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Standard Guide for Measuring and Estimating Quantities of Insulated Piping and Components[1]

This standard is issued under the fixed designation C 1409; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

A committee of ASTM initiated this guide to improve industry-wide understanding of the components in an insulated piping system that affect the installed cost of insulating the system. The method of measurement standard used as a bias for this guide is the National Commercial and Industrial Standards.[2]

The American Society for Testing and Materials defines a guide as a series of options or instructions that does not recommend a specific course of action. A guide only suggests a course of action. Its purpose is to offer guidance based on a consensus of viewpoints, but not to establish a fixed procedure. A guide is intended to increase the awareness of the user to available techniques in a given subject area and to provide information from which subsequent evaluation and standardization can be derived.

It is the intention that this guide will help gain wider acceptance and understanding of the concepts in the MICA standard.

1. Scope

1.1 This guide defines the components of an insulated piping system to be measured or counted to determine quantities and pricing for unit price contracts or extra work.

1.2 Pricing may be done through unit pricing for each item by pipe size, type of insulation system, insulation thickness, double or multilayer insulation, type of weatherproofing or jacketing, and pressure rating (if necessary) or through component (fitting) factor or multipliers.

1.2.1 Component (fitting) factors or multipliers, which are multipliers times the straight length of piping as shown in Table 1, determine relative prices for each component not within the scope of this guide. These factors or multipliers are to be determined by the insulating contractor relative to the given situation and insulation system specification.

1.2.2 It is suggested that only one type of pricing be used on a project.

1.2.3 The values stated in inch-pound units are to be regarded as the standard.

2. Summary of Guide

2.1 This guide lists examples of components of piping systems which effect insulation cost. From this list, components to be counted are selected by the involved parties.

3. Significance and Use

3.1 This guide establishes procedures to help parties involved in unit price piping insulation contracts reach agreement as to what components will be counted for pricing purposes.

4. Procedure

4.1 For a unit price-type contract, establish unit prices for straight run piping. These unit prices should include pipe size, type of insulation system, insulation thickness, double or multilayer insulation, and type of weatherproofing or jacketing such as shown in the example in Table 1.

4.2 Determine the quantity of straight run pipe insulation by straight pipe measurement from centerline to centerline and include lengths of all in-line components. This method is defined as “measured through” (see Fig. X3.1).

4.3 Count the quantities of piping components. The piping components (fittings) to be counted may be modified by those listed in Table 2. The components should be categorized by pipe size, type of insulation system, insulation thickness, and pressure rating, if necessary. Table 2 may be used as a checklist to assist in the categorization.

4.4 The method of pricing (unit price per component or fitting factors) for each category will be determined by the terms of a request for quotation or commercial contract. However, users of this guide must be aware that selection of elements to be counted, categories, and method of measuring pipe, have a direct bearing on the final total price. Knowledge of this fact is critical to the selection of the most qualified installer.

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[1] This guide is under the jurisdiction of ASTM Committee C–16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.40 on Insulation Systems.

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[2] Further information is available from the Midwest Insulation Contractors Assn. (MICA), 2017 S. 139th Circle, Omaha, NE.

TABLE 1 Piping Unit Price Schedule, Hot Insulation, 0.016-in. Thick Aluminum Jacketing, Cost per Linear Foot (All Materials and Labor Necessary for a Complete Installation)

	1½	2	2½	3	3½	4	3½ DL[A,B]	4 DL[A,B]	4 DL[A,B]
2 and under									
2½									
3									
3½									
4									
6									
8									
10									
12									
14									
16									
18									
20									
24									
30									
Over 30 and									
Equipment									

[A]DL = Double layer.
[B]In some insulation systems, double-layer insulation may occur at smaller thickness.

4.5 For a unit price contract, each component shall have its own table categorized by pipe size, type of insulation system, insulation thickness, and pressure rating, if necessary.

5. Piping Components

5.1 Table 2 lists a sample of components which effect the cost of insulation on a piping system. The "Note" column is used when additional information is required to explain a component as it generally applies to the insulation industry.

5.2 Table 2 may be used as a checklist when choosing which components will be counted and when determining difficulty factors. However, for inclusion in contract or request for quote documents, a summary similar to Appendix X1 may be used.

6. Industry Examples

6.1 Examples of how components are categorized and made part of a unit price contract are shown in Appendix X1 and Appendix X2. These examples provide a range of possibilities.

6.2 Examples of unit pricing by component are shown in Appendix X3. One of these schedules, fitting factors, or multipliers will be required for each component.

6.3 The method of measurement and how straight pipe equivalent factors are categorized are shown in Fig. X3.1. Fig. X3.1 is basically the MICA standard and depicts the "Centerline Measure Through" method of determining total quantity of straight run pipe.

7. Keywords

7.1 extra work; factors; fittings; insulated pipe; measure quantities; piping components; unit prices

TABLE 2 Piping Components

Components (Fittings)	Type				Note[A]
	Screwed	Welded	Flanged	Mitered	
Elbow:					1
Long radius 90°					
Long radius 45°					
Short radius 90°					
Short radius 45°					
Less than 45°					
Reducing					2
Bend:					
Radius greater than 1½ D					3
Valve (including Bonnet Flgd.)					6
Gate					
Globe					
Check					
Relief					
Angle					
Control					
Butterfly					
Special					
Valve (excluding Bonnet Flgd.)					6
gate					
globe					
check					
relief					
angle					
Control					
Butterfly					
Special					
Flange:					
Line					
Blind					
Orifice (plate)					
Tee:					4
Straight					
Reducing					2
Strainer					
Lateral (Y-branch)					2
Cross					
Cap					
Bevel					
Reducer:					
Concentric					2
Eccentric					
Union					
Boss					
Stub-in:					
Sockolet					4
Weldolet					
Thredolet					
Thermoweld					
Steam trap					
Expansion joint					
Hanger					
Support					
Patchwork					
Open area (comeback)					5
Instruments					
Instrument tubing					

[A]The following are explanations of Notes 1 to 6:

1. "Mitered" applied to elbows only.
2. Count as larger pipe size.
3. Measure actual length of bend.
4. Items under stub-in category do not count as tees.
5. Areas such as field welds that contractually cannot be insulated at the same time as straight run pipe.
6. Components shall be categorized by pressure rating where applicable.

APPENDIXES

(Nonmandatory Information)

X1. INDUSTRY EXAMPLE 1

X1.1 The piping components to be counted for unit price contract are as follows:

1. Screwed valves (complete).
2. Screwed unions.
3. Screwed reducers, caps, ells, tees, and y-branches.
4. Traps.
5. Bent pipe, 2 through 6 in.
6. Bent pipe, 8 through 12 in.
7. Bent pipe, 14 through 24 in.
8. Bent pipe, 30 through 36 in.
9. Welded valves (bodies only).
10. Welded valves bonnet.
11. Pair of flanges, ½ through 12 in.
12. Pair of flanges, 12 through 24 in.
13. Pair of flanges, 30 through 36 in.
14. Flanged valves (bodies only).
15. Flanges valves (bodies and bonnets, including bonnet, flanges).
16. Flanged valves, complete (including body, bonnet, and flanges) ½ to 4 in.
17. Flanged valves, complete (including body, bonnet, and flanges) 6 to 12 in.
18. Flanged valves, complete (including body, bonnet, and flanges) 12 to 20 in.
19. Flanged valves, complete (including body, bonnet, and flanges) 24 in.
20. Flanged valves, complete (including body, bonnet, and flanges) 30 in.
21. Flanged valves, complete (including body, bonnet, and flanges) 36 in.
22. Welded ells.
23. Welded tees.
24. Welded y-branches.
25. Welded caps.
26. Welded (bosses) outlets.
27. Insulation bevels.
28. Expansion joints.
29. Removal of existing, already-installed insulation.
30. Removal of not-yet-installed insulation from lump sum contract price.
31. Weld areas left open for testing and inspection.
32. Stub-outs, hangers, and supports on hot piping.
33. Stub-outs, hangers, and supports on cold piping.

NOTE X1.1—All pipe bends less than 2-in. NPS shall be priced as ells.

NOTE X1.2—The preceding factors for flanges, weld valves, and flanged valves are based on 150 and 300-lb class. Request additional factors for higher pressure ratings.

NOTE X1.3—Factors for bent pipe are for each lineal foot of bend.

NOTE X1.4—Traced piping will be priced at the next listed size larger than the pipe covering size required to go over the line and its tracers.

X2. INDUSTRY EXAMPLE 2

X2.1 The piping components to be counted or measured for unit price contract are as follows:

1. Straight runs (lineal feet-LF).
2. Elbows (each).
3. Flanges (each).
4. Valves (each).
5. Tees with smallest connection greater that 3½ in. (each).

X2.2 Measurements for straight runs are made from centerline to centerline through all insulated or uninsulated components of an insulated line in accordance with 4.1.

X2.3 A flange connection (a pair of flanges) is counted as one flange.

X2.4 Valves, control valves, check valves, three-way valves, and strainers are counted as valves. If these components are flanged they will be identified as flanged valves and will include flange connections and bonnet flange as applicable.

X2.5 Traced piping will be priced at the next listed size larger than the pipe covering size required to go over the line and its tracer.

X2.6 The unit price for instrument tubing shall be the same as that for piping. The unit price for instruments shall be the price of the size of pipe insulation required to cover the instrument.

X2.7 The unit price for bundled tube or pipe shall be the price of the size pipe insulation required to cover the bundle.

X3. EXAMPLES OF UNIT PRICING BY COMPONENT

X3.1 Examples of unit pricing by component are shown in Tables X3.1-X3.4. Method of measurement and straight pipe equivalent factors are shown in Fig. X3.1.

TABLE X3.1 Unit Price Schedule Hot Insulation, 0.016-In. Thick Aluminum Jacketing, Cost Per Long Radius 90° Elbow All Materials And Labor Necessary For A Complete Installation

Pipe Size (NPS), in.	Insulation Thickness, in.								
	1½	2	2½	3	3½	4	3½ DL[A,B]	4 DL[A,B]	4½ DL[A,B]
2 and under									
2½									
3									
3½									
4									
6									
8									
10									
12									
14									
16									
18									
20									
24									
30									
Over 30 and Equipment									

[A]DL = Double layer.
[B]In some insulation systems, double-layer insulation may occur at smaller thickness.

TABLE X3.2 Unit Price Schedule, Hot Insulation, 0.016-In. Thick Aluminum Jacketing, Cost Per 150-Lb Gate Valve, Including Bonnet Flanges (All Materials And Labor Necessary For A Complete Installation)

Pipe Size (NPS), in.	Insulation Thickness, in.								
	1½	2	2½	3	3½	4	3½ DL[A,B]	4 DL[A,B]	4½ DL[A,B]
2 and under									
2½									
3									
3½									
4									
6									
8									
10									
12									
14									
16									
18									
20									
24									
30									
Over 30 and Equipment									

[A]DL = Double layer.
[B]In some insulation systems, double-layer insulation may occur at smaller thickness.

TABLE X3.3 Unit Price Schedule Hot Insulation, 0.016-In. Thick Aluminum Jacketing, Cost Per 300-Lb Globe Valve, Excluding Bonnet Flanges (All Materials And Labor Necessary For A Complete Installation)

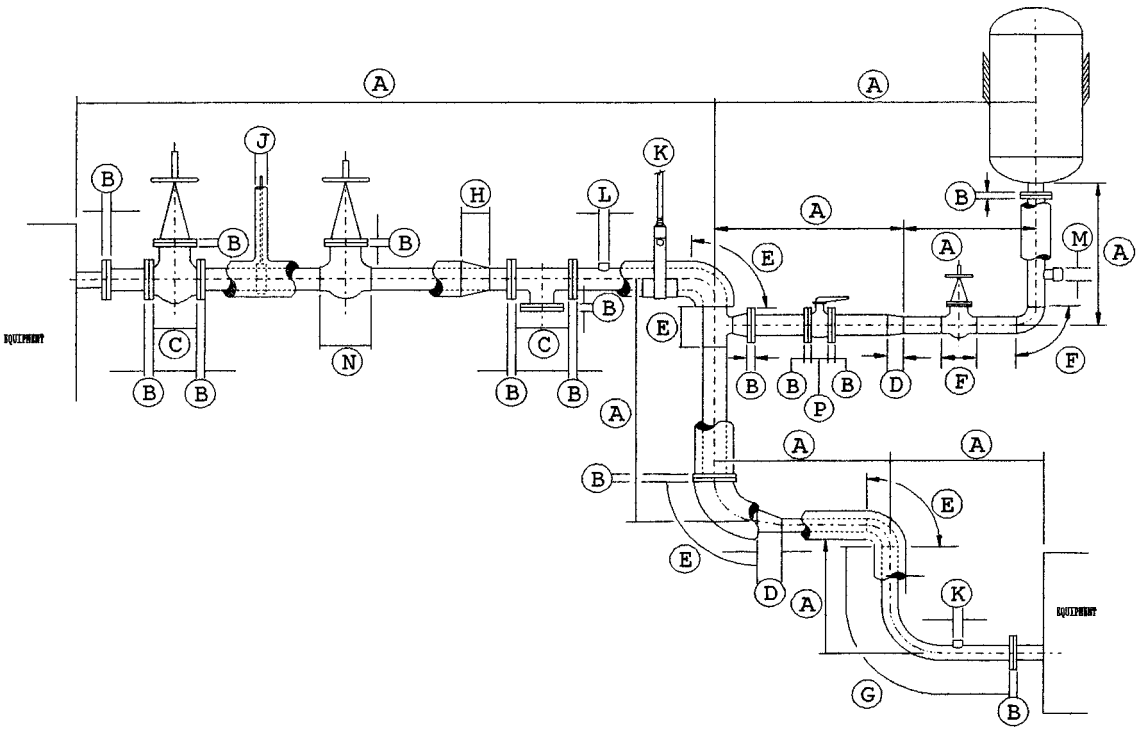
Pipe Size (NPS), in.	Insulation Thickness, in.								
	1½	2	2½	3	3½	4	3½ DL[A,B]	4 DL[A,B]	4½ DL[A,B]
2 and under									
2½									
3									
3½									
4									
6									
8									
10									
12									
14									
16									
18									
20									
24									
30									
Over 30 and Equipment									

[A]DL = Double layer.
[B]In some insulation systems, double-layer insulation may occur at smaller thickness.

TABLE X3.4 Unit Price Schedule, Hot Installation, 0.016-In. Thick Aluminum Jacketing, Cost Per 600-Lb Flange Pair All Materials And Labor Necessary For A Complete Installation

Pipe Size (NPS), in.	Insulation Thickness, in.								
	1½	2	2½	3	3½	4	3½ DL[A,B]	4 DL[A,B]	4½ DL[A,B]
2 and under									
2½									
3									
3½									
4									
6									
8									
10									
12									
14									
16									
18									
20									
24									
30									
Over 30 and Equipment									

[A]DL = Double layer.
[B]In some insulation systems, double-layer insulation may occur at smaller thickness.



ITEM	FACTOR
A. Linear feet of pipe	
B. Pair of flanges	
C. Bodies of flanged tees, valves and strainers	
D. Reducer (Largest pipe size)	
E. Welded fittings (Ells, tees, etc.)	
F. Screwed and socket welded fittings and valves	
G. Long radius bends (Greater than long radius ells)	
H. Tapered insulation (Terminations)	
J. Insulated hangers (Not supports)	
K. Welded couplings	
L. Caps	
M. Welded valve	
N. Butterfly valve	
P. Expansion joints	
R. Open welds	
S. Removal of insulation and weatherjacketing	

FIG. X3.1 Straight Pipe Equivalent Factors