

of manufacture. Note that the joint factor, *c*, is not included for plain end non-ferrous pipe as listed in Table 2.

In addition to *IPS* copper pipe, several varieties of copper tubing are in use with either flared or compression couplings or soldered joints. Dimensions of copper water tubing intended for plumbing, underground water service, fuel-oil lines, gas lines, etc., have been standardized by the U. S. Government and the *American Society for Testing Materials*. There are

TABLE 4. THREADING DATA FOR PIPE

| NOMINAL SIZE <sup>a</sup> | PIPE O. D. | STANDARD WEIGHT               |                |                 | EXTRA AND DOUBLE EXTRA STRONG |                |                 |
|---------------------------|------------|-------------------------------|----------------|-----------------|-------------------------------|----------------|-----------------|
|                           |            | THREADS PER INCH <sup>b</sup> | COUPLING O. D. | COUPLING LENGTH | THREADS PER INCH              | COUPLING O. D. | COUPLING LENGTH |
| 3/8                       | 0.405      | 27                            | 0.563          | 1 3/16          | 27                            | 0.563          | 1 3/16          |
| 1/2                       | 0.540      | 18                            | 0.719          | 1 3/8           | 18                            | 0.719          | 1 3/8           |
| 3/4                       | 0.675      | 18                            | 0.875          | 1 3/8           | 18                            | 0.875          | 1 3/8           |
| 1                         | 0.840      | 14                            | 1.063          | 1 3/8           | 14                            | 1.063          | 2 1/4           |
| 1 1/4                     | 1.050      | 14                            | 1.313          | 1 3/4           | 14                            | 1.313          | 2 1/4           |
| 1 1/2                     | 1.315      | 11 1/4                        | 1.576          | 2               | 11 1/4                        | 1.576          | 2 3/4           |
| 1 3/4                     | 1.660      | 11 1/4                        | 1.900          | 2 1/4           | 11 1/4                        | 2.054          | 2 3/4           |
| 2                         | 1.990      | 11 1/4                        | 2.200          | 2 1/4           | 11 1/4                        | 2.200          | 2 3/4           |
| 2 1/2                     | 2.375      | 11 1/4                        | 2.750          | 2 3/4           | 11 1/4                        | 2.875          | 2 3/4           |
| 3                         | 2.875      | 8                             | 3.250          | 3 1/4           | 8                             | 3.375          | 4 3/4           |
| 3 1/2                     | 3.500      | 8                             | 4.000          | 3 3/4           | 8                             | 4.000          | 4 3/4           |
| 4                         | 4.000      | 8                             | 4.625          | 3 3/4           | 8                             | 4.625          | 4 3/4           |
| 4 1/2                     | 4.500      | 8                             | 5.000          | 3 3/4           | 8                             | 5.200          | 4 3/4           |
| 5                         | 5.563      | 8                             | 6.296          | 3 3/4           | 8                             | 6.296          | 4 3/4           |
| 6                         | 6.625      | 8                             | 7.390          | 4               | 8                             | 7.390          | 4 3/4           |
| 8                         | 8.625      | —                             | —              | —               | 8                             | 9.625          | 5 1/4           |
| 10                        | 10.750     | —                             | —              | —               | 8                             | 11.750         | 5 1/4           |
| 12                        | 12.750     | —                             | —              | —               | 8                             | 14.000         | 6 3/4           |
| 14                        | 14.000     | —                             | —              | —               | 8                             | 15.000         | 6 3/4           |
| 16                        | 16.000     | —                             | —              | —               | 8                             | 17.000         | 6 3/4           |
| 18                        | 18.000     | —                             | —              | —               | 8                             | 19.000         | 7 1/4           |
| 20                        | 20.000     | —                             | —              | —               | 8                             | 21.000         | 7 1/4           |

<sup>a</sup> All dimensions in inches.

<sup>b</sup> Taper of threads is 3/4 in. per ft on diameter on all sizes of pipe, and in couplings of 2 1/4 in. and over. Couplings 2 in. and smaller are straight tapped.

three standard wall-thickness schedules of copper water tubing classified in accordance with their principal uses as follows:

Type K—Designed for underground services and general plumbing service.

Type L—Designed for general plumbing purposes.

Type M—Designed for use with soldered fittings only.

In general, Type K is used where corrosion conditions are severe, and Types L and M where such conditions may be considered normal as, for instance, in heating work. Types K and L are available in both hard and soft tempers; Type M is available only in hard temper. Where flexibility is essential as in hidden replacement work, or where as few joints as possible are desired as in fuel-oil lines, the soft temper is commonly used. In new or exposed work copper pipe of a hard temper is generally used. All three classes are extensively used with soldered fittings.

Standard dimensions, weights, and diameter and wall-thickness tolerances for these classes of copper tubing are obtainable from Table 2. Copper pipe is also available with dimensions of steel pipe.

In refrigeration lines, used in connection with air conditioning equipment, copper tube is used extensively. For refrigeration use where tubing absolutely free from scale and dirt is required, bright annealed copper tubing that has been deoxidized is used. This tubing is available in a variety of sizes and wall thicknesses.

### THREADING PRACTICE

In all threaded pipe for heating and ventilating installations the American Standard taper pipe thread, ASA B2.1-1942 is used. This thread is cut with a taper of 1 in 16 measured on the diameter of the pipe so as to secure a tight joint. The number of threads per inch varies with the pipe size. Threads for fittings are the same, except that it is regular practice to furnish straight tapped couplings for Schedule 40 pipe 2 in. and smaller. For

TABLE 5. NORMAL ENGAGEMENT OF TIGHT-FIT MALE AND FEMALE PIPE THREADS  
For American Standard and API Pipe Threads

| PIPE SIZE | ENGAGED LENGTH* IN. | PIPE SIZES | ENGAGED LENGTH* IN. | PIPE SIZES | ENGAGED LENGTH* IN. |
|-----------|---------------------|------------|---------------------|------------|---------------------|
| 3/8       | 3/4                 | 1 1/4      | 1 1/4               | 4          | 1 1/4               |
| 1/2       | 3/4                 | 1 1/2      | 1 1/4               | 5          | 1 1/4               |
| 3/4       | 3/4                 | 2          | 3/4                 | 6          | 1 1/4               |
| 1         | 3/4                 | 2 1/2      | 1 1/4               | 8          | 1 1/4               |
| 1 1/4     | 1 1/4               | 3          | 1                   | 10         | 1 1/4               |
| 1 1/2     | 1 1/4               | 3 1/2      | 1 1/4               | 12         | 1 1/4               |

\* Dimension shown is the normal tight-fit thread engagement from the leading edge of the female thread back to the leading edge of the male thread. No allowance has been made for threading variations.

steam pressures in excess of 25 psi, it is recommended that taper-tapped couplings be used to obtain a tight joint. These may be secured by ordering *line pipe*<sup>2</sup> which is used for oil piping, the couplings of which are provided with taper-tapped threads and may be used with regular mill-threaded standard weight pipe. Thread lengths should be in accordance with ASA B2.1. Right-hand threads are used unless otherwise ordered. To facilitate drainage, some elbows have the thread tapped at an angle to provide a pitch of the connecting pipe of 1/4 in. to the foot. These elbows are known to the trade as pitch elbows and are commercially available. All threaded pipe joints should be made up with a thread paste suitable for the service for which the pipe is to be used.

Table 4 contains pertinent threading data for standard weight, extra strong and double extra strong steel, and wrought-iron pipe. The normal engagement of pipe threads is given in Table 5.

### PIPE FITTINGS

Pipe is joined by butt welding one length to another or by the use of fittings. Pipe fittings are made in a variety of forms (the common types are listed in Table 6), and are screwed, flanged or welded. The type of