EST.517

DACE Labor Productivity Norms – The New “Gulf Coast”?

Martin S. J. van Vliet

ABSTRACT— During 2008, a Special Interest Group was formed out of cost engineers from the process industry representatives to pick-up the challenge to establish a globally accepted standard for labor productivity norms for the industry. In February 2009, the Dutch Association of Cost Engineers (DACE) published a CD-ROM that provides guidance in the use of labor productivity norms for many of the disciplines which are involved in the construction and maintenance of industrial production facilities.

This paper will provide information on the level of information that should be provided for in the development of any labor productivity norm standards; and proposes that the DACE labor productivity norms, as an available published guideline, may become the new “Gulf Coast” labor productivity norm standards for the construction industries.

Table of Contents

List of Tables

List of Figures

Introduction

During 2008, a Special Interest Group (SIG) was formed out of Cost Engineering Process Industry representatives to pick-up the challenge to establish a globally accepted standard for labor productivity norms for the industry. In February 2009, the Dutch Association of Cost Engineers (DACE) published a CD-ROM that provides guidance in the use of labor productivity norms for many of the disciplines which are involved in the construction and maintenance of industrial production facilities.

For the purposes of this paper, a labor productivity norm is the number of labor hours (work effort) required to complete a defined construction activity, given the specific qualifications associated with each individual labor productivity norm. By definition, each labor productivity norm is a typical or average number of labor hours required by the collection of all individuals (i.e., crew) associated with the construction activity. For simplicity, we define a labor productivity norm as "a number of hours for an activity per unit of measurement."

The published DACE labor productivity norms provide consideration to activity descriptions, qualifications, location factors, indirect costs, overheads, profit and risk, condition and efficiency factors associated with each of the thousands of individual labor productivity norms with the intent of providing clarity to each one.

This paper will provide information on the level that should be provided for in the development of any labor productivity norm standards; and proposes that the DACE labor productivity norms, as an available, published, and comprehensive guideline, may become the new labor productivity norm standards for the construction industries supporting industrial production facilities.

This document contains examples and extracts from the complete publication by the DACE, and will provide sufficient information to allow you to obtain a general impression and the added value of this initiative.

The Usability of labor Productivity Norms and Unit-Rates

Definition of a labor Productivity Norm:
A labor productivity norm is the number of labor hours (work effort) required to complete a defined construction activity, given the specific qualifications associated with each individual labor productivity norm. By definition, each labor productivity norm is a typical or average number of labor hours required by the collection of all individuals (i.e., crew) associated with the construction activity. For simplicity, we define a labor productivity norm as "a number of hours for an activity per unit of measurement."

Definition of a Unit-Rate:
A price to be paid and agreed upon for services performed. For example, technical work-hours will be paid for at the unit-rate agreed upon. Often field work is assigned to a subcontractor by the prime contractor on a unit-rate basis. For simplicity, we define a unit-rate as "a price per unit of measurement."

The difference between a labor productivity norm and a unit-rate is that there are no costs involved in a labor productivity norm, only hours. This makes it more usable for different industries and practices because costs are very much related to volumes, economic circumstances, availability, taxes, etc. labor productivity norms can easily be calibrated to the local circumstances by applying location factors.

labor productivity norms are used for:

1. Cost estimating, planning and cost control.
2. Tendering and contracting.
3. Standardization and world-wide use.
4. Correct definitions using qualifications and preambles.
5. Appling Location factors.
6. Measurement of productivity.
7. Efficiency evaluation. And,
8. Benchmarking.

A good definition of a labor productivity norm must include all of the following:

- General qualifications.
- Direct hours definition.
- Activity descriptions (preambles).
- labor rates definition.
- Productivity definition. And,
- Indirect costs definition.

Figure 1 - Built-Up of a labor Productivity Norm

Page and Nations ("Gulf Coast")

Page and Nations is a commercially available labor productivity norms standard considered by many to be reflective of "Gulf Coast" labor productivity.

Also knows as "**Estimator's Piping Man-Hour Manual**" by John S. Page, it is based on numerous time and method studies both in the shop and field on many piping jobs located on projects in the US, ranging in cost from $1,000,000 to $5,000,000.

It can be used 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 and is strictly for estimating direct labor in labor hours only. You will not find any costs for materials, equipment usage, warehousing and storing, fabricating, shop setup, 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.

According to John S. Page, the most important area to be considered before calculating labor costs is productivity efficiency. This is a must if the many labor hour tables are to be correctly applied. Productivity efficiency in conjunction with the production elements must be considered for each individual project.

By carefully analyzing many reports he has established an average productivity rate of 70 percent. All the labor hours or percentages in the manual are based on this percentage.

He has found 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. construction equipment and tools; and,
6. weather.

The five ranges of productivity efficiency percentages are:

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

Page and Nations and DACE Labor Productivity Norms

In comparison with DACE, the Page and Nations publication lacks many of the elements required for a comprehensive understanding of each individual labor productivity norm.

One of the biggest disadvantages of the Page and Nations system is that it includes the productivity factors in the labor rates, leaving the labor productivity norm itself unaffected by any of the conditions. So this means, for example, you will not be able to measure and apply different location and other adjustment factors to the labor productivity norms themselves.

Below you can find a comparison table between the principles and characteristics of the Page and Nations and DACE Labor Productivity Norms systems.

Description	Page & Nations	DACE labor productivity norms
Same approach for all disciplines	++	++
Completeness	++	+
Definition of Preambles	+	++
Definition of Qualifications	-	++
Description of the productivity	++	++
Productivity included in labor Rate	--	++
Definition of Indirect costs	--	++
Measuring methods	--	++

Table 1 – Page & Nations vs. DACE Labor Productivity Norms

Description	Rating
Very Good	++
Good	+
Average	-
Poor	--

Table 2 - Rating Method

DACE Labor Productivity Norms

In order to introduce a new common labor productivity norms standard for the industry, a comprehensive quality framework containing definitions, boundaries, practical use, etc. has to be defined. To meet this goal, DACE has established qualifications and preambles, which describe the overall conditions and the scope descriptions of the labor productivity norms activities.

Qualifications and Preambles

The purpose of the qualifications is to provide guidance in the development and application of labor productivity norms for estimating. In parallel to the development of these labor productivity norms, consideration has been given to the application of location (productivity) factors, indirect costs, overheads, profit and risk, condition factors and/or efficiency factors.

Therefore the user should have a common understanding of the terminology used in this process to ensure clarity with regard to what is included in labor productivity norms, labor rates and those items that should be captured as derived costs (applying factors and other adjustments).

The preambles and qualifications to the labor productivity norms are intended to provide the basis for completeness and consistency in estimates. The preambles and qualifications are applicable for all types of installation work.

Qualifications

<u>Multipliers (correction factors)</u>
The DACE labor productivity norms levels are based on North West Europe (factor = 1.0 location / efficiency / productivity). Factors can be applied to adjust the labor productivity norms for other locations. The labor productivity norms are deemed to be all-inclusive. Reference is made to the preambles of the relevant disciplines where the scope of each individual norm is explained. In exceptional circumstances or special working conditions, a multiplier (correction factor) may be applied to the labor productivity norm. The labor productivity norms can also be adjusted by an efficiency factor related to the volume of work that is expected.

<u>Productivity</u>
Labor productivity is the amount of services that a craftsmen produces in a given amount of time (labor productivity norm), also referred to as the measured time required to execute a specified amount of work.

Productivity is defined as "the ratio of a volume measure of output to a volume measure of input."
Productivity is dependent on a number of factors:

- type of work;
- discipline; and,
- location.

Often these factors are included in the labor productivity norm and thus become a local labor productivity norm, and the basis for execution. For estimating purposed it is assumed that the “productivity factor” is 1.0.

<u>Efficiency</u>
Worker efficiency is measured in physical terms. Efficiency is measured as "the ratio of planned volume of output to the actual volume of output." The labor productivity norms can also be adjusted by an efficiency factor related to the volume of work that is expected.

Scheduled Overtime and Effect on Labor Productivity Norms

The labor productivity norms are based on normal working hours. When overtime operations are deemed necessary, this can result in decreased productivity or loss of efficiency. When overtime is scheduled for a longer period of time (for example to meet specific planning requirements), the labor productivity norms require a productivity factor correction for the inefficiency caused by long working hours (inefficiency = worked hours / calculated labor productivity norms for a specific activity).

Direct vs. Indirect

Direct costs are costs for materials, labor (including working foreman) and allowances that can be assigned to specific activities, including the set of tools and equipment required to execute the work.

Indirect costs are costs occurring during the execution of the work that cannot be assigned directly to specific activities (for example supervision). Indirect costs may include:

Site Facilities

Costs for site facilities are costs to prepare the construction site, the lay down areas, construction offices and warehouse. This includes all necessary supplies, including but not limited to: mobile scaffolds, warehouse interior, internal transport, and possible climate regulation. Also included are the costs for exploitation, hiring, maintenance, cleaning, heating, electricity, gas water and telephone costs etc.

Overhead

Overhead costs are costs in the indirect sphere that are relevant to the implementation of the work. This includes costs connected to using supervisory, executive and coordinating staff. In addition, overhead can include costs linked to obtaining required approvals, drawing and calculating work for the implementation, as-built, management, work preparation, permits, reports, material management, quality control and project controls. Initial safety introduction for mobilizing direct labor is also included in overhead costs.

Profit and Risk

Profit is the compensation a contractor receives as a component of the contract price. Risk is the compensation that a contractor receives as a component of the contract price for the risk that the contractor takes with regard to the implementation of the work.

Overview of Direct and Indirect

The following scheme gives an overview of how the direct hours, direct labor costs and indirect costs are applied and the total costs are derived.

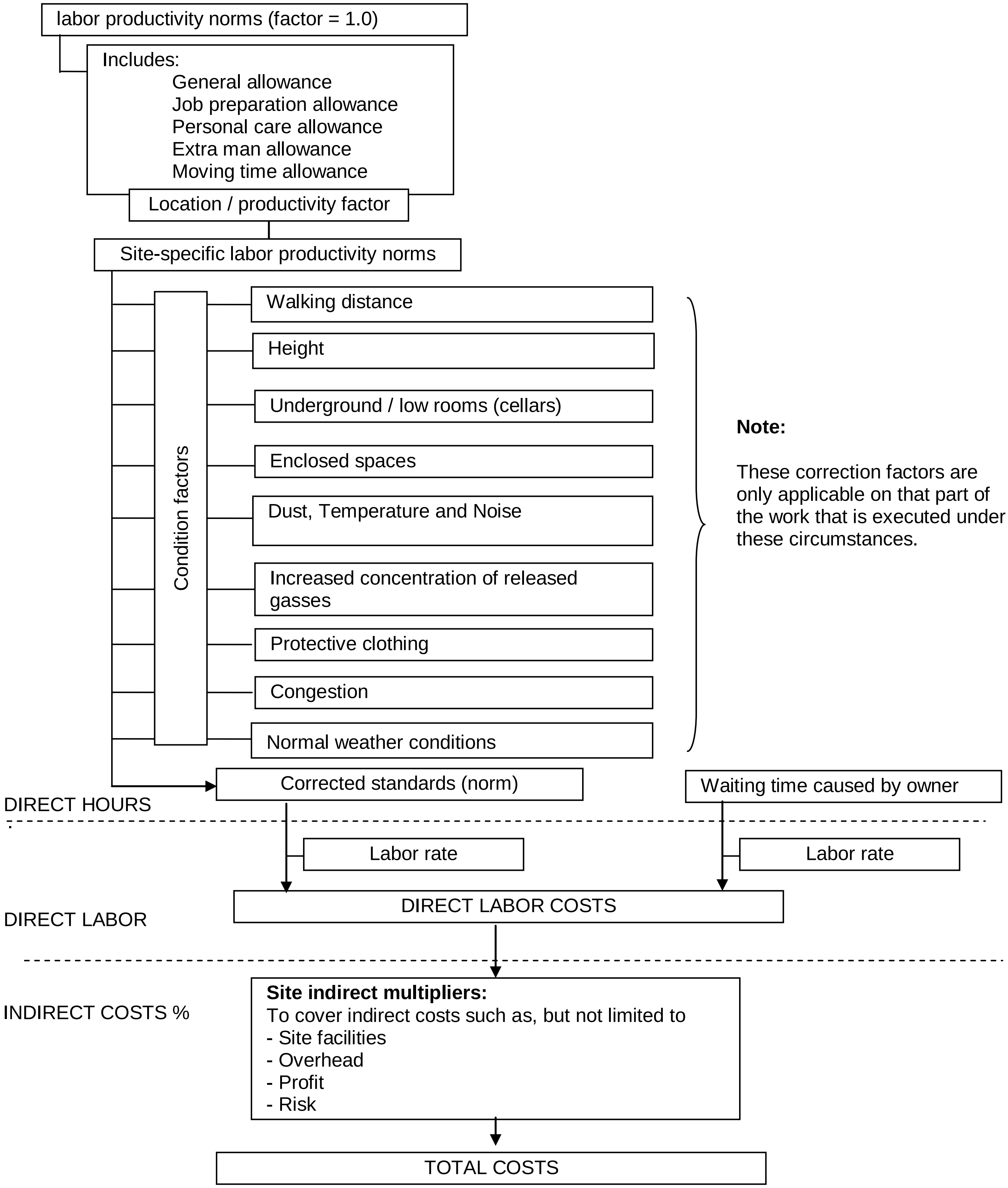

Figure 2 - An Overview of How the Direct Hours, Direct Labor Costs and Indirect Costs are Applied and the Total Costs are Derived

Measurement

The units of measurement to be used shall be as stated within the labor productivity norms and as defined within the preambles.

For example, for a work item for which the unit of measure is defined in meters (m) length, the measurement shall be the length measured along the central axis of the items.

All items of work are measured neat, as fixed in position, with no allowance made in the quantities for cut and waste.

Validity

The labor productivity norms assume that the activities can be carried out under normal conditions. These “normal conditions” are described in the sections below. For activities that are carried out under unusual conditions, condition factors may be applied. (i.e., to condition the activity to reflect the “abnormal condition”).

Conditions

The labor productivity norms can only be realized if the following conditions are met:

- good professionalism;
- good work preparation;
- good project organization;
- good instruction and supervision of assembly personnel;
- timely access to workplace, to sufficient good quality materials, tools, drawings, etc.; and,
- normal weather conditions.

Labor Productivity Norms

The labor productivity norms comprise the following:

The measured labor productivity norms are primarily determined on the basis of the working methods and safety/environmental requirements, as well as on national labor studies. The average labor productivity norms are obtained from the following:

- The labor productivity norms are based on the most efficient execution of the work task. This means applying the best work practices, using the correct tools, and having a minimal disturbance during the execution. Therefore the labor productivity norms are only applicable for all work that is executed under normal conditions, with experienced laborers, having a normal performance, using the correct tools and applying the best working method.

- Labor productivity norms are expressed in the labor hours, required for the direct personnel to complete a work task. A labor productivity norm is an indication of the level of effort required to complete a given work task. It is not duration. The duration time is the period between the start of the implementation and the end of a task or more tasks. To calculate the duration time, the number of laborers required will need to be taken into account.

Preambles

The following sections provide examples of the discipline-specific preambles. The preambles provide information required to understand each specific work task included in the DACE Labor Productivity Norms.

Note that all the examples use the European nomenclature (the comma separates the decimal).

Piping

This section includes labor productivity norms and allowances (correction factors) for piping activities according to ASA and DIN. Pipe sizes included in the labor productivity norms range from ⅛” up to and including 48,” and includes material factors for welding.

The measuring system is intended to support the settlement and the assessment of the progress of piping installation.

The DACE tables specify labor productivity norms for the different nominal bores and wall thicknesses for each measured item. Please note that the unit of quantity (‘1’, viz. per 1 m, per 1 piece, per 1 kg etc.) is always applicable to this labor productivity norm.

In establishing the linear meters, allowances are included in the labor productivity norm to account for the measurement to be taken from pipe center to pipe center or to flange front.

	Size ASA/DIN	34" / 850										
	Outside diameter in mm	864,0										
	Wallthickness in mm	6,3	7,1	7,9	8,8	9,5	11,0	12,7	14,2	15,9	17,5	20,0
	Schedule			10		STD		20 XS		30	40	
1,1	Installation of pipe in plant (ISBL)	2,74	3,02	3,31	3,62	3,86	4,37	4,94	5,43	5,98	6,49	7,28
1,2	Install pipe on sleepers/ in rack (OSBL)	2,33	2,57	2,81	3,08	3,28	3,72	4,20	4,62	5,08	5,52	6,18
2,1	Fitting with 1 end	5,03										
2,2	Fitting with 2 ends	7,18										
2,3	Fitting with 3 ends	9,34										
3,1	Butt weld	10,16	10,68	11,23	11,89	12,43	13,67	15,19	16,64	18,39	20,14	23,06
3,2	Fillet weld	6,10	6,41	6,74	7,13	7,46	8,20	9,12	9,98	11,04	12,08	13,83
3,3	Mittre weld	13,21	13,88	14,60	15,45	16,16	17,77	19,75	21,63	23,91	26,18	29,97
3,4	Branch weld	16,26	17,08	17,96	19,02	19,89	21,87	24,31	26,63	29,43	32,22	36,89
3,5	Reinforcing ring	18,09	19,01	19,99	21,16	22,12	24,33	27,04	29,62	32,74	35,85	41,04
3,6	Olet weld											
3,7	Cutting pipe in case of changes	1,52	1,60	1,68	1,78	1,86	2,05	2,28	2,50	2,76	3,02	3,46
4,1	Flange connection 150# , PN 10-16	7,75										
4,2	Flange connection 300# , PN 25-40	8,72										
4,3	Flange connection 600#- 900# , PN 64-160	9,68										
4,4	Flange connection 1500#-2500# , PN 250-320	10,85										
4,5	Spectacle blind, blind flange, spade	1,55										
4,6	Bending of pipe											
4,7	Cutting thread											
4,8	Threaded connection											
5,1	Installation of valve 150# , PN 10-16	14,45										
5,2	Installation of valve 300# , PN 25-40	16,26										
5,3	Installation of valve 600#- 900# , PN 64-160	18,06										
5,4	Installation of valve 1500#- 2500# , PN 250-320	20,23										
5,5	Installation of valve incl. drive	5,78										
5,6	Installation of wafer-type valve	5,78										
6,1	Pressure testing : hydrostatic/pneumatic	0,62										

Table 3 - Piping Labor Productivity Norms Table

<u>Example of an Estimate Using Labor Productivity Norms</u>

With the information below you will be able to see a practical example how labor productivity norms can be applied in a cost estimate using a drawing and scope of work.

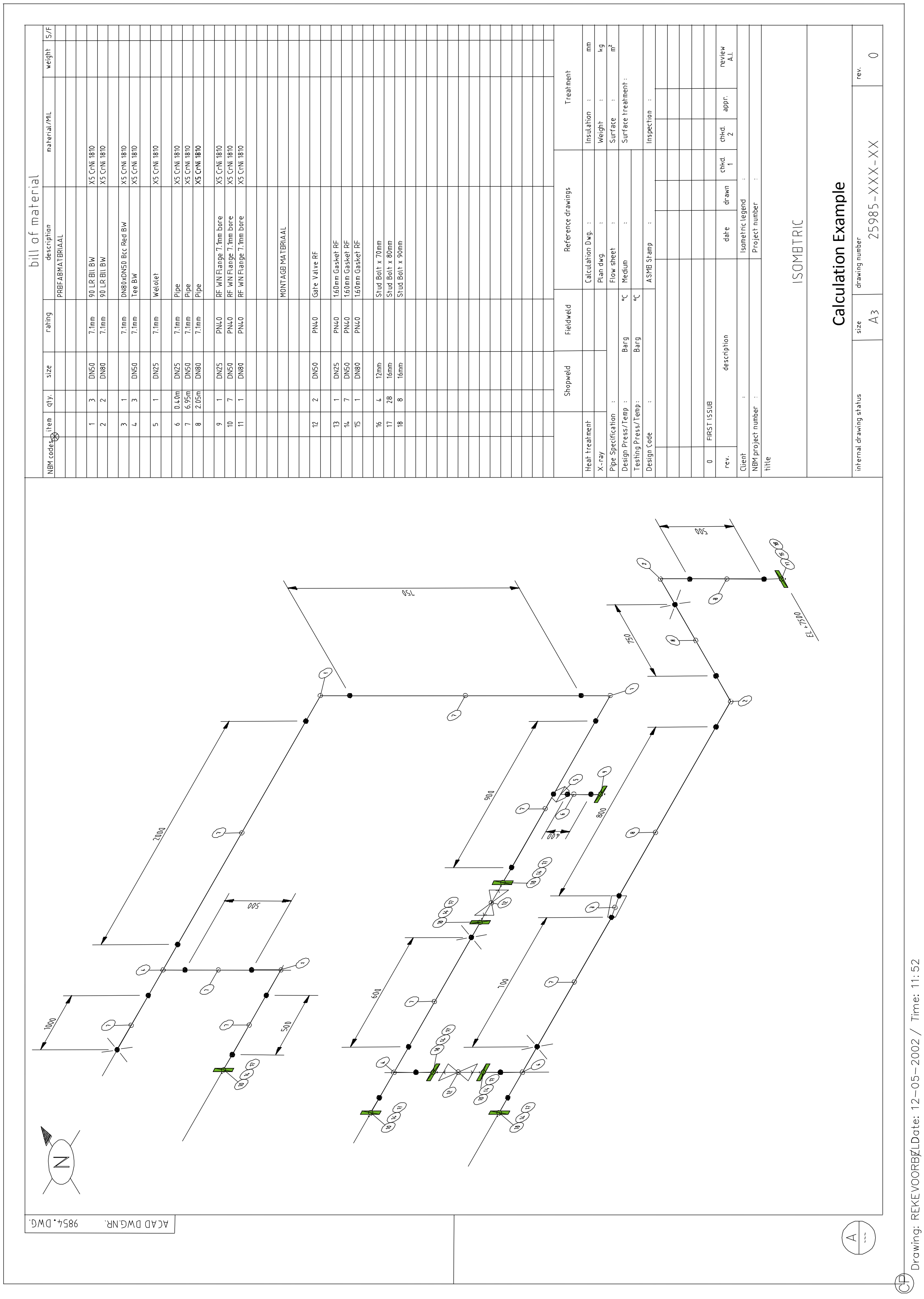

Figure 3 - Piping Isometric

DEFINE SCOPE OF WORK

Installation : For piping installation work under special conditions, correction factors can be applied.

Rates and cost as used are indicative !

Activities to be performed :

			Nom. Diam		
			1"/25	2"/50	3"/80
1.1	Installation of pipe in plant (ISBL)		400	2000	800
				500	750
				500	500
				750	
				900	
				1000	
				600	
				700	
	Total [mm]		400	6950	2050
	Total [m]		0.4	7.0	2.1
1.2	Install pipe on sleepers/in rack (OSBL)				
2.1	Fitting with 1 end	Flange	1	7	1
2.2	Fitting with 2 ends	Elbow		3	2
		Reducer			1
2.3	Fitting with 3 ends	Tee		3	
3.1	Butt weld		2	20	6
	of which : prefab welds		2	17	5
	field welds			3	1
3.2	Fillet weld				
3.3	Mittre weld				
3.4	Branch weld				
3.5	Reinforcing ring				
3.6	Olet weld		1		
3.7	Cutting pipe in case of changes				
4.1	Flanged-connections	150# , PN 10-16			
4.2		300# , PN 25-40	1	7	1
4.3		600#- 900# , PN 64-160			
4.4		1500#- 2500# , PN 250-320			
4.5	Spectacle blind, blind flange, spades				
4.6	Bending of pipes				
4.7	Cutting thread				
4.8	Threaded connection				
5.1	Installation of valve	150# , PN 10-16			
5.2		300# , PN 25-40		2	
5.3		600#- 900# , PN 64-160			
5.4		1500#- 2500# , PN 250-320			
5.5		Incl. drive			
5.6	Installation of wafer-type valve				
6.1	Pressure testing : hydrostatic/pneumatic [mm]		500	9000	2700

Table 4 - Piping Isometric Scope of Work

CALCULATION LABOUR NORMS

Size DIN: 1" / 25 — Outside diameter in mm: 33,4 — Thickness in mm: 2,8 — Schedule: 10S

No.	Item	A: Labour Norms	C1: Material	C2: Height	C3: ——	C4: ——	D: Total (D=C1xC2xC3xC4)	E: Number of units	F1: Subtotal labour norms, Prefabrication (F1 =AxC1xE)	F2: Subtotal labour norms, Installation (F2 =AxDxE)
1,1	Installation of pipe in plant (ISBL)	0,26	1,00	1,10	1,00	1,00	1,10	0,4	0,10	0,11
1,2	Install pipe on sleepers/in rack (OSBL)	0,22	1,00	1,00	1,00	1,00	1,00			
2,1	Fitting with 1 end	0,22	1,00	1,10	1,00	1,00	1,10	1	0,22	0,24
2,2	Fitting with 2 ends	0,31	1,00	1,00	1,00	1,00	1,00			
2,3	Fitting with 3 ends	0,40	1,00	1,00	1,00	1,00	1,00			
3,1	Butt weld — Prefabrication	0,55	1,30	1,00	1,00	1,00	1,30	2	1,43	
	Butt weld — Field	0,55	1,30	1,10	1,00	1,00	1,43			
3,2	Fillet weld	0,33	1,00	1,00	1,00	1,00	1,00			
3,3	Mitre weld	0,72	1,00	1,00	1,00	1,00	1,00			
3,4	Branch weld	0,88	1,00	1,00	1,00	1,00	1,00			
3,5	Reinforcing ring	0,98	1,00	1,00	1,00	1,00	1,00			
3,6	Olet weld	1,09	1,30	1,00	1,00	1,00	1,30	1	1,42	
3,7	Cutting pipe in case of changes	0,08	1,00	1,00	1,00	1,00	1,00			
4,1	Flange-connection 150# , PN 10-16	0,50	1,00	1,00	1,00	1,00	1,00			
4,2	Flange-connection 300# , PN 25-40	0,56	1,00	1,10	1,00	1,00	1,10	1		0,62
4,3	Flange-connection 600#- 900# , PN 64-160	0,62	1,00	1,00	1,00	1,00	1,00			
4,4	Flange-connection 1500#- 2500# , PN 250-320	0,70	1,00	1,00	1,00	1,00	1,00			
4,5	Spectacle blind, blind flange, spader	0,10	1,00	1,00	1,00	1,00	1,00			
4,6	Bending of pipes	0,21	1,00	1,00	1,00	1,00	1,00			
4,7	Cutting thread	0,12	1,00	1,00	1,00	1,00	1,00			
4,8	Threaded connection	0,10	1,00	1,00	1,00	1,00	1,00			
5,1	Installation of valve 150# , PN 10-16	0,31	1,00	1,00	1,00	1,00	1,00			
5,2	Installation of valve 300# , PN 25-40	0,35	1,00	1,10	1,00	1,00	1,10			
5,3	Installation of valve 600#- 900# , PN 64-160	0,39	1,00	1,00	1,00	1,00	1,00			
5,4	Installation of valve 1500#- 2500# , PN 250-320	0,44	1,00	1,00	1,00	1,00	1,00			
5,5	Incl. drive	0,13	1,00	1,00	1,00	1,00	1,00			
5,6	Installation of wafer-type valve	0,06	1,00	1,00	1,00	1,00	1,00			
6,1	Press. testing : hydrostatic/pneumat	0,04	1,00	1,10	1,00	1,00	1,10	0,5		0,02
	Total labour norms								3,17	0,99

Size DIN: 2" / 50 — Outside diameter in mm: 60,3 — Thickness in mm: 2,8 — Schedule: 10S

No.	Item	A: Labour Norms	C1: Material	C2: Height	C3: ——	C4: ——	D: Total (D=C1xC2xC3xC4)	E: Number of units	F1: Subtotal labour norms, Prefabrication (F1 =AxC1xE)	F2: Subtotal labour norms, Installation (F2 =AxDxE)
1,1	Installation of pipe in plant (ISBL)	0,31	1,00	1,10	1,00	1,00	1,10	7,0	2,17	2,39
1,2	Install pipe on sleepers/in rack (OSBL)	0,26	1,00	1,00	1,00	1,00	1,00			
2,1	Fitting with 1 end	0,36	1,00	1,10	1,00	1,00	1,10	7	2,52	2,77
2,2	Fitting with 2 ends	0,52	1,00	1,10	1,00	1,00	1,10	3	1,56	1,72
2,3	Fitting with 3 ends	0,67	1,00	1,10	1,00	1,00	1,10	3	2,01	2,21
3,1	Butt weld — Prefabrication	0,81	1,30	1,00	1,00	1,00	1,30	17	17,90	
	Butt weld — Field	0,81	1,30	1,10	1,00	1,00	1,43	3		3,47
3,2	Fillet weld	0,48	1,00	1,00	1,00	1,00	1,00			
3,3	Mitre weld	1,05	1,00	1,00	1,00	1,00	1,00			
3,4	Branch weld	1,29	1,00	1,00	1,00	1,00	1,00			
3,5	Reinforcing ring	1,44	1,00	1,00	1,00	1,00	1,00			
3,6	Olet weld	1,59	1,30	1,00	1,00	1,00	1,30			
3,7	Cutting pipe in case of changes	0,12	1,00	1,00	1,00	1,00	1,00			
4,1	Flange-connection 150# , PN 10-16	0,61	1,00	1,00	1,00	1,00	1,00			
4,2	Flange-connection 300# , PN 25-40	0,68	1,00	1,10	1,00	1,00	1,10	7		5,24
4,3	Flange-connection 600#- 900# , PN 64-160	0,76	1,00	1,00	1,00	1,00	1,00			
4,4	Flange-connection 1500#- 2500# , PN 250-320	0,85	1,00	1,00	1,00	1,00	1,00			
4,5	Spectacle blind, blind flange, spader	0,12	1,00	1,00	1,00	1,00	1,00			
4,6	Bending of pipes	0,36	1,00	1,00	1,00	1,00	1,00			
4,7	Cutting thread	0,20	1,00	1,00	1,00	1,00	1,00			
4,8	Threaded connection	0,17	1,00	1,00	1,00	1,00	1,00			
5,1	Installation of valve 150# , PN 10-16	0,63	1,00	1,00	1,00	1,00	1,00			
5,2	Installation of valve 300# , PN 25-40	0,70	1,00	1,10	1,00	1,00	1,10	2		1,54
5,3	Installation of valve 600#- 900# , PN 64-160	0,78	1,00	1,00	1,00	1,00	1,00			
5,4	Installation of valve 1500#- 2500# , PN 250-320	0,88	1,00	1,00	1,00	1,00	1,00			
5,5	Incl. drive	0,25	1,00	1,00	1,00	1,00	1,00			
5,6	Installation of wafer-type valve	0,13	1,00	1,00	1,00	1,00	1,00			
6,1	Press. testing : hydrostatic/pneumat	0,06	1,00	1,10	1,00	1,00	1,10	9,0		0,59
	Total labour norms								26,16	19,93

Size DIN: 3" / 80 — Outside diameter in mm: 88,9 — Thickness in mm: 3,1 — Schedule: 10S

No.	Item	A: Labour Norms	C1: Material	C2: Height	C3: ——	C4: ——	D: Total (D=C1xC2xC3xC4)	E: Number of units	F1: Subtotal labour norms, Prefabrication (F1 =AxC1xE)	F2: Subtotal labour norms, Installation (F2 =AxDxE)
1,1	Installation of pipe in plant (ISBL)	0,37	1,00	1,10	1,00	1,00	1,10	2,1	0,78	0,85
1,2	Install pipe on sleepers/in rack (OSBL)	0,31	1,00	1,00	1,00	1,00	1,00			
2,1	Fitting with 1 end	0,54	1,00	1,10	1,00	1,00	1,10	1	0,54	0,59
2,2	Fitting with 2 ends	0,77	1,00	1,10	1,00	1,00	1,10	3	2,31	2,54
2,3	Fitting with 3 ends	1,00	1,00	1,00	1,00	1,00	1,00			
3,1	Butt weld — Prefabrication	1,09	1,30	1,00	1,00	1,00	1,30	5	7,09	
	Butt weld — Field	1,09	1,30	1,10	1,00	1,00	1,43	1		1,56
3,2	Fillet weld	0,65	1,00	1,00	1,00	1,00	1,00			
3,3	Mitre weld	1,41	1,00	1,00	1,00	1,00	1,00			
3,4	Branch weld	1,74	1,00	1,00	1,00	1,00	1,00			
3,5	Reinforcing ring	1,94	1,00	1,00	1,00	1,00	1,00			
3,6	Olet weld	2,19	1,30	1,00	1,00	1,00	1,30			
3,7	Cutting pipe in case of changes	0,16	1,00	1,00	1,00	1,00	1,00			
4,1	Flange-connection 150# , PN 10-16	0,76	1,00	1,00	1,00	1,00	1,00			
4,2	Flange-connection 300# , PN 25-40	0,86	1,00	1,10	1,00	1,00	1,10	1		0,95
4,3	Flange-connection 600#- 900# , PN 64-160	0,95	1,00	1,00	1,00	1,00	1,00			
4,4	Flange-connection 1500#- 2500# , PN 250-320	1,07	1,00	1,00	1,00	1,00	1,00			
4,5	Spectacle blind, blind flange, spader	0,15	1,00	1,00	1,00	1,00	1,00			
4,6	Bending of pipes		1,00	1,00	1,00	1,00	1,00			
4,7	Cutting thread	0,34	1,00	1,00	1,00	1,00	1,00			
4,8	Threaded connection	0,29	1,00	1,00	1,00	1,00	1,00			
5,1	Installation of valve 150# , PN 10-16	1,00	1,00	1,00	1,00	1,00	1,00			
5,2	Installation of valve 300# , PN 25-40	1,13	1,00	1,10	1,00	1,00	1,10			
5,3	Installation of valve 600#- 900# , PN 64-160	1,25	1,00	1,00	1,00	1,00	1,00			
5,4	Installation of valve 1500#- 2500# , PN 250-320	1,40	1,00	1,00	1,00	1,00	1,00			
5,5	Incl. drive	0,40	1,00	1,00	1,00	1,00	1,00			
5,6	Installation of wafer-type valve	0,20	1,00	1,00	1,00	1,00	1,00			
6,1	Press. testing : hydrostatic/pneumat	0,08	1,00	1,10	1,00	1,00	1,10	2,7		0,24
	Total labour norms								10,72	6,73

PART 3: COST CALCULATION

3.1 TOTAL LABOUR NORMS

		Prefabrication	Installation
Pipe spool nom. diameter	25	3,17	0,99
	50	26,16	19,93
	80	10,72	6,73
Total labour norms		40,05	27,65

3.2 RATES

RATES (INDICATIVE)	EURO/LABOUR NORM
Rate prefabrication	50,00
Rate field	70,00

3.3 COST

COST (INDICATIVE)	LABOUR NORMS		EURO/LABOUR NORM		EURO
Prefab part	40,05	x	50,00	=	2.003
Field part	27,65	x	70,00	=	1.936
Total					3.939

Table 5 - Piping Estimate Example

Insulation

This section includes descriptions for thermal insulation and specifies requirements and recommendations for external thermal insulation of above ground surfaces of equipment and piping.

This section is based on the Committee Insulation Netherlands Industry (CINI) manual, "**Insulation for Industries**." DACE follows the CINI standard as much as possible regarding technical recommendations and common practices. However DACE uses a different interpretation for the method of measurement than described, according to CINI, in order to be more in line with the other disciplines.

The CINI Foundation is an institution in which both principals and contractors cooperate. The CINI manual is meant to serve as a tool for designers, purchasers, installers and inspectors in determining the optimal insulation for all common situations. For this purpose, the experience of specialists from dozens of companies were gathered and documented in integrated specifications.

Insulation is defined as those materials or combinations of materials, which retard the flow of heat energy by performing one or more of the following functions:

1. Conserve energy by reducing heat loss or gain;
2. Control surface temperatures for personnel protection and comfort;
3. Facilitate temperature control of process;
4. Prevent vapour flow and water condensation on cold surfaces;
5. Increase operating efficiency of heating/ventilating/cooling, plumbing, steam, process and
1. power systems found in commercial and industrial installations;
6. Prevent or reduce damage to equipment from exposure to fire or corrosive atmospheres;
7. Assist mechanical systems in meeting criteria in food and cosmetic plants; and,
8. Reduce emissions of pollutants to the atmosphere.

<u>Layers of Insulation</u>

Insulation shall be applied in a minimum number of layers of commercially available thicknesses. The total thickness shall be as close as possible to the most economic insulation thickness required, and shall be rounded off to the next largest commercially available thickness.

To reduce heat losses, insulation applied in two or more layers shall have staggered joints.
Circumferential joints between segments in adjacent lengths of pre-formed rigid insulation shall also be staggered.

If economically attractive, a combination of not more than two different insulating materials may be used.

<u>Insulation thickness</u>

Criteria for the table below are:

- Ambient temperature: 25°C
- Wind velocity: 1 m / s

Normal operating temperature in °C

Nominal pipe diameter (inch)	Normal operating temperature in °C											
	<50	51 - 100	101 - 150	151 - 200	201 - 250	251 - 300	301 - 350	351 - 400	401 - 450	451 - 500	501 - 550	551 - 600
	(HOT INSULATION) Minimum insulation thickness (mm)											
< 1"	30	30	30	30	40	40	50	50	60	60	70	70
1"	30	30	30	30	40	40	50	50	60	60	70	70
1.5"	30	30	30	40	50	50	60	60	70	80	80	80
2"	30	30	40	40	60	60	60	70	80	80	90	90
3"	30	30	40	50	60	70	70	80	80	90	90	90
4"	30	50	50	60	60	70	80	90	90	100	100	100
6"	50	50	50	70	70	90	90	100	100	100	120	120
8"	50	50	60	80	90	100	100	110	120	130	130	130
10”	50	50	70	80	90	100	100	110	120	140	140	150
12"	50	50	70	80	90	100	110	120	140	140	140	150
14"	50	60	70	90	100	110	110	120	140	150	150	150
16"	50	60	70	90	100	110	120	120	150	150	150	150
18"	50	60	80	100	120	120	120	150	150	150	150	160
20"	50	70	80	100	120	120	120	150	150	150	150	160
> 20"	50	80	100	110	130	140	160	180	180	200	200	200
Equipment	50	80	100	110	130	140	160	180	180	200	200	200

Table 6 - Minimum Insulation Thickness

Jacketing

All insulated equipment (except for Polyurethane (PUR) / Polyisocyanuraat (PIR) on tank shells) and piping shall be protected with a jacketing system, such as metal, reinforced mastic, tapes or glass reinforced epoxy / glass reinforced plastic finishing.

The jacketing shall provide protection against water and weather, fire, oil spillage, mechanical wear or other damage. Due consideration shall be given to the choice of weatherproofing in terms of safety, life cycle cost, environmental/climate conditions, vulnerability to corrosion, effectiveness and maintainability.

If metal jacketing is used, sufficient space and drainage shall be provided to avoid internal accumulation of water caused by condensation, water vapor diffusion, capillary action and water ingress.

Outside diameter insulation (mm)	Minimum thickness sheeting (mm)				
	Aluminum	Aluminized steel	Aluzinc	Thermal galvanized steel	Stainless
< 140	0.6	0.56	0.5	0.5	0.5
140 – 300	0.8	0.8	0.8	0.8	0.8
> 300	1.0	0.8	0.8	0.8	0.8

Table 7 – Minimum Sheeting Thickness

Note: Aluminum sheets shall not be used as metallic jacketing for fire proofing of insulation.

<u>Activities Codes</u>

All insulation work required for the execution of activities are classified in the following groups:

Code 1: Removal of existing insulation
Activity comprises the removal of insulation material.

Code 2: Removal of existing sheeting
Activity comprises the removal of metal sheeting.

Code 3: Installation of existing insulation
Activity comprises the installation and marking of old, visual inspected and approved insulation material with preservation of the original insulation value, including marking.

Code 4: Installation of existing sheeting
Activity comprises the installation, marking and conditioning of old, qualitative in good shape, visual inspected and approved metal sheeting.

Code 5: Installation of new insulation
Activity comprises the installation of new insulation material.

Code 6P: Prefabrication of new sheeting
Activity comprises the prefabrication of new metal sheeting.

Code 6: Installation of new sheeting
Activity comprises the installation of new metal sheeting.

Hot Insulation Norms type Rockwool									
Size ASA/DIN	12" / 300								
Outside pipe diameter (mm)	323,9								
Insulation Thickness (mm)	30	40	50	60	70	80	100	120	140
Item Pipe (m) / Fittings & Valves (pc)	*Pipe*	*Pipe*	*Pipe*	*Pipe*	*Pipe*	*Pipe*	*Pipe*	*Pipe*	*Pipe*
Removal of existing insulation (1)	0,08	0,08	0,10	0,10	0,11	0,13	0,14	0,15	0,17
Removal of existing sheeting (2)	0,17	0,17	0,18	0,18	0,20	0,20	0,21	0,22	0,22
Erection of existing insulation (3)	0,16	0,19	0,23	0,26	0,30	0,33	0,40	0,47	0,53
Erection of existing sheeting (4)	0,39	0,40	0,42	0,43	0,44	0,46	0,47	0,49	0,52
Erection of new insulation (5)	0,20	0,24	0,29	0,33	0,38	0,41	0,50	0,59	0,66
Prefabrication of new sheeting (6P)	0,12	0,12	0,13	0,13	0,13	0,14	0,15	0,15	0,16
Erection of new sheeting (6)	0,30	0,31	0,32	0,33	0,34	0,35	0,36	0,38	0,40
Item Pipe (m) / Fittings & Valves (pc)	*Elbow*	*Elbow*	*Elbow*	*Elbow*	*Elbow*	*Elbow*	*Elbow*	*Elbow*	*Elbow*
Removal of existing insulation (1)	0,06	0,07	0,07	0,08	0,08	0,10	0,11	0,13	0,15
Removal of existing sheeting (2)	0,22	0,24	0,24	0,25	0,25	0,27	0,28	0,29	0,32
Erection of existing insulation (3)	0,25	0,29	0,34	0,38	0,42	0,46	0,56	0,66	0,76
Erection of existing sheeting (4)	0,65	0,69	0,72	0,74	0,77	0,81	0,86	0,92	0,99
Erection of new insulation (5)	0,31	0,36	0,42	0,47	0,53	0,58	0,70	0,82	0,95
Prefabrication of new sheeting (6P)	0,75	0,78	0,82	0,85	0,89	0,92	1,00	1,07	1,15
Erection of new sheeting (6)	0,50	0,53	0,55	0,57	0,59	0,62	0,66	0,71	0,76
Item Pipe (m) / Fittings & Valves (pc)	*Tee*	*Tee*	*Tee*	*Tee*	*Tee*	*Tee*	*Tee*	*Tee*	*Tee*
Removal of existing insulation (1)	0,07	0,07	0,08	0,08	0,09	0,10	0,11	0,12	0,13
Removal of existing sheeting (2)	0,13	0,13	0,15	0,15	0,16	0,16	0,17	0,18	0,18
Erection of existing insulation (3)	0,13	0,15	0,18	0,21	0,24	0,26	0,32	0,38	0,42
Erection of existing sheeting (4)	0,31	0,32	0,33	0,34	0,35	0,36	0,37	0,40	0,42
Erection of new insulation (5)	0,16	0,19	0,23	0,26	0,30	0,33	0,40	0,47	0,53
Prefabrication of new sheeting (6P)	0,20	0,20	0,20	0,20	0,20	0,20	0,20	0,20	0,20
Erection of new sheeting (6)	0,24	0,25	0,26	0,26	0,27	0,28	0,29	0,30	0,32
Item Pipe (m) / Fittings & Valves (pc)	*Reducer*	*Reducer*	*Reducer*	*Reducer*	*Reducer*	*Reducer*	*Reducer*	*Reducer*	*Reducer*
Removal of existing insulation (1)	0,05	0,05	0,06	0,06	0,07	0,08	0,08	0,09	0,10
Removal of existing sheeting (2)	0,10	0,10	0,11	0,11	0,12	0,12	0,13	0,13	0,13
Erection of existing insulation (3)	0,10	0,11	0,14	0,16	0,18	0,20	0,24	0,28	0,32
Erection of existing sheeting (4)	0,23	0,24	0,25	0,26	0,27	0,27	0,28	0,30	0,31
Erection of new insulation (5)	0,12	0,14	0,17	0,20	0,23	0,25	0,30	0,35	0,40
Prefabrication of new sheeting (6P)	0,20	0,20	0,20	0,20	0,20	0,20	0,20	0,20	0,20
Erection of new sheeting (6)	0,18	0,19	0,19	0,20	0,20	0,21	0,22	0,23	0,24

Table 8 - Insulation Labor Productivity Norms Table

Scaffolding

This section describes the points of attention and the activities for scaffolding. Furthermore, it gives examples for how to measure the most common types of scaffolding using sketches and calculation methods.

Together with a general checklist of the points of attention, scaffolding has been classified in types. For each type of scaffolding, a checklist for assembling the scaffolding types is included. This covers approximately 90 percent of all scaffolding. As an aid, the most common selection has been indicated.

Information regarding scaffolding construction can be obtained at the association of scaffolding companies in the Netherlands called “Vereniging van Steiger-, Hoogwerk- en Betonbekistingbedrijven” [VSB], section “Steigerbedrijven.”

<u>Independent Standing Scaffolding</u>

Definition:
A scaffold where the floor is supported by bracings (example 1), or suspensions to an existing construction or existing scaffolding (example 2).

Code	Checklist		Standard	Selection
ST	Material	Steel	√	
		Aluminum		
	Load	1.5 kN/m^2 (Class II)	√	
		3,0 kN/m^2 (Class III)		
	Type of Connection	Pin	√	
		Bolting		
	Safety harness	Hook-up obligation	√	
	Ladder[1]	Inside scaffolding	√	
		Outside scaffolding	√	
	One floor (top floor)		√	
	Earthing[2]		√	
	Safety swing gate[3]		√	
	Slide connection (security clamp) with "pipe connection"		√	
	Minimum dimension l, b and h = 2m		√	
	Minimum quantity to be settled		√	

Table 9 – Independent Scaffolding Checklist

Method of measurement, round off upwards to 0.5 m.

h = height: vertical distance between foot plate and the top of upper railing

b = width: measured centre to centre distance between outer posts in the transverse plane

l = length: measured centre to centre distance between outer posts in the front view

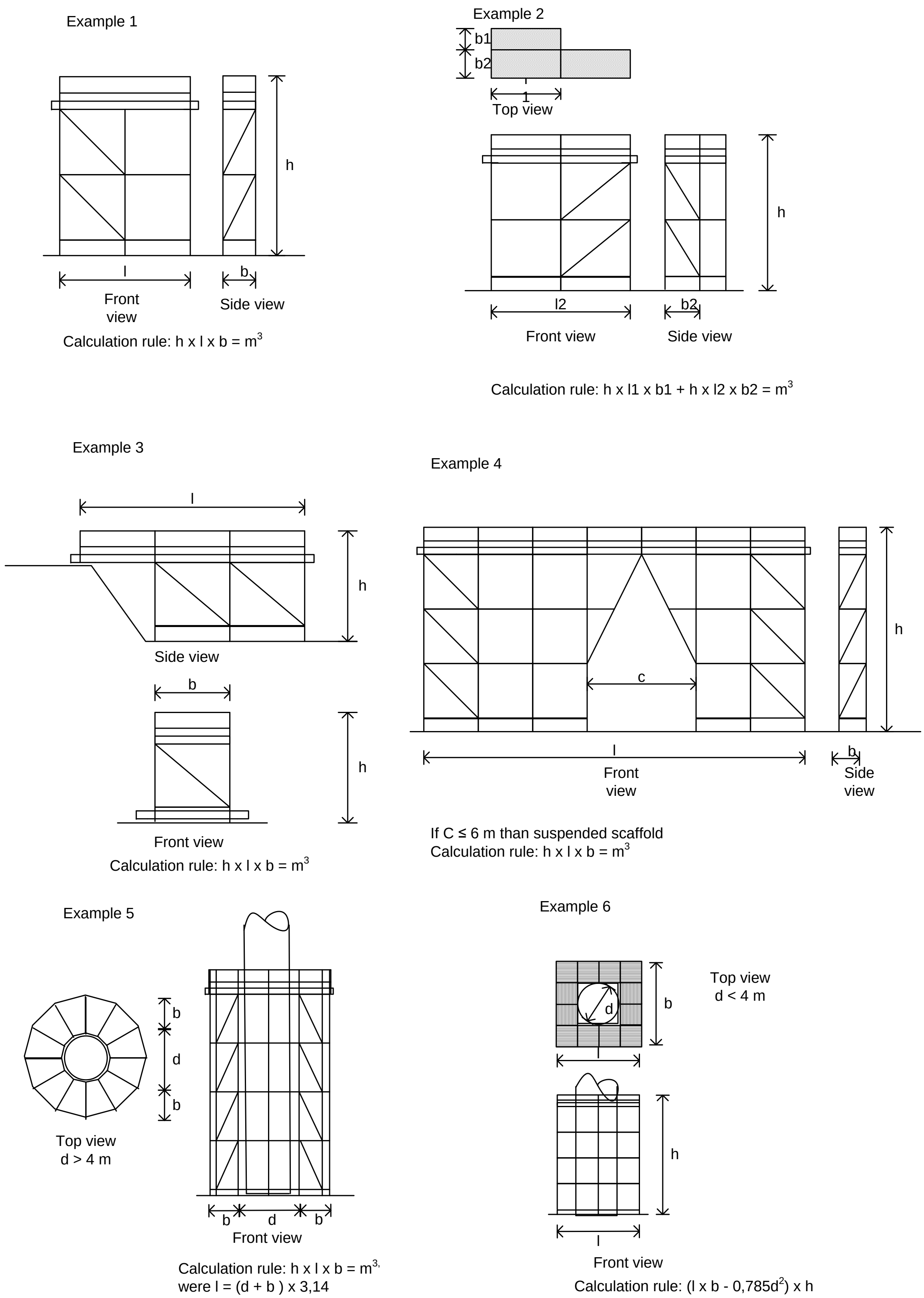

Figure 4 - Independent Scaffolding Examples

Painting

This section describes performance-based coating applicable for painting and coating. It is intended for all painting and coating contracts, including both new construction and maintenance of onshore facilities. It includes labor productivity norms for protection against external corrosion of both ferrous and non-ferrous metals.

This section includes descriptions for coating application and surface preparation and gives labor productivity norms for prefabrication and field work in the same manner as piping.

However, it does not apply for internal coatings, coating of buildings and other civil installations, equipment and components with a service temperature below minus 20°C or over 450°C or equipment where thermal shock may appear when in operation.

Surface Preparation

General

All edges shall be ground to a minimum radius of 2 mm and flame cut areas may have been ground flush. Blast cleaning of surfaces shall, as a general rule, be performed by blast cleaning as outlined in ISO 8504-2. Fabrication may be complete before surface preparation begins.

Pre-Cleaning of Surfaces

Prior to the blast cleaning and/or prior to any painting operation, the surface shall be free of any contamination and any excessive rust scale shall be removed.

All bolt-holes shall be solvent cleaned prior to the commencement of blast cleaning. Solvent cleaning shall be carried out in accordance with SSPC (Society for Protective Coatings), SP1 (Surface Preparation) “Solvent Cleaning.”

Cleaning of Surfaces

Blast cleaning shall continue for a minimum of 25 mm over any adjacent coated areas to feather the edges of the existing coating system. For local blast cleaning the edges of the existing coating system shall be angle-blasted to provide a feathered overlap.

Where pitting corrosion has been located during cleaning of surfaces, attention shall be given to the removal of residual salts.

Abrading with sandpaper or light grinding with a suitable (flexible) disc may be used for surface preparation where sweep blasting is not possible.

New Construction and Maintenance

The surface of carbon or low alloy steelwork for new construction and maintenance to existing installations shall be blast-cleaned to the visual standard in accordance with ISO 8501-1 at the time of coating.

Hand Tool Cleaning (St 2)

Removal of all rust scale, mill scale, loose rust and loose paint that can be accomplished by hand wire brushing, hand sanding, hand scraping, hand chipping or other hand impact tools, or by a combination of these methods. The substrate may have a faint metallic sheen and also be free of oil, grease, dust, soil, salts and other contaminants.

Power Tool Cleaning (St 3)

Removal of all rust scale, mill scale, loose paint, and loose rust that can be accomplished by power wire brushes, power impact tools, power grinders, power sanders or by a combination of these methods. The substrate may have a pronounced metallic sheen and also be free of oil, grease, dirt, soil, salts and other contaminants. Surface may not be buffed or polished smooth.

Brush-Off Blast Cleaning (SA 1)

Removal of loose mill scale, loose rust, and loose paint that can be accomplished by the impact of abrasives propelled through nozzles or by centrifugal wheels. It is not intended that the surface shall be completely free of all mill scale, rust, and paint. The remaining mill scale, rust, and paint may be tight and the surface may be sufficiently abraded to provide good adhesion and bonding of paint. A Brush-Off Blast Cleaned Surface Finish is defined as one from which all oil, grease, dirt, rust scale, loose mill scale, loose rust and loose paint or coatings are removed completely, but tight mill scale and tightly adhered rust, paint and coatings may remain provided that all mill scale and rust have been sufficiently exposed to the abrasive blast pattern so that numerous flecks of the underlying metal are uniformly distributed over the entire surface.

Commercial Blast Cleaning (SA 2)

Removal of mill scale, rust, rust scale, paint or foreign matter by the use of abrasives propelled through nozzles or by centrifugal wheels, to the degree specified. A commercial blast cleaned surface finish is defined as one from which all oil, grease, dirt, rust scale and foreign matter have been completely removed from the surface. In addition, all rust, mill scale and old paint have been completely removed except for slight shadows, streaks, or discolorations caused by rust stain, mill scale oxides or slight, tight residues of paint or coating that may remain. If the surface is pitted, slight residues of rust or paint may be found in the bottom of pits. At least two-thirds of each square inch of surface area shall be free of all visible residues and the remainder shall be limited to the light discoloration, slight staining or tight residues mentioned above.

Near-White Blast Cleaning (SA 2-1 / 2)

Removal of nearly all mill scale, rust, rust scale, paint, or foreign matter by the use of abrasives propelled through nozzles or by centrifugal wheels, to the degree hereafter specified. A near-white blast cleaned surface finish is defined as one from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter have been completely removed from the surface except for very light shadows, very slight streaks or slight discolorations caused by rust stain, mill scale oxides, or light, tight residues of paint or coating that may remain. At least 95 percent of each square inch of surface area shall be free of all visible residues, and the remainder shall be limited to the light discoloration mentioned above.

<u>Coating Application</u>

General

In general the requirements for the coating systems in this section are related to the coating application and to surface preparation.

Before commencing any painting work, the compatibility with existing coating systems or layers must be checked. Existing coating layers may be over coated only with products made by the same manufacturer.

To ensure that only correctly blasted surfaces are coated, a minimum of 100 mm around the edges of prepared areas shall be left uncoated, unless adjoining a coated surface. When adjoining a coated surface, the connection to the existing paint film shall be made as described in this sub-paragraph.
No coating shall be applied within 50 mm to areas that will be welded at a later time.

<u>New Construction</u>

General
Minimum coating requirements for new construction are specified in this paragraph for each field of service. Surface preparation shall be in accordance with this paragraph.
The coatings may be epoxy based.

Coating surfaces and system requirements

Carbon and low alloy steels – External

Service	*Min. Coating layers*	*Total Min. NDFT in microns*
Atmospheric zone -20 up to + 120°C	3	**300**
Atmospheric zone >120 up to 200°C	2	**200**
Atmospheric zone >200 up to 450°C	**3**	**100**

Table 10 - Coating Services CS Requirements

Stainless Steel – External

Service	*Min. Coating layers*	*Total Min NDFT in microns*
Atmospheric zone -20 up to 120°C	2	**250**
Atmospheric zone >120 up to 200°C	2	**200**
Atmospheric zone >200 up to 450°C	**2**	**50**

Table 11 - Coating Services SS Requirements

Example of a Labor Productivity Norms Table

Painting Norms (application only)					
Size ASA/DIN				12" / 300	
Outside diameter (mm)				323,8	
Painting systems			Prefab	Field	Total
Item Pipe (m) / Fittings, Welds & Vales (pc)	***Layer(s)***	***Thickness***	***Pipe***	***Pipe***	***Pipe***
Paint System CS -20 up to +120 Deg. C	3 Layer(s)	300µm	0,1148	0,0765	0,1913
Paint System CS >+120 up to +200 Deg. C	2 Layer(s)	200µm	0,0574	0,0765	0,1339
Paint System CS >+200 up to +450 Deg. C	3 Layer(s)	100µm	0,1148	0,0765	0,1913
Paint System SS -20 up to +120 Deg. C	2 Layer(s)	250µm	0,0574	0,0765	0,1339
Paint System SS >+120 up to +200 Deg. C	2 Layer(s)	200µm	0,0574	0,0765	0,1339
Paint System SS >+200 up to +450 Deg. C	2 Layer(s)	50µm	0,0574	0,0765	0,1339
Item Pipe (m) / Fittings, Welds & Vales (pc)	***Layer(s)***	***Thickness***	***Flange***	***Flange***	***Flange***
Paint System CS -20 up to +120 Deg. C	3 Layer(s)	300µm	0,0574	0,0383	0,0956
Paint System CS >+120 up to +200 Deg. C	2 Layer(s)	200µm	0,0287	0,0383	0,0669
Paint System CS >+200 up to +450 Deg. C	3 Layer(s)	100µm	0,0574	0,0383	0,0956
Paint System SS -20 up to +120 Deg. C	2 Layer(s)	250µm	0,0287	0,0383	0,0669
Paint System SS >+120 up to +200 Deg. C	2 Layer(s)	200µm	0,0287	0,0383	0,0669
Paint System SS >+200 up to +450 Deg. C	2 Layer(s)	50µm	0,0287	0,0383	0,0669
Item Pipe (m) / Fittings, Welds & Vales (pc)	***Layer(s)***	***Thickness***	***Valve***	***Valve***	***Valve***
Paint System CS -20 up to +120 Deg. C	3 Layer(s)	300µm	0,3443	0,2295	0,5738
Paint System CS >+120 up to +200 Deg. C	2 Layer(s)	200µm	0,1721	0,2295	0,4016
Paint System CS >+200 up to +450 Deg. C	3 Layer(s)	100µm	0,3443	0,2295	0,5738
Paint System SS -20 up to +120 Deg. C	2 Layer(s)	250µm	0,1721	0,2295	0,4016
Paint System SS >+120 up to +200 Deg. C	2 Layer(s)	200µm	0,1721	0,2295	0,4016
Paint System SS >+200 up to +450 Deg. C	2 Layer(s)	50µm	0,1721	0,2295	0,4016
Item Pipe (m) / Fittings, Welds & Vales (pc)	***Layer(s)***	***Thickness***		***Weld***	***Weld***
Paint System CS -20 up to +120 Deg. C	3 Layer(s)	300µm		0,0765	0,0765
Paint System CS >+120 up to +200 Deg. C	2 Layer(s)	200µm		0,0765	0,0765
Paint System CS >+200 up to +450 Deg. C	3 Layer(s)	100µm		0,0765	0,0765
Paint System SS -20 up to +120 Deg. C	2 Layer(s)	250µm		0,0765	0,0765
Paint System SS >+120 up to +200 Deg. C	2 Layer(s)	200µm		0,0765	0,0765
Paint System SS >+200 up to +450 Deg. C	2 Layer(s)	50µm		0,0765	0,0765

Table 12 - Painting Labor Productivity Norms Table

Electrical and Instrumentation

Here, DACE has based its labor productivity norms on standard electrical and instrumentation work common to the industry. Beside labor productivity norms, DACE includes sketches with their calculations for typical hook-ups.

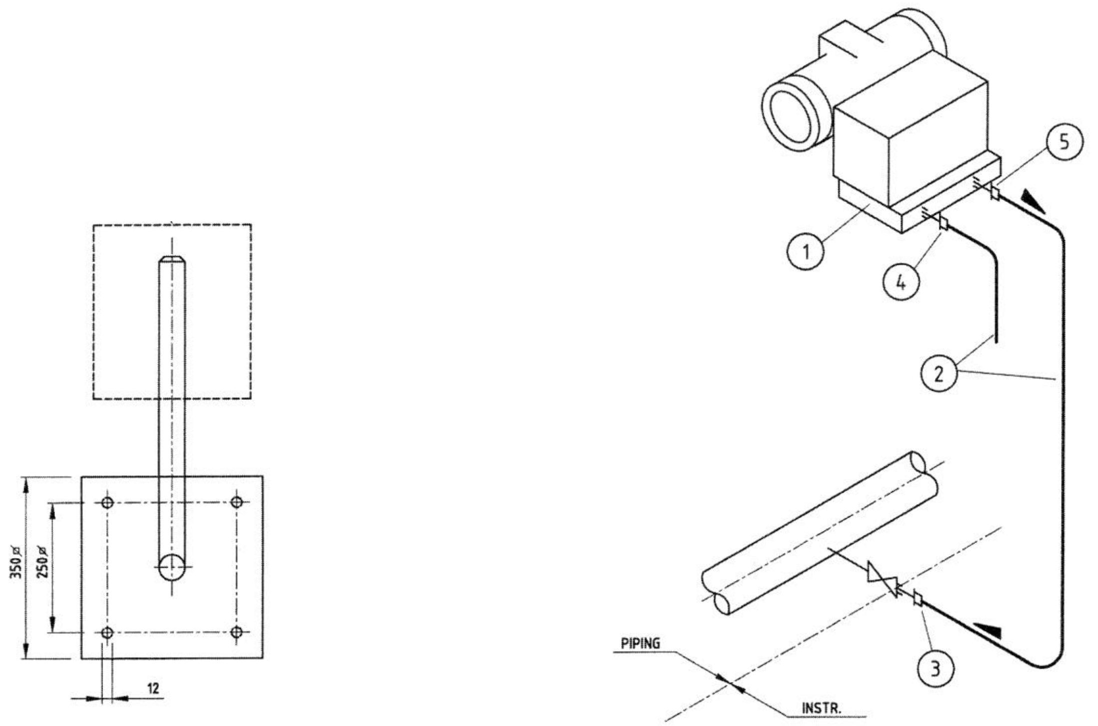

Figure 5 - E&I Typical Hook-ups

<u>Cable and Bundles</u>
Installing and securing cables.

Install and secure cables (using cable fixings) on cable trays, in cable ducts or in cable cellars, including bringing the cable to and from the place where the work is carried out.

Description	**Unit**	**labor productivity norm**
External cable diameter from 0 to 16 mm	m	0.05
External cable diameter from 16 to 23 mm	m	0.07
External cable diameter from 23 to 30 mm	m	0.09
External cable diameter from 30 to 40 mm	m	0.15
External cable diameter from 40 to 50 mm	m	0.19
External cable diameter from 50 to 70 mm	m	0.25
Weight group (kg/m)		
<0.5	Kg/m	0.07
>0.5	Kg/m	0.08
>1-2	Kg/m	0.09
>2-3	Kg/m	0.14
>3-5	Kg/m	0.17
>5-6	Kg/m	0.23
>6-8	Kg/m	0.31
>8-10	Kg/m	0.49

Table 13 – E&I Install Cable Labor Productivity Norms Table

Pulling cable in conduit with open bends.

Description	Unit	labor productivity norm
External cable diameter from 0 to 16 mm	m	0.08
External cable diameter from 16 to 23 mm	m	0.10
External cable diameter from 23 to 30 mm	m	0.17
External cable diameter from 30 to 40 mm	m	0.25
External cable diameter from 40 to 50 mm	m	0.31
External cable diameter from 50 to 70 mm	m	0.37
Weight group (kg/m)		
<0.5	Kg/m	0.07
>0.5	Kg/m	0.07
>1-2	Kg/m	0.09
>2-3	Kg/m	0.13
>3-5	Kg/m	0.18
>5-6	Kg/m	0.23
>6-8	Kg/m	0.32
>8-10	Kg/m	0.49

Table 14 – E&I Pulling Cable Labor Productivity Norms Table

Underground cable installation.

Description	Unit	labor productivity norm
External cable diameter from 0 60 16 mm	m	0.04
External cable diameter from 16 to 23 mm	m	0.06
External cable diameter from 23 to 30 mm	m	0.09
External cable diameter from 30 to 40 mm	m	0.14
External cable diameter from 40 to 50 mm	m	0.17
External cable diameter from 50 to 70 mm	m	0.26
Weight group (kg/m)		
<0.5	Kg/m	0.03
>0.5	Kg/m	0.03
>1-2	Kg/m	0.03
>2-3	Kg/m	0.04
>3-5	Kg/m	0.08
>5-6	Kg/m	0.11
>6-8	Kg/m	0.14
>8-10	Kg/m	0.18

Table 15 – E&I Underground Install Cable Labor Productivity Norms Table

Future Development

At this point in time, DACE has initiated phase two of the DACE labor productivity norms Special Interest Group with the goal to review, enhance and update the content on the following sections:

- New section for structural steel construction;
- New section for equipment installation;
    - Static
    - Rotating
- New section for maintenance of equipment;
- Improve and extend the Insulation section with cold and acoustic Insulation;
- Improve the general section with better definitions of productivity and efficiency;
- Improve the painting section by adding fittings to be consistent with other sections;
- Improve and expand the electrical and instrumentation sections;
- Improve the scaffolding section; and,
- Expand the calculation example with insulation and painting.

DACE is scheduled to publish a new issue of the CD-ROM in the spring of 2011. In order to achieve this, DACE will require additional input from our original project team. Input from members of the DACE Cost Engineering network, contractors and owners will also be required.

Conclusion

DACE succeeded in its primary goal to reduce misunderstanding and dispute between clients and suppliers by creating a common understanding of used practices and standards. Many international companies have already embraced the DACE labor productivity norms as a standard; and are using it to support their tendering, contracting and estimating processes. The DACE SIG is now continuing its efforts, and is preparing additional publications which include new disciplines in order to meet the comprehensive needs of the industry.

The ultimate goal remains to become the new labor productivity norm standard for the construction industry and create a globally accepted standard and guideline for owners and contractors.

REFERENCES

1. *DACE labor productivity norms 2009,* Dutch Association of Cost Engineers, 2009, retrieved from: http://www.dace.nl.
2. Page, John S., *Estimator's piping man-hour manual, 5th Edition p. cm,* Golf Publishing Company, Houston, TX, retrieved from: http://www.bh.com
3. *Insulation for Industries, Latest Edition,* Committee Insulation Netherlands Industry (CINI), retrieved from: http://www.cini.nl.
4. Vereniging van Steiger-, Hoogwerk – en Betonbekistingbedrijven (VSB), retrieved from: http://www.vsb.info.nl.

5. *ASTM A 380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems; and ASTM D-610, Standard test Method for Evaluating Degree of Resting on painted steel surfaces-SSPC-VIS-2,* ASTM Standards, American Society for Testing and Materials, 100 Bar Harbour Drive, West Conshohocken, PA.
6. *ISO 11124 - Preparation of steel substrates before application of paints and related products – specifications for metallic blast-cleaning abrasives – Part 1 to 4; ISO 11126 - Preparation of steel substrates before application of paints and related products – specifications for non-metallic blast-cleaning abrasives – Part 1 to 10; ISO 11127 - Preparation of Steel Substrates Before Application of Paints and Related Products - Test Methods for Non- Metallic Blast-Cleaning Abrasives-Part 1 to 7; ISO 12944 - Paints and Varnishes-Corrosion protection of steel structures by protective paint systems-Part-1 to 8; and ISO 8501-4 - Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness,* ISO Standards, Latest Edition, International Organisation for Standardisation, Case Postale 56, CH-1211 Geneva 20, Switzerland

Martin van Vliet
Cost Engineering Consultancy B.V.
m.van.vliet@costengineering.eu