

random lengths of 16 to 22 ft, although when ordered with plain ends, 5 per cent may be in lengths of 12 to 16 ft. Five per cent of the total number of lengths ordered may be *jointers* which are two pieces coupled together. Extra-strong pipe is generally furnished with plain ends in random lengths of 12 to 22 ft, although 5 per cent may be in lengths of 6 to 12 ft.

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

Class *K*—Designed for underground services and general plumbing service.

Class *L*—Designed for general plumbing purposes.

Class *M*—Designed for use with soldered fittings only.

In general, Type *K* is used where corrosion conditions are severe, and

TABLE 2. NOMINAL WEIGHTS OF WELDED AND SEAMLESS STEEL PIPE

NOMINAL PIPE SIZE INCHES	SCHED. 10 PLAIN ENDS	SCHED. 20 PLAIN ENDS	SCHEDULE 30		SCHEDULE 40		SCHED. 60 PLAIN ENDS	SCHED. 80 PLAIN ENDS	SCHED. 100 PLAIN ENDS	SCHED. 120 PLAIN ENDS	SCHED. 140 PLAIN ENDS	SCHED. 160 PLAIN ENDS
			Plain Ends	Threads and Couplings	Plain Ends	Threads and Couplings						
1/8					0.25*	0.25*		0.32*				
1/4					0.43*	0.43*		0.54*				
3/8					0.57*	0.57*		0.74*				
1/2					0.86*	0.86*		1.09*				1.31
3/4					1.14*	1.14*		1.48*				1.94
1					1.68*	1.69*		2.18*				2.85
1 1/4					2.28*	2.29*		3.00*				3.77
1 1/2					2.72*	2.74*		3.64*				4.86
2					3.66*	3.68*		5.03*				7.45
2 1/2					5.80*	5.82*		7.67*				10.0
3					7.58*	7.62*		10.3*				14.3
3 1/2					9.11*	9.21*		12.5*				
4					10.8*	10.9*		15.0*		19.0		22.6
5					14.7*	14.9*		20.8*		27.1		33.0
6					19.0*	19.2*		28.6*		36.4		45.3
8		22.4	24.7*	25.0*	28.6*	28.8*	35.7	43.4*	50.9	60.7	67.8	74.7
10		28.1	34.3*	35.0*	40.5*	41.2*	54.8*	64.4	77.0	89.2	105.0	116.0
12		33.4	43.8*	45.0*	53.6	55.0	73.2	88.6	108.0	126.0	140.0	161.0
14 O. D.	36.8	45.7	54.6		63.3		85.0	107.0	131.0	147.0	171.0	190.0
16 O. D.	42.1	52.3	62.6		82.8		108.0	137.0	165.0	193.0	224.0	241.0
18 O. D.	47.4	59.0	82.0		105.0		133.0	171.0	208.0	239.0	275.0	304.0
20 O. D.	52.8	78.6	105.0		123.0		167.0	209.0	251.0	297.0	342.0	374.0
24 O. D.	63.5	94.7	141.0		171.0		231.0	297.0	361.0	416.0	484.0	536.0
30 O. D.	99.0	158.0	197.0									

Weights are given in pounds per linear foot and are for pipe with plain ends except for sizes which are commercially available with threads and couplings for which both weights are listed.

*The weights marked with asterisk in Schedules 30 and 40 are identical with weights for *standard-weight* pipe in former lists; those in Schedules 60 and 80 are identical with weights for *extra-strong* pipe in former lists.

The Schedule Numbers indicate approximate values of the expression $1000 \times P/S$.

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. New or exposed work generally employs copper pipe of a hard temper. 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 given in Table 5. Copper pipe is also available with dimensions of steel pipe.

Refrigeration lines used in connection with air conditioning equipment also employ copper tubing 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.

EXPANSION AND FLEXIBILITY

The increase in temperature of a pipe from room temperature to an operating steam or water temperature 100 F or more above room tem-

TABLE 3. DIMENSIONS OF WELDED WROUGHT-IRON PIPE

NOMINAL PIPE SIZE	OUTSIDE DIAMETER	NOMINAL WALL THICKNESSES FOR SCHEDULE NUMBERS					
		Schedule 10	Schedule 20	Schedule 30	Schedule 40	Schedule 60	Schedule 80
1/8	0.405	-----	-----	-----	0.070*	-----	0.098*
1/4	0.540	-----	-----	-----	0.090*	-----	0.122*
3/8	0.675	-----	-----	-----	0.093*	-----	0.129*
1/2	0.840	-----	-----	-----	0.111*	-----	0.151*
3/4	1.050	-----	-----	-----	0.115*	-----	0.157*
1	1.315	-----	-----	-----	0.136*	-----	0.183*
1 1/4	1.660	-----	-----	-----	0.143*	-----	0.195*
1 1/2	1.900	-----	-----	-----	0.148*	-----	0.204*
2	2.375	-----	-----	-----	0.158*	-----	0.223*
2 1/2	2.875	-----	-----	-----	0.208*	-----	0.282*
3	3.5	-----	-----	-----	0.221*	-----	0.306*
3 1/2	4.0	-----	-----	-----	0.231*	-----	0.325*
4	4.5	-----	-----	-----	0.242*	-----	0.344*
5	5.563	-----	-----	-----	0.263*	-----	0.383*
6	6.625	-----	-----	-----	0.286*	-----	0.441*
8	8.625	-----	-----	0.283*	0.329*	-----	0.510*
10	10.75	-----	-----	0.313*	0.372*	0.510*	0.606
12	12.75	-----	-----	0.336*	0.414	0.574	0.702
14 O. D.	14.0	0.250	0.312	0.375	0.437	0.625	0.750
16 O. D.	16.0	0.250	0.312	0.375	0.500	0.687	-----
18 O. D.	18.0	0.250	0.312	0.437	0.562	0.750	-----
20 O. D.	20.0	-----	0.375	0.500	0.562	-----	-----

All dimensions are given in inches.

The decimal thicknesses listed for the respective pipe sizes represent their nominal or average wall dimensions and include an allowance for mill tolerance of 12.5 per cent under the nominal thickness.

*Thicknesses marked with an asterisk in Schedules 30 and 40 are identical with thicknesses for *standard-weight* pipe in former lists; those in Schedules 60 and 80 are identical with thicknesses for *extra-strong* pipe in former lists.

The Schedule Numbers indicate approximate values of the expression $1000 \times P/S$.