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PIPE

Pipe is one of the most ubiquitous products in construction. It is made of a wide variety of materials, including galvanized steel, black steel, copper, cast iron, concrete, and various plastics such as ABS, PVC, CPVC, polyethylene, and polybutylene, among others.

But like wood 2-by-4s which are not really 2 inches by 4 inches, pipe is identified by "nominal" or "trade" names that are related only loosely to actual dimensions. For instance, a 2-inch galvanized steel pipe has an inside diameter of about 2-1/8 inches and an outside diameter of about 2-5/8 inches. It is called "2-inch pipe" only for the sake of convenience.

Since few, if any, pipe products have actual dimensions that are in even, round inch-pound numbers, there is no need to convert them to even, round metric numbers. Instead, only their *names* will change--from inch-pound to metric. *Pipe cross sections will not change*. Fittings, flanges, couplings, valves, and other piping components will be renamed in like manner as will pipe threads.

Here are the inch-pound names for pipe products (called NPS or "nominal pipe size") and their metric equivalents (called DN or "diameter nominal"). The metric names conform to International Standards Organization (ISO) usage and apply to all plumbing, natural gas, heating oil, drainage, and miscellaneous piping used in buildings and civil works projects.

NPS	DN	NPS	DN
1/8"	6 mm	8"	200 mm
3/16"	7 mm	10"	250 mm
1/4"	8 mm	12"	300 mm
3/8"	10 mm	14"	350 mm
1/2"	15 mm	16"	400 mm
5/8"	18 mm	18"	450 mm
3/4"	20 mm	20"	500 mm
1"	25 mm	24"	600 mm
1-1/4"	32 mm	28"	700 mm
1-1/2"	40 mm	30"	750 mm
2"	50 mm	32"	800 mm
2-1/2"	65 mm	36"	900 mm
3"	80 mm	40"	1000 mm
3-1/2"	90 mm	44"	1100 mm
4"	100 mm	48"	1200 mm
4-1/2"	115 mm	52"	1300 mm
5"	125 mm	56"	1400 mm
6"	150 mm	60"	1500 mm

(For pipe over 60 inches, use 1 inch equals 25 mm)

The following examples show how inch-pound names for pipe products are converted to metric designations. By changing their names and referring to the appropriate specification, existing pipe products and thread sizes can be specified in metric.
- In a specification, 1-1/2-inch, 2-inch, 4-inch, and 6-inch pipe are shown as DN40, DN50, DN100 and DN150 pipe.

Comment: The specification will further elaborate, for example, that "Pipe sizes DN50 or less are to be black steel per ASTM A135, Schedule 40, and threaded per ASME B1.20.1. Pipe sizes greater than DN50 are to be black steel per ASTM A135, Schedule 10, and roll grooved." By specifying the appropriate manufacturing standard, the pipe's actual inside diameter (ID), outside diameter (OD), and material are assured.

- An installation standard calling for all pipe threads to be per ASME B1.20.1 remains unchanged.

Comment: The NPT (National Standard Pipe Taper) pipe thread form is the same but its name is converted; for example, 1/2-inch NPT becomes DN15 NPT.

- An installation standard calling for the use of a minimum 2-inch drain valve is revised to indicate the use of a minimum DN50 drain valve.

Comment: Since the 2-inch size is actually a nominal pipe size (NPS), it is converted to a nominal metric size (DN) as opposed to using the conversion of 1 inch equals 25.4 mm.

- A 2-inch Class 150 malleable iron 90° elbow per ASME B16.3 is designated as a DN50 Class 150 malleable iron 90° elbow per ASME B16.3.

Comment: Pipe fittings manufactured to ASME B16.3 are threaded with ASME B1.20.1 pipe threads. Therefore, a DN50 90° elbow will have DN50 NPT pipe threads. The term "Class 150", which refers to a pressure rating, remains unchanged (since the term does not designate an inch-pound increment from which it was derived, it can be used with metric nomenclature).

- A 6-inch × 6-inch × 4-inch, Class 125, Grade A, reducing tee per ASME B16.1 is designated a DN150 × DN150 × DN100, Class 125, Grade A, reducing tee per ASME B16.1.

Comment: All product dimensions covered by ASME B16.1 remain unchanged.

- A 1/2-14 NPT thread per ASME B1.20.1 is designated DN15-14 NPT per ASME B1.20.1.

Comment: In the above designation, "14" refers to 14 threads per inch. Since the term does not designate an inch-pound increment from which it was derived, it can be used with metric nomenclature. It is interesting to note that IS0 7, which is a recognized international pipe thread standard, refers to the number of threads per 25.4 mm, or 1 inch.

The material for this article was developed by the Mechanical Task Group of the Construction Metrication Council, National Institute of Building Sciences. Examples were provided by Roger Wilkins of Grinnell Corporation.

CONCRETE MASONRY BLOCK

In the transition to metric, most construction products (like pipe) will not change size--they simply will be relabeled in metric units. Only products that must fit together in a modular grid are logical candidates for "hard" metric conversion--that is, an actual dimensional change. Such products include drywall, plywood and other wood-based panels, suspended ceiling components, raised flooring, tile, brick, and block.

The manufacturers of most of these products can readily supply hard metric sizes, but the concrete masonry block industry has said it will have difficulty. This industry is composed primarily of small producers with a marketing radius of from 60 to 300 km. Hard metric conversion would require that they buy new mold boxes, which cost in the range of from $10,000 to $20,000 apiece--a large capital investment for small firms that have been hit by the economic downturn.

In response to these problems, the General Services Administration (GSA) has modified its *Metric Design Guide* (July 1993) to permit the use of either conventional inch-pound block or metric block. The *Guide* states:

> Masonry walls have a critical wall thickness for fire resistance and compressive strength. Beyond this, it is not important what dimension the height and width of a masonry unit is except for appearance, the ability to accommodate metric window and door openings, having even coursing for ties and round dimensions between openings for ease of builder measurement, and the weight of the unit for lifting. Project requirements should be limited to these factors with total competitive pricing determining the dimensioning.

Metric modular block is 190 by 190 by 390 mm. This equates to 7-1/2 by 7-1/2 by 15-3/8 inches. Conventional [inch-pound] modular block is 194 by 194 by 397 mm, quite similar to metric block.

While the Construction Metrication Council advocates a timely and complete change to metric, its policy calls for each industry to convert to hard metric when it is economically feasible to do so. Because of the cost of hard conversion in the block industry, the Council endorses GSA's policy of

permitting the use of either inch-pound or metric concrete masonry block, as project requirements dictate.

METRIC PUBLICATIONS

The following metric publications are available from the Publications Department, National Institute of Building Sciences (NIBS), 1201 L St., N.W., Suite 400, Washington DC 20005; phone 202-289-7800. Major credit cards and phone orders are accepted and prices include shipping and handling.

GSA Metric Design Guide (July 1993). Developed for federal project managers and their architect/engineer contractors, the GSA guide contains practical architectural, civil, structural, mechanical, and electrical design information; a list of available "hard" metric product manufacturers; and related reference information. $8.00 ($5.00 if ordered with the *Metric Guide for Federal Construction* described below).

Metric Guide for Federal Construction. Written specifically for the construction industry and reviewed by metric experts throughout the country, the *Metric Guide* includes a background on federal metric laws; facts about metric in construction; an introduction to metric units; a primer on metric usage for architects, engineers, and the trades; requirements for metric drawings and specifications; guidance on metric management and training; and a listing of current metric construction references. $15.00.

Both guides are available in electronic form on the NIBS **Construction Criteria Base** (CCB), a large database of construction criteria and standards on optical disk. For more information about the CCB, call or write NIBS.

Metric (SI) in Everyday Science and Engineering. A clear, authoritative, and easy-to-read text on the use of the metric system written by one of the foremost metric trainers in the United States, Stan Jakuba. This book should be owned by everyone with a serious interest in metric. Call the NIBS Publications Department for more information.

The bimonthly metric newsletter, ***Metric in Construction***, is available from NIBS at no charge. Write or fax (***do not call***) NIBS (the fax number is 202-289-1092). Include only the words "Metric newsletter" and your ***most concise*** mailing address. Please, one subscription per office. Phone orders will not be accepted.

METRIC FACTS: FORCE

How much force will it take to get up to speed? What force will be exerted on the foundation? The metric answers to these questions are expressed in ***newtons*** (N). The newton is defined as the force that when applied to a free mass of 1 kilogram (kg) will impart an acceleration of 1 meter per second per second (kg m/s^2). One of the many advantages of metric is that it uses a different unit for mass (kg) than it uses for force (N), thus reducing the mass-force-weight confusion.

The customary unit for force is the poundal and the conversion is 7.233 poundals per newton. On the earth at sea level, a mass of one kilogram will produce a force on its support of 9.806 newtons.

Problem:
A crane on the earth at sea level lifts a mass of 500 kilograms. What force in newtons is imposed on the crane?

Solution:
500 kg × (9.806 N/kg) = 4903 N

Metric in Construction is the newsletter of the Construction Metrication Council of the
National Institute of Building Sciences, Washington, D.C. Copies of previous newsletters are available upon request.

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Metric in Construction is a bimonthly newsletter published by the Construction Metrication Council to inform the building community about metrication in U.S. construction. The Construction Metrication Council was created by the National Institute of Building Sciences to provide industry-wide, public and private sector support for the metrication of federal construction and to promote the adoption and use of the metric system of measurement as a means of increasing the international competitiveness, productivity, and quality of the U.S. construction industry.

The National Institute of Building Sciences is a nonprofit, nongovernmental organization authorized by Congress to serve as an authoritative source on issues of building science and technology.

The Council is an outgrowth of the Construction Subcommittee of the Metrication Operating Committee of the federal Interagency Council on Metric Policy. The Construction Subcommittee was formed in 1988 to further the objectives of the 1975 *Metric Conversion Act*, as amended by the 1988 *Omnibus Trade and Competitiveness Act*. To foster effective private sector participation, the activities of the subcommittee were transferred to the Council in April 1992.

Membership in the Council is open to all public and private organizations and individuals with a substantial interest in and commitment to the Council's purposes. The Council meets monthly in Washington, D.C.; publishes the *Metric Guide for Federal Construction* and this bimonthly newsletter; and coordinates a variety of industry metrication task groups. For membership information, call the Council at the above phone number.

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