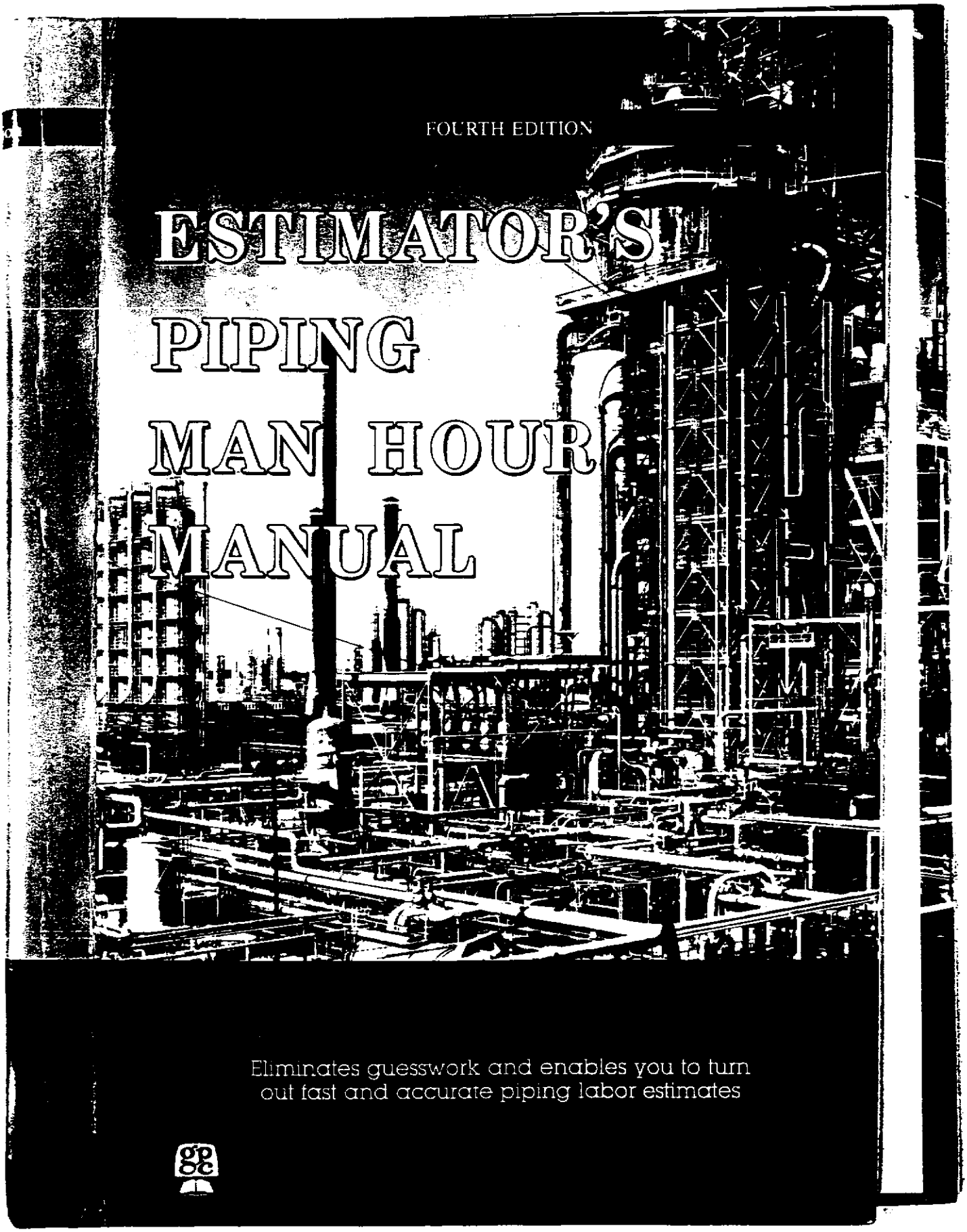

FOURTH EDITION

ESTIMATOR'S PIPING MAN HOUR MANUAL

Eliminates guesswork and enables you to turn out fast and accurate piping labor estimates

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Estimator's Piping Man-Hour Manual

FOURTH EDITION

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JOHN S. PAGE

Gulf Publishing Company
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Estimator's Piping Man-Hour Manual

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Section Eight—INSULATION

Section Nine—SAMPLE ESTIMATE

Section Ten—TECHNICAL INFORMATION

DEDICATION

To all piping estimators who have spent many hours
burning midnight oil and scratching heads trying to
estimate reasonable labor units,
I dedicate this manual.

PREFACE

This fourth edition has been fully updated with the extension of 21 tables and the addition of 11 new ones. It was written for the majority of estimators who have not had the advantages of years of experience or of being associated with a firm that spends thousands of dollars for time studies and research analysts. I believe that the book will decrease the chance of errors and help the partially experienced estimator to determine more accurately the actual direct labor cost for the complete fabrication and installation of process piping for a given industrial or chemical plant.

This book is strictly for estimating direct labor in man-hours only. You will not find any costs for materials, equipment usage, warehousing and storing, fabricating, shop set-up, or overhead. These costs can be readily obtained by a good estimator who can visualize and consider job schedule, size, and location. If a material take-off is available, this cost can be obtained from vendors who will furnish the materials. These items must be considered for each individual job.

The following direct man-hours (or in the case of alloy and nonferrous materials, the percentages) were determined by gathering hundreds of time and method studies coupled with actual cost of various operations, both in the shop and field on many piping jobs located throughout the country, ranging in cost from $50,000 to $20,000,000. By carefully analyzing these many reports, I established an average productivity rate of 70%. The man-hours or percentages compiled throughout this manual are based on this percentage.

I wish to call your attention to the introduction on the following pages entitled "Production and Composite Rate," which is the key to this method of estimating.

John Page
Houston, Texas

INTRODUCTION
Production and Composite Rate

This is the golden key that unlocks the gate to the wealth of process pipe estimating information that follows. The most important area to be considered before calculating labor dollars is productivity efficiency. This is a must if the many man-hour tables that follow are to be correctly applied. Productivity efficiency in conjunction with the production elements must be considered for each individual project.

I have found after comparing many projects that production percentages can be classified into five categories and the production elements can be grouped into six different classifications. The six different classes of production elements are:

1. General economy
2. Project supervision
3. Labor relations
4. Job conditions
5. Equipment
6. Weather

The five ranges of productivity efficiency percentages are:

Type	Percentage Range
1. Very Low	10–40
2. Low	41–60
3. Average	61–80
4. Very Good	81–90
5. Excellent	91–100

Although you may agree with the ranges described here, you may still wonder with such a wide percentage range how to determine a definite percentage. To illustrate how simply this is done we will evaluate each of the six elements and give an example with each.

1. GENERAL ECONOMY

This is simply the state of the nation or area in which your project is to be developed. Things that should be evaluated under this category are:

a. Business trends and outlooks
b. Construction volume
c. The employment situation

Let us say that you find these items to be very good or excellent. This may sound good, but actually it means your productivity range will be very low. This is because when business is good, the type of supervision and craftsmen that you will have to draw from will be very poor. This will tend to create bad labor relations between your company and supervision and thus produce unfavorable job conditions. On the other hand if you find the general economy to be of a fairly good average, the productivity efficiency will tend to rise. Under normal conditions there are enough good supervisors and craftsmen to go around and everyone is satisfied, thus creating good job conditions.

Example: To show how to arrive at a final productivity efficiency percentage, let us say we find this element to be of a high average in the area of the project. Since it is of a high average, but by no means excellent, we estimate our productivity percentage at 75%.

2. PROJECT SUPERVISION

What is the caliber of your supervision? What experience have they had? What can you afford to pay them? What have you to draw from? Areas to be looked at under this element are:

a. Experience
b. Supply
c. Pay

Like *general economy* this too must be carefully analyzed. If business is excellent, the chances are that you will have a poor lot to draw from. If business is normal, you will have a fair chance of obtaining good supervision. The contractor who tries to cut overhead by using cheap supervision usually winds up doing a very poor job. This usually results in a dissatisfied client, a loss of profit, and a loss of future work. However, the estimator has no control over this. It must be left to management. All the estimator can do is estimate his projects accordingly.

Example: After careful analysis of the three items listed under this element, we find that our supervision will be normal for this type of work and we arrive at an estimated productivity rate of 70%.

3. LABOR RELATIONS

Have you a good labor relations man in your organization? Are the craftsmen in the area experienced and satisfied? Are there adequate first-class craftsmen in the area? Like project supervision things that should be analyzed under this element are:

a. Experience
b. Supply
c. Pay

The area where your project is to be constructed should be checked to see if the proper experienced craftsmen are available locally or if you will have to rely on travelers to fill your needs. Can and will your organization pay the prevailing wage rates?

Example: Let us say that for a project in a given area we have found our labor relations to be fair but feel that they could be a little better. Since this is the case, we arrive at an efficiency rating of 65% for this element.

4. JOB CONDITIONS

What is the scope of the work and just what is involved in the job? Is the schedule tight or do you have ample time to complete the project? What is the condition of the site? Is it high and dry and easy to drain or is it low and muddy and hard to drain? Will you be working around a plant already in production? Will there be tie-ins making it necessary to shut down various systems of the plant? What will be the relationship between production personnel and construction personnel? Will most of your operations be manual or mechanized? What kind of material procurement will you have? There are many items that could be considered here, dependent on the project; however, we feel that the most important of these items that should be analyzed under this element are as follows:

a. Scope of work
b. Site conditions
c. Material procurement
d. Manual and mechanized operations

By careful study and analysis of the plans and specifications coupled with a site visitation you should be able to correctly estimate a productivity efficiency percentage for this item.

Example: Let us say that the project we are estimating is a completely new plant and that we have ample time to complete the project but the site location is low and muddy. Therefore, after evaluation we estimate a productivity rating of only 60%.

5. EQUIPMENT

Do you have ample equipment to do your job? What kind of shape is it in? Will you have good maintenance and repair help? The main items to study under this element are:

a. Usability
b. Condition
c. Maintenance and repair

This should be the simplest of all elements to analyze. Every estimator should know what type and kind of equipment his company has as well as what kind of mechanical shape it is in.

Example: Let us assume that our company equipment is in very good shape, that we have an ample supply to draw from, and that we have average mechanics. Since this is the case we estimate a productivity percentage of 70%.

6. WEATHER

Check the past weather conditions for the area in which your project is to be located. During the months that you will be constructing what are the weather predictions based on these past reports? Will there be much rain or snow? Will it be hot and mucky or cold and damp? The main items to check and analyze here are as follows:

a. Past weather reports
b. Rain or snow
c. Hot or cold

This is one of the worst of all elements to be considered. At best, all you have is a guess. However, by giving due consideration to the items as outlined under this element your guess will at least be based on past occurrences.

Example: Let us assume that the weather is about half good and half bad during the period that our project is to be constructed. We must then assume a productivity range of 50% for this element.

We have now considered and analyzed all six elements and in the examples for each individual element have arrived at a productivity efficiency percentage. Let us now group these percentages together and arrive at a total percentage:

Item	*Productivity Percentage*
1. General economy	75
2. Project supervision	70
3. Labor relations	65
4. Job conditions	60
5. Equipment	70
6. Weather	50
Total	390

Since there are six elements involved, we must now divide the total percentage by the number of elements to arrive at an average percentage of productivity.

$$390 \div 6 = 65\% \text{ average productivity efficiency}$$

At this point we must caution the estimator. This example is only a guide to show a method of arriving at a productivity percentage. By considering the preceding elements for each individual project along with the proper man-hour tables that follow, you can make a good labor value estimate for any place in the world at any time.

Next, we must consider the *composite rate* to correctly arrive at a total direct labor cost, using the man-hours in the following tables.

Most organizations consider the cost of field personnel with a rating of superintendent or greater to be a part of job overhead and that of general foreman or lower as direct job labor cost. The direct man-hours on the following pages have been determined on this basis. Therefore, a composite rate should be used when converting the man-hours to direct labor dollars.

The estimator must also again consider labor conditions in the area where the project is to be located. He must determine how many men he will be allowed to use in a crew plus how many crews he will need.

Example: This will illustrate how to obtain a composite rate:

We assume that a certain pipe project will need four 10-man crews and that only one general foreman will be needed to head the four crews.

Rate of pipefitter craft in a given area:

General foreman	$14.43 per hour
Foreman	18.54 per hour
Journeyman	18.04 per hour
Fifth-year apprentice	14.43 per hour

NOTE: General foreman and foreman are dead weight since they do not work with their tools; however, they must be considered and charged to the composite crew.

Crew for composite rate:

One general foreman	2 hours @ 19.29 =	$ 38.58
One foreman	8 hours @ 18.54 =	148.32
Nine journeymen	8 hours @ 18.04 =	1298.88
Fifth-year apprentice	8 hours @ 14.43 =	115.44
Total for 80 hours		$1601.22

$1601.22 ÷ 80 = $20.02 composite man-hour rate for 100% time.

Note that the man-hours are based on an average productivity of 70%. Therefore, the composite rate of $20.02 as figured becomes equal to 70%.

Let us assume that you have evaluated your job and find it to be of a low average with a productivity rating of only 65%. This means a loss of 5% of time paid per man-hours. Therefore, your composite rate should have an adjustment of 5% as follows:

$20.02 × 105% = $21.02 composite rate of 65% productivity

Simply by multiplying the number of man-hours estimated by the calculated composite rate, you can arrive at a total estimated direct labor cost, in dollar value, for pipe fabrication and installation.

The foregoing explanation should enable the ordinary piping estimator to turn out a better labor estimate and will eliminate much guess work.

Section One

SHOP FABRICATION OF PIPE AND FITTINGS

It is the intent and express purpose of this section to cover as nearly as possible all operations which may be encountered in a shop engaged in the prefabrication of process piping for any type of industrial or chemical plant.

The man hours listed for the various operations are for labor only, and have no bearing on materials which must be added in all cases for a complete labor and material estimate.

All labor for unloading from railroad cars on trucks, storing in fabrication yard or warehouse, hauling to fabrication area, fabricating and returning to storage area or loading for delivery to erection site have been given due consideration in the man hours listed. *No consideration has been given to overhead or profit in any way.*

For alloy and non-ferrous fabrication, apply the percentages which appear under Section Three to the following pages listing the various shop fabrication operations.

SHOP HANDLING PIPE FOR FABRICATION

Carbon Steel Material

Wall Thickness Through Schedule 160

DIRECT MAN HOURS PER FOOT

Pipe Size Inches	Schedule 10 to 60	Schedule 80 to 100	Schedule 120 to 160
1/4	0.029	0.031	0.033
3/8	0.029	0.031	0.035
1/2	0.030	0.033	0.036
3/4	0.030	0.034	0.039
1	0.031	0.036	0.041
1-1/4	0.033	0.039	0.044
1-1/2	0.035	0.041	0.049
2	0.036	0.044	0.053
2-1/2	0.039	0.048	0.059
3	0.041	0.053	0.065
3-1/2	0.044	0.055	0.068
4	0.045	0.058	0.071
5	0.048	0.063	0.079
6	0.051	0.070	0.091
8	0.063	0.088	0.119
10	0.079	0.110	0.149
12	0.096	0.134	0.183
14 OD	0.116	0.159	0.218
16 OD	0.138	0.186	0.254
18 OD	0.161	0.214	0.291
20 OD	0.189	0.241	0.329
24 OD	0.210	0.273	0.370

Man hours include unloading pipe from railroad cars or trucks and placing in shop storage, procuring necessary pipe and materials to fabricate spool piece, transporting necessary materials to point of fabrication and the transporting of finished work to temporary storage.

Units apply to any length spool piece or segment of work.

SHOP HANDLING PIPE FOR FABRICATION

Heavy Wall Carbon Steel Material

DIRECT MAN HOURS PER FOOT

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3" or less	0.065	0.078	--	--	--	--	--	--
4	0.071	0.087	0.103	0.119	--	--	--	--
5	--	0.099	0.119	0.139	0.159	0.179	--	--
6	--	0.110	0.129	0.148	0.199	0.218	0.237	--
8	--	0.129	0.146	0.174	0.201	0.228	0.255	0.286
10	--	--	0.149	0.182	0.215	0.248	0.281	0.314
12	--	--	--	0.214	0.245	0.276	0.308	0.339
14	--	--	--	0.246	0.274	0.302	0.330	0.359
16	--	--	--	--	0.284	0.315	0.345	0.377
18	--	--	--	--	--	0.324	0.358	0.392
20	--	--	--	--	--	0.329	0.362	0.405
22	--	--	--	--	--	--	--	0.416
24	--	--	--	--	--	--	--	0.486
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	0.361	0.408	--	--	--	--	--	--
12	0.390	0.441	0.498	0.563	--	--	--	--
14	0.413	0.467	0.528	0.597	0.669	0.743	--	--
16	0.434	0.490	0.554	0.626	0.701	0.778	--	--
18	0.451	0.501	0.576	0.651	0.729	0.809	--	--
20	0.466	0.527	0.596	0.673	0.754	0.837	0.921	1.022
22	0.478	0.540	0.610	0.689	0.772	0.857	0.951	1.046
24	0.494	0.558	0.631	0.713	0.798	0.886	0.983	1.081
	4.75	5.00	5.25	5.50	5.75	6.00		
20	1.124	1.225	1.323	1.429	1.529	1.636		
22	1.151	1.255	1.355	1.463	1.565	1.675		
24	1.189	1.296	1.400	1.512	1.618	1.731		

Man hours include unloading pipe from railroad cars or trucks and placing in shop storage, procuring necessary pipe and materials to fabricate spool piece, transporting necessary materials to point of fabrication and the transporting of finished work to temporary storage.

Units apply to any length spool piece or segment of work.

SHOP HANDLING PIPE FOR FABRICATION

Large O.D. Sizes Carbon Steel Material

DIRECT MAN HOURS PER FOOT

O. D. PIPE INCHES	WALL THICKNESS IN INCHES							
	.500 Or Less	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	0.222	0.234	0.270	0.285	0.303	0.360	0.376	0.410
28	0.251	0.264	0.290	0.322	0.352	0.380	0.410	0.440
30	0.268	0.282	0.307	0.338	0.363	0.403	0.451	0.490
32	0.286	0.301	0.334	0.364	0.402	0.434	0.469	0.502
34	0.304	0.320	0.352	0.387	0.427	0.461	0.502	0.534
36	0.336	0.354	0.386	0.421	0.453	0.506	0.563	0.610
38	0.353	0.372	0.407	0.445	0.479	0.532	0.593	0.642
40	0.372	0.392	0.428	0.468	0.504	0.560	0.624	0.676
42	0.405	0.426	0.464	0.506	0.543	0.603	0.675	--
44	0.422	0.444	0.484	0.528	0.568	0.634	0.708	--
46	0.442	0.465	0.506	0.552	0.593	0.662	0.741	--
48	0.473	0.498	0.543	0.592	0.633	0.706	0.780	--
54	0.542	0.570	0.621	0.677	0.723	0.808	0.891	--
60	0.610	0.642	0.700	0.763	0.813	0.902	1.001	--
	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25
26	0.446	0.514	0.570	0.640	0.720	0.805	0.900	0.993
28	0.453	0.521	0.580	0.650	0.726	0.819	0.910	1.000
30	0.505	0.530	0.588	0.658	0.734	0.830	0.927	1.020
32	0.517	0.543	0.595	0.670	0.740	0.842	0.940	1.041
34	0.550	0.578	0.607	0.690	0.750	0.860	0.954	1.073
36	0.628	0.659	0.692	0.734	0.778	0.877	0.970	1.105
	4.50	4.75	5.00	5.25	5.50	5.75	6.00	
26	1.100	1.194	1.305	1.410	1.520	1.630	1.751	
28	1.120	1.244	1.370	1.453	1.570	1.695	1.810	
30	1.135	1.299	1.440	1.480	1.600	1.765	1.880	
32	1.170	1.359	1.480	1.520	1.660	1.830	1.960	
34	1.204	1.400	1.520	1.570	1.690	1.855	1.995	
36	1.233	1.480	1.560	1.600	1.740	1.895	2.100	

Man hours include unloading pipe from railroad cars or trucks and placing in shop storage, procuring necessary pipe and materials to fabricate spool piece, transporting necessary materials to point of fabrication and the transporting of finished work to temporary storage.

Units apply to any length spool piece or segment of work.

NOTES ON PIPE BENDS

Minimum Bending Radii: Man hours shown for pipe bends are based upon a minimum bending radii of 5 nominal pipe size diameters, with the exception of large sizes and/or lighter walls which must be bent on longer radii. For bends having a radius of less than 5 diameters add 50% to man hours shown.

Welding Long Bends: When it is necessary to weld together two or more pieces of pipe to produce the length required in the pipe bend, add the man hours for welding.

Compound Bends: Man hours of pipe bends other than the standard types illustrated or with bends in more than one plane are obtained by adding together the man hours of the component bends that are combined to produce the compound bend.

Bends Without Tangents: For Pipe Bends (Sch. 160 and less) ordered without tangents, add 15% to man hours shown.

Bends With Long Arcs: For pipe bending with an arc exceeding 10 feet; add 100% to the bending man hours shown for each additional 10 feet of arc or part thereof.

Connecting Tangents: No. 5 Offset Bends and No. 7 U-Bends are to be considered as such only when the bends are continuous arcs or if the tangent between arcs of the same radius is 1'-0" long or less. If the tangent between arcs is longer than 1'-0", the bends should be considered as compound bends, *i. e.*, double angle bends, double quarter bends, etc.

No. 9 Expansion U-Bends are to be considered as such only when the bends are continuous arcs or if the tangents between the "U" and the 90° bends, of the same radius are 1'-0" or less. When such tangents are longer than 1'-0" the bends should be man houred as one "U" and two 90° Pipe Bends. Bends from 181° to 359° should be man houred at the same man hours as a No. 11 Bend.

Offset Bends: No. 5 Offset Bends are considered as such only when each angle is 90° or less and the connecting tangents between arcs are within the maximum of 1'-0" specified in the preceding note.

Beveled Ends: If Pipe Bends are to have the ends beveled for welding add the man hours for beveling.

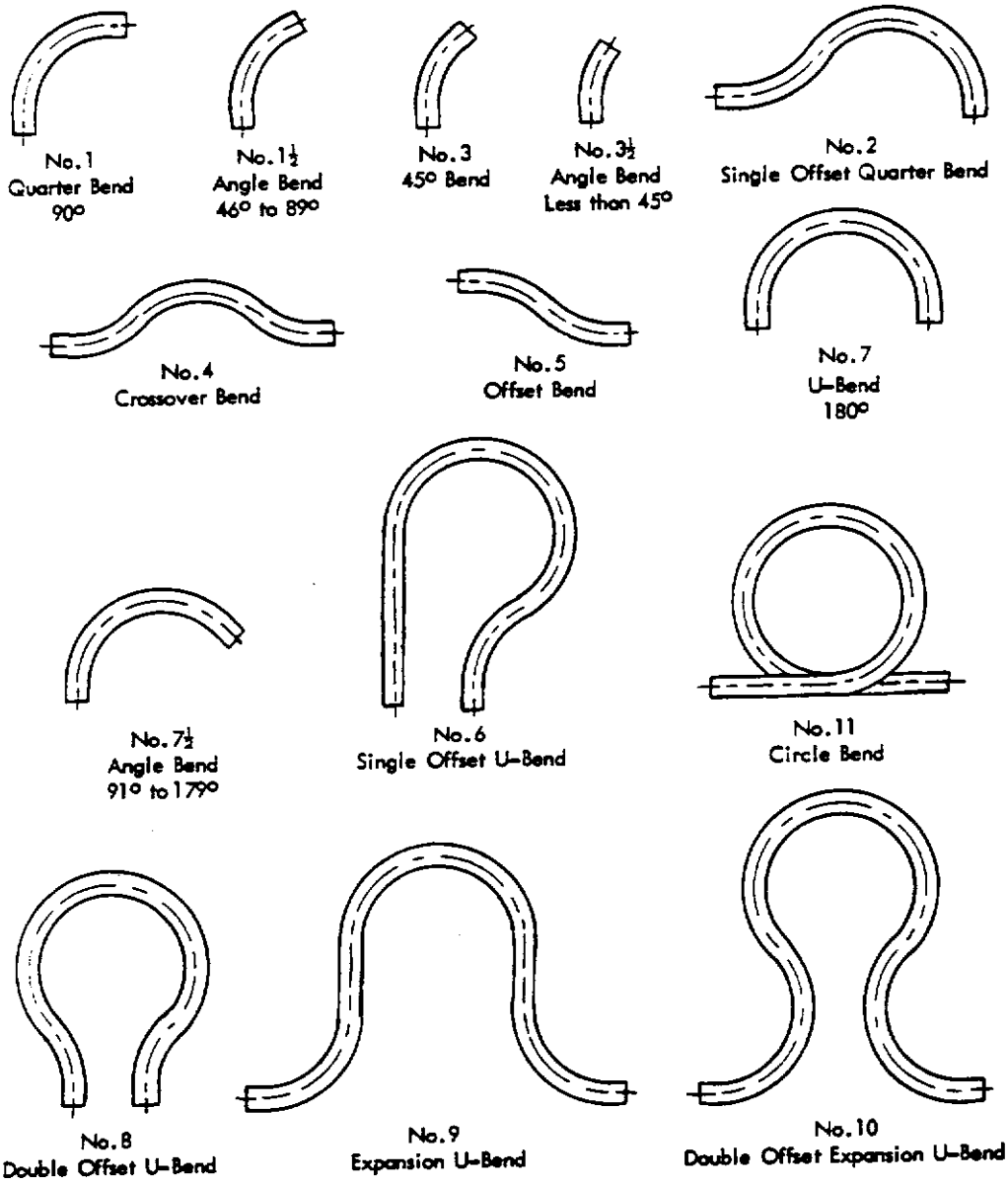
Thread Ends: If Pipe Bends are to have the ends threaded only, add the man hours for threading.

Flanged Ends: If Pipe Bends are to have the ends fitted with screwed flanges, slip-on weld flanges, welding neck flanges, or lap joints add the man hours applicable for this operation.

Preparation For Intermediate Field Welds: When Pipe Bends, particularly No. 9, 10 or 11, are too bulky for transporting or handling and therefore, must be furnished in two or more sections for assembly in the field, an extra charge should be made for the additional cuts and bevels.

Unlisted Sizes: For unlisted sizes, use the man hours of the next larger shown size.

STANDARD TYPES OF BENDS



PIPE BENDS

Schedule Numbers 20 to 100 Inclusive

Labor Only for Making Pipe Bends with Plain Ends

Carbon Steel Material
Double Extra Strong Weight

NET MAN HOURS EACH

Size Ins.	No.1-90° No.1-1/2-46° to 89° No.3-45° No.3-1/2-Less than 45°	No.7 U-180° No.7-1/2-91° to 179°	No. 5 Offset	No.2 Single Offset Quarter	No.6 Single Offset "U"	No.4 Cross-over No.9 Exp. "U"	No.8 Double Offset "U"	No.10 Double Offset Exp. No.11 Circle
1	1.6	2.0	2.4	3.0	3.6	3.5	4.4	4.9
1-1/4	1.8	2.3	2.8	3.4	4.5	4.6	5.2	5.7
1-1/2	2.0	2.6	3.1	3.8	5.0	5.2	5.9	6.6
2	2.3	3.0	3.6	4.6	5.5	6.0	6.0	8.1
2-1/2	2.9	4.1	4.5	5.8	7.2	7.5	8.9	11.7
3	3.1	4.7	5.2	6.3	8.3	8.9	10.0	12.8
3-1/2	3.9	5.2	5.9	7.8	9.7	10.4	12.4	15.8
4	4.4	6.3	6.9	8.6	10.8	11.7	13.7	17.3
5	5.9	7.8	8.3	11.0	13.6	14.6	17.4	22.0
6	7.2	9.2	10.1	12.8	16.0	17.4	21.9	25.8
8	9.4	12.6	12.8	17.3	23.5	25.0	27.3	33.0
10	12.7	17.4	17.4	22.8	31.7	33.8	38.4	43.9
12	17.3	24.4	23.6	32.1	44.8	45.6	61.1	69.4
14 OD	22.0	35.4	31.4	42.8	67.1	67.1	88.6	103.4
16 OD	28.7	54.4	41.3	56.9	83.2	83.2	--	--
18 OD	37.0	72.0	52.3	--	--	--	--	--
20 OD	48.0	--	66.8	--	--	--	--	--
24 OD	81.2	--	103.4	--	--	--	--	--

For General Notes on pipe bends, see pages 5 and 6.

PIPE BENDS

Schedule Numbers 120, 140 and 160

Labor Only for Making Pipe Bends with Plain Ends

Carbon Steel Material
Double Extra Strong Weight

NET MAN HOURS EACH

Size Ins.	No.1-90° No.1-1/2-46° to 89° No.3-45° No.3-1/2-Less than 45°	No.7 U-180° No.7-1/2-91° to 179°	No.5 Offset	No.2 Single Offset Quarter	No.6 Single Offset "U"	No.4 Cross-over No.9 Exp."U"	No.8 Double Offset "U"	No.10 Double Offset Exp. No.11 Circle
1	2.0	2.3	2.8	3.6	4.0	4.7	5.4	6.2
1-1/4	2.1	2.6	3.2	4.2	5.2	5.5	6.5	7.2
1-1/2	2.4	3.1	3.8	4.6	6.2	6.5	7.3	8.6
2	2.7	3.6	4.4	5.4	7.0	7.5	8.1	9.4
2-1/2	3.4	4.7	5.7	6.9	8.6	9.2	10.3	11.7
3	3.9	5.5	6.1	7.7	9.7	10.4	11.7	14.6
4	5.5	7.3	8.5	10.1	13.4	14.3	15.5	18.9
5	6.0	9.2	10.0	12.8	16.4	17.4	20.3	25.7
6	8.5	11.0	11.8	15.5	19.2	20.1	24.8	32.1
8	11.4	14.8	15.2	20.3	27.5	29.3	32.1	40.3
10	14.8	20.8	20.9	26.7	37.0	39.3	45.4	59.5
12	20.3	28.3	28.8	36.6	53.0	54.9	65.8	87.8
14 OD	26.6	45.8	39.7	50.9	75.8	75.8	--	--
16 OD	34.4	64.6	50.9	66.4	103.4	103.4	--	--
18 OD	44.0	82.7	64.7	--	--	--	--	--
20 OD	54.4	--	--	--	--	--	--	--
24 OD	89.2	--	--	--	--	--	--	--

For General Notes on pipe bends, see pages 5 and 6.

PIPE BENDS

Heavy Wall—45° or Less

Labor only for Making Pipe Bends With Plain Ends
Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	7.50	1.00	1.25	1.50	1.75	2.00	2.25	2.50
4" or less	6.6	7.5	8.7	10.1	--	--	--	--
5	--	8.6	10.1	11.8	13.5	15.7	--	--
6	--	10.2	11.8	14.2	16.0	19.4	22.6	--
8	--	13.9	14.4	17.0	19.7	23.0	27.2	31.4
10	--	--	17.8	19.5	21.5	24.8	28.7	33.8
12	--	--	--	22.1	23.3	26.9	31.5	36.8
14	--	--	--	25.4	26.4	29.4	34.6	40.1
16	--	--	--	--	32.4	35.3	39.2	45.8
18	--	--	--	--	--	40.3	45.7	53.3
20	--	--	--	--	--	51.8	52.2	62.0
22	--	--	--	--	--	--	--	69.8
24	--	--	--	--	--	--	--	89.2
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	34.9	38.2	--	--	--	--	--	--
12	39.7	43.9	47.2	51.6	--	--	--	--
14	43.6	48.0	52.1	56.8	61.0	66.4	--	--
16	50.1	54.5	58.8	64.2	69.7	76.2	--	--
18	57.6	63.2	68.6	74.0	80.8	88.1	--	--
20	67.6	73.0	78.4	85.0	92.5	100.2	111.6	124.9
22	75.6	81.6	88.1	94.7	103.4	116.5	124.3	133.3
24	92.1	94.9	98.1	104.5	114.2	132.9	140.5	151.2
	4.75	5.00	5.25	5.50	5.75	6.00		
20	133.3	144.0	153.1	164.6	178.3	191.6		
22	144.0	155.6	165.6	176.5	190.9	205.3		
24	162.1	172.8	183.7	194.5	207.1	223.3		

For General Notes on pipe bends, see pages 5 and 6.

PIPE BENDS

Heavy Wall—Over 45° to 90° Inclusive

Labor Only For Making Pipe Bends With Plain Ends
Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	7.50	1.00	1.25	1.50	1.75	2.00	2.25	2.50
4" or Less	6.6	7.5	8.7	10.1	--	--	--	--
5	--	8.6	10.1	11.8	13.5	15.7	--	--
6	--	10.2	11.8	14.2	16.0	19.4	22.6	--
8	--	13.9	14.4	17.0	19.7	23.0	27.2	31.4
10	--	--	17.8	19.5	21.5	24.8	28.7	33.8
12	--	--	--	22.1	23.3	26.9	31.5	36.8
14	--	--	--	27.0	28.2	31.3	36.0	42.5
16	--	--	--	--	34.6	37.3	41.4	48.0
18	--	--	--	--	--	42.5	47.9	56.6
20	--	--	--	--	--	55.8	56.4	65.2
22	--	--	--	--	--	--	--	74.0
24	--	--	--	--	--	--	--	91.1
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	34.9	38.2	--	--	--	--	--	--
12	39.7	43.9	47.2	51.6	--	--	--	--
14	45.8	50.1	54.5	60.0	64.3	69.7	--	--
16	52.3	57.1	63.0	67.9	74.0	80.6	--	--
18	61.2	67.6	73.0	79.0	86.8	93.6	--	--
20	70.8	76.2	82.8	90.4	98.0	106.8	119.5	133.3
22	81.0	88.4	95.8	104.5	114.1	124.2	132.1	144.0
24	96.0	100.2	109.0	119.8	130.7	141.6	149.8	161.0
	4.75	5.00	5.25	5.50	5.75	6.00		
20	144.0	153.1	163.9	175.4	189.1	203.5		
22	154.9	165.6	176.5	187.3	200.3	216.1		
24	172.8	183.7	194.5	208.9	223.3	237.7		

For General Notes on pipe bends, see pages 5 and 6.

For bends 91° through 180° add 75% to the above man hours.

PIPE BENDS

Large O. D. Sizes

Labor Only for Making Pipe Bends with Plain Ends

Carbon Steel Material

MAN HOURS FOR 10' OF ARC OR PORTION THEREOF

O. D. Pipe Inches	WALL THICKNESS IN INCHES							
	.500 Or Less	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	100.2	101.4	102.0	103.2	104.4	106.2	106.8	115.2
28	114.6	115.8	116.4	118.2	119.4	121.2	123.6	131.4
30	138.6	139.2	140.4	142.2	143.4	145.8	148.2	154.8
32	172.8	174.6	176.4	178.2	180.6	183.6	187.8	194.4
34	216.0	217.8	221.4	223.2	225.6	228.6	231.6	238.2
36	262.8	265.2	266.4	270.0	272.4	277.2	279.0	284.4
	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25
26	120.6	126.0	138.8	138.6	144.0	151.2	158.4	167.4
28	135.0	140.4	145.8	151.2	158.4	166.2	176.4	185.4
30	160.8	165.0	171.0	176.4	183.6	189.6	198.1	208.2
32	199.8	205.2	212.4	217.8	225.0	230.4	237.6	244.8
34	229.8	250.2	255.6	261.0	268.2	271.8	277.2	284.4
36	289.8	295.2	300.6	306.0	313.2	319.2	325.8	333.0
	4.50	4.75	5.00	5.25	5.50	5.75	6.00	
26	176.4	189.0	199.8	210.6	223.2	237.6	253.6	
28	195.0	205.2	216.0	228.6	241.2	255.6	271.8	
30	217.8	227.4	239.4	250.2	264.6	281.2	291.6	
32	253.8	262.8	273.0	286.2	297.0	307.8	322.2	
34	291.6	300.6	311.4	320.4	333.0	345.6	360.0	
36	340.2	348.0	357.0	367.2	378.0	388.8	403.2	

For General Notes on pipe bends, see pages 5 and 6.

ATTACHING FLANGES—SCREWED TYPE

Labor—Cutting and Threading Pipe—Making on Screwed Flanges and Refacing

Carbon Steel Material
For Bends, Headers, Necks and Straight Runs of Pipe

NET MAN HOURS EACH

Pipe Size Inches	125 Lb. Cast Iron and 150 Lb. Steel	250 Lb. Cast Iron and Steel 300 Lb. and Higher
2 or less	1.0	1.2
2-1/2	1.1	1.3
3	1.2	1.4
3-1/2	1.4	1.6
4	1.5	1.7
5	1.6	1.9
6	1.8	2.0
8	2.1	2.4
10	2.6	2.9
12	3.1	3.5
14 OD	3.8	4.3
16 OD	4.6	5.2
18 OD	5.5	6.2
20 OD	6.5	7.4
24 OD	9.3	10.6

Flanges: Man hours are for labor only. The price of the flange must be added in all cases.

Pipe Thickness: Man hours are for any wall thickness of pipe used with listed flange.

Unlisted Sizes: Unlisted sizes take the next higher listing.

ATTACHING FLANGES—SCREWED TYPE

Labor—Cutting and Threading Pipe, Making on Flange,
Manual Seal Welding at Back and Refacing

Carbon Steel Material
Straight Pipe, Bends, Headers and Nozzles

NET MAN HOURS EACH

Size Inches	SERVICE PRESSURE RATING						
	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
2 or less	1.4	1.5	1.7	1.7	2.2	2.2	2.9
2-½	1.5	1.7	1.9	1.9	2.3	2.3	3.1
3	1.7	1.9	2.0	2.0	2.6	2.6	3.4
3½	1.9	2.1	2.3	2.3	--	--	--
4	2.0	2.3	2.5	2.6	3.0	3.3	3.7
5	2.3	2.6	2.9	3.1	3.4	3.8	4.3
6	2.7	3.0	3.5	3.7	4.1	4.5	5.0
8	3.3	3.7	4.4	4.5	4.9	5.5	6.2
10	4.2	4.7	4.9	5.4	5.9	6.6	7.3
12	4.8	5.4	5.9	6.4	6.9	7.6	8.5
14 OD	5.8	6.5	7.2	8.1	9.9	10.7	--
16 OD	7.2	7.9	8.7	9.6	10.7	11.8	--
18 OD	8.3	9.0	9.7	10.6	11.7	13.1	--
20 OD	9.3	10.1	11.0	12.1	13.3	14.9	--
24 OD	13.0	13.8	14.6	15.6	16.8	18.3	--

Flanges: Man hours are for labor only. The price of the flange must be added in all cases.

Pipe Thickness: Man hours are for any wall thickness of pipe used with listed flange.

Unlisted Sizes: Unlisted sizes take the next higher listing.

ATTACHING FLANGES—SCREWED TYPE

Labor—Cutting and Threading Pipe, Making on Flange.
Manual Seal Welding at Back and Front and Refacing

Carbon Steel Material,
Straight Pipe, Bends, Headers and Nozzles

NET MAN HOURS EACH

Pipe Size Inches	SERVICE PRESSURE RATING						
	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
2 or less	1.7	1.9	2.1	2.1	2.7	2.7	3.4
2½	1.9	2.1	2.3	2.3	2.9	2.9	3.7
3	2.1	2.3	2.5	2.5	3.2	3.2	4.0
3½	2.3	2.5	2.8	2.8	--	--	--
4	2.5	2.8	3.1	3.3	3.7	4.2	4.6
5	2.9	3.2	3.6	3.9	4.2	4.8	5.3
6	3.4	3.8	4.4	4.6	5.1	5.6	6.1
8	4.1	4.7	5.5	5.6	6.2	6.9	7.6
10	5.3	5.8	6.2	6.8	7.5	8.3	9.3
12	6.0	6.8	7.4	7.9	8.5	9.2	10.0
14 OD	7.2	8.1	8.9	9.9	11.1	12.2	--
16 OD	9.0	9.9	10.9	12.1	13.6	15.0	--
18 OD	10.4	11.3	12.3	13.5	14.7	16.2	--
20 OD	11.6	12.7	13.8	15.2	16.6	18.1	--
24 OD	16.2	17.3	18.2	19.6	21.0	22.5	--

Flanges: Man hours are for labor only. The price of the flange must be added in all cases.

Pipe Thickness: Man hours are for any wall thickness of pipe used with listed flange.

Unlisted Sizes: Unlisted sizes take the next higher listing.

ATTACHING FLANGES—SLIP-ON TYPE

Labor—Slipping on Flange
Manual Welding at Front and Back

Carbon Steel Material

NET MAN HOURS EACH

Size Inches	SERVICE PRESSURE RATING						
	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
1	0.8	0.9	1.2	1.2	1.4	1.6	1.8
1¼	0.9	1.0	1.2	1.2	1.6	1.8	2.0
1½	0.9	1.1	1.2	1.2	1.6	1.8	2.0
2	1.1	1.2	1.6	1.6	2.1	2.4	2.6
2½	1.3	1.5	2.0	2.0	2.6	2.9	3.2
3	1.6	1.8	2.5	2.5	3.1	3.5	3.9
3½	1.9	2.1	2.9	2.9	--	--	--
4	2.1	2.3	3.0	3.3	4.2	4.7	5.2
5	2.6	2.9	3.9	4.2	5.3	5.9	6.5
6	3.1	3.4	4.5	5.1	6.3	7.1	7.8
8	4.3	4.6	6.2	6.8	8.3	9.3	10.2
10	5.3	5.8	7.6	9.4	10.6	11.9	13.1
12	6.5	7.0	9.3	11.6	13.0	14.6	16.1
14 OD	7.6	8.5	11.0	13.7	15.0	16.8	--
16 OD	8.9	9.6	12.7	15.6	17.0	19.0	--
18 OD	10.3	11.4	14.8	17.9	20.1	22.5	--
20 OD	12.4	13.6	17.9	20.1	23.3	26.1	--
24 OD	15.5	17.0	21.7	26.4	29.5	33.0	--
26 OD	-	-	23.5	28.6	32.0	-	-
30 OD	-	-	27.1	33.0	36.9	-	-
34 OD	-	-	30.7	37.4	41.8	-	-
36 OD	-	-	32.5	39.6	44.2	-	-
42 OD	-	-	37.9	46.2	-	-	-

Flanges: Man hours are for labor attaching the flange perpendicular to the centerline of a section of straight pipe or to a straight section of pipe on the end of a bend.

Pipe Thickness: Man hours are for any wall thickness of pipe used with listed flanges.

Weld Fittings or Bends: For attaching flanges to weld fittings or bends with no straight tangents or on a straight section of pipe, but other than perpendicular to the centerline, add 25% to the above man hours.

Refacing: For flanges requiring refacing after welding increase above man hours 50%.

ATTACHING FLANGES—SLIP-ON TYPE

Labor—Slipping on Flange and
Machine Welding at Front and Back

Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	SERVICE PRESSURE RATING						
	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
2	.66	.72	.96	.96	1.26	1.44	1.56
2-1/2	.78	.90	1.20	1.20	1.56	1.74	1.92
3	.96	1.08	1.50	1.50	1.86	2.10	2.34
4	1.26	1.38	1.80	1.98	2.52	2.82	3.12
6	1.55	1.70	2.25	2.55	3.15	3.55	3.90
8	1.72	1.84	2.48	2.72	3.32	3.72	4.10
10	2.12	2.32	3.04	3.76	4.24	4.76	5.24
12	2.18	2.45	3.26	4.06	4.55	5.11	5.64
14 OD	2.28	2.55	3.30	4.11	4.80	5.88	--
16 OD	2.67	2.88	3.81	4.68	5.10	6.65	--
18 OD	3.09	3.42	4.40	5.37	6.03	6.75	--
20 OD	3.72	4.08	5.37	6.03	6.99	7.83	--
24 OD	4.65	5.10	6.51	7.92	8.85	9.90	--
26 OD	-	-	7.05	8.58	9.59	-	-
30 OD	-	-	8.14	9.90	11.06	-	-
34 OD	-	-	9.22	11.22	12.54	-	-
36 OD	-	-	9.76	11.88	13.28	-	-
42 OD	-	-	11.39	13.86	-	-	-

Man hours include slipping-on carbon steel flange, tack welding and machine submerged arc. Welding both front and back. For sizes 2" through 4" time is included for manual welding on front.

Man hours are for any wall thickness of pipe used with listed flange.

Above man hours should be used in lieu of manual welding slip-on flanged joints on all shop machine welded slip-on flanges which can be rotated.

Unlisted sizes take the next highest listing.

For additional information see notes at bottom of preceding page.

ATTACHING FLANGES—WELD NECK TYPE

Labor—Aligning Flange and Butt Welding

Carbon Steel Material
NET MAN HOURS EACH

Size Ins.	SERVICE PRESSURE RATING						
	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
2	1.05	1.20	1.20	1.50	1.50	1.60	1.70
2½	1.40	1.60	1.60	1.80	1.80	1.90	2.20
3	1.70	1.90	1.90	2.20	2.20	2.30	2.40
4	2.10	2.30	2.30	2.60	2.60	2.90	3.00
6	2.90	3.20	3.20	3.50	3.50	3.90	4.00
8	3.60	3.90	3.90	4.30	4.30	4.90	5.10
10	4.50	4.80	4.80	5.30	5.30	6.10	6.20
12	5.25	5.70	5.70	6.30	6.30	7.40	8.00
14 OD	6.10	6.60	6.60	7.40	7.40	8.90	—
16 OD	7.10	7.70	7.70	8.60	8.60	11.30	—
18 OD	8.30	8.90	8.90	10.10	10.10	12.00	—
20 OD	9.10	9.90	9.90	11.20	11.20	14.30	—
24 OD	10.20	11.10	11.10	12.70	12.70	16.30	—
26 OD	—	—	12.03	13.76	13.76	—	—
30 OD	—	—	13.88	15.88	15.88	—	—
34 OD	—	—	15.73	18.00	18.00	—	—
36 OD	—	—	16.65	19.06	19.06	—	—
42 OD	—	—	19.43	22.23	—	—	—

Man hours include aligning and tack welding carbon steel weld neck flange and machine submerged arc butt welding to pipe.

Man hours are for any wall thickness of pipe used with listed flanges.

Unlisted sizes take the next highest listing.

ATTACHING ORIFICE FLANGES—SLIP-ON AND THREADED TYPES

Carbon Steel Material

MAN HOURS PER PAIR

Size Ins.	SERVICE PRESSURE RATING			
	Slip-On Type		Threaded Types	
	300 Lb.	300 Lb.	400–600 Lb.	900–1500 Lb.
3	5.3	4.7	—	8.3
4	6.5	6.5	7.4	9.5
6	9.0	8.0	9.3	12.0
8	12.2	9.9	12.9	14.8
10	15.5	12.8	15.8	18.2
12	18.3	16.1	18.9	21.6
14	22.0	18.5	—	—
16	25.1	21.2	—	—
18	28.7	24.5	—	—
20	33.9	27.8	—	—
24	41.0	35.3	—	—
26	53.4	—	—	—
30	60.5	—	—	—
34	69.0	—	—	—
36	74.1	—	—	—
42	80.1	—	—	—

Slip-On Types: Man hours include slipping on, welding, placement of paddle-type plates, and bolting of pair of orifice flanges.

Threaded Types: Man hours include screwing on, placement of paddle-type plates, and bolting up of pair of orifice-type flanges.

All man hours exclude cutting, beveling, or threading of pipe. See respective tables for these man hours.

ATTACHING ORIFICE FLANGES—WELD NECK TYPE

Carbon Steel Material

MAN HOURS PER PAIR

Size Ins.	SERVICE PRESSURE RATING				
	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.
3	5.6	6.0	7.7	7.8	8.3
4	7.8	8.2	9.4	9.5	10.7
6	9.8	10.4	12.2	12.4	13.8
8	13.1	13.4	15.6	15.9	18.2
10	14.7	15.0	19.4	20.2	21.6
12	16.8	18.8	20.3	21.5	24.3
14	19.2	20.5	22.8	24.1	27.8
16	21.2	22.0	27.6	28.2	31.2
18	26.1	26.9	29.7	31.1	35.9
20	28.7	29.4	33.3	34.1	41.6
24	37.1	37.8	43.3	44.2	–
26	–	41.1	44.9	45.6	–
30	–	47.5	50.9	52.6	–
34	–	57.2	60.7	62.6	–
36	–	60.0	67.4	68.7	–
42	–	87.6	91.7	–	–

Man hours include setting, aligning, welding, placement of paddle-type plates, and bolting up of pair of orifice flanges.

Man hours exclude cutting and beveling of pipe. See respective tables for these man hours.

GENERAL WELDING NOTES

Backing Rings: When backing rings are used, add 25% to the welding man hours to cover extra problems in fit-up. In addition the following percentages should be added if applicable:

1) When backing rings are tack welded in on one side, add 10% to the man hours of a standard thickness butt weld.

2) When backing rings are completely welded in on one side, add 30% to the man hours of a standard thickness butt weld.

3) Preheating and stress relieving, when required, should be charged at full butt weld preheating and stress relieving man hours for the size and thickness in which the backing ring is installed.

Nozzle Welds: Following percentage increases should be allowed for the following conditions:

1) When nozzle welds are to be located off-center of the run(except tangential) increase man hours shown for nozzle welds, 50%.

2) Add 80% to nozzle welds for tangential nozzle welds.

3) When nozzle welds are to be located on a fitting increase nozzle weld man hours 50%.

Long Neck Nozzle Welds: The welding-on of long neck nozzles should be charged at the schedule 160 reinforced nozzle weld man hours.

Shaped Nozzles, Nozzle Weld Fit-Ups and Dummy Nozzle Welds: These should be charged at a percentage of the completed nozzle weld man hours as follows:

1) Shaped Branch 50%
2) Shaped Hole in Header 50%
3) Fit-up of Both Branch or Header (whether tack-welded or not) 60%
4) Dummy Nozzle Weld (no holes in header) 70%

Sloping Lines: Add 100% to all welding man hours for this condition.

Consumable Inserts: When consumable inserts are used, add the following percentages to the welding man hours to cover extra problems in fit-up:

1) Through 1/2" wall 40%
2) Over 1/2" through 1" wall 30%
3) Over 1" through 2" wall 20%
4) Over 2" through 3" wall 15%
5) Over 3" wall 10%

SPECIAL FITTING AND PREPARATION FOR INERT GAS SHIELDED ROOT PASS WELDING

Butt Welds

NET MAN HOURS EACH

CARBON STEEL, CHROME ALLOY AND STAINLESS STEEL

Pipe Size Inches	All Thicknesses	Pipe Size Inches	All Thicknesses
2" or less	0.45	26 O.D.	5.37
2-1/2	0.64	28 O.D.	6.12
3	0.75	30 O.D.	6.48
4	0.94	32 O.D.	6.83
5	1.14	34 O.D.	6.88
6	1.36	36 O.D.	7.06
8	1.67	38 O.D.	7.39
10	1.92	40 O.D.	8.23
12	2.06	42 O.D.	9.06
14 O.D.	2.66	44 O.D.	9.87
16 O.D.	3.19	46 O.D.	10.93
18 O.D.	3.90	48 O.D.	11.99
20 O.D.	4.22	54 O.D.	13.15
24 O.D.	4.68	60 O.D.	14.42

Man hours shown will apply either with or without an internal nitrogen purge.

For internal argon purge, increase above man hours 20 percent.

Man hours do not include the use of an oxygen analyzer.

Man hours do not include the installation of consumable inserts or end preparation for consumable inserts.

For preparation of nozzle welds, 'olet welds, coupling welds, and mitre butt welds for inert gas shielded root pass add 100 percent to the above man hours.

If the purge is to be held longer than the first two passes, increase the above man hours 50 percent for each additional pass for which the purge is held.

MACHINE BUTT WELDS

Submerged Arc Butt Welds
Carbon Steel Material
NET MAN HOURS EACH

Size Ins.	SCHEDULE NUMBER			
	40	60	80	160
2	.40	--	.45	.70
2-1/2	.50	--	.55	.80
3	.55	--	.60	.90
4	.65	--	.80	1.30
6	.90	--	1.05	2.15
8	.99	1.0	1.12	2.92
10	1.08	1.36	1.72	4.44
12	1.19	1.54	1.96	5.32
14 O.D.	1.26	1.74	2.43	--
16 O.D.	1.68	2.13	3.15	--
18 O.D.	2.19	2.85	4.17	--
20 O.D.	2.37	3.51	4.95	--
24 O.D.	3.36	5.10	7.89	--

Man hours include cutting, beveling, fitting, tack welding, manual single pass or backing ring, machine set-up and submerged welding.

Above man hours should be used in lieu of manual butt weld man hours on all shop machine welds which can be rotated.

Above man hours do not include preheating, grinding or stress relieving. See respective tables for these charges.

This procedure not applicable to alloy pipe.

All sizes of butt welds shown below the ruled lines are ¾" or greater in wall thickness and must be stress relieved.

MANUAL BUTT WELDS

Labor for Welding Only
Carbon Steel Materials
NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
1	0.6	0.7	--	--	0.6	--	0.7	--	--	--	0.9
1-1/4	0.7	0.7	--	--	0.7	--	0.7	--	--	--	1.0
1-1/2	0.7	0.8	--	--	0.7	--	0.8	--	--	--	1.1
2	0.8	0.9	--	--	0.8	--	0.9	--	--	--	1.4
2-1/2	1.0	1.1	--	--	1.0	--	1.1	--	--	--	1.6
3	1.1	1.2	--	--	1.1	--	1.2	--	--	--	1.8
3-1/2	1.2	1.4	--	--	1.2	--	1.4	--	--	--	--
4	1.3	1.6	--	--	1.3	--	1.6	--	2.4	--	2.6
5	1.5	1.9	--	--	1.5	--	1.9	--	2.5	--	3.3
6	1.8	2.1	--	--	1.8	--	2.1	--	3.2	--	4.3
8	2.2	2.8	2.2	2.2	2.2	2.5	2.8	3.8	5.1	6.4	7.3
10	2.7	3.4	2.7	2.7	2.7	3.4	4.3	5.8	8.0	9.6	11.1
12	3.1	4.0	3.1	3.1	3.4	4.4	5.6	8.4	10.4	13.0	15.2
14 OD	3.6	4.8	3.6	3.6	4.2	5.8	8.1	11.2	13.7	16.3	19.2
16 OD	4.2	5.6	4.2	4.2	5.6	7.1	10.5	14.3	17.6	21.1	23.5
18 OD	4.9	6.5	4.9	5.7	7.3	9.5	13.9	18.5	21.7	25.4	28.6
20 OD	5.3	7.1	5.3	7.1	7.9	11.7	16.5	22.1	27.0	31.3	34.6
24 OD	5.9	8.5	5.9	10.5	11.2	17.0	26.3	30.4	36.9	41.8	50.2

Pipe Thickness: Wall thickness of the pipe determines the man hours that will apply. For butt welds of double extra strong materials, use Schedule 160 listings.

Mitre Welds: Add 50% to butt weld man hours.

Cutting and Beveling Pipe: Man hours do not include cutting and beveling of pipe. See respective tables for these charges.

Preheating: If specified or required by Codes, add for this operation. See man hours for preheating.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A. S. A. Code of Pressure piping where the wall thickness is 3/4" or greater.

All sizes of butt welds shown below the ruled lines are 3/4" or greater in wall thickness and must be stress relieved.

Where stress relieving is required, an extra charge should be made. See man hours for stress relieving.

Unlisted Sizes: Unlisted sizes take the next higher listing.

General Notes: For additional notes on welding see page 18.

MANUAL HEAVY WALL BUTT WELDS

Labor for Welding Only

Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	2.3	3.1	--	--	--	--	--	--
4	2.8	3.5	4.8	5.8	--	--	--	--
5	--	4.0	5.7	6.8	8.5	10.5	--	--
6	--	5.4	7.2	8.8	11.3	13.2	15.4	--
8	--	7.4	8.6	11.1	14.0	16.3	19.2	23.2
10	--	--	11.4	13.7	17.0	19.7	23.1	27.2
12	--	--	--	16.6	19.7	23.2	27.5	31.8
14	--	--	--	19.9	22.5	26.4	30.9	36.5
16	--	--	--	--	25.3	30.2	35.2	42.1
18	--	--	--	--	--	33.7	39.3	46.4
20	--	--	--	--	--	39.3	46.4	56.1
22	--	--	--	--	--	--	--	61.3
24	--	--	--	--	--	--	--	66.7
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	31.1	35.7	--	--	--	--	--	--
12	36.3	41.6	46.9	53.5	--	--	--	--
14	41.4	47.0	53.3	60.4	68.8	77.2	--	--
16	47.7	54.8	61.8	70.2	80.8	91.2	--	--
18	53.3	61.8	70.2	80.5	91.9	105.2	--	--
20	63.9	71.6	82.1	92.6	105.2	119.3	135.3	146.7
22	69.8	78.6	89.4	101.1	114.9	130.6	148.1	163.9
24	75.8	83.9	96.9	109.5	124.9	141.9	160.8	177.4
	4.75	5.00	5.25	5.50	5.75	6.00		
20	160.8	172.3	183.8	191.4	213.1	227.2		
22	173.6	186.3	203.9	214.1	234.6	250.1		
24	189.4	203.9	222.8	233.5	252.7	270.3		

For General Notes on welding, see pages 20 and 23.

MANUAL LARGE O.D. BUTT WELDS

Labor for Welding Only

Carbon Steel Material

NET MAN HOURS EACH

O.D. PIPE INCHES	WALL THICKNESS IN INCHES							
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00
26	7.1	9.7	12.8	17.1	22.6	29.2	36.8	44.5
28	8.5	11.1	13.9	18.8	24.8	31.6	39.3	47.2
30	10.6	12.9	16.0	20.4	26.9	33.7	42.0	49.9
32	13.1	15.2	18.2	22.6	29.6	36.4	44.7	52.6
34	16.4	18.2	20.7	25.0	33.3	39.1	47.7	55.4
36	19.5	20.9	23.6	28.1	38.3	44.1	52.8	60.8
38	22.9	24.5	27.1	31.4	44.1	49.8	58.1	66.2
40	26.8	29.0	31.2	35.2	50.6	56.2	63.9	72.2
42	31.3	34.2	36.0	39.5	58.3	63.6	70.2	78.7
44	36.3	39.5	42.3	48.3	63.5	70.5	76.5	85.8
46	40.9	45.0	49.4	57.5	70.1	77.5	83.3	92.9
48	46.2	50.8	57.7	67.0	77.0	84.7	90.5	100.1
54	52.0	57.3	67.4	78.1	84.5	92.6	98.3	107.9
60	58.5	64.6	78.7	91.0	92.8	101.2	106.8	116.3
	2.75	2.50	2.75	3.00	3.25	3.50	3.75	4.00
26	52.3	72.0	81.6	93.2	104.7	117.4	135.3	152.9
28	55.1	77.1	88.5	99.6	117.1	127.4	148.1	165.4
30	57.9	84.3	95.7	107.2	122.2	136.5	157.0	177.4
32	60.5	88.1	100.8	112.6	129.7	144.2	166.9	188.9
34	65.2	93.2	107.2	120.5	136.8	152.9	177.4	201.6
36	70.3	99.6	114.3	127.7	145.5	162.9	188.6	211.9
	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
26	172.3	191.4	206.7	221.8	234.6	252.7	274.3	293.0
28	186.3	207.5	221.5	237.4	253.9	272.9	292.8	311.4
30	199.1	219.0	238.6	255.2	273.1	291.0	314.5	339.0
32	211.9	234.8	252.7	270.6	291.0	310.0	334.4	359.9
34	227.2	252.7	270.6	288.9	310.9	331.8	357.3	382.8
36	239.4	265.4	285.9	305.8	328.0	349.7	377.7	405.3

For General Notes on welding, see pages 20 and 23.

90° WELDED NOZZLES

Labor For Cutting And Welding
Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
1	1.8	1.9	--	--	1.8	--	1.9	--	--	--	2.7
1-1/4	1.9	2.1	--	--	1.9	--	2.1	--	--	--	3.1
1-1/2	2.1	2.3	--	--	2.1	--	2.3	--	--	--	3.5
2	2.2	2.7	--	--	2.2	--	2.7	--	--	--	4.6
2-1/2	2.4	3.3	--	--	2.4	--	3.3	--	--	--	5.1
3	2.8	3.8	--	--	2.8	--	3.8	--	--	--	5.7
3-1/2	3.2	4.3	--	--	3.2	--	4.3	--	--	--	--
4	3.5	4.9	--	--	3.5	--	4.9	--	6.1	--	7.5
5	4.4	6.0	--	--	4.4	--	6.0	--	7.5	--	9.3
6	4.7	6.5	--	--	4.7	--	6.5	--	9.5	--	12.1
8	5.3	7.5	5.3	5.3	5.3	7.0	7.5	10.2	12.9	15.8	18.2
10	6.0	8.7	6.0	6.0	6.0	8.7	10.7	13.9	17.9	23.1	27.8
12	6.9	10.0	6.9	6.9	8.4	11.1	14.4	19.9	24.3	29.4	33.2
14 OD	7.9	11.5	7.9	7.9	9.8	13.6	19.2	24.5	29.3	33.0	40.6
16 OD	9.0	12.9	9.0	9.0	12.9	17.1	22.7	30.9	35.1	38.8	46.9
18 OD	9.8	13.8	9.8	12.8	16.2	21.6	25.5	37.4	41.5	45.0	58.7
20 OD	11.0	15.5	11.0	15.5	18.9	27.6	30.0	43.3	47.3	51.6	65.9
24 OD	12.0	16.8	12.0	18.0	23.5	35.3	39.0	55.0	59.0	66.0	77.1

All Nozzles other than 90° should be charged at the man hours shown for 45° nozzles.

Pipe Thickness: Wall thickness of the pipe used for the nozzle determines the man hours that will apply. For nozzle of double extra strong pipe thickness, use Schedule 160 man hours.

Reinforcement: Man hours given above are for plain welded nozzles only. For use of Gusset plates, etc., as stiffeners not for reinforcement, add 25% to the net man hours shown above. If reinforcement is required and produced by building up the nozzle weld, or by the use of reinforcing rings or saddles as specified, use man hours for 90° reinforced nozzles.

Preheating: If specified or required by Codes, add for this operation. See man hours for preheating. The size and wall thickness of header (not the size of the nozzle) determines the preheating man hours.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A. S. A. Code for Pressure Piping, where the wall thickness is 3/4" or greater. The size and wall thickness of the header determines the man hours to be used for stress relieving.

All pipe sizes shown below the ruled line are 3/4" or greater in wall thickness and must be stress relieved. Where stress relieving is required an extra charge should be made. See man hours for stress relieving.

For General Notes on welding, see pages 20 and 23.

90° WELDED NOZZLES—REINFORCED

Labor For Cutting and Welding

Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
1-1/2	4.4	4.7	--	--	4.4	--	4.7	--	--	--	6.7
2	4.6	5.1	--	--	4.6	--	5.1	--	--	--	8.6
2-1/2	5.0	6.1	--	--	5.0	--	6.1	--	--	--	9.4
3	5.8	6.9	--	--	5.8	--	6.9	--	--	--	10.4
3-1/2	6.5	7.6	--	--	6.5	--	7.6	--	--	--	--
4	7.0	8.7	--	--	7.0	--	8.7	--	10.9	--	13.3
5	8.5	10.3	--	--	8.5	--	10.3	--	13.1	--	16.0
6	8.9	11.1	--	--	8.9	--	11.1	--	16.1	--	20.1
8	9.9	12.3	9.9	9.9	9.9	11.3	12.3	16.8	20.8	24.8	27.8
10	10.8	13.8	10.8	10.8	10.8	13.8	17.1	22.1	26.3	29.5	33.1
12	12.0	15.5	12.0	12.0	13.0	17.2	22.3	30.1	33.5	37.8	40.4
14 OD	13.6	17.5	13.6	13.6	15.1	20.6	29.2	37.3	39.7	44.6	51.3
16 OD	15.2	19.7	15.2	15.2	19.3	25.5	34.0	46.4	48.7	51.4	59.3
18 OD	16.2	20.2	16.2	18.7	23.7	31.7	38.1	50.4	52.4	55.4	74.2
20 OD	17.9	22.5	17.9	22.4	37.4	40.0	47.0	54.0	62.5	71.8	83.3
24 OD	18.9	23.5	18.9	25.7	30.9	44.5	50.4	61.3	72.6	84.0	97.4

All Nozzles other than 90° should be charged at the man hours shown for 45° nozzles.

Pipe Thickness: Wall thickness of the pipe used for the nozzle determines the man hours that will apply. For nozzles of double extra strong pipe thickness, use Schedule 160 man hours.

Reinforcement: Man hours are for labor only. The price of the nozzle and reinforcing materials must be added.

Preheating: If specified or required by Codes, add for this operation. See man hours for preheating. The size and wall thickness of header (not the size of the nozzle) determines the preheating man hours.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A.S.A. Code for Pressure Piping, where the wall thickness is 3/4" or greater. The size and wall thickness of the header determines the man hours to be used for stress relieving.

All pipe sizes shown below the ruled line are 3/4" or greater in wall thickness and must be stress relieved. Where stress relieving is required an extra charge should be made. See man hours for stress relieving.

For General Notes on welding, see pages 20 and 23.

LARGE O.D. 90° NOZZLE WELDS

Labor For Cutting And Welding

Carbon Steel Material

NET MAN HOURS EACH

O. D. Pipe Inches	NON REINFORCED 90° NOZZLE WELDS								
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	21.0	24.6	27.0	38.5	45.2	58.0	66.9	75.4	88.6
28	23.8	28.1	29.4	42.4	49.7	63.3	71.3	79.9	93.3
30	28.1	32.4	33.9	45.9	53.8	67.3	76.1	84.5	98.1
32	32.8	36.7	38.9	50.7	59.1	72.9	81.0	88.9	102.3
34	39.5	40.8	43.8	56.3	66.6	78.3	86.5	93.7	110.3
36	45.6	46.7	50.1	63.3	76.5	88.0	95.8	102.8	119.0
38	51.5	52.7	57.6	71.5	88.1	99.5	106.4	112.1	128.6
40	58.2	59.6	66.3	80.8	101.3	112.4	118.1	122.2	138.9
42	65.8	67.3	76.2	91.3	116.5	127.0	131.1	133.1	150.0
48	72.0	76.8	86.9	104.2	133.0	145.0	149.8	152.2	171.4
54	81.0	86.4	97.7	117.2	149.6	163.1	168.5	171.2	192.8
60	90.0	96.0	108.6	130.2	166.2	181.2	187.2	190.2	214.2
	REINFORCED 90° NOZZLE WELDS								
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	29.1	34.2	37.4	45.4	53.0	68.5	86.5	104.5	123.0
28	32.9	39.0	40.8	49.6	58.0	74.2	92.3	111.0	129.4
30	38.9	44.9	47.0	53.9	63.2	79.2	98.7	117.3	136.1
32	45.4	50.7	53.5	59.8	69.5	85.5	105.0	123.6	142.1
34	54.9	56.7	60.8	66.1	78.2	92.0	112.3	130.0	153.3
36	63.2	64.8	69.3	74.2	89.9	103.5	123.9	142.7	165.1
38	68.7	73.9	79.1	83.9	103.4	117.0	136.4	155.6	178.3
40	80.8	84.2	90.2	94.8	119.0	132.2	150.0	169.6	192.6
42	91.2	96.0	102.8	107.1	136.8	149.4	165.1	184.9	208.1
48	104.2	109.9	117.6	122.4	156.5	170.9	188.6	211.2	237.6
54	117.2	123.7	132.3	137.7	176.0	192.2	212.2	237.6	267.3
60	130.2	137.4	147.0	153.0	195.6	213.6	235.8	264.0	297.0

For General Notes on welding, see pages 20, 23, 26, and 27.

45° WELDED NOZZLES

Labor For Cutting And Welding

Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
1	2.4	2.5	--	--	2.4	--	2.5	--	--	--	3.6
1-1/4	2.5	2.8	--	--	2.5	--	2.8	--	--	--	4.1
1-1/2	2.8	3.1	--	--	2.8	--	3.1	--	--	--	4.7
2	2.9	3.6	--	--	2.9	--	3.6	--	--	--	6.2
2-1/2	3.3	4.4	--	--	3.3	--	4.4	--	--	--	6.9
3	3.8	5.1	--	--	3.8	--	5.1	--	--	--	7.7
3-1/2	4.3	5.6	--	--	4.3	--	5.6	--	--	--	--
4	4.8	6.6	--	--	4.8	--	6.6	--	8.2	--	9.9
5	5.8	7.9	--	--	5.8	--	7.9	--	10.2	--	12.5
6	6.2	8.7	--	--	6.2	--	8.7	--	12.6	--	16.0
8	7.3	9.9	7.3	7.3	7.3	9.4	9.9	13.5	17.0	21.3	24.2
10	8.1	11.6	8.1	8.1	8.1	11.6	14.1	18.5	23.8	30.7	37.0
12	9.2	13.3	9.2	9.2	11.0	14.8	19.4	20.5	32.7	38.7	44.2
14 OD	10.5	15.4	10.5	10.5	13.0	18.1	25.5	32.5	38.9	43.7	54.4
16 OD	12.0	17.1	12.0	12.0	17.1	22.7	29.9	41.3	46.4	51.8	62.8
18 OD	13.1	18.3	13.1	17.0	21.6	29.1	34.4	50.1	55.6	60.1	78.6
20 OD	14.5	20.1	14.5	20.1	25.1	36.7	39.7	57.9	63.4	70.0	88.3
24 OD	15.9	22.5	15.9	28.2	30.1	46.8	47.5	73.6	79.1	89.6	103.3

Pipe Thickness: Wall thickness of the pipe used for the nozzle determines the man hours that will apply. For nozzles of double extra strong pipe thickness, use Schedule 160 man hours.

Reinforcement: Man hours given above are for plain nozzles only. For use of Gusset plates, etc., as stiffeners, not for reinforcement, add 25% to the net man hours shown above. If reinforcement is required and produced by building up the nozzle weld, or by the use of reinforcing rings or saddles as specified use man hours for 45° reinforced nozzles.

Preheating: If specified or required by Codes, add for this operation. See man hours for preheating. The size and wall thickness of header (not the size of the nozzle) determines the preheating man hours.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A. S. A. Code for Pressure Piping, where the wall thickness is 3/4" or greater. The size and wall thickness of the header determines the man hours to be used for stress relieving.

All pipe sizes shown below the ruled line are 3/4" or greater in wall thickness and must be stress relieved. Where stress relieving is required an extra charge should be made. See man hours for stress relieving.

For General Notes on welding, see pages 20 and 23.

45° WELDED NOZZLES—REINFORCED

Labor For Cutting And Welding

Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
1-1/2	5.9	6.2	--	--	5.9	--	6.2	--	--	--	8.9
2	6.0	6.7	--	--	6.0	--	6.7	--	--	--	11.6
2-1/2	6.8	8.1	--	--	6.8	--	8.1	--	--	--	12.7
3	7.6	9.1	--	--	7.6	--	9.1	--	--	--	14.0
3-1/2	8.7	10.1	--	--	8.7	--	10.1	--	--	--	--
4	9.7	11.7	--	--	9.7	--	11.7	--	14.5	--	17.6
5	11.4	13.7	--	--	11.4	--	13.7	--	17.2	--	21.7
6	12.0	14.9	--	--	12.0	--	14.9	--	21.3	--	27.3
8	13.4	18.3	13.4	13.4	13.4	15.3	18.3	22.4	27.8	33.7	37.7
10	14.7	18.4	14.7	14.7	14.7	18.4	22.0	27.2	37.7	41.4	45.1
12 OD	16.3	20.6	16.3	16.3	17.2	23.0	30.0	38.7	43.8	51.5	60.1
14 OD	17.8	23.4	17.8	17.8	19.8	27.6	38.9	44.6	52.7	59.7	68.8
16 OD	20.1	25.6	20.1	20.1	25.6	34.0	44.8	55.7	70.0	71.8	79.5
18 OD	21.6	26.8	21.6	24.9	31.7	42.5	50.4	67.6	70.3	74.1	99.5
20 OD	23.9	30.2	23.9	30.2	36.9	53.3	60.4	72.5	83.9	96.0	111.8
24 OD	25.0	32.5	25.0	32.8	43.3	60.5	65.1	82.3	97.4	112.3	130.6

Pipe Thickness: Wall thickness of the pipe used for the nozzle determines the man hours that will apply. For nozzles of double extra strong pipe thickness, use Schedule 160 man hours.

Reinforcement: Man hours are for labor only. The price of the nozzle and reinforcing materials must be added.

Preheating: If specified or required by Codes, add for this operation. See man hours for preheating. The size and wall thickness of header (not the size of the nozzle) determines the preheating man hours.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A. S. A. Code for Pressure Piping, where the wall thickness is 3/4" or greater. The size and wall thickness of the header determines the man hours to be used for stress relieving.

All pipe sizes shown below the ruled line are 3/4" or greater in wall thickness and must be stress relieved. Where stress relieving is required an extra charge should be made. See man hours for stress relieving.

For General Notes on welding, see pages 20 and 23.

LARGE O.D. 45° NOZZLE WELDS

Labor for Cutting and Welding

Carbon Steel Material

NET MAN HOURS EACH

O.D. Pipe Inches	NON-REINFORCED 45° NOZZLE WELDS								
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	28.1	32.8	36.1	51.5	60.2	77.8	89.1	100.5	118.2
28	31.5	37.6	39.1	56.4	65.8	84.2	95.1	106.5	124.4
30	37.4	43.2	45.1	61.2	71.7	90.0	101.6	112.7	130.7
32	43.6	48.8	51.4	67.9	78.8	97.2	108.0	118.8	136.5
34	52.7	54.6	58.3	75.0	88.8	104.3	115.5	124.9	147.3
36	60.7	62.2	66.7	84.2	102.0	117.4	127.5	137.2	158.5
38	68.6	71.0	76.8	95.2	117.4	132.7	140.4	149.6	171.4
40	77.5	80.9	88.3	107.6	135.1	149.9	154.4	163.0	185.0
42	87.6	92.2	101.6	121.5	155.3	169.4	176.1	190.4	199.8
48	100.3	105.6	116.2	138.7	177.6	192.0	201.1	217.4	228.0
54	112.9	118.8	130.7	156.1	199.8	216.0	226.3	244.6	256.5
60	125.4	132.0	145.2	173.4	222.0	240.0	251.4	271.8	285.0

	REINFORCED 45° NOZZLE WELDS								
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	38.9	45.5	49.9	63.6	70.6	91.2	115.3	139.3	163.8
28	43.7	52.0	54.3	66.1	77.4	99.0	123.1	147.9	172.7
30	51.8	59.9	62.7	71.9	84.2	105.8	131.5	156.3	181.4
32	60.6	67.6	71.4	79.7	92.7	114.0	140.0	164.8	189.4
34	73.1	75.7	81.0	88.1	104.3	122.6	149.7	173.4	204.3
36	84.1	86.3	92.5	99.0	119.9	137.9	165.2	190.2	220.2
38	95.0	98.5	105.5	111.9	137.9	155.8	181.9	207.4	237.9
40	107.4	112.2	120.3	126.4	158.6	176.1	200.0	226.0	256.9
42	121.4	127.9	137.2	142.9	182.4	199.0	220.0	246.4	277.5
48	138.7	146.4	157.0	163.2	208.3	227.5	251.5	281.8	317.3
54	156.1	164.7	176.6	183.6	234.4	256.0	283.0	317.0	356.9
60	173.4	183.0	196.2	204.0	260.4	284.4	314.4	352.2	396.6

For General Notes on welding, see pages 20, 23, 29, and 30.

CONCENTRIC SWEDGED ENDS

Labor for Welding

Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2	1.4	1.8	--	--	1.4	--	1.8	--	--	--	2.8
2-1/2	1.6	2.1	--	--	1.6	--	2.1	--	--	--	3.3
3	1.7	2.4	--	--	1.7	--	2.4	--	--	--	3.9
3-1/2	2.0	2.8	--	--	2.0	--	2.8	--	--	--	--
4	2.3	3.3	--	--	2.3	--	3.3	--	4.7	--	5.6
5	3.0	4.2	--	--	3.0	--	4.2	--	6.6	--	7.8
6	3.6	5.4	--	--	3.6	--	5.4	--	8.9	--	10.1
8	5.0	7.8	--	5.0	5.0	--	7.8	10.1	13.2	15.5	17.0
10	6.6	10.5	--	6.6	6.6	10.5	12.4	15.8	22.6	--	29.5
12	8.7	14.0	--	8.7	13.2	16.4	21.0	27.9	37.2	--	42.7
14 OD	11.5	19.4	11.5	11.5	18.7	23.3	30.3	38.1	52.8	--	--
16 OD	16.4	24.8	16.4	16.4	24.8	29.5	33.5	43.4	58.3	--	--
18 OD	20.1	32.6	20.1	30.3	38.1	54.3	--	--	--	--	--
20 OD	23.3	36.5	23.3	36.5	42.7	65.1	--	--	--	--	--
24 OD	31.0	50.5	31.0	50.5	--	--	--	--	--	--	--

Pipe Thickness: The wall thickness of the pipe determines the man hours that will apply. For swedged ends on double extra strong pipe thickness, use Schedule 160 man hours.

Ends: All man hours are based on ends being furnished either plain or beveled for welding.

Unlisted Sizes: Unlisted sizes take the next higher listing.

ECCENTRIC SWEDGED ENDS

Labor for Welding

Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2	1.6	1.9	--	--	1.6	--	1.9	--	--	--	3.4
2-1/2	1.7	2.5	--	--	1.7	--	2.5	--	--	--	4.0
3	2.0	2.8	--	--	2.0	--	2.8	--	--	--	4.5
3-1/2	2.3	3.3	--	--	2.3	--	3.3	--	--	--	--
4	2.7	3.9	--	--	2.7	--	3.9	--	6.2	--	6.6
5	3.5	5.2	--	--	3.5	--	5.2	--	8.2	--	9.0
6	4.3	6.2	--	--	4.3	--	6.2	--	11.1	--	12.5
8	6.2	10.1	6.2	6.2	6.2	--	10.1	12.4	17.0	18.7	20.4
10	8.1	13.7	8.1	8.1	8.1	13.7	17.0	21.0	27.2	--	38.8
12	11.6	17.9	11.6	11.6	17.9	21.7	27.9	37.2	48.1	--	54.2
14 OD	16.4	25.6	16.4	16.4	26.3	31.8	38.8	49.7	68.2	--	--
16 OD	23.2	34.1	23.2	23.2	34.1	40.3	44.3	58.3	76.0	--	--
18 OD	27.5	46.5	27.5	27.5	51.2	72.2	--	--	--	--	--
20 OD	30.5	53.3	30.5	30.5	58.3	85.3	--	--	--	--	--
24 OD	43.5	69.8	43.5	43.5	--	--	--	--	--	--	--

Pipe Thickness: The wall thickness of the pipe determines the man hours that will apply. For swedged ends on double extra strong pipe thickness, use Schedule 160 man hours.

Ends: All man hours are based on ends being furnished either plain or beveled for welding.

Unlisted Sizes: Unlisted sizes take the next higher listing.

END CLOSURES

Pressure Type

All Labor

Carbon Steel Materials

NET MAN HOURS EACH

Nom. Pipe Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS						
			40	60	80	100	120	140	XX Hy. or 160
1-1/2	0.8	0.9	0.8	--	0.8	--	--	--	2.0
2	1.0	1.1	1.0	--	1.1	--	--	--	3.0
2-1/2	1.1	1.3	1.1	--	1.3	--	--	--	3.7
3	1.3	1.6	1.3	--	1.6	--	--	--	3.9
3-1/2	1.4	1.8	1.4	--	1.8	--	--	--	--
4	1.6	2.1	1.6	--	2.1	--	4.9	--	5.2
5	2.0	2.5	2.0	--	2.5	--	6.5	--	6.9
6	2.3	2.9	2.3	--	2.9	--	8.1	--	8.9
8	3.1	4.0	3.1	--	4.0	7.5	10.6	12.5	13.2
10	3.9	5.0	3.9	5.0	8.7	10.8	18.1	--	20.9
12	4.7	6.1	5.7	6.5	11.0	16.0	24.2	19.5	28.6
14	5.6	7.3	6.8	8.4	12.8	17.7	27.9	26.4	39.2
16	6.3	8.2	8.2	10.6	14.1	19.9	32.1	37.7	49.8
18	7.6	9.6	11.8	13.7	18.5	25.1	36.3	47.5	60.4
20	8.2	10.6	14.2	16.8	22.9	30.3	40.5	57.3	--
24	9.0	12.6	16.6	19.9	27.3	35.7	44.2	67.0	--

Pipe Thickness: Wall thickness of pipe determines the man hours that will apply. For double extra strong pipe thickness use Schedule 160 man hours.

Construction: End closures as such are shop fabricated closures; orange peel, saddle, or flat plate type.

Preheating: If specified or required by Codes, add for this operation. See man hours for preheating.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A.S.A. Code of Pressure Piping where the wall thickness is 3/4" or greater.

All sizes of butt welds shown below the ruled lines are 3/4" or greater in wall thickness and must be stress relieved, if the end closure involves a circumferential weld.

Where stress relieving is required, an extra charge should be made. See man hours for stress relieving.

Unlisted Sizes: Unlisted sizes take the next higher listing.

HEAVY WALL END CLOSURES—PRESSURE TYPE

Carbon Steel Material
NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN.							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	4.6	—	—	—	—	—	—	—
4	—	6.9	8.1	9.2	—	—	—	—
5	—	8.4	9.8	11.1	12.5	—	—	—
6	—	13.4	15.7	17.8	20.1	21.9	23.2	—
8	—	14.1	16.5	18.7	21.1	23.0	24.4	26.1
10	—	—	22.3	25.3	28.6	31.2	33.1	35.4
12	—	—	—	35.0	39.6	43.2	45.8	49.0
14	—	—	—	40.4	45.7	49.8	52.8	56.5
16	—	—	—	—	53.2	58.0	61.5	65.7
18	—	—	—	—	—	64.6	68.5	73.2
20	—	—	—	—	—	69.7	73.9	79.0
22	—	—	—	—	—	76.7	81.3	86.9
24	—	—	—	—	—	83.7	88.7	94.8
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	37.8	40.4	—	—	—	—	—	—
12	52.4	56.0	58.6	61.2	—	—	—	—
14	52.8	56.4	59.1	61.8	64.6	67.6	—	—
16	70.2	75.0	78.5	82.0	85.7	89.6	—	—
18	78.3	83.7	87.6	91.5	95.6	99.9	—	—
20	84.5	90.3	94.5	98.8	103.2	107.8	112.1	116.0
22	92.9	99.3	104.0	108.7	113.6	118.7	123.4	127.7
24	101.3	108.3	113.4	118.5	123.8	129.4	134.6	139.3
	4.75	5.00	5.25	5.50	5.75	6.00		
20	120.8	125.0	129.4	133.3	137.3	141.4		
22	132.9	137.6	142.4	146.7	151.1	155.6		
24	145.0	150.1	155.4	160.1	164.9	169.8		

Construction: End closures as such are shop fabricated closures: orange peel, saddle, or flat plate type.

Preheating: If specified or required by code, add for this operation. See man hours for preheating.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A.S.A. Code of Pressure Piping where the wall thickness is ¾" or greater.

All the above butt welds are ¾" or greater and must be stress relieved, if end closure involves a circumferential weld.

See respective man hour tables for stress relieving.

LARGE O.D. PIPE END CLOSURES—PRESSURE TYPE

Carbon Steel Material
NET MAN HOURS EACH

O.D. Pipe In.	WALL THICKNESS IN.							
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00
26	28.2	34.5	45.1	55.1	64.4	73.4	81.5	89.5
28	29.8	36.4	48.3	59.1	69.1	78.5	87.1	96.1
30	31.3	38.3	50.9	62.3	72.8	82.7	91.7	101.1
32	32.6	39.9	53.0	64.8	75.8	86.1	95.5	105.3
34	33.9	41.5	55.1	67.4	78.8	89.5	99.3	109.5
36	35.1	42.9	57.0	69.7	81.5	92.6	102.7	113.3
38	36.3	44.4	59.0	72.2	84.4	95.9	106.4	117.4
40	37.8	46.2	61.4	75.1	87.8	99.7	110.6	122.0
42	39.3	48.1	63.9	78.1	91.3	103.7	115.0	126.8
44	40.6	49.7	66.0	80.7	94.3	107.1	118.8	131.0
46	42.0	51.4	68.3	83.5	97.6	110.9	123.0	135.7
48	43.4	53.1	70.5	86.2	100.8	114.5	127.0	140.1
54	46.4	56.7	75.3	92.1	107.7	122.3	135.6	149.6
60	49.6	60.7	80.6	98.6	115.3	131.0	145.3	160.3
	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
26	97.2	105.8	113.1	120.3	128.7	134.9	141.4	148.2
28	104.4	113.6	121.4	129.2	138.2	144.8	151.8	159.1
30	109.8	119.5	127.7	135.9	145.4	152.4	159.7	167.4
32	114.4	124.5	133.1	141.6	151.5	158.8	166.4	174.4
34	118.9	129.4	138.3	147.2	157.5	165.1	173.0	181.3
36	123.0	133.8	143.0	152.2	162.9	170.1	178.3	186.9
	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
26	154.3	160.6	167.2	172.9	178.8	184.9	191.2	196.6
28	165.6	172.4	179.5	185.6	191.9	198.4	205.1	210.8
30	174.3	181.4	188.8	195.2	201.8	208.7	215.8	221.8
32	181.6	189.0	196.7	203.4	210.3	217.5	224.9	231.2
34	188.7	196.4	204.5	211.5	218.7	226.1	233.8	240.3
36	194.6	202.6	210.9	218.1	225.5	233.2	241.1	247.9

Construction: End closures as such are shop fabricated closures: orange peel, saddle, or flat plate type.

Preheating: If specified or required by codes, add for this operation. See man hours for preheating.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A.S.A. Code of Pressure Piping where the wall thickness is 3/4" or greater.

Above wall thickness .750 through 6.00 must be stress relieved, if the end closure involves a circumferential weld.

See respective table for stress relieving.

Pipe Sizes Inches
1/2" or 3/4
1
1-1/4
1-1/2
2
2-1/2
3
Man hours sh
If couplings a and an additi
Any coupling
For coupling hours 50%.
For coupling
Socket welds

'OLET TYPE WELDS

Labor For Cutting And Welding

Carbon Steel Material

NET MAN HOURS EACH

NOMINAL PIPE SIZE		Standard Weight And 2000#	Extra Strong And 3000#	Greater Extra S And 60
Outlet	Header			
1/2	All Sizes	1.3	1.7	2.
3/4	All Sizes	1.6	1.9	2.(
1	All Sizes	1.8	2.2	2.9
1-1/4	All Sizes	2.0	2.5	3.3
1-1/2	All Sizes	2.5	3.2	4.3
2	All Sizes	3.4	4.2	5.6
2-1/2	All Sizes	4.0	5.1	6.7
3	All Sizes	4.6	5.9	9.2
4	All Sizes	6.1	7.4	9.8
5	All Sizes	6.9	8.1	11.9
6	All Sizes	7.6	8.6	13.9
8	All Sizes	8.4	9.2	16.4
10	All Sizes	11.8	16.9	26.3
12	All Sizes	16.5	19.6	38.9
14	14" and 16"	20.7	23.0	.9
14	18" And Larger	18.4	20.7	51.0
16	16" and 18"	24.7	26.4	61.2
16	20" and Larger	21.8	23.9	66.3
18	18" and 20"	29.3	32.1	79.1
18	24" and Larger	25.8	28.4	85.2
20	20" and 24"	35.6	39.0	87.8
20	26" and Larger	31.0	34.7	94.6
24	24" and 26"	54.5	63.7	105.3
24	28" and Larger	45.9	55.1	113.5

Man hours are based on the outlet size and schedule except when the run schedule is greater than the schedule, in which case the man hours are based on the outlet size and run schedule.

For elbolet or latrolet welds, and weldolets, threadolets, etc., that are attached to fittings or welded at any other than 90°, add 50% to the above man hours.

For sweepolet attachment welds, add 150% to the above man hours.

FLAME CUTTING PIPE—PLAIN ENDS

Labor For Straight Pipe Only

Carbon Steel Material

NET MAN HOURS EACH

Pipe Size Inches	Standard Pipe & O.D. Sizes 3/8" Thick	Extra Hvy. Pipe & O.D. Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2" or Less	0.09	0.13	--	--	0.09	--	0.13	--	--	--	0.18
2-1/2	0.10	0.15	--	--	0.10	--	0.15	--	--	--	0.20
3	0.13	0.18	--	--	0.13	--	0.18	--	--	--	0.24
4	0.18	0.24	--	--	0.18	--	0.24	--	0.33	--	0.36
5	0.21	0.31	--	--	0.21	--	0.31	--	0.38	--	0.43
6	0.29	0.38	--	--	0.29	--	0.38	--	0.49	--	0.55
8	0.40	0.56	0.40	0.40	0.40	0.51	0.56	0.66	0.75	0.84	0.99
10	0.56	0.80	0.56	0.56	0.56	0.80	0.86	0.95	1.08	1.24	1.50
12	0.61	0.95	0.61	0.61	0.75	1.13	1.19	1.29	1.50	1.66	1.78
14 O.D.	0.85	1.13	0.85	0.85	1.00	1.25	1.45	1.55	1.70	2.00	2.10
16 O.D.	0.95	1.40	0.95	0.95	1.40	1.55	1.65	1.85	2.00	2.25	2.55
18 O.D.	1.20	1.70	1.20	1.40	1.70	1.90	2.00	2.25	2.40	2.70	3.15
20 O.D.	1.45	1.90	1.45	1.95	2.10	2.25	2.40	2.65	2.80	3.25	3.70
24 O.D.	2.20	2.80	2.20	2.95	3.10	3.25	3.35	3.65	4.05	4.55	5.15

For mitre cuts less than 30°, add 50% to the above man hours.

For mitre cuts 30° or greater, add 100% to the above man hours.

Man hours are for cutting pipe with plain ends only and do not include beveling, threading, etc. See appropriate man hour tables for these operations and time requirements.

For cutting the ends of bends or trimming fittings, add 50% to the above man hours.

FLAME CUTTING HEAVY WALL PIPE—PLAIN ENDS

Labor For Straight Pipe Only

Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	0.45	0.80	--	--	--	--	--	--
4	0.80	0.95	1.35	1.50	--	--	--	--
5	--	1.10	1.40	1.70	1.90	2.15	--	--
6	--	1.35	1.60	1.90	2.15	2.35	2.70	--
8	--	1.60	1.90	2.10	2.45	2.65	2.95	3.45
10	--	--	2.10	2.35	2.65	2.90	3.25	3.70
12	--	--	--	2.65	2.85	3.25	3.60	4.05
14	--	--	--	3.05	3.15	3.50	3.90	4.45
16	--	--	--	--	3.65	4.20	4.75	5.20
18	--	--	--	--	--	3.90	5.20	5.80
20	--	--	--	--	--	5.20	5.80	6.55
22	--	--	--	--	--	--	--	7.10
24	--	--	--	--	--	--	--	8.05
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	4.00	4.25	--	--	--	--	--	--
12	4.50	4.85	5.20	5.60	--	--	--	--
14	4.95	5.35	5.60	6.35	6.80	7.45	--	--
16	5.65	6.10	6.55	7.10	7.70	8.45	--	--
18	6.35	6.80	7.45	8.05	8.70	9.65	--	--
20	7.00	7.55	8.30	9.05	9.80	10.65	11.55	12.40
22	7.85	8.50	9.05	10.05	10.95	11.80	12.70	13.65
24	8.70	9.45	10.25	11.20	11.80	13.10	14.30	15.65
	4.75	5.00	5.25	5.50	5.75	6.00		
20	13.25	14.05	15.00	15.80	16.75	17.60		
22	14.60	15.55	16.40	17.30	18.25	19.25		
24	16.90	17.80	18.90	20.00	21.00	22.15		

For mitre cuts less than 30°, add 50% to the above man hours.

For mitre cuts 30° or greater, add 100% to the above man hours.

Man hours are for cutting pipe with plain ends only and do not include beveling, threading, etc. See appropriate man hour tables for these operations and time requirements.

For cutting the ends of bends or trimming fittings, add 50% to the above man hours.

FLAME CUTTING LARGE O. D. PIPE—PLAIN ENDS

Labor For Straight Pipe Only

Carbon Steel Material

NET MAN HOURS EACH

O.D. Pipe Inches	WALL THICKNESS IN INCHES							
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00
26	3.50	4.65	5.25	5.65	5.80	6.10	6.35	6.55
28	4.05	5.05	5.65	6.10	6.30	6.60	6.70	6.95
30	4.30	5.45	6.10	6.35	6.70	6.95	7.15	7.45
32	4.75	5.80	6.40	6.80	7.10	7.45	7.70	7.85
34	5.20	6.40	6.90	7.30	7.55	7.85	8.15	8.35
36	5.80	6.95	7.45	7.85	8.15	8.45	8.70	9.00
38	6.55	7.15	8.05	8.45	8.70	9.10	9.60	9.90
40	7.30	8.15	8.80	9.05	9.45	9.85	10.25	10.65
42	8.15	9.30	9.65	9.90	10.25	10.80	11.20	11.55
44	9.25	10.20	10.65	10.95	11.40	11.75	12.15	12.55
46	10.35	11.20	11.70	11.95	12.35	12.85	13.30	13.65
48	11.70	12.30	12.70	13.10	13.50	13.90	14.45	14.80
54	13.16	13.83	14.28	14.74	15.18	15.63	16.25	16.65
60	14.62	15.37	15.87	16.37	16.87	17.37	18.06	18.50
	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
26	6.90	8.90	9.65	10.40	11.20	12.15	12.70	14.05
28	7.45	9.45	9.85	10.65	11.50	12.55	13.15	14.40
30	7.85	9.90	10.20	10.95	12.00	12.95	13.50	14.85
32	8.30	10.40	10.80	11.40	12.40	13.35	13.90	15.25
34	8.80	10.95	11.35	11.75	12.90	13.75	14.30	15.65
36	9.30	11.40	11.80	12.15	13.30	14.30	14.85	16.20
	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
26	15.25	16.55	17.75	18.90	20.10	21.35	22.55	23.75
28	15.65	17.00	18.15	19.45	20.50	21.75	22.95	24.15
30	16.05	17.30	18.65	19.85	21.00	22.15	23.35	24.55
32	16.55	17.80	19.05	20.25	21.40	22.60	23.75	25.00
34	17.00	18.30	19.50	20.65	21.85	23.10	24.30	25.50
36	17.40	18.75	20.00	21.20	22.40	23.50	24.75	26.05

For mitre cuts less than 30°, add 50% to the above man hours.

For mitre cuts 30° or greater, add 100% to the above man hours.

Man hours are for cutting pipe with plain ends only and do not include beveling, threading, etc. See appropriate man hour tables for these operations and time requirements.

For cutting the ends of bends or trimming fittings, add 50% to the above man hours.

MACHINE CUTTING PIPE—PLAIN ENDS

Labor For Straight Pipe Only

Carbon Steel Material

NET MAN HOURS EACH

Pipe Sizes Inches	Standard Pipe & O. D. Size 3/8" Thick	Extra Hvy. Pipe & O.D. Sizes 1'2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2" or Less	0.20	0.29	--	--	0.20	--	0.29	--	--	--	0.40
2-1/2"	0.22	0.33	--	--	0.22	--	0.33	--	--	--	0.44
3	0.29	0.40	--	--	0.29	--	0.40	--	--	--	0.53
4	0.40	0.53	--	--	0.40	--	0.53	--	0.73	--	0.80
5	0.47	0.69	--	--	0.47	--	0.69	--	0.84	--	0.95
6	0.64	0.84	--	--	0.64	--	0.84	--	1.09	--	1.22
8	0.89	1.24	0.89	0.89	0.89	1.13	1.24	1.47	1.67	1.86	2.20
10	1.24	1.78	1.24	1.24	1.24	1.78	1.91	2.11	2.40	2.75	3.33
12	1.35	2.11	1.35	1.35	1.67	2.51	2.64	2.86	3.33	3.69	3.95
14 O.D.	1.89	2.51	1.89	1.89	2.22	2.78	3.22	3.44	3.77	4.44	4.66
16 O.D.	2.11	3.11	2.11	2.11	3.11	3.44	3.66	4.11	4.44	5.00	5.66
18 O.D.	2.66	3.77	2.66	3.11	3.77	4.22	4.44	5.00	5.33	5.99	6.99
20 O.D.	3.22	4.22	3.22	4.33	4.66	5.00	5.33	5.88	6.22	7.22	8.21
24 O.D.	4.88	6.22	4.88	6.55	6.88	7.22	7.44	8.10	8.99	10.10	11.43

For mitre cuts less than 30°, add 50% to the above man hours.

For mitre cuts 30° or greater, add 100% to the above man hours.

Man hours are for cutting pipe with plain ends only and do not include beveling, threading, etc. See appropriate man hours tables for these operations and time requirements.

For cutting the ends of bends or trimming fittings, add 50% to the above man hours.

MACHINE CUTTING HEAVY WALL PIPE—PLAIN ENDS

Labor For Straight Pipe Only

Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	1.00	1.78	--	--	--	--	--	--
4	1.78	2.11	3.00	3.33	--	--	--	--
5	--	2.44	3.11	3.77	4.22	4.77	--	--
6	--	3.00	3.55	4.22	4.77	5.22	5.99	--
8	--	3.55	4.22	4.66	5.44	5.88	6.55	7.66
10	--	--	4.66	5.22	5.88	6.44	7.22	8.21
12	--	--	--	5.88	6.33	7.22	7.99	8.99
14	--	--	--	6.77	6.99	7.77	8.66	9.88
16	--	--	--	--	8.10	9.32	10.55	11.54
18	--	--	--	--	--	8.66	11.54	12.88
20	--	--	--	--	--	11.54	12.88	14.54
22	--	--	--	--	--	--	--	15.76
24	--	--	--	--	--	--	--	17.87
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	8.88	9.44	--	--	--	--	--	--
12	9.99	10.77	11.54	12.43	--	--	--	--
14	10.99	11.88	12.43	14.10	15.10	16.54	--	--
16	12.54	13.54	14.54	15.76	17.09	18.76	--	--
18	14.10	15.10	16.54	17.87	19.31	21.42	--	--
20	15.54	16.76	18.43	20.09	21.76	23.64	25.64	27.53
22	17.43	18.87	20.09	22.31	24.31	26.20	28.19	30.30
24	19.31	20.98	22.76	24.86	26.20	29.08	31.75	34.74
	4.75	5.00	5.25	5.50	5.75	6.00		
20	49.42	31.19	33.30	35.08	37.19	39.07		
22	32.41	34.52	36.41	38.41	40.52	42.74		
24	37.52	39.52	41.96	44.40	46.62	49.17		

For mitre cuts less than 30°, add 50% to the above man hours.

For mitre cuts 30° or greater, add 100% to the above man hours.

Man hours are for cutting pipe with plain ends only and do not include beveling, threading, etc. see appropriate man hour tables for these operations and time requirements.

For cutting the ends of bends or trimming fittings, add 50% to the above man hours.

MACHINE CUTTING LARGE O.D. PIPE—PLAIN ENDS

Labor For Straight Pipe Only
Carbon Steel Material

NET MAN HOURS EACH

O.D. Pipe Inches	WALL THICKNESS IN INCHES							
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00
26	7.77	10.32	11.66	12.54	12.88	13.54	14.10	14.54
28	8.99	11.21	12.54	13.54	14.10	14.65	14.87	15.43
30	9.55	12.10	13.54	14.10	14.87	15.43	15.87	16.54
32	10.55	12.88	14.21	15.10	15.76	16.54	17.09	17.43
34	11.54	14.21	15.32	16.21	16.76	17.43	18.09	18.54
36	12.88	15.43	16.54	17.43	18.09	18.76	19.31	19.98
38	14.54	15.87	17.87	18.76	19.31	20.20	21.31	21.98
40	16.21	18.09	19.54	20.09	20.98	21.87	22.76	23.64
42	18.09	20.65	21.42	21.98	22.76	23.98	24.86	25.64
44	20.54	22.64	23.64	24.31	25.31	26.09	26.97	27.86
46	22.98	24.86	25.97	26.53	27.42	28.53	29.53	30.30
48	25.97	27.31	28.19	29.08	29.97	30.86	32.08	32.86
54	29.22	30.70	31.70	32.72	33.70	34.70	36.08	36.96
60	32.46	34.12	35.23	36.34	37.45	38.56	40.09	41.07
	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
26	15.32	19.76	21.42	23.09	24.86	26.97	28.19	31.19
28	16.54	20.98	21.87	23.64	25.53	27.86	29.19	31.97
30	17.43	21.98	22.64	24.31	26.64	28.75	29.97	32.97
32	18.43	23.09	23.98	25.31	27.53	29.64	30.86	33.86
34	19.54	24.31	25.20	26.09	28.64	30.53	31.75	34.74
36	20.65	25.31	26.20	26.97	29.52	31.75	32.97	35.96
	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
26	33.86	36.74	39.41	41.96	44.62	47.40	50.06	52.73
28	34.74	37.74	40.29	43.18	45.51	48.29	50.95	53.61
30	35.63	38.41	41.40	44.07	46.62	49.17	51.84	54.50
32	36.74	39.52	42.29	44.96	47.51	50.17	52.73	55.50
34	37.74	40.63	43.29	45.84	48.51	51.28	53.95	56.61
36	38.63	41.63	44.40	47.06	49.73	52.17	54.95	57.83

For mitre cuts less than 30°, add 50% to the above man hours.

For mitre cuts 30° or greater, add 100% to the above man hours.

Man hours are for cutting pipe with plain ends only and do not include beveling, threading, etc. See appropriate man hour tables for these operations and time requirements.

For cutting the ends of bends or trimming fittings, add 50% to the above man hours.

FLAME BEVELING PIPE FOR WELDING

"V" TYPE BEVELS

Labor For Straight Pipe Only
Carbon Steel Material

NET MAN HOURS EACH

Pipe Size Inches	Standard Pipe & O.D. Sizes 3/8" Thick	Extra Hvy. Pipe & O.D. Sizes 1/8" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2" Or Less	0.07	0.10	--	--	0.07	--	0.10	--	--	--	0.14
2-1/2"	0.08	0.12	--	--	0.08	--	0.12	--	--	--	0.16
3	0.10	0.14	--	--	0.10	--	0.14	--	--	--	0.19
4	0.14	0.19	--	--	0.14	--	0.19	--	0.26	--	0.28
5	0.17	0.24	--	--	0.17	--	0.24	--	0.30	--	0.34
6	0.23	0.30	--	--	0.23	--	0.30	--	0.39	--	0.43
8	0.32	0.44	0.32	0.32	0.32	0.40	0.44	0.52	0.59	0.65	--
10	0.44	0.63	0.44	0.44	0.44	0.63	0.68	0.75	0.83	--	--
12	0.48	0.75	0.48	0.48	0.59	0.89	0.94	1.03	--	--	--
14 O.D.	0.67	0.89	0.67	0.67	0.79	0.98	1.14	--	--	--	--
16 O.D.	0.75	1.10	0.75	0.75	1.10	1.22	1.35	--	--	--	--
18 O.D.	0.94	1.34	0.94	1.10	1.34	1.50	--	--	--	--	--
20 O.D.	1.14	1.50	1.14	1.54	1.65	1.82	--	--	--	--	--
24 O.D.	1.73	2.20	1.73	2.32	2.44	--	--	--	--	--	--

For mitre bevels add 50% to the above man hours.

Above man hours are for flame "V" beveling only and do not include cutting or internal machining. See respective man hour tables for these charges.

For beveling on the ends of bends or shop trimmed fittings. add 50% to the above man hours.

The above man hours are for wall thicknesses of 7/8" or less. For wall thicknesses greater than 7/8" refer to man hours on following pages.

MACHINE BEVELING PIPE FOR WELDING

"U" Type, "V" Type And Double-Angle Bevels

Labor For Straight Pipe Only
Carbon Steel Material

NET MAN HOURS EACH

Pipe Size Inches	Standard Pipe & O.D. Sizes 3/8" Thick	Extra Hvy. Pipe & O.D. Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2" Or Less	0.33	0.36	--	--	0.33	--	0.36	--	--	--	0.87
2-1/2"	0.34	0.37	--	--	0.34	--	0.37	--	--	--	0.91
3	0.36	0.39	--	--	0.36	--	0.39	--	--	--	0.93
4	0.39	0.42	--	--	0.39	--	0.42	--	0.72	--	0.99
5	0.40	0.50	--	--	0.40	--	0.50	--	0.78	--	1.06
6	0.46	0.59	--	--	0.46	--	0.59	--	0.83	--	1 16
8	0.63	0.91	0.63	0.63	0.63	0.81	0.91	1.05	1.18	1.32	1.87
10	0.91	1.26	0.91	0.91	0.91	1.26	1.36	1.50	1.69	2.34	2.83
12	0.97	1.50	0.97	0.97	1.18	1.77	1.87	2.03	2.83	3.14	3.35
14 O.D.	1.34	1.77	1.34	1.34	1.57	1.97	2.28	2.93	3.21	3.78	3.97
16 O.D.	1.50	2.20	1.50	1.50	2.20	2.44	2.60	3.50	3.78	4.25	4.82
18 O.D.	1.89	2.68	1.89	2.20	2.68	2.99	3.21	4.25	4.54	5.10	5.95
20 O.D.	2.28	2.99	2.28	3.07	3.31	3.54	4.54	5.01	5.29	6.14	6.99
24 O.D.	3.46	4.41	3.46	4.65	4.88	6.14	6.33	6.90	7.65	8.60	9.73

For bevels on the ends of bends or shop trimmed fittings, or mitre bevels, add 50% to the above man hours.

For "lip" bevels, add 50% to the above man hours.

For rolled down "lip" bevels, add 75% to the above man hours.

Above man hours are for machine beveling only and do not include cutting or internal machining. See respective man hour tables for these charges.

All pipe sizes shown below the ruled line have a wall thickness greater than 7/8" and must have U-type or double angle bevels in accordance with ANSI and ASME codes for pressure piping. Sizes above the ruled line are 7/8" wall thickness or less. The man hours shown above the ruled line are for bevels as required for inert arc root pass welding.

BEVELING HEAVY WALL PIPE FOR WELDING

"U" Type Or Double Angle Bevels

Labor For Straight Pipe Only
Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	1.54	1.57	--	--	--	--	--	--
4	1.57	1.61	1.70	1.89	--	--	--	--
5	--	1.73	1.76	2.14	2.39	2.71	--	--
6	--	1.86	2.02	2.39	2.71	2.96	3.40	--
8	--	1.95	2.29	2.65	3.09	3.34	3.72	4.35
10	--	--	2.65	2.96	3.34	3.65	4.09	4.66
12	--	--	--	3.34	3.59	4.09	4.54	5.10
14	--	--	--	3.84	3.97	4.41	4.91	5.61
16	--	--	--	--	4.60	5.29	5.98	6.55
18	--	--	--	--	--	5.98	6.55	7.31
20	--	--	--	--	--	6.55	7.31	8.25
22	--	--	--	--	--	--	--	8.94
24	--	--	--	--	--	--	--	10.14
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	5.04	5.35	--	--	--	--	--	--
12	5.67	6.11	6.55	7.06	--	--	--	--
14	6.24	6.74	7.06	8.00	8.60	9.39	--	--
16	7.12	7.69	8.25	8.94	9.70	10.65	--	--
18	8.00	8.60	9.39	10.14	10.96	12.16	--	--
20	8.82	9.51	10.46	11.40	12.35	13.42	14.55	15.62
22	9.89	10.71	11.40	12.66	13.80	14.87	16.00	17.20
24	10.96	11.91	12.91	14.11	14.87	16.50	18.02	19.72
	4.75	5.00	5.25	5.50	5.75	6.00		
20	16.69	17.70	18.90	19.91	21.10	22.17		
22	18.39	19.59	20.66	21.80	22.99	24.25		
24	21.29	22.43	23.81	25.20	26.46	27.91		

For General Notes, see the bottom of pages 45 and 46.

BEVELING LARGE O. D. PIPE FOR WELDING

Labor For Straight Pipe Only

Carbon Steel Material

NET MAN HOURS EACH

O.D. Pipe Inches	WALL THICKNESS IN INCHES							
	FLAME CUT "V" BEVELS			MACHINE CUT "V" OR DOUBLE ANGLE BEVELS				
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00
26	2.77	3.65	4.13	7.12	7.31	7.69	8.00	8.25
28	3.18	3.97	4.44	7.69	8.00	8.32	8.44	8.76
30	3.40	4.28	4.82	8.00	8.44	8.76	9.01	9.39
32	3.75	4.57	5.04	8.57	8.95	9.39	9.70	9.89
34	4.10	5.04	5.45	9.20	9.51	9.89	10.27	10.52
36	4.57	5.48	5.86	9.89	10.27	10.65	10.96	11.34
38	5.17	6.08	6.33	10.65	10.96	11.47	12.10	12.47
40	5.76	6.65	6.93	11.40	11.91	12.41	12.92	13.42
42	6.43	7.34	7.59	12.47	12.92	13.61	14.11	14.55
44	7.28	8.03	8.38	13.80	14.36	14.81	15.31	15.81
46	8.16	8.82	9.23	15.06	15.56	16.19	16.76	17.20
48	9.23	9.70	10.02	16.51	17.01	17.51	18.21	18.65
54	10.38	10.91	11.28	18.58	19.14	19.70	20.49	20.98
60	11.54	12.13	12.53	20.64	21.26	21.89	22.76	23.31
	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
26	8.69	11.21	12.16	13.10	14.11	15.31	16.00	17.70
28	9.39	11.91	12.41	13.42	14.49	15.81	16.57	18.14
30	9.89	12.47	12.85	13.80	15.12	16.32	17.01	18.71
32	10.46	13.10	13.61	14.36	15.62	16.82	17.51	19.22
34	11.09	13.80	14.30	14.81	16.25	17.33	18.02	19.92
36	11.72	14.36	14.87	15.31	16.76	18.02	18.71	20.41
	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
26	19.22	20.85	22.37	23.81	25.33	26.90	28.41	29.93
28	19.72	21.42	22.87	24.51	25.83	27.41	28.92	30.43
30	20.23	21.80	23.50	25.01	26.46	27.91	29.42	30.93
32	20.85	22.43	24.00	25.52	26.96	28.48	29.93	31.50
34	21.42	23.06	24.57	26.02	27.53	29.11	30.62	32.13
36	21.92	23.63	25.20	26.71	28.22	29.61	31.19	32.82

For General Notes, see the bottom of pages 45 and 46.

THREADING PIPE—INCLUDING CUT

Labor for Cutting and Threading Only
Carbon Steel Material

NET MAN HOURS EACH

Pipe Size Inches	Standard Pipe & O.D. Sizes 3/8" Thick	Extra Hvy. Pipe & O.D. Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2" or less	0.17	0.25	--	--	0.17	--	0.25	--	--	--	0.36
2-1/2	0.23	0.34	--	--	0.23	--	0.34	--	--	--	0.40
3	0.25	0.36	--	--	0.25	--	0.36	--	--	--	0.49
4	0.36	0.49	--	--	0.36	--	0.49	--	0.71	--	0.76
5	0.46	0.66	--	--	0.46	--	0.66	--	0.77	--	0.91
6	0.59	0.79	--	--	0.59	--	0.79	--	1.00	--	1.14
8	0.82	1.14	0.82	0.82	0.82	1.07	1.14	1.39	1.55	1.73	2.02
10	1.17	1.56	1.17	1.17	1.17	1.56	1.79	2.07	2.19	2.61	3.09
12	1.30	2.07	1.30	1.30	1.75	2.33	2.46	2.69	3.09	3.51	3.71
14 O.D.	1.75	2.26	1.75	1.75	2.26	2.50	2.87	3.26	3.51	--	--
16 O.D.	2.01	2.92	2.01	2.01	2.92	3.14	3.51	3.71	4.13	--	--
18 O.D.	2.50	3.51	2.50	3.09	3.51	3.71	4.13	4.59	--	--	--
20 O.D.	3.00	4.00	3.00	4.00	4.81	5.22	5.50	--	--	--	--
24 O.D.	4.39	5.84	4.39	6.13	6.50	6.72	7.09	--	--	--	--

Above man hours are for die cut IPS pipe threads only.

For shop make-on of screwed fittings use 50% of the above man hours.

For threading the ends of bends, add 100% to the above man hours.

WELDED CARBON STEEL ATTACHMENTS

NET MAN HOURS PER LINEAL INCH

Thickness of Plate, etc. Inches	**Layout and Flame Cutting per Lin. Inch	Fillet Welding per Lin. Inch
1/2 or less	0.04	0.04
3/4	0.04	0.06
1	0.04	0.08
1-1/4	0.06	0.1
1-1/2	0.06	0.1
1-3/4	0.07	0.2
2	0.08	0.2

**Figure labor on basis of total lineal inches to be cut and fillet welded.
Unlisted thicknesses take the next higher listing.
Man hours do not include machining of bases, anchors, supports, lugs, etc.
If preheating is required, add 100% to the above man hours.

DRILLING HOLES IN WELDED ATTACHMENTS

Carbon Steel Material
MAN HOURS EACH

Thickness of Plates, Angles Etc. in Inches	HOLE SIZE			
	3/4" and Smaller	7/8", 1" and 1-1/8"	1-1/4", 1-1/2" and 2"	2-1/4" and 2-1/2"
1/2" or less	0.20	0.24	0.28	0.39
3/4	0.24	0.28	0.36	0.46
1	0.26	0.33	0.41	0.51
1-1/4	0.33	0.41	0.46	0.59
1-1/2	0.41	0.46	0.59	0.76
1-3/4	0.46	0.59	0.72	0.93
2	0.59	0.68	0.84	1.10
2-1/2	0.68	0.73	0.93	1.35
3	0.76	0.93	1.10	1.52
3-1/2	0.84	1.01	1.27	1.78
4	1.01	1.18	1.44	2.03

Unlisted thicknesses of plate or sizes of holes take the next higher listing.
If holes are to be tapped—Add 33-1/3%.
Drilling of Sentinel, Safety or Tell Tale holes will be charged at .05 man hours.
The above man hours are for drilling holes in flat carbon steel plate and structural shapes only.
For drilling holes in pipe or other contoured objects, perpendicular to contoured surface, add 100% to the above man hours.
For drilling holes in pipe or other contoured objects, oblique to contoured surface, add 175% to the above man hours.

MACHINING INSIDE OF PIPE

Built-Up-Ends
Carbon Materials Only

Machining Inside of Pipe Net Man Hours per End			Built Up Ends on Inside Diameter of Pipe and Fittings with Weld Metal to Provide for Specified Outside Diameter of Machined Backing Ring	
Size Inches	Standard Extra Strong & Sch. Nos. to 100 Inclusive	Double Extra Strong & Sch. Nos. 120, 140 & 160	Size Inches	Net Man Hours per End
2 or less	0.4	0.6	2 or less	0.5
2-1/2	0.4	0.6	2-1/2	0.5
3	0.4	0.6	3	0.6
3-1/2	0.4	0.7	3-1/2	0.6
4	0.6	0.7	4	0.7
5	0.7	0.8	5	0.8
6	0.7	0.9	6	0.9
8	0.9	1.1	8	1.2
10	1.0	1.3	10	1.7
12	1.1	1.5	12	2.1
14 OD	1.3	1.8	14	2.6
16 OD	1.5	2.1	16	3.2
18 OD	1.8	2.4	18	3.9
20 OD	2.1	2.9	20	4.7
24 OD	2.9	3.8	24	7.1

Machining: Man hours for machining the inside of straight pipe are for any taper bore from 10° through 30° included angle. For machining the ends of bends add 100% to the above man hours. For counterboring (up to a maximum of 2" in length), add 50% to the above man hours. For machining to a controlled "C" dimension (as required for power piping critical systems), add 225% to the above man hours.

Cutting and Beveling: Man hours do not include cutting and beveling. See respective tables for these charges.

Built-Up Ends: Man hours for built-up ends are for building up the I.D. of straight pipe, bends or fittings, at the ends with weld metal and grinding where it is necessary for proper fit of backing rings.

MACHINING INSIDE OF LARGE O.D. PIPE

Built-Up Ends
Carbon Steel Material

O.D. Pipe Size Inches	NET MAN HOURS PER END Machining Inside of Straight Pipe Only — WALL THICKNESS IN INCHES					I.D. Build-Up with Weld Metal
	.500 to 1.50	1.51 to 2.25	2.26 to 3.00	3.01 to 4.50	4.51 to 6.00	Man Hours Per End
26	3.74	4.49	5.35	6.84	8.57	12.88
28	4.03	4.83	5.75	7.25	9.03	15.24
30	4.49	5.18	6.15	7.71	9.55	19.26
32	4.95	5.75	6.50	8.22	10.18	23.58
34	5.58	6.27	7.13	8.80	10.70	29.67
36	6.27	7.02	7.76	9.32	11.27	35.31
38	7.02	7.82	8.63	10.00	11.90	41.40
40	7.82	8.63	9.55	10.70	12.59	48.36
42	8.68	9.37	10.47	11.39	13.34	56.70
44	9.49	10.41	11.39	12.25	14.03	65.67
46	10.41	11.27	12.36	13.23	14.89	74.00
48	11.39	12.25	13.28	14.15	15.76	83.43
54	12.81	13.78	14.94	15.92	17.73	93.86
60	14.24	15.31	16.60	17.69	19.70	104.29

Machining: Man hours for machining the inside of straight pipe are for any taper bore from 10° through 30° included angle. For machining the ends of bends add 100% to the above man hours. For counterboring (up to a maximum of 2" in length), add 50% to the above man hours. For machining to a controlled "C" dimension (as required for power piping critical systems), add 225% to the above man hours.

Cutting and Beveling: Man hours do not include cutting and beveling. See respective tables for these charges.

Built-Up Ends: Man hours for built-up ends are for building up the I.D. of straight pipe, bends or fittings, at the ends with weld metal and grinding where it is necessary for proper fit of backing rings.

BORING INSIDE DIAMETER OF PIPE AND INSTALLING STRAIGHTENING VANES

NET MAN HOURS EACH

Nominal Pipe Size Inches	Boring I.D. of Pipe	Installing Straightening Vanes	
	Carbon Steel	Carbon Steel	Alloy
4	8.3	6.4	9.6
5	9.9	7.4	11.1
6	11.3	9.1	12.9
8	14.8	10.7	16.0
10	17.7	11.8	17.7
12	21.7	13.2	20.1
14	25.0	14.9	22.3
16	30.0	16.5	25.0
18	37.3	18.7	28.0
20	48.9	21.0	31.5
24	67.0	25.6	38.5
26	--	30.4	45.8
28	--	33.6	50.7
30	--	38.9	58.3
32	--	45.0	67.7
34	--	50.7	76.2
36	--	58.3	87.5
38	--	65.2	98.1
40	--	72.2	108.2
42	--	79.4	119.2

Man hours for boring I.D. only include boring pipe for a length of four times nominal pipe size.

Man hours for installing straightening vanes are based on installing vanes in pipe where boring the I.D. of pipe is not required. If boring I.D. of pipe is required or specified, add boring man hours as shown above.

INSTALLING FLOW NOZZLES

Holding Ring Type

Carbon Steel and Alloy Materials

NET MAN HOURS EACH

Pipe Size Inches	Flow Nozzles		Pipe O.D. Inches	Flow Nozzles	
	Carbon Steel	Alloy		Carbon Steel	Alloy
4	32.9	38.4	26	140.3	168.4
5	35.7	41.4	28	160.7	188.1
6	39.8	46.1	30	184.2	211.8
8	46.8	53.0	32	210.6	239.2
10	53.4	61.6	34	240.4	268.0
12	60.2	70.0	36	270.4	302.9
14 O.D.	65.8	77.3	38	303.0	342.4
16 O.D.	74.2	87.6	40	339.4	386.9
18 O.D.	83.7	99.3	42	380.1	437.3
20 O.D.	94.1	113.3	--	--	--
24 O.D.	118.9	144.7	--	--	--

Man hours include internal machining and nozzle installation.

For installing welding type flow nozzles, add for the bevels, butt weld, butt weld preheat, and any other labor operation or non-destructive testing operation required for the butt weld. See respective tables for these charges.

PREHEATING BUTT WELDS AND ANY TYPE OF FLANGE WELDS

Labor Only

Carbon Steel, or Alloy Materials
For Temperatures Up To 400°F.

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2	0.2	0.3	--	--	0.2	--	0.3	--	--	--	0.4
2-1/2	0.3	0.4	--	--	0.3	--	0.4	--	--	--	0.5
3	0.4	0.5	--	--	0.4	--	0.5	--	--	--	0.6
3-1/2	0.4	0.5	--	--	0.4	--	0.5	--	--	--	0.8
4	0.5	0.6	--	--	0.5	--	0.6	--	0.8	--	0.8
5	0.6	0.8	--	--	0.6	--	0.8	--	0.8	--	0.9
6	0.7	0.9	--	--	0.7	--	0.9	--	1.1	--	1.3
8	0.8	1.1	0.8	0.8	0.8	1.1	1.1	1.5	1.6	2.0	2.1
10	1.1	1.5	1.1	1.1	1.1	1.5	1.7	2.0	2.3	2.8	3.2
12	1.3	1.7	1.3	1.3	1.6	1.9	2.4	2.8	3.2	3.7	4.5
14 OD	1.6	2.1	1.6	1.6	1.9	2.5	3.0	3.7	4.2	4.9	5.6
16 OD	1.9	2.8	1.9	1.9	2.5	3.2	3.8	4.6	5.1	6.2	7.2
18 OD	2.2	3.0	2.2	2.6	3.5	4.2	5.1	5.9	6.7	7.2	8.9
20 OD	2.6	3.5	2.6	3.5	4.4	5.3	6.3	7.4	8.3	9.4	10.9
24 OD	3.1	4.2	3.1	4.5	5.4	6.6	7.9	8.8	9.9	11.3	12.9

Pipe Thickness: The wall thickness of the material determines the man hours that will apply. For preheating of double extra strong material, use Schedule 160 man hours.

Mitre Welds: For preheating of mitre welds, add 50% to above man hours.

Man Hours: Man hours for preheating are additional to charges for welding operations.

Preheating: For preheating to temperatures above 400°F. but not exceeding 600°F., add 100% to the above man hours.

PREHEATING HEAVY WALL PIPE BUTT WELDS LABOR ONLY

Carbon Steel or Alloy Materials
For Temperatures Up to 400°F.

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	0.9	1.0	--	--	--	--	--	--
4	1.2	1.3	1.5	1.7	--	--	--	--
5	--	1.6	1.8	2.0	2.1	2.4	--	--
6	--	1.8	2.1	2.3	2.5	2.7	2.9	--
8	--	2.5	2.9	3.1	3.3	3.7	3.8	4.1
10	--	--	3.5	3.7	4.0	4.6	4.9	5.3
12	--	--	--	5.2	5.6	5.9	6.3	6.8
14	--	--	--	6.2	6.7	7.1	7.7	8.1
16	--	--	--	--	8.0	8.5	8.9	9.8
18	--	--	--	--	--	10.4	11.0	11.6
20	--	--	--	--	--	11.9	12.8	13.5
22	--	--	--	--	--	--	--	14.6
24	--	--	--	--	--	--	--	15.8
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	6.0	6.4	--	--	--	--	--	--
12	7.3	7.7	8.3	8.8	--	--	--	--
14	8.7	9.2	9.8	10.4	11.0	11.9	--	--
16	10.4	11.0	11.6	12.4	13.2	14.1	--	--
18	12.5	13.4	14.2	15.0	15.9	16.8	--	--
20	14.4	15.4	16.4	17.4	18.5	19.4	20.3	21.3
22	15.6	16.8	17.7	18.9	20.2	21.4	22.5	23.7
24	16.8	18.0	19.3	20.5	21.9	23.5	24.1	25.6
	4.75	5.00	5.25	5.50	5.75	6.00		
20	22.4	23.5	24.8	26.0	27.2	28.6		
22	24.8	26.0	27.2	28.6	29.7	30.9		
24	27.2	28.6	29.7	30.9	32.2	33.5		

For General Notes, see the bottom of page 55.

PREHEATING LARGE O.D. PIPE BUTT WELDS AND ANY TYPE FLANGE WELDS

Carbon Steel Material
For Temperatures Up to 400°F.

NET MAN HOURS EACH

O.D. Pipe Inches	WALL THICKNESS IN INCHES							
	.500 or less	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	6.4	7.2	8.7	10.6	12.3	13.6	15.5	17.4
28	7.0	7.8	9.2	11.1	13.0	14.4	16.5	18.6
30	7.5	8.1	10.0	11.9	13.8	15.3	17.6	19.9
32	7.9	8.7	10.4	12.5	14.6	16.2	18.6	21.0
34	8.5	9.2	11.0	13.4	15.8	17.4	19.7	22.5
36	9.1	10.0	11.7	14.6	17.4	19.1	21.8	24.6
38	9.2	10.6	12.7	15.5	19.3	21.0	24.0	27.0
40	9.5	11.4	13.8	16.5	21.4	23.0	26.3	29.8
42	10.2	12.2	14.9	17.8	23.8	25.4	28.9	32.7
44	11.0	13.0	16.5	20.3	24.8	27.9	31.9	36.7
46	11.8	13.9	18.0	22.3	26.7	30.6	34.8	39.1
48	12.7	14.9	19.5	24.2	28.7	33.3	38.0	42.6
54	14.3	16.8	21.9	27.2	32.3	37.5	42.7	47.9
60	15.9	18.6	24.4	30.2	35.9	41.6	47.5	53.3
	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25
26	19.3	21.1	23.0	24.9	26.8	28.6	30.5	32.4
28	20.5	22.3	24.6	26.1	28.0	29.9	31.8	33.7
30	21.8	23.7	25.7	27.2	29.2	31.0	33.3	34.8
32	22.9	24.8	27.0	28.4	30.3	32.2	34.4	36.0
34	24.4	26.3	28.4	29.9	31.9	33.7	35.9	37.5
36	25.6	28.4	30.5	32.1	34.0	35.9	38.0	39.7
	4.50	4.75	5.00	5.25	5.50	5.75	6.00	
26	34.3	36.2	38.0	39.9	41.8	43.7	45.6	
28	35.6	37.3	39.2	41.1	43.0	44.9	47.2	
30	36.7	38.6	40.5	42.4	44.1	46.0	48.3	
32	37.8	39.7	41.6	43.5	45.4	47.3	49.5	
34	39.3	40.7	43.1	45.0	46.6	48.7	51.0	
36	41.5	43.4	45.3	47.2	48.9	50.8	53.1	

For General Notes, see the bottom of page 55.

PREHEATING 90° NOZZLE WELDS

Carbon Steel, or Alloy Materials
For Temperatures Up to 400°F

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2	0.4	0.5	--	--	0.4	--	0.5	--	--	--	0.6
2-1/2	0.5	0.6	--	--	0.5	--	0.6	--	--	--	0.8
3	0.5	0.8	--	--	0.5	--	0.8	--	--	--	0.9
3-1/2	0.6	0.8	--	--	0.6	--	0.8	--	--	--	--
4	0.8	0.9	--	--	0.8	--	0.9	--	1.2	--	1.4
5	0.9	1.2	--	--	0.9	--	1.2	--	1.4	--	1.6
6	1.1	1.6	--	--	1.1	--	1.6	--	1.7	--	2.1
8	1.4	1.8	1.4	1.4	1.4	1.7	1.8	2.3	2.6	3.0	3.5
10	1.7	2.3	1.7	1.7	1.7	2.3	2.6	3.2	3.8	4.4	5.0
12	2.1	2.8	2.1	2.1	2.4	3.0	3.8	4.4	5.1	5.9	7.0
14 OD	2.5	3.2	2.5	2.5	3.0	3.9	5.0	5.6	6.6	7.3	8.9
16 OD	2.9	3.9	2.9	2.9	3.9	5.0	6.1	7.2	8.3	9.1	11.6
18 OD	3.6	4.7	3.6	4.1	5.3	6.7	8.1	8.9	10.8	11.4	14.4
20 OD	4.7	5.5	4.2	5.5	7.0	8.6	10.0	11.6	13.2	13.5	15.5
24 OD	5.1	6.6	5.1	7.2	8.7	10.6	12.8	14.0	16.0	16.7	18.6

Pipe Thickness: The size of the nozzle and the wall thickness of the header or nozzle (whichever is greater) determines the man hours to be used. For preheating of double extra strong thickness use schedule 160 man hours.

Time: For reinforced 90° nozzle welds, add 100% to the above man hours. For 45° nozzle welds, add 50% to the above man hours. For reinforced 45° nozzle welds, add 150% to the above man hours. For preheating to temperatures above 400°F. but not exceeding 600°F., add 100% to the above man hours. Preheating of coupling, weldolet, threadolet or socket welds should be charged at the same man hours as shown for the same size and schedule nozzle. Man hours for preheating are additional to man hours for welding operations.

PREHEATING LARGE O.D. 90° NOZZLE WELDS

Carbon Steel, or Alloy Materials
For Temperatures Up to 400°F.

NET MAN HOURS EACH

O.D. Pipe Sizes	WALL THICKNESS IN INCHES							
	.500	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	8.2	9.1	10.9	13.2	15.5	17.0	19.5	21.9
28	8.7	9.7	11.7	14.1	16.3	18.0	20.7	23.5
30	9.2	10.3	12.5	14.9	17.4	19.3	22.1	25.0
32	9.8	10.9	13.1	15.7	18.3	20.3	23.3	26.3
34	10.7	11.7	13.8	16.9	19.7	21.8	24.8	28.3
36	11.4	12.5	14.8	18.3	21.8	23.9	27.3	30.9
38	12.1	13.4	16.0	19.5	24.2	26.3	30.1	34.0
40	13.0	14.4	17.2	20.8	26.9	29.0	33.1	37.4
42	13.7	15.3	18.5	22.3	28.8	32.0	36.4	41.1
48	15.7	17.5	21.1	25.5	32.9	36.6	41.6	47.0
54	17.6	19.7	23.8	28.7	37.0	41.1	46.8	52.8
60	19.6	21.9	26.4	31.9	41.1	45.7	52.0	58.7

Pipe Thickness: The size of the nozzle and the wall thickness of the header or nozzle (whichever is greater) determines the man hours to be used.

Time: For reinforced 90° nozzle welds, add 100% to the above man hours.
For 45° nozzle welds, add 50% to the above man hours.
For reinforced 45° nozzle welds, add 150% to the above man hours.
For preheating to temperatures above 400°F. but not exceeding 600°F., add 100% to the above man hours.
Preheating of coupling, weldolet, threadolet or socket welds should be charged at the same man hours as shown for the same size and schedule nozzle.
Man hours for preheating are additional to man hours for welding operations.

LOCAL STRESS RELIEVING

Gas or Electric Method—Butt Welds—Nozzle Welds or Any Type of Flange Welds
Carbon Steel Materials
Temperatures to 1400°F.

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2	2.3	2.4	--	--	2.3	--	2.4	--	--	--	2.6
2-1/2	2.4	2.5	--	--	2.4	--	2.5	--	--	--	2.7
3	2.5	2.6	--	--	2.5	--	2.6	--	--	--	3.0
3-1/2	2.6	2.7	--	--	2.6	--	2.7	--	--	--	3.3
4	2.6	3.0	--	--	2.6	--	3.0	--	3.1	--	3.4
5	3.0	3.2	--	--	3.0	--	3.2	--	3.5	--	3.7
6	3.2	3.6	--	--	3.2	--	3.6	--	3.7	--	4.3
8	3.6	4.0	3.6	3.6	3.6	3.7	4.0	4.3	4.5	4.7	5.0
10	3.9	4.3	3.9	3.9	3.9	4.3	4.5	4.8	5.0	5.3	5.7
12	4.3	4.7	4.3	4.3	4.5	4.9	5.1	5.5	5.8	6.0	6.3
14 OD	4.7	5.0	4.7	4.7	5.0	5.3	5.7	6.0	6.4	6.7	7.0
16 OD	5.0	5.4	5.0	5.0	5.4	5.8	6.1	6.6	6.8	7.2	7.8
18 OD	5.4	5.8	5.4	5.6	5.8	6.2	6.6	7.0	7.4	7.8	8.6
20 OD	5.6	5.9	5.6	5.8	6.2	6.6	7.0	7.8	8.1	8.5	9.4
24 OD	6.0	6.2	6.0	6.4	6.8	7.2	7.8	8.6	8.9	9.5	10.6

Pipe Thickness: For Stress relieving butt welds and flange welds, the wall thickness of the pipe determines the man hours that will apply. For stress relieving nozzle welds, the size and thickness of the header to which the nozzle is attached determines the man hours that will apply. For local stress relieving of double extra strong material, use Schedule 160 man hours.

Man Hours: The total man hours for stress relieving shall be determined as follows:

(1) By computing the total of all welds contained in the complete requirement figure on the basis of local stress relieving unit man hours;

(2) By totaling all pieces included in the complete requirement which can be full furnace stress relieved as units, classifying them in their applicable groups. and computing the total man hours.

Whichever of these two methods develops the lower man hours should be used in determining the man hours for stress relieving.

Valves: Stress relieving may be done by the local stress relieving process, or, unless valves have been welded into the assembly, the complete fabricated assembly may be full furnace stress relieved as a unit.

The stress relieving of butt welds joining valves to fabricated assemblies must be man houred as the man hours covering local stress relieving, even though adjacent assemblies can be full furnace stress relieved as a unit.

Code Requirements: All welds in piping materials having a wall thickness of 3/4" or greater must be stress relieved to comply with the requirements of the A. S. A. Code for Pressure Piping. Man hours shown below the ruled line in the above schedule cover sizes having a wall thickness of 3/4" or greater.

HEAVY WALL LOCAL STRESS RELIEVING
BUTT WELDS

Carbon Steel Material
Temperatures To 1400° F.

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	4.5	4.7	--	--	--	--	--	--
4	4.7	5.2	5.6	6.0	--	--	--	--
5	--	5.5	5.9	6.3	6.7	7.2	--	--
6	--	5.9	6.3	6.8	7.2	7.9	8.5	--
8	--	6.5	6.8	7.4	7.8	8.3	8.9	9.5
10	--	--	7.1	7.7	8.1	8.6	9.0	9.8
12	--	--	--	7.9	8.4	9.0	9.5	10.1
14	--	--	--	8.4	9.0	9.8	10.2	10.8
16	--	--	--	--	9.4	10.1	10.7	11.4
18	--	--	--	--	--	10.7	11.4	12.2
20	--	--	--	--	--	11.6	12.4	13.2
22	--	--	--	--	--	--	--	14.3
24	--	--	--	--	--	--	--	15.4
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	10.4	11.0	--	--	--	--	--	--
12	10.8	11.6	12.3	13.2	--	--	--	--
14	11.6	12.4	13.2	14.1	14.8	15.9	--	--
16	12.2	13.0	13.9	14.7	15.7	16.8	--	--
18	13.0	13.9	14.7	15.9	16.9	18.1	--	--
20	14.1	15.1	16.0	17.0	18.4	19.7	21.1	22.5
22	15.1	16.7	17.4	18.5	19.8	21.1	22.5	23.8
24	16.4	17.5	18.7	19.9	21.3	22.6	24.0	25.3
	4.75	5.00	5.25	5.50	5.75	6.00		
20	23.8	25.2	26.5	27.9	29.3	30.7		
22	25.2	26.6	27.9	29.3	30.7	32.1		
24	26.6	28.0	29.3	30.7	32.0	33.4		

For General Notes, see the bottom of page 60.

LARGE O.D. LOCAL STRESS RELIEVING

Butt Welds, Nozzle Welds or Any Type of Flange Weld

Carbon Steel Material
Temperatures to 1400° F.

NET MAN HOURS EACH

O.D. Pipe Size	WALL THICKNESS IN INCHES								
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	7.9	8.5	9.8	10.3	11.0	12.3	14.2	16.1	18.5
28	8.3	9.1	10.6	11.0	12.0	13.2	15.4	17.4	19.9
30	9.0	9.8	11.4	12.1	12.8	14.5	16.7	18.7	21.4
32	9.8	10.7	12.4	13.0	13.7	15.7	18.1	20.2	23.0
34	10.8	11.7	13.5	14.1	14.9	17.0	19.6	21.6	24.5
36	11.8	12.8	14.8	15.7	16.8	18.7	21.3	23.5	26.6
38	12.8	14.0	16.3	17.4	18.8	20.8	23.5	25.5	29.1
40	14.0	15.3	17.9	19.4	21.1	23.1	25.8	27.8	31.7
42	15.5	16.9	19.7	21.4	23.7	25.7	28.3	30.4	34.5
44	17.3	18.7	21.5	23.5	25.8	28.3	31.1	34.1	37.2
46	19.0	20.5	23.4	26.0	28.4	31.3	34.2	37.2	40.4
48	21.2	22.6	25.4	28.4	31.1	34.2	37.3	40.3	43.3
54	24.8	25.4	28.6	32.0	35.0	38.5	42.0	45.3	48.7
60	26.4	28.2	31.8	35.5	38.9	42.8	46.6	50.4	55.3
	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
26	20.7	23.0	25.3	27.6	29.9	32.2	34.5	36.8	39.1
28	22.2	24.5	26.8	29.1	31.4	33.7	36.0	38.3	40.5
30	23.7	26.0	28.3	30.6	32.9	35.1	37.4	39.7	42.0
32	25.3	27.6	29.8	32.1	34.4	36.7	39.0	41.3	43.6
34	26.8	29.1	31.4	33.0	36.0	38.3	40.6	42.9	45.2
36	28.9	31.2	32.4	35.1	38.1	40.4	42.7	45.0	47.3
	4.75	5.00	5.25	5.50	5.75	6.00			
26	41.4	43.7	45.9	48.2	50.5	52.8			
28	42.8	45.1	47.4	49.7	52.0	54.3			
30	44.3	46.6	48.9	51.1	53.4	55.7			
32	45.9	48.2	50.5	52.7	55.0	57.3			
34	47.5	49.8	52.1	54.3	56.6	58.9			
36	49.9	51.8	54.1	56.4	58.7	61.0			

For General Notes, see the bottom of page 60.

FULL FURNACE STRESS RELIEVING AND HEATING TREATMENT

Carbon Steel and Alloy Materials

NET MAN HOURS

Fahrenheit Temperature	Per Hundred Pounds
0° to 1250° Inclusive	0.3
1251° to 1400° Inclusive	0.4
1401° to 1700° Inclusive	0.7
1701° to 2200° Inclusive	1.1

Exposed sections of pieces too large to be placed entirely within the furnace will be included in subsequent furnace heat or heats until all parts of the piece have been stress relieved or heat treated. To calculate the man hours for this operation use: total weight of fabricated piece times man hours per pound depending on temperature, times total number of times piece must be heated to get full coverage.

Quenching is included in the above man hours. Materials to be quenched after annealing must not exceed over-all furnace dimension.

RADIOGRAPHIC INSPECTION

X-Ray or Gamma Ray Inspection of Butt Welds

Carbon Steel Material

Nominal Pipe Size	NET MAN HOURS EACH		
	Wall Thickness Thru Extra Strong	Wall Thickness Greater Than Extra Strong Thru Schedule 120	Wall Thickness Greater Than Schedule 120 Thru Double Extra Strong
2 or less	0.75	--	0.98
3	0.75	--	0.98
4	0.85	0.98	1.10
5	0.93	1.07	1.20
6	1.04	1.20	1.36
8	1.17	1.34	1.52
10	1.31	1.50	1.71
12	1.49	1.71	1.94
14	1.62	1.86	2.10
16	1.81	2.08	2.35
18	2.02	2.32	2.62
20	2.22	2.56	2.90
24	2.74	3.15	3.55

Man hours listed above cover radiographic inspection of butt welded joints by X-raying or gamma-ray, at t option of the client.

For radiographic inspection of mitre butt welds add 50% to above man hours.

For radiographic inspection of slip-on flange welds add 100% to above man hours.

For radiographic inspection of nozzle welds add 200% to above man hours.

HEAVY WALL RADIOGRAPHIC INSPECTION

X-Ray or Gamma Ray Inspection of Butt Welds

Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	1.06	1.17	--	--	--	--	--	--
4	1.17	1.22	1.25	1.41	--	--	--	--
5	--	1.28	1.36	1.47	1.55	1.68	--	--
6	--	1.36	1.47	1.55	1.68	1.79	1.92	--
8	--	1.49	1.60	1.71	1.85	1.95	2.10	2.35
10	--	--	1.78	1.87	2.05	2.14	2.30	2.53
12	--	--	--	2.03	2.21	2.34	2.51	2.67
14	--	--	--	2.24	2.38	2.58	2.74	2.91
16	--	--	--	--	2.59	2.77	2.94	3.15
18	--	--	--	--	--	3.02	3.25	3.44
20	--	--	--	--	--	3.31	3.50	3.76
22	--	--	--	--	--	--	--	4.19
24	--	--	--	--	--	--	--	4.62
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	2.70	2.85	--	--	--	--	--	--
12	2.85	3.07	3.25	3.47	--	--	--	--
14	3.10	3.31	3.50	3.76	4.00	4.27	--	--
16	3.39	3.60	3.81	4.11	4.37	4.62	--	--
18	3.70	3.95	4.21	4.45	4.77	5.12	--	--
20	4.00	4.27	4.54	4.83	5.16	5.50	5.37	6.22
22	4.46	4.77	5.10	5.41	5.76	6.19	6.61	7.01
24	4.94	5.30	5.66	5.98	6.42	6.85	7.49	7.79
	4.75	5.00	5.25	5.50	5.75	6.00		
20	6.61	6.98	7.33	7.70	8.03	8.40		
22	7.30	7.65	8.00	8.35	8.72	9.07		
24	8.08	8.34	8.66	9.06	9.44	9.82		

For General Notes, see the bottom of page 64.

LARGE O.D. RADIOGRAPHIC INSPECTION

X-Ray or Gamma Ray Inspection of Butt Welds

Carbon Steel Material

NET MAN HOURS EACH

O.D. Pipe Size	WALL THICKNESS IN INCHES							
	.750 or Less	1.00	1.25	1.50	1.75	2.00	2.25	2.50
26	3.15	3.31	3.44	3.71	3.97	4.27	4.56	4.90
28	3.65	3.78	3.94	4.19	4.46	4.75	5.07	5.42
30	4.40	4.56	4.69	4.94	5.23	5.50	5.79	6.18
32	5.44	5.57	5.70	5.98	6.27	6.54	6.80	7.17
34	6.74	6.90	7.02	7.30	7.57	7.84	8.13	8.50
36	8.29	8.45	8.59	8.86	9.14	9.42	9.73	10.05
38	9.89	10.06	10.24	10.50	10.78	11.06	11.38	--
40	11.62	11.86	12.03	12.27	12.61	12.91	13.22	--
42	13.50	13.70	13.89	14.19	14.54	14.82	15.14	--
44	15.54	15.70	15.92	16.22	16.59	16.91	17.22	--
46	17.63	17.84	18.08	18.40	18.77	19.07	19.36	--
48	19.86	20.06	20.29	20.61	21.04	21.30	21.62	--
54	22.34	22.57	22.83	23.18	23.67	23.96	24.32	--
60	24.82	25.07	25.36	25.76	26.30	26.62	27.02	--
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
26	5.31	5.81	6.22	6.56	7.06	7.49	8.32	8.70
28	5.84	6.54	6.78	7.09	7.58	8.10	8.86	9.22
30	6.56	7.33	7.52	7.84	8.34	8.86	9.58	9.95
32	7.57	8.32	8.51	8.83	9.33	9.86	10.59	10.94
34	8.90	9.63	9.86	10.16	10.66	11.17	11.92	12.29
36	10.48	11.22	11.42	11.73	12.22	12.75	13.50	13.87
	4.75	5.00	5.25	5.50	5.75	6.00		
26	9.00	9.26	9.52	9.92	10.18	10.56		
28	9.52	9.81	10.05	10.43	10.69	11.09		
30	10.29	10.54	10.80	11.17	11.46	11.84		
32	11.28	11.54	11.79	12.16	13.15	13.57		
34	12.59	12.88	13.10	13.50	14.50	15.26		
36	14.18	14.45	14.69	15.07	16.06	15.85		

For General Notes, see the bottom of page 64.

MAGNETIC OR DYE PENETRANT INSPECTION OF WELDED JOINTS

All Thicknesses and Schedules

NET MAN HOURS EACH

Size Inches	MAGNETIC		DYE PENETRANT	
	Butt Welds	Nozzle Welds	Butt Welds	Nozzle Welds
2 or less	0.6	0.9	0.8	1.3
2-1/2	0.7	1.1	0.9	1.4
3	0.8	1.2	1.1	1.6
3-1/2	0.9	1.4	1.2	1.9
4	1.1	1.6	1.5	2.2
5	1.4	2.1	1.9	2.8
6	1.7	2.6	2.3	3.5
8	2.0	3.0	2.8	4.1
10	2.5	3.7	3.3	5.0
12	3.1	4.7	4.2	6.3
14 OD	3.4	5.2	4.6	6.9
16 OD	3.9	5.8	5.2	7.9
18 OD	4.4	6.6	5.8	8.7
20 OD	4.8	7.2	6.5	9.7
24 OD	5.6	8.5	7.5	11.1

Man hours above are for a single inspection. When specifications call for multiple inspections during the progress of welding, the man hours shown above will apply for each of the total number of inspections.

Magnetic particle or liquid penetrant inspection of weld end preparations should be charged at the same man hours as comparable inspection of the same size butt weld.

For inspection of reinforced nozzle welds, add 150% to the above man hours to include both the nozzle weld and the pad weld.

For inspection of slip-on flange welds add 50% to the above man hours.

For inspection of small connections such as couplings, bosses, thredolets and weldolets use the man hours shown for corresponding sizes of nozzle welds.

MAGNETIC OR DYE PENETRANT INSPECTION OF WELDED JOINTS

All Thicknesses and Schedules

NET MAN HOURS EACH

O.D. Pipe Size	ALL THICKNESSES AND SCHEDULES			
	Magnetic		Dye Penetrant	
	Butt Welds	Nozzle Welds	Butt Welds	Nozzle Welds
26	5.9	8.8	7.8	11.7
28	6.4	9.5	8.5	12.6
30	6.9	10.3	9.2	13.7
32	7.3	10.9	9.7	14.5
34	7.8	11.6	10.4	15.4
36	8.2	12.4	10.9	16.5
38	8.8	13.1	11.7	17.4
40	9.3	13.9	12.4	18.5
42	9.8	14.7	13.0	19.6
44	10.3	15.5	13.7	20.6
46	10.8	16.3	14.4	21.7
48	11.4	17.0	15.2	22.6
54	12.8	19.1	17.0	25.4
60	14.3	21.2	19.0	28.2

Man hours above are for a single inspection. When specifications call for multiple inspections during the progress of welding, the man hours shown above will apply for each of the total number of inspections.

Magnetic particle or liquid penetrant inspection of weld end preparations should be charged at the same man hours as comparable inspection of the same size butt weld.

For inspection of reinforced nozzle welds, add 150% to the above man hours to include both the nozzle weld and the pad weld.

For inspection of slip-on flange welds add 50% to the above man hours.

For inspection of small connections such as couplings, bosses, thredolets and weldolets use the man hours shown for corresponding sizes of nozzle welds.

TESTING FABRICATED ASSEMBLIES

Hydrostatic Testing of Flanged Ends

Carbon Steel Material

For Pressures Not Exceeding 4.000 P.S.I.

NET MAN HOURS PER FLANGED OUTLET

Nominal Pipe Size	300 Lb. or Less	400 Lb. and 600 Lb.	900 Lb. and 1500 Lb.	2500 Lb.
2" or less	1.0	1.2	1.3	1.6
2-1/2	1.3	1.5	1.6	2.0
3	1.4	1.6	1.8	2.1
4	1.6	1.8	2.0	2.5
5	1.8	2.0	2.2	2.7
6	2.1	2.2	2.7	3.0
8	2.7	3.0	3.3	3.9
10	3.2	3.7	4.2	5.1
12	4.2	4.5	5.2	6.8
14	5.0	5.3	6.1	--
16	6.3	6.4	7.5	--
18	7.2	8.1	9.1	--
20	8.5	9.3	10.7	--
24	12.6	14.1	15.7	--

Above man hours are for flanged ends only. See following tables for plain or beveled ends.

Man hours are for a maximum holding time of one hour at test pressure.

TESTING FABRICATED ASSEMBLIES

Hydrostatic Testing of Plain or Beveled Ends Only

Carbon Steel Material
For Pressures Not Exceeding 4,000 P.S.I.

NET MAN HOURS PER END

Pipe Size Inches	Standard Pipe & O.D. Sizes 3/8" Thick	Extra Hvy. Pipe & O.D. Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2" or Less	2.5	2.8	--	--	2.5	--	2.8	--	--	--	4.4
2-1/2"	2.6	3.1	--	--	2.6	--	3.1	--	--	--	5.0
3	3.0	3.4	--	--	3.0	--	3.4	--	--	--	5.6
4	3.5	4.2	--	--	3.5	--	4.2	--	5.7	--	6.4
5	3.9	4.6	--	--	3.9	--	4.6	--	6.2	--	7.4
6	4.4	5.1	--	--	4.4	--	5.1	--	7.0	--	8.4
8	4.9	5.8	4.9	4.9	4.9	5.3	5.8	7.0	8.2	9.2	10.1
10	5.5	6.3	5.5	5.1	5.5	6.3	7.3	8.7	9.8	11.2	12.5
12	6.1	7.0	6.1	6.1	6.7	7.9	9.5	10.9	12.2	13.7	15.6
14 O.D.	6.8	7.8	6.8	6.8	7.4	9.0	11.0	12.4	14.0	16.2	18.9
16 O.D.	7.8	8.8	7.8	7.8	8.8	11.1	13.4	15.4	17.3	20.4	23.9
18 O.D.	9.1	10.4	9.1	9.8	11.5	13.7	16.9	19.2	21.9	25.1	29.3
20 O.D.	10.1	11.9	10.1	11.9	14.0	16.9	20.6	23.8	26.9	30.7	36.2
24 O.D.	13.5	15.4	13.5	15.6	20.6	25.1	31.3	35.8	41.1	47.3	54.3

Above man hours are for plain or beveled ends only. See preceding table for flanged ends.

Man hours are for a maximum holding time of one hour at test pressure.

HEAVY WALL TESTING FABRICATED ASSEMBLIES

Hydrostatic Testing of Plain or Beveled Ends Only

Carbon Steel Material

For Pressures Not Exceeding 4,000 P.S.I.

NET MAN HOURS PER END

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3" or less	6.3	6.9	--	--	--	--	--	--
4	7.2	7.5	7.9	8.5	--	--	--	--
5	--	8.2	8.7	9.2	10.5	12.9	--	--
6	--	9.5	10.3	10.8	13.9	16.3	19.0	--
8	--	11.5	12.1	13.6	17.3	20.1	23.7	28.6
10	--	--	13.5	16.9	21.0	24.3	28.5	33.5
12	--	--	--	20.5	24.3	28.6	33.9	39.2
14	--	--	--	23.4	27.7	32.5	38.1	45.0
16	--	--	--	--	31.1	37.2	43.4	51.9
18	--	--	--	--	--	41.5	48.4	57.2
20	--	--	--	--	--	48.4	57.2	69.2
22	--	--	--	--	--	--	--	75.6
24	--	--	--	--	--	--	--	82.2
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	38.3	44.0	--	--	--	--	--	--
12	44.8	51.3	57.8	66.0	--	--	--	--
14	51.1	58.0	65.7	74.4	84.8	95.2	--	--
16	58.8	67.5	76.2	86.5	98.7	112.5	--	--
18	65.7	76.2	86.5	99.3	113.3	129.7	--	--
20	78.8	88.3	101.2	114.2	129.7	147.1	166.8	180.9
22	86.0	96.9	110.3	124.6	141.7	161.0	182.5	202.0
24	93.5	103.4	119.5	135.1	154.0	174.9	198.3	218.7
	4.75	5.00	5.25	5.50	5.75	6.00		
20	198.3	212.4	226.6	236.0	262.7	280.1		
22	214.0	229.7	251.4	264.0	289.2	308.3		
24	233.5	251.4	274.7	287.9	311.5	333.2		

Above man hours are for plain or beveled ends only. See preceeding table for flanged ends.

Man hours are for a maximum holding time of one hour at test pressure.

ACCESS HOLES

Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS				
	Up to 1"	Over 1" to 2"	Over 2" to 2-1/2"	Over 2-1/2" to 4"	Over 4" to 6"
2-1/2, 3, 4	1.6	1.7	--	--	--
5, 6, 8	1.8	1.9	2.3	--	--
10, 12	1.9	2.1	2.5	3.5	--
14, 16, 18	2.0	2.2	2.6	3.7	--
20, 22, 24	2.2	2.5	2.7	3.9	5.9
26, 28, 30	2.5	2.8	2.9	4.2	6.3
32, 34, 36	2.7	2.9	3.2	4.4	6.6
38, 40, 42	2.9	3.2	3.5	4.9	7.3
44, 46, 48	3.2	3.5	3.8	5.8	8.8
54, 60	4.0	4.3	4.7	7.2	10.9

Man hours include access holes through 1" diameter (drilled and tapped) for radiographic inspection of welds when specified or required.

For openings larger than 1" in diameter add 25% to the above man hours for each 1/4" increase in diameter.

If plugs are to be included and seal welded, add 0.5 man hours each.

MISCELLANEOUS FABRICATION OPERATIONS

Descaling R. T. J. Flange Faces: Oxidation (scale) created in R. T. J. grooves of flanges because of Stress Relieving or Heat Treating should be removed and charged for at the following man hours.

Flange Size Inches	Man Hours	Flange Size Inches	Man Hours
3 or less	0.6	14	2.5
4	0.9	16	3.2
6	1.0	18	3.5
8	1.3	20	3.9
10	1.6	24	4.6
12	1.9	--	--

Miscellaneous X-Rays: If specified, the following X-Rays should be taken and charged accordingly. Slip-on Welds X-rayed will be charged the same man hours as a Butt Weld X-ray.

Mitre and Nozzle Welds X-rayed should be charged at 50% more than the Butt Weld X-ray man hours.

Lineal Welding X-rayed should be charged at 0.7 man hours per foot through 1" thickness and at 1.0 man hours per foot for thickness greater than 1". For alloys add 25% to these man hours.

Preheating Coupling Welds: On any size you should charge the man hours of Preheating a 2" extra heavy Nozzle Weld.

MAN HOURS PER FOOT OF CYLINDRICAL COIL FABRICATION BENDING ONLY

"A" — Coils containing 40 Ft. and Less
"B" — Coils containing 40 Ft. to 100 Ft.
"C" — Coils containing 100 Ft. and More

Diameter of Coil (C-C)	1/2" PIPE						3/4" PIPE					
	Schedule 10-60			Schedule 80-160			Schedule 10-60			Schedule 80-160		
	A	B	C	A	B	C	A	B	C	A	B	C
18" to 36"	0.06	0.05	0.04	0.06	0.05	0.04	0.06	0.05	0.04	0.06	0.05	0.05
36" to 60"	0.05	0.04	0.04	0.05	0.04	0.04	0.06	0.04	0.04	0.06	0.05	0.04
60" and over	0.05	0.04	0.04	0.05	0.04	0.04	0.05	0.04	0.04	0.05	0.04	0.04

Diameter of Coil (C-C)	1" PIPE						1-1/4" PIPE					
	Schedule 10-60			Schedule 80-160			Schedule 10-60			Schedule 80-160		
	A	B	C	A	B	C	A	B	C	A	B	C
18" to 36"	0.07	0.06	0.05	0.07	0.06	0.05	0.08	0.06	0.06	0.08	0.07	0.06
36" to 60"	0.07	0.05	0.05	0.07	0.05	0.05	0.07	0.06	0.05	0.08	0.06	0.06
60" and over	0.06	0.05	0.04	0.06	0.05	0.05	0.07	0.06	0.05	0.07	0.06	0.05

Diameter of Coil (C-C)	1-1/2" PIPE						2" PIPE					
	Schedule 10-60			Schedule 80-160			Schedule 10-60			Schedule 80-160		
	A	B	C	A	B	C	A	B	C	A	B	C
18" to 36"	0.09	0.08	0.07	0.10	0.08	0.08	0.12	0.09	0.08	0.13	0.10	0.09
36" to 60"	0.09	0.07	0.06	0.09	0.08	0.07	0.09	0.09	0.08	0.11	0.10	0.08
60" and over	0.08	0.07	0.06	0.09	0.07	0.07	0.09	0.08	0.07	0.11	0.09	0.08

Work Included: Man hours include bending only. All welding, handling and erection are additional. See respective pages for these man hours.

Section Two

FIELD FABRICATION AND ERECTION

This section is intended to suffice for the complete labor involved in the installation and field fabrication as may be necessary to put a system of process piping into operation in an industrial or chemical plant.

The man hours listed are for labor only and do not have any bearing on materials or equipment.

All labor for unloading from railroad cars or trucks hauling to and unloading at storage facilities, hauling from storage to erection site and rigging or hoisting into place have been given due consideration in the man hours listed for the various operations. While it is true that the aforementioned operations involve more time than is required merely to haul materials from and on the job, fabricating shop or storage area, nevertheless, we have found that these are operations that will balance themselves out over a complete piping job. No consideration has been given to overhead or profit.

For the field fabrication and erection of alloy and non-ferrous piping and fittings, apply the percentages which appear under Section Three to the following pages listing the various field operations.

HANDLING AND ERECTING STRAIGHT RUN PIPE

DIRECT MAN HOURS — PER FOOT

Pipe Size Inches	SCHEDULE NUMBERS		
	10 to 60	80 to 100	120 to 160
1/4	0.16	0.17	0.18
3/8	0.16	0.17	0.19
1/2	0.16	0.18	0.20
3/4	0.17	0.19	0.21
1	0.17	0.20	0.23
1-1/4	0.18	0.21	0.24
1-1/2	0.19	0.22	0.27
2	0.20	0.24	0.29
2-1/2	0.21	0.26	0.32
3	0.23	0.28	0.35
3-1/2	0.24	0.30	0.38
4	0.25	0.31	0.39
5	0.26	0.34	0.43
6	0.28	0.38	0.50
8	0.34	0.48	0.65
10	0.43	0.60	0.82
12	0.52	0.73	1.00
14 OD	0.64	0.87	1.19
16 OD	0.75	1.02	1.39
18 OD	0.88	1.17	1.60
20 OD	1.03	1.32	1.81
24 OD	1.15	1.49	2.04

Man hours include all labor for unloading and storing in yard, loading and hauling to erection site, and rigging and aligning in place. It does not include welding, bolt-ups, make-ons or scaffolding. See respective pages for these items.

For brass, copper, and everdur pipe, double above man hours.

HANDLING AND ERECTING HEAVY WALL STRAIGHT RUN PIPE

Carbon Steel Material

NET MAN HOURS PER FOOT

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3" or less	0.36	0.43	--	--	--	--	--	--
4	0.40	0.48	0.56	0.65	--	--	--	--
5	--	0.54	0.65	0.76	0.87	0.98	--	--
6	--	0.60	0.71	0.81	1.09	1.19	1.30	--
8	--	0.71	0.80	0.95	1.10	1.25	1.40	1.57
10	--	--	0.95	1.00	1.18	1.36	1.54	1.72
12	--	--	--	1.17	1.34	1.51	1.69	1.86
14	--	--	--	1.35	1.50	1.66	1.81	1.97
16	--	--	--	--	1.56	1.73	1.89	2.07
18	--	--	--	--	--	1.78	1.96	2.15
20	--	--	--	--	--	1.80	1.98	2.22
22	--	--	--	--	--	--	--	2.28
24	--	--	--	--	--	--	--	2.33
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	1.98	2.24	--	--	--	--	--	--
12	2.14	2.42	2.73	3.09	--	--	--	--
14	2.26	2.56	2.89	3.27	3.67	4.07	--	--
16	2.38	2.69	3.04	3.43	3.84	4.26	--	--
18	2.47	2.79	3.16	3.57	3.99	4.43	--	--
20	2.55	2.89	3.27	3.69	4.13	4.59	5.09	5.60
22	2.62	2.96	3.34	3.78	4.23	4.70	5.21	5.73
24	2.71	3.06	3.46	3.91	4.37	4.86	5.39	5.92
	4.75	5.00	5.25	5.50	5.75	6.00		
20	6.16	6.71	7.25	7.55	8.38	8.97		
22	6.31	6.88	7.43	8.02	8.58	9.18		
24	6.52	7.10	7.67	8.29	8.87	9.49		

Man hours include all labor for unloading and storing in yard, loading and hauling to erection site, and rigging and aligning in place.

Man hours do not include welding, bolt-ups, make-ons or scaffolding. See respective tables for these items.

HANDLING AND ERECTING LARGE O.D. STRAIGHT RUN PIPE

Carbon Steel Material

NET MAN HOURS PER FOOT

O.D. Pipe Inches	WALL THICKNESS IN INCHES							
	.500 or less	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	1.18	1.24	1.45	1.54	1.61	1.94	2.03	2.17
28	1.33	1.40	1.54	1.71	1.87	2.01	2.17	2.33
30	1.42	1.49	1.63	1.79	1.92	2.14	2.39	2.60
32	1.52	1.60	1.77	1.93	2.13	2.30	2.49	2.66
34	1.61	1.70	1.87	2.05	2.26	2.44	2.66	2.83
36	1.78	1.88	2.05	2.23	2.40	2.67	2.98	3.23
38	1.88	1.98	2.16	2.35	2.53	2.82	3.15	3.41
40	1.98	2.09	2.28	2.48	2.67	2.97	3.31	3.59
42	2.15	2.26	2.46	2.68	2.88	3.20	3.58	--
44	2.25	2.37	2.58	2.81	3.02	3.35	3.75	--
46	2.36	2.47	2.70	2.93	3.16	3.51	3.92	--
48	2.51	2.64	2.88	3.14	3.35	3.73	4.13	--
54	2.87	3.02	3.29	3.59	3.83	4.26	4.72	--
60	3.23	3.40	3.71	4.04	4.31	4.78	5.31	--
	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25
26	2.41	2.78	3.08	3.49	3.92	4.40	4.91	5.41
28	2.47	2.84	3.16	3.54	3.96	4.46	4.96	5.45
30	2.68	2.89	3.21	3.59	4.00	4.52	5.05	5.56
32	2.74	2.93	3.24	3.65	4.06	4.60	5.12	5.67
34	2.92	3.06	3.31	3.73	4.11	4.69	5.20	5.79
36	3.33	3.49	3.67	3.89	4.20	4.74	5.29	5.97
	4.50	4.75	5.00	5.25	5.50	5.75	6.00	
26	5.94	6.54	7.15	7.73	8.33	8.93	9.60	
28	6.05	6.72	7.40	7.85	8.48	9.07	9.68	
30	6.12	7.01	7.63	7.99	8.64	9.35	9.96	
32	6.20	7.20	7.84	8.06	8.80	9.70	10.39	
34	6.38	7.42	8.06	8.32	8.96	9.83	10.57	
36	6.53	7.84	8.27	8.48	9.22	10.04	11.13	

Man hours include all labor for unloading and storing in yard, loading and hauling to erection site, and rigging and aligning in place.

Man hours do not include welding, bolt-ups, make-ons or scaffolding. See respective tables for these items.

HANDLING AND ERECTING FABRICATED SPOOL PIECES

Carbon Steel Material

DIRECT MAN HOURS — PER FOOT BY SIZE

Pipe Size Inches	SCHEDULE NUMBERS		
	10 to 60	80 to 100	120 to 160
1/4	0.26	0.29	0.30
3/8	0.27	0.29	0.32
1/2	0.27	0.30	0.34
3/4	0.28	0.32	0.35
1	0.29	0.34	0.39
1-1/4	0.30	0.35	0.41
1-1/2	0.32	0.37	0.45
2	0.34	0.40	0.49
2-1/2	0.36	0.44	0.54
3	0.39	0.48	0.59
3-1/2	0.40	0.50	0.62
4	0.41	0.52	0.66
5	0.44	0.57	0.72
6	0.47	0.64	0.84
8	0.57	0.81	0.99
10	0.72	1.00	1.38
12	0.88	1.23	1.69
14 OD	1.01	1.46	2.01
16 OD	1.27	1.71	2.34
18 OD	1.48	1.96	2.69
20 OD	1.74	2.22	3.04
24 OD	1.94	2.51	3.43

Man hours are for labor only and includes handling and hauling from storage yard, unloading and rigging in place, and aligning. It does not include welding, bolt-ups, make-ons or scaffolding. See other pages for these charges.

For brass, copper and everdur pipe, double above man hours.

Units apply to any length spool piece or segment of work.

HANDLING AND ERECTING HEAVY WALL FABRICATED SPOOL PIECES

Carbon Steel Material

NET MAN HOURS PER FOOT

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3" or less	0.61	0.67	--	--	--	--	--	--
4	0.68	0.72	0.84	0.98	--	--	--	--
5	--	0.81	0.98	1.14	1.31	1.47	--	--
6	--	0.90	1.07	1.22	1.64	1.79	1.95	--
8	--	1.07	1.20	1.43	1.65	1.88	2.10	2.36
10	--	--	1.43	1.50	1.77	2.04	2.31	2.58
12	--	--	--	1.76	2.01	2.27	2.54	2.79
14	--	--	--	2.03	2.25	2.49	2.72	2.96
16	--	--	--	--	2.42	2.60	2.84	3.11
18	--	--	--	--	--	2.76	2.94	3.23
20	--	--	--	--	--	3.07	3.17	3.33
22	--	--	--	--	--	--	--	3.42
24	--	--	--	--	--	--	--	3.50
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	2.77	3.14	--	--	--	--	--	--
12	3.00	3.39	3.82	4.33	--	--	--	--
14	3.16	3.58	4.05	4.58	5.14	5.70	--	--
16	3.33	3.77	4.26	4.80	5.38	5.96	--	--
18	3.46	3.91	4.42	5.00	5.59	6.20	--	--
20	3.57	4.05	4.58	5.17	5.78	6.43	7.13	7.84
22	3.67	4.14	4.68	5.29	5.92	6.58	7.29	8.02
24	3.79	4.28	4.84	5.47	6.12	6.80	7.55	8.29
	4.75	5.00	5.25	5.50	5.75	6.00		
20	8.01	8.72	9.43	9.82	10.89	11.66		
22	8.20	8.94	9.66	10.43	11.15	11.93		
24	8.48	9.23	9.97	10.78	11.53	12.34		

Man hours are for labor only and include handling and hauling from storage yard, unloading and rigging in place and aligning. This does not include welding, bolt-ups, make-ons or scaffolding. See other pages for these charges.

Units apply to any length spool piece or segment of work.

HANDLING AND ERECTING LARGE O.D. FABRICATED SPOOL PIECES

Carbon Steel Material

NET MAN HOURS PER FOOT

O.D. Pipe Inches	WALL THICKNESS IN INCHES							
	.500 or less	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	1.77	1.86	2.18	2.31	2.42	2.91	3.05	3.26
28	1.97	2.07	2.28	2.53	2.77	2.97	3.21	3.45
30	2.07	2.18	2.38	2.61	2.80	3.12	3.49	3.80
32	2.17	2.29	2.53	2.76	3.05	3.29	3.56	3.86
34	2.25	2.38	2.62	2.87	3.16	3.42	3.72	3.96
36	2.46	2.59	2.83	3.08	3.31	3.68	4.11	4.46
38	2.56	2.69	2.94	3.20	3.44	3.84	4.28	4.64
40	2.65	2.80	3.06	3.32	3.58	3.98	4.44	4.81
42	2.84	2.98	3.25	3.54	3.80	4.22	4.73	--
44	2.93	3.08	3.35	3.65	3.93	4.36	4.88	--
46	3.02	3.16	3.46	3.75	4.04	4.49	5.02	--
48	3.19	3.35	3.66	3.99	4.25	4.74	5.25	--
54	3.64	3.84	4.18	4.60	4.86	5.41	5.99	--
60	4.07	4.28	4.67	5.09	5.43	6.02	6.69	--
	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25
26	3.62	4.17	4.62	5.24	5.88	6.60	7.37	8.12
28	3.66	4.20	4.68	5.30	5.94	6.67	7.43	8.18
30	3.91	4.27	4.75	5.35	6.00	6.73	7.52	8.28
32	4.08	4.37	4.83	5.44	6.05	6.55	7.63	8.45
34	4.35	4.60	4.93	5.56	6.12	6.99	7.75	8.63
36	4.96	5.20	5.47	5.68	6.26	7.06	7.88	8.90
	4.50	4.75	5.00	5.25	5.50	5.75	6.00	
26	8.85	9.74	10.66	11.52	12.41	13.31	14.30	
28	9.01	10.01	11.03	11.70	12.64	13.51	14.42	
30	9.12	10.44	11.37	11.91	12.87	13.93	14.84	
32	9.24	10.73	11.68	12.00	13.11	14.45	15.48	
34	9.51	11.06	12.00	12.40	13.35	14.65	15.75	
36	9.73	11.68	12.32	12.64	13.74	14.96	16.58	

Man hours are for labor only and include handling and hauling from storage yard, unloading and rigging in place, and aligning. This does not include welding, bolt-ups, make-ons or scaffolding. See other pages for these charges.

Units apply to any length spool piece or segment of work.

MAKING ON SCREWED FITTINGS AND VALVES

NET MAN HOURS EACH

Nom. Size Inches	PER CONNECTION	
	PLAIN	BACK WELDED
1/4	0.1	0.4
3/8	0.1	0.4
1/2	0.1	0.4
3/4	0.1	0.5
1	0.2	0.5
1-1/4	0.2	0.6
1-1/2	0.3	0.7
2	0.3	0.9
2-1/2	0.4	1.0
3	0.4	1.2
3-1/2	0.4	1.4
4	0.5	1.6
6	.7	2.3
8	.9	2.8
10	1.1	3.4
12	1.2	3.9
14	1.3	4.2
16	1.4	4.5
18	1.5	4.8
20	1.6	5.1
24	1.7	5.5

Man hours per connection only. For cutting, threading, field handling and erection, additional man hours are required. See pages pertaining to these operations.

Ells and Valves = Two Connections
Tees = Three Connections
Crosses = Four Connections

FIELD HANDLING VALVES

NET MAN HOURS EACH

Pipe Size Inches	SERVICE PRESSURE RATING				
	150 Lb.	300-400 Lb.	600-900 Lb.	1500 Lb.	2500 Lb.
¼	0.2	0.2	0.2	0.4	0.4
⅜	0.2	0.2	0.3	0.4	0.5
½	0.2	0.2	0.3	0.5	0.5
¾	0.2	0.3	0.5	0.6	0.6
1	0.3	0.3	0.6	0.6	0.7
1¼	0.3	0.3	0.7	0.9	1.2
1½	0.4	0.4	1.0	1.2	1.4
2	0.5	0.8	1.3	1.5	1.8
2½	0.8	1.1	1.5	1.9	2.1
3	1.2	1.5	2.0	2.4	2.6
3½	1.4	1.7	2.3	2.7	2.9
4	1.7	2.0	2.6	3.1	3.4
5	2.0	2.4	3.0	3.6	4.0
6	2.2	2.7	3.3	4.1	4.1
8	2.8	3.4	4.2	5.3	5.9
10	3.6	4.2	5.1	6.3	7.0
12	4.3	5.1	6.3	8.5	9.5
14	5.1	6.0	7.5	10.5	11.4
16	5.9	7.1	8.8	12.7	13.0
18	6.7	8.1	10.4	15.1	15.8
20	7.7	9.2	11.9	17.9	18.4
24	8.5	10.3	13.6	20.7	21.5
26	8.9	10.8	14.2	21.7	—
28	9.3	11.3	14.9	22.7	—
30	9.7	11.8	15.5	23.6	—
32	10.1	12.3	16.1	24.6	—
34	10.5	12.8	16.8	25.6	—
36	10.9	13.2	17.4	26.5	—
38	11.3	13.7	18.0	27.4	—
40	11.6	14.1	18.5	28.2	—
42	11.9	14.5	19.1	29.0	—
44	12.3	14.9	19.7	29.9	—
46	12.7	15.3	20.3	30.3	—
48	13.0	15.7	20.8	31.5	—

Man hours only — screwed, flanged, and weld end valves, and expansion joints. No man hours for welds, making-on, or bolt-up included. See pages pertaining to these items.

Use 150# allowance for standard brass and iron valves.

Use 300# allowance for extra heavy and 200 lb. brass and iron valves.

For motor operated or diaphragm valves, add 125% to above man hours.

FIELD ERECTION BOLT-UPS

NET MAN HOURS EACH

Pipe Size Inches	SERVICE PRESSURE RATING					
	150 Lb.	300-400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
2 or less	0.7	0.8	0.9	1.0	1.2	1.6
2½	0.8	0.9	1.0	1.2	1.5	2.0
3	0.8	0.9	1.0	1.2	1.5	2.0
3½	1.0	1.2	1.3	1.5	1.8	2.4
4	1.2	1.4	1.5	1.7	2.1	2.8
6	1.5	1.7	1.8	2.1	2.6	3.4
8	2.1	2.4	2.6	3.0	3.7	4.9
10	2.7	3.0	3.2	3.7	4.6	6.1
12	3.4	3.8	4.1	4.7	5.8	7.7
14	3.8	4.3	4.6	5.3	6.5	—
16	4.4	4.9	5.2	6.0	7.4	—
18	4.8	5.4	5.8	6.7	8.2	—
20	5.5	6.2	6.6	7.6	9.3	—
24	6.6	7.4	7.9	9.1	11.2	—
26	7.0	7.8	8.4	9.6	—	—
28	7.4	8.3	8.9	10.2	—	—
30	7.8	8.7	9.4	10.7	—	—
32	8.2	9.2	9.9	11.3	—	—
34	8.6	9.6	10.3	11.8	—	—
36	9.0	10.0	10.8	12.3	—	—
38	9.4	10.4	11.3	12.8	—	—
40	9.7	10.8	11.7	13.3	—	—
42	10.1	11.2	12.1	13.8	—	—

Man hours for labor only for each joint on valves, flanged fittings, and spools. Above man hours do not include handling of valves, fittings or spools. The handling of bolts or studs and gaskets *is* included.

Where tongue and groove, ring joint, female or fittings with special facings are used, add 25% to above units.

For standard cast iron use 150# allowance.

For extra heavy cast iron use 300# allowance.

ATTACHING FLANGES - SCREWED TYPE

Man hours — Cutting and Threading Pipe — Making on Screwed Flanges and Refacing

Carbon Steel Material for Bends, Headers, Necks and Straight Runs of Pipe

NET MAN HOURS EACH

Pipe Size Inches	125 Lb. Cast Iron and 150 Lb. Steel	250 Lb. Cast Iron and Steel 300 Lb. and Higher
2 or less	1.2	1.4
2-1/2	1.3	1.5
3	1.4	1.6
3-1/2	1.6	1.8
4	1.7	2.0
5	1.8	2.2
6	2.1	2.3
8	2.5	2.8
10	3.1	3.4
12	3.7	4.1
14 OD	4.5	5.1
16 OD	5.4	6.1
18 OD	6.5	7.3
20 OD	7.7	8.7
24 OD	11.0	12.5

Flanges: Man hours are for field labor only. The price of the flange must be added in all cases.

Pipe Thickness: Man hours are for any wall thickness of pipe used with listed flanges.

Unlisted Sizes. Unlisted sizes take the next higher listing.

ATTACHING FLANGES—SCREWED TYPE

Man Hours—Cutting and Threading Pipe, Making on Flange
Manual Seal Welding at Back and Front and Refacing

Welded or Seamless Carbon Steel Material, Straight Pipe,
Bends, Headers and Nozzles

NET MAN HOURS EACH

Pipe Size Inches	SERVICE PRESSURE RATING						
	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 L
2 or less	2.0	2.2	2.4	2.4	3.1	3.1	3.9
2-1/2	2.2	2.4	2.6	2.6	3.3	3.3	4.2
3	2.4	2.6	2.9	2.9	3.7	3.7	4.6
3-1/2	2.6	2.9	3.2	3.2	--	--	--
4	2.9	3.2	3.6	3.8	4.3	4.8	5.2
5	3.3	3.7	4.1	4.5	4.8	5.5	6.0
6	3.9	4.4	5.1	5.3	5.9	6.4	7.0
8	4.8	5.5	6.5	6.6	7.3	8.1	9.0
10	6.2	6.8	7.3	8.0	8.9	9.8	11.0
12	7.1	8.0	8.7	9.3	10.0	10.9	11.8
14 OD	8.5	9.6	10.1	11.7	13.1	14.4	--
16 OD	10.6	11.7	12.9	14.3	16.0	17.7	--
18 OD	12.3	13.3	14.5	15.9	17.3	19.1	
20 OD	13.7	15.0	16.3	17.9	19.6	21.4	--
24 OD	19.1	20.4	21.5	22.7	24.8	26.6	--

Flanges: Man hours are for labor only. The price of the welding materials and flange must be added in all cases.

Pipe Thickness: Man hours are for any wall thickness of pipe used with listed flanges.

Unlisted Sizes: Unlisted sizes take the next higher listing.

ATTACHING FLANGES—SCREWED TYPE

Man Hours—Cutting and Threading Pipe, Making on Flange
Manual Seal Welding at Back and Refacing
Carbon Steel Material, Straight Pipe,
Bends, Headers and Nozzles

NET MAN HOURS EACH

Pipe Size Inches	SERVICE PRESSURE RATING						
	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
2 or less	1.6	1.7	2.0	2.0	2.5	2.5	3.3
2-1/2	1.7	2.0	2.2	2.2	2.6	2.6	3.5
3	2.0	2.2	2.3	2.3	3.0	3.0	3.9
3-1/2	2.2	2.4	2.6	2.6	--	--	--
4	2.3	2.6	2.9	3.0	3.5	3.8	4.2
5	2.6	3.0	3.3	3.6	3.9	4.4	4.9
6	3.1	3.5	4.0	4.3	4.7	5.2	5.7
8	3.9	4.4	5.2	5.3	5.8	6.5	7.3
10	5.0	5.5	5.8	6.4	7.0	7.8	9.8
12	5.7	6.4	7.0	7.6	8.1	9.0	10.0
14 OD	6.8	7.7	8.5	9.6	10.5	12.6	--
16 OD	8.5	9.3	10.3	11.3	12.6	13.9	--
18 OD	9.9	10.6	11.4	12.5	13.8	15.5	--
20 OD	11.0	11.9	13.0	14.3	15.7	17.6	--
24 OD	15.3	16.3	17.2	18.4	19.8	21.6	--

Flanges: Man hours are for field labor only. The price of the flange must be added in all cases.

Pipe Thickness: Man hours are for any wall thickness of pipe used with listed flanges.

Unlisted Sizes: Unlisted sizes take the next higher listing.

ATTACHING FLANGES—SLIP-ON TYPE

Man Hours Slipping on Flange, Manual Welding at Front and Back

Carbon Steel Material, Straight Pipe, Bends, Headers and Nozzles

NET MAN HOURS EACH

Pipe Size Inches	SERVICE PRESSURE RATING						
	150 LB.	300 LB.	400 LB.	600 LB.	900 LB.	1500 LB.	2500 LB.
1	0.9	1.0	1.4	1.4	1.6	1.8	2.1
1-1/4	1.0	1.2	1.4	1.4	1.8	2.1	2.3
1-1/2	1.0	1.3	1.4	1.4	1.8	2.1	2.3
2	1.3	1.4	1.8	1.8	2.4	2.7	3.0
2-1/2	1.5	1.7	2.3	2.3	3.0	3.3	3.6
3	1.8	2.1	2.9	2.9	3.6	4.0	4.4
3-1/2	2.2	2.4	3.3	3.3	--	--	--
4	2.4	2.6	3.5	3.8	4.8	5.4	5.9
5	3.0	3.3	4.5	4.8	6.1	6.7	7.4
6	3.6	3.9	5.2	5.9	7.2	8.1	8.9
8	5.1	5.4	7.3	8.0	9.9	11.0	12.0
10	6.3	6.8	9.0	11.1	12.5	14.0	15.5
12	7.7	8.3	11.0	13.7	15.3	17.2	19.0
14 O.D.	9.0	10.0	13.0	16.2	17.7	19.8	--
16 O.D.	10.5	11.3	15.0	18.4	20.1	22.4	--
18 O.D.	12.2	13.5	17.5	21.1	23.7	26.6	--
20 O.D.	14.6	16.0	21.1	23.7	27.5	30.8	--
24 O.D.	18.3	20.1	25.6	31.2	34.8	38.9	--
26 O.D.	—	—	27.7	33.7	37.8	—	—
30 O.D.	—	—	32.0	38.9	43.5	—	—
34 O.D.	—	—	36.2	44.1	49.3	—	—
36 O.D.	—	—	38.4	46.7	52.2	—	—
42 O.D.	—	—	44.7	54.5	—	—	—

Flanges: Man hours are for field labor only. The price of welding materials and the flange must be added in all cases.

Pipe Thickness: Man hours are for any wall thickness of pipe used with listed flanges.

Preheating: If specified or required by codes, add for this operation. See man hours for pre-heating.

Stress Relieving: If specified or required by codes, add for this operation. See man hours for stress relieving.

Unlisted Sizes: Unlisted sizes take the next higher listing.

ATTACHING FLANGES—WELD NECK TYPE

Labor—Aligning Flange and Butt Welding

Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	SERVICE PRESSURE RATING						
	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
2	1.5	1.8	1.8	2.6	2.6	2.8	3.0
2½	2.0	2.3	2.3	3.4	3.4	3.6	4.2
3	2.5	2.8	2.8	4.1	4.1	4.3	4.5
4	3.2	3.5	3.5	5.0	5.0	5.6	5.8
6	4.2	4.7	4.7	6.7	6.7	7.4	7.6
8	5.4	6.0	6.0	8.6	8.6	9.8	10.2
10	6.7	7.3	7.3	10.1	10.1	11.6	11.8
12	7.3	7.9	7.9	10.5	10.5	12.3	13.3
14 OD	8.8	9.5	9.5	11.9	11.9	14.3	—
16 OD	9.6	10.2	10.2	12.3	12.3	16.1	—
18 OD	12.0	12.7	12.7	15.4	15.4	18.3	—
20 OD	13.3	14.0	14.0	16.9	16.9	21.6	—
24 OD	17.6	18.5	18.5	22.4	22.4	28.7	—
26 OD	—	—	20.5	23.2	23.2	—	—
30 OD	—	—	24.8	26.7	26.7	—	—
34 OD	—	—	30.8	32.8	32.8	—	—
36 OD	—	—	34.5	36.5	36.5	—	—
42 OD	—	—	49.8	52.1	—	—	—

Man hours include aligning, tack, and butt welding carbon steel weld neck flange to pipe.

Man hours are for any wall thickness of pipe used with listed flanges.

Unlisted sizes take the next highest listing.

ATTACHING ORIFICE FLANGES—SLIP-ON AND THREADED TYPES

Carbon Steel Material

MAN HOURS PER PAIR

Size Ins.	SERVICE PRESSURE RATING			
	Slip-On Type		Threaded Types	
	300 Lb.	300 Lb.	400–600 Lb.	900–1500 Lb.
1	3.8	5.2	—	7.2
1¼	4.2	5.2	—	7.2
1½	4.4	5.2	—	7.2
2	4.6	5.2	—	7.2
2½	5.3	5.8	—	7.7
3	7.1	6.3	—	11.0
4	8.6	8.6	9.8	12.7
6	12.0	10.7	12.4	16.0
8	16.2	13.2	17.2	19.7
10	20.6	17.0	21.0	24.2
12	24.4	21.4	25.2	28.8
14	29.3	24.7	—	—
16	33.5	28.3	—	—
18	38.2	32.6	—	—
20	45.2	37.0	—	—
24	54.6	47.0	—	—
26	71.2	—	—	—
30	80.7	—	—	—
34	92.0	—	—	—
36	98.8	—	—	—
42	107.6	—	—	—

Slip-On Types: Man hours include slipping on, welding, placement of paddle-type plates, and bolting of pair of orifice flanges.

Threaded Types: Man hours include screwing on, placement of paddle-type plates, and bolting up of pair of orifice flanges.

All man hours exclude cutting, beveling, or threading of pipe. See respective tables for these man hours.

ATTACHING ORIFICE FLANGES—WELD NECK TYPE

Carbon Steel Material
MAN HOURS PER PAIR

Size Ins.	SERVICE PRESSURE RATING				
	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.
1	5.2	5.4	7.1	7.2	7.8
1¼	5.2	5.4	7.1	7.2	7.8
1½	5.2	5.4	7.1	7.2	7.8
2	5.2	5.4	7.1	7.2	7.8
3	7.5	8.0	10.2	10.4	11.1
4	10.4	10.9	12.5	12.7	14.3
6	13.1	13.8	16.2	16.5	18.4
8	17.4	17.9	20.8	21.2	24.3
10	19.6	20.0	25.9	26.9	28.8
12	22.4	25.0	27.1	28.7	32.4
14	25.6	27.3	30.4	32.1	37.1
16	28.3	29.3	36.8	37.6	41.6
18	34.8	35.8	39.6	41.5	47.8
20	38.2	39.2	44.4	45.4	55.5
24	49.4	50.4	57.7	58.9	—
26	—	54.3	59.8	60.8	—
30	—	63.3	67.8	70.1	—
34	—	76.2	80.9	83.4	—
36	—	80.0	89.8	91.6	—
42	—	116.8	122.3	—	—

Man hours include setting, aligning, welding, placement of paddle-type plates, and bolting up of pair of orifice flanges.

Man hours exclude cutting and beveling of pipe. See respective tables for these man hours.

GENERAL WELDING NOTES

Backing Rings: When backing rings are used, add 25% to the welding man hours to cover extra problems in fit-up. In addition the following percentages should be added if applicable.

1) When backing rings are tack welded in on one side, add 10% to the man hours of a standard thickness butt weld.

2) When backing rings are completely welded in on one side, add 30% to the man hours of a standard thickness butt weld.

3) Preheating and stress relieving, when required, should be charged at full butt weld preheating and stress relieving man hours for the size and thickness in which the backing ring is installed.

Nozzle Welds: Following percentage increases should be allowed for the following conditions:

1) When nozzle welds are to be located off-center of the run (except tangential) increase man hours shown for nozzle welds, 50%.

2) Add 80% to nozzle welds for tangential nozzle welds.

3) When nozzle welds are to be located on a fitting increase nozzle weld man hours 50%.

Long-neck Nozzle Welds: The welding-on of long neck nozzles should be charged at the schedule 160 reinforced nozzle weld man hours.

Shaped Nozzles, Nozzle Weld fit-ups and Dummy Nozzle Welds: These should be charged at a percentage of the completed nozzle weld man hours as follows:

1) Shaped branch 50%
2) Shaped hole in header 50%
3) Fit-up of both branch or header (whether tack-welded or not) 60%
4) Dummy nozzle weld (no holes in header) 70%

Sloping Lines: Add 100% to all welding man hours for this condition.

Consumable Inserts: When consumable inserts are used, add the following percentages to the welding man hours to cover extra problems in fit-up:

1) Through 1/2" wall 40%
2) Over 1/2" through 1" wall 30%
3) Over 1" through 2" wall 20%
4) Over 2" through 3" wall 15%
5) Over 3" wall 10%

MANUAL BUTT WELDS

Man Hours—Welding Only
Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
1	0.7	0.8	--	--	0.7	--	0.8	--	--	--	1.0
1-1/4	0.8	0.8	--	--	0.8	--	0.8	--	--	--	1.1
1-1/2	0.8	0.9	--	--	0.8	--	0.9	--	--	--	1.3
2	1.0	1.0	--	--	1.0	--	1.0	--	--	--	1.6
2-1/2	1.2	1.3	--	--	1.2	--	1.3	--	--	--	1.8
3	1.3	1.4	--	--	1.3	--	1.4	--	--	--	2.1
3-1/2	1.4	1.6	--	--	1.4	--	1.6	--	--	--	--
4	1.5	1.8	--	--	1.5	--	1.8	--	2.8	--	3.0
5	1.7	2.1	--	--	1.7	--	2.1	--	2.9	--	3.8
6	2.0	2.5	--	--	2.0	--	2.5	--	3.8	--	4.9
8	2.6	3.3	2.6	2.6	2.6	3.0	3.3	4.6	6.0	7.5	8.6
10	3.1	4.0	3.1	3.1	3.1	4.0	5.1	6.8	9.4	11.4	13.1
12	3.6	4.7	3.6	3.6	4.1	5.2	6.6	9.9	12.2	15.3	17.9
14 OD	4.3	5.7	4.3	4.3	5.0	6.8	9.6	13.2	16.2	19.2	22.7
16 OD	5.0	6.6	5.0	5.0	6.6	8.4	12.4	19.5	20.7	25.0	27.7
18 OD	5.9	7.7	5.9	6.8	8.6	11.2	16.4	21.8	25.6	29.9	33.7
20 OD	6.3	8.4	6.3	8.4	9.4	13.8	19.5	26.0	31.9	37.0	40.8
24 OD	6.9	10.1	6.9	--	13.3	20.1	25.2	35.8	43.5	49.3	59.3

Pipe Thickness: Wall thickness of the pipe determines the man hours that will apply, for butt welds of double extra strong materials, use schedule 160 man hours.

Mitre Welds: Add 50% to butt weld man hours.

Cutting and Beveling Pipe: Man hours do not include cutting and beveling of pipe. See respective tables for these charges.

Preheating: If specified or required by codes, add for this operation. See man hours for preheating.

Stress Relieving: Stress relieving of welds in carbon steel materials is required by the A.S.A. code for pressure piping, where the wall thickness is 3/4" or greater.

All sizes of butt welds shown below the ruled lines are 3/4" or greater in wall thickness and must be stress relieved.

Where stress relieving is required an extra charge should be made. See man hours for stress relieving.

For General Notes on welding, see page 92.

MANUAL HEAVY WALL BUTT WELDS

Labor for Welding Only

Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	2.7	3.7	--	--	--	--	--	--
4	3.3	4.1	5.7	6.8	--	--	--	--
5	--	4.7	6.7	8.0	10.0	12.4	--	--
6	--	6.4	8.5	10.4	13.3	15.6	18.2	--
8	--	8.7	10.1	13.1	16.5	19.2	22.7	27.4
10	--	--	13.5	16.2	20.1	23.2	27.3	32.1
12	--	--	--	19.6	23.2	27.4	32.6	37.5
14	--	--	--	23.5	26.6	31.2	36.5	43.1
16	--	--	--	--	29.9	35.6	41.5	49.7
18	--	--	--	--	--	39.8	46.4	54.8
20	--	--	--	--	--	46.4	54.8	66.2
22	--	--	--	--	--	--	--	72.3
24	--	--	--	--	--	--	--	78.7
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	36.7	42.1	--	--	--	--	--	--
12	42.8	49.1	55.3	63.1	--	--	--	--
14	48.9	55.5	62.9	71.3	81.2	91.1	--	--
16	56.3	64.7	72.9	82.8	94.4	107.6	--	--
18	62.9	72.9	82.8	95.0	108.4	124.1	--	--
20	75.4	84.5	96.9	109.3	124.1	140.8	159.7	173.1
22	82.4	92.7	105.5	119.3	135.6	154.1	174.8	193.4
24	89.4	99.0	114.3	129.2	147.4	167.4	189.7	209.3
	4.75	5.00	5.25	5.50	5.75	6.00		
20	189.7	203.3	216.9	225.9	251.5	268.1		
22	204.8	219.8	240.6	252.6	276.8	295.1		
24	223.5	240.6	262.9	275.5	298.2	319.0		

For General Notes on welding, see pages 92 and 93.

MANUAL LARGE O.D. BUTT WELDS

Labor for Welding Only

Carbon Steel Material

NET MAN HOURS EACH

O.D. Pipe Inches	WALL THICKNESS IN INCHES							
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00
26	8.4	11.4	15.1	20.2	26.7	34.5	43.4	52.5
28	10.0	13.1	16.4	22.2	29.3	37.3	46.4	55,7
30	12.5	15.2	18.9	24.1	31.7	39.8	49.6	58.9
32	15.5	17.9	21.5	26.7	34.9	43.0	52.7	62.1
34	19.4	21.5	24.4	29.5	39.3	46.1	56.3	65.4
36	23.0	24.7	27.8	33.2	45.2	52.0	62.3	71.7
38	27.0	28.9	32.0	37.1	52.0	58.8	68.6	78.1
40	31.6	34.2	36.8	41.5	59.7	66.3	75.4	85.2
42	36.9	40.4	42.5	46.6	68.8	75.0	82.8	92.9
44	42.8	46.6	49.9	57.0	74.9	83.2	90.3	101.2
46	48.3	53.1	58.3	67.9	82.7	91.5	98.3	109.6
48	54.5	59.9	68.1	79.1	90.9	99.9	106.8	118.1
54	61.4	67.6	79.5	92.2	99.7	109.3	116.0	127.3
60	69.0	76.2	92.9	107.4	109.5	119.4	126.0	137.2
	2.75	2.50	2.75	3.00	3.25	3.50	3.75	4.00
26	61.7	85.0	96.3	110.0	123.5	138.5	159.7	180.4
28	6 .0	91.0	104.4	117.5	138.2	150.3	174.8	195.2
30	68.3	99.5	112.9	126.5	144.2	161.1	185.3	209.3
32	71.4	104.0	118.9	132.9	153.0	170.2	196.9	222.9
34	76.9	110.0	126.5	142.2	161.4	180.4	209.3	237.9
36	83.0	117.5	134.9	150.7	171.7	192.2	222.5	250.0
	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
26	203.3	225.9	243.9	261.7	276.8	298.2	323.7	345.7
28	219.8	244.9	261.4	280.1	299.6	322.0	345.5	367.5
30	234.9	258.4	281.5	301.1	322.3	343.4	371.1	400.0
32	250.0	277.1	298.2	319.3	343.4	365.9	394.6	424.7
34	268.1	298.2	319.3	340.9	366.9	391.5	421.6	451.7
36	282.5	313.2	337.4	360.8	387.0	412.6	445.7	478.3

For General Notes on welding, see pages 92 and 93.

90° WELDED NOZZLES

Labor for Cutting and Welding Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
1	2.1	2.2	--	--	2.1	--	2.2	--	--	--	3.1
1-1/4	2.2	2.4	--	--	2.2	--	2.4	--	--	--	3.6
1-1/2	2.4	2.6	--	--	2.4	--	2.6	--	--	--	4.0
2	2.5	3.1	--	--	2.5	--	3.1	--	--	--	5.3
2-1/2	2.8	3.8	--	--	2.8	--	3.8	--	--	--	5.9
3	3.2	4.4	--	--	3.2	--	4.4	--	--	--	6.6
3-1/2	3.7	4.9	--	--	3.7	--	4.9	--	--	--	--
4	4.0	5.6	--	--	4.0	--	5.6	--	7.0	--	8.6
5	5.1	6.9	--	--	5.1	--	6.9	--	8.6	--	10.7
6	5.4	7.5	--	--	5.4	--	7.5	--	10.9	--	13.9
8	6.3	8.9	6.3	6.3	6.3	8.3	8.9	12.0	15.2	18.6	21.5
10	7.1	10.3	7.1	7.1	7.1	10.3	12.6	16.4	21.1	27.3	32.8
12	8.1	11.8	8.1	8.1	9.9	13.1	17.0	23.5	28.7	34.7	39.2
14 OD	9.3	13.6	9.3	9.3	11.6	16.0	22.7	28.9	34.6	38.9	47.9
16 OD	10.6	15.2	10.6	10.6	15.2	20.2	26.8	36.5	41.4	45.7	55.3
18 OD	11.6	16.3	11.6	15.1	19.1	25.4	30.1	44.1	49.0	53.0	69.1
20 OD	13.0	18.3	13.0	18.3	22.3	32.6	35.4	51.0	55.9	60.8	77.
24 OD	14.2	19.8	14.2	21.2	27.7	41.7	46.0	64.8	69.7	77.8	90.

All nozzles other than 90° should be charged at the man hours shown for 45° nozzles.

Pipe Thickness: Wall thickness of the pipe used for the nozzle determines the man hours that will apply. nozzles of double extra strong pipe thickness, use schedule 160 man hours.

Reinforcement: Man hours given above are for plain welded nozzles only. For use of gusset plates, etc., as stiffer not for reinforcement, add 25% to the net man hours shown above. If reinforcement is required produced by building up the nozzle weld, or by the use of reinforcing rings or saddles as specified use r hours for 90° reinforced nozzles.

Preheating: If specified or required by codes, add for this operation. See man hours for preheating. The size and thickness of the header (not the size of the nozzle) determines the preheating man hours.

Stress Relieving: Stress relieving of welds in carbon steel materials is required by the A.S.A. code for pres piping, where the wall thickness is 3/4" or greater. The size and wall thickness of the header determine man hours to be used for stress relieving.

All pipe sizes shown below the ruled line are 3/4" or greater in wall thickness and must be stress reli Where stress relieving is required an extra charge should be made. See man hours for stress relievin

For General Notes on welding, see page 92.

LARGE O.D. 90° NOZZLE WELDS

Labor for Cutting and Welding

Carbon Steel Material

NET MAN HOURS EACH

O.D. Pipe Inches	NON-REINFORCED 90° NOZZLE WELDS — WALL THICKNESS IN INCHES							
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00
26	24.8	29.0	31.9	45.4	53.3	68.4	78.7	89.0
28	28.1	33.2	34.7	50.0	58.6	74.7	84.1	94.3
30	33.2	38.2	40.0	54.2	63.5	79.4	89.8	99.7
32	38.7	43.3	45.9	59.8	69.7	86.0	95.6	104.9
34	46.6	48.1	51.7	66.4	78.6	92.4	102.1	110.6
36	53.1	55.1	59.1	74.7	90.3	103.8	113.0	121.3
38	60.8	62.2	68.0	84.4	104.0	117.4	125.6	132.3
40	68.7	70.3	78.2	95.3	119.5	132.6	139.4	144.2
42	77.6	79.4	89.9	107.7	137.5	149.9	154.7	157.1
48	85.0	90.6	102.5	123.0	156.9	171.1	176.8	179.6
54	95.6	102.0	115.3	138.3	176.5	192.5	198.8	202.0
60	106.2	113.3	128.1	153.6	196.1	213.8	220.9	224.4
	REINFORCED 90° NOZZLE WELDS							
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00
26	34.3	40.4	44.1	53.6	62.5	80.8	102.0	123.3
28	38.8	46.0	48.1	58.5	68.4	87.6	108.9	131.0
30	45.9	53.0	55.5	63.6	74.6	93.5	116.5	138.4
32	53.6	59.8	63.1	70.6	82.0	100.9	123.9	145.8
34	64.8	66.9	71.7	78.0	92.3	108.6	132.5	152
36	74.6	76.5	81.8	87.6	106.1	122.1	146.2	1
38	81.1	87.2	93.3	99.0	122.0	138.1	161.0	183.6
40	95.3	99.4	106.4	111.9	140.4	156.0	177.0	200.1
42	107.6	113.3	121.3	126.4	161.4	176.3	194.8	218.2
48	123.0	129.7	138.8	144.4	184.7	201.7	222.5	249.2
54	138.3	146.0	156.1	162.5	207.7	226.8	250.4	280.4
60	153.6	162.1	173.5	180.5	230.8	252.0	278.2	311.5

For General Notes on welding, see pages 92, 96, and 97.

45° WELDED NOZZLES—REINFORCED

Labor for Cutting and Welding

Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
1-1/2	6.8	7.1	--	--	6.8	--	7.1	--	--	--	10.2
2	6.9	7.7	--	--	6.9	--	7.7	--	--	--	13.3
2-1/2	7.8	9.3	--	--	7.8	--	9.3	--	--	--	14.6
3	8.7	10.5	--	--	8.7	--	10.5	--	--	--	16.1
3-1/2	10.0	11.6	--	--	10.0	--	11.6	--	--	--	--
4	11.2	13.5	--	--	11.2	--	13.5	--	--	--	20.2
5	13.1	15.8	--	--	13.1	--	15.8	--	--	--	25.0
6	13.8	17.1	--	--	13.8	--	17.1	--	--	--	31.4
8	15.8	21.6	15.8	15.8	15.8	18.1	21.6	26.4	32.8	39.8	44.5
10	17.3	21.7	17.3	17.3	17.3	21.7	26.0	32.1	44.5	48.9	53.2
12	19.2	24.3	19.2	19.2	20.5	27.1	35.4	45.7	51.7	60.8	70.9
14 OD	21.0	27.6	21.0	21.0	23.4	32.6	45.9	52.6	62.2	70.5	81.2
16 OD	23.7	30.2	23.7	23.7	30.2	40.1	52.9	65.7	82.6	84.8	93.8
18 OD	25.5	31.6	25.5	29.4	37.4	50.2	59.5	79.7	92.9	87.5	117.4
20 OD	28.2	35.6	28.2	35.6	43.4	62.9	71.3	85.5	98.9	113.4	131.9
24 OD	29.5	38.4	29.5	38.7	51.1	71.2	76.8	97.1	114.8	132.7	154.1

Pipe Thickness: Wall thickness of the pipe used for the nozzle determines the man hours that will apply. For nozzles of double extra strong pipe thickness, use schedule 160 man hours.

Reinforcement: Man hours given above includes the labor requirements for reinforcement produced by building up the nozzle weld, or by the use of reinforcing rings or saddles as may be specified.

Preheating: If specified or required by codes, add for this operation. See man hours for preheating. The size and wall thickness of the header (not the size of the nozzles) determines the preheating man hours.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A. S. A. code for pressure piping, where the wall thickness is 3/4" or greater. The size and wall thickness of the header determines the man hours to be used for stress relieving. All pipe sizes shown below the ruled line are 3/4" or greater in wall thickness and must be stress relieved. Where stress relieving is required an extra charge should be made. See man hours for stress relieving.

For General Notes on welding, see page 92.

45° WELDED NOZZLES—REINFORCED

Labor for Cutting and Welding

Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
1-1/2	6.8	7.1	--	--	6.8	--	7.1	--	--	--	10.2
2	6.9	7.7	--	--	6.9	--	7.7	--	--	--	13.3
2-1/2	7.8	9.3	--	--	7.8	--	9.3	--	--	--	14.6
3	8.7	10.5	--	--	8.7	--	10.5	--	--	--	16.1
3-1/2	10.0	11.6	--	--	10.0	--	11.6	--	--	--	--
4	11.2	13.5	--	--	11.2	--	13.5	--	--	--	20.2
5	13.1	15.8	--	--	13.1	--	15.8	--	--	--	25.0
6	13.8	17.1	--	--	13.8	--	17.1	--	--	--	31.4
8	15.8	21.6	15.8	15.8	15.8	18.1	21.6	26.4	32.8	39.8	44.5
10	17.3	21.7	17.3	17.3	17.3	21.7	26.0	32.1	44.5	48.9	53.2
12	19.2	24.3	19.2	19.2	20.5	27.1	35.4	45.7	51.7	60.8	70.9
14 OD	21.0	27.6	21.0	21.0	23.4	32.6	45.9	52.6	62.2	70.5	81.2
16 OD	23.7	30.2	23.7	23.7	30.2	40.1	52.9	65.7	82.6	84.8	93.8
18 OD	25.5	31.6	25.5	29.4	37.4	50.2	59.5	79.7	82.9	87.5	117.4
20 OD	28.2	35.6	28.2	35.6	43.4	62.9	71.3	85.5	98.9	113.4	131.9
24 OD	29.5	38.4	29.5	38.7	51.1	71.2	76.8	97.1	114.8	132.7	154.1

Pipe Thickness: Wall thickness of the pipe used for the nozzle determines the man hours that will apply. For nozzles of double extra strong pipe thickness, use schedule 160 man hours.

Reinforcement: Man hours given above includes the labor requirements for reinforcement produced by building up the nozzle weld, or by the use of reinforcing rings or saddles as may be specified.

Preheating: If specified or required by codes, add for this operation. See man hours for preheating. The size and wall thickness of the header (not the size of the nozzles) determines the preheating man hours.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A. S. A. code for pressure piping, where the wall thickness is 3/4" or greater. The size and wall thickness of the header determines the man hours to be used for stress relieving. All pipe sizes shown below the ruled line are 3/4" or greater in wall thickness and must be stress relieved. Where stress relieving is required an extra charge should be made. See man hours for stress relieving.

For General Notes on welding, see page 92.

LARGE O.D. 45° NOZZLE WELDS

Labor for Cutting and Welding

Carbon Steel Material

NET MAN HOURS EACH

NON-REINFORCED 45° NOZZLE WELDS

O.D. Pipe Inches	WALL THICKNESS IN INCHES								
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	33.2	38.7	42.6	60.8	71.0	91.8	105.1	118.6	139.5
28	37.2	44.4	46.1	66.6	77.6	99.4	112.2	125.7	146.8
30	44.1	51.0	53.2	72.2	84.6	106.2	119.9	133.0	154.2
32	51.4	57.6	60.7	80.1	93.0	114.7	127.4	140.2	161.1
34	62.2	64.4	68.8	88.5	104.8	123.1	136.3	147.4	173.8
36	71.6	73.4	78.7	99.4	120.4	138.5	150.5	161.9	187.0
38	80.9	83.8	90.6	112.3	138.5	156.6	165.7	176.5	202.3
40	91.5	95.5	104.2	127.0	159.4	176.9	182.2	192.3	218.3
42	103.4	108.8	119.9	143.4	183.3	199.9	207.8	224.7	235.8
48	118.4	124.6	137.1	163.7	209.6	226.6	237.3	256.5	269.0
54	133.2	140.2	154.2	184.2	235.8	254.9	267.0	288.6	302.7
60	148.0	155.8	171.3	204.6	262.0	283.2	296.7	320.7	336.3

REINFORCED 45° NOZZLE WELDS

	.375	.500	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	45.9	53.7	58.9	75.0	83.3	107.6	136.1	164.4	193.3
28	51.6	61.4	64.1	78.0	91.3	116.8	145.3	174.5	203.8
30	61.1	70.7	74.0	84.8	99.4	124.8	155.2	184.4	214.1
32	71.5	79.8	84.3	94.0	109.4	134.5	165.2	194.5	223.5
34	86.3	89.3	95.6	104.0	123.1	144.7	176.6	204.6	241.1
36	99.2	101.8	109.2	116.8	141.5	162.7	194.9	224.4	259.8
38	112.1	116.2	124.5	132.0	162.7	183.8	214.6	244.7	280.7
40	126.7	132.4	142.0	149.2	187.1	207.8	236.0	266.7	303.1
42	143.3	150.9	161.9	168.6	215.2	234.8	259.6	290.8	327.5
48	163.7	172.8	185.3	192.6	245.8	268.5	296.8	332.5	374.4
54	184.2	194.3	208.4	216.6	276.6	302.1	333.9	374.1	421.1
60	204.6	215.9	231.5	240.7	307.3	335.6	371.0	415.6	468.0

For General Notes on welding, see pages 92, 96, and 97.

CONCENTRIC SWEDGED ENDS

Labor For Welding

Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2	1.6	2.1	--	--	1.6	--	2.1	--	--	--	3.2
2-1/2	1.8	2.4	--	--	1.8	--	2.4	--	--	--	3.8
3	2.0	2.8	--	--	2.0	--	2.8	--	--	--	4.5
3-1/2	2.3	3.2	--	--	2.3	--	3.2	--	--	--	--
4	2.6	3.8	--	--	2.6	--	3.8	--	5.4	--	6.4
5	3.5	4.8	--	--	3.5	--	4.8	--	7.6	--	9.0
6	4.1	6.2	--	--	4.1	--	6.2	--	10.2	--	11.6
8	5.9	9.2	--	5.9	5.9	--	9.2	11.9	15.6	18.3	20.1
10	7.8	12.4	--	7.8	7.8	12.4	14.6	18.6	26.7	--	34.8
12	10.3	16.5	--	10.3	15.6	19.4	24.8	32.9	43.9	--	50.4
14 OD	13.8	22.9	13.6	13.6	22.1	27.5	35.8	45.0	62.3	--	--
16 OD	19.4	29.3	19.4	19.4	29.3	34.7	39.5	51.2	68.8	--	--
18 OD	23.7	38.5	23.7	35.8	45.0	64.1	--	--	--	--	--
20 OD	27.5	43.1	27.5	43.1	50.4	76.8	--	--	--	--	--
24 OD	36.6	59.6	36.6	59.6	--	--	--	--	--	--	--

Pipe Thickness: The wall thickness of the pipe determines the man hours that will apply. For swedged ends on double extra strong pipe thickness, use schedule 160 man hours.

Ends: All man hours are based on ends being furnished either plain or beveled for welding.

Unlisted Sizes: Unlisted sizes take the next higher listing.

ECCENTRIC SWEDGED ENDS

Labor For Welding

Carbon Steel Material

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2	1.8	2.2	--	--	1.8	--	2.2	--	--	--	3.9
2-1/2	2.0	2.9	--	--	2.0	--	2.9	--	--	--	4.6
3	2.3	3.2	--	--	2.3	--	3.2	--	--	--	5.2
3-1/2	2.6	3.8	--	--	2.6	--	3.8	--	--	--	--
4	3.1	4.5	--	--	3.1	--	4.5	--	7.1	--	7.6
5	4.0	6.0	--	--	4.0	--	6.0	--	9.4	--	10.4
6	4.9	7.1	--	--	4.9	--	7.1	--	12.8	--	14.4
8	7.3	11.9	7.3	7.3	7.3	--	11.9	20.5	20.1	22.1	24.1
10	10.0	16.2	10.0	10.0	10.0	16.2	20.1	24.8	32.1	--	45.8
12	13.7	21.1	13.7	13.7	21.1	25.6	32.9	43.9	56.8	--	64.0
14 OD	19.4	30.2	19.4	19.4	31.0	37.5	45.8	58.6	80.5	--	--
16 OD	27.4	40.2	27.4	27.4	40.2	47.6	52.3	68.8	89.7	--	--
18 OD	32.5	54.9	32.5	32.5	60.4	85.2	--	--	--	--	--
20 OD	36.0	62.9	36.0	36.0	68.8	100.7	--	--	--	--	--
24 OD	51.3	82.4	51.3	51.3	--	--	--	--	--	--	--

Pipe Thickness: The wall thickness of the pipe determines the man hours that will apply. For swedged ends on double extra strong pipe thickness, use schedule 160 man hours.

Ends: All man hours are based on ends being furnished either plain or beveled for welding.

Unlisted Sizes: Unlisted sizes take the next higher listing.

END CLOSURES—PRESSURE TYPE

Carbon Steel Material

NET MAN HOURS EACH

Nom. Pipe Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS						
			40	60	80	100	.120	140	XX Hy. or 160
1-1/2	0.9	1.0	0.9	--	0.9	--	--	--	2.3
2	1.2	1.3	1.2	--	1.3	--	--	--	3.5
2-1/2	1.3	1.5	1.3	--	1.5	--	--	--	4.3
3	1.5	1.8	1.5	--	1.8	--	--	--	4.5
3-1/2	1.6	2.1	1.6	--	2.1	--	--	--	--
4	1.8	2.4	1.8	--	2.4	--	5.6	--	6.0
5	2.3	2.9	2.3	--	2.9	--	7.5	--	7.9
6	2.6	3.3	2.6	--	3.3	--	9.3	--	10.2
8	3.7	4.7	3.7	--	4.7	8.9	12.5	14.8	15.6
10	4.6	5.9	4.6	5.9	10.3	12.7	21.4	23.0	24.7
12	5.5	7.2	6.7	7.7	13.0	18.9	28.6	31.2	33.7
14	6.6	8.6	8.0	9.9	15.1	20.9	32.9	44.5	46.3
16	7.4	9.7	9.7	12.5	16.6	23.5	37.9	56.1	58.8
18	9.0	11.3	13.9	16.2	21.8	29.6	42.8	67.6	71.3
20	9.7	12.5	16.8	19.8	27.0	35.8	47.8	79.1	--
24	10.6	14.9	19.6	23.5	32.2	42.1	52.2	--	--

Pipe Thickness: Wall thickness of pipe determines the man hours that will apply. For double strong pipe thickness use schedule 160 man hours.

Construction: End closures such as orange peel, saddle, or flat plate type.

Preheating: If specified or required by codes, add for this operation. See man hours for preheating.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A. S. A. Code for pressure piping where the wall thickness is 3/4" or greater.

All sizes of butt welds shown below the ruled lines are 3/4" or greater in wall thickness and must be stress relieved, if the end closure involves a circumferential weld. Where stress relieving is required, an extra charge should be made. See man hours for stress relieving.

Unlisted Sizes: Unlisted sizes take the next higher listing.

HEAVY WALL END CLOSURES—PRESSURE TYPE

Carbon Steel Material
NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN.							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	5.4	—	—	—	—	—	—	—
4	—	8.1	9.6	10.9	—	—	—	—
5	—	9.9	11.6	13.1	14.8	—	—	—
6	—	15.8	18.5	21.0	23.7	25.8	27.4	—
8	—	16.6	19.5	22.1	24.9	27.1	28.8	30.8
10	—	—	26.3	29.9	33.7	36.8	39.1	41.8
12	—	—	—	41.3	46.7	51.0	54.0	57.8
14	—	—	—	47.7	53.9	58.8	62.3	66.7
16	—	—	—	—	62.8	68.4	72.6	77.5
18	—	—	—	—	—	76.2	80.8	86.4
20	—	—	—	—	—	82.2	87.2	93.2
22	—	—	—	—	—	90.5	95.9	102.5
24	—	—	—	—	—	98.8	104.7	111.9
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	44.6	47.7	—	—	—	—	—	—
12	61.8	66.1	69.1	72.2	—	—	—	—
14	62.3	66.6	69.7	72.9	76.2	79.8	—	—
16	82.8	88.5	92.6	96.8	101.1	105.7	—	—
18	92.4	98.8	103.4	108.0	112.8	117.9	—	—
20	99.7	106.6	111.5	116.6	121.8	127.2	132.3	136.9
22	109.6	117.2	122.7	128.3	134.0	140.1	145.6	150.7
24	119.5	127.8	133.8	139.8	146.1	152.7	158.8	164.4
	4.75	5.00	5.25	5.50	5.75	6.00		
20	142.5	147.5	152.7	157.8	162.0	166.9		
22	156.8	162.4	168.0	173.1	178.3	183.6		
24	171.1	177.1	183.4	188.9	194.6	200.4		

Construction: End closures as such are field fabricated closures: orange peel, saddle, or flat plate type.

Preheating: If specified or required by codes, add for this operation. See man hours for preheating.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A.S.A. Code of Pressure Piping where the wall thickness is ¾" or greater.

All the above butt welds are ¾" or greater and must be stress relieved, if end closure involves a circumferential weld.

See respective man hour tables for stress relieving.

LARGE O.D. PIPE END CLOSURES—PRESSURE TYPE

Carbon Steel Material

NET MAN HOURS EACH

O.D. Pipe In.	WALL THICKNESS IN.							
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00
26	33.3	40.7	53.2	65.0	76.0	86.6	96.2	105.6
28	35.2	43.0	57.0	69.7	81.5	92.6	102.8	113.4
30	36.9	45.2	60.1	73.5	85.9	97.6	108.2	119.3
32	38.5	47.1	62.5	76.5	89.4	101.6	112.7	124.3
34	40.0	49.0	65.0	79.5	93.0	105.6	117.2	129.2
36	41.4	50.6	67.3	82.2	96.2	109.3	121.2	133.7
38	42.8	52.4	69.6	85.2	100.0	113.2	125.6	138.5
40	44.6	54.5	72.5	88.6	103.6	117.6	130.5	144.0
42	46.4	56.8	75.4	92.2	107.7	122.4	135.7	149.6
44	47.9	58.6	77.9	95.2	111.3	126.4	140.2	154.6
46	87.4	60.7	80.6	98.5	115.2	130.9	145.1	160.1
48	51.2	62.7	83.2	101.7	118.9	135.1	149.9	165.3
54	54.8	66.9	88.9	108.7	127.1	144.3	160.0	176.5
60	58.5	71.6	95.1	116.3	136.1	154.6	171.5	189.2
	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
26	114.7	124.8	133.5	142.0	151.9	159.2	166.9	174.9
28	123.2	134.0	143.3	152.5	163.1	170.9	179.1	187.7
30	129.6	141.0	150.7	160.4	171.6	179.8	188.4	197.5
32	135.0	146.9	157.1	167.1	178.8	187.4	196.4	205.8
34	140.3	152.7	163.2	173.7	185.9	194.8	204.1	213.9
36	145.1	157.9	168.7	179.6	192.2	200.7	210.4	220.5
	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
26	182.1	189.5	197.3	204.0	211.0	218.2	225.6	232.0
28	195.4	203.4	211.8	219.0	226.4	234.1	242.0	248.7
30	205.7	214.1	222.8	230.3	238.1	246.3	254.6	261.7
32	214.3	223.0	232.1	240.0	248.2	256.7	265.4	272.8
34	222.7	231.8	241.3	249.6	258.1	266.8	275.9	283.6
36	229.6	239.1	248.9	257.4	266.1	275.2	284.5	292.5

Construction: End closures as such are field fabricated closures; orange peel, saddle, or flat plate type.

Preheating: If specified or required by codes, add for this operation. See man hours for preheating.

Stress Relieving: Stress relieving of welds in carbon steel material is required by the A.S.A. Code of Pressure Piping where the wall thickness is ¾" or greater.

Above wall thickness .750 through 6.00 must be stress relieved, if the end closure involves a circumferential weld.

See respective table for stress relieving.

90° COUPLING WELDS AND SOCKET WELDS

Labor for Cutting and Welding

Carbon Steel Material

NET MAN HOURS EACH

Pipe Size Inches	90°—3000 # Coupling Weld	90°—6000 # Coupling Weld	SOCKET WELDS	
			Sch. 40 & 80 Pipe	Sch. 100 & Heavier Pipe
1/2" or less	1.6	2.0	0.6	0.6
3/4	1.8	2.2	0.6	0.7
1	2.1	2.5	0.7	0.8
1-1/4	2.4	2.9	0.9	1.0
1-1/2	2.6	3.2	0.9	1.2
2	3.3	4.1	1.0	1.5
2-1/2	3.9	4.8	1.3	1.6
3	4.6	5.6	1.4	2.0

Man hours shown are for welding of coupling to the O.D. of the pipe only.

If couplings are to be welded to the I.D. of the pipe, add 50% to the above man hours. For pipe thickness up to 1 inch, add an additional 12% for each 1/4 inch or fraction thereof of pipe thickness over 1 inch.

Any coupling welded to pipe heavier than schedule 160 should be man houred as a 6000 pound coupling.

For couplings welded at angles from 45° to less than 90° and couplings attached to fittings increase above man hours 50%.

For couplings welded at angles less than 45° increase above man hours 75%.

Socket welds do not include cut. See respective man hour table for this charge.

'OLET TYPE WELDS

Labor Cutting And Welding

Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size		Standard Weight And 2000 #	Extra Strong and 3000.=	Greater Than Extra Strong and 6000 #
Outlet	Header			
1/2	All Sizes	1.5	2.0	2.5
3/4	All Sizes	1.8	2.2	3.0
1	All Sizes	2.1	2.5	3.3
1-1/4	All Sizes	2.3	2.9	3.8
1-1/2	All Sizes	2.9	3.7	4.9
2	All Sizes	3.9	4.8	6.4
2-1/2	All Sizes	4.6	5.9	7.7
3	All Sizes	5.3	6.8	10.6
4	All Sizes	7.0	8.5	11.3
5	All Sizes	7.9	9.3	13.7
6	All Sizes	8.7	9.9	16.0
8	All Sizes	9.7	10.6	18.9
10	All Sizes	13.6	19.4	30.2
12	All Sizes	19.0	22.5	44.7
14	14" And 16"	23.8	26.5	53.9
14	18" And Larger	21.2	23.8	58.7
16	16" And 18"	28.4	30.4	70.4
16	20" And Larger	25.1	27.4	76.2
18	18" And 20"	33.7	36.9	91.0
18	24" And Larger	29.7	32.7	98.0
20	20" And 24"	40.9	44.9	100.9
20	26" And Larger	35.7	39.9	108.8
24	24" And 26"	62.7	73.3	121.1
24	28" And Larger	52.8	63.4	130.5

Man hours are based on the outlet size and schedule except when the run schedule is greater than the outlet schedule, in which case the man hours are based on the outlet size and run schedule.

For elbolet or latrolet welds and weldolets, thredolets, etc., that are attached to fittings or welded at any angle other than 90°, add 50% to the above man hours.

For sweepolet attachment welds, add 150% to the above man hours.

FLAME CUTTING PIPE—PLAIN ENDS

Labor For Straight Pipe Only

Carbon Steel Material

NET MAN HOURS EACH

Pipe Size Inches	Standard Pipe & O.D. Size 3/8" Thick	Extra Hvy. Pipe & O.D. Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2" Or Less	0.10	0.15	--	--	0.10	--	0.15	--	--	--	0.21
2-1/2	0.12	0.17	--	--	0.12	--	0.17	--	--	--	0.23
3	0.15	0.21	--	--	0.15	--	0.21	--	--	--	0.28
4	0.21	0.28	--	--	0.21	--	0.28	--	0.38	--	0.41
5	0.24	0.36	--	--	0.24	--	0.36	--	0.44	--	0.49
6	0.33	0.45	--	--	0.33	--	0.45	--	0.56	--	0.63
8	0.46	0.64	0.46	0.46	0.46	0.59	0.64	0.76	0.86	0.97	1.14
10	0.64	0.92	0.64	0.64	0.64	0.92	0.99	1.09	1.24	1.43	1.73
12	0.70	1.09	0.70	0.70	0.86	1.30	1.37	1.48	1.73	1.91	2.05
14 O.D.	0.98	1.30	0.98	0.98	1.15	1.44	1.67	1.78	1.96	2.30	2.42
16 O.D.	1.09	1.61	1.09	1.09	1.61	1.78	1.90	2.13	2.30	2.59	2.93
18 O.D.	1.42	2.01	1.42	1.65	2.01	2.24	2.36	2.66	2.83	3.19	3.72
20 O.D.	1.71	2.24	1.71	2.30	2.48	2.66	2.83	3.13	3.30	3.84	4.37
24 O.D.	2.60	3.30	2.60	3.48	3.66	3.84	3.95	4.31	4.78	5.37	6.08

For mitre cuts less than 30°, add 50% to the above man hours.

For mitre cuts 30° or greater, add 100% to the above man hours.

Man hours are for cutting pipe with plain ends only and do not include beveling, threading, etc. See appropriate man hour tables for these operations.

For cutting the ends of bends or trimming fittings, add 50% to the above man hours.

FLAME CUTTING HEAVY WALL PIPE—PLAIN ENDS

Labor For Straight Pipe Only

Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	0.53	0.94	--	--	--	--	--	--
4	0.94	1.12	1.59	1.77	--	--	--	--
5	--	1.30	1.65	2.00	2.24	2.54	--	--
6	--	1.59	1.89	2.24	2.54	2.77	3.19	--
8	--	1.89	2.24	2.48	2.89	3.13	3.48	4.07
10	--	--	2.48	2.77	3.13	3.42	3.84	4.37
12	--	--	--	3.13	3.36	3.84	4.25	4.78
14	--	--	--	3.60	3.72	4.13	4.60	5.25
16	--	--	--	--	4.31	4.96	5.61	6.14
18	--	--	--	--	--	4.60	6.14	6.84
20	--	--	--	--	--	6.14	6.84	7.73
22	--	--	--	--	--	--	--	8.38
24	--	--	--	--	--	--	--	9.50
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	4.72	5.02	--	--	--	--	--	--
12	5.31	5.72	6.14	6.61	--	--	--	--
14	5.84	6.31	6.61	7.49	8.02	8.79	--	--
16	6.67	7.20	7.73	8.38	9.09	9.97	--	--
18	7.49	8.02	8.79	9.50	10.27	11.39	--	--
20	8.26	8.91	9.79	10.68	11.56	12.57	13.63	14.63
22	9.26	10.03	10.68	11.86	12.92	13.92	14.99	16.11
24	10.27	11.15	12.10	13.22	13.92	15.46	16.87	18.47
	4.75	5.00	5.25	5.50	5.75	6.00		
20	15.64	16.58	17.70	18.64	19.77	20.77		
22	17.23	18.35	19.35	20.41	21.54	22.72		
24	19.94	21.00	22.30	23.60	24.78	26.14		

For mitre cuts less than 30°, add 50% to the above man hours.

For mitre cuts 30° or greater, add 100% to the above man hours.

Man hours are for cutting pipe with plain ends only and do not include beveling, threading, etc. See appropriate man hour tables for these operations.

For cutting the ends of bends or trimming fittings, add 50% to the above man hours.

FLAME CUTTING LARGE O.D. PIPE-PLAIN ENDS

Labor for Straight Pipe Only

Carbon Steel Material

NET MAN HOURS EACH

O.D. Pipe Inches	WALL THICKNESS IN INCHES							
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00
26	4.13	5.49	6.20	6.67	6.84	7.20	7.49	7.73
28	4.78	5.96	6.67	7.20	7.49	7.29	7.91	8.20
30	5.07	6.43	7.20	7.49	7.91	8.20	8.44	8.79
32	5.61	6.84	7.55	8.02	8.38	8.79	9.09	9.26
34	6.14	7.55	8.14	8.61	8.91	9.26	9.62	9.85
36	6.84	8.20	8.79	9.26	9.62	9.97	10.27	10.62
38	7.72	8.44	9.50	9.97	10.27	10.74	11.33	11.68
40	8.61	9.62	10.38	10.68	11.15	11.62	12.10	12.57
42	9.62	10.97	11.39	11.68	12.10	12.74	13.22	13.63
44	10.92	12.04	12.57	12.92	13.45	13.87	14.34	14.81
46	12.21	13.22	13.81	14.10	14.57	15.16	15.69	16.11
48	13.81	14.51	14.99	15.46	15.93	16.40	17.05	17.46
54	15.53	16.32	16.85	17.39	17.91	18.44	19.18	19.65
60	17.25	18.14	18.73	19.32	19.91	20.50	21.31	21.83
	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
26	8.14	10.50	11.39	12.27	13.22	14.34	14.99	16.58
28	8.79	11.15	11.63	12.57	13.57	14.81	15.52	16.99
30	9.26	11.68	12.04	12.92	14.16	15.28	15.93	17.52
32	9.79	12.27	12.74	13.45	14.63	15.75	16.40	18.00
34	10.38	12.92	13.39	13.87	15.22	16.23	16.87	18.47
36	10.97	13.45	13.92	14.34	15.69	16.87	17.52	19.12
	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
26	18.00	19.53	20.95	22.30	23.72	25.19	26.61	28.03
28	18.47	20.06	21.42	22.95	24.19	25.67	27.08	28.50
30	18.94	20.41	22.00	23.42	24.78	26.14	27.55	28.97
32	19.53	21.00	22.48	23.90	25.25	26.67	28.03	29.50
34	20.06	21.59	23.00	24.37	25.78	27.26	28.67	30.09
36	20.53	22.13	23.60	25.00	26.43	27.73	29.21	30.74

For General Notes, see the bottom of page 110.

FLAME BEVELING PIPE FOR WELDING

"V" Type Bevels

Labor for Straight Pipe Only

Carbon Steel Material

NET MAN HOURS EACH

Pipe Size Inches	Standard Pipe & O.D. Sizes 3/8" Thick	Extra Hvy. Pipe & O.D. Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2" or less	0.08	0.12	--	--	0.08	--	0.12	--	--	--	0.16
2-1/2"	0.09	0.14	--	--	0.09	--	0.14	--	--	--	0.18
3	0.12	0.16	--	--	0.12	--	0.16	--	--	--	0.22
4	0.16	0.22	--	--	0.16	--	0.22	--	0.30	--	0.32
5	0.20	0.28	--	--	0.20	--	0.28	--	0.35	--	0.39
6	0.26	0.35	--	--	0.26	--	0.35	--	0.45	--	0.49
8	0.37	0.51	0.37	0.37	0.37	0.46	0.51	0.60	0.68	0.75	--
10	0.51	0.72	0.51	0.51	0.51	0.72	0.78	0.86	0.95	--	--
12	0.55	0.86	0.55	0.55	0.68	1.02	1.08	1.18	--	--	--
14 O.D.	0.57	1.02	0.77	0.77	0.91	1.13	1.31	--	--	--	--
16 O.D.	0.86	1.27	0.86	0.86	1.27	1.40	1.55	--	--	--	--
18 O.D.	1.11	1.58	1.11	1.30	1.58	1.77	--	--	--	--	--
20 O.D.	1.35	1.77	1.35	1.82	1.95	2.15	--	--	--	--	--
24 O.D.	2.04	2.60	2.04	2.74	2.88	--	--	--	--	--	--

For mitre bevels add 50% to the above man hours.

Above man hours are for flame "V" beveling only and do not include cutting or internal machining. See respective man hour tables for these charges.

For beveling on the ends of bends or shop trimmed fittings, add 50% to the above man hours.

FLAME BEVELING LARGE O.D. PIPE FOR WELDING

Labor For Straight Pipe Only

Carbon Steel Material

NET MAN HOURS EACH

O. D. Pipe Size Inches	WALL THICKNESS IN INCHES		
	.375	.500	.750
26	3.27	4.31	4.87
28	3.75	4.68	5.24
30	4.00	5.05	5.69
32	4.43	5.39	5.95
34	4.84	5.95	6.43
36	5.39	6.47	6.91
38	6.10	7.17	7.47
40	6.80	7.85	8.18
42	7.59	8.66	8.96
44	8.59	9.48	9.89
46	9.63	10.41	10.89
48	10.89	11.45	11.82
54	12.25	12.87	13.31
60	13.62	14.31	14.79

For Mitre Bevels add 50% to the above man hours.

Above man hours are for flame "V" beveling only and do not include cutting or internal machining. See respective man hour tables for these charges.

For beveling on the ends of bends or shop trimmed fittings, add 50% to the above man hours.

THREADING PIPE—INCLUDING CUT

Labor For Cut and Thread Only

Carbon Steel Material

NET MAN HOURS EACH

Pipe Size Inches	Standard Pipe & O.D. Sizes 3/8" Thick	Extra Hvy. Pipe & O.D. Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2" or Less	0.20	0.30	--	--	0.20	--	0.30	--	--	--	0.42
2-1/2"	0.27	0.40	--	--	0.27	--	0.40	--	--	--	0.47
3	0.30	0.42	--	--	0.30	--	0.42	--	--	--	0.58
4	0.42	0.58	--	--	0.42	--	0.58	--	0.84	--	0.90
5	0.54	0.78	--	--	0.54	--	0.78	--	0.91	--	1.07
6	0.70	0.93	--	--	0.70	--	0.93	--	1.18	--	1.35
8	0.97	1.35	0.97	0.97	0.97	1.26	1.35	1.64	1.83	2.04	2.38
10	1.38	1.84	1.38	1.38	1.38	1.84	2.11	2.44	2.58	3.08	3.65
12	1.53	2.44	1.53	1.53	2.07	2.75	2.90	3.17	3.65	4.14	4.38
14 O.D.	2.07	2.67	2.07	2.07	2.67	2.95	3.39	3.85	4.14	--	--
16 O.D.	2.37	3.45	2.37	2.37	3.45	3.71	4.14	4.38	4.87	--	--
18 O.D.	2.95	4.14	2.95	3.65	4.14	4.38	4.87	5.42	--	--	--
20 O.D.	3.54	4.72	3.54	4.72	5.68	6.16	6.49	--	--	--	--
24 O.D.	5.18	6.89	5.18	7.23	7.67	7.93	8.37	--	--	--	--

Above man hours are for die cut IPS pipe threads only.

For threading the ends of bends, add 100% to the above man hours.

WELDED CARBON STEEL ATTACHMENTS

NET MAN HOURS PER LINEAL FOOT

Thickness of Plate Etc., Inches	Layout & Flame Cutting Per Lineal Inch	Fillet Welding Per Lineal Inch
1/2 or less	0.05	0.05
3/4	0.05	0.07
1	0.05	0.09
1-1/4	0.07	0.10
1-1/2	0.07	0.10
1-3/4	0.08	0.20
2	0.09	0.20

Figure labor on basis of total lineal inches to be cut and fillet welded.

Unlisted thickness take the next higher listing.

Any machining of bases, anchors, supports, lugs, etc., should be charged as an extra.

If preheating is required, add 100% to the above man hours.

DRILLING HOLES IN WELDED ATTACHMENTS

Carbon Steel Material

NET MAN HOURS EACH

Thickness of Plates, Angles, Etc. in Inches	HOLE SIZE			
	3/4" and smaller	7/8", 1" and 1-1/8"	1-1/4", 1-1/2" and 2"	2-1/4" and 2-1/2"
1/2" or less	0.24	0.29	0.34	0.47
3/4	0.29	0.34	0.43	0.64
1	0.31	0.40	0.49	0.67
1-1/4	0.40	0.49	0.55	0.71
1-1/2	0.49	0.55	0.71	0.91
1-3/4	0.55	0.71	0.86	1.12
2	0.71	0.82	1.00	1.32
2-1/2	0.82	0.91	1.12	1.62
3	0.91	1.12	1.32	1.82
3-1/2	1.01	1.21	1.52	2.14
4	1.21	1.42	1.73	2.44

Unlisted thickness of plate or size of holes take the next higher listing.

If holes are to be tapped—Add 33-1/3%.

Drilling of sentinel safety or tell tale holes should be charged at .05 man hours each net.

The above man hours are for drilling holes in flat carbon steel plate and structural shapes only.

For drilling holes in pipe or other contoured objects, perpendicular to contoured surface, add 100% to above man hours.

For drilling holes in pipe or other contoured objects, oblique to contoured surface, add 175% to above man hours.

MACHINING INSIDE OF PIPE

Built-Up-Ends

Carbon Materials Only

Machining Inside of Pipe Net Man Hours per End			Built Up Ends on Inside Diameter of Pipe and Fittings with Weld Metal to Provide for Specified Outside Diameter of Machined Backing Ring	
Size Inches	Standard Extra Strong & Sch. Nos. to 100 Inclusive	Double Extra Strong & Sch.Nos. 120,140 & 160	Size Inches	Net Man Hours per End
2 or less	0.5	0.7	2 or less	0.6
2-1/2	0.5	0.7	2-1/2	0.6
3	0.5	0.7	3	0.7
3-1/2	0.5	0.8	3-1/2	0.7
4	0.7	0.8	4	0.8
5	0.8	0.9	5	0.9
6	0.8	1.0	6	1.0
8	1.0	1.3	8	1.4
10	1.2	1.5	10	2.0
12	1.3	1.8	12	2.5
14 OD	1.5	2.1	14	3.1
16 OD	1.8	2.5	16	3.7
18 OD	2.1	2.8	18	4.6
20 OD	2.5	3.4	20	5.5
24 OD	3.4	4.5	24	8.4

Machining: Man hours for machining the inside of straight pipe are for any taper bore from 10° through 30° included angle. For machining the ends of bends add 100% to the above man hours. For counterboring (up to a maximum of 2" in length), add 30% to the above man hours. For machining to a controlled "C" dimension (as required for power piping critical systems), add 225% to the above man hours.

Cutting and Beveling: Man hours do not include cutting and beveling. See respective tables for these charges.

Built-Up Ends: Man hours for built-up ends are for building up the I.D. of straight pipe, bends or fittings, at the ends with weld metal and grinding where it is necessary for proper fit of backing rings.

MACHINING INSIDE OF LARGE O.D. PIPE

Built-Up Ends

Carbon Steel Material

O.D. Pipe Size Inches	NET MAN HOURS—PER END Machining Inside of Straight Pipe Only — WALL THICKNESS IN INCHES					I.D. Built-up with Weld Material
	.500 to 1.50	1.51 to 2.25	2.26 to 3.00	3.01 to 4.50	4.51 to 6.00	Man Hours Per End
26	4.41	5.30	6.31	8.07	10.11	15.20
28	4.76	5.70	6.79	8.56	10.66	17.98
30	5.30	6.11	7.26	9.10	11.27	22.73
32	5.84	6.79	7.67	9.70	12.01	27.82
34	6.58	7.40	8.41	10.38	12.63	35.01
36	7.40	8.28	9.16	11.00	13.30	41.67
38	8.28	9.23	10.18	11.80	14.04	48.85
40	9.23	10.18	11.27	12.63	14.86	57.06
42	10.24	11.06	12.35	13.44	15.74	66.91
44	11.20	12.28	13.44	14.46	16.56	77.49
46	12.28	13.30	14.58	15.61	17.57	87.32
48	13.44	14.46	15.67	16.70	18.60	98.45
54	15.12	16.26	17.63	18.79	20.92	110.75
60	16.80	18.07	19.59	20.87	23.25	123.06

Machining: Man hours for machining the inside of straight pipe are for any taper bore from 10° through 30° included angle. For machining the ends of bends add 100% to the above man hours. For counterboring (up to a maximum of 2" in length), add 30% to the above man hours. For machining to a controlled "C" dimension (as required for power piping critical systems), add 225% to the above man hours.

Cutting and Beveling: Man hours do not include cutting and beveling. See respective tables for these charges.

Built-Up Ends: Man hours for built-up ends are for building up the I.D. of straight pipe, bends or fittings, at the ends with weld metal and grinding where it is necessary for proper fit of backing rings.

BORING INSIDE DIAMETER OF PIPE AND INSTALLING STRAIGHTENING VANES

NET MAN HOURS EACH

Nominal Pipe Size Inches	Boring I.D. of Pipe	Installing Straightening Vanes	
	Carbon Steel	Carbon Steel	Alloy
4	9.8	7.6	11.3
5	11.7	8.7	13.1
6	13.3	10.7	15.2
8	17.5	12.6	18.9
10	20.9	13.9	20.9
12	25.6	15.6	23.7
14	29.5	17.6	26.3
16	35.5	19.5	29.5
18	44.0	22.1	33.0
20	57.7	24.8	37.2
24	79.1	30.2	45.4
26	--	35.9	54.0
28	--	39.6	59.8
30	--	45.9	68.8
32	--	53.1	79.9
34	--	59.8	89.9
36	--	68.8	103.3
38	--	76.9	115.8
40	--	85.2	127.7
42	--	93.7	140.7

Man hours for boring I.D. of pipe include boring for a length of four times nominal pipe size.

Man hours for installing straightening vanes are based on installing vanes in pipe where boring the I.D. of pipe is not required. If boring I.D. of pipe is required or specified, add boring man hours as shown above.

INSTALLING FLOW NOZZLES

Holding Ring Type

Carbon Steel and Alloy Materials

NET MAN HOURS EACH

Pipe Size Inches	FLOW NOZZLES		Pipe O.D. Inches	FLOW NOZZLES	
	Carbon Steel	Alloy		Carbon Steel	Alloy
4	37.8	44.2	26	165.6	198.7
5	41.1	47.3	28	189.6	222.0
6	45.8	53.0	30	217.4	249.9
8	55.2	62.5	32	248.5	282.3
10	63.0	72.7	34	283.7	316.2
12	71.0	82.6	36	319.1	357.4
14 O.D.	77.6	91.2	38	357.5	404.0
16 O.D.	87.6	103.4	40	400.5	456.5
18 O.D.	98.8	117.2	42	448.5	516.0
20 O.D.	111.0	133.7	--	--	--
24 O.D.	140.3	170.7	--	--	--

Man hours include internal machining and nozzle installation.

For installing welding type flow nozzles, add for the bevels, butt weld, butt weld preheat, and any other labor operation or non-destructive testing operation required for the butt weld. See respective tables for these charges.

PREHEATING

Butt Welds and Any Type of Flange Welds

Carbon Steel, or Alloy Materials

For Temperatures Up to 400°F

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2	0.2	0.3	--	--	0.2	--	0.3	--	--	--	0.5
2-1/2	0.3	0.5	--	--	0.3	--	0.5	--	--	--	0.6
3	0.5	0.6	--	--	0.5	--	0.6	--	--	--	0.7
3-1/2	0.5	0.6	--	--	0.5	--	0.6	--	--	--	0.9
4	0.6	0.7	--	--	0.6	--	0.7	--	0.9	--	0.9
5	0.7	0.9	--	--	0.7	--	0.9	--	0.9	--	1.0
6	0.8	1.0	--	--	0.8	--	1.0	--	1.3	--	1.5
8	0.9	1.3	0.9	0.9	0.9	1.3	1.3	1.8	1.9	2.4	2.5
10	1.3	1.8	1.3	1.3	1.3	1.8	2.0	2.4	2.7	3.3	3.8
12	1.5	2.0	1.5	1.5	1.9	2.2	2.8	3.3	3.8	4.4	5.3
14 OD	1.9	2.5	1.9	1.9	2.2	3.0	3.5	4.4	5.0	5.8	6.6
16 OD	2.2	3.3	2.2	2.2	3.0	3.8	4.5	5.4	6.0	7.3	8.5
18 OD	2.6	3.5	2.6	3.1	4.1	5.0	6.0	7.0	7.9	8.5	10.5
20 OD	3.1	4.1	3.1	4.1	5.2	6.3	7.4	8.7	9.8	11.1	12.9
24 OD	3.7	5.0	3.7	5.3	6.4	7.8	9.3	10.4	11.7	13.3	15.2

Pipe Thickness: The wall thickness of the material determines the man hours that will apply. For preheating of double extra strong material, use schedule 160 man hours.

Mitre Welds: For preheating of mitre welds, add 50% to above man hours.

Man Hours: Man hours for preheating are additional to charges for welding operations.

Preheating: For preheating to temperatures above 400°F. but not exceeding 600°F., add 100% to the above man hours.

PREHEATING HEAVY WALL PIPE BUTT WELDS

Carbon Steel or Alloy Materials

For Temperatures Up to 400°F

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	1.0	1.2	--	--	--	--	--	--
4	1.4	1.5	1.8	2.0	--	--	--	--
5	--	1.9	2.1	2.4	2.5	2.8	--	--
6	--	2.1	2.5	2.7	3.0	3.2	3.4	--
8	--	3.0	3.4	3.7	3.9	4.4	4.5	4.8
10	--	--	4.1	4.4	4.7	5.4	5.8	6.3
12	--	--	--	6.1	6.6	7.0	7.4	8.0
14	--	--	--	7.3	7.9	8.4	9.1	9.6
16	--	--	--	--	9.4	10.0	10.5	11.6
18	--	--	--	--	--	12.3	13.0	13.7
20	--	--	--	--	--	14.0	15.1	15.9
22	--	--	--	--	--	--	--	17.2
24	--	--	--	--	--	--	--	18.6
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	7.1	7.6	--	--	--	--	--	--
12	8.6	9.1	9.8	10.4	--	--	--	--
14	10.3	10.9	11.6	12.3	13.0	14.0	--	--
16	12.3	13.0	13.7	14.6	15.5	16.6	--	--
18	14.8	15.8	16.8	17.7	18.8	19.8	--	--
20	17.0	18.2	19.4	20.5	21.8	22.9	24.0	25.1
22	18.4	19.8	20.9	22.3	23.8	25.3	26.6	28.0
24	19.8	21.2	22.8	24.2	25.8	27.7	28.4	30.2
	4.75	5.00	5.25	5.50	5.75	6.00		
20	26.4	27.7	29.3	30.7	32.1	33.7		
22	29.3	30.7	32.1	33.7	35.0	36.5		
24	32.1	33.7	34.5	36.5	38.0	39.5		

For General Notes, see the bottom of page 121.

PREHEATING LARGE O.D. PIPE BUTT WELDS AND ANY TYPE FLANGE WELDS

Carbon Steel Or Alloy Materials

For Temperatures Up To 400°F

NET MAN HOURS EACH

O.D. Pipe Inches	WALL THICKNESS IN INCHES							
	.500 Or Less	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	7.6	8.5	10.3	12.5	14.5	16.0	18.3	20.5
28	8.3	9.2	10.9	13.1	15.3	17.0	19.5	21.9
30	8.9	9.6	11.8	14.0	16.3	18.1	20.8	23.5
32	9.3	10.3	12.3	14.8	17.2	19.1	21.9	24.8
34	10.0	10.9	13.0	15.8	18.6	20.5	23.2	26.6
36	10.7	11.8	13.8	17.2	20.5	22.5	25.7	29.0
38	10.9	12.5	15.0	18.3	22.8	24.8	28.3	31.9
40	11.2	13.5	16.3	19.5	25.3	27.1	31.0	35.2
42	12.0	14.4	17.6	21.0	28.1	30.0	34.1	38.6
44	13.0	15.3	19.5	24.0	29.3	32.9	37.6	43.3
46	13.9	16.4	21.2	26.3	31.5	36.1	41.1	46.1
48	15.0	17.6	23.0	28.6	33.9	39.3	44.8	50.3
54	16.9	19.8	25.8	32.1	38.1	44.3	50.4	56.5
60	18.8	21.9	28.8	35.6	42.4	49.1	56.1	62.9
	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25
26	22.8	24.9	27.1	29.4	31.6	33.7	36.0	38.2
28	24.2	26.3	29.0	30.8	33.0	35.3	37.5	39.8
30	25.7	28.0	30.3	32.1	34.5	36.6	39.3	41.1
32	27.0	29.3	31.9	33.5	35.8	38.0	40.6	42.5
34	28.8	31.0	33.5	35.3	37.6	39.8	42.4	44.3
36	30.2	33.5	36.0	37.9	40.1	42.4	44.8	46.8
	4.50	4.75	5.00	5.25	5.50	5.75	6.00	
26	40.5	42.7	44.8	47.1	49.3	51.6	53.8	
28	42.0	44.0	46.3	48.5	50.7	53.0	55.7	
30	43.3	45.5	47.8	50.0	52.0	54.3	57.0	
32	44.6	46.8	49.1	51.3	53.6	55.8	58.4	
34	46.4	48.0	50.9	53.1	55.0	57.5	60.2	
36	49.0	51.2	53.5	55.7	57.7	59.9	62.7	

For General Notes, see the bottom of page 121.

PREHEATING 90° NOZZLE WELDS

Carbon Steel. or Alloy Materials

For Temperatures Up To 400°F

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2	0.5	0.6	--	--	0.5	--	0.6	--	--	--	0.7
2-1/2	0.6	0.7	--	--	0.6	--	0.7	--	--	--	0.9
3	0.6	0.9	--	--	0.6	--	0.9	--	--	--	1.0
3-1/2	0.7	0.9	--	--	0.7	--	0.9	--	--	--	--
4	0.9	1.0	--	--	0.9	--	1.0	--	1.4	--	1.7
5	1.0	1.4	--	--	1.0	--	1.4	--	1.7	--	1.8
6	1.3	1.8	--	--	1.3	--	1.8	--	2.0	--	2.4
8	1.8	2.1	1.7	1.7	1.7	2.0	2.1	2.7	3.1	3.5	4.1
10	2.0	2.7	2.0	2.0	2.0	2.7	3.1	3.8	4.5	--	5.9
12	2.5	3.3	2.5	2.5	2.8	3.5	4.5	5.2	6.0	--	8.3
14 OD	3.0	3.8	3.0	3.0	3.5	4.6	5.9	6.6	7.8	--	10.5
16 OD	3.4	4.6	3.4	3.4	4.6	5.9	7.2	8.5	9.8	--	13.7
18 OD	4.2	5.5	4.2	4.8	6.3	7.9	9.6	10.5	12.7	--	17.0
20 OD	5.0	6.5	5.0	6.5	8.3	10.1	11.8	13.7	15.6	--	--
24 OD	6.0	7.8	6.0	8.5	10.3	12.5	15.1	16.5	18.9	--	--

Pipe Thickness: The size of the nozzle and the wall thickness of the header or nozzle (whichever is greater) determines the man hours to be used. For preheating of double extra strong thickness use schedule 160 man hours.

Time: For reinforced 90° nozzle welds, add 100% to the above man hours.
For 45° nozzle welds, add 50% to the above man hours.
For reinforced 45° nozzle welds, add 150% to the above man hours.
For preheating to temperatures above 400°F. but not exceeding 600°F., add 100% to the above man hours.
Preheating of coupling, weldolet, threadolet or socket welds should be charged at the same man hours as shown for the same size and schedule nozzle.
Man hours for preheating are additional to man hours for welding operations.

PREHEATING LARGE O.D. 90° NOZZLE WELDS

Carbon Steel or Alloy Materials

For Temperatures Up To 400°F

NET MAN HOURS EACH

O.D. Pipe Sizes	WALL THICKNESS IN INCHES							
	.500	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	9.7	10.7	12.9	15.6	18.3	20.1	23.0	25.8
28	10.3	11.4	13.8	16.6	19.2	21.2	24.4	27.7
30	10.9	12.2	14.8	17.6	20.5	22.8	26.1	29.5
32	11.6	12.9	15.5	18.5	21.6	24.0	27.5	31.0
34	12.6	13.8	16.3	19.9	23.2	25.7	29.3	33.4
36	13.5	14.8	17.5	21.6	25.7	28.2	32.2	36.5
38	14.3	15.8	18.9	23.0	28.6	31.0	35.5	40.1
40	15.3	17.0	20.2	24.5	31.7	34.2	39.1	44.1
42	16.2	18.1	21.8	26.3	34.0	37.8	43.0	48.5
48	18.5	20.7	24.9	30.1	38.8	43.2	49.1	55.5
54	20.8	23.2	28.1	33.9	43.7	48.5	55.2	62.3
60	23.1	25.8	31.2	37.6	48.5	53.9	61.4	69.3

Pipe Thickness: The size of the nozzle and the wall thickness of the header or nozzle (whichever is greater) determines the man hours to be used. For preheating of double extra strong thickness use schedule 160 man hours.

Time: For reinforced 90° nozzle welds, add 100% to the above man hours.
For 45° nozzle welds, add 50% to the above man hours.
For reinforced 45° nozzle welds, add 150% to the above man hours.
For preheating to temperatures above 400°F. but not exceeding 600°F., add 100% to the above man hours.
Preheating of coupling, weldolet, threadolet or socket welds should be charged at the same man hours as shown for the same size and schedule nozzle.
Man hours for preheating are additional to man hours for welding operations.

LOCAL STRESS RELIEVING

Butt Welds, Nozzle Welds or Any Type of Flange Welds

Carbon Steel Material

Temperatures To 1400°F

NET MAN HOURS EACH

Size Ins.	Standard Pipe & OD Sizes 3/8" Thick	Extra Heavy Pipe & OD Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2	2.6	2.8	--	--	2.6	--	2.8	--	--	--	3.0
2-1/2	2.8	2.9	--	--	2.8	--	2.9	--	--	--	3.1
3	2.9	3.0	--	--	2.9	--	3.0	--	--	--	3.5
3-1/2	3.0	3.1	--	--	3.0	--	3.1	--	--	--	3.8
4	3.0	3.5	--	--	3.0	--	3.5	--	3.6	--	3.9
5	3.5	3.7	--	--	3.5	--	3.7	--	4.1	--	4.3
6	3.7	4.1	--	--	3.7	--	4.1	--	4.3	--	4.9
8	4.2	4.7	4.2	4.2	4.2	4.4	4.7	5.1	5.3	5.5	5.9
10	4.6	5.1	4.6	4.6	4.6	5.1	5.3	5.7	5.9	6.3	6.7
12	5.1	5.5	5.1	5.1	5.3	5.8	6.0	6.5	6.8	7.1	7.4
14 OD	5.5	5.9	5.5	5.5	5.9	6.3	6.7	7.1	7.6	7.9	8.3
16 OD	5.9	6.4	5.9	5.9	6.4	6.8	7.2	7.8	8.0	8.5	9.2
18 OD	6.4	6.8	6.4	6.6	6.8	7.3	7.8	8.3	8.7	9.2	10.1
20 OD	6.6	7.0	6.6	6.8	7.3	7.8	8.3	9.2	9.6	10.0	11.1
24 OD	7.1	7.3	7.1	7.6	8.0	8.5	9.2	10.1	10.5	11.2	12.5

Pipe Thickness: For stress relieving butt welds and flange welds, the wall thickness of the pipe determines the man hours that will apply. For stress relieving nozzle welds, the size and thickness of the header to which the nozzle is attached determines the man hours that will apply. For local stress relieving of double extra strong material, use schedule 160 man hours.

Code Requirements: All welds in piping materials having a wall thickness of 3/4" or greater must be stress relieved to comply with the requirements of the A. S. A. Code for pressure piping. Man hours shown below the ruled line in the above schedule cover sizes having a wall thickness of 3/4" or greater.

HEAVY WALL LOCAL STRESS RELIEVING

Butt Welds

Carbon Steel Material

Temperatures To 1400°F

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	5.1	5.4	--	--	--	--	--	--
4	5.4	5.9	6.4	6.8	--	--	--	--
5	--	6.3	6.7	7.2	7.6	8.2	--	--
6	--	6.7	7.2	7.8	8.2	9.0	9.7	--
8	--	7.4	7.8	8.4	8.9	9.5	10.1	10.8
10	--	--	8.1	8.8	9.2	9.8	10.3	11.2
12	--	--	--	9.0	9.6	10.3	10.8	11.5
14	--	--	--	9.6	10.3	11.2	11.6	12.3
16	--	--	--	--	10.8	11.6	12.3	13.1
18	--	--	--	--	--	12.3	13.1	14.0
20	--	--	--	--	--	13.3	14.3	15.2
22	--	--	--	--	--	--	--	16.4
24	--	--	--	--	--	--	--	17.7
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	11.9	12.5	--	--	--	--	--	--
12	12.3	13.2	14.0	15.0	--	--	--	--
14	13.2	14.1	15.0	16.1	16.9	18.1	--	--
16	14.0	15.0	16.0	16.9	18.1	19.3	--	--
18	15.0	16.0	16.9	18.3	19.4	20.6	--	--
20	16.2	17.4	18.4	19.6	21.2	22.7	24.3	25.9
22	17.4	19.2	20.0	21.3	22.8	24.3	25.9	27.4
24	18.9	20.1	21.5	22.9	24.5	26.0	27.6	29.1
	4.75	5.00	5.25	5.50	5.75	6.00		
20	27.4	29.0	30.5	32.1	33.7	35.3		
22	29.0	30.6	32.1	33.7	35.3	36.9		
24	30.6	32.2	33.7	35.3	36.8	38.4		

For General Notes, see the bottom of page 126.

LARGE O.D. LOCAL STRESS RELIEVING

Butt Welds, Nozzle Welds or Any Type Flange Weld

Carbon Steel Material

Temperatures To 1400°F

NET MAN HOURS EACH

O.D. Pipe Size	WALL THICKNESS IN INCHES								
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	9.1	9.8	11.3	11.8	12.7	14.1	16.3	18.5	21.3
28	9.5	10.5	12.2	12.7	13.8	15.2	17.7	20.0	22.9
30	10.4	11.3	13.1	13.9	14.7	16.7	19.2	21.5	24.6
32	11.2	12.3	14.3	15.0	15.8	18.1	20.8	23.2	26.5
34	12.4	13.5	15.5	16.2	17.1	19.6	22.5	24.8	28.2
36	13.6	14.7	17.0	18.1	19.3	21.5	24.5	27.0	30.6
38	14.7	16.1	18.7	20.0	21.6	23.9	27.0	29.3	33.5
40	16.1	17.6	20.6	22.3	24.3	26.6	29.7	32.0	36.5
42	17.8	19.4	22.7	24.6	27.3	29.6	32.5	35.0	39.7
44	19.9	21.5	24.7	27.0	29.7	32.5	35.8	39.2	42.8
46	21.9	23.6	26.9	29.9	32.7	36.0	39.3	42.8	46.5
48	24.4	26.0	29.2	32.7	35.8	39.3	42.9	46.3	49.8
54	28.5	29.2	32.9	36.8	40.3	45.4	49.6	53.5	57.5
60	30.4	32.4	36.6	41.9	44.7	49.2	53.6	58.0	63.6

	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
26	23.8	26.5	29.1	31.7	34.4	37.0	39.7	42.3	45.0
28	25.5	28.2	30.8	33.5	36.1	38.8	41.4	44.0	46.6
30	27.3	29.9	32.5	35.2	37.8	40.4	43.0	45.7	48.3
32	29.1	31.7	34.3	36.9	39.6	42.2	44.9	47.5	50.1
34	30.8	33.5	36.1	38.0	41.4	44.0	46.7	49.3	52.0
36	33.2	35.9	37.3	40.4	43.8	46.5	49.1	51.8	54.4

	4.75	5.00	5.25	5.50	5.75	6.00
26	47.6	50.3	52.8	55.4	58.1	60.7
28	49.2	51.9	54.5	57.2	59.8	62.4
30	50.9	53.6	56.2	58.8	61.4	64.1
32	52.8	55.4	58.1	60.6	63.3	65.9
34	54.6	57.3	59.9	62.4	65.1	67.7
36	56.9	59.6	62.2	64.9	67.5	70.2

For General Notes, see the bottom of page 126.

RADIOGRAPHIC INSPECTION

Field X-Ray Of Butt Welds

Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	Wall Thickness Thru Extra Strong	Wall Thickness Greater Than Extra Strong Thru Schedule 120	Wall Thickness Greater Than Schedule 120 Thru Double Extra Strong
2 Or Less	0.86	--	1.13
3	0.86	--	1.13
4	0.98	1.13	1.27
5	1.07	1.23	1.40
6	1.20	1.40	1.56
8	1.35	1.54	1.75
10	1.51	1.73	1.97
12	1.71	1.97	2.23
14	1.86	2.14	2.42
16	2.08	2.39	2.70
18	2.32	2.67	3.01
20	2.55	2.94	3.34
24	3.15	3.62	4.08

Man hours listed above cover radiographic inspection of butt welded joints by x-raying.

For radiographic inspection of mitre butt welds, add 50% to above man hours.

For radiographic inspection of slip-on flange welds, add 100% to above man hours.

For radiographic inspection of nozzle welds add 200% to above man hours.

HEAVY WALL RADIOGRAPHIC INSPECTION

Field X-Ray Of Butt Welds

Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	1.24	1.37	--	--	--	--	--	--
4	1.37	1.43	1.46	1.65	--	--	--	--
5	--	1.50	1.59	1.72	1.81	1.97	--	--
6	--	1.59	1.72	1.81	1.97	2.09	2.25	--
8	--	1.74	1.87	2.00	2.16	2.28	2.46	2.75
10	--	--	2.08	2.19	2.40	2.50	2.69	2.96
12	--	--	--	2.38	2.59	2.74	2.94	3.12
14	--	--	--	2.62	2.78	3.02	3.21	3.40
16	--	--	--	--	3.03	3.24	3.44	3.69
18	--	--	--	--	--	3.53	3.80	4.02
20	--	--	--	--	--	3.87	4.10	4.40
22	--	--	--	--	--	--	--	4.90
24	--	--	--	--	--	--	--	5.41
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	3.16	3.33	--	--	--	--	--	--
12	3.33	3.59	3.80	4.06	--	--	--	--
14	3.63	3.87	4.10	4.40	4.68	5.00	--	--
16	3.97	4.21	4.46	4.81	5.11	5.41	--	--
18	4.33	4.62	4.93	5.21	5.58	5.98	--	--
20	4.68	5.00	5.31	5.65	6.04	6.44	6.87	7.28
22	5.22	5.58	5.97	6.33	6.74	7.24	7.73	8.20
24	5.81	6.20	6.62	7.00	7.51	8.01	8.76	9.11
	4.75	5.00	5.25	5.50	5.75	6.00		
20	7.73	8.17	8.58	9.01	9.40	9.83		
22	8.54	8.95	9.36	9.77	10.03	10.61		
24	9.45	9.77	10.13	10.60	11.04	11.49		

For General Notes, see the bottom of page 129.

LARGE O.D. RADIOGRAPHIC INSPECTION

Field X-Ray Of Butt Welds

Carbon Steel Material

NET MAN HOURS EACH

O.D. Pipe Size	WALL THICKNESS IN INCHES							
	.750 Or Less	1.00	1.25	1.50	1.75	2.00	2.25	2.50
26	3.62	3.81	3.96	4.27	4.57	4.91	5.24	5.64
28	4.20	4.35	4.53	4.82	5.13	5.46	5.83	6.23
30	5.06	5.24	5.39	5.68	6.01	6.33	6.66	7.11
32	6.26	6.41	6.56	6.88	7.21	7.52	7.82	8.25
34	7.75	7.94	8.07	8.40	8.71	9.02	9.35	9.78
36	9.53	9.78	9.88	10.19	10.51	10.83	11.19	11.56
38	11.37	11.57	11.78	12.08	12.40	12.72	13.09	--
40	13.36	13.64	13.83	14.11	14.50	14.85	15.20	--
42	15.53	15.76	15.97	16.32	16.72	17.04	17.41	--
44	17.87	18.06	18.31	18.65	19.08	19.46	19.80	--
46	20.27	20.52	20.79	21.16	21.59	21.93	22.26	--
48	22.84	23.07	23.33	23.70	24.20	24.50	24.86	--
54	25.69	25.96	26.25	26.66	27.22	27.55	27.97	--
60	28.54	28.83	29.16	29.62	30.25	30.61	31.07	--
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
26	6.11	6.68	7.15	7.54	8.12	8.61	9.57	10.00
28	6.72	7.52	7.80	8.15	8.72	9.32	10.19	10.60
30	7.54	8.43	8.65	9.02	9.59	10.19	11.02	11.44
32	8.67	9.57	9.79	10.15	10.73	11.34	12.18	12.58
34	10.24	11.07	11.34	11.68	12.26	12.85	13.71	14.13
36	12.05	12.90	13.13	13.49	14.05	14.66	15.53	15.95
	4.75	5.00	5.25	5.50	5.75	6.00		
26	10.35	10.65	10.95	11.41	11.71	12.14		
28	10.95	11.28	11.56	11.99	12.29	12.75		
30	11.83	12.12	12.42	12.85	13.18	13.62		
32	12.97	13.27	13.56	13.98	15.12	15.61		
34	14.48	14.81	15.07	15.53	16.68	17.55		
36	16.31	16.62	16.89	17.33	18.47	18.23		

For General Notes, see the bottom of page 129.

HYDROSTATIC TESTING

For Pressures Not Exceeding 4,000 P.S.I.

Carbon Steel Material

NET MAN HOURS PER LINEAR FOOT

Pipe Size Inches	Standard Pipe & O.D. Sizes 3/8" Thick	Extra Hvy. Pipe & O.D. Sizes 1/2" Thick	SCHEDULE NUMBERS								
			20	30	40	60	80	100	120	140	160
2" Or Less	0.014	0.016	--	--	0.014	--	0.016	--	--	--	0.025
2-1/2"	0.015	0.017	--	--	0.015	--	0.017	--	--	--	0.028
3	0.017	0.019	--	--	0.017	--	0.019	--	--	--	0.031
4	0.020	0.024	--	--	0.020	--	0.024	--	0.032	--	0.036
5	0.022	0.026	--	--	0.022	--	0.026	--	0.035	--	0.041
6	0.025	0.029	--	--	0.025	--	0.029	--	0.039	--	0.047
8	0.027	0.032	0.027	0.027	0.027	0.030	0.032	0.039	0.046	0.052	0.057
10	0.031	0.035	0.031	0.031	0.031	0.035	0.041	0.049	0.055	0.063	0.070
12	0.034	0.039	0.034	0.034	0.038	0.044	0.053	0.061	0.068	0.077	0.087
14 O.D.	0.038	0.044	0.038	0.038	0.041	0.050	0.062	0.069	0.078	0.091	0.106
16 O.D.	0.044	0.049	0.044	0.044	0.049	0.062	0.075	0.086	0.097	0.114	0.134
18 O.D.	0.051	0.058	0.051	0.055	0.064	0.077	0.095	0.108	0.123	0.141	0.164
20 O.D.	0.057	0.067	0.057	0.067	0.078	0.095	0.115	0.133	0.151	0.172	0.203
24 O.D.	0.076	0.086	0.076	0.087	0.115	0.141	0.175	0.200	0.230	0.265	0.304

Above man hours are average for testing completed process systems, for a maximum holding time of one hour, and include time for the following operations when required:

1) Place and remove blinds and blanks as required.
2) Opening and closing of valves.
3) Removal and replacement of valves, orifice plates, expansion joints, and short pieces of pipe as may be required.
4) Block up and block removal of spring-supported or counterweight-supported lines.
5) Air purging of lines before hydro-test.
6) Soap testing joints where required.
7) Drain lines after testing.

If individual segments or spools are to be tested separately multiply above man hours by a factor of ten (10).

HYDROSTATIC TESTING—HEAVY WALL PIPE

For Pressures Not Exceeding 4,000 P.S.I.

Carbon Steel Material

NET MAN HOURS PER LINEAR FOOT

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50
3	0.035	0.039	--	--	--	--	--	--
4	0.040	0.042	0.044	0.048	--	--	--	--
5	--	0.046	0.049	0.052	0.059	0.072	--	--
6	--	0.053	0.058	0.060	0.078	0.091	0.106	--
8	--	0.064	0.068	0.076	0.097	0.113	0.133	0.160
10	--	--	0.076	0.095	0.118	0.136	0.160	0.188
12	--	--	--	0.103	0.122	0.143	0.170	0.196
14	--	--	--	0.117	0.139	0.163	0.191	0.225
16	--	--	--	--	0.156	0.186	0.217	0.260
18	--	--	--	--	--	0.208	0.242	0.286
20	--	--	--	--	--	0.242	0.286	0.346
22	--	--	--	--	--	--	--	0.378
24	--	--	--	--	--	--	--	0.411
	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
10	0.192	0.220	--	--	--	--	--	--
12	0.224	0.257	0.289	0.330	--	--	--	--
14	0.256	0.290	0.329	0.372	0.424	0.476	--	--
16	0.294	0.338	0.381	0.433	0.494	0.563	--	--
18	0.328	0.381	0.433	0.497	0.567	0.649	--	--
20	0.394	0.442	0.506	0.571	0.649	0.736	0.834	0.905
22	0.430	0.485	0.552	0.623	0.709	0.805	0.913	1.010
24	0.468	0.517	0.598	0.676	0.770	0.875	0.992	1.094
	4.75	5.00	5.25	5.50	5.75	6.00		
20	0.992	1.062	1.133	1.180	1.314	1.400		
22	1.070	1.149	1.257	1.320	1.446	1.542		
24	1.168	1.257	1.374	1.440	1.558	1.666		

For General Notes, see the bottom of page 132.

HYDROSTATIC TESTING—LARGE O.D. PIPE

For Pressures Not Exceeding 4,000 P.S.I.

Carbon Steel Material

NET MAN HOURS PER LINEAR FOOT

O.D. Pipe Inches	WALL THICKNESS IN INCHES							
	.500 or Less	.750	1.00	1.25	1.50	1.75	2.00	2.25
26	0.140	0.161	0.185	0.213	0.245	0.281	0.323	0.389
28	0.162	0.186	0.214	0.246	0.283	0.326	0.375	0.431
30	0.194	0.223	0.257	0.296	0.340	0.391	0.450	0.518
32	0.241	0.277	0.319	0.367	0.422	0.485	0.558	0.642
34	0.299	0.344	0.396	0.455	0.523	0.601	0.691	0.795
36	0.368	0.423	0.487	0.560	0.644	0.741	0.852	0.980
38	0.438	0.504	0.580	0.667	0.767	0.882	1.014	1.166
40	0.517	0.595	0.684	0.787	0.905	1.041	1.197	1.377
42	0.600	0.690	0.794	0.913	1.050	1.208	1.389	1.597
44	0.690	0.794	0.913	1.050	1.208	1.389	1.597	1.837
46	0.780	0.897	1.032	1.187	1.365	1.570	1.806	2.077
48	0.881	1.013	1.165	1.340	1.541	1.772	2.038	2.344
54	0.987	1.135	1.305	1.501	1.726	1.985	2.283	2.626
60	1.096	1.260	1.449	1.666	1.916	2.203	2.534	2.914
	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25
26	0.447	0.509	0.562	0.650	0.735	0.837	0.951	1.078
28	0.492	0.561	0.617	0.716	0.809	0.922	1.051	1.188
30	0.551	0.628	0.691	0.802	0.906	1.033	1.178	1.331
32	0.738	0.841	0.925	1.073	1.213	1.383	1.577	1.782
34	0.914	1.042	1.146	1.329	1.502	1.712	1.952	2.206
36	1.127	1.285	1.414	1.640	1.853	2.112	2.408	2.721
	4.50	4.75	5.00	5.25	5.50	5.75	6.00	
26	1.189	1.269	1.366	1.493	1.565	1.693	1.810	
28	1.260	1.348	1.456	1.587	1.666	1.799	1.925	
30	1.361	1.456	1.573	1.715	1.801	1.945	2.081	
32	1.960	2.097	2.265	2.469	2.593	2.800	2.996	
34	2.427	2.597	2.805	3.058	3.211	3.468	3.711	
36	2.993	3.203	3.459	3.770	3.959	4.276	4.575	

For General Notes, see the bottom of page 132.

ACCESS HOLES

Carbon Steel Material

NET MAN HOURS EACH

Nominal Pipe Size	WALL THICKNESS				
	Up To 1"	OVER 1" to 2"	OVER 2" to 2-1/2"	OVER 2-1/2" to 4"	OVER 4" to 6"
2-1/2, 3, 4	1.8	2.0	--	--	--
5, 6, 8	2.0	2.2	2.6	--	--
10, 12	2.2	2.4	2.9	4.0	--
14, 16, 18	2.3	2.5	3.0	4.3	--
20, 22, 24	2.5	2.9	3.1	4.5	6.8
26, 28, 30	2.9	3.2	3.3	4.8	7.2
32, 34, 36	3.1	3.3	3.7	5.1	7.6
38, 40, 42	3.3	3.7	4.0	5.6	8.4
44, 46, 48	3.7	4.0	4.4	6.7	10.1
54, 60	4.6	4.9	5.4	8.3	12.5

Man hours include access holes through 1" diameter (drilled and tapped) for radiographic inspection of welds when specified or required.

For openings larger than 1" in diameter, add 25% to the above man hours for each ¼" increase in diameter.

If plugs are to be included and seal welded, add 0.75 man hours each.

INSTRUMENT AND CONTROL PIPING

TRACING

Man hours are for all fabrication and installation or erection of all copper tubing, steel piping, alloy tubing and capillary tubing used for tracing or for interconnecting all instruments and control devices, regardless of location, whether on panel board, piping or equipment, for all instrument and control piping up to and including one (1) inch.

Man hours include the labor of installing all connections, fittings, and supporting clips or hangers.

Should the lines be group installed and protected by casings or channels, the installation labor of such casings or channels are extra.

Runs up to 10 feet	5.0 Man hours total
Runs over 10 feet	0.4 Man hours per foot of length
Asbestos wrap pipe before tracing	0.05 Man hours per foot

SOLDERED NON-FERROUS FITTINGS

NET MAN HOURS EACH

Nominal Size—Ins.	Coup-lings	Ells	Tees	Flanges	Re-ducers	Adapters	Unions	Caps & Plugs	Valves
1/8—3/8	.16	.17	.24	.16	.18	.15	.18	.08	.35
1/2	.22	.23	.33	.22	.25	.20	.25	.11	.40
3/4	.28	.29	.42	.28	.32	.25	.35	.14	.45
1"	.43	.44	.63	.32	.50	.40	.55	.22	.60
1-1/4	.80	.85	1.20	.64	.85	.75	.90	.40	1.00
1-1/2	.85	.90	1.26	.70	.90	.80	1.00	.42	1.15
2	.96	1.00	1.44	.90	1.00	.92	1.15	.50	1.25
2-1/2	1.50	1.55	2.25	1.15	1.65	1.35	1.85	.75	2.10
3	1.95	2.00	2.91	1.40	2.00	1.80	2.25	.95	2.50
4	2.00	2.25	3.00	1.65	2.15	1.90	2.75	1.00	3.00

Man hours include procuring, handling, and complete jointing or making on of solder-type cast and wrought pressure type brass or copper fittings.

Man hours do not include installation of tubing or pipe, supports, instruments or scaffolding. See respective tables for these charges.

PVC-PLASTIC PIPE

MAN HOURS PER UNITS LISTED

Size Ins.	Handle Pipe Per L. F.	Cemented Socket Joints – Ea.	Saddles Each	Handle Valves PCV Body – Ea.
1/2	.07	.20	.38	.13
3/4	.07	.22	.39	.16
1	.07	.25	.40	.17
1-1/4	.08	.27	.43	.20
1-1/2	.08	.29	.45	.25
2	.09	.33	.50	.35
2-1/2	.09	.38	.55	.58
3	.10	.45	.63	.85
4	.11	.55	.73	1.25
6	.12	.70	.90	1.60
8	.14	.80	1.00	1.95
10	.17	1.00	1.20	2.50
12	.20	1.25	1.40	3.00

Handle Pipe Units: Man hours include handling, hauling rigging and aligning in place.

Cement Socket Joint Units: Man hours include cut, square, ream, fit-up and make joint.

Saddle Units: Man hours include fit-up, drill hole in header and cement saddle to header. Maximum hole size is assumed to be 1½ inch. For larger branch lines the use of tees should be estimated. The size of the header not the size of the saddle determines the man hours that apply.

Handle Valve Units: Man hours include handling, hauling and positioning of valve only. Connections of the type as required must be added.

Units are for all wall thickness.

Units do not include scaffolding. See respective table for this charge.

SARAN LINED STEEL PIPE AND FITTINGS

MAN HOURS PER UNITS LISTED

Size Inches	Pipe Per L.F.	Cut & Thread Each	Make-Ons Each	Bolt-Ups Each
1	.20	.10	.20	.50
1-1/4	.22	.15	.30	.60
1-1/2	.23	.16	.35	.65
2	.25	.25	.40	.70
2-1/2	.27	--	--	.80
3	.30	--	--	.85
4	.35	--	--	1.20
6	.40	--	--	1.50
8	.52	--	--	2.10

Pipe Units: Pipe units include rigging, erecting and aligning of pipe. Pipe is normally furnished in 10-foot lengths, with ends threaded and flanges installed at the factory. If this is the case, add 15 percent to above pipe man hours for handling additional weight.

Make-On Units: Make-on units include making on of screwed type fittings. Ells = two make-ons, tees = three make-ons, etc.

Bolt-Up Units: Bolt-up units include bolting together of flanged connections.

All Units: All units include unloading, handling and hauling to storage and erection site.

Man hours do not include supports or scaffolding. See respective tables for these charges.

SCHEDULE 30 OR 40 RUBBER-LINED STEEL PIPE AND FITTINGS

MAN HOURS PER UNITS LISTED

Size Ins.	Pipe Per L. F.	Cut & Thread Each	Make-Ons Each	Bolt-Ups Each
1-1/4	.22	.15	.30	.60
1-1/2	.23	.16	.35	.65
2	.25	.25	.40	.70
2-1/2	.27	.30	.45	.80
3	.30	.32	.50	.85
3-1/2	.33	.35	.55	1.00
4	.35	.50	.60	1.20
5	.38	--	--	1.30
6	.40	--	--	1.50
8	.52	--	--	2.10
10	.60	--	--	2.70
12	.75	--	--	3.40

Pipe Units: Pipe units include rigging, erecting and aligning of pipe.

Cut Thread Units: Cut and thread units include hand cutting and threading of pipe two inches and smaller and machine cutting and threading of size two and one half inches and larger.

Make-On Units: Make-on units include making on of screwed type fittings. Ells = two make-ons, tees = three make-ons, etc.

Bolt-Up Units: Bolt-up units include bolting together of flanged connections.

All Units: All units include unloading, handling and hauling to storage and erection site.

If pipe is received from factory in flanged 20 foot lengths add 10 percent to pipe handling manhours for handling of additional weight.

Man hours do not include supports or scaffolding. See respective tables for these charges.

SCHEDULE 40 LEAD LINED STEEL PIPE AND FITTINGS

MAN HOURS PER UNITS LISTED

Pipe Size	Handle Pipe Per L. F.	Cut and Thread Each	Make-Ons Each	Butt Welds Incl. Lead Burning Each	Bolt-Ups Each
1-1/4	.22	.15	.30	.90	.60
1-1/2	.25	.16	.35	1.10	.65
2	.33	.25	.38	1.30	.70
2-1/2	.35	.30	.40	1.45	.80
3	.40	.33	.45	1.55	.85
3-1/2	.45	.35	.47	1.65	1.00
4	.50	.50	.55	1.85	1.20
5	.65	--	--	2.20	1.35
6	.80	--	--	2.80	1.50
8	1.20	--	--	3.40	2.10
10	1.60	--	--	4.30	2.70
12	2.25	--	--	5.55	3.40

Pipe Units: Pipe units include rigging, erecting and aligning of pipe. It is customary to order this type piping prefabricated with lead lined fittings in place. Should this be the case add 20 percent to handling pipe units for elimination of field make-ons and handling of additional weight.

Cut and Thread Units: Cut and thread units include hand cutting and threading of pipe two inches and smaller and machine cutting and threading of sizes two and one half inches and larger.

Make-On Units: Make-on units include making on of screwed type fittings. Ells = two make-ons, tees = three make-ons, etc.

Butt Welds: Butt welds including lead burning units include circumferntial manual electric weld and fusing together of lead at joint.

Bolt-Up Units: Bolt-up units include bolting together of flanged connections.

All Units: All units include unloading, handling and hauling to storage and erection site.

Man hours do not include supports or scaffolding. See respective tables for these charges.

FLANGED CAST IRON CEMENT LINED PIPE AND FITTINGS

MAN HOURS PER UNITS LISTED

Pipe Size Ins.	Handle Pipe Per Foot	Handle Fittings Each	Handle Valves Each	Flange Bolt-Up Each
3	.20	.43	1.20	.80
4	.27	.61	1.70	1.20
6	.40	.79	2.20	1.50
8	.50	1.00	2.80	2.10
10	.65	1.30	3.60	2.70
12	.80	1.55	4.30	3.40
14	.95	1.84	5.10	3.80
16	1.25	2.12	5.90	4.40

Pipe, fittings, and valve units include handling, unloading, hauling to storage and erection sites, and setting and aligning.

Bolt-up man hours include bolting up of flanged joints.

Above man hours are for installation on pipe racks to 20'0" high. For other installation conditions add or deduct the following percentage.

On sleepers 2'0" high ..... Deduct 12%
In enclosed passage way ..... Add 80%
Inside buildings (horizontal or vertical) ..... Add 60%
In battery limits of process area ..... Add 150%

SCHEDULE 40 CEMENT LINED CARBON STEEL PIPE WITH STANDARD FITTINGS

MAN HOURS PER UNITS LISTED

Pipe Size Ins.	Handle Pipe Per Foot	Cutting Pipe Per Cut	Butt Welds Each	Sleeve Joint With Two Welds Each	90° Welded Nozzle Each	Smooth On Cement Per Joint
6	.40	.65	2.0	3.30	6.05	.35
8	.50	1.00	2.6	4.60	7.30	.50
10	.65	1.20	3.1	5.70	8.30	.60
12	.80	1.45	4.1	6.90	11.35	.65
14	.95	2.30	5.0	7.90	13.90	.80
16	1.25	2.95	6.6	9.20	18.15	.95
18	1.40	3.70	8.6	10.40	22.80	1.10
20	1.75	4.65	9.4	12.40	26.95	1.25
24	2.20	5.90	13.3	15.50	33.60	1.50

Handle Pipe Units: Man hours include handling, unloading, hauling to storage and erection site and setting and aligning.

Cutting Pipe Units: Man hours include cutting pipe and lining. Lining to be cut square and flush with ends.

Butt Weld Units: Man hours include making complete electric weld. Cement lining should be wet with water around welding area.

Sleeve Joint Units: Man hours include slipping on of sleeve, aligning and welding at both ends.

90° Welded Nozzle Units: Man hours include complete operations for welding nozzle.

Smooth on Cement Units: Man hours include mixing and patching weld joints with cement.

Man hours do not include excavation or racks or supports. See respective tables for these charges.

DOUBLE TOUGH PYREX PIPE AND FITTINGS

MAN HOURS PER UNITS LISTED

Pipe Size	Erect Spool Piece Pipe Per L. F.	Standard Bolt-Up Each	Split Flange Bolt-Up Each
1	.35	.35	.50
1-1/2	.45	.40	.70
2	.55	.45	.80
3	.66	.55	.90
4	.75	.85	1.33
6	1.00	.95	1.50
8	1.30	1.00	2.00

Pyrex pipe is usually ordered from factory prefabricated into spool pieces with all necessary fittings and standard flanges in place. Should pipe be ordered without factory installed flanges it is good practice to install split type flanges in the field.

Above man hours are based on installing factory fabricated spool pieces, up to 10 feet long, in the field and include all handling, unloading and hauling to storage and erection site.

Spool Piece Units: Spool piece units include rigging, erecting and aligning.

Standard Bolt-Up Units: Standard bolt-up units include bolting up of factory furnished fabricated flanges.

Split Flange Bolt-Up Units: Split flange bolt-up units include all operations necessary for the slipping on of flanges and gaskets and bolting-up.

Man hours do not include installation of hangers or supports or the erection of scaffolding. See respective tables for these charges.

OVERHEAD TRANSITE PRESSURE PIPE–CLASS 150

NET MAN HOURS PER UNITS LISTED

Size Inches	Pipe Per L. F.	Make-Ons Each	Bolt-Ups Each
4	.20	.50	1.2
6	.25	.75	1.5
8	.30	.85	2.1
10	.40	1.00	2.7
12	.50	1.25	3.4
14	.60	1.50	3.8
16	.70	1.75	4.4

Pipe Units: Pipe units include rigging, erecting and aligning of pipe.

Make-On Units: Make-on units include erecting, aligning pouring joint. Ells = two make-ons, tees = three make-ons, etc.

Bolt-Up Units: Bolt-up units include bolting together of flanged connections.

All Units: All units include unloading, handling and hauling to storage and erection site.

Man hours do not include supports or scaffolding. See respective tables for these charges.

Transite pipe = 4 inches I.D. and above. It is usually supplied in standard 13-foot lengths.

Section Three

ALLOY AND NON-FERROUS FABRICATION

This section is intended to cover the complete shop fabrication and field fabrication and erection of alloy and non-ferrous piping. Alloy and non-ferrous piping operations are to be man houred on the same basis as corresponding carbon steel materials, *plus* the percentage given in the following tables applicable to the carbon steel man hours listed in sections one and two.

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

SHOP HANDLING PIPE FOR FABRICATION

PERCENT ADDITIVE

Nominal Pipe Size	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	17.0	22.5	30.0	31.8	13.0	39.0	84.0	36.0	46.0
3	18.5	25.0	33.0	35.0	15.0	41.0	88.0	39.0	51.0
4	20.0	27.0	36.0	38.0	17.0	45.5	90.5	41.0	55.0
5	21.0	28.0	38.0	40.0	18.0	49.0	—	42.0	58.0
6	23.0	31.0	41.5	42.5	20.0	50.0	94.0	43.5	64.0
8	26.0	35.0	47.0	48.0	33.5	59.0	100.5	49.5	72.0
10	28.5	38.0	51.0	54.0	50.0	64.0	117.0	57.0	78.0
12	30.0	40.0	54.0	58.0	54.0	70.0	134.0	64.0	83.0
14	33.0	44.0	59.0	62.0	67.0	78.0	--	67.0	90.0
16	35.0	47.0	63.0	67.0	74.0	86.0	--	77.0	96.0
18	39.5	53.0	71.0	75.0	77.0	92.0	--	82.0	108.5
20	43.5	58.0	78.0	83.0	84.0	100.0	--	87.0	120.0
22	46.0	62.0	83.0	88.0	89.0	103.5	--	93.0	127.0
24	49.0	66.0	88.0	93.0	94.0	107.0	--	97.0	135.0
26	53.0	71.5	95.4	100.1	101.9	116.0	—	105.0	146.4
28	57.0	77.0	102.8	108.6	109.8	124.9	—	113.0	157.6
30	61.0	82.5	110.0	116.4	117.6	133.8	—	121.0	168.9
32	65.3	88.0	117.4	124.2	125.4	142.7	—	129.3	180.2
34	69.4	93.5	124.8	131.9	133.3	151.6	—	137.4	191.4
36	73.4	99.0	132.0	139.7	141.1	160.6	—	145.4	202.7
38	77.5	104.5	139.5	147.4	149.0	169.5	—	153.5	213.9
40	81.6	110.0	146.8	155.2	156.8	178.4	—	161.6	225.2
42	85.7	115.5	154.0	163.0	164.6	187.3	—	169.7	236.5

GROUP 1	ASTM A335-P1	.50% Moly
	ASTM A335-P2	.50-.70% Chr.
	ASTM A335-P12	.85-1.10% Chr.
	ASTM A335-P11	1.05-1.45% Chr.
	ASTM A335-P3	1.50-2.00% Chr.
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.
	ASTM A335-P22	2.00-2.50% Chr.
	ASTM A335-P21	2.75-3.25% Chr.
	ASTM A335-P5,b,c	4.00-6.00% Chr.
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.
	ASTM A335-P9	8.00-10.00% Chr.
	Ferritic Chromes	10.00-15.00% Chr.
	ASTM A333 Gr. 3	3.50% Nickel

GROUP 4	Stainless Steels Types 304. 309. 310. 316 (including "L" & "H" Grades)
GROUP 5	Copper. Brass. Everdur
GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
GROUP 7	Hastelloy. Titanium, 99% Ni.
GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

HANDLE AND ERECT FABRICATED SPOOL PIECES

PERCENT ADDITIVE

Nominal Pipe Size	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	17.0	22.5	30.0	31.8	13.0	39.0	84.0	36.0	46.0
3	18.5	25.0	33.0	35.0	15.0	41.0	88.0	39.0	51.0
4	20.0	27.0	36.0	38.0	17.0	45.0	90.5	41.0	55.0
5	21.0	28.0	38.0	40.0	18.0	49.0	–	42.0	58.0
6	23.0	31.0	41.5	42.5	20.0	50.0	94.0	43.5	64.0
8	26.0	35.0	47.0	48.0	33.5	59.0	100.5	49.5	72.0
10	28.5	38.0	51.0	54.0	50.0	64.0	117.0	57.0	78.0
12	30.0	40.0	54.0	58.0	54.0	70.0	134.0	64.0	83.0
14	33.0	44.0	59.0	62.0	67.0	78.0	–	67.0	90.0
16	35.0	47.0	63.0	67.0	74.0	86.0	–	77.0	96.0
18	39.5	53.0	71.0	75.0	77.0	92.0	–	82.0	108.5
20	43.5	58.0	78.0	83.0	84.0	100.0	–	87.0	120.0
22	46.0	62.0	83.0	88.0	89.0	103.5	–	93.0	127.0
24	49.0	66.0	88.0	93.0	94.0	107.0	–	97.0	135.0
26	53.0	71.5	95.4	100.1	101.9	116.0	–	105.0	146.4
28	57.0	77.0	102.8	108.6	109.8	124.9	–	113.0	157.6
30	61.0	82.5	110.0	116.4	117.6	133.8	–	121.0	168.9
32	65.3	88.0	117.4	124.2	125.4	142.7	–	129.3	180.2
34	69.4	93.5	124.8	131.9	133.3	151.6	–	137.4	191.4
36	73.4	99.0	132.0	139.7	141.1	160.6	–	145.4	202.7
38	77.5	104.5	139.5	147.4	149.0	169.5	–	153.5	213.9
40	81.6	110.0	146.8	155.2	156.8	178.4	–	161.6	225.2
42	85.7	115.5	154.0	163.0	164.6	187.3	–	169.7	236.5

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5.b.c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

HANDLE AND ERECT STRAIGHT RUN PIPE (PERCENT ADDITIVE)

Nominal Pipe Size	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	17.0	22.5	30.0	31.8	13.0	39.0	84.0	36.0	46.0
3	18.5	25.0	33.0	35.0	15.0	41.0	88.0	39.0	51.0
4	20.0	27.0	36.0	38.0	17.0	45.5	90.5	41.0	55.0
5	21.0	28.0	38.0	40.0	18.0	49.0	--	42.0	58.0
6	23.0	31.0	41.5	42.5	20.0	50.0	94.0	43.5	64.0
8	26.0	35.0	47.0	48.0	33.5	59.0	100.5	49.5	72.0
10	28.5	38.0	51.0	54.0	50.0	64.0	117.0	57.0	78.0
12	30.0	40.0	54.0	58.0	54.0	70.0	134.0	64.0	83.0
14	33.0	44.0	59.0	62.0	67.0	78.0	--	67.0	90.0
16	35.0	47.0	63.0	67.0	74.0	86.0	--	77.0	96.0
18	39.5	53.0	71.0	75.0	77.0	92.0	--	82.0	108.5
20	43.5	58.0	78.0	83.0	84.0	100.0	--	87.0	120.0
22	46.0	62.0	83.0	88.0	89.0	103.5	--	93.0	127.0
24	49.0	66.0	88.0	93.0	94.0	107.0	--	97.0	135.0
26	53.0	71.5	95.4	100.1	101.9	116.0	—	105.0	146.4
28	57.0	77.0	102.8	108.6	109.8	124.9	—	113.0	157.6
30	61.0	82.5	110.0	116.4	117.6	133.8	—	121.0	168.9
32	65.3	88.0	117.4	124.2	125.4	142.7	—	129.3	180.2
34	69.4	93.5	124.8	131.9	133.3	151.6	—	137.4	191.4
36	73.4	99.0	132.0	139.7	141.1	160.6	—	145.4	202.7
38	77.5	104.5	139.5	147.4	149.0	169.5	—	153.5	213.9
40	81.6	110.0	146.8	155.2	156.8	178.4	—	161.6	225.2
42	85.7	115.5	154.0	163.0	164.6	187.3	—	169.7	236.5

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

PIPE BENDS

PERCENT ADDITIVE

Nominal Pipe Size	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	10.0	13.0	18.0	19.0	6.0	13.5	50.0	15.0	27.5
3	12.5	17.0	22.5	24.0	9.0	17.0	65.0	19.0	34.0
4	15.0	20.0	27.0	28.5	12.0	20.0	75.0	22.0	41.0
5	16.5	22.0	30.0	31.0	--	22.0	--	24.0	45.0
6	19.5	26.0	35.0	37.0	15.0	23.0	90.0	26.0	53.5
8	24.0	32.0	43.0	46.0	20.0	27.0	120.0	30.0	66.0
10	27.5	37.0	49.5	52.0	22.0	37.0	150.0	41.0	69.0
12	30.0	40.0	54.0	57.0	25.0	39.0	165.0	43.0	82.5
14	34.0	45.5	61.0	64.5	--	--	--	46.0	--
16	36.5	49.0	66.0	69.0	--	--	--	49.0	--
18	40.0	53.5	72.0	76.0	--	--	--	50.0	--
20	46.0	61.5	83.0	87.0	--	--	--	52.0	--
22	51.5	69.0	93.0	98.0	--	--	--	54.0	--
24	54.0	72.0	97.0	103.0	--	--	--	56.0	--

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

ATTACHING FLANGES (PERCENT ADDITIVE)

Nominal Pipe Size	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	25.0	33.5	45.0	47.5	20.0	58.0	125.0	54.0	69.0
3	27.5	37.0	49.5	52.0	23.0	61.0	132.0	58.0	76.0
4	30.0	40.0	54.0	57.0	25.0	68.0	135.0	61.0	82.5
5	31.5	42.0	57.0	60.0	27.5	73.0	. --	63.0	87.0
6	34.5	46.0	62.0	63.5	30.0	75.0	140.0	65.0	95.0
8	39.0	52.0	70.0	72.0	50.0	87.5	150.0	74.0	107.0
10	42.5	57.0	76.5	81.0	75.0	95.0	175.0	85.0	117.0
12	45.0	60.0	81.0	86.0	80.0	104.0	200.0	95.0	124.0
14	49.0	65.5	88.0	93.0	100.0	117.0	--	100.0	135.0
16	52.5	70.0	94.5	100.0	110.0	128.0	--	115.0	144.0
18	59.0	79.0	106.0	112.0	115.0	138.0	--	123.0	162.0
20	65.0	87.0	117.0	123.5	125.0	149.0	--	130.0	179.0
22	69.0	92.9	124.0	131.0	133.0	154.5	--	139.0	190.0
24	73.0	98.0	131.0	139.0	140.0	160.0	--	145.0	201.0
26	79.0	106.0	142.0	150.4	151.6	173.4	—	157.0	217.9
28	85.0	114.2	152.9	162.0	163.2	186.8	—	169.0	234.6
30	91.2	122.4	163.8	173.7	174.9	200.0	—	181.2	251.4
32	97.3	130.6	174.7	185.3	186.6	213.4	—	193.3	268.2
34	103.4	138.7	185.6	196.9	198.2	226.8	—	205.4	284.9
36	109.4	146.9	196.6	208.4	209.9	240.0	—	217.4	301.7
38	115.5	155.0	207.5	220.0	221.5	253.5	—	229.5	318.4
40	121.6	163.2	218.4	231.6	233.2	266.8	—	241.6	335.2
42	127.7	171.4	229.3	243.2	244.9	280.0	—	253.7	352.0

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

MAKE-ONS THROUGH 12-IN. HANDLE VALVES THROUGH 42-IN.

PERCENT ADDITIVE

Nominal Size Inches	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
1/4	9.0	11.0	16.0	17.0	7.0	21.0	45.0	20.0	25.0
3/8	10.0	12.5	18.0	19.0	8.0	23.0	50.0	22.0	28.0
1/2	11.0	14.0	20.0	21.0	9.0	26.0	56.0	24.0	31.0
3/4	12.0	16.0	22.5	23.0	10.0	29.0	62.0	27.0	34.0
1	13.5	18.0	25.0	26.0	11.0	32.0	69.0	30.0	38.0
1-1/4	15.0	20.0	27.5	29.0	12.0	36.0	76.5	33.0	42.0
1-1/2	17.0	22.5	30.5	32.0	13.5	40.0	85.0	37.0	47.0
2	19.0	25.0	34.0	36.0	15.0	44.0	94.0	41.0	52.0
2-1/2	20.5	27.0	35.5	37.5	16.0	45.5	97.0	42.5	55.0
3	21.0	28.0	37.0	39.0	17.0	46.0	99.0	44.0	57.0
3-1/2	22.5	29.0	39.5	42.0	18.0	49.5	100.0	45.0	60.5
4	23.0	30.0	41.0	43.0	19.0	51.0	101.0	46.0	62.0
6	24.2	31.6	43.3	45.5	19.4	55.3	105.0	51.4	66.0
8	32.2	42.2	57.8	60.7	25.9	73.8	140.0	68.6	88.0
10	40.3	52.7	72.2	75.9	32.4	92.2	175.0	85.7	110.0
12	48.4	63.2	86.6	91.1	38.9	110.6	210.0	102.8	132.0
14	56.4	73.8	101.0	106.3	45.4	129.0	—	120.0	154.0
16	64.5	84.3	115.5	121.4	51.8	147.5	—	137.0	176.0
18	72.5	94.9	130.0	136.6	58.3	166.0	—	154.3	198.0
20	80.1	105.4	158.8	151.8	64.8	184.4	—	171.4	220.0
22	88.7	115.9	173.3	167.0	71.3	202.8	—	188.5	242.0
24	96.7	126.5	187.7	182.2	77.8	221.3	—	205.7	264.0
26	104.8	137.0	187.7	197.3	84.2	239.7	—	222.8	286.0
28	112.8	147.6	202.2	212.5	90.7	258.2	—	240.0	308.0
30	120.9	158.0	216.6	227.7	97.2	276.6	—	257.0	330.0
32	129.0	168.6	231.0	242.9	103.7	295.0	—	274.2	352.0
34	137.0	179.2	245.5	258.1	110.2	313.5	—	291.4	374.0
36	145.0	189.7	259.9	273.2	116.6	331.9	—	308.5	396.0
38	153.0	200.3	274.4	288.4	123.0	350.4	—	325.6	418.0
40	161.2	210.8	288.8	303.6	129.6	368.8	—	342.8	440.0
42	169.3	221.3	303.2	318.8	136.0	387.2	—	359.9	462.0

(table continued on next page)

MAKE-ONS THROUGH 12-IN. HANDLE VALVES THROUGH 42-IN.

(CONTINUED)

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

FIELD ERECTION BOLT-UPS (PERCENT ADDITIVE)

Nominal Pipe Size	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	24.0	32.0	43.0	45.0	19.0	55.0	119.0	51.0	66.0
3	26.0	35.0	47.0	49.0	22.0	58.0	125.0	55.0	72.0
4	28.5	38.0	51.0	54.0	24.0	65.0	128.0	58.0	78.0
5	30.0	40.0	54.0	57.0	26.0	69.0	--	60.0	83.0
6	33.0	44.0	59.0	60.0	28.5	71.0	133.0	62.0	90.0
8	37.0	49.0	66.5	68.0	47.5	83.0	143.0	70.0	102.0
10	40.0	54.0	73.0	77.0	71.0	90.0	166.0	81.0	111.0
12	43.0	57.0	77.0	82.0	76.0	99.0	190.0	90.0	118.0
14	47.0	62.0	84.0	88.0	95.0	111.0	--	95.0	128.0
16	50.0	66.5	90.0	95.0	105.0	122.0	--	109.0	137.0
18	56.0	75.0	101.0	106.0	109.0	131.0	--	117.0	154.0
20	62.0	83.0	111.0	117.0	119.0	142.0	--	124.0	170.0
22	65.0	88.0	118.0	124.0	126.0	147.0	--	132.0	181.0
24	69.0	93.0	124.0	132.0	133.0	152.0	--	138.0	191.0
26	74.9	100.1	134.4	143.0	144.0	164.6	--	149.5	207.0
28	80.6	108.6	144.8	154.0	155.0	177.2	--	161.0	222.9
30	86.4	116.4	155.0	165.0	166.2	189.9	--	172.5	238.8
32	92.2	124.2	165.4	176.0	177.3	202.6	--	184.0	254.7
34	97.9	131.9	175.8	187.0	188.4	215.2	--	195.5	270.6
36	103.7	139.7	186.1	198.0	199.4	227.9	--	207.0	286.6
38	109.4	147.4	196.5	209.0	210.5	240.5	--	218.5	302.5
40	115.2	155.2	206.8	220.0	221.6	253.2	--	230.0	318.4
42	121.0	163.0	217.0	231.0	232.7	265.9	--	241.5	334.3

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

ALL WELDED FABRICATION (PERCENT ADDITIVE)

Nominal Pipe Size	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	25.0	33.5	45.0	47.5	20.0	58.0	125.0	54.0	69.0
3	27.5	37.0	49.5	52.0	23.0	61.0	132.0	58.0	76.0
4	30.0	40.0	54.0	57.0	25.0	68.0	135.0	61.0	82.5
5	31.5	42.0	57.0	60.0	27.5	73.0	--	63.0	87.0
6	34.5	46.0	62.0	63.5	30.0	75.0	140.0	65.0	95.0
8	39.0	52.0	70.0	72.0	50.0	87.5	150.0	74.0	107.0
10	42.5	57.0	76.5	81.0	75.0	95.0	175.0	85.0	117.0
12	45.0	60.0	81.0	86.0	80.0	104.0	200.0	95.0	124.0
14	49.0	65.5	88.0	93.0	100.0	117.0	--	100.0	135.0
16	52.5	70.0	94.5	100.0	110.0	128.0	--	115.0	144.0
18	59.0	79.0	106.0	112.0	115.0	138.0	--	123.0	162.0
20	65.0	87.0	117.0	123.5	125.0	149.0	--	130.0	179.0
22	69.0	92.5	124.0	131.0	133.0	154.5	--	139.0	190.0
24	73.0	98.0	131.0	139.0	140.0	160.0	--	145.0	201.0
26	79.0	106.0	142.0	150.5	151.6	173.4	--	157.0	217.9
28	85.0	114.2	152.9	162.0	163.2	186.8	--	169.0	234.6
30	91.2	122.4	163.8	173.7	174.9	200.0	--	181.2	251.4
32	97.3	130.6	174.7	185.3	186.6	213.4	--	193.3	268.2
34	103.4	138.7	185.6	196.9	198.2	226.8	--	205.4	284.9
36	109.4	146.9	196.6	208.4	209.9	240.0	--	217.4	301.7
38	115.5	155.0	207.5	220.0	221.5	253.5	--	229.5	318.4
40	121.6	163.2	218.4	231.6	233.2	266.8	--	241.6	335.2
42	127.7	171.4	229.3	243.2	244.9	280.0	--	253.7	352.0

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

FLAME CUTTING OR BEVELING (PERCENT ADDITIVE)

Nominal Pipe Size	MTR'L. CLASSIFICATION		
	Group 1	Group 2	Group 6
2 or less	17.0	22.5	39.0
3	18.5	25.0	41.0
4	20.0	27.0	45.5
5	21.0	28.0	49.0
6	23.0	31.0	50.0
8	26.0	35.0	59.0
10	28.5	38.0	64.0
12	30.0	40.0	70.0
14	33.0	44.0	78.0
16	35.0	47.0	86.0
18	39.5	53.0	92.0
20	43.5	58.0	100.0
22	46.0	62.0	103.5
24	49.0	66.0	107.0
26	53.0	71.5	116.0
28	57.0	77.0	124.9
30	61.0	82.5	133.8
32	65.3	88.0	142.7
34	69.4	93.5	151.6
36	73.4	99.0	160.6
38	77.5	104.5	169.5
40	81.6	110.0	178.4
42	85.7	115.5	187.3

Material in Groups 1, 2 and 6 only will flame cut. All others are to be machine cut. See respective percentage tables for others.

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

MACHINE CUTTING AND BEVELING PIPE (PERCENT ADDITIVE)

Nominal Pipe Size	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	17.0	22.5	30.0	31.8	13.0	39.0	84.0	36.0	46.0
3	18.5	25.0	33.0	35.0	15.0	41.0	88.0	39.0	51.0
4	20.0	27.0	36.0	38.0	17.0	45.5	90.5	41.0	55.0
5	21.0	28.0	38.0	40.0	18.0	49.0	--	42.0	58.0
6	23.0	31.0	41.5	42.5	20.0	50.0	94.0	43.5	64.0
8	26.0	35.0	47.0	48.0	33.5	59.0	100.5	49.5	72.0
10	28.5	38.0	51.0	54.0	50.0	64.0	117.0	57.0	78.0
12	30.0	40.0	54.0	58.0	54.0	70.0	134.0	64.0	83.0
14	33.0	44.0	59.0	62.0	67.0	78.0	--	67.0	90.0
16	35.0	47.0	63.0	67.0	74.0	86.0	--	77.0	96.0
18	39.5	53.0	71.0	75.0	77.0	92.0	--	82.0	108.5
20	43.5	58.0	78.0	83.0	84.0	100.0	--	87.0	120.0
22	46.0	62.0	83.0	88.0	89.0	103.5	--	93.0	127.0
24	49.0	66.0	88.0	93.0	94.0	107.0	--	97.0	135.0
26	53.0	71.5	95.4	100.1	101.9	116.0	--	105.0	146.4
28	57.0	77.0	102.8	108.6	109.8	124.9	--	113.0	157.6
30	61.0	82.5	110.0	116.4	117.6	133.8	--	121.0	168.9
32	65.3	88.0	117.4	124.2	125.4	142.7	--	129.3	180.2
34	69.4	93.5	124.8	131.9	133.3	151.6	--	137.4	191.4
36	73.4	99.0	132.0	139.7	141.1	160.6	--	145.4	202.7
38	77.5	104.5	139.5	147.4	149.0	169.5	--	153.5	213.9
40	81.6	110.0	146.8	155.2	156.8	178.4	--	161.6	225.2
42	85.7	115.5	154.0	163.0	164.6	187.3	--	169.7	236.5

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

THREADING PIPE

PERCENT ADDITIVE

Nominal Size Inches	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGE								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	20.0	27.0	36.0	38.0	16.0	46.0	100.0	43.0	55.0
3	22.0	30.0	40.0	42.0	18.0	49.0	106.0	46.0	61.0
4	24.0	32.0	43.0	46.0	20.0	54.0	108.0	49.0	66.0
5	25.0	34.0	46.0	48.0	22.0	58.0	--	50.0	70.0
6	28.0	37.0	50.0	51.0	24.0	60.0	112.0	52.0	76.0
8	31.0	42.0	56.0	58.0	40.0	70.0	120.0	59.0	86.0
10	34.0	46.0	61.0	65.0	60.0	76.0	140.0	68.0	94.0
12	36.0	48.0	65.0	69.0	64.0	83.0	160.0	76.0	99.0

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

WELDED ATTACHMENTS AND DRILLING HOLES IN WELDED ATTACHMENTS

PERCENT ADDITIVE

Thickness of Plate, Angle Etc., Inches	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
1/2 or less	21.0	29.0	40.0	43.0	16.0	53.0	98.0	49.0	62.0
3/4	21.5	29.5	40.5	43.5	16.5	53.5	102.0	49.5	62.5
1	22.0	30.0	41.0	44.0	17.0	54.0	106.0	50.0	63.0
1-1/4	22.5	30.5	41.5	44.5	17.5	54.5	110.0	50.5	63.5
1-1/2	23.0	31.0	42.0	45.0	18.0	55.0	115.0	51.0	64.0
1-3/4	24.0	32.0	43.0	46.0	19.0	56.0	120.0	52.0	66.0
2	25.0	33.5	45.0	47.5	20.0	58.0	125.0	54.0	69.0
2-1/2	26.5	35.0	47.0	50.5	22.0	59.0	129.0	56.0	73.5
3	27.5	37.0	49.5	52.0	23.0	61.0	132.0	58.0	76.0
3-1/2	29.0	39.0	52.5	55.0	24.5	65.0	134.0	59.5	79.0
4	30.0	40.0	54.0	57.0	25.0	68.0	135.0	61.0	82.5

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

LOCAL STRESS RELIEVING (PERCENT ADDITIVE)

Nominal Pipe Size	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	17.0	22.5	30.0	31.3	13.0	39.0	84.0	36.0	46.0
3	18.5	25.0	33.0	35.0	15.0	41.0	88.0	39.0	51.0
4	20.0	27.0	36.0	38.0	17.0	45.5	90.5	41.0	55.0
5	21.0	28.0	38.0	40.0	18.0	49.0	--	42.0	58.0
6	23.0	31.0	41.5	42.5	20.0	50.0	94.0	43.5	64.0
8	26.0	35.0	47.0	48.0	33.5	59.0	100.5	49.5	72.0
10	28.5	38.0	51.0	54.0	50.0	64.0	117.0	57.0	78.0
12	30.0	40.0	54.0	58.0	54.0	70.0	134.0	64.0	83.0
14	33.0	44.0	59.0	62.0	67.0	78.0	--	67.0	90.0
16	35.0	47.0	63.0	67.0	74.0	86.0	--	77.0	96.0
18	39.5	53.0	71.0	75.0	77.0	92.0	--	82.0	108.5
20	43.5	58.0	78.0	83.0	84.0	100.0	--	87.0	120.0
22	46.0	62.0	83.0	88.0	89.0	103.5	--	93.0	127.0
24	49.0	66.0	88.0	93.0	94.0	107.0	--	97.0	135.0
26	53.0	71.5	95.4	100.1	101.9	116.0	--	105.0	146.4
28	57.0	77.0	102.8	108.6	109.8	124.9	--	113.0	157.6
30	61.0	82.5	110.0	116.4	117.6	133.8	--	121.0	168.9
32	65.3	88.0	117.4	124.2	125.4	142.7	--	129.3	180.2
34	69.4	93.5	124.8	131.9	133.3	151.6	--	137.4	191.4
36	73.4	99.0	132.0	139.7	141.1	160.6	--	145.4	202.7
38	77.5	104.5	139.5	147.4	149.0	169.5	--	153.5	213.9
40	81.6	110.0	146.8	155.2	156.8	178.4	--	161.6	225.2
42	85.7	115.5	154.0	163.0	164.6	187.3	--	169.7	236.5

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

RADIOGRAPHIC INSPECTION (PERCENT ADDITIVE)

Nominal Pipe Size	MATERIAL CLASSIFICATION-GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	5.0	7.0	15.0	9.5	4.0	11.5	42.5	18.0	34.5
3	5.5	7.0	17.0	10.0	4.5	12.0	45.0	20.0	38.0
4	6.0	8.0	18.0	11.5	5.0	13.5	46.0	21.0	41.0
5	6.5	8.5	19.0	12.0	5.5	14.5	--	21.5	43.5
6	7.0	9.0	21.0	13.0	6.0	15.0	47.5	22.0	47.5
8	8.0	10.0	24.0	14.0	10.0	17.5	51.0	25.0	53.5
10	9.0	11.0	26.0	16.0	15.0	19.0	59.5	29.0	58.5
12	9.5	12.0	27.5	17.0	16.0	21.0	68.0	32.0	62.0
14	10.0	13.0	30.0	19.0	20.0	23.0	--	34.0	67.5
16	10.5	14.0	32.0	20.0	22.0	25.5	--	39.0	72.0
18	12.0	16.0	36.0	22.0	23.0	27.5	--	42.0	81.0
20	13.0	17.0	40.0	25.0	25.0	30.0	--	44.0	89.5
22	14.0	18.5	42.0	26.0	27.0	31.0	--	47.0	95.0
24	15.0	20.0	44.5	28.0	28.0	32.0	--	49.0	101.0
26	16.4	21.6	48.1	30.4	30.4	34.6	—	53.0	109.2
28	17.6	23.2	51.8	32.8	32.8	37.2	—	57.0	117.6
30	18.9	24.9	55.5	35.1	35.1	39.9	—	61.0	126.0
32	20.2	26.6	59.2	37.4	37.4	42.6	—	65.3	134.4
34	21.4	28.2	62.9	39.8	39.8	45.2	—	69.4	142.8
36	22.7	29.9	66.5	42.1	42.1	47.9	—	73.4	151.2
38	23.9	31.5	70.3	44.5	44.5	50.5	—	77.5	159.6
40	25.2	33.2	74.0	46.8	46.8	53.2	—	81.6	168.0
42	26.5	34.9	77.7	49.1	49.1	55.9	—	85.7	176.4

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

MAGNETIC OR DYE PENETRANT INSPECTION (PERCENT ADDITIVE)

Nominal Pipe Size	MATERIAL CLASSIFICATION—GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	5.0	7.0	9.0	9.5	4.0	11.5	25.0	11.0	14.0
3	5.5	7.0	10.0	10.0	4.5	12.0	26.0	11.5	15.0
4	6.0	8.0	11.0	11.5	5.0	13.5	27.0	12.0	16.5
5	6.5	8.5	11.5	12.0	5.5	14.5	--	12.5	17.0
6	7.0	9.0	12.0	13.0	6.0	15.0	28.0	13.0	19.0
8	8.0	10.0	14.0	14.0	10.0	17.5	30.0	15.0	21.0
10	9.0	11.0	15.0	16.0	15.0	19.0	35.0	17.0	23.0
12	9.5	12.0	16.0	17.0	16.0	21.0	40.0	19.0	25.0
14	10.0	13.0	17.5	19.0	20.0	23.0	--	20.0	27.0
16	10.5	14.0	19.0	20.0	22.0	25.5	--	23.0	29.0
18	12.0	16.0	21.0	22.0	23.0	27.5	--	24.5	32.0
20	13.0	17.0	23.0	25.0	25.0	30.0	--	26.0	36.0
22	14.0	18.5	25.0	26.0	27.0	31.0	--	28.0	38.0
24	15.0	20.0	26.0	28.0	28.0	32.0	--	29.0	40.0
26	16.4	21.6	28.1	30.4	30.4	34.6	—	31.2	43.4
28	17.6	23.2	30.2	32.8	32.8	37.2	—	33.6	46.8
30	18.9	24.9	32.4	35.1	35.1	39.9	—	36.0	50.1
32	20.2	26.6	34.6	37.4	37.4	42.6	—	38.4	53.4
34	21.4	28.2	36.7	39.8	39.8	45.2	—	40.8	56.8
36	22.7	29.9	38.9	42.1	42.1	47.9	—	43.2	60.1
38	23.9	31.5	41.0	44.5	44.5	50.5	—	45.6	63.5
40	25.2	33.2	43.2	46.8	46.8	53.2	—	48.0	66.8
42	26.5	34.9	45.4	49.1	49.1	55.9	—	50.4	70.1

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

HYDROSTATIC TESTING (PERCENT ADDITIVE)

Nominal Pipe Size	MATERIAL CLASSIFICATION—GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2 or less	5.0	7.0	9.0	9.5	4.0	11.5	25.0	11.0	14.0
3	5.5	7.0	10.0	10.0	4.5	12.0	26.0	11.5	15.0
4	6.0	8.0	11.0	11.5	5.0	13.5	27.0	12.0	16.5
5	6.5	8.5	11.5	12.0	5.5	14.5	--	12.5	17.0
6	7.0	9.0	12.0	13.0	6.0	15.0	28.0	13.0	19.0
8	8.0	10.0	14.0	14.0	10.0	17.5	30.0	15.0	21.0
10	9.0	11.0	15.0	16.0	15.0	19.0	35.0	17.0	23.0
12	9.5	12.0	16.0	17.0	16.0	21.0	40.0	19.0	25.0
14	10.0	13.0	17.5	19.0	20.0	23.0	--	20.0	27.0
16	10.5	14.0	19.0	20.0	22.0	25.5	--	23.0	29.0
18	12.0	16.0	21.0	22.0	23.0	27.5	--	24.5	32.0
20	13.0	17.0	23.0	25.0	25.0	30.0	--	26.0	36.0
22	14.0	18.5	25.0	26.0	27.0	31.0	--	28.0	38.0
24	15.0	20.0	26.0	28.0	28.0	32.0	--	29.0	40.0
26	16.4	21.6	28.1	30.4	30.4	34.6	—	31.2	43.4
28	17.6	23.2	30.2	32.8	32.8	37.2	—	33.6	46.8
30	18.9	24.9	32.4	35.1	35.1	39.9	—	36.0	50.1
32	20.2	26.6	34.6	37.4	37.4	42.6	—	38.4	53.4
34	21.4	28.2	36.7	39.8	39.8	45.2	—	40.8	56.8
36	22.7	29.9	38.9	42.1	42.1	47.9	—	43.2	60.1
38	23.9	31.5	41.0	44.5	44.5	50.5	—	45.6	63.5
40	25.2	33.2	43.2	46.8	46.8	53.2	—	48.0	66.8
42	26.5	34.9	45.4	49.1	49.1	55.9	—	50.4	70.1

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Fabrication of alloy and non-ferrous piping is to be figured on the same basis as for corresponding operation on carbon steel materials, plus the percentage given below applicable to the carbon steel man hour schedules.

ACCESS HOLES

Percent Additive

Nominal Pipe Size	MATERIAL CLASSIFICATION—GROUP NUMBERS AND PERCENTAGES								
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
2-1/2. 3. 4	6.0	8.0	11.0	11.5	5.0	13.5	27.0	12.0	16.5
5. 6. 8	8.0	10.0	14.0	14.0	10.0	17.5	30.0	15.0	21.0
10. 12	9.5	12.0	16.0	17.0	16.0	21.0	40.0	19.0	25.0
14. 16. 18	12.0	16.0	21.0	22.0	23.0	27.5	--	24.5	32.0
20. 22. 24	15.0	20.0	26.0	28.0	28.0	32.0	--	29.0	40.0

GROUP 1	ASTM A335-P1	.50% Moly	GROUP 4	Stainless Steels Types 304, 309, 310, 316 (including "L" & "H" Grades)
	ASTM A335-P2	.50-.70% Chr.		
	ASTM A335-P12	.85-1.10% Chr.		
	ASTM A335-P11	1.05-1.45% Chr.	GROUP 5	Copper, Brass, Everdur
	ASTM A335-P3	1.50-2.00% Chr.		
GROUP 2	ASTM A335-P3b	1.75-2.25% Chr.	GROUP 6	ASTM A-333-GR-1 ASTM A-333-GR4 ASTM A-333-GR9
	ASTM A335-P22	2.00-2.50% Chr.		
	ASTM A335-P21	2.75-3.25% Chr.		
	ASTM A335-P5,b,c	4.00-6.00% Chr.		
GROUP 3	ASTM A335-P7	6.00-8.00% Chr.	GROUP 7	Hastelloy, Titanium, 99% Ni.
	ASTM A335-P9	8.00-10.00% Chr.	GROUP 8	Stainless Steels Types 321 & 347, Cu-Ni, Monel, Inconel, Incoloy, Alloy 20
	Ferritic Chromes	10.00-15.00% Chr.		
	ASTM A333 Gr. 3	3.50% Nickel	GROUP 9	Aluminum

Section Four

UNDERGROUND PIPING

In this section we have tried to cover all labor items related to a complete installation of underground piping.

First of all, the area in which the pipe is to be installed must be excavated. Before an estimate is made on this item it is well to know the kind of soil that may be encountered. For this reason, we have divided soil into five groups according to the difficulty experienced in excavating it. Soils vary greatly in character and no two are exactly alike.

Group 1: LIGHT SOIL — Earth which can be shoveled easily and requires no loosening, such as sand.

Group 2: MEDIUM OR ORDINARY SOILS — Type of earth easily loosened by pick. Preliminary loosening is not required when power excavating equipment such as shovels, dragline scrapers and backhoes are used. This earth is usually classified as ordinary soil and loam.

Group 3: HEAVY OR HARD SOIL — This type of soil can be loosened by pick but this loosening is sometimes very hard to do. It may be excavated by sturdy power shovels without preliminary loosening. Hard and compacted loam containing gravel, small stones and boulders, stiff clay or compacted gravel are good examples of this type.

Group 4: HARD PAN OR SHALE — A soil that has hardened and is very difficult to loosen with picks. Light blasting is often required when excavating with power equipment.

Group 5: ROCK — Requires blasting before removal and transporting. (May be divided into different grades such as hard, soft, or medium.)

For pipe installation we have included man hour tables covering cast iron, concrete and vitrified clay under this section. For carbon steel pipe installation man hours refer to section two of this manual.

In many instances specifications may call for the coating and wrapping of underground pipe. This too, has been covered with a table listing the direct man hours that are required for coating and wrapping various sizes of pipe.

MACHINE EXCAVATION

EQUIPMENT	NET MAN HOURS PER 100 CUBIC YARDS								
	LIGHT SOIL			MEDIUM SOIL			HEAVY SOIL		
	Op. Engr.	Oiler	Labor	Op. Engr.	Oiler	Labor	Op. Engr.	Oiler	Labor
Power Shovel									
1 cubic yard Dipper	1.1	1.1	1.1	2.0	2.0	2.0	2.7	2.7	2.7
3/4 cubic yard Dipper	1.5	1.5	1.5	2.8	2.8	2.8	3.7	3.7	3.7
1/2 cubic yard Dipper	2.0	2.0	2.0	3.7	3.7	3.7	4.9	4.9	4.9
Backhoe									
1 cubic yard Bucket	1.4	1.4	1.4	2.6	2.6	2.6	3.5	3.5	3.5
3/4 Cubic yard Bucket	1.5	1.5	1.5	3.8	3.8	3.8	3.7	3.7	3.7
1/2 cubic yard Bucket	2.0	2.0	2.0	3.7	3.7	3.7	4.9	4.9	4.9
Dragline									
2 cubic yard Bucket	0.7	0.7	0.7	1.3	1.3	1.3	1.7	1.7	1.7
1 cubic yard Bucket	1.1	1.1	1.1	2.0	2.0	2.0	2.7	2.7	2.7
1/2 cubic yard Bucket	2.0	2.0	2.0	3.7	3.7	3.7	4.9	4.9	4.9
Trenching Machine	--	--	--	3.8	--	7.5	4.8	--	9.4

EQUIPMENT	NET MAN HOURS PER 100 CUBIC YARDS					
	HARD PAN			ROCK		
	Op. Engr.	Oiler	Labor	Op. Engr.	Oiler	Labor
Power Shovel						
1 cubic yard Dipper	3.4	3.4	3.4	3.4	3.4	3.4
3/4 cubic yard Dipper	4.6	4.6	4.6	4.6	4.6	4.6
1/2 cubic yard Dipper	6.1	6.1	6.1	6.1	6.1	6.1
Backhoe						
1 cubic yard Bucket	4.4	4.4	4.4	4.4	4.4	4.4
3/4 cubic yard Bucket	4.6	4.6	4.6	4.6	4.6	4.6
1/2 cubic yard Bucket	6.1	6.1	6.1	6.1	6.1	6.1

Man hours are for operational procedures only and do not include equipment rental or depreciation. This must be added in all cases.

Operation includes excavation and dumping on side line or into trucks for hauling but does not include hauling. See pages on hauling for this charge.

For excavations greater than 5'6" add 25% to above man hours.

HAND EXCAVATION

NET LABORER MAN HOURS PER CUBIC YARD

Soil	Excavation	First Lift	Second Lift	Third Lift
Light	General Dry	1.07	1.42	1.89
	General Wet	1.60	2.13	2.83
	Special Dry	1.34	1.78	2.37
Medium	General Dry	1.60	2.13	2.83
	General Wet	2.14	2.85	3.79
	Special Dry	1.07	2.49	3.31
Hard or Heavy	General Dry	2.67	3.55	4.72
	General Wet	3.21	4.27	5.68
	Special Dry	2.94	3.91	5.20
Hard Pan	General Dry	3.74	4.97	6.61
	General Wet	4.28	5.69	7.57
	Special Dry	4.01	5.33	7.09

Man hours include picking and loosening where necessary and placing on bank out of way of excavation or loading into trucks or wagons for hauling away. Man hours do not include hauling or unloading.

ROCK EXCAVATION

Net Man Hours for Drilling, Blasting and Loading
per Cubic Yard of Rock in Place in Ground

Operation	Labor Hours per Cubic Yard		
	Soft	Medium	Hard
Hand Drill, Plug and Feathers	15.0	21.0	30.0
Hand Drill, Blasting	13.0	16.0	22.0
Machine Drill, Plug and Feathers	8.0	11.0	14.0
Machine Drill, Blasting	4.0	6.0	7.0

Man hours are for above described operations only.

For hauling see respective man hour page.

Equipment and materials must be added in all cases.

SHORING AND BRACING TRENCHES

Net Man Hours per 100 Square Feet

Operation	Laborers	Carpenters	Truck Drivers
Placing	3.0	3.0	0.4
Removing	2.5	---	0.4

Man hours include hauling, erecting and stripping.

DISPOSAL OF EXCAVATED MATERIAL

NET MAN HOURS PER 100 CUBIC YARDS

Length of Haul and Truck Capacity	Average Speed 10 M. P. H.		Average Speed 15 M. P. H.		Average Speed 20 M. P. H.	
	Truck Driver	Laborer	Truck Driver	Laborer	Truck Driver	Laborer
3 cubic yard Truck:						
One Mile Haul	15.0	2.8	11.6	2.8	10.5	2.8
Two Mile Haul	21.8	2.8	16.2	2.8	14.0	2.8
Three Mile Haul	28.2	3.0	20.6	3.0	17.3	3.0
Four Mile Haul	36.0	3.0	26.8	3.0	21.0	3.0
Five Mile Haul	41.7	2.5	--	--	--	--
4 cubic yard Truck:						
One Mile Haul	11.3	2.1	8.8	2.3	7.9	2.1
Two Mile Haul	16.2	2.0	12.0	2.0	10.4	2.2
Three Mile Haul	21.6	2.1	15.8	2.3	13.2	2.1
Four Mile Haul	26.4	2.0	18.7	2.0	15.6	2.0
Five Mile Haul	31.3	1.3	--	--	--	--
5 cubic yard Truck:						
One Mile Haul	9.0	1.7	7.0	1.7	6.3	1.7
Two Mile Haul	13.0	1.7	9.7	1.7	8.3	1.7
Three Mile Haul	17.1	1.8	12.3	1.8	10.4	1.7
Four Mile Haul	21.0	2.0	15.0	2.0	12.4	1.6
Five Mile Haul	25.0	1.7	--	--	--	--
8 cubic yard Truck:						
One Mile Haul	5.6	1.0	4.8	1.0	4.0	1.0
Two Mile Haul	8.2	1.0	6.0	1.0	5.2	1.0
Three Mile Haul	10.5	0.9	7.8	0.9	6.5	1.0
Four Mile Haul	13.2	1.0	9.2	1.0	7.6	1.0
Five Mile Haul	15.6	1.0	--	--	--	--

Man hours include round trip for truck, spotting at both ends, unloading and labor for minor repairs and maintenance to vehicle. For loading and excavating see respective man hour listings.

Man hours do not include equipment rental or depreciation. This must be added in all cases.

BACKFILLING AND TAMPING

NET MAN HOURS PER CUBIC YARD

Soil	Hand Shovel Placed	Bulldoze Placed	Tamped 6" Layers
Light	0.60	0.04	--
Medium	0.80	0.07	1.00
Heavy	1.00	0.10	1.20

Man hours for hand shoveling and tamping is that of common labor. Man hours for bulldozer placing is that of operating engineer.

All man hours are based on backfill materials being located within shoveling distance of excavated area.

UNDERGROUND 150 LBS. B. & S. CAST IRON PIPE

LABOR IN MAN HOURS

MAN HOURS PER FOOT		PER MAKE-ON		
		150 Lb. B & S Fittings		
Size Inches	Pipe Set & Align	Lead & Mech. Joint	Cement Joint	Sulphur Joint
4	0.09	0.50	0.35	0.25
6	0.11	0.57	0.37	0.29
8	0.14	0.70	0.50	0.35
10	0.17	0.85	0.60	0.43
12	0.24	1.23	0.95	0.62
14	0.35	1.78	1.25	0.89
16	0.45	2.28	1.60	1.14
18	0.53	2.68	1.89	1.34
20	0.63	3.19	2.24	1.59
24	0.79	4.00	2.81	2.00

Pipe man hours includes handle, haul, set and align in trench.

Fitting man hours includes one make-on.

Man hours must be added for excavation. See respective pages for this charge.

UNDERGROUND VITRIFIED CLAY AND CONCRETE PIPE

LABOR IN MAN HOURS

Size Inches	CONCRETE PIPE (Not Reinforced)		VITRIFIED CLAY PIPE	
	Set & Align Pipe Per Foot	Cement Poured Joint Each	Set & Align Pipe Per Foot	Poured Joint Each
4	0.07	0.20	0.07	0.25
6	0.08	0.25	0.07	0.29
8	0.10	0.32	0.07	0.35
10	0.11	0.39	0.08	0.43
12	0.15	0.50	0.10	0.62
15	0.19	0.75	0.11	0.89
18	0.28	0.95	0.14	1.14
21	0.29	1.15	0.19	1.38
24	0.32	1.25	0.25	1.63
30	0.40	1.56	0.31	2.04
36	0.48	1.88	0.37	2.44
42	0.56	2.19	0.44	2.85
48	0.64	2.50	0.50	3.26
60	0.80	3.13	0.62	4.07

Man hours includes handle, haul, set in trench and align. Man hours for joint or connection of fittings is for one make-up only.

No labor for excavation or backfill is included. Add from respective pages for these charges.

For reinforced concrete pipe add 5% to man hours listed for concrete pipe.

SOCKET CLAMPS FOR CAST IRON PIPE

NET LABOR IN MAN HOURS

Pipe Size Inches	Friction Clamps Complete	Positive Clamps Complete
4	0.25	0.30
6	0.28	0.33
8	0.33	0.38
10	0.38	0.43
12	0.45	0.52
14	0.52	0.62
16	0.60	0.75
18	0.68	0.85
20	0.75	0.95
24	0.88	1.10

Man hours are for labor only and include handling, hauling and the complete installation in all cases.

PIPE COATED WITH TAR AND FIELD WRAPPED BY MACHINE

NET MAN HOURS PER LINEAL FOOT

Nominal Pipe Size	Man Hours Per Foot	Nominal Pipe Size	Man Hours Per Foot
3/4	0.04	22	0.50
1	0.04	24	0.54
1-1/4	0.05	26	0.59
1-1/2	0.06	28	0.63
2	0.07	30	0.68
2-1/2	0.08	32	0.73
3	0.09	34	0.78
4	0.12	36	0.82
5	0.13	38	0.87
6	0.16	40	0.91
8	0.20	42	0.96
10	0.25	44	1.00
12	0.28	46	1.05
14	0.32	48	1.10
16	0.37	54	1.24
18	0.41	60	1.38
20	0.45	--	--

Man hours include:

Sandblast commercially
Apply one prime coat of pipeline primer
Apply 3/32" pipeline enamel
Apply two ply of 15# tarred felt
Apply one seal coat of pipeline enamel

For hand coating and wrapping add 100% to above man hours.

Section Five

HANGERS AND SUPPORTS

The following table is intended to cover labor in man hours for the hanging and/or supporting of a process piping system.

It includes labor man hours for the installation of patented clevis, band, ring, expansion and trapeze types as well as fabricated hangers and supports made from structural angles, channels, etc.

In many cases, the drawings will not show hangers and supports but the specifications will state that they are to be furnished and installed by the contractor. Thus, this becomes the estimator's problem for the purpose of bidding the job. You will find under Section Ten entitled "Technical Information" on pages 214 through 221, diagrams, tables, formulas and solutions as to how a process piping system should be hung and/or supported.

HANGERS AND SUPPORTS

Fabrication: Labor only for fabrication of other than standard manufactured hangers and supports can be performed at 0.07 man hours per pound.

Field Erection:

Type of Hanger	Hanger Suspended From	Man Hours Per Hanger* — Hanger Fastened To			
		Steel	Concrete or Masonry	Wood	Existing Pipe
PATENT	Welded Clip Angle	1.50	--	--	--
	Clip Angle — Ramset	1.00	--	--	--
	Female Stud or Male Stud & Coupling — Ramset	.60	.60	--	--
Clevis Hanger Band Hanger Ring Hanger Expansion Hanger	Female Stud or Male Stud & Coupling — Nelson Stud Welder	.60	--	--	--
	Beam Clamp or Corn Clamp	1.30	--	--	--
	Cinch Anchor	--	2.00	--	--
	Bolt or Strap	--	--	1.60	--
	Band and Rod	--	--	--	1.00
PATENT	Welded Clip Angles	2.00	--	--	--
	Clip Angle — Ramset	1.50	--	--	--
	Female Stud or Male Stud & Coupling — Ramset	1.20	--	--	--
Trapeze Hanger (1' - 4' Bar)	Female Stud or Male Stud & Coupling — Nelson Stud Welder	1.20	--	--	--
	Beam Clamp or Corn Clamp	2.00	--	--	--
	Cinch Anchor	--	4.00	--	--

**The patent hanger allowances are for supporting pipe through 4" size.*

Fabricated Hangers (Angles, Channels, Etc.): 0.08 man hours per pound with a minimum time of 1 man hour regardless of weight.

The following factors should be applied for sizes over 4":

6" — 1.20 man hours
8" — 1.50 man hours
10" — 1.80 man hours
12" — 2.20 man hours

Section Six

PAINTING

This section deals solely with the sandblasting and painting of a piping system and is so arranged as to include the direct man hours by pipe size for six (6) different types or specifications.

We have not covered color coding under this section due to the fact that the scope of the work involved in this operation can vary so greatly. As an example, you may be able to set-up in one location and band as many as a dozen lines, on the other hand the same set-up may be required to band one line. Therefore, we feel that this operation must be looked at individually according to piping specifications and locations.

SURFACE AREA OF PIPE FOR PAINTING

Nominal Size Inches	Surface Area S.F. Per L.F.	Nominal Size Inches	Surface Area S.F. Per L.F.
1	0.344	22	5.75
1-1/2	0.497	24	6.28
2	0.622	26	6.81
2-1/2	0.753	28	7.32
3	0.916	30	7.85
3-1/2	1.047	32	8.38
4	1.178	34	8.89
5	1.456	36	9.42
6	1.734	38	9.96
8	2.258	40	10.46
10	2.810	42	11.00
12	3.142	44	11.52
14	3.67	46	12.03
16	4.19	48	12.57
18	4.71	54	14.13
20	5.24	60	15.71

SAND BLAST AND PAINT PIPE

COMMERCIAL BLAST

NET MAN HOURS PER LINEAL FOOT

Nominal Size Inches	4-Coats Conventional Paint	4-Coats Chlorinated Rubber	4-Coats Vinyl Paint	1-Coat Dimetcote #3	5-Coats Epoxy Paint	1/16" Barretts 10-70
2	0.05	0.05	0.06	0.05	0.08	0.04
2-1/2	0.05	0.06	0.08	0.07	0.10	0.05
3	0.06	0.07	0.09	0.08	0.12	0.06
3-1/2	0.07	0.08	0.10	0.09	0.13	0.07
4	0.08	0.08	0.10	0.10	0.14	0.07
5	0.09	0.10	0.13	0.11	0.17	0.08
6	0.10	0.12	0.15	0.13	0.19	0.10
8	0.13	0.15	0.19	0.17	0.24	0.13
10	0.16	0.18	0.23	0.20	0.29	0.15
12	0.18	0.19	0.25	0.21	0.32	0.16
14	0.19	0.21	0.27	0.24	0.35	0.18
16	0.22	0.24	0.31	0.27	0.40	0.21
18	0.25	0.27	0.35	0.31	0.45	0.24
20	0.28	0.31	0.40	0.34	0.50	0.26
22	0.31	0.34	0.44	0.38	0.55	0.29
24	0.34	0.37	0.47	0.42	0.60	0.32
26	0.37	0.40	0.52	0.46	0.65	0.35
28	0.40	0.43	0.56	0.49	0.70	0.37
30	0.42	0.46	0.59	0.52	0.75	0.40
32	0.45	0.49	0.64	0.56	0.80	0.43
34	0.48	0.52	0.68	0.60	0.85	0.45
36	0.50	0.56	0.71	0.63	0.90	0.48
38	0.53	0.59	0.76	0.67	0.95	0.51
40	0.56	0.62	0.80	0.70	1.00	0.53
42	0.59	0.65	0.83	0.74	1.06	0.56
44	0.62	0.68	0.88	0.77	1.10	0.59
46	0.64	0.71	0.92	0.81	1.15	0.61
48	0.65	0.72	0.96	0.84	1.20	0.64
54	0.73	0.87	1.08	0.95	1.35	0.72
60	0.85	0.93	1.19	1.05	1.51	0.80

Man hours for painting pipe only. Labor for scaffolding must be added.

Man hours for galvanizing exterior of pipe only is approximately 80% of conventional paint.

Man hours to galvanize exterior and interior of pipe is approximately the same as dimetcote.

Section Seven

PATENT SCAFFOLDING

This section covers labor in man hours for the erection and dismantling of patent tubular steel type scaffolding.

In the process of making the piping material take-off, the estimator should give due consideration to the lengths of run, the height, etc., so that the number and height of sections of scaffolding may be determined for the entire piping job.

We have not attempted to cover job fabricated homemade scaffolding due to the fact that this type of scaffolding for a piping job is so outrageously high. If this type of scaffolding is desired, you must look elsewhere or draw from your past experience.

ERECT AND DISMANTLE

DIRECT LABOR — MAN HOURS PER SECTION

Patent Tubular Steel Scaffolding — 2" Planking Top.
Sections — 7' L x 5' W x 5' H

Includes: Transporting scaffolding and materials from storage.
Erection of scaffolding including leveling and securing.
Installation of 2" planking.
Dismantling of scaffolding.
Transporting scaffolding and materials to storage.

	MAN HOURS PER SECTION					
	One or Two Sections High			More than Two Sections High		
	Erect	Dismantle	Total	Erect	Dismantle	Total
One to two sections long	1.40	1.00	2.40	1.70	1.20	2.90
Three to five sections long	0.90	0.60	1.50	1.00	0.70	1.70
Six sections and more long	0.70	0.40	1.10	0.90	0.50	1.40

Section Eight

INSULATION

The hardest of all piping items for which to try to set a standard man hour rate is insulation. This is due largely to the fact that this is a very special item which is usually subcontracted to an organization who specializes in this field. Too, an insulation contractor will consider many factors before he submits his bid — such as, "Do I want or need this job, is the job large or small, etc." The cost of moving in and setting up is just as great regardless of the size of the job.

The man hours which appear in the following tables are the average of many jobs and we believe they will work fine for the types of insulation they cover. However, we believe that for projects where much and varied insulation is to be used a contractor who specializes in this type of work should be consulted on this matter.

INDOOR THERMAL TYPE

NET MAN HOURS

Thickness Inches	Pipe Size	Straight Pipe per LF	Bent Pipe per LF	Flanges Line per Ea.	Valves Flgd. per Ea.	Valves S & W per Ea.	Fittings Flanged per Ea.	Fittings S & W per Ea.	Hangers Pipe per Ea.	Nozzles per Each
1.0	1/2	.18	.28	.56	1.50	.75	1.50	.28	.18	.18
	3/4	.19	.29	.59	1.58	.79	1.58	.29	.19	.19
	1	.21	.31	.63	1.69	.84	1.69	.31	.21	.21
	1-1/2	.24	.36	.72	1.92	.96	1.92	.36	.24	.24
	2	.25	.38	.76	2.04	1.02	2.04	.38	.25	.25
	3	.31	.47	.94	2.52	1.26	2.52	.47	.31	.31
	4	.37	.56	1.12	2.99	1.49	2.99	.74	.37	.37
	6	.43	.64	1.29	3.45	1.72	3.45	.86	.43	.43
1.5	1/2	.28	.43	.86	2.30	1.15	2.30	.43	.28	.28
	3/4	.30	.45	.90	2.42	1.21	2.42	.45	.30	.30
	1	.31	.47	.95	2.54	1.27	2.54	.47	.31	.31
	1-1/2	.35	.53	1.06	2.84	1.42	2.84	.53	.35	.35
	2	.37	.56	1.13	3.01	1.50	3.01	.56	.37	.37
	3	.44	.66	1.34	3.57	1.78	3.57	.66	.44	.44
	4	.50	.76	1.52	4.06	2.03	4.06	1.01	.50	.50
	6	.57	.86	1.73	4.63	2.31	4.63	1.15	.57	.57
	8	.67	1.01	2.03	5.43	2.71	5.43	1.69	.67	.67
	10	.80	1.21	2.43	6.48	3.24	6.48	2.02	.80	.80
	12	.91	1.36	2.73	7.30	3.65	7.30	2.73	.91	.91
	14	1.01	1.52	3.05	8.14	4.07	8.14	3.05	1.01	1.01
	16	1.14	1.71	3.43	9.15	4.57	9.15	4.56	1.14	1.14
	18	1.27	1.90	3.80	10.17	5.08	10.17	6.35	1.27	1.27
	20	1.39	2.08	4.17	11.13	5.56	11.13	6.94	1.39	1.39
	24	1.62	2.43	4.87	12.99	6.49	12.99	9.74	1.62	1.62
2.5	1/2	.47	.71	1.42	3.79	1.89	3.79	.71	.47	.47
	3/4	.48	.72	1.45	3.88	1.94	3.88	.72	.48	.48
	1	.50	.76	1.52	4.06	2.03	4.06	.76	.50	.50
	1-1/2	.55	.82	1.65	4.41	2.20	4.41	.82	.55	.55
	2	.58	.87	1.74	4.65	2.32	4.65	.87	.58	.58
	3	.68	1.02	2.04	5.30	2.72	5.30	1.02	.68	.68
	4	.78	1.16	2.33	6.21	3.10	6.21	1.55	.78	.78
	6	.86	1.28	2.58	6.88	3.44	6.88	1.72	.86	.86
	8	.97	1.46	2.93	7.81	3.90	7.81	2.43	.97	.97
3.5	1/2	.74	1.12	2.24	6.00	3.00	6.00	1.12	.74	.74
	3/4	.78	1.18	2.36	6.31	3.15	6.31	1.18	.78	.78
	1	.80	1.20	2.40	6.42	3.21	6.42	1.20	.80	.80
	1-1/2	.86	1.29	2.59	6.91	3.45	6.91	1.29	.86	.86
	2	.91	1.37	2.74	7.32	3.66	7.32	1.37	.91	.91
	3	1.02	1.54	3.08	8.22	4.11	8.22	1.54	1.02	1.02
	4	1.11	1.67	3.34	8.93	4.46	8.93	2.23	1.11	1.11
	6	1.21	1.81	3.63	9.69	4.84	9.69	2.42	1.21	1.21
	8	1.35	2.03	4.06	10.84	5.42	10.84	3.38	1.35	1.35

Thermal Insulation: Consists of applying hydraulic setting, insulating cement by spraying, brushing, troweling or palming, coating with vinyl emulsion, double wrapping with glass fiber cloth and coating with vinyl emulsion seal coat.

Outside Use: Add 10% to above man hours.

Foamglass: Use same man hours as appear above for this type insulation. This will include labor for butter joints with "Seal Koat" and secure with 16 and 14 gauge galvanized wire on 9" centers. Finish with one coat "Seal Koat" for indoor piping and 55# asbestos roofing felt secured with 16 gauge wire 6" on center over the layer of "Seal Koat" on outside piping.

Note: S & W denotes screwed and welded.

INSULATION

HOT PIPING — MAN HOURS

Pipe Size Inches	Thickness and Type	Straight Pipe per l. f.	Screwed & Weld Fittings per each	Flanges per pair	Flanged Valves & Fittings each
1/2	1" thick Calsilite	.11	.14	.36	.74
3/4	1" thick Calsilite	.11	.15	.36	.74
1	1" thick Calsilite	.12	.18	.36	.74
1-1/2	1" thick Calsilite	.13	.21	.41	.83
2	1" thick Calsilite	.14	.22	.44	.88
3	1" thick Calsilite	.18	.27	.54	1.37
4	1" thick Calsilite	.21	.34	.65	1.65
5	1" thick Calsilite	.25	.52	.72	2.05
6	1" thick Calsilite	.25	.61	.77	2.15
7	1-1/2" thick Calsilite	.33	.93	.96	2.96
8	1-1/2" thick Calsilite	.36	1.18	1.10	3.39

Man Hour:

1. Above thicknesses and man hours are for all hot services, if calcium silicate is used.
2. The above man hours are for either *indoor* or *outdoor* service.
3. *Bent Pipe:* 1.5 x straight pipe of like size and thickness measured along outside radius.
4. *Steam Traced Piping:* To be man houred at size of pipe covering required to fit over pipe and tracer line.
5. *Method of Measurement:* Straight pipe to be determined by measuring along approximate center line over the exterior of the insulation from center line to center line of change of direction. Measurement shall be made through all valves and fittings, except bent pipe.
6. *Specifications:*
   a. *Pipe Covering:* Molded sections secured with 16 ga. galvanized tie wire. *Finish:* Indoors with 6 ounce canvas with laps sealed with Arabol lagging adhesive. *Finish:* Outdoors with 55# Fiberock Asbestos Roofing felt secured with 16 ga. galvanized tie wire 6" o.c.
   b. *Fittings:* To be built-up with insulating cement or sectional pipe covering pointed up with asbestos cement, finished with 6 ounce canvas and Arabel for indoor service and "Seal Perm" for outdoor service.

Section Nine

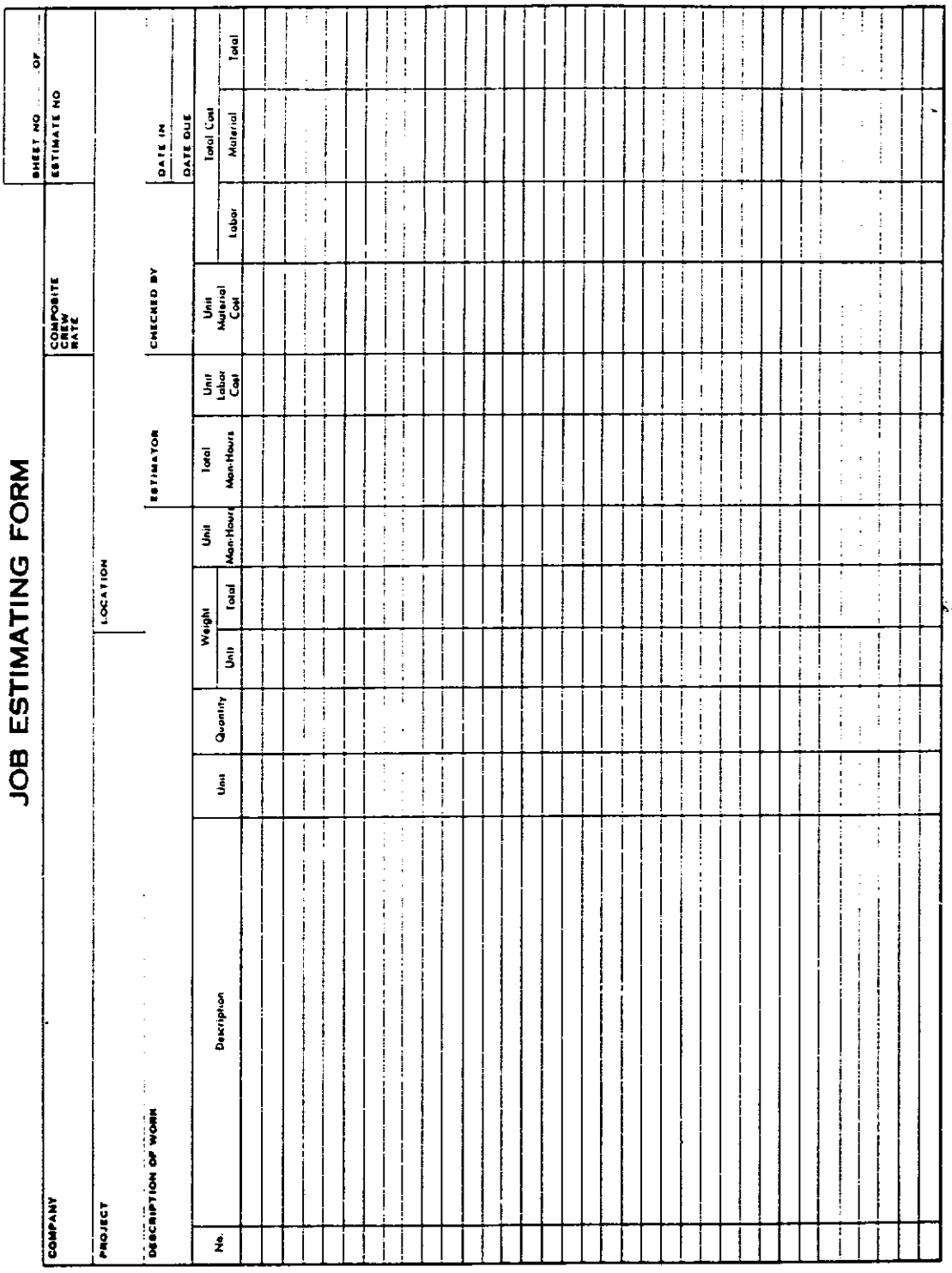
SAMPLE ESTIMATE

This section is presented for the purpose of showing the work ability of a few of the man hour charts as appea throughout this manual. It does not mean that a take-off must be made in this manner before the man hour charts will work. It is merely a suggested method.

You will note on the following take-off sheets at the top of the page a predetermined composite rate, arrived at as outlined in the Introduction of this manual. Simply by multiplying this composite rate by the total man hours involved, a total estimated direct labor dollar value can be easily and accurately obtained.

We do not show in this sample estimate any material cost, nevertheless, you will find ample space provided for this item. You will also find space provided for both unit and total weights of pipe and fittings. We feel that this item has much value such as an estimate check using the weight method, or for the estimation of warehousing, equipment usage and fabrication shop set-up.

We purposely have not included material, miscellaneous supplies, equipment usage, overhead and profit in this estimate. As is stated in the Preface of this manual, its sole purpose is for the estimation of direct labor in man hours only.



This Job Estimating Form is ideal for use when working with the Estimating Man-Hour Manuals.

JOB ESTIMATING FORM

SHEET NO 1 OF 7

COMPANY: AMERICAN CHEMICAL COMPANY
COMPOSITE CREW RATE: 11.11
ESTIMATE NO: 203
PROJECT: PROCESS PIPING
LOCATION: ANYWHERE, U.S.A.
DESCRIPTION OF WORK: SHOP FABRICATION - CARBON STEEL - Owner Furnished Materials
ESTIMATOR: Page
CHECKED BY: Nation
DATE IN: 7-3-75
DATE DUE: 7-5-75

No.	Description	Unit	Quantity	Weight Unit	Weight Total	Unit Man Hours	Total Man Hours	Unit Labor Cost	Unit Material Cost	Total Cost Labor	Total Cost Material	Total Cost Tax
1	3" - 90° Sch. 40 Wld. Ell	Pcs.	10	4.6	46	Hdlg.	Hdlg.		Owner		Owner	
2	4" - " " " " "	"	8	8.7	70	Incl.	Incl.		Furn.		Furn	
3	6" - " " " " "	"	3	23.0	69	w/Pipe	w/Pipe		"		"	
4	3" - 45° " " " "	"	5	2.3	12	"	"		"		"	
5	4" - Sch. 40 Wld. Tee	"	3	12.6	38	"	"		"		"	
6	4" x 3" - Sch. 40 Wld. Red	"	2	3.6	7	"	"		"		"	
7	3" - Sch. 40 Wld. Cap	"	2	1.4	3	"	"		"		"	
8	4" - Sch. 40 Butt Welds	En.	30	--	--	1.3	41.6		"	462	"	
9	3" - " " " "	"	50	--	--	1.1	55.0		"	611	"	
10	6" - Sch. 80 " "	"	15	--	--	2.1	31.5		"	350	"	
11	4" - Sch. 40 Cut	"	2	--	--	.2	.4		"	4	"	
12	4" - " " U-Bevel	"	2	--	--	1.5	3.0		"	33	"	
13	3" - 150# S.O. Flgs.	Pcs.	2	10	20	1.6	3.2		"	36	"	
14	3" - Sch. 40 45° Bend	"	2	--	--	3.1	6.2		"	69	"	
15	4" - Sch. 40 90° Bend	"	1	--	--	4.4	4.4		"	49	"	
16	6" - Sch. 80 Offset Bend	"	1	--	--	10.1	10.1		"	112	"	
17	6" - Sch. 80 Preheat	Ea.	1	--	--	.9	.9		"	10	"	
18	6" - Sch. 80 Stress Relieve	"	1	--	--	3.6	3.6		"	40	"	
19	3" - Test Fab. Assy. (2-Outlets)	"	1	--	--	5.2	5.2		"	58	"	
20	3" - Sch. 40 Sml s A-53 Pipe	LF	200	7.6	1520	.041	8.2		"	91	"	
21	4" - " " " "	"	350	10.8	3780	.045	15.8		"	176	"	
22	6" - " 80 " " "	"	100	28.6	2860	.070	7.0		"	78	"	
		TOTAL FITTING WEIGHT			265		TOTAL THIS SHEET			2179		
		" PIPE		"	8160							

JOB ESTIMATING FORM

SHEET NO 2 OF 7

COMPANY: AMERICAN CHEMICAL COMPANY

COMPOSITE CREW RATE: 11.11

ESTIMATE NO: 203

PROJECT: PROCESS PIPING

LOCATION: ANYWHERE, USA

DESCRIPTION OF WORK: SHOP FABRICATION - ALLOY - Owner Furnished Materials

ESTIMATOR: Page

CHECKED BY: Nation

DATE IN: 7-3-75

DATE DUE: 7-5-75

No	Description	Unit	Quantity	Weight Unit	Weight Total	Unit Man Hours	Total Man Hours	Unit Labor Cost	Unit Material Cost	Total Cost Labor	Total Cost Material	Total Cost Total
1	8" - 90° Sch. 40 Wld. Ell	Pcs	8	46.0	368	Hdlg	Hdlg.		Owner		Owner	
2	6" - " " " " "	"	6	23.0	138	Incl	Incl		Furn.		Furn	
3	8" - 45° " " " "	"	2	23.0	46	w/pipe	w/pipe		"		"	
4	8" - 300# W.N. Flgs.	"	10	67.0	670	3.83	38.30		"	426	"	
5	6" - " " " " "	"	8	42.0	336	2.97	23.76		"	264	"	
6	8" - Sch. 40 Butt Welds	Ea.	35	--	--	3.83	134.05		"	1489	"	
7	6" " " " " "	"	25	--	--	2.97	74.25		"	825	"	
8	8" S.40 Smls. 18-8 Type 304 Pipe	LF	180	28.55	5367	.063	11.34		"	126	"	
9	6" " " " " " " "	"	60	18.97	1138	.051	3.06		"	34	"	
	FIELD ERECT - SHOP FABRICATED PIPING											
1	3" S.40 Shop Fab Spool 10' long	Pcs.	20	76.0	1520	3.9	78.00		"	867	"	
2	4" " " " " " "	"	35	108.0	3780	4.1	143.50		"	1594	"	
3	6" " " " " " "	"	6	190.0	1140	4.7	28.20		"	313	"	
4	6" S.80 " " " " "	"	10	286.0	2860	6.4	64.00		"	711	"	
5	8" S.40 " " " " "	"	18	286.0	5148	5.7	102.60		"	1140	"	
6	3" Bolt-Ups 150#	Ea.	40	1.5	60	.8	32.00		"	356	"	
7	4" " " "	"	70	4.0	280	1.2	84.00		"	933	"	
8	6" " " " 300#	"	32	11.5	368	1.7	54.40		"	604	"	
9	8" " " "	"	36	18.0	648	2.4	86.40		"	960	"	
		TOTAL FITTING WT.			2914		TOTAL THIS SHEET			10642.00		
		" PIPE "			20953							

JOB ESTIMATING FORM

COMPANY: AMERICAN CHEMICAL COMPANY

COMPOSITE CREW RATE: 11.11

SHEET NO 3 OF 7

ESTIMATE NO: 203

PROJECT: PROCESS PIPING

LOCATION: ANYWHERE, USA

DESCRIPTION OF WORK: FIELD FABRICATE AND ERECT--SCREWED - Owner Furnished Materials

ESTIMATOR: Page

CHECKED BY: Nation

DATE IN: 7-3-75

DATE DUE: 7-5-75

No.	Description	Unit	Quant.	Weight Unit	Weight Total	Unit Man Hours	Total Man Hours	Unit Labor Cost	Unit Material Cost	Total Cost Labor	Total Cost Material	Total Cost Total
1	1/2" 90° Ell Serd. 150# M.I.	Pcs.	15	.25	4	.2	3.0		Owner	33	Owner	
2	1" " " " " "	"	10	.60	6	.4	4.0		Furn.	44	Furn.	
3	2" " " " 2000# f.s.	"	5	4.00	20	.6	3.0		"	33	"	
4	1/2" 45° Ell Serd. 150# M.I.	"	4	.23	1	.2	.80		"	9	"	
5	1" " " " " "	"	2	.52	1	.4	.80		"	9	"	
6	2" " " " 2000# f.s.	"	1	3.00	3	.6	.6		"	7	"	
7	1" Tee Serd. 150 # M.I.	"	2	.86	2	.6	1.2		"	13	"	
8	2" " Serd. 2000# f.s.	"	1	5.00	5	.9	.9		"	10	"	
9	1" Cross Serd. 150# M.I.	"	1	.97	1	.8	.8		"	9	"	
10	2" " " 2000# f.s.	"	1	5.00	5	1.2	1.2		"	13	"	
11	1" x 1/2" Swgs.S.40 T.B.E.	"	2	1.00	2	.3	.6		"	7	"	
12	2" x 1" Swgs. S. 80 T.B.E.	"	1	2.00	2	.5	.5		"	6	"	
13	2" Coup. 2000# f.s.	"	2	1.05	2	.6	1.2		"	13	"	
14	1/2" Union 150# M.I.	"	10	.38	4	.2	2.0		"	22	"	
15	1" " " "	"	5	.90	5	.4	2.0		"	22	"	
16	2" " 2000# f.s.	"	3	5.00	15	.6	1.8		"	20	"	
17	2" - 150# Serd. Flgs.	"	2	5.00	10	1.2	2.4		"	27	"	
18	1" x 1/2" Serd. Red. 150# M.I.	"	2	.44	1	.3	.6		"	7	"	
19	2" x 1" " " 2000# f.s.	"	1	3.00	3	.5	.5		"	6	"	
20	1/2" x 6" Nipple Sch. 40	"	5	.38	2	.2	1.0		"	11	"	
21	1" x 6" " " 80	"	2	.99	2	.4	.8		"	9	"	
22	1/2" Sch. 40 Buttweld T&C pipe	LF	100	.85	85	.16	16.0		"	178	"	
23	1" " " " " "	"	75	1.68	126	.17	12.75		"	142	"	
24	2" " 80 " " "	"	50	5.02	251	.24	12.0		"	133	"	
25	2" - 150# Bolts & Gaskets	Sets	2	1.50	3	.7	1.4		"	16	"	
26	1/2" Make-Ons	Ea.	5	—	—	.1	.5		"	6	"	
27	1" " "	"	4	—	—	.2	.8		"	9	"	
28	2" " "	"	3	—	—	.3	.9		"	10	"	
	TOTAL FITTING WEIGHT				99		TOTAL THIS SHEET			824.00		
	TOTAL PIPE WEIGHT				462							

JOB ESTIMATING FORM

SHEET NO 4 OF 7

COMPANY: AMERICAN CHEMICAL COMPANY

COMPOSITE CREW RATE: 11.11

ESTIMATE NO: 203

PROJECT: PROCESS PIPING

LOCATION: ANYWHERE, USA

DESCRIPTION OF WORK: FIELD FABRICATE AND ERECT - WELDED - Owner Furnished Materials

ESTIMATION: Page

CHECKED BY: Nation

DATE IN 7-3-75

DATE DUE 7-5-75

No	Description	Unit	Quantity	Weight Unit	Weight Total	Unit Man-Hours	Total Man-Hours	Unit Labor Cost	Unit Material Cost	Total Cost Labor	Total Cost Material	Total Cost Tax
1	3" Sch. 40 90° Wld. Ell.	Pcs.	8	4.6	37	Hdlg.	Hdlg.		Owner		Owner	
2	4" " " " " "	"	15	8.7	131	Incl.	Incl.		Furn.		Furn.	
3	6" " 80 " " "	"	5	34.0	170	w/pipe	w/pipe		"		"	
4	4" Sch. 40 45° Wld. Ell.	"	4	4.3	17	"	"		"		"	
5	6" Sch. 80 Wld. Tee	"	2	42.0	84	"	"		"		"	
6	4" x 3" Sch. 40 Wld. Red	"	1	3.6	4	"	"		"		"	
7	6" Sch. 80 Wld. Cap	"	1	9.2	9	"	"		"		"	
8	3" - 150# Bolts & Gaskets	Sets	7	1.5	11	.8	5.6		"	62	"	
9	4" - 300# " " "	"	10	7.5	75	1.4	14.0		"	156	"	
10	6" - 600# " " "	"	2	30.0	60	1.8	3.6		"	40	"	
11	3" - Sch. 40 Butt-Welds	Ea.	22	--	--	1.3	28.60		"	318	"	
12	4" - " " " "	"	50	--	--	1.5	75.00		"	833	"	
13	6" - " 80 " "	"	20	--	--	2.5	50.00		"	556	"	
14	4" Sch. 40 90° Nozzle Weld	"	2	--	--	4.0	8.00		"	89	"	
15	3" Sch. 40 Mitre Weld	"	1	--	--	1.95	1.95		"	22	"	
16	3" - 150# Flg. S.O.	Pcs.	2	10.0	20	1.8	3.60		"	40	"	
17	6" - 600# " "	"	1	95.0	95	5.9	5.9		"	66	"	
18	3" - 150# Flg. W.N.	"	3	10.0	30	1.3	3.9		"	43	"	
19	4" - 300# " "	"	10	25.0	250	1.5	15.0		"	167	"	
20	6" - 600# " "	"	1	85.0	85	2.0	2.0		"	22	"	
21	3" - 150# Flg. Bld.	"	2	11.0	22	.8	1.6		"	18	"	
22	3" Sch. 40 Smls. A-53 Pipe	LF	100	7.57	757	.23	23.0		"	256	"	
23	4" " " " A-106 Pipe	"	230	10.79	2482	.25	57.50		"	639	"	
24	6" Sch. 80 " " "	"	50	28.57	1429	.38	19.00		"	211	"	
	TOTAL FITTING WEIGHT				1100		TOTAL THIS SHEET			3538.00		
	TOTAL PIPE WT.				4670							

JOB ESTIMATING FORM

SHEET NO. 5 OF 7

COMPANY: AMERICAN CHEMICAL COMPANY

COMPOSITE CREW RATE: 11.11

ESTIMATE NO: 203

PROJECT: PROCESS PIPING

LOCATION: ANYWHERE, USA

DESCRIPTION OF WORK: ERECT VALVES - SCREWED AND FLANGED - Owner Furnished Materials

ESTIMATOR: Page

CHECKED BY: Nation

DATE 7-3-75

DATE DUE 7-5-75

No.	Description	Unit	Quantity	Weight Unit	Weight Total	Unit Man Hours	Total Man Hours	Unit Labor Cost	Unit Material Cost	Total Cost Labor	Total Cost Material	Total Cost Total
1	1/2" Gate Va. Scrd.	Prs.	20	2	40	.2	4.0		Owner	44	Owner	
2	1" " " "	"	15	4	60	.4	6.0		Furn.	67	Furn.	
3	2" " " "	"	10	12	120	.6	6.0		"	67	"	
4	1/2" Globe Va. Screwed	"	5	2	10	.2	1.0		"	11	"	
5	1" " " "	"	3	4	12	.4	1.2		"	13	"	
6	1" Check Valve Screwed	"	2	4	8	.4	.8		"	9	"	
7	2" " " "	"	1	12	12	.6	.6		"	7	"	
8	3" Gate Va. 150# Fldg.	"	10	97	970	2.8	28.0		"	311	"	
9	4" " " 300# "	"	6	225	1350	4.8	28.8		"	320	"	
10	6" " " " "	"	2	457	914	6.1	12.2		"	136	"	
11	6" " " 600# "	"	1	743	743	6.9	6.9		"	77	"	
12	8" " " 300# "	"	2	683	1366	8.2	16.4		"	182	"	
13	3" Globe Valve 150# Fldg.	"	1	100	100	2.8	2.8		"	31	"	
14	4" " " 300# Fldg.	"	1	220	220	4.8	4.8		"	53	"	
15	3" Check Valve 150# "	"	1	71	71	2.8	2.8		"	31	"	
16	3" Plug Va. 150# Flgd.	"	1	42	42	2.8	2.8		"	31	"	
		TOTAL VALVE WT.			5295		TOTAL THIS SHEET			1390.00		

JOB ESTIMATING FORM

SHEET NO. 6 OF 7

COMPANY: AMERICAN CHEMICAL COMPANY

COMPOSITE CREW RATE: Labor fitter 11.11

ESTIMATE NO: 203

PROJECT: PROCESS PIPING

LOCATION: ANYWHERE, USA

DESCRIPTION OF WORK: HANGERS AND SUPPORTS - Owner Furnished Materials

ESTIMATOR: Page

CHECKED BY: Nation

DATE IN: 7-3-75

DATE DUE: 7-5-75

No	Description	Unit	Quantity	Weight Unit	Weight Total	Unit Man-Hours	Total Man-Hours	Unit Labor Cost	Unit Material Cost	Total Cost Labor	Total Cost Material	Total Cost Total
1	Ring Hanger - WH Clip Angle & Steel	Ea.	25	--	--	1.50	37.50		Owner Furn.	417	Owner Furn.	
2	Trapese Hanger - Wld. Clip Angle Steel	"	15	--	--	2.00	30.00		"	333	"	
3	Fabricated Hangers	Lbs.	65	--	650	.08	52.00		"	578	"	
	SAND-BLAST & PAINT PIPE											
1	3" Pipe - 4 coats Conv. Paint	LF	300	--	--	.06	18.0		"	200	"	
2	4" " " " " "	"	580	--	--	.08	46.40		"	516	"	
3	6" " 4 coats Vinyl Paint	"	150	--	--	.15	22.50		"	250	"	
	INSULATION											
1	8" Pipe - 1-1/2" Thk. Calsite	LF	180	--	--	.36	64.80		"	720	"	
	HAND EXCAVATE											
1	Medium - Gen Dry - First Lift	CY	20	--	--	1.60	32.00		"	160	"	
1	Back Filling & Tamping Medium Soil	"	15	--	--	.80	12.0		"	60	"	
	Underground Piping											
1	6" - 150# B & S C.I. Pipe	LF	200	--	--	.11	22.0		"	244	"	
2	6" - 1/4 Bends (Lead Joint)	Ea.	10	--	--	.57	5.7		"	63	"	
3	6" - 1/8 Bends (Lead Joint)	"	5	--	--	.57	2.85		"	32	"	
4	6" Make-Ons (Lead Joint)	"	40	--	--	.57	22.80		"	253	"	
	TOTAL HANGER WT.		650				TOTAL THIS SHEET			3826.00		

JOB ESTIMATING FORM

SHEET NO 7 OF 7

COMPANY: AMERICAN CHEMICA L COMPANY

COMPOSITE CREW RATE:

ESTIMATE NO 203

PROJECT: PROCESS PIPING

LOCATION: ANYWHERE, USA

DESCRIPTION OF WORK: SUMMARY

ESTIMATOR: Page

CHECKED BY: Nation

DATE IN 7-3-75

DATE DUE 7-5-75

No	Description	Unit	Quantity	Weight Unit	Weight Total	Unit Man-Hours	Total Man Hours	Unit Labor Cost	Unit Material Cost	Total Cost Labor	Total Cost Material	Total Cost Total
1	Shop fabrication - Carbon Steel								2179.00			
2	Shop Fabrication - Alloy and Field Erect - Shop Fabricated Piping								10642.00			
3	Field Fabricate and Erect - Screwed								824.00			
4	Field Fabricate and Erect - Welded								3538.00			
5	Erect Valves - Screwed and Flanged								1390.00			
6	Hangers and Supports, Sandblast and Paint Pipe Insulation, Hand Exca vate, and Underground Piping								3826.00			
	TOTAL DIRECT LABOR								22399.00			

Section Ten

TECHNICAL INFORMATION

As we stated in the Preface of this book, its intention is solely for the estimation of labor and is not intended for the design of piping. Therefore, this section has been held to a minimum and includes only information that we feel will benefit the estimator in the preparation of his estimate.

Included in this section are tables showing the circumferences of pipes for welding purposes. the amount of materials needed for insulation. the weights of pipe. fittings and valves and methods of hanging and supporting pipe and fittings.

We wish to acknowledge and to express our appreciation to the Grinnell Company, Inc., of Providence, Rhode Island, who has so graciously allowed us to reproduce the following tables.

CIRCUMFERENCES OF PIPE FOR COMPUTING WELDING MATERIAL

CIRCUMFERENCE OF PIPE IN INCHES

Nominal Pipe Size	Schedule Numbers									
	10	20	30	40	60	80	100	120	140	160
1	--	--	--	3.98	--	4.27	--	--	--	4.71
1-1/4	--	--	--	4.81	--	5.13	--	--	--	5.50
1-1/2	--	--	--	5.62	--	5.97	--	--	--	6.47
2	--	--	--	7.25	--	7.65	--	--	--	8.44
3	--	--	--	10.78	--	11.31	--	--	--	12.17
4	--	--	--	14.06	--	14.68	--	15.31	--	15.90
5	--	--	--	17.33	--	18.06	--	18.85	--	19.64
6	--	--	--	20.61	--	21.56	--	22.38	--	22.44
8	--	26.70	26.87	27.16	27.68	28.27	28.86	29.64	30.23	30.83
10	--	32.99	33.34	33.71	34.56	35.14	35.93	36.71	37.70	38.48
12	--	39.27	39.77	40.25	41.23	42.02	43.00	43.98	44.77	45.94
14	45.55	45.94	46.34	46.73	47.71	48.69	49.87	50.85	51.84	52.82
16	51.84	52.23	52.62	53.41	53.82	55.56	56.74	57.92	59.29	60.27
18	58.12	58.51	59.29	60.09	61.26	62.44	63.81	65.19	66.36	67.74
20	64.40	65.19	65.97	66.56	67.93	69.31	70.88	72.26	73.83	75.20
24	76.97	77.75	78.54	79.71	81.48	83.05	85.02	86.78	88.35	90.12

CIRCUMFERENCES OF HEAVY WALL PIPE FOR COMPUTING WELDING MATERIAL

CIRCUMFERENCE OF PIPE IN INCHES

Nominal Pipe Size	Wall Thickness in Inches							
	.500	.750	1.00	1.25	1.50	1.75	2.00	2.25
3	12.57	14.14	15.71	17.28	18.85	20.42	21.99	23.56
4	15.71	17.28	18.85	20.42	21.99	23.56	25.13	26.70
5	18.85	20.42	21.99	23.56	25.13	26.70	28.27	29.85
6	21.99	23.56	25.13	26.70	28.27	29.85	31.42	32.99
8	28.27	29.85	31.42	32.99	34.56	36.13	37.70	39.27
10	34.56	36.13	37.70	39.27	40.84	42.41	43.98	45.55
12	40.84	42.41	43.98	45.55	47.12	48.69	50.27	51.84
14	47.12	48.69	50.27	51.84	53.41	54.98	56.55	58.12
16	53.41	54.98	56.55	58.12	59.69	61.26	62.83	64.40
18	59.69	61.26	62.83	64.40	65.97	67.54	69.12	70.69
20	65.97	67.54	69.12	70.69	72.26	73.83	75.40	76.37
22	72.26	73.83	75.40	76.97	78.54	80.11	81.68	83.25
24	78.54	80.11	81.68	83.25	84.82	86.39	87.96	89.54
	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25
10	47.12	48.69	50.27	51.84	53.41	54.98	56.55	58.12
12	53.41	54.98	56.55	58.12	59.69	61.26	62.83	64.40
14	59.69	61.26	62.83	64.40	65.97	67.54	69.12	70.69
16	65.97	67.54	69.12	70.69	72.26	73.83	75.40	76.97
18	72.26	73.83	75.40	76.97	78.54	80.11	81.68	83.25
20	78.54	80.11	81.68	83.25	84.82	86.39	87.96	89.54
22	84.82	86.39	87.96	89.54	91.11	92.68	94.25	95.82
24	91.11	92.68	94.25	95.82	97.39	98.96	100.53	102.10
	4.50	4.75	5.00	5.25	5.50	5.75	6.00	
20	91.11	92.68	94.25	95.82	97.39	98.96	100.53	
22	97.39	98.96	100.53	102.10	103.67	105.24	106.81	
24	103.67	105.24	106.81	108.39	109.96	111.53	113.10	

CIRCUMFERENCES OF LARGE O.D. PIPE FOR COMPUTING WELDING MATERIAL

CIRCUMFERENCE OF PIPE IN INCHES

Nominal Pipe Size	WALL THICKNESS IN INCHES							
	.375	.500	.750	1.00	1.25	1.50	1.75	2.00
26	84.04	84.82	86.39	87.96	89.54	91.11	92.68	94.25
28	90.32	91.11	92.68	94.25	95.82	97.39	98.96	100.53
30	96.60	97.39	98.96	100.53	102.10	103.67	105.24	106.81
32	102.89	103.67	105.24	106.81	108.39	109.96	111.53	113.10
34	109.17	109.96	111.53	113.10	114.67	116.24	117.81	119.38
36	115.45	116.24	117.81	119.38	120.95	122.52	124.09	125.66
38	121.74	122.52	124.09	125.66	127.23	128.81	130.38	131.95
40	128.02	128.81	130.38	131.94	133.52	135.09	136.66	138.23
42	134.30	135.09	136.66	138.23	139.80	141.37	142.94	144.51
44	140.59	141.37	142.94	144.51	146.08	147.66	149.23	150.80
46	146.87	147.66	149.23	150.80	152.36	153.94	155.51	157.08
48	153.15	153.94	155.51	157.08	158.65	160.22	161.79	163.36
54	172.00	172.79	174.36	175.93	177.50	179.07	180.64	182.21
60	190.82	191.64	193.21	194.78	196.35	197.92	199.49	201.06
	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
26	95.82	97.39	98.96	100.53	102.10	103.67	105.24	106.81
28	102.10	103.67	105.24	106.81	108.39	109.96	111.53	113.10
30	108.39	109.96	111.53	113.10	114.67	116.24	117.81	119.38
32	114.67	116.24	117.81	119.38	120.95	122.52	124.09	125.66
34	120.95	122.52	124.09	125.66	127.23	128.81	130.38	131.95
36	127.23	128.81	130.38	131.95	133.52	135.09	136.66	138.23
	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
26	108.39	109.96	111.53	113.10	114.67	116.24	117.81	119.38
28	114.67	116.24	117.81	119.38	120.95	122.52	124.09	125.66
30	120.95	122.52	124.09	125.64	127.23	128.81	130.38	131.95
32	127.23	128.81	130.38	131.95	133.52	135.09	136.66	138.23
34	133.52	135.09	136.66	138.23	139.80	141.37	142.94	144.51
36	139.80	141.37	142.94	144.51	146.08	147.66	149.23	150.80

WEIGHTS OF PIPING MATERIALS

The weight per foot of steel pipe is subject to the following tolerances:

SPECIFICATION	TOLERANCE
A.S.T.M. A-53 A.S.T.M. A-120	STD WT + 5%, − 5% XS WT + 5%, − 5% XXS WT +10%, −10%
A.S.T.M. A-106	SCH 10–120 +6.5%, −3.5% SCH 140–160 +10%, −3.5%
A.S.T.M. A-158 A.S.T.M. A-206 A.S.T.M. A-280	12" and under +6.5%, −3.5% over 12" +10%, −5%
API 5L	All sizes +6.5%, −3.5%

Weight of Tube = $F \times 10.6802 \times T \times (D - T)$ pounds foot

T = wall thickness in inches

D = outside diameter in inches

F = relative weight factor

The weight of tube furnished in this piping data is based on low carbon steel weighing 0.2833 pounds per cubic inch.

Relative Weight Factor F of various metals

Aluminum	= 0.35
Brass	= 1.12
Cast Iron	= 0.91
Copper	= 1.14
Lead	= 1.44
Ferritic Stainless Steel	= 0.95
Austenitic Stainless Steel	= 1.02
Steel	= 1.00
Tin	= 0.93
Wrought Iron	= 0.98

(Weight of Contents of a Tube = $G \times 0.3405 \times (D - 2T)^2$ pounds per foot)

G = Specific Gravity of Contents

T = Tube Wall Thickness, inches

D = Tube Outside Diameter, inches

The weight of Welding Tees and Laterals is for full size fittings. The weight of reducing fittings is approximately the same as for full size fittings.

The weight of Welding Reducers is for one size reduction, and is approximately correct for other reductions.

Pipe Covering temperature ranges are intended as a guide only and do not constitute a recommendation for specific thickness of material.

Pipe Covering thicknesses and weights indicate average conditions and include all allowance for wire, cement, canvas, bands, and paint. The listed thicknesses of combination covering is the sum of the inner and the outer layer thickness. When specific inner and outer layer thicknesses are known, add them, and use the weight for the nearest tabulated thickness.

To find the weight of covering on Fittings, Valves, or Flanges, multiply the weight factor (light faced subscript) by the weight per foot of covering used on straight pipe. All Flange weights include the proportional weight of bolts or studs required to make up all joints.

Lap Joint Flange weights include the weight of the lap.

Welding Neck Flange weights are compensated to allow for the weight of pipe displaced by the flange. Pipe should be measured from the face of the flange.

All Flanged Fitting weights include the proportional weight of bolts or studs required to make up all joints.

To find the approximate weight of Reducing Flanged Fittings, subtract the weight of a full size Slip-On Flange and add the weight of reduced size Slip-On Flange.

Weights of valves of the same type may vary because of individual Manufacturer's design. Listed valve weights are approximate only. When it is possible to obtain specific weights from the Manufacturer, such weights should be used.

To obtain the approximate weight of Flanged End Steel Valves, add the weight of two Slip-On Flanges of the same size and series to the weight of the corresponding Welding End Valves.

WEIGHTS OF PIPING MATERIALS—1" PIPE SIZE

PIPE	Schedule No.	40	80	160								
	Wall Designation	Std.	XS		XXS							
	Thickness—In.	.133	.179	.250	.358							
	Pipe—Lbs Ft	1.68	2.17	2.84	3.66							
	Water—Lbs Ft	.37	.31	.23	.12							
WELDING FITTINGS	L.R. 90° Elbow	.3 .3	.4 .3	.6 .3	.7 .3							
	S.R. 90° Elbow	.2 .2										
	L.R. 45° Elbow	.2 .2	.3 .2	.4 .2	.4 .2							
	Tee	.8 .4	.9 .4	1.1 .4	1.3 .4							
	Lateral											
	Reducer	.3 .2	.4 .2	.4 .2	.5 .2							
	Cap	.2 .3	.3 .3	.4 .3	.4 .3							

	Temperature Range °F	to 250°	250-360	360-440	440-525	525-600°	600-700	700-800	800-900	900-1000		
COVERING	85% Magnesia	Thickness—in.	½	⅝	1½	2	$1^{13}/_{16}$					
		Lbs Ft	.65	.65	1.45	2.25	2.20					
	Combination	Thickness—In.						2	2	2	2	
		Lbs Ft						3.7	3.7	3.7	3.7	
	Calcium Silicate	Thickness—in.	1	1	1	1	1½	1½	1½	2	2	
		Lbs Ft	.75	.75	.75	.75	1.27	1.27	1.27	1.94	1.94	

FLANGES	Pressure Rating psi	Cast Iron		Steel							
		125	250	150	300	400	600	900	1500	2500	
	Screwed or Slip-On	2.5 1.5	4 1.5	2.5 1.5	4 1.5		5 1.5		12 1.5	15 1.5	
	Welding Neck			2.3 1.5	4.8 1.5		7 1.5		11 1.5	15 1.5	
	Lap Joint			2.5 1.5	4 1.5		5 1.5		12 1.5	15 1.5	
	Blind	2.5 1.5	4 1.5	2.5 1.5	5 1.5		5 1.5		12 1.5	15 1.5	
FLANGED FITTINGS	S.R. 90° Elbow	6 3.6					15 3.7		28 3.8		
	L.R. 90° Elbow	6 3.6									
	45° Elbow	5 3.2					14 3.4		26 3.6		
	Tee	11 5.4					20 5.6		39 5.7		
**VALVES	Flanged Bonnet Gate								67 4.3		
	Flanged Bonnet Globe or Angle										
	Flanged Bonnet Check										
	Pressure Seal Bonnet—Gate							31 1.7	31 0.9		
	Pressure Seal Bonnet—Globe										
Bolts	*One Complete Flanged Joint	1	2	1	2		2		6	6	

SEE GENERAL NOTES FOR MATERIALS NOT SHOWN

All weights are shown in bold type.

The weight of steel pipe is per linear foot.

For Boiler Feed Piping, add the weight of water to the weight of steel pipe.

The pipe covering thicknesses and weights indicate the average conditions per linear foot and include all allowances for wire, cement, canvas, bands and paint. The listed thickness of combination covering is the sum of the inner and the outer layer thickness.

Pipe covering temperature ranges are intended as a guide only and do not constitute a recommendation for specific thickness of materials.

To find the weight of covering on Flanged Fittings, Valves, or Flanges, multiply the weight factor (lightface subscript) by the weight per foot of covering used on straight pipe.

*All Flanged Fitting, Flanged Valve and Flange weights include the proportional weight of bolts or studs required to make up all joints.

**Cast Iron Valve weights are for flanged valves. Steel Valve weights are for welding end valves.

WEIGHTS OF PIPING MATERIALS—1¼" PIPE SIZE

PIPE	Schedule No.	40	80	160								
	Wall Designation	Std.	XS		XXS							
	Thickness—In.	.140	.191	.250	.382							
	Pipe—Lbs/Ft	2.27	3.00	3.77	5.21							
	Water—Lbs/Ft	.65	.56	.46	.27							
WELDING FITTINGS	L.R. 90° Elbow	.6 .3	.8 .3	.9 .3	1.2 .3							
	S.R. 90° Elbow	.4 .2										
	L.R. 45° Elbow	.4 .2	.5 .2	.6 .2	.8 .2							
	Tee	1.3 .5	1.6 .5	1.9 .5	2.4 .5							
	Lateral	3.4 1.2	4.2 1.2									
	Reducer	.5 .2	.5 .2	.6 .2	.8 .2							
	Cap	.3 .3	.4 .3	.5 .3	.6 .3							

COVERING	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000		
	85% Magnesia—Thickness—In.	½	½	1½	2	1 15/16						
	85% Magnesia—Lbs/Ft	.80	.80	1.60	2.45	2.25						
	Combination—Thickness—In.						2	2	2	2		
	Combination—Lbs/Ft						4.1	4.1	4.1	4.1		
	Calcium Silicate—Thickness—In.	1	1	1	1	1½	1½	2	2	2½		
	Calcium Silicate—Lbs/Ft	.68	.68	.68	.68	1.19	1.19	1.87	1.87	2.68		

	Pressure Rating	Cast Iron		Steel								
	psi	125	250	150	300	400	600	900	1500	2500		
FLANGES	Screwed or Slip-On	2.5 1.5	5 1.5	3.5 1.5	5 1.5		7 1.5		13 1.5	23 1.5		
	Welding Neck			3.3 1.5	6.5 1.5		7 1.5		12 1.5	23 1.5		
	Lap Joint			3.5 1.5	5 1.5		7 1.5		13 1.5	22 1.5		
	Blind	3.5 1.5	5 1.5	3.5 1.5	7 1.5		7 1.5		13 1.5	23 1.5		
FLANGED FITTINGS	S.R. 90° Elbow	8 3.6			17 3.7		18 3.8		33 3.9			
	L.R. 90° Elbow	10 3.9			13 3.9							
	45° Elbow	7 3.3			15 3.4		16 3.5		31 3.7			
	Tee	13 5.4			23 5.6		28 5.7		49 5.9			
**VALVES	Flanged Bonnet Gate				34 3.8				95 4.4			
	Flanged Bonnet Globe or Angle											
	Flanged Bonnet Check				21 4							
	Pressure Seal Bonnet—Gate							38 1.8	38 1.1			
	Pressure Seal Bonnet—Globe											
Bolts	*One Complete Flanged Joint	1	2	1	2		2		6	9		

SEE GENERAL NOTES FOR MATERIALS NOT SHOWN

All weights are shown in bold type.

The weight of steel pipe is per linear foot.

For Boiler Feed Piping, add the weight of water to the weight of steel pipe.

The pipe covering thicknesses and weights indicate the average conditions per linear foot and include all allowances for wire, cement, canvas, bands and paint. The listed thickness of combination covering is the sum of the inner and the outer layer thickness.

Pipe covering temperature ranges are intended as a guide only and do not constitute a recommendation for specific thickness of materials.

To find the weight of covering on Flanged Fittings, Valves, or Flanges, multiply the weight factor (lightface subscript) by the weight per foot of covering used on straight pipe.

*All Flanged Fitting, Flanged Valve and Flange weights include the proportional weight of bolts or studs required to make up all joints.

**Cast Iron Valve weights are for flanged valves. Steel Valve weights are for welding end valves.

WEIGHTS OF PIPING MATERIALS—1½" PIPE SIZE

PIPE	Schedule No.	40	80	160									
	Wall Designation	Std.	XS		XXS								
	Thickness—In.	.145	.200	.281	.400								
	Pipe—Lbs/Ft	2.72	3.63	4.86	6.41								
	Water—Lbs/Ft	.88	.77	.61	.41								
WELDING FITTINGS	L.R. 90° Elbow	.8 .4	1.1 .4	1.4 .4	1.8 .4								
	S.R. 90° Elbow	.6 .3	.7 .3										
	L.R. 45° Elbow	.5 .2	.7 .2	.8 .2	1 .2								
	Tee	2 .6	2.5 .6	3.1 .6	3.7 .6								
	Lateral	4.3 1.3	5.8 1.3										
	Reducer	.6 .2	.7 .2	.9 .2	1.2 .2								
	Cap	.4 .3	.5 .3	.7 .3	.7 .3								

COVERING	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000			
	85% Magnesia	Thickness—In.	½	¾	1½	2	1¹⁵⁄₁₆						
		Lbs Ft	.85	.85	1.75	2.65	2.45						
	Combination	Thickness—In.						2	2	2	2		
		Lbs/Ft						4.2	4.2	4.2	4.2		
	Calcium Silicate	Thickness—In.	1	1	1	1	1½	1½	2	2½	2½		
		Lbs/Ft	.88	.88	.88	.88	1.45	1.45	1.82	2.63	2.63		

		Cast Iron		Steel						
FLANGES	Pressure Rating psi	125	250	150	300	400	600	900	1500	2500
	Screwed or Slip-On	3.5 1.5	7 1.5	3.5 1.5	8 1.5		9 1.5		19 1.5	31 1.5
	Welding Neck			4 1.5	9 1.5		11 1.5		17 1.5	32 1.5
	Lap Joint			3.5 1.5	8 1.5		9 1.5		19 1.5	31 1.5
	Blind	3.5 1.5	7 1.5	3.5 1.5	9 1.5		10 1.5		19 1.5	31 1.5
FLANGED FITTINGS	S.R. 90° Elbow	10 3.7		12 3.7	23 3.8		26 3.9		46 4	
	L.R. 90° Elbow	12 4		13 4	24 4					
	45° Elbow	9 3.4		11 3.4	21 3.5		23 3.5		39 3.7	
	Tee	17 5.6		20 5.6	30 5.7		37 5.8		70 6	
**VALVES	Flanged Bonnet Gate	27 6.8			51 4		71 4.2		114 4.5	
	Flanged Bonnet Globe or Angle				40 4.1		46 4.2		111 4.5	
	Flanged Bonnet Check				32 4.1		33 4.2		81 4.5	
	Pressure Seal Bonnet—Gate							42 1.9	42 1.2	
	Pressure Seal Bonnet—Globe									
Bolts	*One Complete Flanged Joint	1	2.5	1	3.5		3.5		9	12

SEE GENERAL NOTES FOR MATERIALS NOT SHOWN

All weights are shown in bold type.

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For Boiler Feed Piping, add the weight of water to the weight of steel pipe.

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To find the weight of covering on Flanged Fittings, Valves, or Flanges, multiply the weight factor (lightface subscript) by the weight per foot of covering used on straight pipe.

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WEIGHTS OF PIPING MATERIALS—2" PIPE SIZE

PIPE	Schedule No.	40	80	160							
	Wall Designation	Std.	XS		XXS						
	Thickness—In.	.154	.218	.343	.436						
	Pipe—Lbs Ft	3.65	5.02	7.44	9.03						
	Water—Lbs Ft	1.46	1.28	.97	.77						
WELDING FITTINGS	L.R. 90° Elbow	1.5 .5	2 .5	2.9 .5	3.5 .5						
	S.R. 90° Elbow	1 .3	1.3 .3								
	L.R. 45° Elbow	.8 .2	1.1 .2	1.6 .2	1.8 .2						
	Tee	3 .6	3.7 .6	5 .6	5.7 .6						
	Lateral	6.6 1.4	9.8 1.4								
	Reducer	.9 .3	1.2 .3	1.6 .3	1.9 .3						
	Cap	.5 .4	.7 .4	1.2 .4	1.2 .4						
COVERING	Temperature Range °F	to 200°	200-300	300-400	400-525	525-600	600-700	700-800	800-900	900-1000	
	85% Magnesia Thickness—In.	1	1	1½	2	2½					
	85% Magnesia Lbs Ft	1.25	1.25	2.05	3.15	3.40					
	Combination Thickness—In.						2¼	2½	3¼	3½	
	Combination Lbs Ft						5.8	5.8	7.4	9.2	
	Calcium Silicate Thickness—In.	1	1	1	1½	1½	2	2	2½	2½	
	Calcium Silicate Lbs Ft	1.01	1.01	1.01	1.69	1.69	2.50	2.50	3.38	3.38	

		Cast Iron			Steel					
	Pressure Rating psi	125	250	150	300	400	600	900	1500	2500
FLANGES	Screwed or Slip-On	6 1.5	9 1.5	6 1.5	9 1.5		11 1.5		32 1.5	48 1.5
	Welding Neck			6 1.5	10 1.5		13 1.5		29 1.5	48 1.5
	Lap Joint			6 1.5	9 1.5		12 1.5		32 1.5	48 1.5
	Blind	6 1.5	10 1.5	4.8 1.5	10 1.5		12 1.5		31 1.5	49 1.5
FLANGED FITTINGS	S.R. 90° Elbow	16 3.8	24 3.8	19 3.8	29 3.8		35 4		83 4.2	
	L.R. 90° Elbow	18 4.1	27 4.1	22 4.1	31 4.1					
	45° Elbow	14 3.4	22 3.5	16 3.4	24 3.5		33 3.7		73 3.9	
	Tee	23 5.7	37 5.7	27 5.7	41 5.7		52 6		129 6.3	
**VALVES	Flanged Bonnet Gate	37 6.9	52 7.1	43 3.9	65 4.1		83 4.4		154 4.8	
	Flanged Bonnet Globe or Angle	30 7	64 7.3	42 4	58 4.3		78 4.4		157 4.8	
	Flanged Bonnet Check	26 7	51 7.3	27 4	55 4.3		47 4.4		106 4.8	
	Pressure Seal Bonnet—Gate							75 2.1	75 1.4	
	Pressure Seal Bonnet—Globe								135 2.1	
Bolts	*One Complete Flanged Joint	1.5	3.5	1.5	4		4.5		12.5	21

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WEIGHTS OF PIPING MATERIALS—2½" PIPE SIZE

PIPE	Schedule No.	40	80	160								
	Wall Designation	Std.	XS		XXS							
	Thickness—In.	.203	.276	.375	.552							
	Pipe—Lbs Ft	5.79	7.66	10.01	13.70							
	Water—Lbs Ft	2.08	1.84	1.54	1.07							
WELDING FITTINGS	L.R. 90° Elbow	2.9 .6	3.8 .6	4.9 .6	6.5 .6							
	S.R. 90° Elbow	1.9 .4	2.5 .4									
	L.R. 45° Elbow	1.6 .3	2.1 .3	2.7 .3	3.5 .3							
	Tee	5.2 .8	6.4 .8	7.9 .8	9.9 .8							
	Lateral	11 1.5	14.4 1.5									
	Reducer	1.6 .3	2.1 .3	2.7 .3	3.4 .3							
	Cap	.8 .4	1 .4	2 .4	2.1 .4							
COVERING	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000		
	85% Magnesia	Thickness—In.	1	1	1½	2	2½					
		Lbs Ft	1.35	1.35	2.30	3.40	3.75					
	Combination	Thickness—In.						2 15/16	2 15/16	3 5/16	3 5/16	
		Lbs/Ft						6.6	6.6	8.5	8.5	
	Calcium Silicate	Thickness—In.	1	1	1	1½	1½	2	2½	2½	3	
		Lbs/Ft	1.15	1.15	1.15	1.53	1.53	2.34	3.22	3.22	4.23	

		Cast Iron		Steel						
	Pressure Rating psi	125	250	150	300	400	600	900	1500	2500
FLANGES	Screwed or Slip-On	8 1.5	14 1.5	9 1.5	14 1.5		17 1.5		46 1.5	68 1.5
	Welding Neck			9 1.5	14 1.5		20 1.5		42 1.5	59 1.5
	Lap Joint			9 1.5	14 1.5		18 1.5		46 1.5	67 1.5
	Blind	8 1.5	15 1.5	9 1.5	16 1.5		19 1.5		45 1.5	69 1.5
FLANGED FITTINGS	S.R. 90° Elbow	21 3.8	36 3.9	27 3.8	42 3.9		50 4.1		114 4.4	
	L.R. 90° Elbow	25 4.2	40 4.2	30 4.2	47 4.2					
	45° Elbow	19 3.5	34 3.6	22 3.5	35 3.6		46 3.8		99 3.9	
	Tee	32 5.7	55 5.8	42 5.7	61 5.9		77 6.2		169 6.6	
**VALVES	Flanged Bonnet Gate	50 7	82 7.1	53 4	83 4.1		108 4.6		221 5.1	
	Flanged Bonnet Globe or Angle	43 7.1	87 7.4	50 4.1	84 4.4		98 4.6		242 5.1	
	Flanged Bonnet Check	36 7.1	71 7.4	32 4.1	68 4.4		68 4.6		175 5.1	
	Pressure Seal Bonnet—Gate							100 2.3	100 1.7	
	Pressure Seal Bonnet—Globe								180 2.3	
Bolts	*One Complete Flanged Joint	1.5	6	1.5	7		8		19	27

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WEIGHTS OF PIPING MATERIALS—3" PIPE SIZE

PIPE	Schedule No.	40	80	160								
	Wall Designation	Std.	XS		XXS							
	Thickness—In.	.216	.300	.437	.600							
	Pipe—Lbs/Ft	7.58	10.25	14.32	18.58							
	Water—Lbs/Ft	3.20	2.86	2.35	1.80							
WELDING FITTINGS	L.R. 90° Elbow	4.6 .8	6.1 .8	8.4 .8	10.7 .8							
	S.R. 90° Elbow	3 .5	4 .5									
	L.R. 45° Elbow	2.4 .3	3.2 .3	4.4 .3	5.4 .3							
	Tee	7.4 .8	9.5 .8	12.2 .8	14.8 .8							
	Lateral	17 1.8	24 1.8									
	Reducer	2.2 .3	2.9 .3	3.7 .3	4.7 .3							
	Cap	1.4 .5	1.8 .5	3.5 .5	3.7 .5							

COVERING	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000	
	85% Magnesia Thickness—In.	1½	1½	1½	2	2½					
	85% Magnesia Lbs/Ft	1.55	1.55	2.65	3.95	4.25					
	Combination Thickness—In.						3½	3½	3½	3½	
	Combination Lbs. Ft						8.3	8.3	10.7	10.7	
	Calcium Silicate Thickness—In.	1	1	1	1½	1½	2	2½	2½	3	
	Calcium Silicate Lbs/Ft	1.28	1.28	1.28	2.09	2.09	2.98	3.98	3.98	5.11	

FLANGES	Pressure Rating psi	Cast Iron 125	Cast Iron 250	Steel 150	Steel 300	Steel 400	Steel 600	Steel 900	Steel 1500	Steel 2500	
	Screwed or Slip-On	9 1.5	17 1.5	10 1.5	17 1.5		20 1.5	38 1.5	61 1.5	101 1.5	
	Welding Neck			10 1.5	17 1.5		24 1.5	35 1.5	54 1.5	101 1.5	
	Lap Joint			10 1.5	17 1.5		21 1.5	38 1.5	62 1.5	100 1.5	
	Blind	10 1.5	19 1.5	11 1.5	20 1.5		24 1.5	39 1.5	61 1.5	104 1.5	
FLANGED FITTINGS	S.R. 90° Elbow	26 3.9	46 4	32 3.9	53 4		67 4.1	98 4.3	150 4.6		
	L.R. 90° Elbow	30 4.3	50 4.3	40 4.3	63 4.3						
	45° Elbow	22 3.5	41 3.6	28 3.5	46 3.6		60 3.8	93 3.9	135 4		
	Tee	39 5.9	67 6	52 5.9	81 6		102 6.2	151 6.5	238 6.9		
**VALVES	Flanged Bonnet Gate	66 7	112 7.4	77 4	119 4.4		153 4.8	225 4.9	338 5.3		
	Flanged Bonnet Globe or Angle	56 7.2	121 7.6	80 4.2	102 4.6		132 4.8	242 4.9	341 5.3		
	Flanged Bonnet Check	46 7.2	100 7.6	51 4.2	101 4.6		91 4.8	146 4.9	233 5.3		
	Pressure Seal Bonnet—Gate							140 2.5	140 2.5		
	Pressure Seal Bonnet—Globe							160 2.5	260 2.5		
Bolts	*One Complete Flanged Joint	1.5	6	1.5	7.5		8	12.5	25	37	

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WEIGHTS OF PIPING MATERIALS—3½" PIPE SIZE

PIPE	Schedule No.	40	80									
	Wall Designation	Std.	XS	XXS								
	Thickness—In.	.226	.318	.636								
	Pipe—Lbs Ft	9.11	12.51	22.85								
	Water—Lbs Ft	4.28	3.85	2.53								
WELDING FITTINGS	L.R. 90° Elbow	6.4 .9	8.7 .9	15.4 .9								
	S.R. 90° Elbow	4.3 .6	5.8 .6									
	L.R. 45° Elbow	3.3 .4	4.4 .4	7.5 .4								
	Tee	9.9 .9	12.6 .9	20 .9								
	Lateral	22 1.8										
	Reducer	3.1 .3	4.1 .3	6.9 .3								
	Cap	2.1 .6	2.8 .6	5.5 .6								

COVERING	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000
85% Magnesia	Thickness—In.	1½	1½	1½	2	2½				
	Lbs. Ft	1.70	1.70	2.90	4.25	4.65				
Combination	Thickness—In.						2½	2½	3½	3½
	Lbs. Ft						7.8	7.8	10.2	10.2
Calcium Silicate	Thickness—In.	1	1	1½	1½	2	2	2½	3	3
	Lbs. Ft	1.06	1.06	1.86	1.86	2.75	2.75	3.75	4.88	4.88

	Pressure Rating	Cast Iron		Steel						
	psi	125	250	150	300	400	600	900	1500	2500
FLANGES	Screwed or Slip-On	13 1.5	21 1.5	13 1.5			27 1.5			
	Welding Neck			12 1.5			28 1.5			
	Lap Joint			14 1.5			28 1.5			
	Blind	14 1.5	23 1.5	15 1.5			35 1.5			
FLANGED FITTINGS	S.R. 90° Elbow	35 4	56 4.1	49 4			82 4.3			
	L.R. 90° Elbow	40 4.4	62 4.4	54 4.4						
	45° Elbow	31 3.6	51 3.7	39 3.6			75 3.9			
	Tee	54 6	86 6.2	70 6			133 6.4			
**VALVES	Flanged Bonnet Gate	82 7.1	143 7.5	88 4.1			201 4.9			
	Flanged Bonnet Globe or Angle	74 7.3	137 7.7	99 4.3			168 4.9			
	Flanged Bonnet Check	71 7.3	125 7.7	54 4.3			123 4.9			
	Pressure Seal Bonnet—Gate									
	Pressure Seal Bonnet—Globe									
Bolts	*One Complete Flange Joint	3.5	6.5	3.5			12			

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WEIGHTS OF PIPING MATERIALS—4" PIPE SIZE

PIPE	Schedule No.	40	80	120	160						
	Wall Designation	Std.	XS			XXS					
	Thickness—In.	.237	.337	.437	.531	.674					
	Pipe—Lbs Ft	10.79	14.98	18.96	22.51	27.54					
	Water—Lbs Ft	5.51	4.98	4.48	4.02	3.38					
WELDING FITTINGS	L.R. 90° Elbow	8.7 1	11.9 1		17.6 1	21 1					
	S.R. 90° Elbow	5.8 .7	7.9 .7								
	L.R. 45° Elbow	4.3 .4	5.9 .4		8.5 .4	10.1 .4					
	Tee	12.6 1	16.4 1		23 1	27 1					
	Lateral	30 2.1	45 2.1								
	Reducer	3.6 .3	4.9 .3		6.6 .3	8.2 .3					
	Cap	2.6 .6	3.4 .6		6.5 .6	6.7 .6					
COVERING	Temperature Range °F	(to 250°	250-350	350-400	400-525	525-600	600-700	700-800	800-900	900-1000	
	85% Magnesia	Thickness—In.	1	1	1½	2	2½				
		Lbs Ft	2.10	2.10	3.15	4.75	5.10				
	Combination	Thickness—In.						3	3	3	3
		Lbs Ft						9.8	9.8	12.2	12.2
	Calcium Silicate	Thickness—In.	1	1	1½	1½	2	2	2½	3	3
		Lbs Ft	1.60	1.60	2.49	2.49	3.40	3.40	4.62	6.03	6.03

		Cast Iron		Steel						
FLANGES	Pressure Rating psi	125	250	150	300	400	600	900	1500	2500
	Screwed or Slip-On	16 1.5	26 1.5	15 1.5	26 1.5	32 1.5	43 1.5	66 1.5	94 1.5	158 1.5
	Welding Neck			14 1.5	26 1.5	37 1.5	43 1.5	57 1.5	81 1.5	159 1.5
	Lap Joint			16 1.5	27 1.5	33 1.5	45 1.5	67 1.5	94 1.5	155 1.5
	Blind	18 1.5	29 1.5	19 1.5	31 1.5	39 1.5	47 1.5	66 1.5	90 1.5	164 1.5
FLANGED FITTINGS	S.R. 90° Elbow	45 4.1	72 4.2	59 4.1	85 4.2	99 4.3	125 4.4	185 4.5	254 4.8	
	L.R. 90° Elbow	52 4.5	79 4.5	72 4.5	98 4.5					
	45° Elbow	40 3.7	65 3.8	51 3.7	78 3.8	82 3.9	110 4	170 4.1	214 4.2	
	Tee	70 6.1	109 6.3	86 6.1	121 6.3	153 6.4	187 6.6	262 6.8	386 7.2	
**VALVES	Flanged Bonnet Gate	109 7.2	188 7.5	114 4.2	173 4.5	213 5	274 5.1	370 5.3	566 5.7	
	Flanged Bonnet Globe or Angle	97 7.4	177 7.8	127 4.4	168 4.8	194 5	222 5.1	383 5.3	546 5.7	
	Flanged Bonnet Check	80 7.4	146 7.8	104 4.4	146 4.8	180 5	159 5.1	256 5.3	344 5.7	
	Pressure Seal Bonnet—Gate							230 2.8	235 3	
	Pressure Seal Bonnet—Globe							260 2.8	375 3	
Bolts	*One Complete Flanged Joint	4	6.5	4	7.5	12	12.5	25	34	61

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WEIGHTS OF PIPING MATERIALS—5" PIPE SIZE

PIPE	Schedule No.	40	80	120	160								
	Wall Designation	Std.	XS			XXS							
	Thickness—in.	.258	.375	.500	.625	.750							
	Pipe—Lbs Ft	14.62	20.78	27.04	32.96	38.55							
	Water—Lbs Ft	8.66	7.89	7.09	6.33	5.62							
WELDING FITTINGS	L.R. 90° Elbow	14.7 1.3	21 1.3		32 1.3	37 1.3							
	S.R. 90° Elbow	9.8 .8	13.7 .8										
	L.R. 45° Elbow	7.3 .5	10.2 .5		15.6 .5	17.7 .5							
	Tee	19.8 1.2	26 1.2		39 1.2	43 1.2							
	Lateral	49 2.5	70 2.5										
	Reducer	6 .4	8.3 .4		12.4 .4	14.2 .4							
	Cap	4.2 .7	5.7 .7		11 .7	11 .7							
COVERING	Temperature Range °F	to 200°	200–300	300–400	400–500	500–600	600–700	700–800	800–900	900–1000			
	85% Magnesia	Thickness—In.	1½	1½	2	2½	3						
		Lbs Ft	2.50	3.75	5.60	7.40	9.30						
	Combination	Thickness—In.						3	3½	4	4½	5	5½	6
		Lbs Ft						10.9	13.3	16.1	20.6	25.6	29.7	34.1
	Calcium Silicate	Thickness—In.	1	1	1½	1½	2	2	2½	3	3	3½	4	4½
		Lbs/Ft	1.84	1.84	2.84	2.84	3.97	3.97	5.37	6.75	6.75	8.26	10.3	12.1

		Cast Iron		Steel						
FLANGES	Pressure Rating psi	125	250	150	300	400	600	900	1500	2500
	Screwed or Slip-On	20 1.5	32 1.5	18 1.5	32 1.5	37 1.5	73 1.5	100 1.5	172 1.5	259 1.5
	Welding Neck			18 1.5	31 1.5	42 1.5	70 1.5	94 1.5	145 1.5	263 1.5
	Lap Joint			19 1.5	33 1.5	39 1.5	75 1.5	101 1.5	171 1.5	257 1.5
	Blind	23 1.5	37 1.5	23 1.5	39 1.5	50 1.5	78 1.5	104 1.5	172 1.5	272 1.5
FLANGED FITTINGS	S.R. 90° Elbow	56 4.3	94 4.3	80 4.3	113 4.3	123 4.5	205 4.7	268 4.8	435 5.2	
	L.R. 90° Elbow	68 4.7	105 4.7	91 4.7	128 4.7					
	45° Elbow	51 3.8	83 3.8	66 3.8	98 3.8	123 4	180 4.2	239 4.3	350 4.5	
	Tee	90 6.4	145 6.5	119 6.4	172 6.4	179 6.8	304 7	415 7.2	665 7.8	
*VALVES	Flanged Bonnet Gate	136 7.3	264 7.9	151 4.3	257 4.9	309 5.3	386 5.5	508 5.8	841 6.3	
	Flanged Bonnet Globe or Angle	138 7.6	247 8	172 4.6	237 5	277 5.3	274 5.5	658 5.8		
	Flanged Bonnet Check	115 7.6	210 8	141 4.6	198 5	249 5.3	244 5.5	326 5.8	531 6.3	
	Pressure Seal Bonnet—Gate							350 3.1	370 3.4	
	Pressure Seal Bonnet—Globe							395 3.1	500 3.4	
Bolts	*One Complete Flanged Joint	6	6.5	6	8	12.5	19.5	33	60	98

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WEIGHTS OF PIPING MATERIALS—6" PIPE SIZE

PIPE	Schedule No.	40	80	120	160								
	Wall Designation	Std.	XS			XXS							
	Thickness—In.	.280	.432	.562	.718	.864							
	Pipe—Lbs/Ft	18.97	28.57	36.39	45.3	53.2							
	Water—Lbs/Ft	12.51	11.29	10.30	9.2	8.2							
WELDING FITTINGS	L.R. 90° Elbow	**23** 1.5	**34** 1.5		**53** 1.5	**62** 1.5							
	S.R. 90° Elbow	**15.2** 1	**23** 1										
	L.R. 45° Elbow	**11.3** .6	**16.7** .6		**26** .6	**30** .6							
	Tee	**29.3** 1.4	**42** 1.4		**60** 1.4	**68** 1.4							
	Lateral	**79** 2.9	**101** 2.9										
	Reducer	**8.7** .5	**12.6** .5		**18.8** .5	**21** .5							
	Cap	**6.4** .9	**9.2** .9		**17.5** .9	**17.5** .9							

COVERING	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000			
	85% Magnesia	Thickness—In.	1½	1½	2	2½	3						
		Lbs. Ft.	**2.90**	**4.15**	**6.40**	**8.40**	**10.0**						
	Combination	Thickness—In.						3	3½	4	4½	5	5½	6
		Lbs/Ft						12.3	14.9	18.2	24.2	28.2	32.6	37.4
	Calcium Silicate	Thickness—In.	1½	1½	1½	1½	2	2	2½	3	3	3½	4	4½
		Lbs/Ft	3.13	3.13	3.13	3.13	4.54	4.54	5.92	7.42	7.42	9.47	11.2	13.1

		Cast Iron		Steel						
	Pressure Rating psi	125	250	150	300	400	600	900	1500	2500
FLANGES	Screwed or Slip-On	**25** 1.5	**42** 1.5	**22** 1.5	**45** 1.5	**54** 1.5	**95** 1.5	**128** 1.5	**202** 1.5	**395** 1.5
	Welding Neck			**22** 1.5	**42** 1.5	**56** 1.5	**85** 1.5	**116** 1.5	**176** 1.5	**402** 1.5
	Lap Joint			**24** 1.5	**47** 1.5	**56** 1.5	**98** 1.5	**131** 1.5	**213** 1.5	**393** 1.5
	Blind	**28** 1.5	**51** 1.5	**29** 1.5	**56** 1.5	**71** 1.5	**101** 1.5	**133** 1.5	**197** 1.5	**417** 1.5
FLANGED FITTINGS	S.R. 90° Elbow	**74** 4.3	**125** 4.4	**90** 4.3	**147** 4.4	**184** 4.6	**275** 4.8	**375** 5	**566** 5.3	
	L.R. 90° Elbow	**91** 4.9	**145** 4.9	**126** 4.9	**182** 4.9					
	45° Elbow	**66** 3.8	**115** 3.9	**82** 3.8	**132** 3.9	**149** 4.1	**240** 4.3	**320** 4.3	**476** 4.6	
	Tee	**114** 6.5	**195** 6.6	**149** 6.5	**217** 6.6	**279** 6.9	**400** 7.2	**565** 7.5	**839** 8	
**VALVES	Flanged Bonnet Gate	**172** 7.3	**359** 8	**210** 4.3	**367** 5	**409** 5.5	**553** 5.8	**784** 6	**1227** 6.6	
	Flanged Bonnet Globe or Angle	**184** 7.8	**345** 8.2	**238** 4.8	**333** 5.2	**366** 5.4	**465** 5.8	**844** 6		
	Flanged Bonnet Check	**154** 7.8	**286** 8.2	**176** 4.8	**272** 5.2	**341** 5.4	**335** 5.8	**459** 6	**877** 6.5	
	Pressure Seal Bonnet—Gate							**540** 3.5	**600** 3.8	
	Pressure Seal Bonnet—Globe							**600** 3.5	**700** 3.8	
Bolts	*One Complete Flanged Joint	**6**	**10**	**6**	**11.5**	**19**	**38**	**40**	**76**	**145**

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WEIGHTS OF PIPING MATERIALS—8" PIPE SIZE

PIPE	Schedule No.	20	30	40	60	80	100	120	140		160		
	Wall Designation			Std.		XS				XXS			
	Thickness—In.	.250	.277	.322	.406	.500	.593	.718	.812	.875	.906		
	Pipe—Lbs. Ft.	**22.36**	**24.70**	**28.55**	**35.64**	**43.4**	**50.9**	**60.6**	**67.8**	**72.4**	**74.7**		
	Water—Lbs. Ft.	**22.48**	**22.18**	**21.69**	**20.79**	**19.8**	**18.8**	**17.6**	**16.7**	**16.1**	**15.8**		
WELDING FITTINGS	L.R. 90° Elbow			**46** 2		**69** 2				**114** 2	**117** 2		
	S.R. 90° Elbow			**31** 1.3		**46** 1.3							
	L.R. 45° Elbow			**23** .8		**34** .8				**55** .8	**56** .6		
	Tee			**54** 1.8		**76** 1.8				**116** 1.8	**120** 1.8		
	Lateral			**155** 3.8		**216** 3.8							
	Reducer			**13.9** .5		**20** .5				**32** .5	**33** .5		
	Cap			**11.3** 1		**16.3** 1				**31** 1	**32** 1		

COVERING	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000			
85% Magnesia	Thickness—In.	1¼	1½	2	2½	3							
	Lbs./Ft.	**4.05**	**5.30**	**7.70**	**10.3**	**12.5**							
Combination	Thickness—In.						3	3½	4	4½	5	5½	6
	Lbs./Ft.						**16.9**	**19.6**	**23.1**	**26.7**	**32.8**	**38.3**	**43.4**
Calcium Silicate	Thickness—In.	1½	1½	1½	1½	2	2	2½	3	3½	4	4½	5
	Lbs./Ft.	**4.06**	**4.06**	**4.06**	**4.06**	**5.56**	**5.56**	**7.61**	**9.38**	**11.3**	**13.3**	**15.4**	**17.6**

FLANGES	Pressure Rating psi	Cast Iron		Steel						
		125	250	150	300	400	600	900	1500	2500
	Screwed or Slip-On	**34** 1.5	**64** 1.5	**33** 1.5	**67** 1.5	**82** 1.5	**135** 1.5	**206** 1.5	**319** 1.5	**601** 1.5
	Welding Neck			**33** 1.5	**66** 1.5	**87** 1.5	**117** 1.5	**193** 1.5	**288** 1.5	**613** 1.5
	Lap Joint			**36** 1.5	**70** 1.5	**86** 1.5	**139** 1.5	**227** 1.5	**354** 1.5	**595** 1.5
	Blind	**45** 1.5	**83** 1.5	**48** 1.5	**90** 1.5	**115** 1.5	**159** 1.5	**231** 1.5	**362** 1.5	**649** 1.5
FLANGED FITTINGS	S.R. 90° Elbow	**117** 4.5	**201** 4.7	**157** 4.5	**238** 4.7	**310** 5	**435** 5.2	**639** 5.4	**995** 5.7	
	L.R. 90° Elbow	**152** 5.3	**236** 5.3	**202** 5.3	**283** 5.3					
	45° Elbow	**101** 3.9	**171** 4	**127** 3.9	**203** 4	**215** 4.1	**368** 4.4	**507** 4.5	**870** 4.8	
	Tee	**175** 6.8	**304** 7.1	**230** 6.8	**337** 7.1	**445** 7.5	**610** 7.8	**978** 8.1	**1465** 8.6	
**VALVES	Flanged Bonnet Gate	**251** 7.5	**583** 8.1	**329** 4.5	**549** 5.1	**727** 6	**1008** 6.3	**1332** 6.6		
	Flanged Bonnet Globe or Angle	**317** 8.4	**554** 8.6	**408** 5.4	**509** 5.6	**576** 5.9	**1200** 6.3			
	Flanged Bonnet Check	**302** 8.4	**454** 8.6	**301** 5.4	**467** 5.6	**561** 5.9	**563** 6.3	**677** 6.6		
	Pressure Seal Bonnet—Gate							**835** 4.3	**975** 4.5	
	Pressure Seal Bonnet—Globe							**1000** 4.3	**1115** 4.5	
Bolts	*One Complete Flanged Joint	**6.5**	**16**	**6.5**	**18**	**30**	**40**	**69**	**121**	**232**

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WEIGHTS OF PIPING MATERIALS—10" PIPE SIZE

PIPE	Schedule No.	20	30	40	60	80	100	120	140	160			
	Wall Designation			Std	XS								
	Thickness—In.	.250	.307	.365	.500	.593	.718	.843	1.000	1.125			
	Pipe—Lbs. Ft.	28.04	34.24	40.5	54.7	64.3	76.9	89.2	104.1	115.7			
	Water—Lbs. Ft.	35.27	34.98	34.1	32.3	31.1	29.5	28.0	26.1	24.6			
WELDING FITTINGS	L.R. 90° Elbow			**82** 2.5	**109** 2.5					**226** 2.5			
	S.R. 90° Elbow			**54** 1.7	**73** 1.7								
	L.R. 45° Elbow			**40** 1	**54** 1					**109** 1			
	Tee			**91** 2.1	**118** 2.1					**222** 2.1			
	Lateral			**238** 4.4	**335** 4.4								
	Reducer			**23** .6	**31** .6					**58** .6			
	Cap			**20** 1.3	**26** 1.3					**54** 1.3			
COVERING	Temperature Range °F	to 250	250-300	300-400	400-450	450-500	500-550	550-600	600-650	650-700			
	85% Magnesia	Thickness—In.	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3						
		Lbs. Ft.	5.20	6.60	9.50	12.3	14.2						
	Combination	Thickness—In.						3	$3\frac{1}{8}$	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5
		Lbs. Ft.						20.5	23.5	28.0	33.3	38.5	43.9
	Calcium Silicate	Thickness—In.	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	2	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$
		Lbs. Ft.	5.10	5.10	5.10	5.10	6.87	6.87	8.76	10.8	12.9	15.2	17.5

FLANGES	Pressure Rating	Cast Iron		Steel							
	psi	125	250	150	300	400	600	900	1500	2500	
	Screwed or Slip-On	53 1.5	**97** 1.5	**51** 1.5	**100** 1.5	**117** 1.5	**213** 1.5	**292** 1.5	**528** 1.5	**1148** 1.5	
	Welding Neck			**46** 1.5	**95** 1.5	**128** 1.5	**196** 1.5	**267** 1.5	**447** 1.5	**1129** 1.5	
	Lap Joint			**54** 1.5	**114** 1.5	**143** 1.5	**236** 1.5	**332** 1.5	**589** 1.5	**1131** 1.5	
	Blind	71 1.5	**136** 1.5	**78** 1.5	**146** 1.5	**180** 1.5	**267** 1.5	**337** 1.5	**599** 1.5	**1243** 1.5	
FLANGED FITTINGS	S.R. 90° Elbow	190 4.8	**323** 4.9	**240** 4.8	**343** 4.9	**462** 5.2	**747** 5.6	**995** 5.8			
	L.R. 90° Elbow	245 5.8	**383** 5.8	**290** 5.8	**438** 5.8						
	45° Elbow	160 4.2	**273** 4.2	**185** 4.1	**288** 4.2	**332** 4.3	**572** 4.6	**732** 4.7			
	Tee	293 7.2	**479** 7.4	**353** 7.2	**527** 7.4	**578** 7.8	**1087** 8.4	**1417** 8.7			
*VALVES	Flanged Bonnet Gate	471 7.7	**899** 8.3	**513** 4.7	**888** 5.3	**1193** 6.3	**1571** 6.9	**2511** 7.1			
	Flanged Bonnet Globe or Angle	541 9.1	**943** 9.1		**993** 6.1	**1068** 6.8	**1346** 6.9	**2586** 7.1			
	Flanged Bonnet Check	453 9.1	**751** 9.1	**413** 6	**586** 6.1	**718** 6.3	**746** 6.9				
	Pressure Seal Bonnet—Gate							**1400** 4.9	**1650** 5.2		
	Pressure Seal Bonnet—Globe							**1800** 4.9	**1910** 5.2		
Bolts	*One Complete Flanged Joint	15	**33**	15	**38**	**52**	**72**	**95**	**184**	**445**	

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WEIGHTS OF PIPING MATERIALS—12" PIPE SIZE

PIPE	Schedule No.	20	30		40		60	80	100	120	140	160
	Wall Designation			Std.		XS						
	Thickness—In.	.250	.330	.375	.406	.500	.562	.687	.843	1.000	1.125	1.312
	Pipe—Lbs Ft	33.38	43.8	49.6	53.5	65.4	73.2	88.5	107.2	125.5	139.7	160.3
	Water—Lbs Ft	51.10	49.7	49.0	48.5	47.0	46.0	44.0	41.6	39.3	37.5	34.9
WELDING FITTINGS	L.R. 90° Elbow			**119** 3		**157** 3						**375** 3
	S.R. 90° Elbow			**80** 2		**104** 2						
	L.R. 45° Elbow			**60** 1.3		**76** 1.3						**181** 1.3
	Tee			**132** 2.5		**167** 2.5						**360** 2.5
	Lateral			**337** 5.4		**556** 5.4						
	Reducer			**33** .7		**44** .7						**94** .7
	Cap			**30** 1.5		**38** 1.5						**89** 1.5

COVERING	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000		
85% Magnesia	Thickness—In.	1½	2	2½	3	3						
	Lbs Ft	9.60	12.5	15.5	18.8	18.8						
Combination	Thickness—In.						3	4	4½	4½	5	5½	6
	Lbs Ft						27.4	31.6	33.3	36.5	43.4	49.5	55.8
Calcium Silicate	Thickness—In.	1½	1½	1½	1½	2	2½	3	3	3½	4	4½	5
	Lbs Ft	5.91	5.91	5.91	5.91	7.92	10.1	12.3	12.3	14.7	17.2	19.8	22.5

FLANGES	Pressure Rating psi	Cast Iron: 125	250	Steel: 150	300	400	600	900	1500	2500
	Screwed or Slip-On	**71** 1.5	**137** 1.5	**72** 1.5	**140** 1.5	**163** 1.5	**261** 1.5	**388** 1.5	**820** 1.5	**1611** 1.5
	Welding Neck			**69** 1.5	**142** 1.5	**181** 1.5	**233** 1.5	**361** 1.5	**691** 1.5	**1671** 1.5
	Lap Joint			**77** 1.5	**169** 1.5	**193** 1.5	**293** 1.5	**445** 1.5	**920** 1.5	**1591** 1.5
	Blind	**96** 1.5	**177** 1.5	**118** 1.5	**209** 1.5	**260** 1.5	**341** 1.5	**475** 1.5	**928** 1.5	**1775** 1.5
FLANGED FITTINGS	S.R. 90° Elbow	**265** 5	**453** 5.2	**345** 5	**509** 5.2	**669** 5.5	**815** 5.5	**1474** 6.2		
	L.R. 90° Elbow	**375** 6.2	**553** 6.2	**485** 6.2	**624** 6.2			**1598** 6.2		
	45° Elbow	**235** 4.3	**383** 4.3	**282** 4.3	**414** 4.3	**469** 4.5	**705** 4.7	**1124** 4.8		
	Tee	**403** 7.5	**684** 7.8	**513** 7.5	**754** 7.8	**943** 8.3	**1361** 8.7	**1928** 9.3		
*VALVES	Flanged Bonnet Gate	**687** 7.8	**1298** 8.5	**726** 4.8	**1337** 5.5	**1611** 6.8	**2263** 7.1	**3248** 7.8		
	Flanged Bonnet Globe or Angle	**808** 9.4	**1200** 9.5		**1409** 6.5	**1493** 6.8				
	Flanged Bonnet Check	**674** 9.4	**1160** 9.5	**701** 6.5	**874** 6.5	**1118** 6.8	**1168** 7.1			
	Pressure Seal Bonnet—Gate							**2080** 5.5	**2400** 5.9	
	Pressure Seal Bonnet—Globe							**2150** 5.5	**2500** 5.9	
Bolts	*One Complete Flanged Joint	**15**	**44**	**15**	**49**	**69**	**91**	**124**	**306**	**622**

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WEIGHTS OF PIPING MATERIALS—14" PIPE SIZE

PIPE	Schedule No.	10	20	30	40		60	80	100	120	140	160	
	Wall Designation			Std.		XS							
	Thickness—In.	.250	.312	.375	.437	.500	.593	.750	.937	1.093	1.250	1.406	
	Pipe—Lbs/Ft	36.71	45.7	54.6	63.4	72.1	84.9	106.1	130.7	150.7	170.2	189.1	
	Water—Lbs/Ft	62.86	60.92	59.7	58.7	57.5	55.9	53.2	50.0	47.5	45.0	42.6	
WELDING FITTINGS	L.R. 90° Elbow			**154** 3.5		**202** 3.5							
	S.R. 90° Elbow			**102** 2.3		**135** 2.3							
	L.R. 45° Elbow			**77** 1.5		**100** 1.5							
	Tee			**159** 2.8		**203** 2.8							
	Lateral			**495** 5.8		**588** 5.8							
	Reducer			**63** 1.1		**83** 1.1							
	Cap			**35** 1.7		**46** 1.7							

COVERING	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000			
85% Magnesia	Thickness—In.	1½	2	2½	3	3							
	Lbs Ft	10.4	13.4	16.8	20.3	20.3							
Combination	Thickness—In.						3½	4	4	4½	5	5½	6
	Lbs Ft						28.7	33.1	33.1	39.4	46.4	53.0	59.7
Calcium Silicate	Thickness—In.	1	1	1½	1½	2	2½	3	3½	4	4½	5	
	Lbs Ft	3.89	3.89	5.90	5.90	8.03	10.3	12.6	15.1	17.7	20.5	23.3	

		Cast Iron		Steel						
FLANGES	Pressure Rating psi	125	250	150	300	400	600	900	1500	2500
	Screwed or Slip-On	**93** 1.5	**184** 1.5	**96** 1.5	**195** 1.5	**235** 1.5	**318** 1.5	**460** 1.5		
	Welding Neck			**90** 1.5	**192** 1.5	**240** 1.5	**358** 1.5	**473** 1.5		
	Lap Joint			**116** 1.5	**226** 1.5	**261** 1.5	**358** 1.5	**491** 1.5		
	Blind	**126** 1.5	**239** 1.5	**142** 1.5	**267** 1.5	**354** 1.5	**437** 1.5	**648** 1.5		
FLANGED FITTINGS	S.R. 90° Elbow	**372** 5.3	**617** 5.5	**497** 5.3	**632** 5.5	**664** 5.7	**918** 5.9	**1549** 6.4		
	L.R. 90° Elbow	**492** 6.6	**767** 6.6	**622** 6.6	**772** 6.6					
	45° Elbow	**292** 4.3	**497** 4.4	**377** 4.3	**587** 4.4	**638** 4.6	**883** 4.8	**1246** 4.9		
	Tee	**563** 8	**956** 8.4	**683** 8	**968** 8.3	**1131** 8.6	**1652** 8.9	**2318** 9.6		
**VALVES	Flanged Bonnet Gate	**921** 7.9	**1762** 8.8	**830** 4.9	**1872** 6.3	**2018** 7.1	**3082** 7.4	**3989** 8.1		
	Flanged Bonnet Globe or Angle	**1171** 9.9								
	Flanged Bonnet Check	**885** 9.9								
	Pressure Seal Bonnet—Gate									
	Pressure Seal Bonnet—Globe									
Bolts	*One Complete Flanged Joint	**22**	**57**	**22**	**62**	**88**	**118**	**159**		

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WEIGHTS OF PIPING MATERIALS—16" PIPE SIZE

PIPE	Schedule No.	10	20	30	40	60	80	100	120	140	160		
	Wall Designation			Std.	XS								
	Thickness—In.	.250	.312	.375	.500	.565	.843	1.031	1.218	1.437	1.593		
	Pipe—Lbs Ft	**42.1**	**52.4**	**62.6**	**82.8**	**107.5**	**136.5**	**164.8**	**192.3**	**223.6**	**245.1**		
	Water—Lbs Ft	**81.8**	**80.5**	**79.1**	**76.5**	**73.4**	**69.7**	**66.1**	**62.6**	**58.6**	**55.9**		
WELDING FITTINGS	L.R. 90° Elbow			**201** 4	**265** 4								
	S.R. 90° Elbow			**135** 2.5	**177** 2.5								
	L.R. 45° Elbow			**100** 1.7	**132** 1.7								
	Tee			**202** 3.2	**257** 3.2								
	Lateral			**650** 6.7	**774** 6.7								
	Reducer			**78** 1.2	**102** 1.2								
	Cap			**44** 1.8	**58** 1.8								

	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000			
COVERING	85% Magnesia	Thickness—In.	1½	2	2½	3	3						
		Lbs Ft	**11.6**	**15.1**	**18.8**	**22.6**	**22.6**						
	Combination	Thickness—In.						3½	4	4	4½	5	5½	6
		Lbs Ft						**32.0**	**37.2**	**37.2**	**43.6**	**51.4**	**58.4**	**65.7**
	Calcium Silicate	Thickness—In.	1	1	1½	1½	2	2½	3	3½	4	4½	5	
		Lbs Ft	**4.40**	**4.40**	**6.65**	**6.65**	**9.02**	**11.5**	**14.1**	**16.8**	**19.7**	**22.7**	**25.8**	

	Pressure Rating psi	Cast Iron		Steel						
		125	250	150	300	400	600	900	1500	2500
FLANGES	Screwed or Slip-On	**120** 1.5	**233** 1.5	**108** 1.5	**261** 1.5	**319** 1.5	**442** 1.5	**559** 1.5		
	Welding Neck			**116** 1.5	**257** 1.5	**308** 1.5	**492** 1.5	**564** 1.5		
	Lap Joint			**151** 1.5	**289** 1.5	**347** 1.5	**489** 1.5	**607** 1.5		
	Blind	**175** 1.5	**308** 1.5	**185** 1.5	**348** 1.5	**455** 1.5	**603** 1.5	**809** 1.5		
FLANGED FITTINGS	S.R. 90° Elbow	**501** 5.5	**826** 5.8	**656** 5.5	**958** 5.8	**1014** 6	**1402** 6.3	**1886** 6.7		
	L.R. 90° Elbow	**701** 7	**1036** 7	**781** 7	**1058** 7					
	45° Elbow	**391** 4.3	**696** 4.6	**481** 4.3	**708** 4.6	**639** 4.7	**1212** 5	**1586** 5		
	Tee	**746** 8.3	**1263** 8.7	**961** 8.3	**1404** 8.6	**1671** 9	**2128** 9.4	**3054** 10		
**VALVES	Flanged Bonnet Gate	**1254** 8	**2321** 9	**1315** 5	**2511** 7.1	**2694** 7.5	**3668** 7.9			
	Flanged Bonnet Globe or Angle									
	Flanged Bonnet Check	**1166** 10.5								
	Pressure Seal Bonnet—Gate									
	Pressure Seal Bonnet—Globe									
Bolts	*One Complete Flanged Joint	**31**	**76**	**31**	**83**	**114**	**152**	**199**		

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WEIGHTS OF PIPING MATERIALS—18" PIPE SIZE

PIPE	Schedule No	10	20		30		40	60	80	100	120	140	160
	Wall Designation			Std.		XS							
	Thickness—In.	.250	.312	.375	.437	.500	.563	.750	.937	1.156	1.375	1.562	1.781
	Pipe—Lbs. Ft	47.4	59.0	70.6	82.1	93.5	104.8	138.2	170.8	208.0	244.1	274.2	308.5
	Water—Lbs. Ft	104.3	102.8	101.2	99.9	98.4	97.0	92.7	88.5	83.7	79.2	75.3	71.0
WELDING FITTINGS	L.R. 90° Elbow			**256** 4.5		**338** 4.5							
	S.R. 90° Elbow			**171** 2.8		**225** 2.8							
	L.R. 45° Elbow			**128** 1.9		**168** 1.9							
	Tee			**258** 3.6		**328** 3.6							
	Lateral			**798** 7.5		**984** 7.5							
	Reducer			**94** 1.3		**123** 1.3							
	Cap			**57** 2.1		**75** 2.1							
COVERING	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000			
	85% Magnesia	Thickness—In.	1½	2	2½	3	3						
		Lbs. Ft	**12.9**	**16.0**	**20.8**	**25.0**	**25.0**						
	Combination	Thickness—In.						3½	4	4	4½	5	5½	6
		Lbs. Ft						**35.3**	**40.9**	**40.9**	**48.0**	**56.3**	**64.0**	**71.7**
	Calcium Silicate	Thickness—In.	1	1	1½	1½	2	2½	3	3½	4	4½	5	
		Lbs. Ft.	**4.91**	**4.91**	**7.40**	**7.40**	**10.0**	**12.7**	**15.6**	**18.6**	**21.7**	**25.9**	**28.2**	

	Pressure Rating psi	Cast Iron 125	Cast Iron 250	Steel 150	Steel 300	Steel 400	Steel 600	Steel 900	Steel 1500	Steel 2500
FLANGES	Screwed or Slip-On	**140** 1.5		**140** 1.5	**331** 1.5	**380** 1.5	**573** 1.5	**797** 1.5		
	Welding Neck			**128** 1.5	**316** 1.5	**377** 1.5	**569** 1.5	**786** 1.5		
	Lap Joint			**176** 1.5	**365** 1.5	**428** 1.5	**584** 1.5	**850** 1.5		
	Blind	**210** 1.5	**396** 1.5	**229** 1.5	**441** 1.5	**572** 1.5	**762** 1.5	**1152** 1.5		
FLANGED FITTINGS	S.R. 90° Elbow	**621** 5.8	**1060** 6	**711** 5.8	**1126** 6	**1340** 6.2	**1793** 6.6	**2817** 7		
	L.R. 90° Elbow	**881** 7.4	**1350** 7.4	**941** 7.4	**1426** 7.4					
	45° Elbow	**461** 4.4	**870** 4.7	**521** 4.4	**901** 4.7	**1040** 4.8	**1543** 5	**2252** 5.2		
	Tee	**921** 8.6	**1625** 9	**1010** 8.6	**1602** 9	**1909** 9.3	**2690** 9.9	**4327** 10.5		
**VALVES	Flanged Bonnet Gate	**1629** 8.2	**2578** 9.3		**3189** 7.5	**3580** 7.8	**5647** 8.4			
	Flanged Bonnet Globe or Angle									
	Flanged Bonnet Check	**1371** 10.5								
	Pressure Seal Bonnet—Gate									
	Pressure Seal Bonnet—Globe									
Bolts	*One Complete Flanged Joint	**41**	**93**	**41**	**101**	**139**	**193**	**299**		

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WEIGHTS OF PIPING MATERIALS—20" PIPE SIZE

PIPE	Schedule No.	10	20	30	40	60	80	100	120	140	160		
	Wall Designation		Std.	XS									
	Thickness—In.	.250	.375	.500	.593	.812	1.031	1.281	1.500	1.750	1.968		
	Pipe—Lbs Ft	**52.7**	**78.6**	**104.1**	**122.9**	**166.4**	**208.9**	**256.1**	**296.4**	**341.1**	**379.0**		
	Water—Lbs/Ft	**129.5**	**126.6**	**122.8**	**120.4**	**115.0**	**109.4**	**103.4**	**98.3**	**92.6**	**87.9**		
WELDING FITTINGS	L.R. 90° Elbow		**317** 5	**419** 5									
	S.R. 90° Elbow		**212** 3.4	**278** 3.4									
	L.R. 45° Elbow		**158** 2.1	**208** 2.1									
	Tee		**321** 4	**407** 4									
	Lateral		**1024** 8.3	**1221** 8.3									
	Reducer		**142** 1.7	**186** 1.7									
	Cap		**72** 2.3	**94** 2.3									

COVERING	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000			
	85% Magnesia — Thickness—In.	1½	2	2½	3	3							
	85% Magnesia — Lbs Ft	**14.2**	**18.4**	**22.8**	**27.2**	**27.2**							
	Combination — Thickness—In.						3½	4	4	4½	5	5½	6
	Combination — Lbs Ft						**38.6**	**44.7**	**44.7**	**52.2**	**61.2**	**69.4**	**77.8**
	Calcium Silicate — Thickness—In.	1	1	1½	1½	2	2½	3	3½	4	4½	5	
	Calcium Silicate — Lbs Ft	**5.39**	**5.39**	**8.15**	**8.15**	**11.0**	**14.0**	**17.1**	**20.3**	**23.6**	**27.0**	**30.6**	

		Cast Iron		Steel						
FLANGES	Pressure Rating psi	125	250	150	300	400	600	900	1500	2500
	Screwed or Slip-On	**176** 1.5		**181** 1.5	**376** 1.5	**468** 1.5	**733** 1.5	**973** 1.5		
	Welding Neck			**159** 1.5	**389** 1.5	**475** 1.5	**704** 1.5	**952** 1.5		
	Lap Joint			**222** 1.5	**438** 1.5	**524** 1.5	**748** 1.5	**1085** 1.5		
	Blind	**276** 1.5	**487** 1.5	**298** 1.5	**545** 1.5	**711** 1.5	**976** 1.5	**1438** 1.5		
FLANGED FITTINGS	S.R. 90° Elbow	**792** 6	**1315** 6.3	**922** 6	**1375** 6.3	**1680** 6.5	**2314** 6.9	**3610** 7.3		
	L.R. 90° Elbow	**1132** 7.8	**1725** 7.8	**1352** 7.8	**1705** 7.8					
	45° Elbow	**592** 4.6	**1055** 4.8	**652** 4.6	**1105** 4.8	**1330** 4.9	**1917** 5.2	**2848** 5.4		
	Tee	**1178** 9	**2022** 9.5	**1378** 9	**1908** 9.5	**2370** 9.7	**3463** 10.1	**5520** 11		
**VALVES	Flanged Bonnet Gate	**1934** 6.3	**3823** 9.5		**4449** 7.9	**4744** 8.2	**6470** 8.9			
	Flanged Bonnet Globe or Angle									
	Flanged Bonnet Check	**1772** 11								
	Pressure Seal Bonnet—Gate									
	Pressure Seal Bonnet—Globe									
Bolts	*One Complete Flanged Joint	**52**	**95**	**52**	**185**	**180**	**242**	**361**		

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WEIGHTS OF PIPING MATERIALS—24" PIPE SIZE

PIPE	Schedule No.	10	20		30	40	60	80	100	120	140	160	
	Wall Designation		Std.	XS									
	Thickness—In.	.250	.375	.500	.562	.687	.968	1.218	1.531	1.812	2.062	2.343	
	Pipe—Lbs/Ft	63.4	94.6	125.5	140.8	171.2	238.1	296.4	367.4	429	484	541	
	Water—Lbs/Ft	188.0	183.8	180.1	178.1	174.3	165.8	158.3	149.3	141	134	127	
WELDING FITTINGS	L.R. 90° Elbow		**458** 6	**606** 6									
	S.R. 90° Elbow		**305** 3.7	**404** 3.7									
	L.R. 45° Elbow		**229** 2.5	**302** 2.5									
	Tee		**445** 4.9	**563** 4.9									
	Lateral		**1452** 10	**1769** 10									
	Reducer		**167** 1.7	**220** 1.7									
	Cap		**102** 2.8	**134** 2.8									

	Temperature Range °F	to 260°	260-360	360-440	440-525	525-600	600-700	700-800	800-900	900-1000			
COVERING	85% Magnesia — Thickness—In.	1½	2	2½	3	3							
	85% Magnesia — Lbs. Ft	**16.7**	**21.8**	**26.8**	**32.0**	**32.0**							
	Combination — Thickness—In.						3½	4	4	4½	5	5½	6
	Combination — Lbs/Ft						**45.2**	**52.2**	**52.2**	**60.8**	**71.2**	**80.4**	**90.8**
	Calcium Silicate — Thickness—In.	1	1	1½	1½	2	2½	3	4	4½	5		
	Calcium Silicate — Lbs/Ft	**6.44**	**6.44**	**9.65**	**9.65**	**13.0**	**16.4**	**20.0**	**27.5**	**31.4**	**35.5**		

	Pressure Rating psi	Cast Iron 125	Cast Iron 250	Steel 150	Steel 300	Steel 400	Steel 600	Steel 900	Steel 1500	Steel 2500
FLANGES	Screwed or Slip-On	**255** 1.5		**245** 1.5	**577** 1.5	**676** 1.5	**1055** 1.5	**1823** 1.5		
	Welding Neck			**248** 1.5	**580** 1.5	**702** 1.5	**998** 1.5	**1793** 1.5		
	Lap Joint			**309** 1.5	**631** 1.5	**770** 1.5	**1080** 1.5	**2058** 1.5		
	Blind	**405** 1.5	**757** 1.5	**446** 1.5	**841** 1.5	**1073** 1.5	**1354** 1.5	**2715** 1.5		
FLANGED FITTINGS	S.R. 90° Elbow	**1231** 6.7	**2014** 6.8	**1671** 6.7	**2174** 6.8	**2474** 7.1	**3506** 7.6	**6155** 8.1		
	L.R. 90° Elbow	**1711** 8.7	**2644** 8.7	**1821** 8.7	**2874** 8.7					
	45° Elbow	**871** 4.8	**1604** 5	**1121** 4.8	**1634** 5	**1974** 5.1	**2831** 5.5	**5124** 6		
	Tee	**1836** 10	**3061** 10.2	**2276** 10	**3161** 10.2	**3811** 10.6	**5184** 11.4	**9387** 12.1		
**VALVES	Flanged Bonnet Gate	**3062** 8.5	**6484** 9.8		**6920** 8.7	**7122** 9.1	**9246** 9.9			
	Flanged Bonnet Globe or Angle									
	Flanged Bonnet Check	**2956** 12								
	Pressure Seal Bonnet—Gate									
	Pressure Seal Bonnet—Globe									
Bolts	*One Complete Flanged Joint	**71**	**174**	**71**	**174**	**274**	**360**	**687**		

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HANGER LOAD CALCULATIONS

The thermal deflection of piping in modern high pressure and high temperature power stations has made it necessary to specify flexible supports, thereby requiring the designer to give considerable thought to the calculations of hanger loads for the steam pipe lines. Most manufacturers of power station equipment place limitations on the allowable loads at terminal points. Boiler and turbine manufacturers are especially concerned about the pipe weight on their equipment and sometimes specify that the reactions at pipe connections shall be zero. Piping engineers are interested in knowing the proper procedure to follow in calculating the loads at various points of support on a pipe line and also to determine the position of support on a pipe line where the pipe load at the anchor or terminal point is limited.

Pipe lines should be supported so that the load on the terminal points is not greater than the allowable load throughout the full range of thermal expansion.

Therefore, it is desirable to know the supporting force at each pipe suspension point and to have the total supporting forces equal to the calculated weight of the piping system.

With these conditions in mind, it is quite evident that the pipe support engineer has need for a method of calculating the supports that will be clear, concise and easily understood.

In the example problems to follow it is assumed that the hangers have been located. The approach and the assumptions made in solving a hanger load problem could be numerous, depending on the designer. The solution that follows is not intended as being the only method but rather as a method of producing a good balanced system for the problem under consideration. Of the approaches that could be made in the solution of any problem there will be one solution that produces the best balanced system. Individual loads will very likely be different but the total of each combination of hanger loads plus reactions obtained should be approximately the same in every case.

A well balanced suspension system will result in values for the loads on the hangers to be in close proximity to one another provided all pipe is of the same size or there are no highly concentrated loads located near a hanger; where there are concentrated loads within the system the supporting forces required of the adjacent hangers will be correspondingly large.

Figure 1 illustrates a pipe line drawn in isometric with all the necessary dimensions shown in the same plane as the related section of pipe. This illustration is limited to as few pipe sections as possible but incorporates most of the problems commonly encountered in power station piping support. The type of support, spring or rigid, is not covered here as this is a function of the piping system's thermal deflection and should be treated as a separate study.

The first step in the solution of a problem of this kind is to prepare a table of weights. Such a table, for the pipe line shown in Figure 1, is given on the following page.

Calculation of loads is accomplished by taking moments about an unknown value and solving for a second unknown value, or if all loads except one are known, summation of the individual loads will produce the unknown load. It is preferred in this explanation that the summation method be used as check method on the accuracy of the computations made in the moment method.

The calculation of loads for hangers of a piping system involves first dividing the system into convenient sections at the following points in the system and the order of preference is as listed: (1) Hangers, (2) Bends (either vertical or horizontal), and (3) Risers.

The next step is to isolate each section for study beginning with the section of pipe supported by hangers *H*-1 and *H*-2. The solution of each section should be prefaced by the drawing of a free body diagram. This will provide a clearer picture of the steps involved in the solution.

Section 1

Draw a single line sketch, preferably to scale, as in Figure 2, and show all dimensions and weights. (The weight should be shown at the center of gravity of each piece of pipe, valve or fitting.)

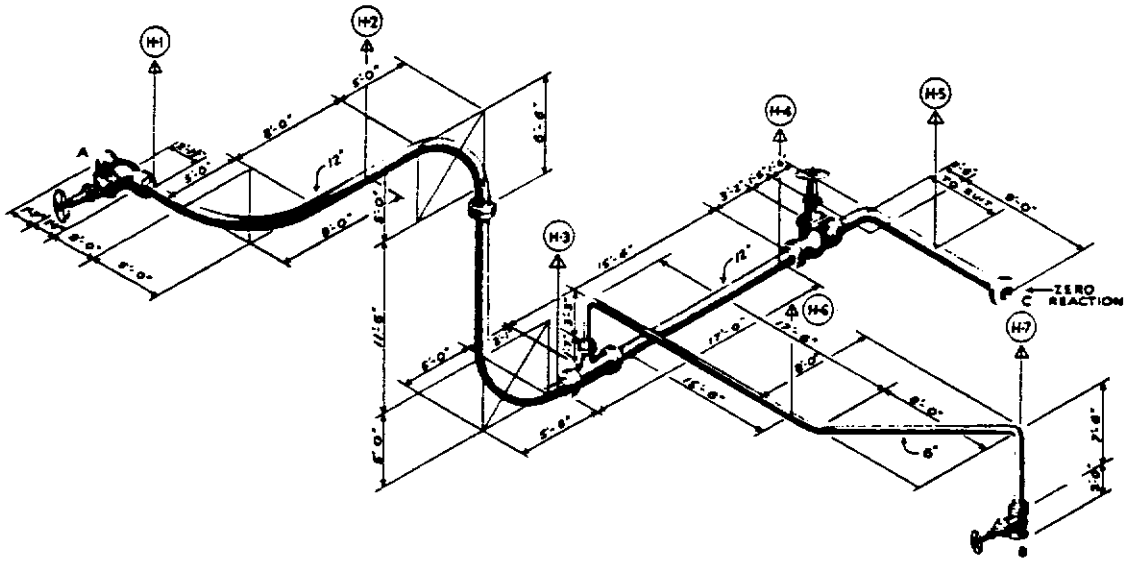

Figure 1

NOTE: Maximum Allowable Load at B = 650lb

Table of Weights

Description	Weight in Pounds	Insulation Weight in Pounds	Total Weight	Weight Used in Calculations	Unit
12"-Schedule 160 Pipe	161	36.5	197.5	197.5	Per Ft
6"-Schedule 160 Pipe	45.3	24.2	69.5	69.5	Per Ft
12"-900lb Stop and Check Valve	3960	394.0	4354.0	4354.0	Each
12"-900lb Lap Flange	445	54.75	499.75	500.0	Each
12" × 12" × 6"-900lb Flanged Tee	1683	321.0	2004.0	2004.0	Each
12"-900lb Flanged Gate Valve	4024	394.0	4418.0	4418.0	Each
12"-Schedule 160 Weld Ell	460	109.5	569.5	570.0	Each
6"-W.N.F.S. 900lb Flange	116	36.3	152.3	152.0	Each
6"-Schedule 160 Weld Ell	59	36.3	95.3	95.0	Each
6"-900lb Flanged Globe Valve	1100	217.8	1317.8	1318.0	Each
12"-900lb Flanged Elbow	1598	226.3	1824.3	1824.0	Each

The weight of the 90° bend is shown as 1550lb at the center of gravity of the bend. Consider this bend as supported on a beam which passes through the center of gravity and rests on the extensions of the tangents to the bend. This imaginary beam is shown resting on the tangents at a distance D of $1'\text{-}4\frac{1}{2}''$ and the load on each end of the beam is one half the total load or 775lb.

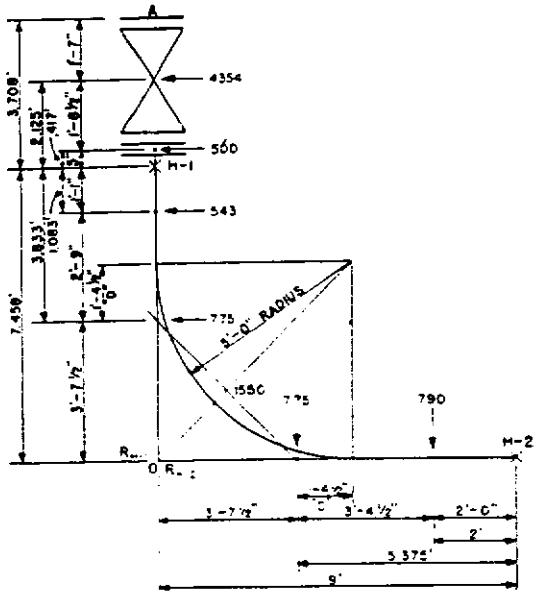

Figure 2. Horizontal Bend—Plan View

The distance D is determined trigonometrically or from Figure 3 which has been drawn for convenience.

$$D = 5 \times 0.273 = 1.365' \quad \text{or} \quad 1'\text{-}4\tfrac{1}{2}''$$

Now consider the forces between H-1 and H-2 acting in two planes which intersect at 0. There will be two reactions at 0 which are designated as $R_{H\text{-}1}$ and $R_{H\text{-}2}$. $R_{H\text{-}1}$ is the reaction of line 0–(H-2) to be carried on Hanger H-1 and $R_{H\text{-}2}$ is the reaction of line (H-1)–0 to be carried on Hanger H-2. Transpose the feet and inches to their decimal equivalent in feet. Consider line (H-1)–0 as a free body and by taking moments about H-1 solve for $R_{H\text{-}2}$.

$$\begin{aligned} 7.458R_{H\text{-}2} &= 543(1.083) + 775(3.833) \\ &= 588.069 + 2970.575 \\ &= 3558.664 \\ R_{H\text{-}2} &= 477\text{lb} \end{aligned}$$

By taking moments about $R_{H\text{-}2}$ solve for $(H\text{-}1)'$, the force on H-1 due to the line (H-1)–0.

$$\begin{aligned} 7.458(H\text{-}1)' &= 775(3.625) + 543(6.375) \\ &= 2809.375 + 3460.625 \\ &= 6270 \\ (H\text{-}1)' &= 841\text{lb} \end{aligned}$$

or

$$(H\text{-}1)' = 543 + 775 - 477 = 841\text{lb}$$

This latter method of calculating $(H\text{-}1)'$ can be used as a check on the work of calculating the loads by taking moments, it consists of the sum of the loads minus the reaction.

Consider line 0–(H-2) as a free body and by taking moments about H-2 solve for $R_{H\text{-}1}$.

$$\begin{aligned} 9R_{H\text{-}1} &= 790(2) + 775(5.375) \\ &= 1580 + 4165.625 \\ &= 5745.625 \\ R_{H\text{-}1} &= 638\text{lb} \end{aligned}$$

By taking moments about $R_{H\text{-}1}$ solve for $(H\text{-}2)'$, the force on H-2 due to the line 0–(H-2).

$$\begin{aligned} 9(H\text{-}2)' &= 775(3.625) + 790(7) \\ &= 2809.375 + 5530 \\ &= 8339.375 \\ (H\text{-}2)' &= 927\text{lb} \end{aligned}$$

or

$$(H\text{-}2)' = 775 + 790 - 638 = 927\text{lb}$$

For the section of pipe considered, H-1 to H-2, we have reactions as follows:

$$\begin{aligned} (H\text{-}1)' &= 841\text{lb} \\ (H\text{-}2)' &= 927\text{lb} \\ R_{H\text{-}1} &= 638\text{lb} \\ R_{H\text{-}2} &= 477\text{lb} \end{aligned}$$

We must now determine the load on H-1 due to the forces between H-1 and A. By definition we said that the force resulting from (H-1)–0 was to be carried by H-2, this means that this section is to be balanced by the section between H-2 and H-3 so that in calculating the load on A. section (H-1)–0 is considered weightless.

Conversely, section 0–(H-2), which results in reaction $R_{H\text{-}1}$ at 0, is to be carried by H-1 and therefore balanced by section A–(H-1). Section A–0 in this case is a simple beam and is solved by taking moments about H-1 to find the reaction at A.

$$\begin{aligned} 3.708A &= 4354(2.125) + 500(0.417) - 638(7.458) \\ &= 9252.25 + 208.5 - 4758.204 \\ &= 4702.546 \\ A &= 1268\text{lb which is below the allowable load at } A \\ &\quad \text{of } 1500\text{lb} \end{aligned}$$

Taking moments about A solve for $(H\text{-}1)''$, the

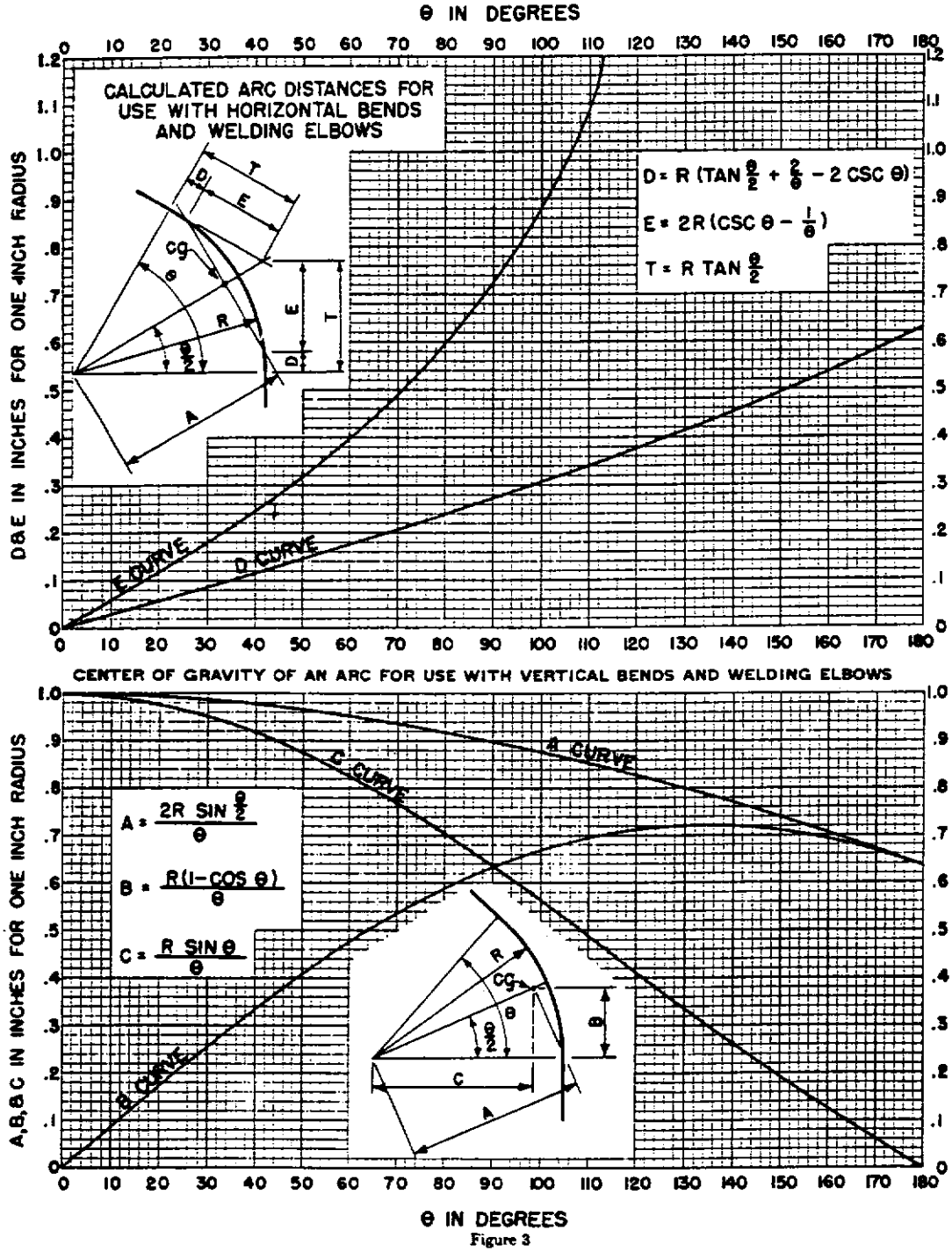
θ IN DEGREES
CALCULATED ARC DISTANCES FOR USE WITH HORIZONTAL BENDS AND WELDING ELBOWS
D = R (TAN θ/2 + 2/θ − 2 CSC θ)
E = 2R (CSC θ − 1/θ)
T = R TAN θ/2
D & E IN INCHES FOR ONE INCH RADIUS
E CURVE
D CURVE
CENTER OF GRAVITY OF AN ARC FOR USE WITH VERTICAL BENDS AND WELDING ELBOWS
A = 2R SIN θ/2 / θ
B = R(1−COS θ) / θ
C = R SIN θ / θ
A CURVE
C CURVE
B CURVE
A,B & C IN INCHES FOR ONE INCH RADIUS
θ IN DEGREES

Figure 3

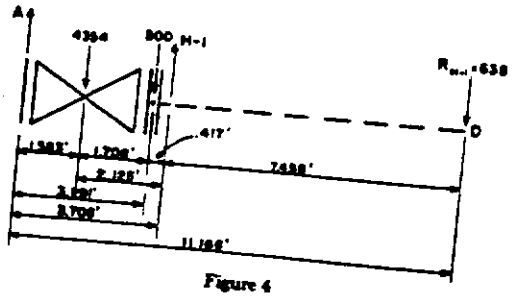

Figure 4

force on H-1 due to the line A–(H-1) plus $R_{H\text{-}1}$ reacting at 0.

$$3.708(H\text{-}1)'' = 4354(1.583) + 500(3.291) + 638(11.166)$$
$$= 6892.382 + 1645.5 + 7123.908$$
$$= 15{,}661.79$$
$$(H\text{-}1)'' = 4224\text{lb}$$

or

$$(H\text{-}1)'' = 4354 + 500 + 638 - 1268 = 4224\text{lb}$$

Total load on H-1 = $(H\text{-}1)' + (H\text{-}1)'' = 841 + 4224 = 5065$lb

Section 2

Consider next the section of pipe between H-2 and H-3. Figure 5 shows the section in elevation with the loads indicated as in Figure 2. In this section we will consider $R_{H\text{-}2}$, which as yet has not been balanced.

The weight of the vertical bend is considered as acting at the center of gravity of the bend. Figure 3 can be used to determine this location.

$$C = 5 \times 0.637 = 3.183' = 3'\text{-}2\tfrac{1}{4}''$$

All forces are in the vertical plane.

Take moments about H-2, solve for $(H\text{-}3)'$, the load H-3 due to the line (H-2)–(H-3).

$$(H\text{-}3)' = -477(9) + 790(2) + 1550(7.187) + 3173(9) + 1550(10.183) + 99(14.25)$$
$$= -4293 + 1580 + 11{,}139.85 + 28{,}557 + 16{,}760.15 + 1410.75$$
$$= 55{,}154.75$$
$$(H\text{-}3)' = 3804\text{lb}$$

moments about H-3 to solve for $(H\text{-}2)''$, the H-2 due to line (H-2) to (H-3).

$$(H\text{-}2)'' = 99(0.25) + 1550(3.683) + 3173(5.5) + 1550(7.317) + 790(12.5) + 477(23.5)$$
$$= 24.75 + 5708.65 + 17{,}451.5 + 11{,}341.35 + 9875 + 11{,}209.5$$
$$= 55{,}610.75$$
$$= 3835\text{lb}$$

or

$$(H\text{-}2)'' = 99 + 1550 + 3173 + 1550 + 790 + 477 - 3804 = 3835\text{lb}$$

Total load on H-2 = $(H\text{-}2)' + (H\text{-}2)'' = 927 + 3835 = 4762$lb.

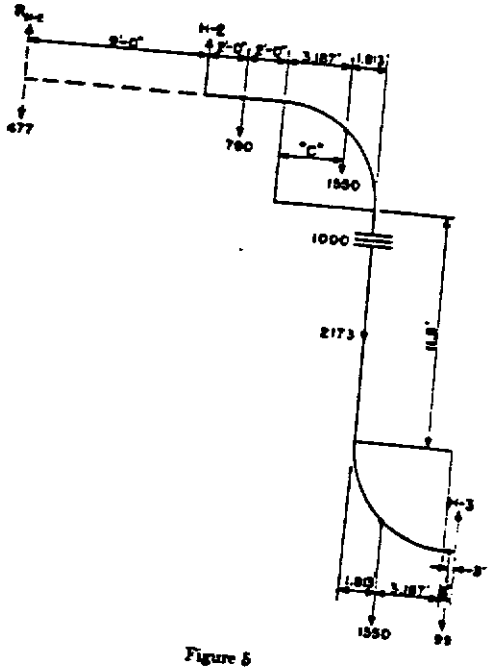

Figure 5

Section 3

The section of pipe between H-4 and H-5 has an imposed load of the 6″ line through the flanged tee. This load must now be determined and at the same time solve for loads on Hangers H-6 and H-7. See Figure 6.

The load and the imaginary beam reactions for the 45° bend are calculated as in Section 1. The load due to line (H-6)–$R_{H\text{-}7}$ results in the reaction $R_{H\text{-}7}$ which is to be carried by H-7. The load due to line $R_{H\text{-}6}$–(H-7) results in the reaction $R_{H\text{-}6}$ which is to be carried by H-6.

Taking moments about H-6 solve for $R_{H\text{-}7}$, see Figure 7.

$$2R_{H\text{-}7} = 62(0.437) + 146(1.208)$$
$$= 27.094 + 176.368$$
$$= 203.462$$
$$R_{H\text{-}7} = 102\text{lb}$$

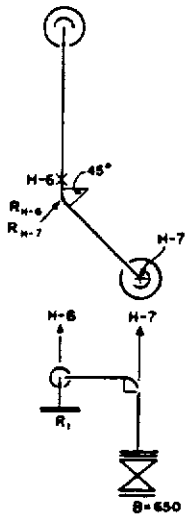

Figure 6

Taking moments about $R_{H\text{-}7}$ solve for $(H\text{-}6)'$, the load on H-6 due to the line $(H\text{-}6)$–$R_{H\text{-}7}$.

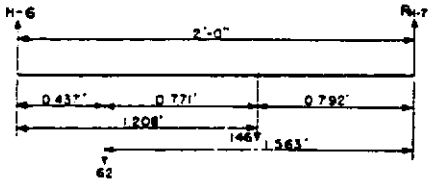

Figure 7

$$\begin{aligned} 2(H\text{-}6)' &= 146(0.792) + 62(1.563) \\ &= 115.632 + 96.906 \\ &= 212.538 \\ (H\text{-}6)' &= 106\text{lb} \end{aligned}$$

or

$$(H\text{-}6)' = 146 + 62 - 102 = 106\text{lb}$$

Figure 8 is a free body diagram of section $R_{H\text{-}6}$–$(H\text{-}7)$. Take moments about H-7 to solve for $R_{H\text{-}6}$.

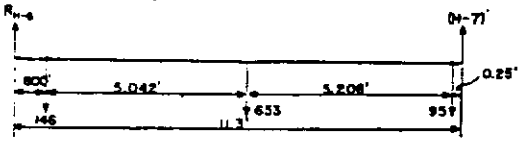

Figure 8

$$\begin{aligned} 11.3R_{H\text{-}6} &= 95(0.25) + 653(5.458) + 146(10.5) \\ &= 23.75 + 3564.074 + 1533 \\ &= 5120.824 \\ R_{H\text{-}6} &= 453\text{lb} \end{aligned}$$

Taking moments about $R_{H\text{-}6}$ solve for $(H\text{-}7)'$, the load on H-7 due to the line $R_{H\text{-}6}$–$(H\text{-}7)$.

$$\begin{aligned} 11.3(H\text{-}7)' &= 146(0.800) + 653(5.834) + 95(11.05) \\ &= 116.8 + 3809.602 + 1049.75 \\ &= 4976.152 \\ (H\text{-}7)' &= 441\text{lb} \end{aligned}$$

or

$$(H\text{-}7)' = 146 + 653 + 95 - 453 = 441\text{lb}$$

Next consider the section between H-7 and B plus the reaction $R_{H\text{-}7}$, see Figure 9.

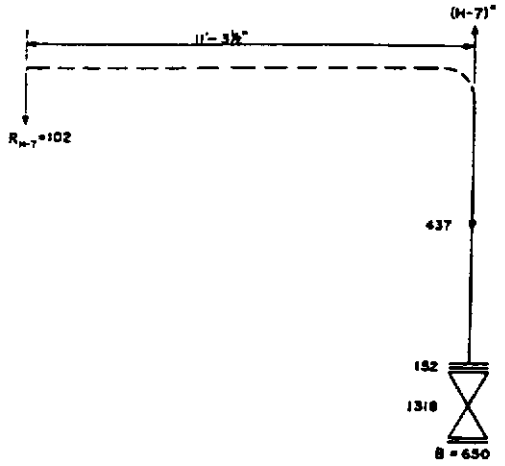

Figure 9

It is necessary to treat this section as a cantilever beam. The load on H-7 caused by this section is $(H\text{-}7)''$ and can be solved for by summing the forces.

$$(H\text{-}7)'' = 102 + 437 + 152 + 1318 - 650 = 1359\text{lb}$$

Total load on H-7 = $(H\text{-}7)' + (H\text{-}7)'' = 441 + 1359 = 1800\text{lb}$.

Section 4

Figure 10 is an elevation view of the section of 6" pipe between H-6 and the flanged tee with the reaction $R_{H\text{-}6}$, which is the load on H-6 due to the line $R_{H\text{-}6}$–$(H\text{-}7)$.

Taking moments about R_1 solve for $(H\text{-}6)''$.

$$15.5(H\text{-}6)'' = 95(0.25) + 1025(8.125) + 453(17.5)$$
$$= 23.75 + 8328.125 + 7927.5$$
$$= 16{,}279.375$$
$$(H\text{-}6)'' = 1050\text{lb}$$

Total load on H-6 = $(H\text{-}6)' + (H\text{-}6)'' = 106 + 1050 = 1156$lb.

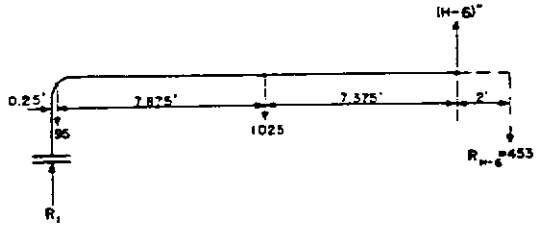

Figure 10

Taking moments about $(H\text{-}6)''$ solve for R_1, the load on the flanged tee.

$$15.5R_1 = 1025(7.375) + 95(15.25) + 140(15.5) - 453(2)$$
$$= 7559.375 + 1448.75 - 2170 - 906$$
$$= 10{,}272.125$$
$$R_1 = 663\text{lb}$$

or

$$R_1 = 140 + 95 + 1025 + 453 - 1050 = 663\text{lb}$$

Section 5

Figure 11 shows the pipe section $(H\text{-}3)$-$(H\text{-}4)$ as a simple beam. Solve for the reaction $(H\text{-}3)''$ by taking moments about H-4.

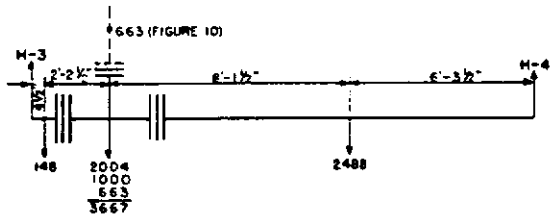

Figure 11

$$17(H\text{-}3)'' = 2488(6.292) + 3667(14.417) + 148(16.625)$$
$$= 15{,}654.496 + 52{,}867.139 + 2460.5$$
$$= 70{,}982.135$$
$$(H\text{-}3)'' = 4175\text{lb}$$

Total load on H-3 = $(H\text{-}3)' + (H\text{-}3)'' = 3804 + 4175 = 7979$lb.

Take moments about H-3 and solve for $(H\text{-}4)'$, the load on H-4 due to the H-3–H-4 line.

$$17(H\text{-}4)' = 148(0.375) + 3667(2.583) + 2488(10.708)$$
$$= 55.5 + 9472.861 + 26{,}641.504$$
$$= 36{,}169.865$$
$$(H\text{-}4)' = 2128\text{lb}$$

or

$$(H\text{-}4)' = 148 + 3667 + 2488 - 4175 = 2128\text{lb}$$

Section 6

Referring to Figure 1 it will be noted that it is required that there be zero reaction at point marked C.

Draw a sketch to scale as in Figure 12 showing loads and dimensions.

Consider the forces as acting in two planes which intersect at 0.

Calculate the load $(H\text{-}4)''$ on H-4 due to the section $(H\text{-}4)$ to 0 by taking moments about 0.

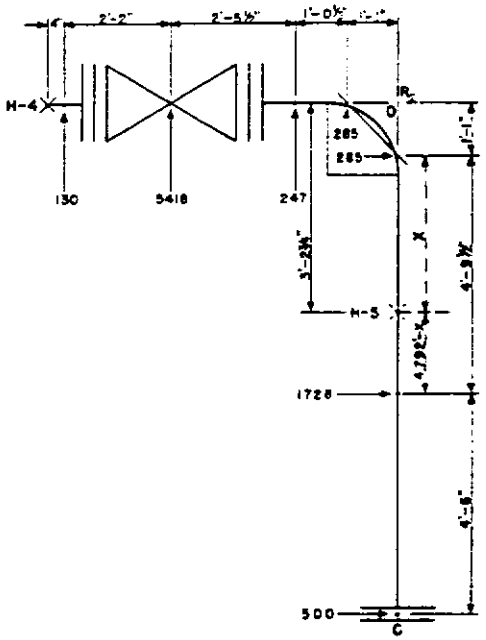

Figure 12

$$7.083(H\text{-}4)'' = 285(1.083) + 247(2.125)$$
$$+ 5418(4.583) + 130(6.75)$$
$$= 308.655 + 524.875 + 24{,}830.694 + 877.5$$
$$= 26{,}541.724$$
$$(H\text{-}4)'' = 3747\text{lb}$$

Total load on H-4 = $(H\text{-}4)' + (H\text{-}4)'' = 2128 + 3747. = 5875$lb.

MINUTES TO DECIMAL HOURS CONVERSION TABLE

Minutes	Hours	Minutes	Hours
1	.017	31	.517
2	.034	32	.534
3	.050	33	.550
4	.067	34	.567
5	.084	35	.584
6	.100	36	.600
7	.117	37	.617
8	.135	38	.634
9	.150	39	.650
10	.167	40	.667
11	.184	41	.684
12	.200	42	.700
13	.217	43	.717
14	.232	44	.734
15	.250	45	.750
16	.267	46	.767
17	.284	47	.784
18	.300	48	.800
19	.317	49	.817
20	.334	50	.834
21	.350	51	.850
22	.368	52	.867
23	.384	53	.884
24	.400	54	.900
25	.417	55	.917
26	.434	56	.934
27	.450	57	.950
28	.467	58	.967
29	.484	59	.984
30	.500	60	1.000

Calculate the reaction at R_2 due to loads in the plane H-4 to 0 by taking moments about H-4.

$$7.083R_2 = 130(0.333)+5418(2.5)+247(4.958)+285(6)$$
$$= 43.29+13{,}545+1224.626+1710$$
$$= 16{,}522.916$$
$$R_2 = 2333\text{lb}$$

or

$$R_2 = 130 + 5418 + 247 + 285 - 3747 = 2333\text{lb}$$

Solve for load and location of H-5 by taking moments about H-5.

$$2333(1.083+X)+285(X)$$
$$= 1728(4.792-X)+500(4.5+4.792-X)$$
$$2526.639+2333X+285X$$
$$= 8280.576-1728X+2250+2396-500X$$
$$2333X+285X+1728X+500X$$
$$= 8280.576+2250+2396-2526.639$$
$$4846X = 10{,}399.937$$
$$X = 2.146' = 2'\text{-}1\tfrac{3}{4}''$$

Location of H-5 is $2'\text{-}1\frac{3}{4}'' + 1'\text{-}1'' = 3'\text{-}2\frac{3}{4}''$ from 0.
Check

$$2333(3.229) = 7533.257$$
$$285(2.146) = 611.610$$
$$8144.867 \text{ ft lb}$$
$$1728(2.646) = 4572.288$$
$$500(7.146) = 3573.000$$
$$8145.288 \text{ ft lb}$$

Take moments about R_2 to solve for H-5.

$$3.229H\text{-}5 = 285(1.083)+1728(5.875)+500(10.375)$$
$$= 308.655+10{,}152+5187.5$$
$$= 15{,}648.155$$
$$H\text{-}5 = 4846\text{lb}$$

or

$$H\text{-}5 = 2333 + 285 + 1728 + 500 = 4846\text{lb}$$

Summary:

The loads to be supported by each of the seven hangers as determined in the foregoing calculations are as follows:

H-1 = 5065lb
H-2 = 4762lb
H-3 = 7979lb
H-4 = 5875lb
H-5 = 4846lb
H-6 = 1156lb
H-7 = 1800lb

MINUTES TO DECIMAL HOURS CONVERSION TABLE

Minutes	Hours	Minutes	Hours
1	.017	31	.517
2	.034	32	.534
3	.050	33	.550
4	.067	34	.567
5	.084	35	.584
6	.100	36	.600
7	.117	37	.617
8	.135	38	.634
9	.150	39	.650
10	.167	40	.667
11	.184	41	.684
12	.200	42	.700
13	.217	43	.717
14	.232	44	.734
15	.250	45	.750
16	.267	46	.767
17	.284	47	.784
18	.300	48	.800
19	.317	49	.817
20	.334	50	.834
21	.350	51	.850
22	.368	52	.867
23	.384	53	.884
24	.400	54	.900
25	.417	55	.917
26	.434	56	.934
27	.450	57	.950
28	.467	58	.967
29	.484	59	.984
30	.500	60	1.000