CONSTRUCTION METRICATION

Volume 8, Issue 2 2nd Quarter 1999

PIPE

This is an update of an article published in the September-October 1993 issue of this newsletter.

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* change— from inch-pound to metric. Pipe cross sectional sizes do not change. Fittings, flanges, couplings, valves, and other piping components are renamed in like manner, as are 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 designations conform to International Standards Organization (ISO) usage and apply to all plumbing, natural gas, heating oil, and miscellaneous piping used in buildings. Reinforced concrete pipe and corrugated steel pipe used in highways and other civil works construction also use these designations.

Note that all whole-number inch designations on the following chart convert to multiples of 25 mm except for 3-inch pipe, which ISO designates as 80 mm.

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

(continued on page 2)

Construction Metrication is the newsletter of the Construction Metrication Council of the National Institute of Building Sciences. Reproduction and distribution of its contents is encouraged provided the Council receives attribution. This and previous newsletters may be viewed on the NIBS Web site at ***www.nibs.org***.

CONSTRUCTION METRICATION COUNCIL

National Institute of Building Sciences
1090 Vermont Avenue, N.W., Suite 700
Washington, D.C. 20005-4905
Telephone 202-289-7800; fax 202-289-1092
E-mail: bbrenner@nibs.org
Internet: www.nibs.org

Construction Metrication is a quarterly newsletter published by the Construction Metrication Council to disseminate information about construction metrication activities. The National Institute of Building Sciences created the Council in 1992 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 publishes the *Metric Guide for Federal Construction* and this newsletter. It is funded primarily by contributions from federal agencies but also receives private sector support.

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.

SMART METRICATION TIPS:

P Obtain a metric tape measure right away. So equipped, you readily can adapt to metric usage. Unequipped, you can't do your job. Some advocate dual unit tapes, others metric-only tapes. Take your pick.

P You won't need many other metric tools. There is no such thing as a metric hammer, saw, screwdriver, chisel, pliers, power drill, level, or trowel. You probably already have a set of metric wrenches.

P If you scale dimensions off drawings, use a metric scale. One 3-sided metric scale can be used for both architectural and engineering drawings. Don't use an inch scale – you'll make mistakes.

P Try to use only metric measures right from the start. It will be hard at first but you'll soon get the hang of it. Talk "metric-only" on the work site and adopt a pro-metric tone. Experience has shown that a positive, professional attitude about metrication minimizes problems.

P Do not convert metric drawings and specs back to conventional units. This "shortcut" invariably leads to mistakes, so *resist the temptation*. Execute all work in metric units with metric tape measures and you'll learn faster, too.

P Conversions are unnecessary except, perhaps, when dealing with some suppliers or comparing costs. Double check any conversions you do make.

P Be prepared to submit shop drawings and product information in metric units.

METRIC RULES-OF-THUMB

1 mm = about 1/25 inch = thickness of a dime

25 mm = about 1 inch (1" = 25.4 mm)

300 mm = about 1 foot (12" = 304.8 mm)

1000 mm = 1 m = about 3 feet + 10% more

1 m^2 = roughly 10 square feet ($1m^2 = 10.76\ ft^2$)

1 L = about 1 quart (1L = 1.06 qt)

1 m^3 = about 35 cubic feet (about 30% more than a yd^3)

1 kg = about 2.2 pounds

1000 kg = 1Mg = 1 metric ton = about 2200 pounds

100 kPa = about 15 psi; 1 MPa = about 150 psi

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 inch-pound 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

By Oscar Fisher; used with the permission of the American Society of Mechanical Engineers.

Address Service Requested

The Construction Metrication Newsletter

FHWA STAYS THE COURSE

On June 17, 1999, the Federal Highway Administration issued a final rule adopting the ***Guide to Metric Conversion***, AASHTO, 1993, and ***Traffic Engineering Metric Conversion Factors, 1993—Addendum to the Guide to Metric Conversion***, AASHTO, October 1993, as the national standards for traffic control devices (23 CFR Part 655, Subpart F). This formalized FHWA's interim rule on metric conversion published on June 11, 1996. As background to its rulemaking, FHWA stated in part (with emphasis added):

"Section 1211(d) of the Transportation Equity Act for the 21st Century (TEA-21) (Pub. L. 105-178, 112 Stat. 107) removed the target date for metric conversion, thereby allowing the State departments of transportation (DOTs) the option of converting to the International System of Measurements (SI). Section 205(c)(2) of the National Highway System Designation Act of 1995 (Pub. L. 104-59, 109 Stat. 568) was amended by striking the language "before September 30, 2000," which removes the mandate that States convert to SI.

"Most of the State DOTs have substantially converted their project development and construction processes to SI. Full conversion by all the State DOTs remains an FHWA goal since it will improve efficiency within the highway construction industry by reducing translation errors and enabling the contractors, consultants, fabricators and materials suppliers to utilize a single system of units. The FHWA believes that it is in the best interest of the highway community to expedite the metrication process and ensure compatibility within the highway industry and with other industries. Reversion to inch-pound units by some States will perpetuate a confusing mix of measurement systems.

".....Many States have progressed in their conversion activities to a point that it is impractical not to continue the transition into full metric use. Because of the long lead times required for highway construction projects, planning for projects is already underway and, in fact, the majority of the Federal-aid highway construction program nationwide is currently being constructed in metric units. It is the intent of this rulemaking to assure the States and other FHWA partners that the metric conversions used to formulate their plans are consistent nationwide.

".....The FHWA initiated a phased five-year plan to convert its activities and business operations to the metric system of weights and measures as required by the Metric Conversion Act of 1975 ((Pub. L. 94-168, 89 Stat. 1007) as amended by sec. 5164 of the Omnibus Trade and Competitiveness Act of 1988 (Pub. L. 100-418, 102 Stat. 1107, 1451)) (Metric Act). The TEA-21, section 1211(d), does not change the requirements placed on the FHWA by the Omnibus Trade and Competitiveness Act of 1988. Therefore, the FHWA will continue to use SI in its daily business activities."