to the developmental nature of metric design in the United States, it is probable that this document will be updated occasionally to incorporate new metric design information and metric product manufacturers.

Benefits Of Metric

International Acceptance

U.S. industrial firms have sometimes been excluded from dealing in international markets because they are unable to deliver goods measured in metric terms. Others are increasingly unwilling to overcome this hurdle to utilize our products. U.S. firms in many cases then have to produce two sizes of a particular product.

U.S. firms will enjoy enhanced export potential by conducting business in the international language of measurement. Many companies have taken the initiative to understand foreign markets and become fluent in metric.

Simplicity

Metric is decimal-based, and therefore simpler and faster to use. Trying to multiply 27 feet, 8-5/8 inches, by 32 feet, 6-7/16 inches, to obtain area demonstrates the complexity of our current system. English dimensions have to be converted to be added or multiplied, while metric ones do not.

The Canadian Construction Association reports that metric produced direct benefits, in terms of reductions in design costs and time, increased efficiencies in construction operations, and improved material and component dimensioning techniques, when commercial construction in Canada switched to the metric system years ago.

The U.S. Government in its own operations could expect the same advantages as stated in Pub. L. 100-418.

Product Variations

Many organizations and some businesses have viewed metric conversion as an opportunity, and simultaneously selected fewer standard product sizes, reducing inventories and required manufacturing equipment. This opportunity exists with us as well.

One Unit For Each Property

The metric system simplifies building engineering by using only one unit for each physical property. Examples:

Pressure. While the English system has pounds per square inch (psi), pounds per square foot (psf), tons per square foot (tons/SF), inches of water (inH₂O), inches of mercury (inHg), and kips/SF, the SI metric system has only one pressure unit, the pascal (Pa). If more than 1 000 Pa are present, the kilopascal (kPa) is used. If more than 1 000 000 Pa, the Megapascal (MPa).

Power. The English system has watts (W), British thermal units (Btu's), horsepower (hp), tons, boiler hp, and other units. SI uses only W, kilowatts (kW), or milliwatts (mW), depending on the size of the number. An example of metric simplicity:

If an additional light fixture produces 600 W of heat, how many additional Btu's of cooling are needed to prevent a room temperature rise? Exactly how much will this add to system requirements? This must be calculated when using English units.

In SI, all thermal power units are measured in W.

The fixture produces 600 W, so the net system capacity must increase by 600W.

Standards

See *Standard for Metric Practice* (ASTM E380), *SI Guide for HVAC & R* (ASHRAE), and *Handbook of Fundamentals* (ASHRAE) for accepted units and conversion tables.

Summary

The American construction community is able to meet the metric conversion challenge in Federal construction, and it is in our long-term strategic interest to do so. There will be some initial effort involved, but close cooperation between the public and private sector will allow the goals to be successfully met.

Metric Project Definition

A project is "metric" when:

- Specifications show SI units only.
- Drawings show SI units only.
- Construction takes place in SI units only.
- Inspection occurs in SI units only.

This does not imply that building products change. Over 95 percent of the products used in building construction today will undergo no physical change in metric construction. Dimensions of products will be identified in drawings, specifications, and product literature in metric units. These products will be spaced or cut in the factory or field to round metric dimensions

There are a few *products* that can be purchased in a slightly different size in order to be efficiently used in metric construction. This is generally called *hard* conversion. GSA will call all products round-numbered products whether they are manufactured in a different size or cut to size later. Spacing of materials such as stud spacing or floor-to-floor height or field-cutting materials to length should never be considered *hard* but merely round numbers. As international standards are developed, other products may be manufactured in round sizes to enhance their market potential.

Dual Dimensions

Dual-dimensioning is a wasted effort. When English measurements are present, U.S. readers will use them and ignore the metric measurement. A project that is round in one measurement system will be unround in the other, and therefore more difficult to design and particularly build in the other system.

Summary

It is important that drawings and specifications be metric exclusively. Most dimensions, particularly linear ones, should be round to avoid seriously impacting the largest cost component of a construction project, which is field labor.

Round Metric Dimensions

Over 95 percent of currently used building products will not be sized differently in metric construction. Product literature and engineering data on these products should be requested with metric dimensions.

Product literature may contain both metric and English dimensions. Since product literature costs can be substantial, firms without metric product literature need only develop a supplement to their existing literature. Supplements will be accepted as submittals for an interim period.

In the future, as standard international metric product sizes are developed by the International Standards Organization (ISO) or another standards organization, more products may undergo modification to be compatible in the world market.

Listed below are examples of standard products that can be utilized on a metric project today.

Architectural

- Carpeting.
- Door hardware.
- Elevators and escalators.
- Filing and shelving units.
- Kitchen equipment.
- Landscaping products.
- Lavatory units.
- Paint products.
- Resilient base.
- Revolving entrance doors.
- Roofing membranes.
- Systems furniture.
- Toilets.
- Toilet partitions.
- Vertical blinds.

Civil

- Caisson forms.
- Reinforced concrete pipe.

Structural

- Steel deck.
- Structural steel shapes.

Mechanical

- Air handling units.
- Boilers.
- Chillers.
- Fan coil units.
- Pumps of any type.
- Heating, ventilating, and air-conditioning (HVAC) control systems.
- Pipe.
- Plumbing fixtures.
- Pumps.
- Valves.

Electrical

- Cable trays.
- Conduit.
- Copper wire sizes (eventually metric sizes may be used).
- Fiber optic cables.
- Fire alarm systems and components.
- Junction boxes.
- Motors.
- Panelboards.
- Receptacles.
- Switches.
- Switchgear.
- Transformers.
- Underfloor duct systems.
- UPS systems.

Custom Products

Custom products may be specified in any size. These products are made to fit a specific project in any measurement system and may therefore be specified in round metric sizes. Specific firms which are able to make these products are listed later in this document. Examples:

- Aluminum curtainwall systems.
- Wood doors.
- Glass.
- Interior stonework.
- Precast facade systems.
- Metal ductwork.
- Windows.

Not all dimensions of custom products will change. For example, while the length and width of curtainwall panels can be specified in round metric sizes, the cross-section of the extrusion does not need to change for construction. The dimensions of the cross-section can be a mathematical conversion or any number the industry decides to name the product. This also applies to window systems or ceiling grid systems where length and width or height are critical and the section dimensions are not.

Modular Products

Modular products may be slightly different sizes in metric projects. The size of the product has been modified in order to be efficiently utilized in a metric project. A handful of currently used building products may undergo *hard* conversion to fit a round metric project.

Examples of products that may be physically changed:

- Suspended ceiling tiles and grids.
- Fluorescent lighting fixtures (lay-in type only).
- Air diffusers and grilles (lay-in type only).
- Brick and CMU (see *Architectural/Masonry* for contractor options).
- Drywall. (see *Architectural/General* section for contractor options).
- Raised access flooring.

Drawings

SI drawings preferably use only millimeters (mm) to avoid fractions and to eliminate the repetitious suffix. The following note on drawings will avoid confusion: "ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED."

Decimal mm (such as: 2 034.5) are not required on SI drawings unless a high precision part or product thickness is being detailed. A whole number such as: 2 035 is adequate.

Dual dimensions should not be used.

Shop drawings or catalog data using the same dimensions as on contract documents will avoid errors in translation.

Space Between Groups. A space separating groups of three digits on drawing dimensions will allow faster and more accurate dimensional interpretation.

Example: A 20 meter dimension can be shown as 20 000.

Scales. American Institute of Architects (AIA) preferred metric scales, all multiples of 1, 2, or 5. See *Graphic Standards* for other scale information.

<u>Metric</u>	<u>Current</u>
1:2	1:2
1:5	3"-1'
1:10	-1/2"-1', 1"-1'
1:20	3/4"-1', 1/2"-1'
1:50	1/4"-1'
1:100	1/8"-1'
1:200	1/16"-1', 1"-20'
1:500	1/32"-1', 1"-40', 1"-50'
1:1 000	1"-80', 1"-100'

Sheet Sizes. While there are standard SI drawing sizes, any size may be used until new ones are issued through the usual supply process.

Specifications

Millimeters (mm)

SI specifications have used mm for almost all measurements, even large ones. Use of mm is consistent with dimensions in major codes, such as the National Building Code (Building Officials and Code Administrators International, Inc.) and the National Electric Code (National Fire Protection Association).

Use of mm leads to integers for all building dimensions and nearly all building product dimensions, so use of the decimal point is almost completely eliminated. Even if some large dimensions seem to have many digits there still will usually be fewer pencil or CAD strokes than conventional English Dimensioning

Meters (m)

Meters have been used where large, round metric sizes are meant or where it is already customary, such as in surveying.

Example: "Contractor will be provided an area of 5 by 20 meters for storage of materials."

Centimeters (cm)

Centimeters are typically not used in U.S. specifications. This is consistent with the recommendations of AIA and the American Society of Testing Materials (ASTM). Centimeters are not used in major codes.

Use of centimeters leads to extensive usage of decimal points and confusion to new readers. Whole millimeters are being used for specification measurements, unless extreme precision is being indicated. A credit card is about 1 mm thick.

Example 1 - Mortar Joint Thickness. If a 3/8-inch mortar joint between brick is needed, this would convert to 9.525 mm. Whole mm are used. Specify 10 mm joint thickness.

Example 2 - Stainless Steel Thickness. Bath accessories are commonly made from 22-gage (0.034-inch) thick stainless steel. Exact conversion is 0.8636 mm. This is

a precision measurement. However, since gage is a name and not a dimension, it is acceptable to use 22-gage on metric drawings and specifications until an industry converts sizes.

Rounding and Conversion

Simple Mathematical Rounding . This leads to many problems. An example is to take an existing criteria dimension, such as 12 feet, convert it mathematically to 3 658 mm, and use this dimension. Builders, faced with entire drawing sets of awkward, nonrounded numbers, will find that metric is more difficult. In projects to date, a number of builders converted back to be able to measure with English tapes. They also made conversion mistakes, causing rebuilding and delay. It is very important to make job site labor more efficient by professionally rounding dimensions.

Professional Rounding . This technique takes the result of simple mathematical rounding, and applies professional judgment. The basic module of metric design is 100 mm.

Following are two examples of professional judgment in rounding design criteria that have already been included in GSA metric criteria in the *Facilities Standards for the Public Buildings Service (PBS-PQ100.1)*:

Example 1: Conversion of a code requirement.

Step 1. Determine the nonoffending direction.

1993 National Building Code Article 1011.3 requires 44 inches (1 118 mm) of unobstructed pedestrian corridor width. However, 1 118 mm is not a round number. It should be rounded to facilitate the cleanest construction possible. Narrower doesn't meet the code. The nonoffending direction is larger.

Step 2. Select the largest feasible module.

- 1 200 mm is feasible, so this represents a choice however GSA corridors are usually above code minimums. 1 500 may be more like current usage.
- Every effort should be made to keep design dimensions in increments of 100 mm.

In each case, the user must determine the acceptable choice, but the user is encouraged to present clean, rounded metric dimensions as alternatives. Simple mathematically converted dimensions will lead to an increase in project cost and time.

Example 2: Conversion of an existing design practice.

Professional rounding used when converting conventional design dimensions.

Ceiling Height. A common office ceiling height is 9 feet. Simple mathematical conversion yields 2 743 mm. This is an awkward dimension and can decrease productivity in use. Since this is above code requirements, there is no close minimum requirement.

Step 1. Determine the metric design tolerance.

If, instead of 9 feet, the installed height varies by a few inches, the visual and technical requirements will still be met and cannot be detected by casual observation. This variation in actual height becomes a "design tolerance." The selection of design tolerance is a professional judgment.

Step 2. Determine the acceptable design range.

A range is a simple mathematical conversion, such as 2 743, plus and minus 50 mm. Acceptable design range becomes 2 693 to 2 793.

Step 3. Select a preferred dimension.

2 700 and 2 800 are within an acceptable design range. 2 700 will cost less than 2 800 and is usually given first priority.

Example: Some roof flashing systems require fasteners at a minimum 24 inches on center, which mathematically converts to 609.6 mm. More fasteners would probably be acceptable at a slight increase in material cost. Selection of equivalent distance yields 600, which will be easier to install.

Architectural/General

Module

New GSA office building construction should use a 600 mm planning module. This is the closest to the common 24-inch module and products are made this size. See page 3-19 of the metric version of PBS-PQ100.1

Drywall

Major drywall manufacturers currently offer round metric sizes in minimum order quantities. Only sheet length and width are classified in round metric. Standard sheet width is 1 200 mm. Lengths are available in 2 400 mm and several longer sizes. Thicknesses remain the same to minimize code impact. Standard thicknesses are 12.7 mm and 15.9 mm. Some architects are showing these as 13 and 16mm on drawings. Standard stud spacing is 400 mm, as it is the closest to 16 inches and is an even multiple of the sheet size. If drywall is installed horizontally across studs then the contractor could purchase drywall with the vertical dimension in a converted English size so only the length is round metric. This may widen the availability in smaller purchases.

Since a minimum order quantity can be significant, its use must be evaluated for each project. Currently this may be as high as a truckload, or about 700, of 1 200 by 2 400 sheets.) If minimum quantities will not be satisfied, then English-size drywall as shown above can be used and cut even though the project is metric, as is done in Canada. *These decisions can be left to the marketplace to determine by specifying stud spacing and drywall thickness but not length and width.*

Doors

A common metric door size is 900 by 2 100 mm. This may be used on metric projects where other project specific design criteria are satisfied. Door thicknesses will remain the same, being identified by the nominal mm equivalent such as 45. A 950 by 2 150 door size is used in Canada as it matches metric block coursing.

Ceiling Systems

Manufacturers make round-metric-size tiles and grids for use in metric projects. The most common sizes are 600 by 600, and 600 by 1 200 mm.

Architectural/Masonry

Masonry walls have a critical wall thickness for fire resistance and compressive strength. They also are never relocated after construction. Beyond this, it is not important what dimension the height and width of a masonry unit is except for appearance, ability to accommodate metric window and door openings, having even coursing for ties and round dimensions between openings for ease of builder measurement, and weight of the unit for lifting. Project requirements then should be limited to these factors, with total competitive pricing determining the dimensioning. It should be noted that there are a number of proprietary, nonmortar joint, concrete block systems using English measurements, with builder labor advantages, that also require a local manufacturer to have different molds for concrete masonry units, as do metric units.

Brick

The "metric modular brick" is the most common. Its size is 90 by 57 by 190mm (3-9/16 by 2-1/4 by 7-1/2 inches). American modular brick is:

- 3-5/8 by 2-1/4 by 7-5/8 inches (92 by 57 by 194 mm) when 3/8-inch joint is used.
- 3-1/2 by 2-3/16 by 7-1/2 inches (89 by 56 by 190 mm) when 1/2-inch joint is used.

The standard American modular brick used with a 1/2-inch joint is so close to the metric modular brick that it can be used with only a slight variation in joint thickness during field installation. Three vertical courses of metric modular brick with 10 mm joints equals 201 mm, which is rounded to 200.

Other sizes of metric brick are identified in *Graphic Standards*.

Block

A standard American "8-inch" block is 194 by 194 by 397 mm for use with mortar joints. A nonmortar joint stacking block is usually 203 by 203 by 406 mm. GSA has used 190 by 190 by 390 mm metric blocks on some projects, which is the size that companies shown in the *Product Information* section responded to. The National Concrete Masonry Association may set a size standard in the future.

Architectural/Sheet Metal

Most specification references use gage number followed by the decimal inch thickness.

Example: 22 gage (0.034 inch).

Use current standard sheet thicknesses. Show only the gage number on metric documents until a metric standard is developed.

Example of usage: Provide grab bar with a minimum wall thickness of 18 gage (0.051 inch). Replace with: Provide grab bar with minimum wall thickness of 18 gage.

Civil/Surveying

The two primary Federal agencies involved in the production of survey information for public use are the National Geodetic Survey (NGS) and the U.S. Geological Survey (USGS). The databases for these two agencies are metric.

NGS, which maintains a database of hundreds of thousands of horizontal and vertical survey control points on which U.S. surveys are based, has been metric since 1983. USGS, which produces topographic maps of terrain elevations, has digitally mapped the U.S. surface. The ground distance between each pair of digitized points is 30 meters. Survey and mapping data necessary to do metric design and construction in the United States are available. Most states have adopted metric in their state plane coordinate systems.

The following information has been used on site plans and topographic maps.

Contour intervals utilize either 1.000, 0.500, or 0.250 m as contour intervals, depending on site slope.

Elevation measurements are given in m.

Benchmark elevations are converted from feet to m.

Examples:

Benchmark is 314.15 feet. Convert to 95.753m.

Sample Contour Lines:

———— 106.0 ————
———— 105.5 ————

Civil/Concrete

Concrete strength is specified in MPa. The following strengths, which are used in Canada, may be used in metric construction. It is a good practice to use round numbers so that additional accuracy over English designations is not implied. The general purpose concrete strengths are reduced from six strengths to four strengths. Strengths above 35 MPa can be specified in 5 MPa intervals (40, 45, 50, 55, etc.). ACI 318 M, which is the metric version, is now used as a standard.

<i>Previous psi</i>	<i>Conversion MPa</i>	<i>Exact Specify MPa</i>	
2 500	17.23	20	
3 000 below)		20.67	20 or 25 (See note)
3 500	24.12	25	
4 000	27.56	30	
4 500	31.01	35	
5 000	34.45	35	

Note: If code requires 3 000 psi, then 25 MPa must be used; otherwise, it is a professional judgment on 20 or 25.

Civil/Reinforcement

Metric projects have used ASTM A615M reinforcing bars for general purpose applications. The M after A615 indicates a metric specification. A615M reinforcing bar comes in Grades 300 and 400, indicating 300 and 400 MPa yield strength.

There are 8 bar sizes, which replace the 11 English bar sizes. The Concrete Reinforcing Steel Institute (CRSI) is requesting that ASTM develop a new metric standard as the existing one uses bar numbers that are neither the bar diameter nor the overall diameter. The existing metric standard is merely different, it was never a true *hard* dimensioned product. Project managers are advised to check with the State Department of Transportation in their area to see what they are currently specifying as highways use proportionally more of this product than buildings.

While many firms can make metric rebar, and there are fewer sizes to evaluate and install, minimum order quantities apply. Canadians add M after each bar size to avoid confusion with larger English sizes.

<i>Nominal Diameter (mm)</i>	<i>Actual Diameter (mm)</i>	<i>Cross- Section Area (mm)</i>
10	11.3	100
15	16.0	200
20	19.5	300
25	25.2	500
30	29.9	700
35	35.7	1 000
45	43.7	1 500
55	56.4	2 500

Some applications may need A616M, A617M, A706M, or A775M.

Structural/General

There are three world steel shape standards:

- ASTM A6/A6M (American).
- Japanese Industrial Standard (JIS).
- *Deutsches Institut fuer Normung (DIN)* (German).

A fourth is the BI, or British Imperial. None is dominant worldwide, but each is used extensively. There is no international standard issued by ISO, the official international group that develops worldwide standards.

An ISO standard is currently undergoing development, and will probably involve selection of shapes from the three primary world standards, coupled with elimination of redundant shapes.

Metric Projects

Since no international trend exists on standardization of steel shapes, the American Institute of Steel Construction (AISC) recommends that metric projects use the same steel shapes currently used, but use the metric dimensions listed in ASTM A6/A6M. A6/A6M lists both inch and mm dimensions of shapes. All load and resistance factor design (LRFD) property, shape, and specification design data are available in metric from AISC for A6/A6M steel shapes. (Phone orders: AISC, Chicago, IL, 312-670-5414.)

Structural calculations done in metric are easier to review and have a lower probability of error.

Fasteners

ASTM A325M and A490M are standards for structural metric bolts. There are seven standard metric bolt sizes, which replace the nine bolts currently used. Standard sizes are 16, 20, 22, 24, 27, 30, and 36 mm. Many manufactured products now use metric fasteners either in part or for all of a product. There are hundreds of firms making metric fasteners, screws, and bolts

Structural/Floorload

Calculations are in kPa, but floorloading can be in kilograms (kg) per square meter because many dead and live loads are given in kg.

The following chart gives kPa strength ratings that can be used to replace the psf strength rating and not imply a greater accuracy:

<i>Previous (psf)</i>	<i>New (kPa)</i>	<i>Percent Stronger</i>
50	2.5	4.4
80	4	1.8*
100	5	4.4
120	6	4.4
150	7.5	4.4
200	10	4.4
250	12	0.2
300	15	4.4
350	17	1.4
400	20	4.4
450	22	2.1
500	24	0.2

*GSA office floor standard, *PBS-PQ100.1*.

Mechanical/General

Temperature

Celsius is used for temperature designations in new or modernization building projects. Renovation projects where the entire mechanical system is not to be changed may retain Fahrenheit.

All major manufacturers of HVAC control systems offer products in Celsius.

Air Distribution

Many manufacturers of diffusers and registers indicate they currently offer sizes to fit a round metric ceiling grid.

Ductwork

Rectangular metal ductwork is a custom-made product. Typically, English-dimensioned ductwork is only shown to the nearest 2-inch increment. Round metric sizes are easier to measure (*example*: 300 by 600 mm) on a metric project. Prefabricated flexible round duct is specified in converted sizes.

Units. See the ASHRAE SI Guide.

Mechanical/Pipe

Steel pipe and copper tube sizes will not now change. American sizes are used in many parts of the world and should be designated by nominal mm size. *Hard* metric pipe size may be used in the future. ASTM B88M, which gives standard hard metric copper tube sizes, will not be used until ample product availability can be established.

During transition to metric the following should be on at least the mechanical first sheet:

"ALL SIZES ARE INDUSTRY STANDARD ASTM A53 PIPE AND ASTM B88 TUBE DESIGNATED BY THEIR NOMINAL MILLIMETER (mm) DIAMETER EQUIVALENT. SEE CHART BELOW."

<i>Nominal Size</i>	
<i>Inch</i>	<i>mm</i>
1/2	15
3/4	20
1	25
1-1/4	32
1-1/2	40
2	50
2-1/2	65
3	80
3-1/2	90
4	100
5	125
6	150
8	200
10	250
12	300

Electrical/General

Conduit will not now change size in metric. It will be classified by a nominal mm size. During transition to metric the following should be placed on at least the first electrical sheet. These are NEMA standards.

"ALL CONDUIT SIZES ARE INDUSTRY STANDARD ENGLISH SIZE CONDUIT DESIGNATED BY THEIR ROUNDED NOMINAL MILLIMETER (mm) DIAMETER EQUIVALENT. SEE CHART BELOW."

<i>Nominal Size</i>	
<i>Inch</i>	<i>mm</i>
1/2	16
3/4	21
1	27
1-1/4	35
1-1/2	41
2	53
2-1/2	63
3	78
3-1/2	91
4	103
5	129
6	155

Wire Size

Use AWG or MCM until availability of wire manufactured to ASTM B682, standard metric conductor sizes, is determined. Round metric sizes per the above standard are substantially larger than round English sizes in secondary circuit use. Fiber optic cables are already metric.

Lighting Fixtures

Round metric lay-in type fixture sizes are used when using a round-metric-sized ceiling grid. Many domestic manufacturers currently manufacture or can produce round metric sizes of 600 by 600 mm and 600 by 1 200 mm. The 600 by 600 mm size with sockets on one end is easier to manufacture in metric and may have more competition.

See PBS-PQ100.1 for GSA criteria for general ceiling lighting, including life-cycle cost requirements. Caution must be used to not take an older design and merely round off fixture dimensions or spacing because new energy requirements may substantially change a lighting layout from previous ones.

American manufacturers have produced metric fixtures either by modifying existing production machinery or they already had machinery that was specifically made for the metric market. To date, metric fixtures are being sold, in building quantities, at the same price as English sized fixtures.

Some manufacturers, even those who have competitively sold metric fixtures, claim that their costs are higher for metric production. Sources and costs of these products should be checked before requesting a project bid or proposal. Spare building fixtures for *Property Management* replacements beyond the *Initial Space Alteration* should also be considered to extend the time required before small purchases are needed.

Product Information

This directory lists domestic manufacturers of commercial building products in one of the following classes:

- Manufacturers who make products that will not change size during metric conversion, but have developed product literature with metric dimensions in it.
- Manufacturers who currently manufacture or can manufacture round metric product sizes.

Each section will identify if the product being discussed is a converted odd dimension product or a round metric product size. All building products in this directory are made in the United States. Firms interested in being included in this directory may do so by contacting the Construction Metrication Council of the National Institute of Building Sciences, 1201 L Street, NW., Washington, DC 20005.

Air Diffusers and Grilles

Lay-in air distribution grilles and diffusers use round metric sizes. Those that are wall mounted or ceiling mounted in drywall or cut in tile may use converted dimensions. Many companies making metric sizes simply modify their existing product.

Example:

- The actual width of a nominal 24- by 24-inch (610 by 610 mm) diffuser is usually about 23-3/4 inch (604 mm).
- To produce the same product for a nominal 600 by 600 grid, each edge must be slightly shorter, or about 590 mm (23-1/4 inch).

The following manufacturers can make round metric sizes for layin type applications.

- Acutherm, Emeryville, CA, a manufacturer of variable air volume air distribution devices, can manufacture its products in round metric sizes (Jim Kline, 510-428-1064).
- Aireguide, Hialeah, FL, a large manufacturer of air distribution products, can make 80 to 90 percent of its products in round metric sizes (Daryl Gray, 305-888-1631).

- Carnes, Verona, WI, one of the larger manufacturers of air distribution products, regularly makes round metric sizes (Dick Laughlin, 608-845-6411).
- Donco Air Products, Albion, IA, a small fixture manufacturer but a major manufacturer of light troffer diffusers, can manufacture light troffer, slot, and layin diffusers in round metric sizes up to 1 500 mm length (Ron Jansen/Marc Vandegrift, Engineering, 515488-2211).
- Duralast, New Orleans, LA, can make its primary diffuser product in a 600 by 600 mm variation (Ron Vinson (distributor), 504-837-2346).
- J & J Register, El Paso, TX, can make round metric sizes (Chris Smith, 915-852-9111).
- Juniper Industries, Middle Valley, NY, has previously made and can currently produce metric-size diffusers and grilles (Steve Liebermann, 718-326-2546).
- Krueger, Inc., Tucson, AZ, a large manufacturer of grilles and diffusers, has the capability to manufacture round metric sizes (Steve Bowser, 602-622-7601).
- Reliable Metal Products, Geneva, AL, a subsidiary of Hart & Cooley, is a medium-size manufacturer of air distribution products and can make about 90 percent of its products in round metric sizes (John Bowers, 205-684-3621).
- Rock Island Register, Rock Island, IL, can make its standard product, a 2- by 2-foot diffuser, in a 600 by 600 mm size (John Howarth, 309-788-5611).
- Sommerville Metalcraft, Cranfordsville, IL, can produce grilles and diffusers in round metric sizes (Paul Moehling, 800-654-3124).
- Thermo Kinetics, Greenville, SC, can make its standard grilles and diffusers in round metric sizes (Terry Rutledge, 803-277-8080).
- Titus Products, Richardson, TX, a major manufacturer of air distribution grilles and products, indicates a number of products currently available in round metric sizes (Dave Loren, 214-699-1030).

Carpet

Although a few companies can make round-metric-size carpet tiles, this material may be procured by specifying other salient characteristics and allowing the competitive process to determine sizes, since all carpeting, tiles, and roll goods are cut at boundaries.

Curtainwall Systems

Curtainwall systems are obtainable in round metric sizes. Length and width of the panels are available in any size. The other dimensions are typically in converted metric.

- Kalwell Corporation, Manchester, NH, is able to produce any size metric curtainwall system (Bruce Keller, 800-258-9777).
- Kawneer Company, Norcross, GA, has been supplying curtainwall systems in metric units to foreign markets and can handle any metric order (Enrique Morales/Edward Bugg, 703-433-2711).
- Profile Systems, Gerald, MO, subsidiary of the Maune Company, can produce in any size (Grant Maune, 800-962-8100).

Doors

Domestic manufacturers produce hollow metal doors and wooden doors in any length and width desired. Round metric sizes can therefore be specified. Some firms producing round metric metal doors:

- Allied Steel Products, FL (Bill Desin, 305-624-3333).
- American Steel Products, Farmingdale, NY, can make any size metric door (Hank, 516-293-7100).
- Amweld Building Products, OH, has made and can make metric sizes (Mike Scott/Fred Bloom Jr., 216-527-4385).
- Ceco Door Division, Oak Brook, IL, a major manufacturer in the door industry, can make any round-metric-size door (Norb Bruzan, 312-242-2000).

- Duolock, Portland, OR, a division of Alumax, a major U.S. manufacturer of aluminum products, can make any size metric door (Clem Grant, 800-678-0566).
- SW Fleming, CA, MA, PA, SC (William Strong, 800-263-7515).
- Howard Industries, FL, has made and can make metric sizes (Bob Voigt/Joe Sixto, 305-888-1521).
- Republic Builders Products, TN (Jim Jackson, 901-352-3383).
- Steelcraft Manufacturing Company, OH, has been making metric sizes for export (Bill Ball/Claude Frederick, 513-745-6400).
- Tex Steel Corporation, TX (George Maldonado, 512-423-0912).

Firms producing round-metric-size wood doors:

- Eagle Plywood and Door Manufacturing, NJ (Tony Shiffano, 908-769-7650).
- Marlite, OH (Donald Sweitzer, 216-343-6621).
- Michigan Birch Door, MI, with a minimum of six doors (Roger Eger, 313-949-2020).
- Mohawk Flush Doors, PA (Don Enigk, 717-473-3557).
- Vancouver Door, WA (Gary Geppert, 206-845-9581).

Drywall

The largest drywall manufacturers either actively sell metric-size drywall or have the capability to produce it. Standard metric drywall width is 1 200 mm. Lengths are available in any size. Thicknesses are 12.7 and 15.9 mm, which correspond to English sizes. Minimum order quantities apply, but are typically about a truckload, or 700 sheets.

- Celotex, FL (George Mitchel, 813-873-4027).
- Centex American Gypsum (Lex Dominey, 800-545-6302).
- Domtar Gypsum, MI (Jim Hanser/George Shortreed, 313930-4700).

- Georgia Pacific, GA (Bronwyn Dawkins, 404-521-4000).
- James Hardie Gypsum, NV (Todd Thomas, 310-787-6950/Alex Beaman, 800995-0950 x210).
- Temple Inland (Jim Rush, 800-231-6060).
- USG Interiors International, Chicago, IL (William Nelson, 312-606-5383/David Vanosdall, 312-606-3804).

Elevators

All U.S. manufacturers can provide data and drawings in metric. Some product lines are produced in round metric dimensions

HVAC Controls

All of the major manufacturers of HVAC controls currently offer products that will operate in Celsius. Some of those firms are:

- Johnson Controls.
- Barber Coleman.
- Robertshaw.
- Andover.
- Honeywell.

Contact your local representative for ordering information.

Lighting Fixtures

When a round metric 600 by 600 or 600 by 1 200 ceiling grid is installed, round metric lay-in type fixture sizes must match. Many fixture manufacturers currently produce or can produce both modular metric sizes and still utilize currently used standard bulb sizes. When other than a lay-in type of lighting fixture is used in a project, then size is not critical and can be specified as an approximate size as in other equipment. The following companies produce both 600 by 600 and 600 by 1 200 fixtures unless otherwise noted.

- American Fluorescent, IL, supplies fixtures in orders of at least 500 fixtures (Gary Stabelfeldt, 708-249-5970).

- Bieber Lighting Corporation, CA, supplies fixtures in orders of at least 50 fixtures (Bob Bieber, 800-243-2375/213-776-4744).
- C. W. Cole and Co., CA, supplies fixtures in orders of at least 20 fixtures (Frank Dayley/Jose Lopez, 818-443-2473).
- Day-O-Lite Manufacturing, RI, supplies fixtures with no minimum stated (Arthur Goldstein, 401-467-8232).
- Hasco Electric Corp., CT, supplies fixtures in orders of at least 20 (Anthony Vabaro, 203-531-9400).
- Holcor, IL, supplies fixtures in orders of 5 to 10 fixtures (Mark Nelson/Kathy Dykstra, 312-376-9780).
- Holophane, OH, supplies fixtures in orders of at least 100 fixtures (Bob Catone, 614-345-9631).
- Louisville Lamp, KY, supplies fixtures with no minimum stated (Mike Davidson, 502-964-4094).
- Lumispec, PA, supplies in orders of at least 30 fixtures (Eric Papougenis, 215-228-3830).
- Mark Lighting, NJ, supplies fixtures in orders of at least 50 fixtures (George Miller, 201-939-0880).
- Midwest Chandelier, KS, supplies in 600 by 1 200 size, in orders of at least 50 fixtures (Tom Lefkovitz/Doug Pasternak, 913-281-1100).
- Prudential Lighting, CA, supplies lensed fixtures only in orders of at least 75 fixtures (Tammy Swaim, 213-746-0360).
- Simkar Lighting, PA, supplies fixtures but has a premium on orders of less than 20 fixtures (Robert McCully, 215-831-7700).
- Solar Kinetics, TX, supplies fixtures with no stated minimum (Sandy McCrea, 214-556-2376).
- Thomas Industries Day-Bright, MS (Joe Kolarik, 601-842-7212).

- USI/Columbia Lighting, WA, supplies fixtures with no stated minimum, but is a large company (Mark Johnson/Fred Smith, 509-924-7000).
- Wellmade Metal Products, CA, supplies fixtures in orders of at least 100 (Bernie Shane, 510-562-1878).

Masonry

Many companies can make metric brick and block sizes. Unless otherwise stated, there will generally be lead time and cost impact on this product.

- Adams Products, NC, can make metric block (several hundred block orders are acceptable) (Buddy Ray, 919-467-2218/Cheryl Gaw, 919-488-4120/Betty Hughes, 919-523-5136).
- Amcor Block, UT, can make metric block (Gayland Smith, 801-295-5470).
- Basalite, CA, can supply (Jim Mayer, 916-678-1901).
- Betco Block is supplying metric block to GSA (minimum order is 150 m³) (MD, Scott Harper, 301-654-2312/NY, Steve Nagel, 518-756-2125/VA, Robert Carmody, 703-591-2770).
- Buehner Block, UT, can supply metric block (Ron Hoffmann/Kent Mortensen, 801-467-5456).
- Burns and Russell, MD (Michelle McVey, 800-638-3188).
- Clarkes Block, GA, can supply (L.E. Wells, 912-234-3436).
- Colorado Concrete Manufacturing, CO, can supply metric block (Karl Dolder/Thor Kaumeyer, (303- 390-5477).
- Concrete Mold Components, CA, can supply molds (Maurice Alhadeff, 213-636-7534).
- Dagostino Building Blocks, NY (Ken Dagostino, 518-374-3116).
- Elco, PA, can produce metric block. Several hundred block orders acceptable (William Albright, 717-274-3661).

- Featherlight Building Products, TX, can produce metric block (Wade Albritton/H.V. Moss, 512-472-2424).
- Gorla Enterprises, NC, can make metric block (Ken Mayo, 919-375-5821).
- Grand Blanc Cement, MI, can supply metric block and metric molds, all shapes (Michael Hicks/Ron Hunt, 800-875-7500).
- Hagerstown Block, MD, can make metric block (301-733-3510).
- E.P. Henry, NJ, can supply hard metric block (Stephen Reale/Mariane Anzaldo, 609-845-6200).
- Adolph Jandris, MA (Tony Raila, 508-632-0089).
- Jewell Concrete Products, TX, can make metric block. Several hundred block orders are acceptable (Walter Grisham, 817-772-3440/Tom Call, 903-592-0752).
- Marquart Block, IA, can supply hard metric block (John Thiele/Scott Shimp, 319-233-8421).
- Miller Materials, MO, can make metric block (several hundred block orders are acceptable) (Charles Kreutzer, 816-444-2244).
- Mission Masonry, CO, supplied metric block to the GSA Denver facility (303-841-6089).
- Phoenix, Inc., MD (John Cissel/Don Bowers, 301-698-4010).
- Plasticrete, CT (Joe Rescigno, 800-243-6934).
- Proudfoot Corporation, CT, has made metric molds in the past, can supply metric sizes (Michael Thompson/James Loseth, 203-459-0031).
- Reading Rock, Inc., OH (Stan Bass, 513-874-2345).
- Sherman International, AL (Dannie Rodgers, 205-252-6900).
- Southern Brick & Block, VA (Ron Peters, 804-353-6681).

- Superlite Block, AZ. Several hundred block orders acceptable (John Graves, 602-352-3500).
- Trenwyth Industries, PA, makes many metric block sizes (Linda Adcock 800-233-1924).
- Tricon Enterprises, MA (Monica Maracaccio, 508-697-6112).
- Glen Gery Corporation, Wyomissing, PA, can make metric modular brick (Ron Hunsicker, Baltimore, 301-837-3170).
- Ochs Brick and Tile, Springfield, MN, can make metric modular brick (Rod Schutt, Plant Manager, 612-944-1450/Bob Larson, Sales Manager, 612-944-1450).
- U.S. Brick, Streetsville, Ontario, has 12 plants in the United States that can make metric modular brick (Ron Spencer, 416-821-8800 (Ontario)).

Since there are many U.S. brick and block manufacturers, check with your usual supplier to see if they can make the metric modular brick.

Plywood

- Amer-Ply, NJ, can supply metric sheets. No minimum order quantity (Mr. Matthew, 908-352-8111).
- Boise-Cascade, ID, has made metric before, can supply metric (Jan Blechschmidt, 206-572-8300).
- Champion International, WA, makes metric sheet sizes and thicknesses. Metric available for underlayment, sheathing, and sanded products. Metric concrete form panels can be ordered. Minimum order is one truckload (Jim DiStefano, 206-572-8300 (form panels)/Steve Williams, 206-572-8300 (plywood, western)/Jim Clark, TN, 901-731-4550 (plywood, southern)).
- Furman Lumber, MA, can supply metric from their usual suppliers (Chris Hemingway, 508-670-3800/Offices: CT, FL, GA, MD, NJ, NY, PA, TX, VA).

- Multnomah, OR, can supply 50 - 100 piece orders (Paul Brooks/Anne Snyder, 503-297-4738).
- Murphy Plywood OR, can make metric plywood (John Murphy/Mark Gryziec, 503-459-3225).
- Oregon Strand Board, OR, can make metric engineering panels, similar to plywood, at no additional cost. Minimum order is one truckload (Joe Maliszewski, 503-466-5177).
- Potlatch, WA, has exported metric, can make metric sizes (C. D. Whitney/Mac Ryerse, 509-328-0930).
- Roseburg Forest Products, OR, makes 6 - 19 mm thick plywood, can make metric sheets. Makes other metric wood building products. Minimum order is one truckload (Dave Adams/Kevin Barry, 503-679-3311).
- Stone Forest Industries, OR, currently produces both metric dimensional and thickness plywood. This firm could produce about two pressloads (about 60 sheets) minimum order but premiums would apply to small orders of this size (Lain Osborn/Tom Clow, 800-541-6906).
- Vancouver Standard has made metric sizes, can make metric sizes. Generally makes AC and higher grade (Ken Trimbell/Bill Sparks, 800-367-0038).

Raised Access Flooring

- C-TEC, Inc., Grand Rapids, MI, makes a 600 by 600 mm access flooring product line called the Metric Panel (Don Heeney, 616-243-2211).
- Interstitial Systems, Oakbrook, IL, currently manufactures a 600 by 600 mm raised floor system (Bill Collier, 708-691-8600).
- Tate Access Floors, Inc, Jessup, MD, currently produces a 600 by 600 mm access floor in light, medium, and heavy duty ratings. Generally, component unit prices are the same as English sizes (Lida Poole, 410-799-0123/Victor Sainato, 410-799-4200).
- USG Interiors/Donn, Chicago, IL, regularly makes metric access flooring in one of its four product lines (William E. Nelson 312-606-5358/David C. Vanosdall, 312606-3804).

Reinforcing Steel

- Atlantic Steel, GA (R.S. Mellum, 404-897-4505).
- Birmingham Steel, AL, produces metric bar in one plant and can produce it in IL, AL, and MS (Chuck James/Paul Corey, 800-677-1012; Robert Wilson/H.J. Hilton, 205-985-9290).
- Cascade Steel, OR (Glenn Peterson, 503-472-4181 x3307/Dennis Lauber).
- Florida Steel, FL, produces also in NC and TN; Don Ballard/Don Haney, 813-251-8811).
- New Jersey Steel, NJ, has made and can make metric bars (Gary Giovannetti/Elaine Skiba, 908-721-6600).
- North Star Steel, MN, has made and can make metric steel in both MN and IA (Michael Hanson, 612-688-1719/William Pepper, 612-731-5644).
- Nucor Steel, Plymouth, UT (R. Wayne Jones, 801-458-3961).
- Thomas Steel, IL, has and can make metric bar (Edward Koper/Jerry Wensel, 708-257-7701).

Steel Fabrication

Many firms have the capability of fabricating steel from metric design drawings. Some of these firms are:

- Falcon Steel, Wilmington, DE (302-571-0890).
- Havens Steel, Kansas City, MO (816-231-5724).
- Interstate Iron Works, White Horse, NJ (Robert Aberson, 908-534-6644).
- Lehigh Structural Steel, Lancaster, SC (803-286-5656).
- Montague-Betts, Lynchburg, VA (804-522-3331).
- Steelco Division, Metropolitan Steel, Sinking Spring, PA (Ron Keating, 215-678-6411).

Structural Bolts

Use metric bolt sizes in metric construction even though the steel sections are conversions. See *Structural/General* section. It is important in modern friction fittings in steel construction that bolts and holes use the same dimensioning system. Since the documents are metric, round metric avoids confusion. A benefit of using ASTM A615M sizes is that there is a reduction in the number of sizes of bolts, from nine to seven.

There are at least 20 firms that can make metric sizes. Minimum orders may be given in dollars (\$100), or by number (500) or by at least a keg. Where minimums exist they are in this range.

Suspended Ceiling Systems

Suspended ceiling systems use round metric size in full scale metric construction. Many manufacturers currently make these metric sizes.

- Armstrong World Industries, PA, currently manufactures and sells round-metric-size ceiling products. Except for selected specialty items, the major portion of the Armstrong product line has already been or can be manufactured in round metric dimensions (Dan Kennard, 717-396-2684/Deb Kantner, 717-396 3045).
- Capaul Architectural Acoustics, Plainfield, IL, a medium-sized manufacturer, can produce and bid round-metric-size projects (Tom Stanton, Baltimore MD, 410-234-0010).
- Celotex Corporation, Tampa, FL, offers an entire product line of round metric sizes (George Mitchell, 813-873-4027).
- Chicago Metallic Corp., Chicago, IL, produces round-metric-size grids (Craig Trotier, 800-323-7164).
- National Rolling Mills, Malvern, PA, regularly makes round metric sizes (Rich Mattion, 215-644-6700).
- USG Interiors, Chicago, IL, regularly makes round-metric-size ceiling systems. Starting in 1994, this company will show all its round metric products and prices in its catalogue (William E. Nelson, 312-606-5358/David C. Vanosdall, 312-606-3804).

Systems Furniture

Systems furniture manufacturers will not all convert to metric sizes immediately. Many companies export their English-dimensioned products to countries that construct buildings in metric. These products will need their dimensions identified in metric units in product literature for ease of layout. Listed below are some firms that have product literature with metric dimensions.

- GF Furniture Systems, Inc., Youngstown, OH, currently exports its English-size panels all over the world for use in metric construction. Product literature is available with metric dimensions (Don Detweiler, 216-533-7799).
- Herman Miller, Inc., Zeeland, MI, produces both English-size and round metric-size systems furniture. Standard round metric panels are 600, 800, 1 000, 1 200, and 1600 mm. Both the metric and the English sizes are sold outside the United States and utilized in metric construction. All Herman Miller production processes are in metric. Product literature is available with metric dimensions (Mark DeSchon, 616-772-3300).
- Steelcase, Grand Rapids, MI, currently exports its English-size products all over the world for use in metric construction. Product literature is available with metric dimensions (Ken Gilpin, 616-246-4990).

Tools

- Lufkin Tools, NC, produces metric tape measures (919-362-7511).
- Stanley Tools, New Britain, CT, manufactures metric and metric/English tape measures (Carl Lickwar/Alan G. Martin, 203-225-5111).
Model 32-158, Metric/English, 5 m/16 feet. Model 32-156, Metric, 5 m.
Model 33-428, Metric/English, 7.5 m/25 feet. Model 33-443, Metric, 10 m.
These can be ordered directly from Stanley or through your local hardware store.

Windows

Commercial window systems are available in round metric sizes. They are typically made specifically for a project in a wide range in small increments of size, so that they can be round metric even if the manufacturer does not call them metric..

- Alenco Commercial Group, Bryan, TX, makes aluminum metric windows primarily for export, and can make any size for domestic use (Harold Chilton, 409-823-6557).
- Andersen Windows, Commercial Group, Bayport, MN, currently fabricates windows in its one domestic plant and exports to several countries (Craig Johnson, 612-439-5150).
- Caradco, IL, can make any size round metric window (Roy Szyhowski, 217-893-4444).
- Desco Company, DeSmet, SD, can produce round metric sizes (Cindy Albrecht, 605-854-9126).
- Marmet Corporation, Wausau, WI, can make any size metric window (Brent Schepp, 715-845-5242).
- Marvin Windows, Warroad, MN, has previously manufactured and can produce windows in metric sizes (218-386-1430).
- Optimum Windows, Bronx, NY, can produce round metric sizes (Candido Perez, 212-991-0700).
- Peerless Commercial Window Division, Kansas City, MO, can make any size round metric window (Tony Grossi, 913-432-2232).
- Pella Windows, Pella, IA, can make any size metric window (Cheryl Waits, 515-628-1000).

General Information

Executive Order 12770 of July 25, 1991

(Federal Register/Vol. 56, No. 145/ Monday, July 29, 1991 / Presidential Documents, pp. 35801-3)

PRESIDENTIAL DOCUMENTS

Executive Order 12770 of July 25, 1991

Metric Usage in Federal Government Programs

By the authority vested in me as President by the Constitution and the laws of the United States of America, including the Metric Conversion Act of 1975, Public Law 94-168 (15 U.S.C. 205a *et seq.*) ("the Metric Conversion Act"), as amended by section 5164 of the Omnibus Trade and Competitiveness Act of 1988, Public Law 100-418 ("the Trade and Competitiveness Act"), and in order to implement the congressional designation of the metric system of measurement as the preferred system of weights and measures for United States trade and commerce, it is hereby ordered as follows:

Section 1. Coordination by the Department of Commerce. (a) The Secretary of Commerce ("Secretary") is designated to direct and coordinate efforts by Federal departments and agencies to implement Government metric usage in accordance with section 3 of the Metric Conversion Act (15 U.S.C. 205b), as amended by section 5164(b) of the Trade and Competitiveness Act.

(b) In furtherance of his duties under this order, the Secretary is authorized:

(1) to charter an Interagency Council on Metric Policy ("ICMP"), which will assist the Secretary in coordinating Federal Government-wide implementation of this order. Conflicts and questions regarding implementation of this order shall be resolved by the ICMP. The Secretary may establish such subcommittees and subchairs within this Council as may be necessary to carry out the purposes of this order.

(2) to form such advisory committees representing other interests, including State and local governments and the business community, as may be necessary to achieve the maximum beneficial effects of this order; and

(3) to issue guidelines, to promulgate rules and regulations, and to take such actions as may be necessary to carry out the purposes of this order. Regulations promulgated by the Secretary shall function as policy guidelines for other agencies and departments.

(c) The Secretary shall report to the President annually regarding the progress made in implementing this order. The report shall include:

(1) an assessment of progress made by individual Federal agencies towards implementing the purposes underlying this order;

(2) an assessment of the effect that this order has had on achieving the national goal of establishing the metric system as the preferred system of weights and measures for United States trade and commerce; and

(3) on October 1, 1992, any recommendations which the Secretary may have for additional measures, including proposed legislation, needed to achieve the full economic benefits of metric usage.

Sec. 2. Department of Agency Responsibilities. All executive branch departments and agencies of the United States Government are directed to take all appropriate measures within their authority to carry out the provisions of this order. Consistent with this mission, the head of each executive department and agency shall:

(a) use, to the extent economically feasible by September 30, 1992, or by such other date or dates established by the department or agency in consultation with the Secretary of Commerce, the metric system of measurement in Federal Government procurement, grants, and other business-related activities. Other business-related activities include all use of measurement units in agency programs and functions related to trade, industry, and commerce.

(1) Metric usage shall not be required to the extent that such use is impractical or is likely to cause significant inefficiencies or loss of markets to United States firms.

(2) Heads of departments and agencies shall establish an effective process for a policy-level and program-level review of proposed exceptions to metric usage. Appropriate information about exceptions granted shall be included in the agency annual report along with recommendations for actions to enable future metric usage.

(b) seek out ways to increase understanding of the metric system of measurement through educational information and guidance and in Government publications. The transition to use of metric units in Government publications should be made as publications are revised on normal schedules or new publications are developed, or as metric publications are required in support of metric usage pursuant to paragraph (a) of this section.

(c) seek the appropriate aid, assistance, and cooperation of other affected parties, including other Federal, State, and local agencies and the private sector, in implementing this order. Appropriate use shall be made of governmental, trade, professional, and private sector metric coordinating groups to secure the maximum benefits of this order through proper communication among affected sectors.

(d) formulate metric transition plans for the department or agency which shall incorporate the requirements of the Metric Conversion Act and this order, and which shall be approved by the department or agency head and be in effect by November 30, 1991. Copies of approved plans shall be forwarded to the Secretary of Commerce. Such metric transition plans shall specify, among other things:

(1) the total scope of the metric transition task for that department or agency, including firm dates for all metric accomplishment milestones for the current and subsequent fiscal year;

(2) plans of the department or agency for specific initiatives to enhance cooperation with industry, especially small business, as it voluntarily converts to the metric system, and with all affected parties in undertaking the requirements of paragraph (a) of this section; and

(3) specific steps and associated schedules through which the department or agency will seek to increase understanding of the metric system through educational information and guidance, and in department or agency publications.

(e) designate a senior-level official as the Metric Executive for the department or agency to assist the head of each executive department or agency in implementing this order. The responsibilities of the Metric Executive shall include, but not be limited to:

(1) acting as the department's or agency's policy-level representative to the ICMP and as a liaison with other government agencies and private sector groups:

(2) management oversight of department or agency outreach and response to inquiries and questions from affected parties during the transition to metric system usage; and

(3) management oversight of preparation of the department's or agency's metric transition plans and progress reports, including the Annual Metric Report required by 15 U.S.C. 205j and OMB Circular A11.

(4) preparation by June 30, 1992, of an assessment of agency progress and problems, together with recommendations for steps to assure successful implementation of the Metric Conversion Act. The assessment and recommendations shall be approved by the head of the department or agency and provided to the Secretary by June 30, 1992, for inclusion in the Secretary's October 1, 1992, report on implementation of this order.

Sec. 3. *Application of Resources.* The head of each executive department and agency shall be responsible for implementing and applying the necessary resources to accomplish the goals set forth in the Metric Conversion Act and this order.

Sec. 4 *Judicial Review.* This order is intended only to improve the internal management of the executive branch and is not intended to create any right or benefit, substantive or procedural, enforceable at law by a party against the United States, its agencies, its officers, or any other person.

<signature of President>

THE WHITE HOUSE,
July 25, 1991.

[FR Doc. 91-18028
Filed 7-25-91; 3:06 pm]
Billing code 3195-01-M

AGC Letter to Metrication Operating Committee

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA
1957 E Street N.W. Washington, D.C. 20008 (202) 393-2040 FAX (202) 347-4004
MARVIN M. BLACK, President ROBINS H. JACKSON, Senior Vice President
BYRON L. FARRELL, Vice President LAWRENCE J. MCGOUGH, Treasurer
HUBERT BEATTY, Executive Vice President

Mr. Thomas R. Rutherford, P.E.
Chairman, Construction Subcommittee
Metrication Operating Committee
5901 Leesburg Pike, Skyline 6, Suite 310
Falls Church, VA 22041

Dear Tom:

Thank you for your fine presentations on "Federal Metrication Efforts" to the Federal Building Procedures and Project Delivery Systems Committees in Asheville, North Carolina. You will be pleased to know that both committees plus the Building Division Steering Committee strongly endorse your efforts, in fact, urge you to pick up the pace of metric conversion. The committee recommendations are consistent with AGC national policy which states unequivocally:

"Recognizing the inevitability of the nation eventually adopting the metric system, AGC endorses the consensus statement of the American Metric Council that, "If the industry is to go metric, a hard conversion is recommended where there is an economic advantage."²¹ AGC supports an orderly conversion to the metric system at the earliest practical date.³²"

We look forward to working with you and the Metrication Operating Committee in achieving total conversion within your timetable. As you put it so succinctly, metric is the language of 93% of the world's population, only the U.S. remains in inch/pound. If we are to protect and develop global markets, we must speak the same language.

Sincerely,
<signature of Director>
William J. Angelo
Director
Building Division

Note: ²¹ Metric Conversion Committee Meeting Report, September 16, 1977
³² Metric Committee Report to Board, March 17, 1981

cc: Robert F. Lathlaen
J. Howard Mock
Thomas J. McGough
J. Doug Pruitt

Recommended Preparation

Governmental Organizations

- Provide this guide to staff and architectural/engineering (A/E) firms.
- Place CBD advertisements in metric format. See *A/E-CM CBD Guidance* section.

Private Design Firms

- Contact product suppliers for metric product literature. If not available, request it be developed, even as a supplement to existing material. Research for competitive sources of materials specified must be performed just as it is for English-dimensioned documents.
- U.S. Government selection of design firms will increasingly emphasize firms with metric capabilities.
- Obtain important design documents: ASTM E380, ASTM E621, Graphic Standards (Eighth Edition), AISC LRFD Steel Data (Metric Version), ACI 318M Building Code (metric), and the ASHRAE SI metric version handbooks.

Product Manufacturers

- Develop metric product literature. Most products in use today will not undergo any physical change during the metric transition. However, they will be specified only in metric dimensions on Federal projects.
- Metric product literature may be as simple as bond paper supplements, with metric dimensions, attached to existing material.
- Products identified herein as hard metric products have been researched and are competitively available today. Manufacturers of these products may wish to coordinate with trade groups to develop new standard metric sizes and use this as an opportunity to reduce product variations. Many other countries have done this as metric was implemented.

Metric Projects

Some round metric products have minimum order quantities which may limit them to a project involving renovation of a floor or more of a building. Individual projects must be evaluated by managers for scope and size in planning them. Most products, however, are identical to the English-dimensioned products and can be used on any project. A modification of an entire building or a new building project has a large enough buying power and trade learning curve that all products in this guide may be used without extraordinary research.

Computer-aided drafting (CAD) has simplified execution of metric renovation projects, since drawings can be digitized in English dimensions and converted to metric scale. However, professional rounding must still be done after conversion. In major renovations, new round metric sizes can be installed, such as an entire new 600by 600 mm ceiling system, even if the original module was different. Many historical buildings do not fit any module.

Do not control HVAC in one part of a building using Celsius temperature, while another part retains Fahrenheit. An entire building should be switched at once. A building temperature system can be converted to Celsius with no cost impact today, since modern digital HVAC control equipment has either degrees C or F as a software option.

Small Projects

On some smaller size metric design and construction projects, contractors converted drawings and specifications done completely in metric dimensions back to English dimensions. In a few cases the contractor made mistakes in translation, one of them resulting in the wrong size steel columns being delivered to the job site. Contractors should be cautioned at the preconstruction meeting not to do this, as such errors are at their expense. Projects below \$1 - 2million have been successfully completed in round metric, but they should be carefully reviewed so issues such as minimum order quantities do not have a large effect on time and cost.

A/E-CM CBD Guidance

Commerce Business Daily (CBD) advertisements for A/E or construction management (CM) solicitations should use the following terminology.

- State the area of the project in square meters only.

Example: The new building will be approximately 15 000 occupiable square meters of office and storage space.

- Each announcement should state: "This project will be designed and built entirely in metric units."
- For A/E firm announcements, including term contract announcements, the following should be added as an evaluation factor: "Familiarity with metric system and ability to design in metric units."

Note: Do not yet mandate metric experience. While many firms have substantial metric experience, many excellent design firms have not yet had a metric design opportunity.

- For CM announcements, including term CM announcements, the following should be added as an evaluation factor: "Familiarity with metric system and ability to perform required services in metric units."

Each Request For Proposal (RFP) shall require a summary of the firm's metric experience, its experience with the metric system, and its ability to perform required services in metric units.

Construction CBD Guidance

Use the following terminology for each CBD advertisement for construction projects designed in metric.

- Show the area of the project in metric dimensions only:

Example: "This project involves the renovation of a 24 000 gross square meter (GSM) building."

- State: "This project has been designed completely in metric units. All testing will use metric units. Shop drawings and product literature must be submitted with metric dimensions. Supplements to existing product literature will be accepted on bond paper."

A/E-CM Scope Guidance

The following terminology is recommended for insertion into each A/E scope of work.

Metric Measurement. Measurements and units of any type, on all submissions of this project, shall be shown in SI metric units exclusively. English system measurements shall not

appear in reports, drawings, specifications, or any other submissions. A/E firms must strive to utilize as many round metric products as possible.

- All cost estimating should be submitted in metric units only.
- All correspondence should be written in SI units exclusively.
- Submit shop drawings, catalog cuts, and other construction phase material in metric units.
- Submit all operation and maintenance manuals in metric units.

Specification Guidance

Based on metric project experience, terminology similar to the following three paragraphs should be included in Division One of the construction specification.

"During the prebid and/or preconstruction conference, a session will be specifically devoted to metric. GSA or its representatives will explain that most products specified are the same products contractors are currently using, only specified in metric dimensions. Modular metric products used on the project will be identified and discussed. Contractors will be cautioned that they should ask suppliers about delivery schedules on modular and round metric products, and not assume they are the same as English-dimensioned ones. Contractors should ensure that all workers are using metric tapes and not trying to convert to English at every measurement.

"All correspondence must use SI metric units exclusively. All cost data submitted by the contractor in a proposal or any other submission must be in metric units. All shop drawings, catalog cuts, and other submittals must be submitted with metric units and dimensions that clearly demonstrate conformance with the metric units given in the drawings and specifications. Metric supplements to existing product literature or data will be accepted on bond paper.

"All operations and maintenance (O&M) material must be submitted with metric units and dimensions that clearly demonstrate conformance with the metric units given in the drawings and specifications. Metric supplements to existing O&M material will be accepted on bond paper."