TECHNICAL CALCULATION AND ESTIMATOR'S MAN-HOUR MANUAL

Marko Bulić

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ERECTION OF PROCESS OR CHEMICAL PLANTS

ZAGREB, 2003.
(Completed edition)

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PREFACE

All 40 years of my working life, I spent on erection of different process plants most of which were oil industry projects in the country and abroad, in Europe and North Africa. Since 1978 with occasional interruptions because of simultaneous involvement in several different projects, I worked mostly on technical calculations. I have made hundreds and hundreds calculations based on all kinds of tenders and erection of mechanical equipment. The tenders were written in various foreign languages and alphabet, even in Cyrillic. I am fully aware of the problems an estimator encounters when working on technical calculations for specific technologies. Very often tenders were not complete and not detailed enough, and the time required for a good technical calculation is getting every day shorter. It is not easy to present exact technical figures and quantities for the equipment or operations not fully defined, hard to comprehend, or even unknown to the estimator. Technical terms and expressions written in different languages and dialects are often incorrect and specific for individual branches. Enormous experience is needed, an ability to assess and estimate, and even the courage to write down the technical quantities and figures.
That was the reason for collecting various technical bibliography, standards, catalogues, man hours and rates from the European and USA countries. I have made the analyses, comparisons, simulations, new measures, and manhour tables. A great deal of that was verified in practice during the plant erection. I surveyed the results and analyses of as-built designs. On many occasions, I sought a compromise between different opinions and standpoints. Too many things collected on too many places. Finally, I decided to write this manual for discriminative estimators. It is important to understand that there are no identical projects or jobs in this business, that each project is specific and that no automatism or copying is possible. Approach to any job should be serious and professional and a technical calculation should be made with the assistance of this Manual. Many people try to include the man hours from the tables into the computer systems, which I oppose. Those are the people, which instead of using a computer, a computer uses them. An estimator himself must choose the values and define the man hours taking into account all the elements that might have any influence on them. Only when the relevant man hours are estimated and selected, a computer can be used. A saying "Switch on your brain before switching on the computer" should be followed.
The most complex work in developing these man hours was the work on the man hours for piping above ground. A basis I used was a system for estimating the value of erection works of a German Company LINDE, which I completed and modified. Generally, for elaboration of the man hours for erection/installation of process equipment, I used the English man hours of the Oil and Chemical Plant Constructors Association, but I used other sources as well.
The source or the author was noted for other tables and if I modified them, I provided the modification basis. Where there are no such notes, I am the only author.

A complete edition of this manual in the Croatian language and its sections were published in 1997 and 2000. This is why I have not given a unified percentage of the production efficiency but each chapter has its own.

Marko Bulić

Zagreb Croatia, 2003

CONTENTS

CHAPTER X. PIPING ABOVE GROUND

INTRODUCTION

With proper and conscientious application of these data for making estimates, the estimator will calculate hourly time requirements i.e. the man hours required for the erection.

The man hours (Mhr) do not refer to any condition or PRODUCTIVITY EFFICIENCY PERCENTAGES (PEP, Leistungsfähigkeit - Prozentsatz), but to precisely determined below stated PEPs.

The standard ranges of productivity efficiency percentages are:

1. Very low 10÷40 %
2. Low 41÷60%
3. Average 61÷80%
4. Very good 81÷90%
5. Excellent 91÷100%
6. Extraordinary 101÷120%

Man hours in this Manual refer to the following Productivity Efficiency Percentages:

1. PIPING ABOVE GROUND IN PLANTS

1.1Calculation based on the estimate points of basic erection items and man hours and ef fects derived thereby

PEP = high average 80%

1.2Calculation based on man hours and ef fects for quick calculation and special man hours

PEP = high average 75%

1.3Calculation based on man hou rs for piping per inch - diameter (ID)

PEP = high average 80%

1.4Calculation based on man hours f or units of operation

PEP = very good 85 %

2.PIPELINES

PEP = high average 75 %

3.STEEL STRUCTURES

PEP = high average 75 %

4.PROCESS EQUIPMENT IN PL ANTS

PEP = average 70%

5.CYLINDRICAL ST ORAGE TANKS

PEP = very good 85 %

6.WELDING AND CUT TING

PEP = average 70 %

7. CORROSION PROTECTION

PEP = high average 80 %

8. THERMAL INSULATION

PEP = very good 85 %

For each project, before the labour value is calculated, the Productivity Efficiency Percentage should be determined. This is done by the project manager with the assistance of his collaborators.
John S. Page (USA) stated six production elements that have an impact on PEP determination.
They are:

1. Project Management and Supervision
2. Labour Conditions
3. Job Conditions
4. Machinery and Equipment
5. Weather Conditions
6. General Economy (for J. S. P. this is a leading element, which I shall not consider)

1. Project Management and Supervision

Has the company already executed such projects? How often? What is the calibre of your supervision? Are skilled and experienced staff available? What can you afford to pay them? Will they be satisfied with the accommodation? Will they be satisfied with the salaries? Will you have enough money at the site (down payments)?
After evaluating these questions, estimate the percentage according to the PEP table.

2. Labour Conditions

Does the company have a good labour relations man? Has the company sufficient number of skilled and trained labour? What are the foremen like? Will they be satisfied with their salaries? Will they be satisfied with accommodation, food, transport? How often will they be able to visit their families?
Estimate the percentage according to the PEP table.

3. Job Conditions

What is the scope of the work and just what is involved in the job? What is the schedule? Is it tight, or do you have ample time to complete the work? What is the condition of the site? Is it low and muddy, and hard to drain, or is it high and dry? Does it involve a plant already in operation? Will there be tie-ins to the existing systems? What will the relationship be between the production personnel and office personnel? Will most of the operations be manual or mechanized? What kind of material procurement will you have?
Estimate the percentage according to the PEP table.

4. Machinery and Equipment

Do you have ample equipment to finish your job? What kind of shape is it in, and will you have good maintenance and repair help? The qualifications and experience of crane and other operators? The plant-hire company for the machinery? Past experience?
Estimate the percentage according to the PEP table.

5. Weather Conditions

What were past weather conditions for the area? If necessary, can they be checked? What future weather forecasts? Will there be much rain or snow? What differences are expected in the weather with regard to Central Europe - Zagreb?
Estimate the percentage according to PEP table. When we have considered and analysed all the percentages, we have to divide the total sum by five to arrive at an average percentage of productivity that is the Productivity Efficiency Percentage (PEP).
Dividing the PEP declared by the average PEP we obtain a factor. This factor is multiplied by the calculated man hours (MHr) and will give actually needed man hours (MHr). The number of hours can be either increased or decreased.

ABBREVIATIONS & UNITS

PEP = Productivity efficiency percentage

Mhr = Man Hours

mm = millimeters = 0.03937 inches

m = linear meters = 3.281 feet

km = kilometers = 0.6214 miles

m^2= square meters = 10. 764 feet

m^3= cubic meters = 35.314 f eet

ft = linear feet = 0.3048 meters

l = liters = 61.023 cu inches = 0.03531 cu feet = 0.2642 u.s. gal

kg = kilogram = 2.2046 lbs

lbs = pound = 0.4536 kg

t or ton = metric tons = 1000 kg

ea = each

pc = piece

PN = pressure nominal or NP

bar = 14.5 psi (lb/sq in)

Dn = diametar nominal

OD or d_o = outer diametar

ID = inch diametar

MID = meter inch diametar

t = thickness mm

V = volume

max. = maximum

min. = minimum

ř = phi (Greek) = round

kW = kilowatts = 1.341 horse power

kWh = kilowatthours

kVA = kilovoltampers

kg/Mhr = kilograms per man hour

Mhr/m = man hours per meter

f = factor

k = coefficient

Notice:

Decimal numbers are listed with a comma (European way).

I. PIPING ABOVE GROUND

DERIVED OPERATING TIME STANDARD FOR TABLES FACTOR OF BASIC ASSEMBLY
POSITION CHAPTER X, ACCORDING TO FORMS ON PAGE 142 ÷ 146
Productivity efficiency percentage (PEP) = 80%

FOR PREFABRICATION : 8%
FOR INSTALLATION : 92%

1. PIPES (ANSI B 36.10)

1.1 PIPE INSTALLATION ON PROCESS PLANT [Mhr/m]

			CARBON STEEL - NONWRAPPED - ABOVE GROUND													STAINLESS STEEL				
Dn-mm	ø-Inch	OD-mm	Sch 10	Sch 20	Sch 30	Std	Sch 40	Sch 60	XS	Sch 80	Sch 100	Sch 120	Sch 140	Sch 160	XXS	Sch 5S	Sch 10S	Sch 40S	Sch 80S	ø -Inch
15	1/2″	21,3																		1/2″
20	3/4″	26,7																		3/4″
25	1″	33,4																		1″
32	1 1/4″	42,2																		1 1/4″
40	1 1/2″	48,3																		1 1/2″
50	2″	60,3																		2″
65	2 1/2″	73																		2 1/2″
80	3″	88,9																		3″
100	4″	114,3																		4″
125	5″	141,3																		5″
150	6″	168,3																		6″
200	8″	219,1																		8″
250	10″	273																		10″
300	12″	323,9																		12″
350	14″	355,6																		14″
400	16″	406,4																		16″
450	18″	457																		18″
500	20″	508																		20″
550	22″	559																		22″
600	24″	610																		24″
650	26″	660																		26″
700	28″	711																		28″
750	30″	762																		30″
800	32″	813																		32″
850	34″	864																		34″
900	36″	914																		36″

Man hour included next activities :

- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

Materials:	**k**
- alloy steel	[Mhr/m] x 1,10
- prewrapped	[Mhr/m] x 1,15 (underground install.)
- galvanized	[Mhr/m] x 0,70
- aluminium alloy	[Mhr/m] x 0,85

Mhr/m x 0,3048 = Mhr/ft

1. PIPES (ANSI B. 36.10)

1.2 INSTALLATION ON PIPE RACK OR SLEEPER WAY [Mhr/m]

FOR PREFABRICATION : 8%

FOR INSTALLATION : 92%

			CARBON STEEL NONWRAPPED												STAINLESS STEEL				
Dn-mm	ø Inch	OD-mm	Sch 10	Sch 20	Sch 30	Std	Sch 40	Sch 60	XS	Sch 80	Sch 100	Sch 120	Sch 140	Sch 160	XXS	Sch 5S	Sch 10S	Sch 40S	Sch 80S	ø Inch
15	1/2″	21,3																		1/2″
20	3/4″	26,7																		3/4″
25	1″	33,4																		1″
32	1 1/4″	42,4																		1 1/4″
40	1 1/2″	48,3																		1 1/2″
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600	24″	610																		24″
650	26″	660																		26″
700	28″	711																		28″
750	30″	762																		30″
800	32″	813																		32″
850	34″	864																		34″
900	36″	914																		36″

Man hour include the next activities:

- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

Materials:	**k**
- alloy steel	[Mhr/m] x 1,10
- galvanized	[Mhr/m] x 0,70
- aluminium alloy	[Mhr/m] x 0,85

Mhr/m x 0,3048 = Mhr/ft

2. FITTINGS (ANSI 36.10)

2.1 ELBOWS [Mhr/ea]

FOR PREFABRICATION : 85%

FOR INSTALLATION: 15%

			CARBON STEEL													STAINLESS STEEL				
DN-mm	ø-Inch	OD-mm	Sch 10	Sch 20	Sch 30	Std	Sch 40	Sch 60	XS	Sch 80	Sch 100	Sch 120	Sch 140	Sch 160	XXS	Sch 5S	Sch 10S	Sch 40S	Sch 80S	ø-Inch
15	1/2″	21,3																		1/2″
20	3/4″	26,7																		3/4″
25	1″	33,4																		1″
32	1 1/4″	42,2																		1 1/4″
40	1 1/2″	48,3																		1 1/2″
50	2″	60,3																		2″
65	2 1/2″	73																		2 1/2″
80	3″	88,9																		3″
100	4″	114,3																		4″
125	5″	141,3																		5″
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550	22″	559																		22″
600	24″	610																		24″
650	26″	660																		26″
700	28″	711																		28″
750	30″	762																		30″
800	32″	813																		32″
850	34″	864																		34″
900	36″	914																		36″

2.2 CAPS [Mhr/ea] x

Materials:	**f**		**f**
- Cr-Mo alloy steel	1,40 ÷ 1,60	- High temp. alloy steel	1,00 ÷ 1,80
- Copper alloy	1,20	- Alloy steel Ni	1,60
- Killed C.S.	1,00 ÷ 1,25	- Aluminium alloy	1,50

2. FITTINGS (ANSI B.36.10)

2.3 TEES

2.3.1 STRAIGHT TEE [Mhr/ea]

FOR PREFABRICATION : 85%

FOR INSTALLATION : 15%

			CARBON STEEL												STAINLESS STEEL				
Dn-mm	ø-Inch	OD-mm	Sch 10	Sch 20	Sch 30	Std	Sch 40	Sch 60	XS	Sch 80	Sch 100	Sch 120	Sch 140	Sch 160	XXS	Sch 5S	Sch 10S	Sch 40S	Sch 80S	ø-Inch
15	1/2″	21,3																		1/2″
20	3/4″	26,7																		3/4″
25	1″	33,4																		1″
32	1 1/4″	42,4																		1 1/4″
40	1 1/2″	48,3																		1 1/2″
50	2″	60,3																		2″
65	2 1/2″	73																		2 1/2″
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600	24″	610																		24″
650	26″	660																		26″
700	28″	711																		28″
750	30″	762																		30″
800	32″	813																		32″
850	34″	864																		34″
900	36″	914																		36″

2.3.2 REDUCED TEE [Mhr/ea] x

Materials:	**f**		**f**
- Cr-Mo alloy steel	1,40 ÷ 1,60	- High temp. alloy steel	1,00 ÷ 1,80
- Copper alloy	1,20	- Alloy steel Ni	1,60
- Killed C.S.	1,00 ÷ 1,25	- Auminium alloy	1,50

2. FITTINGS (ANSI)

2.4 REDUCERS - CONCENTRIC AND ECCENTRIC [Mhr/ea]

FOR PREFABRICATION : 85%

FOR INSTALLATION: 15%

			CARBON STEEL													STAINLESS STEEL				
Dn-mm	ø-Inch	OD-mm	Sch 10	Sch 20	Sch 30	Std	Sch 40	Sch 60	XS	Sch 80	Sch 100	Sch 120	Sch 140	Sch 160	XXS	Sch 5S	Sch 10S	Sch 40S	Sch 80S	ø-Inch
20	3/4"	26,7																		3/4"
25	1"	33,4																		1"
32	1 1/4"	42,2																		1 1/4"
40	1 1/2"	48,3																		1 1/2"
50	2"	60,3																		2"
65	2 1/2"	73																		2 1/2"
80	3"	88,9																		3"
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750	30"	762																		30"
800	32"	813																		32"
850	34"	864																		34"
900	36"	914																		36"

Man hour include next activities:

- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

Materials:	**f**		**f**
- Cr-Mo alloy steel	1,40 ÷ 1,60	- High temp. alloy steel	1,00 ÷ 1,80
- Copper alloy	1,20	- Alloy steel Ni	1,60
- Killed C.S	1,00 ÷ 1,25	- Aluminium alloy	1,50

1. PIPES (DIN 2448/2458)

1.1 INSTALLATION IN PROCESS PLANT [Mhr/m]

FOR PREFABRICATION : 8%
FOR INSTALLATION : 92%

CARBON STEEL - NONWRAPPED - ABOVE GROUND - WALL THICKNESS 2 - 12,5 mm

Dn-mm	OD-mm	t - Std|Ext	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	6,3	7,1	8	8,8	10	11	12,5	OD-mm
15	21,3	2\2																		21,3
20	26,9	2\2,3																		26,9
25	33,7	2\2,6																		33,7
32	42,4	2\2,6																		42,4
40	48,3	2,3\2,6																		48,3
50	60,3	2,3\2,9																		60,3
65	73,1	2,6\2,9																		73,1
65	76,1	2,6\2,9																		76,1
80	88,9	2,9\3,2																		88,9
100	114,3	3,2\3,6																		114,3
125	139,7	3,6\4																		139,7
150	168,3	4\4,5																		168,3
200	219,1	4,5\6,3																		219,1
250	273	5\6,3																		273
300	323,9	5,6\7,1																		323,9
350	355,6	5,6\8																		355,6
400	406,4	6,3\8,8																		406,4
450	457	6,3\10																		457
500	508	6,3\11																		508
550	559	6,3\12,5																		559
600	610	6,3\12,5																		610
650	660	7,1\14,2																		660
700	711	7,1																		711
750	762	8																		762
800	813	8																		813
850	864	8,8																		864
900	914	10																		914

Man hour include next activities:

- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

Materials:	**k**
- Stainless steel	[Mhr/m] x 1,10
- High temp. alloy steel	[Mhr/m] x 1,10
- Prewrapped	[Mhr/m] x 1,15 (underground install.)
- Galvanized	[Mhr/m] x 0,70
- Aluminium alloy	[Mhr/m] x 0,85

Mhr/m x 0,3048 = Mhr/ft

1. PIPES (DIN 2448/2458)

1.1 INSTALLATION IN PROCESS PLANT [Mhr/m]

FOR PREFABRICATION : 8%

FOR INSTALLATION : 92%

CARBON STEEL - NONWRAPPED - ABOVE GROUND - WALL THICKNESS 14,2 - 60 mm

Dn-mm	OD-mm	t - Std|Ext	14,2	16	17,5	20	22,2	25	28	30	32	36	40	45	50	55	60	65	70	OD-mm
15	21,3	2\2																		21,3
20	26,9	2\2,3																		26,9
25	33,7	2\2,6																		33,7
32	42,4	2\2,6																		42,4
40	48,3	2,3\2,6																		48,3
50	60,3	2,3\2,9																		60,3
65	73,1	2,6\2,9																		73,1
65	76,1	2,6\2,9																		76,1
80	88,9	2,9\3,2																		88,9
100	114,3	3,2\3,6																		114,3
125	139,7	3,6\4																		139,7
150	168,3	4\4,5																		168,3
200	219,1	4,5\6,3																		219,1
250	273	5\6,3																		273
300	323,9	5,6\7,1																		323,9
350	355,6	5,6\8																		355,6
400	406,4	6,3\8,8																		406,4
450	457	6,3\10																		457
500	508	6,3\11																		508
550	559	6,3\12,5																		559
600	610	6,3\12,5																		610
650	660	7,1\14,2																		660
700	711	7,1																		711
750	762	8																		762
800	813	8																		813
850	864	8,8																		864
900	914	10																		914

Man hour include next activities:

- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

Materials:	**k**
- Stainless steel	[Mhr/m] x 1,10
- High temp. alloy steel	[Mhr/m] x 1,10
- Prewrapped	[Mhr/m] x 1,15
- Galvanized	[Mhr/m] x 0,70
- Aluminium alloy	[Mhr/m] x 0,85

Mhr/m x 0,3048 = Mhr/ft

1. PIPES (DIN 2448/2458)
1.2 INSTALLATION ON PIPE RACK OR SLEEPER WAY [Mhr/m]

FOR PREFABRICATION : 8%
FOR INSTALLATION : 92%

CARBON STEEL - NONINSULATED - WALL THICKNESS - 2 mm - 12,5 mm

Dn-mm	OD-mm	t - Std|Ext	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	6,3	7,1	8	8,8	10	11	12,5	OD-mm
15	21,3	2\2																		21,3
20	26,9	2\2,3																		26,9
25	33,7	2\2,6																		33,7
32	42,4	2\2,6																		42,4
40	48,3	2,3\2,6																		48,3
50	60,3	2,3\2,9																		60,3
65	73,1	2,6\2,9																		73,1
65	76,1	2,6\2,9																		76,1
80	88,9	2,9\3,2																		88,9
100	114,3	3,2\3,6																		114,3
125	139,7	3,6\4																		139,7
150	168,3	4\4,5																		168,3
200	219,1	4,5\6,3																		219,1
250	273	5\6,3																		273
300	323,9	5,6\7,1																		323,9
350	355,6	5,6\8																		355,6
400	406	6,3\8,8																		406,4
450	457	6,3\10																		457
500	508	6,3\11																		508
550	559	6,3\12,5																		559
600	610	6,3\12,5																		610
650	660	7,1\14,2																		660
700	711	7,1																		711
750	762	8																		762
800	813	8																		813
850	864	8,8																		864
900	914	10																		914

Man hour include next activities:

- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

Materials:	**k**
- Stainless steel	[Mhr/m] x 1,10
- High temp. alloy steel	[Mhr/m] x 1,10
- Prewraped	[Mhr/m] x 0,70
- Aluminium alloy	[Mhr/m] x 0,85

Mhr/m x 0,3048 = Mhr/ft

1. PIPES (DIN 2448/2458)

1.2 INSTALLATION ON PIPE RACK OR SLEEPER WAY [Mhr/m]

FOR PREFABRICATION : 8%

FOR INSTALLATION : 92%

CARBON STEEL - NONINSULATED - WALL THICKNESS 14,2 - 60 mm

Dn-mm	OD-mm	t - Std|Ext	14,2	16	17,5	20	22,2	25	28	30	32	36	40	45	50	55	60	OD-mm
15	21,3	2\2																21,3
20	26,9	2\2,3																26,9
25	33,7	2\2,6																33,7
32	42,4	2\2,6																42,4
40	48,3	2,3\2,6																48,3
50	60,3	2,3\2,9																60,3
65	73,1	2,6\2,9																73,1
65	76,1	2,6\2,9																76,1
80	88,9	2,9\3,2																88,9
100	114,3	3,2\3,6																114,3
125	139,7	3,6\4																139,7
150	168,3	4\4,5																168,3
200	219,1	4,5\6,3																219,1
250	273	5\6,3																273
300	323,9	5,6\7,1																323,9
350	355,6	5,6\8																355,6
400	406,4	6,3\8,8																406,4
450	457	6,3\10																457
500	508	6,3\11																508
550	559	6,3\12,5																559
600	610	6,3\12,5																610
650	660	7,1\14,2																660
700	711	7,1																711
750	762	8																762
800	813	8																813
850	864	8,8																864
900	914	10																914

Man hour include next activities:

- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

Materials:	**k**
- Stainless steel	[Mhr/m] x 1,10
- High temp. alloy steel	
- Galvanized	[Mhr/m] x 0,70
- Aluminium alloy	[Mhr/m] x 0,85

Mhr/m x 0,3048 = Mhr/ft

1. PIPES (ANSI and DIN)

1.3 STEAM TRACING [Mhr/m]

(Values in this table apply only to piping in plants. For steam tracing of pipe lines on piperacks or sleepeways other table for the installation of pipes on piperacks are applied.)

			CARBON STEEL							STAINLESS STEEL			
Dn-mm	ř-Inch	OD-mm	Sch 10	Std	Sch 40	XS	Sch 80	Sch 160	XXS	Sch 5S	Sch 10S	Sch 40S	Sch 80S
15	1/2"	21,3											
20	3/4"	26,7											
25	1"	33,4											
32	1 1/4"	42,2											
40	1 1/2"	48,3											
50	2"	60,3											
65	2 1/2"	76,1											
80	3"	88,9											

STEAM TRACING ON PROCESS LINES
(manhour per meter of process line incl. steam supply and condensate return)

Dn	ø tracer	number of tubes	[Mhr/m] (proc.)
to 3"	1/2"	1	
4" ÷ 8"	3/4"	1	
10" ÷ 16"	3/4"	2	
18" ÷ 36"	3/4"	3	
above 36 "	3/4"	4	

CARBON STEEL - WALL THICKNESS 2 - 7,1 mm

Dn-mm	OD-mm	t -Std|Ext	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	6,3	7,1
15	21,3	2\2												
20	26,9	2\2,3												
25	33,7	2\2,6												
32	42,4	2\2,6												
40	48,3	2,3\2,6												
50	60,3	2,3\2,9												
65	73	2,6\2,9												
65	76,1	2,6\2,9												
80	88,9	2,9\3,2												

COPPER TUBES - DUCTILE			
OD-mm	Mhr/m	OD-mm	[Mhr/m]
10	0,12	22	
12	0,14	25	
14	0,18	28	
15	0,20	30	
16	0,21	35	
18	0,24	38	
20	0,27	42	

COPPER TUBES - STRONG : x

1.4 INSTRUMENT AND CONTROL PIPING

All activityes on installation and supporting these lines, also sizes to 1/2", are included.

Lines to 3 m (10 ft) [Mhr] totally

Lines above 3 m (10 ft) [Mhr/m]

1.5 STEAM DISTRIBUTORS AND CONDENSATE COLLECTORS FABRICATED FROM PIPES AND FITTINGS

1.5.1 STEAM DISTRIBUTORS

Fabrication [Mhr/ea] + [Mhr/connect.]

Erection [Mhr/ea] (supporting included)

1.5.2 CONDENSATE COLLECTORS

Fabrication [Mhr/ea] + [Mhr/ connect.]

Erection [Mhr/ea] (supporting included)

Mhr/m x 0,3048 = Mhr/ft

1.6 STEAM DISTRIBUTORS AND CONDENSATE COLLECTORS FABRICATED FROM

READY-MADE DISTRIBUTORS FOR 4 CONNECTIONS

(ready-made distributors for 4, 8 or 12 connections)

1.6.1 STEAM DISTRIBUTORS

Fabrication : [Mhr] x number of connections

Erection : [Mhr/ea] (supporting included)

1.6.2 CONDENSATE COLLECTORS

Fabrication: [Mhr] x number of connections

Erection: [Mhr/ea] (supporting included)

2. FITTING (DIN)

2.1 ELBOWS [Mhr/ea]

FOR PREFABRICATION : 85%

FOR INSTALLATION: 15%

CARBON STEEL - WALL THICKNESS 2 - 12,5 mm

Dn-mm	OD-mm	?Std|Ext	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	6,3	7,1	8	8,8	10	11	12,5	OD-mm
15	21,3	2\2																		21,3
20	26,9	2\2,3																		26,9
25	33,7	2\2,6																		33,7
32	42,4	2\2,6																		42,4
40	48,3	2,3\2,6																		48,3
50	60,3	2,3\2,9																		60,3
65	73,1	2,6\2,9																		73,1
65	76,1	2,6\2,9																		76,1
80	88,9	2,9\3,2																		88,9
100	114,3	3,2\3,6																		114,3
125	139,7	3,6\4																		139,7
150	168,3	4\4,5																		168,3
200	219,1	4,5\6,3																		219,1
250	273	5\6,3																		273
300	323,9	5,6\7,1																		323,9
350	355,6	5,6\8																		355,6
400	406,4	6,3\8,8																		406,4
450	457	6,3\10																		457
500	508	6,3\11																		508
550	559	6,3\12,5																		559
600	610	6,3\12,5																		610
650	660	7,1\14,2																		660
700	711	7,1																		711
750	762	8																		762
800	813	8																		813
850	864	8,8																		864
900	914	10																		914

2.2 CAPS [Mhr/ea] x

Materials:	**f**		
- Cr-Mo alloy steel	1,40÷1,60	- High temp. alloy steel	1,00 ÷ 1,80
- Copper alloy	1,20	- Alloy steel Ni	1,60
- Killed C.S	1,00÷1,25	- Aluminium alloy	1,50

2. FITTINGS (DIN)
2.1 ELBOWS [Mhr/ea]

FOR PREFABRICATION : 85%
FOR INSTALLATION : 15%

CARBON STEEL - WALL THICKNESS 14,2 - 60 mm

Dn-mm	OD-mm	t - Std|Ext	14,2	16	17,5	20	22,2	25	28	30	32	36	40	45	50	55	60	OD-mm
15	21,3	2\2																21,3
20	26,9	2\2,3																26,9
25	33,7	2\2,6																33,7
32	42,4	2\2,6																42,4
40	48,3	2,3\2,6																48,3
50	60,3	2,3\2,9																60,3
65	73,1	2,6\2,9																73,1
65	76,1	2,6\2,9																76,1
80	88,9	2,9\3,2																88,9
100	114,3	3,2\3,6																114,3
125	139,7	3,6\4																139,7
150	168,3	4\4,5																168,3
200	219,1	4,5\6,3																219,1
250	273	5\6,3																273
300	323,9	5,6\7,1																323,9
350	355,6	5,6\8																355,6
400	406,4	6,3\8,8																406,4
450	457	6,3\10																457
500	508	6,3\11																508
550	559	6,3\12,5																559
600	610	6,3\12,5																610
650	660	7,1\14,2																660
700	711	7,1																711
750	762	8																762
800	813	8																813
850	864	8,8																864
900	914	10																914

2.2 CAPS [Mhr/ea] x

Materials:	**f**	Stainless steel	1,25
- Cr-Mo alloy steel	1,40 ÷ 1,60	High temp. alloy steel	1,00 ÷ 1,80
- Copper alloy	1,20	Alloy steel Ni	1,60
Killed C.S	1,00 ÷ 1,25	Aluminium alloy	1,50

2. FITTINGS (DIN)

2.3 TEES [Mhr/ea]

2.3.1 STRAIGHT TEE

FOR PREFABRICATION : 85%

FOR INSTALLATION: 15%

CARBON STEEL - WALL THICKNESS 2 mm - 12,5 mm

Dn-mm	OD-mm	t - Std|Ext	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	6,3	7,1	8	8,8	10	11	12,5	OD-mm
15	21,3	2\2																		21,3
20	26,9	2\2,3																		26,9
25	33,7	2\2,6																		33,7
32	42,4	2\2,6																		42,4
40	48,3	2,3\2,6																		48,3
50	60,3	2,3\2,9																		60,3
65	73,1	2,6\2,9																		73,1
65	76,1	2,6\2,9																		76,1
80	88,9	2,9\3,2																		88,9
100	114,3	3,2\3,6																		114,3
125	139,7	3,6\4																		139,7
150	168,3	4\4,5																		168,3
200	219,1	4,5\6,3																		219,1
250	273	5\6,3																		273
300	323,9	5,6\7,1																		323,9
350	355,6	5,6\8																		355,6
400	406,4	6,3\8,8																		406,4
450	457	6,3\10																		457
500	508	6,3\11																		508
550	559	6,3\12,5																		559
600	610	6,3\12,5																		610
650	660	7,1\14,2																		660
700	711	7,1																		711
750	762	8																		762
800	813	8																		813
850	864	8,8																		864
900	914	10																		914

2.3.2 REDUCED TEE [Mhr/ea] x

Materials:	**f**	- Stainless steel	1,25
- Cr-Mo alloy steel	1,40 ÷ 1,60	- High temp. alloy steel	1,00 ÷ 1,80
- Copper alloy	1,20	- Alloy steel Ni	1,60
- Killed C.S	1,00 ÷ 1,25	- Aluminium alloy	1,50

2.3 TEES

FOR PREFABRICATION : 85%
FOR INSTALLATION : 15%

2.3.1 STRAIGHT TEE

[Mhr/ea]

CARBON STEEL - WALL THICKNESS 14,2 - 60 mm

Dn-mm	OD-mm	t - Std|Ext	14,2	16	17,5	20	22,2	25	28	30	32	36	40	45	50	55	60	OD-mm
15	21,3	2\2																21,3
20	26,9	2\2,3																26,9
25	33,7	2\2,6																33,7
32	42,4	2\2,6																42,4
40	48,3	2,3\2,6																48,3
50	60,3	2,3\2,9																60,3
65	73,1	2,6\2,9																73,1
65	76,1	2,6\2,9																76,1
80	88,9	2,9\3,2																88,9
100	114,3	3,2\3,6																114,3
125	139,7	3,6\4																139,7
150	168,3	4\4,5																168,3
200	219,1	4,5\6,3																219,1
250	273	5\6,3																273
300	323,9	5,6\7,1																323,9
350	355,6	5,6\8																355,6
400	406,4	6,3\8,8																406,4
450	457	6,3\10																457
500	508	6,3\11																508
550	559	6,3\12,5																559
600	610	6,3\12,5																610
650	660	7,1\14,2																660
700	711	7,1																711
750	762	8																762
800	813	8																813
850	864	8,8																864
900	914	10																914

2.3.2 REDUCED TEE

[Mhr/ea] x

Materials:	**f**	- Stainless steel	1,25
- Cr-Mo alloy steel	1,40 ÷ 1,60	- High temp. alloy steel	1,00 ÷ 1,80
- Copper alloy	1,20	- Alloy steel Ni	1,60
- Killed C.S	1,00 ÷ 1,25	- Aluminium alloy	1,50

2. FITTINGS (DIN)

2.4 REDUCERS - CONCENTRIC AND ECCENTRIC [Mhr/ea]

FOR PREFABRICATION : 85%

FOR INSTALLATION: 15%

CARBON STEEL - WALL THICKNESS 2 - 12,5 mm

Dn-mm	OD-mm	t - Std|Ext	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	6,3	7,1	8	8,8	10	11	12,5	OD-mm
15	21,3	2\2																		21,3
20	26,9	2\2,3																		26,9
25	33,7	2\2,6																		33,7
32	42,4	2\2,6																		42,4
40	48,3	2,3\2,6																		48,3
50	60,3	2,3\2,9																		60,3
65	73,1	2,6\2,9																		73,1
65	76,1	2,6\2,9																		76,1
80	88,9	2,9\3,2																		88,9
100	114,3	3,2\3,6																		114,3
125	139,7	3,6\4																		139,7
150	168,3	4\4,5																		168,3
200	219,1	4,5\6,3																		219,1
250	273	5\6,3																		273
300	323,9	5,6\7,1																		323,9
350	355,6	5,6\8																		355,6
400	406,4	6,3\8,8																		406,4
450	457	6,3\10																		457
500	508	6,3\11																		508
550	559	6,3\12,5																		559
600	610	6,3\12,5																		610
650	660	7,1\14,2																		660
700	711	7,1																		711
750	762	8																		762
800	813	8																		813
850	864	8,8																		864
900	914	10																		914

Man hour include next activities:

- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

Materials:	**f**		
- Cr Mo alloy steel	1,40 ÷ 1,60	- Stainless steel	1,25
- Copper alloy	1,20	- High temp. alloy steel	1,00 ÷ 1,80
- Killed C.S.	1,00 ÷ 1,25	- Alloy steel Ni	1,60
		- Aluminium alloy	1,50

2. FITTINGS (DIN)

2.4 REDUCERS - CONCENTRIC AND ECCENTRIC [Mhr/ea]

FOR PREFABRICATION : 85%

FOR INSTALLATION : 15%

CARBON STEEL - WALL THICKNESS 14,2 -60 mm

Dn-mm	OD-mm	t - Std|Ext	14,2	16	17,5	20	22,2	25	28	30	32	36	40	45	50	55	60	OD-mm
15	21,3	2\2																21,3
20	26,9	2\2,3																26,9
25	33,7	2\2,6																33,7
32	42,4	2\2,6																42,4
40	48,3	2,3\2,6																48,3
50	60,3	2,3\2,9																60,3
65	73,1	2,6\2,9																73,1
65	76,1	2,6\2,9																76,1
80	88,9	2,9\3,2																88,9
100	114,3	3,2\3,6																114,3
125	139,7	3,6\4																139,7
150	168,3	4\4,5																168,3
200	219,1	4,5\6,3																219,1
250	273	5\6,3																273
300	323,9	5,6\7,1																323,9
350	355,6	5,6\8																355,6
400	406,4	6,3\8,8																406,4
450	457	6,3\10																457
500	508	6,3\11																508
550	559	6,3\12,5																559
600	610	6,3\12,5																610
650	660	7,1\14,2																660
700	711	7,1																711
750	762	8																762
800	813	8																813
850	864	8,8																864
900	914	10																914

Man hour include next activities:

- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

Materials:	**f**		
- Cr Mo alloy steel	1,40 ÷ 1,60	- Stainless steel	1,25
- Copper alloy	1,20	- High temp. alloy steel	1,00 ÷ 1,80
- Killed C.S.	1,00 ÷ 1,25	- Alloy steel Ni	1,60
		- Aluminium alloy	1,50

3. FLANGES

3.1 WELDING NECK [Mhr/ea]

FOR PREFABRICATION : 80%
FOR INSTALLATION: 20%

CARBON STEEL

		150# PN6-16			300# PN25-40			400# PN64			600# PN100			900# PN160			1500# PN250			2500# PN320			
Dn-mm	ø -Inch	[kg]	[Mhr/ea]	[kg/Mhr]	[kg]	[Mhr/ea]	[kg/Mhr]	[kg]	[Mhr/ea]	[kg/Mhr]	[kg]	[Mhr/ea]	[kg/Mhr]	[kg]	[Mhr/ea]	[kg/Mhr]	[kg]	[Mhr/ea]	[kg/Mhr]	[kg]	[Mhr/ea]	[kg/Mhr]	ø-Inch
15	1/2″	0,5			0,8			0,9			0,9			1,9			1,9			3,6			1/2″
20	3/4″	0,7			1,3			1,5			1,5			2,6			2,6			4,0			3/4″
25	1″	1,1			1,7			1,9			1,9			3,8			3,8			6,0			1″
32	1 1/4″	1,5			2,2			2,6			2,6			4,4			4,4			9,0			1 1/4″
40	1 1/2″	1,8			3,2			3,3			3,3			6,1			6,1			13,0			1 1/2″
50	2″	2,7			3,6			4,7			4,7			11,1			11,1			19,0			2″
65	2 1/2″	4,4			5,4			6,5			6,5			15,5			15,5			24,0			2 1/2″
80	3″	5,2			7,4			8,7			8,7			14,0			20,5			43,0			3″
100	4″	7,5			11,9			14,0			18,1			23,0			30,5			66,0			4″
125	5″	9,2			16,0			19,0			30,0			37,0			58,0			111,0			5″
150	6″	1,0			20,0			26,0			36,0			49,0			70,0			172,0			6″
200	8″	18,3			31,0			40,0			50,0			84,0			119,0			261,0			8″
250	10″	25,0			44,0			54,0			90,0			123,0			204,0			485,0			10″
300	12″	39,0			64,0			78,0			110,0			168,0			303,0			730,0			12″
350	14″	51,0			88,0			105,0			150,0			186,0			400,0			14″			
400	16″	60,0			113,0			131,0			190,0			224,0			510,0			16″			
450	18″	71,0			134,0			159,0			240,0			300,0			18″						
500	20″	88,0			171,0			190,0			295,0			373,0			20″						
550	22″	103,5			204,5			232,5			330,0			526,5			22″						
600	24″	119,0			238,0			275,0			365,0			680,0			24″						
650	26″	136,0			304,0			340,0			404,0			715,0			26″						
700	28″	143,0			367,0			400,0			480,0			840,0			28″						
750	30″	168,0			422,0			454,0			560,0			975,0			30″						
800	32″	197,0			465,0			522,0			680,0			1170,0			32″						
850	34″	211,0			545,0			590,0			750,0			1375,0			34″						
900	36″	236,0			590,0			670,0			795,0			1565,0			36″						

Notice:
Unit weights in this table refer to welding neck flanges acc. to ANSI B 16-5.1977.

for to 24″
and BS-3293-1960 (1)
for26″ ÷ 36″

Man hour include next activities:

- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

Materials:	**f**		
- Cr Mo alloy steel	1,40 ÷ 1,60	- Stainless steel	1,25
- Copper alloy	1,20	- High temp. alloy steel	1,00 ÷ 1,80
- Killed C.S.	1,00 ÷ 1,25	- Alloy steel Ni	1,60
		- Aluminium alloy	1,50

kg x 0,4536 = lbs
kg/Mhr x 2,2046 = lbs/Mhr

3. FLANGES

3.2 SLIP - ON [Mhr/ea]

kg x 0.4536 = lbs
kg/Mhr x 2,2046 = lbs/Mhr

FOR PREFABRICATION: 80%
FOR INSTALLATION : 20%

CARBON STEEL

		150# PN6-16			300# PN25-40			400# PN64			600# PN100			900# PN160			1500# PN250			2500# PN320			
Dn-mm	ø-Inch	[kg]	[Mhr/ea]	[kg/Mhr]	[kg]	[Mhr/ea]	[kg/Mhr]	[kg]	[Mhr/ea]	[kg/Mhr]	[kg	[Mhr/ea]	[kg/Mhr]	[kg]	[Mhr/ea]	[kg/Mhr]	[kg]	[Mhr/ea]	[kg/Mhr]	[kg]	[Mhr/ea]	[kg/Mhr]	ø-Inch
15	1/2"	0,4			0,7			0,8			0,8			1,7			1,7			3,0			1/2"
20	3/4"	0,7			1,1			1,4			1,4			2,3			2,3			4,0			3/4"
25	1"	0,8			1,4			1,6			1,6			3,4			3,4			5,0			1"
32	1 1/4"	1,1			1,8			2,1			2,1			3,9			3,9			8,0			1 1/4"
40	1 1/2"	1,4			2,6			3,1			3,1			5,4			5,4			11,0			1 1/2"
50	2"	2,2			3,4			3,7			3,7			9,8			9,8			17,0			2"
65	2 1/2"	,6			4,4			5,4			5,4			13,7			13,7			24,0			2 1/2"
80	3"	4,1			6,1			7,3			7,3			11,6			18,0			36,0			3"
100	4"	5,6			10,1			11,5			15,8			19,8			27,8			55,0			4"
125	5"	6,3			12,5			14,5			24,5			32,0			52,0			93,0			5"
150	6"	7,5			14,1			19,0			29,5			41,2			61,0			142,0			6"
200	8"	12,6			24,8			29,0			43,0			71,0			104,0			214,0			8"
250	10"	18,5			37,1			39,5			70,0			100,0			175,0			407,0			10"
300	12"	28,0			50,0			58,0			86,0			133,0			264,0			573,0			12"
350	14"	36,0			70,0			82,0			100,0			152,0			308,0			14"			
400	16"	46,0			97,0			105,0			142,0			184,0			352,0			16"			
450	18"	50,0			123,0			126,0			175,0			258,0			18"						
500	20"	64,0			133,0			152,0			221,0			317,0			20"						
550	22"	76,5			170,5			185,0			268,0			462,5			22"						
600	24"	89,0			208,0			218,0			315,0			608,0			24"						
650	26"	106,0			255,0			295,0			425,0			692,0			26"						
700	28"	126,0			321,0			354,0			470,0			817,0			28"						
750	30"	140,0			362,0			408,0			533,0			942,0			30"						
800	32"	168,0			398,0			465,0			624,0			1135,0			32"						
850	34"	179,0			480,0			522,0			681,0			1339,0			34"						
900	36"	205,0			540,0			601,0			726,0			1521,0			36"						

Notice:
Unit weights in this table refer to slip on flanges acc. to ANSI B 16-5. 1977.
for to 24"
and BS-3293-1960
for 26" ÷ 36"

3.3. SOCKET WELDING [Mhr/ea] x

3.4. LAP JOINT + STUB END [Mhr/ea] x

3.5. BLIND [Mhr/ea] x

3.6. ORIFICE COMPLETE [Mhr/ea] x

Man hour include next activities:
- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

Materials:	**f**
- Cr Mo alloy steel	1,40 ÷ 1,60
- Copper alloy	1,20
- Killed C.S.	1,00 ÷ 1,25
- Stainless steel	1,25
- High temp. alloy steel	1,00 ÷ 1,80
- Alloy steel Ni	1,60
- Aluminium alloy	1,50

4. SMALL FITTINGS [Mhr/ea]

4.1 WELDOLETS, SOCKOLETS, NIPOLETS, etc.

			CARBON STEEL		
			1500#	3000#	6000#
Dn-mm	ø-Inch	OD-mm	Std	XS	XXS
15	1/2"	21,3			
20	3/4"	26,7			
25	1"	33,4			
32	1 1/4"	42,2			
40	1 1/2"	48,3			
50	2"	60,3			
65	2 1/2"	73			
80	3"	88,9			
100	4"	114,3			
125	5"	141,3			
150	6"	168,3			
200	8"	219,1			
250	10"	273			
300	12"	323,9			
350	14"	355,6			
400	16"	406,4			
450	18"	457			
500	20"	508			
550	22"	559			
600	24"	610			
650	26"	660			
700	28"	711			
750	30"	762			

4.2 HALF COUPLINGS FOR WELDING

			CARBON STEEL	
			3000#	6000#
Dn-mm	ø-Inch	OD-mm	XS	XXS
15	1/2"	21,3		
20	3/4"	26,7		
25	1"	33,4		
32	1 1/4"	42,2		
40	1 1/2"	48,3		
50	2"	60,3		
65	2 1/2"	73		
80	3"	88,9		
100	4"	114,3		

FOR PREFABRICATION : 85%
FOR INSTALLATION: 15%

4.3 FITTINGS WITH SOCKET ENDS

CARBON STEEL			
WITH ONE END			
Dn-mm	ø-Inch	OD-mm	[Mhr/ea]
15	1/2"	21,3	
20	3/4"	26,7	
25	1"	33,4	
32	1 1/4"	42,2	
40	1 1/2"	48,3	
50	2"	60,3	
65	2 1/2"	73	
80	3"	88,9	
100	4"	114,3	

WITH 2 ENDS x 2
WITH 3 ENDS x 3

4.4 THREADED FITTINGS

4.4.1 CARBON STEEL

WITH ONE END			
Dn-mm	ø-Inch	OD-mm	[Mhr/ea]
15	1/2"	21,3	
20	3/4"	26,7	
25	1"	33,4	
32	1 1/4"	42,2	
40	1 1/2"	48,3	
50	2"	60,3	
65	2 1/2"	73	
80	3"	88,9	
100	4"	114,3	

Man hour include next activities:

- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

Materials:

(FOR WELDED FITTINGS ONLY)	f
- Stainless steel	1,25
- Cr Mo alloy steel	1,40 ÷ 1,60
- High temp. alloy steel	1,00 ÷ 1,80
- Copper alloy	1,20
- Alloy steel Ni	1,60
- Killed C.S.	1,00 ÷ 1,25
- Aluminium alloy	1,50

4.4.2 NON-FERROUS METALS
VALUES FOR
CARBON STEEL x

4.4.3 "HERMETO" COUPLINGS
VALUES IN
TABLE 4.4.1 x

5. VALVES

5.1 VALVES WITH FLANGED ENDS

5.1.1 GATE, GLOBE, CHECK, SWING CHECK, BONNET,
BALL, BUTTERFLY, FILTER, etc [Mhr/ea]

		150#	300#	400#	600#	900#	1500#	2500#
Dn-mm	ø -Inch	PN6-16	25-40	PN64	PN100	PN160	PN250	PN320
15	1/2"							
20	3/4"							
25	1"							
32	1 1/4"							
40	1 1/2"							
50	2"							
65	2 1/2"							
80	3"							
100	4"							
125	5"							
150	6"							
200	8"							
250	10"							
300	12"							
350	14"							
400	16"							
450	18"							
500	20"							
550	22"							
600	24"							
650	26"							
700	28"							
750	30"							
800	32"							
850	34"							
900	36"							

VF - Factor for installation of flanged valves

for flanged valves		Dn to 100 ø to 4"	Dn 125 ÷ 200 ø 5" ÷ 8"	Dn above 250 ø above 10"
PN 6 ÷ 16	150#			
PN 25 ÷ 40	300#			
PN 64	400#			
PN 100	600#			
PN 160	900#			
PN 250	1500#			
PN 320	2500#			

← (included in table)

5.1.2	CONTROL VALVES	[Mhr/ea] x
5.1.3	SAFETY VALVES	[Mhr/ea] x
5.1.4	HYDRANTS	[Mhr/ea] x
5.1.5	FLOW RATE METER	[Mhr/ea] x
5.1.6	LEVEL GAUGES	[Mhr/ea] x
5.1.7	CONDENSATE SEPARATORS	[Mhr/ea] x
5.1.8	SIGHT GLASS	[Mhr/ea] x
5.1.9	VENTURI TUBE	[Mhr/ea] x
5.1.10	VALVES WITH E.M. DRIVE	[Mhr/ea] x

5. VALVES

5.2 VALVES WITH WELDING ENDS [Mhr/ea]

5.2.1 BUTT WELD

CARBON STEEL			150#	300#	400#	600#	800#	900#	1500#	2500#
Dn-mm	ø -Inch	OD-mm	PN6-16	25-40	PN64	PN100		PN160	PN250	PN320
15	1/2″	21,3								
20	3/4″	26,7								
25	1″	33,4								
32	1 1/4″	42,2								
40	1 1/2″	48,3								
50	2″	60,3								
65	2 1/2″	73								
80	3″	88,9								
100	4″	114,3								
125	5″	141,3								
150	6″	168,3								
200	8″	219,1								
250	10″	273								
300	12″	323,9								
350	14″	355,6								
400	16″	406,4								
450	18″	457								
500	20″	508								
550	22″	559								
600	24″	610								
650	26″	660								
700	28″	711								
750	30″	762								
800	32″	813								
850	34″	864								
900	36″	914								

Man hour include next activities:

- handling
- on-site transport
- prefabrication
- erection
- welding
- pressure testing

5.2.2 VALVES WITH SOCKET ENDS

CARBON STEEL			
Dn-mm	ø -Inch	OD-mm	[Mhr/ea]
15	1/2″	21,3	
20	3/4″	26,7	
25	1″	33,4	
32	1 1/4″	42,2	
40	1 1/2″	48,3	
50	2″	60,3	
65	2 1/2″	73	
80	3″	88,9	
100	4″	114,3	

5.3 VALVES WITH THREADED ENDS

ø -Inch	OD-mm	[Mhr/ea]
1/2"	21,3	
3/4″	26,7	
1″	33,4	
1 1/4″	42,2	
1 1/2″	48,3	
2″	60,3	
2 1/2″	73	
3″	88,9	
4″	114,3	

5.4 PRESSURE GAUGES [Mhr/ea]

5.5 THERMOMETERS [Mhr/ea]

Materials:	**f**
- Cr Mo alloy steel	1,40 ÷ 1,60
- Copper alloy	1,20
- Killed C.S.	1,00 ÷ 1,25
- Stainless steel	1,25
- High temp. alloy steel	1,00 ÷ 1,80
- Alloy steel Ni	1,60
- Aluminium alloy	1,50

RATES FOR TENDER CALCULATIONS

1. MANHOUR ESTIMATE FOR INSTALLATION OF PIPING

BASED ON DIAMETERS AND WEIGHTS (FOR CARBON STEEL ONLY)

(Origin: Technical Journal "3R International" of April 4, 1985)

Productivity Efficiency Percentage (PEP) = 75%

		TypeAS		TypeAF		Type BS		TypeBF	
Dn-mm	ø -In ch	[Mhr/ton]	[kg/Mhr]	[Mhr/ton]	[kg/Mhr]	[Mhr/ton]	[kg/Mhr]	[Mhr/ton]	[kg/Mhr]
25	1″	417							
32	1 1/4″	359							
40	1 1/2″	330							
50	2″	286							
65	2 1/2″	246							
80	3″	209							
100	4″	165							
125	5″	135							
150	6″	111							
200	8″	93,6							
250	10″	75,9							
300	12″	63,2							
350	14″	59,5							
400	16″	50,6							
500	20″	43,8							
600	24″	38,9							
1000	40″	20,8							

Type AS Piping in the plant with prefabricated weld joints

Type AF Piping in the plant with prefabricated flanged joints

Type BS Piping outside the plant (pipe racks, sleeper ways, etc.) with prefabricated weld joints

Type BF Piping outside the plant (pipe racks, sleeper ways etc.) with prefabricated flanged joints

kg/Mhr x 2,2046 = lbs/Mhr

Above standards do not include:

- storing and store handling (calculate separately)
- site grading and facilities (add %)
- decrease effect of due to bad weather (add ÷ %)
- scaffolding (calculate separately)
- radiographic inspection (calculate separately)
- performance tests (calculate separately)

Time allowance for

- space obstruction to %
- connection to the existing lines to ÷ %
- erection at higher elevations ÷ % (above 4 m)

2. EFFECT ASSESSMENT FOR QUICK CALCULATION (Use only if not possible acc. to man hours derived from basic estimate points)

2.1 PIPING IN PROCESS PLANT

Prefabrication and erection [kg/Mhr] Productivity efficiency percentage (PEP) = 75%

Dn-mm	ø -Inch	OD-mm	Sch 10	Sch 20	Sch 30	Std	Sch 40	Sch 60	XS	Sch 80	Sch 100	Sch 120	Sch 140	Sch 160	XXS	ø -Inch
15	1/2″	21,3														1/2″
20	3/4″	26,7														3/4″
25	1″	33,4														1″
32	1 1/4″	42,2														1 1/4″
40	1 1/2″	48,3														1 1/2″
50	2″	60,3														2″
65	2 1/2″	73,0														2 1/2″
80	3″	88,9														3″
100	4″	114,3														4″
125	5″	141,3														5″
150	6″	168,3														6″
200	8″	219,1														8″
250	10″	273														10″
300	12″	323,9														12″
350	14″	355,6														14″
400	16″	406,4														16″
450	18″	457														18″
500	20″	508														20″
550	22″	559														22″
600	24″	610														24″
650	26″	660														26″
700	28″	711														28″
750	30″	762														30″
⩾ 800	⩾ 32″	⩾ 813														above 32″

Included: pipes, fittings, flanges, valves and supports

Material: carbon steel

Approximate division of hours for prefabrication and erection

	Prefabrication	Erection
to 11/2″	-	%
2″ ÷ 5″	%	%
6″ ÷ 10″	%	%

Piping between plants:

ON PIPE RACKS [kg/Mhr] x 1,35

ON SLEEPER WAYS [kg/Mhr] x 1,50

kg/Mhr x 2,2046 = lbs/Mhr

2. RATES FOR QUICK CALCULATION

2.2 PIPES (CARBON STEEL - NOT INSULATED)

MEAN VALUE

(Used only when such data provided in tendering documents)

[Mhr/m] [kg/Mhr]

Productivity Efficiency Percentage (PEP) = 75%

			Sch 10		Sch 20		Std		Sch 40		XS		Sch 80		Sch 120		Sch 160		FOR " TECHNIP" COMP.	
Dn-mm	ø-Inch	OD-mm	[Mhr/m]	[kg/Mhr]	[Mhr/m]	[kg/Mhr]	[Mhr/m]	[kg/Mhr]	[Mhr/m]	[kg/Mhr]	[Mhr/m]	[kg/Mhr]	[Mhr/m]	[kg/Mhr]	[Mhr/m]	[kg/Mhr]	[Mhr/m]	[kg/Mhr]	Average diameter[inch]	Mhr/ ton*
15	1/2"	21,3																	< 0,66	
20	3/4"	26,7																	0,67-0,87	
25	1"	33,4																	0,88-1,12	
32	1 1/4″	42,2																	1,13-1,37	
40	1 1/2″	48,3																	1,38-1,75	
50	2″	60,3																	1,76-2,25	
65	2 1/2″	73																	2,26-2,75	
80	3"	88,9																	2,76-3,50	
100	4"	114,3																	3,51-4,50	
125	5"	141,3																	4,51-5,50	
150	6"	168,3																	5,51-7,00	
200	8"	219,1																	7,01-9,00	
250	10"	273																	9,01-11,0	
300	12"	323,9																	11,01-13,0	
350	14"	355,6																	13,01-15,0	
400	16"	406,4																	15,01-17,0	
450	18"	457																	17,01-19,0	
500	20"	508																	19,01-21,0	
550	22"	559																	21,01-23,0	
600	24"	610																	23,01-25,0	
650	26"	660																	25,01-27,0	
700	28"	711																	27,01-29,0	
750	30"	762																	29,01-31,0	
800	32"	813																	31,01-33,0	
850	34"	864																	33,01-35,0	
900	36"	914																	35,01-37,0	
950	38	966																	37,01-39,0	
1000	40"	1016																	>39,0	
1050	42"	1066																		
1100	44"	1118																		
1150	46"	1168																		
1200	48"	1219																		

*Mhr/ton for one millimetre of average wall thickness

Mhr/m x 0,3048 = Mhr/ft
kg/Mhr x 2,2046 = lbs/Mhr

2. EFFECT ASSESSMENT FOR QUICK CALCULATION (Used only if such data provided in tendering documents)

Productivity efficiency percentage (PEP) 75%

2.3 FITTINGS (CARBON STEEL) - MEAN VALUE [kg/Mhr]

All types of fittings included.

													FOR "TECHNIP" COMP.	
													Average diameter [inch]	[Mhr/ton]*
Dn-mm	ø-Inch	OD-mm	Sch 10	Sch 20	Std	Sch 40	XS	Sch 80	Sch 120	Sch 160	XXS	"SOCKET"		
15	**1/2"**	21,3											< 0,66	
20	**3/4"**	26,7											0,67-0,87	
25	**1"**	33,4											0,88-1,12	
32	**1 1/4"**	42,2											1,13-1,37	
40	**1 1/2"**	48,3											1,38-1,75	
50	**2"**	60,3											1,76-2,25	
65	**2 1/2"**	73											2,26-2,75	
80	**3"**	88,9											2,76-3,50	
100	**4"**	114,3											3,51-4,50	
125	**5"**	141,3											4,51-5,50	
150	**6"**	168,3											5,51-7,00	
200	**8"**	219,1											7,01-9,00	
250	**10"**	273											9,01-11,0	
300	**12"**	323,9											11,01-13,0	
350	**14"**	355,6											13,01-15,0	
400	**16"**	406,4											15,01-17,0	
450	**18"**	457											17,01-19,0	
500	**20"**	508											19,01-21,0	
550	**22"**	559											21,01-23,0	
600	**24"**	610											23,01-25,0	
650	**26"**	660											25,01-27,0	
700	**28"**	711											27,01-29,0	
750	**30"**	762											29,01-31,0	
800	**32"**	813											31,01-33,0	
850	**34"**	864											33,01-35,0	
900	**36"**	914											35,01-37,0	
950	**38"**	966											37,01-39,0	
1000	**40"**	1016											39,01-41,0	
1050	**42"**	1066											41,01-43,0	
1100	**44"**	1118											43,01-45,0	
1150	**46"**	1168											45,01-47,0	
1200	**48"**	1219											>47,0	

Materials:	**f**
Stainless steel	1,25
High temp. alloy steel	1,00 ÷ 1,80
Killed C.S	1,00 ÷ 1,25
Cr Mo alloy steel	1,40 ÷ 1,60
Alloy steel Ni	1,60
Copper alloy	1,20
Aluminium alloy	1,50

Note:

Generally, socket fittings to Ø 1 1/2"
are used in petrochemical plants.

*[Mhr/ton] for one millimetre of average wall thickness

kg/Mhr x 2,2046 =lbs/Mhr

2.4 VALVES MEAN VALUE
(ALL KINDS OF VALVES INCLUDED)
Productivity Efficiency Percentage (PEP) = 75%
2.4.1. WITH FLANGED ENDS [Mhr/kg]

		150#	300#	600#	900#	1500#
Dn-mm	ø-Inch	NP6-16	NP25	NP40	NP64	100-160
15	1/2″					
20	3/4″					
25	1″					
32	1 1/4″					
40	1 1/2″					
50	2″					
65	2 1/2″					
80	3″					
100	4″					
150	6″					
200	8″					
250	10″					
300	12″					
350	14″					
400	16″					
450	18″					
500	20″					
550	22″					
600	24″					

2.4.2. WITH WELDING ENDS

2.4.2.1. BUTT WELDING: [Mhr/kg] x

2.4.2.2. SOCKET WELDING: [Mhr/kg] x

Mhr/kg x 0,4536 = Mhr/lbs
kg/Mhr x 2,2046 = lbs/Mhr

2.5 PIPE SUPPORTS
Productivity Efficiency Percentage (PEP) = 80%

2.5.1. PARTICIPATION IN THE PIPING QUANTITY
to be estimated with %

2.5.2. FABRICATION AND INSTALLATION

2.5.2.1 DIVISION BASED ON THE UNIT WEIGHT OF SUPPORT

Unit weight	Fabrication	Installation	Fabrication+ installation
[kg/pc]	[kg/Mhr]	[kg/Mhr]	[kg/Mhr]
to 5			
5 ÷ 20			
20 ÷ 50			
50 ÷ 75			
75 ÷100			
100÷150			
above 150			
Spring supports			

2.5.2.2 DIVISION BASED ON THE PIPING DIAMETER

DN		Fabrication	Installation	Fabrication+ installation
		[kg/Mhr]	[kg/Mhr]	[kg/Mhr]
15 ÷ 50	″″ ÷2″			
65 ÷ 100	2 ″″ ÷4″			
125÷150	5″÷6″			
200÷350	8″÷14″			
above 350	above 14″			

2.5.2.3 EFFECT OF SUPPORT FABRICATION AND INSTALLATION WITH ALREADY KNOWN AVERAGE DIAMETER OF PIPING
The effect of the fabrication and installation [kg/Mhr] is to the average diameter in inches.

2.6 AVERAGE DIAMETER - Manner of Calculation

Average diameter of all pipings in the plant or on the project shall be calculated in the following way:

Sum of the multiplication product of the diameter and length of each pipe shall be divided by the sum of all pipe lengths.

$$\frac{(Dn_1 \times l)_1 + (Dn \times_2 l) + {}_2 (Dn \times l)_3 + \ldots_3}{l_1 + l_2 + l_3 \ldots}$$

3. RATES FOR INSTALLATION OF POLYETHYLENE PIPING

Productivity Efficiency Percentage (PEP) = 80%

3.1 PE Pipes DIN 8074

					PIPES		FITTINGS AND VALVES					
	PN 6		PN 10		Straight pipes	Coils	Bends	Tees	Reducers	Caps	Flanges	Valves
Dn-mm	t [mm]	[kg/m]	t [mm]	[kg/m]	[Mhr/m]	[Mhr/m]	[Mhr/ea]	[Mhr/ea]	[Mhr/ea]	[Mhr/ea]	[Mhr/ea]	[Mhr/ea]
16												
20			2,0	0,12								
25	2,0	0,15	2,3	0,17								
32	2,0	0,17	2,9	0,27								
40	2,3	0,29	3,6	0,42								
50	2,8	0,43	4,5	0,65								
63	3,6	0,68	5,7	1,03								
75	4,3	0,97	6,8	1,47								
90	5,1	1,38	8,2	2,11								
110	6,2	2,04	10,0	3,14								
140	7,9	3,60	12,7	5,07								
160	9,1	4,33	14,6	6,66								
180	10,2	5,45	16,4	8,41								
200	11,4	6,77	18,2	10,40								
225	12,8	8,55	20,5	13,10								
250	14,2	10,50	22,8	16,20								
280	15,9	13,20	25,5	20,30								
315	17,9	16,70	28,7	25,70								
355	20,1	21,10	32,3	32,60								

3.2 Rates for installation of PE reinforcement pads for branch connection [Mhr/ea]

PIPE	BRANCH					
Dn-mm	20	25	32	40	50	63
40						
63						
90						
110						
125						
160						
180						
200						
225						

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
Mhr/m x 0,3048 = Mhr/ft

4. RATES FOR ERECTION OF PVC & FRP PIPING

Productivity Efficiency Percentage (PEP) 80%

Dn-mm	ø-Inch	Pipes handling [Mhr/m]	Socket joint [Mhr/ea]	Nozzle at 90° and reinforcement [Mhr/ea]	Valves PVC housing (handling) [Mhr/ea]
15	1/2″				
20	3/4″				
25	1″				
30	1 1/4″				
40	1 1/2″				
50	2″				
65	2 1/2″				
80	3″				
100	4″				
150	6″				
200	8″				
250	10″				
300	12″				
350	14″				
400	16″				
450	18″				
500	20″				
550	22″				
600	24″				
650	26″				
700	28″				
750	30″				
800	32″				
850	34″				
900	36″				
950	38″				
1000	40″				

SYNTHETIC MATERIALS ABBREVIATIONS & INTERPRETATION

FRP - FIBREGLASS RESIN POLYESTER
PE - POLYETHYLENE
PVDF -POL YVINYLDENFLUORIDE
PVC - POLYVINYLCHLORIDE, HARD
PP - POLYPROPYLENE
FPM - (VITON A ®) FLUOR INDIAN RUBBER (KAUTSCHUK)
EPDM -(APTK) ETHYLENE PROPYLENE- INDIAN RUBBER
CR - (NEOPRENE ®) CHLOROPRENE INDIAN RUBBER
PTFE - (TEFLON ®) POLYTETRAFLUORETHYLENE
PVC-C -POL YVINYLCHLORIDE, ADDITIONALLY CHLORINATED
PB - POLYBUTENE
POM - POLYXYMETHYLENE
NBR - NITRIL INDIAN RUBBER
IIR BUTYL INDIAN RUBBER
CSM - (HYPALON ®) CHLORSULFONYLPOLYETHYLENE
PEHD -POL YETHYLENE HIGH DENSITY
PRFV -POL YESTER RESIN FIBREGLASS REINFORCED, INTERNAL CORE OF PVC

5. CARBON STEEL PIPING (SCH 40)

CEMENT LINED INSIDE

Productivity Efficiency Percentage (PEP) 80%

Dn-mm	ø-Inch	Pipes handling [Mhr/m]	Pipe cutting [Mhr/cut.]	Butt weld [Mhr/ea]	Sleeve joint with two fillet welds [Mhr/joint]	Nozzle at 90° [Mhr/ea]	Repair of concrete lining on joints [Mhr/joint]
150	6″						
200	8″						
250	10″						
300	12″						
350	14″						
400	16″						
500	20″						
600	24″						
700	28″						
800	32″						
900	36″						
1000	40″						
1100	44″						
1200	48″						

Note:

1. Piping of synthetic materials to be calculated acc. to the tables for PE or PVC piping
2. For diameters larger than 40″ (1000 mm), to be calculated proportionally to 40″

Mhr/m x 0,3048 = Mhr/ft

6. PIPING MADE OF STEEL AND GREY CAST-IRON

I made an exception and included steel and grey cast piping in the Chapter Piping Above Ground although they are in most cases laid underground. According to these man hour rates only the pipes are determined according to the unit of length whereas the man hour rates for all other fittings should be calculated acc. to the type and number of joints. For example, Tpiece with a flange at one end and a socket at two ends should be calculated as 1 x flanged end and 2 x socket end.

Productivity efficiency percentage (PEP) = 80%

6.1 CAST IRON PIPES

Nominal diameter	Pipe length	
DN	[m]	[Mhr/m] *
80 (3″)	3; 4; 5	
100 (4″)	3; 4; 5	
125 (5″)	3; 4; 5	
150 (6″)	3; 4; 5	
200 (8″)	5	
250 (10″)	5	
300 (12″)	5	
350 (14″)	5	
400 (16″)	5	
450 (18″)	5	
500 (20″)	5	
600 (24″)	5; 6	
700 (28″)	6	
800 (32″)	6	

*** Note:**
According to John S. Page's manual each joint between the pipes is also added man hour for the socket joint. I do not agree with that. This could apply only if the fittings are not calculated separately. Just to mention that his man hour for a socket joint is 1/3 lower than the man hour in this table.

Mhr/m x 0,3048 = Mhr/ft

6.2 FITTINGS

(DIN: A, E, F, FF, K, FFK, Q, MQ, MMQ, MMK, FFR, T, TT, U, MMA, MMB, MMR, X, N)
When calculating man hours for each fitting each end is calculated according to its type, except for the straight end.

Nominal diameter	Socket end	Flanged end
DN	[Mhr/ea]	[Mhr/ea]
80 (3″)		
100 (4″)		
125 (5″)		
150 (6″)		
200 (8″)		
250 (10″)		
300 (12″)		
350 (14″)		
400 (16″)		
450 (18″)		
500 (20″)		
600 (24″)		
700 (28″)		
800 (32″)		

6.3 VALVES

Valves to be estimated by considering the handling as for the piping above ground and by adding 2 x Mhr/ea for a flanged end.

7. RATES FOR PIPING BASED ON INCH-DIAMETER (ID)

Productivity efficiency percentage (PEP) 80%

Some world companies ask in their call for tender for a price review according to inchdiameter (ID) and inclusion of all the operations and works involved in installation of piping.

$$\frac{\text{Item 3.1} \times F}{D} = \frac{\text{Mhr}}{ID}$$

Item 3.1 - Estimate points for butt joint of a relative diameter and wall thickness(Chapter X. Pages 147 ÷ 201)
F - sum of factors for the activities required (see below)
D - diameter (or average diameter) of piping in inches

	ACTIVITY FACTORS	
- PIPES	- prefabrication	
- PIPES	- installation	
- FITTINGS	- prefabrication	
- FITTINGS	- installation	
- FLANGES	- prefabrication	
- FLANGES	- installation	
- VALVES	- installation	
- PRESSURE TEST	- hydrostatic	
- PRESSURE TEST	- pneumatic	
- ELEVATION IMPACT		
- IMPACT OF SPACE OBSTRUCTION		
	Sum	

Every company has its own way of listing the prices for each activity in its call for tenders. Therefore, only the factors for the activities that are required by tenderin documents are summed up.

Fabrication and installation of pipe supports is considered separately according to the tables on page 39..

CORRECTION FACTORS:

- Different materials

CS		3,5 Ni	
Low alloy (0,5 Mo)		SS 304	
1,25 Cr		SS 316	
5 Cr		SS 321	
9 Cr		SS 347	
Composite pipe			
Non-ferrous material			
Plastic resin			
CS pipe -	- cement		
lined inside	- resin		
(Lining CS):-	glass		

- Place of installation:

Above Ground	
Under Ground	
Pipe rack	
Bridge	
Around equipment	
Line pipe - Sleeper way	

- Prefabrication

- Type of joint:

Butt weld	
90° Nozzle weld	
90° Reinforced nozzle weld	
Socket weld	
Seal weld	
Threaded joint	
Root pass	
Fillet weld	
Mitre weld	
(Sockolet, weldolet, coupling, etc.)	
Tie-in to existing piping	

8. RATES FOR UNITS OF OPERATION (BASED ON INCH-DIAMETER)

Productivity efficiency percentage (PEP) = 80%

1. Cuts, bevels and welds

1.1 Cuts and bevels - all materials

- Schedule	10		[Mhr/ID]
- Schedule	20		[Mhr/ID]
- Schedule	40		[Mhr/ID]
- Std			[Mhr/ID]
- Schedule	60		[Mhr/ID]
- Schedule	80		[Mhr/ID]
- XS			[Mhr/ID]
- Schedule	100		[Mhr/ID]
- Schedule	120		[Mhr/ID]
- Schedule	160		[Mhr/ID]
- XXS			[Mhr/ID]
- Shop fabrication			
- Field fabrication			

1.2 Welding

1.2.1 Carbon Steel

- Schedule	10		[Mhr/ID]
- Schedule	20		[Mhr/ID]
- Schedule	40		[Mhr/ID]
- Std			[Mhr/ID]
- Schedule	60		[Mhr/ID]
- Schedule	80		[Mhr/ID]
- XS			[Mhr/ID]
- Schedule	100		[Mhr/ID]
- Schedule	120		[Mhr/ID]
- Schedule	160		[Mhr/ID]
- XXS			[Mhr/ID]
- Shop fabrication			
- Field fabrication			

1.2.2 Stainless steel

- Schedule	5S		[Mhr/ID]
- Schedule	10S		[Mhr/ID]
- Schedule	20		[Mhr/ID]
- Schedule	40S		[Mhr/ID]
- Schedule	60		[Mhr/ID]
- Schedule	80S		[Mhr/ID]
- Schedule	80		[Mhr/ID]
- Schedule	100		[Mhr/ID]
- Schedule	120		[Mhr/ID]
- Schedule	160		[Mhr/ID]
- Shop fabrication			
- Field fabrication			

1.2.3 Alloy Steel

- Schedule	10		[Mhr/ID]
- Schedule	20		[Mhr/ID]
- Schedule	40		[Mhr/ID]
- Std			[Mhr/ID]
- Schedule	60		[Mhr/ID]
- Schedule	80		[Mhr/ID]
- XS			[Mhr/ID]
- Schedule	100		[Mhr/ID]
- Schedule	120		[Mhr/ID]
- Schedule	160		[Mhr/ID]
- XXS			[Mhr/ID]
- Shop fabrication			
- Field fabrication			

8. RATES FOR UNITS OF OPERATION (BASED ON INCH-DIAMETER)

2. Pipe - Handling
Based on MID (meter-inch-diameter)

- Schedule 10		[Mhr/MID]
- Schedule 20		[Mhr/MID]
- Schedule 40		[Mhr/MID]
- Std		[Mhr/MID]
- Schedule 60		[Mhr/MID]
- Schedule 80		[Mhr/MID]
- XS		[Mhr/MID]
- Schedule 100		[Mhr/MID]
- Schedule 120		[Mhr/MID]
- Schedule 160		[Mhr/MID]
- XXS		[Mhr/MID]

- Shop fabrication %

- Field fabrication %

Mhr/kg x 0,4536 = Mhr/ft

3. Miscellaneous

3.1 Temporary Items

- Temporary Supports [Mhr/kg]

- Temporary Spacers [Mhr/kg]

3.2 Tapering Wall Thickness for Fittings and Flanges

- to 5 mm		[Mhr/ID]
- 5 ÷ 10 mm		[Mhr/ID]
- 10 ÷ 15 mm		[Mhr/ID]
- 15 ÷ 20 mm		[Mhr/ID]
- 20 ÷ 25 mm		[Mhr/ID]

- Shop fabrication %

- Field fabrication %

3.3 Bending of pipe

- Bending of pipe to 1 1/2” [Mhr/bend]

9. RATES FOR PIPING WELDING- (Fitter's work not included)
BUTT WELD (C. S.) - COMPLETE [Mhr/weld]
Productivity efficiency percentage (PEP) = 90%

ø -Inch	10	20	30	Std	40	60	XS	80	100	120	140	160	XXS	ø -Inch
1/2″														1/2″
3/4″														3/4″
1″														1″
1 1/4″														1 1/4″
1 1/2″														1 1/2″
2″														2″
2 1/2″														2 1/2″
3″														3″
4″														4″
6″														6″
8″														8″
10″														10″
12″														12″
14″														14″
16″														16″
18″														18″
20″														20″
22″														22″
24″														24″
26″														26″
28″														28″
30″														30″
32″														32″
34″														34″
36″														36″

Factors for different kinds of materials

1. Carbon steel
2. Stainless steel
3. Chromium-Molibden steel

Factors for calculating the rates acc. to type of weld

1. Nozzle weld 90°
2. Nozzle weld 90° w. reinforcement
3. Nozzle weld bevelled
4. Nozzle weld bevelled w. reinforcement
5. Weldolet, sockolet, nipolet, etc.
6. Fillet weld "socket weld"
7. Fillet weld "dummy" 90°
8. Fillet weld "dummy" on elbow
9. Fillet weld closing dummy
10. Mitre weld

10. MAN HOURS FOR WELDING OF PIPING

BUTT WELD - ROOT PASS AND FILLER PASSE

	Root pass - GTAW	FILLER AND COVER PASSES - SMAW [Mhr/weld]													
ø -Inch	[Mhr/weld]	10	20	30	Std	40	60	XS	80	100	120	140	160	XXS	ø -Inch
1/2″															1/2″
3/4″															3/4″
1″															1″
1 1/4″															1 1/4″
1 1/2″															1 1/2″
2″															2″
2 1/2″															2 1/2″
3″															3″
4″															4″
6″															6″
8″															8″
10″															10″
12″															12″
14″															14″
16″															16″
18″															18″
20″															20″
22″															22″
24″															24″
26″															26″
28″															28″
30″															30″
32″															32″
34″															34″
36″															36″

M. BULIĆ

2003.

				PIPES & VALVES INSTALL.			PIPING SUPPORTS		PIPEFITTER WORKS															WELDING	
				PIPES		FLANGED VALVES			BUTT JOINT				MITRE JOINT			FLANGED CONNECT.		THREADING	THREADED CONNECT.	BRANCH CONNECT.	WELDOLET SOCKOLET	SOCKET JOINT	BENDING R=5d	BUTT WELD	
				PROCESS	RACK		FABR.	INSTALL.	CUTTING	BEVELL.	JOINT	CUTTING	BEVELL.	JOINT	INSTALL.	REMOVAL									
							All types without spring sup.		Mhr/pc		incl.6+8			incl.10+11	incl. gasket & bolts		incl. 6	excl. 15	excl. 21	excl. 21	excl. 21	cold	excl. 9	
ZAGREB - CROATIA				Mhr/mtr	Mhr/mtr	Mhr/pc	Mhr/kg	Mhr/kg	FLAME	COLD	Mhr/pc	Mhr/pc	Mhr/pc	Mhr/pc	Mhr/pc	Mhr/pc	Mhr/pc	Mhr/pc	Mhr/pc	Mhr/pc	Mhr/pc	Mhr/pc	Mhr/pc	Mhr/weld	
DN	NW	SCH	mm	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	NW
15	1/2"	80	3,73																						1/2"
20	3/4"	80	3,91																						3/4"
25	1"	80	4,55																						1"
40	11/2"	80	5,08																						11/2"
50	2"	80	5,54																						2"
65	21/2"	40	5,16																						21/2"
80	3"	40	5,49																						3"
100	4"	40	6,02																						4"
125	5"	40	6,55																						5"
150	6"	40	7,11																						6"
200	8"	40	8,18																						8"
250	10"	20	6,35																						10"
300	12"	20	6,35																						12"
350	14"	20	7,92																						14"
400	16"	20	9,52																						16"
450	18"	20	7,92																						18"
500	20"	20	9,52																						20"
600	24"	20	9,52																						24"

GENERAL FACTORS

DIFFERENT MATERIALS FOR ITEMS: 6,7,8,9,10,11,12,17,18,19 and 21

MATERIAL	FACTOR
CARBON STEEL	
ALLOY STEEL > 5% Cr	
ALLOY STEEL < 5% Cr	
STAINLESS STEEL	
Ni - ALLOY	
Cu - ALLOY	
Al - ALLOY	

DIFFERENT WALL THICKNESSES FOR ITEMS 1,2,6,7,8,9,10,11,12,17,18 and 21

The a. m. norms apply only to the above Schedules and the wall thicknesses. For different wall thicknesses calculation should be made so, that the required wall thickness is divided by the a. m. thickness and then multiplied by the norm from the table. The result is the norm for the new thickness.
Example: Installation of a pipe in a process plant Ø4" Sch 80 (8,56mm)
(8,56/ 6,02) X 1,0 = 1,42 Hr

HEIGHT WORK LOCATIONS (OVER STABLE BOTTOM)

HEIGHT	FACTORS
CHANEL	
0-3m	
3-6m	
6-9m	
9-12m	
12-15m	
> 15m	

FACTORS FOR PIPEFITTER WORKS

DIFFERENT RATINGS FOR ITEMS 3, 13 and 14

RATING	FACTORS
150#	
300#	
400#	
600#	
900#	
1500#	
2500#	

DIFFERENT VALVE ENDS ITEM 3

TYPE	FACTORS
FLANGED	
WELDED BUTT	
WELDED SOCKET	
THREAD	

BRANCH CONNECTIONS ITEM 17

TYPE	FACTORS
BRANCH 90°	
90° with reinforcing	
BRANCH 45°	
45° with reinforcing	

WELDING FACTORS

DIFFERENT WELD CONNECTIONS

TYPE	FACTOR	TYPE	FACTOR
BUTT WELD		WELDOLET, SOCKOLET, ETC	
BRANCH CONNECT. WELD 90°		SOCKET WELD	
90° W. REINFORCEMENT PAD		SEAL WELD	
BRANCH CONNECT. WELD 45°		MITRE WELD	
45° W. REINFORCEMENT PAD		SLIP - ON WELD	

WORK CALCULATION - MAN HOURS FOR PIPING MODIFICATION AT SITE

1. DISMANTLING IS 50% OF THE SPECIFIED MANHOUR RATE FOR INSTALLATION (WITHOUT ITEM 13 and 14)
2. PRODUCTIVITY EFFICIENCY PERCENTAGE: 85% - VERY GOOD

12. INSTALLATION OF PIPING ABOVE - GROUND

Unit standards as per integral elements
Prefabrication and installation breakdown
(Technical calculation manual, year 2003.)

			Prefabrication	Installation
1.	**Pipes**			
1.1.	Pipes in the plant	to 1 1/2"	%	%
		2"- 48"	%	%
		above 48"	%	%
1.2.	Pipes on pipe rack		%	%
2.	**Fittings**			
2. 1.Elbows				
2.1.1.Elbows and mitre				
	bends prefabricated to	to 1 1/2"	%	%
		2" - 48"	%	%
2.2.2.Mitre bends to be				
	manufactured	to 48"	%	%
		above48"	%	%
2.2.	Tee - pieces to	to 1 1/2"	%	%
		2"- 48"	%	%
2.3.	Reducing pieces completed	to1 1/2"	%	%
		2"- 36"	%	%
2.4.	Caps - all bores		%	%
2.5.	O' lets, half - couplings and the like		%	%
3.	**Flanges**			
3.1.	Flanges - for welding all types and bores,		%	%
3.2.	Blind flanges, orifice plates, spectacle blind and the like		%	%
4.	**Valves -**all kinds, types pad bores		%	%
5.	**Pipe supports**	to 2"	%	%
		3" - 6"	%	%
		8"- 14"	%	%
		16" and above	%	%
6.	**Miscellaneous**			
6. 1.All br anch welds			%	%
6. 1.Stiff ener rings and reinforcing pads			%	%

7. **Bolts and gaskets -** not to be taken into account

II. PIPELINES - Basis for calculation of man hours

Productivity efficiency percentage (PEP) = 75%

Contents:

To make an estimate for laying a pipeline is a very "sensitive" operation, particularly for estimators lacking experience in the laying and installation of such pipelines. World recognized companies specializing in this kind of work have empirical rates based on diameter and length, and on "inch-meter" respectively. A widely recognized manual for that purpose is John S. Page's Cost Estimating Manual for Pipelines and Marine Structures.

The impact of climate, ground and the state is quantified empirically. Since our company does not specialize only in pipelines, we developed rates and elements for calculation of the time needed. However, these rates cannot substitute an estimator. They can assist estimators in making their estimates. In principle, call for tenders do not provide all the elements needed to determine precisely the time needed for erection/installation/laying. Therefore, there are many variables to be taken into account and evaluated by the estimator in order to foresee in detail the conditions under which the works may be executed. The estimator has to make an accurate estimate of the rates, and when and which rates to apply. Similarly, he can change them depending on the case.

1. PIPE TRANSPORT

Basic rate for pipe transport is..... [Mhr/ton]

The basic rate changes with the conditions by adding or deducting the following rates:

Distance:	for each kilometre more than 5 km.....	plus	[Mhr/ton]
Roads:	- city roads+.....	plus	[Mhr/ton]
	- asphalt roads to 50 %.....	not considered	
	- asphalt roads above 50 %.....	plus	[Mhr/ton]
Means of transport:	- trailer truck long vehicle.....	not considered	
	- trailer with HIAB.....	minus	[Mhr/ton]
	- tracktor with a trailer.....	plus	[Mhr/ton]
Loading:	- special crane for loading.....	not considered	
	- loading by HIAB.....	plus	[Mhr/ton]
	- crane used also for loading.....	plus	[Mhr/ton]
Unloading:	- unloading by a special crane to		
	- a temporary pipe storage.....	minus	[Mhr/ton]
	- unloading with pipe stringing along the right-of-way by a special crane.....	not considered	
	- unloading and pipe stringing by HIAB.....	plus	[Mhr/ton]

Pipe Diameter:	to4"	plus	[Mhr/ton]
	6" ÷ 8"	not considered	
	10" ÷ 12"	minus	[Mhr/ton]
	14" ÷ 16"	minus	[Mhr/ton]
	18" ÷ 24"	minus	[Mhr/ton]
	26" and above	minus	[Mhr/ton]
Pipe Type:	- not wrapped	not considered	
	- wrapped	plus	[Mhr/ton]
Continuity of continuous transport:		minus	[Mhr/ton]
	- with occasional stoppages	not considered	
	- acc. to circumstances	plus	[Mhr/ton]

* Crane operators and drivers included in the price of machinery

2. PIPE STRINGING

If pipe stringing is done as a separate operation by stringing pipes along the right-of-way from the reference storage, the following rates apply:

to 3"	plus	[Mhr/pc]
to 4"	plus	[Mhr/ pc]
6" ÷ to 8"	plus	[Mhr/ pc]
10" ÷ to 14"	plus	[Mhr/ pc]
16" ÷ to 20"	plus	[Mhr/ pc]
22" and above	plus	[Mhr/ pc]

If no data is available on the number of pipes, it should be estimated. The manhour does not include transport of temporary timber supports. Drivers and crane operators are not included.

3. BENDING OF PIPES

- Pipe bending on the right-of-way

to 3"	[Mhr/bending]
4"	[Mhr/bending]
6" ÷ 8"	[Mhr/bending]
10" ÷ 14"	[Mhr/bending]
16" ÷ 20"	[Mhr/bending]
22" and above	[Mhr/bending]

- Shop bending: contractors
- Bending for special points is not calculated according to this rate but is included under special points.

4. PIPE JOINTING

It includes pipefitter works for joining of pipes. Welding is not included.

- Basic rates:

3"	[Mhr/joint]	14"	[Mhr/joint]
4"	[Mhr/joint]	16"	[Mhr/joint]
6"	[Mhr/joint]	18"	[Mhr/joint]
8"	[Mhr/joint]	20"	[Mhr/joint]
10"	[Mhr/joint]	22"	[Mhr/joint]
12"	[Mhr/joint]	24"	[Mhr/joint]

The rate for pipe joining is calculated by increasing or decreasing the basic rate by the following percentages:

a. Place of jointing:

- near trench on temp. timber supports
- above trench + %
- in trench + %

b. Type of pipe:

- iron pipes
- prewrapped pipes + %

c. Right-of-way quality:

- city street + %
- along a road - %
- dry rocky right-of-way
- possible mud + %

d. Means of production:

- crane + %
- pipelaying machine

e. Average pipe length:

- shorter than 8 m
- longer than 8 m + %

Example: pipe Ø6" basic rate is 1,75 [Mhr/joint]

- a.	+ %
- b.	+ %
- c.	- %
- d.	+ %
- e.	+ %
Total	+ %

The final manhour rate is a sum of the basic rate [Mhr/joint] + %= [Mhr/joint]

5. WELDING

SMAW vertical up (conventional): Mhr/weld=Xx Øxt/
SMAW verical down (Fallnaht): Mhr/weld=Xx Øxt/

X = values from below table; Ø = pipe diameter in inches; t - wall thickness in mm

X-value table

Ø	X	Ø	X
		14″	
3″		16″	
4″		18″	
6″		20″	
8″		22″	
10″		24″	
12″		above 24″	

6. WRAPPING

6.1 MACHINE WRAPPING (acc. t John S. Page)

Ø	to 2″	3″	4″	6″	8″	10″	12″	14″	16″	18″
[Mhr/m]										
Ø	20″	22″	24″	26″	28″	30″	32″	34″	36″	
[Mhr/m]										

I find above values overestimated, which is based on my monitoring the wrapping works. Therefore, I suggest that the following percentages of the above values are considered.

Diameter	%	Mhr/m2	Mhr/sqft
2"-8"	%		
10"-16"	%		
18"-24"	%		
26"-36"	%		

6.2 HAND WRAPPING

Single-layer wrapping: Machine wr apping x
Double-layer wrapping: Machine wr apping x
Weld wrapping: Mhr/weld= Mhr/m for hand wrapping

Mhr/m x 0,3048 = Mhr/ft

7. LAYING IN TRENCH

This kind of laying is considered only when the pipeline is hand wrapped near a trench or above a trench. Man hours include also collection and tr ansport of timber supports and possible installation of concrete weights in case of an underwater pipeline.

to 4″..... [Mhr/m]
6″ ÷ 8″..... [Mhr/m]
10″ ÷ 12″..... [Mhr/m]
14″ ÷ 16″..... [Mhr/m]
18″ ÷ 24″..... [Mhr/m]
above 24″..... [Mhr/m]

8. SPECIAL POINTS

The term "special points" means the works on pipelines where a point crew cannot do the work and the special points are left for later on. This requires special teams for executing such works. The special points are:

8.1 BORING UNDER ROADS AND RAILROADS

Generally, the erection company does not perform the boring. The erection company performs the following activities:

Supply of the material needed for protection and header pipe
Cutting of protection conduit to the length dictated by a boring team
Protection conduit welding
Protection conduit wrapping
Header pipe assembling and wrapping
Header pipe leak test
Installation of spacers and pulling in the main pipe
Installation of "Z" seals (sleeve)
Construction of air vents on both sides of the road/railroad
Putting up necessary signs for the road/railroad works

		to 4"		[Mhr]
6"	÷	8"		[Mhr]
10"	÷	12"		[Mhr]
14"	÷	16"		[Mhr]
18"	÷	24"		[Mhr]
		above 24"		[Mhr]

Connection to the header is included.

8.2 BREAK OUT OF ROADS

These special points can be performed without stopping the road traffic or by bypassing the traffic. This rate does not include the excavation and repair of the right-of-way.

w/o protection pipe				w/o traffic	with traffic
		to 4"		[Mhr]	[Mhr]
6"	÷	8"		[Mhr]	[Mhr]
10"	÷	12"		[Mhr]	[Mhr]
14"	÷	16"		[Mhr]	[Mhr]
18"	÷	24"		[Mhr]	[Mhr]
		above 24"		[Mhr]	[Mhr]

with protection pipe				w/o traffic	with traffic
		to 4"		[Mhr]	[Mhr]
6"	÷	8"		[Mhr]	[Mhr]
10"	÷	12"		[Mhr]	[Mhr]
14"	÷	16"		[Mhr]	[Mhr]
18"	÷	24"		[Mhr]	[Mhr]
		above 24"		[Mhr]	[Mhr]

The connection to the header is included.

8.3 CONNECTING PIPELINE SECTIONS

This item includes the works on interconnecting two pipeline sections.

		to 4"		[Mhr]
6"	÷	8"		[Mhr]
10"	÷	12"		[Mhr]
14"	÷	16"		[Mhr]
18"	÷	24"		[Mhr]
		above 24"		[Mhr]

8.4 CROS SING WATERCOURSES

The watercourses are rivers, streams and canals with or without water, etc. Generally, specialist firms undertake the works on river crossings whereas crossings under streams and canals are executed by erection companies, which undertake also the straight sections. The following operations are included under this item.

- Bending
- Connecting & welding of sections
- Leak test of sections
- Wrapping
- Laying in trench
- Installation of concrete weights
- Backfilling

(Other works are the responsibility of a civil contractor)

	Canal w/o water	Canal with water	Stream with water
to 4"	[Mhr]	[Mhr]	[Mhr]
6" ÷ 8"	[Mhr]	[Mhr]	[Mhr]
10" ÷ 12"	[Mhr]	[Mhr]	[Mhr]
14" ÷ 16"	[Mhr]	[Mhr]	[Mhr]
18" ÷ 24"	[Mhr]	[Mhr]	[Mhr]
above 24"	[Mhr]	[Mhr]	[Mhr]

- Connecting to the header:
  - one side included
  - the other side according to the rate for "Connecting Pipeline Sections"

8.5 INSTALLATION OF CLEANING STATIONS

This item includes the installation of pipes coming out of the ground and installation of a pig launcher and a pig trap. The construction of the station is not included but it can be rated as prefabrication:

to 4"	[Mhr/station]
6" ÷ 8"	[Mhr/station]
10" ÷ 12"	[Mhr/station]
14" ÷ 16"	[Mhr/station]
18" ÷ 24"	[Mhr/station]
above 24".	[Mhr/station]

8.6 PUTTING UP PIPELINE MARKERS

This item covers all the operations relating to putting up the pipeline markers. Their fabrication is not included.

Each marker = [Mhr]

8.7 OTHER SPECIAL POINTS

- Make-on of branches on a pipeline
- Installation of measuring and control stations
- Installation of reducing stations
- Installation of condensate drain stations
- Bridge crossings
- Watercourse crossings

Man hours for these special points are calculated according to the manhour rates for fabrication and installation of the piping in plants.

9. PRESSURE TESTS

Generally, the pressure tests on the pipelines are performed by teams specialized for this kind of work. The team must be provided with all necessary equipment.
The pipelines are constructed in sections, which start and end at a stream that is at a place with sufficient water to wash and test the pipeline washing and testing. The section length depends on the pipeline right-of-way configuration. This rate determines the time needed to test a 5 km (3 miles) long section. The following time allowances to be considered for longer sections:

- Pipeline section to 5 km or 3 miles..... = [Mhr]
- Each kilometre longer than 5 km or 3 miles.....plus [Mhr/km] or [Mhr/mile]

10. PRELIMINARY AND FINISHING WORKS

10.1 PRELIMINARY WORKS

They include:

- Setting up a camp
- Setting up offices
- Setting up warehouses and stores
- Setting up workshops
- Erection of necessary fences
- Preparation of machinery
- Construction of auxiliary devices

The rate for the **preliminary works is** % of the total man hours for the works **f**om 1 through 9.

10.2 FINISHING WORKS

The finishing works include:

-Cleaning the right-of-way from residual material, pipes, timber supports, construction material, and other debris
- Dismantling temporary works
- Loading the equipment and material
- Other finishing works

The rate for the **finishing works is** % of manhours for preliminary works.

III. STEEL STRUCTURE ERECTION (Acc. to MONTMONTAŽA Co. 1980) **[Productivity efficiency percentage (PEP)=75%]**

1. BASIC MAN HOURS - UNIT		Unit weight of elements in [t] and man hours [Mhr/ton]																	
	Kind of Work	0,05	0,1	0,15	0,2	0,25	0,35	0,5	0,8	1	2	3	4	5	8	10	12	15	20
1.1	Sorting the structure and preparation for erection and pre-erection														-	-	-	-	-
1.2	Pre-erection of structure																		
	a) by crane:																		
	1.2.1. a Columns	-	-	-	-	-	-	-	-										
	1.2.2. a Beams and columns	-	-	-	-	-	-	-	-										
	1.2.3. a Lattice beams	-	-	-	-	-	-	-	-										
	b) by hand:																		
	1.2.1. b Columns and beams	-	-	-	-	-	-	-	-										
	1.2.2. b Lattice beams	-	-	-	-	-	-	-	-										-
1.3	Transport of structure to erection place																		
	1.3.1. Columns and beams	-	-	-	-	-	-	-	-										
	1.3.2. Lattice beam	-	-	-	-	-	-	-	-	-									-
	1.3.3. Small structure										-	-	-	-	-	-	-	-	-
1.4	Installation of anchor bolts and break in	-	-	-	-	-	-	-	-										
1.5	Structure erection																		
	(hoisting and putting up the structure)																		
	a) by crane:																		
	1.5.1.a Columns	-	-	-	-	-	-	-	-										
	1.5.2.a Beams	-	-	-	-	-	-												
	1.5.3.a Lattice beam	-	-	-	-	-	-	-	-										
	1.5.4.a Different diagonal small items	-	-	-								-	-	-	-	-	-	-	-
	b) by el. winches:																		
	1.5.1.b Columns by supporting arms	-	-	-	-	-	-	-	-								-	-	-
	1.5.2.b Beams " " " "	-	-	-	-	-	-	-	-								-	-	-
	1.5.3.b Lattice supports by masts	-	-	-	-	-	-	-	-									- -	
	1.5.4.b Binding joists							-	-	-	-	-	-	-	-	-	-	-	-
	1.5.5.b Longitudinal beams								-	-	-	-	-	-	-	-	-	-	-
	1.5.6.b Floor grids and chequered sheets									-	-	-	-	-	-	-	-	-	-
	c) By hand operated winches																		
	or haulage cranes:																		
	1.5.1.c Columns by supporting arms	-	-	-	-	-	-	-	-								-	-	-
	1.5.2.c Beams " " " "	-	-	-	-	-	-	-	-								-	-	-
	1.5.3.c Trusses supports by sup. arms	-	-	-	-	-	-	-	-								-	-	-
	1.5.4.c Binding joists							-	-	-	-	-	-	-	-	-	-	-	-
	1.5.5.c Longitudinal beams																		
	1.5.6.c Floor grids and chequered sheets									-	-	-	-	-	-	-	-	-	-
	1.5.7.c Wall windows					-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.5.8.c Misc. construct, diagonals																		
	& small items pcs.	-	-	-	-	-				-	-	-	-	-	-	-	-	-	-
	1.5.9.c Staircase treads [Mhr/ea]		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1.6 INSTALLATION OF LOST FORMWORK Trapezoidal sheets for concrete slabs

- Bolting of binding beams is performed by the manufacture the structure supplier.
- Sheets are fastened by nails driven in by pistols.

1.6.1 Type "HOLORIB" or "MONTANA" (length c. 4 m, width 620 mm)

	weight [kg/m²]	to 100 m² / to 1000 sqft	100 ÷ 500 m² / 1000 ÷ 5000 sqft	500 ÷ 1000 m² / 5000 ÷ 10 000 sqft	1000 ÷ 10000 m² / 10000 ÷ 100 000 sqft	10000 ÷ 50000 m² / 100 000 ÷ 500 000 sqft	above 50000 m² / above 500 000 sqft
t = 0,75 mm	11,4	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²
t = 0,88 mm	13,5	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²
t = 1,0 mm	15,3	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²

1.6.2 Type "KRUPP HÖSCH" (length 3,6 ÷ 5,8 m, width 700 ÷ 800 mm)

	weight [kg/m²]	to 100 m² / to 1000 sqft	100 ÷ 500 m² / 1000 ÷ 5000 sqft	500 ÷ 1000 m² / 5000 ÷ 10 000 sqft	1000 ÷ 10000 m² / 10000 ÷ 100 000 sqft	10000 ÷ 50000 m² / 100 000 ÷ 500 000 sqft	above 50000 m² / above 500 000 sqft
t = 1,0 mm	12,8	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²
t = 1,25 mm	16,0	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²
t = 1,50 mm	19,2	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²	Mhr/m²

Note: 1. Steel brackets for trapezoidal plates (Stahlknagge) are generally shop welded.
If site welded, the rate of % is added.
2. Above rates include also placement of Z sections and seal caps.

1.7 INSTALLATION OF WIRE ROPE CLAMPS

ø	Mhr/ea	ø	Mhr/ea	ø	Mhr/ea	ø	Mhr/ea	ø	Mhr/ea
to 20 mm		26 ÷ 30 mm		36 ÷ 40 mm		46 ÷ 50 mm		56 ÷ 60 mm	
21 ÷ 25 mm		31 ÷ 35 mm		41 ÷ 45 mm		51 ÷ 55 mm		> 60 mm	

1.8 REAMING OF HOLES

M 20	M 22	M 24	M 27	M 30	M 36	M 42	M 48	M 56	M 64
a) by pn. or el. drilling machine from scaffold - manhour/hole									
b) by a reamer - man hour/hole									

1.9 BOLTING FROM SCAFFOLDING - MANHOUR PER 100 PIECES

M 20	M 22	M 24	M 27	M 30	M 36	M 42	M 48	M 56	M 64

mm x 0,03937 = inch
m x 3,28 = ft
Mhr/m²x0,0929 = Mhr/sqft
kg/m²x 0,2048 = lbs/sqft

When tightening the bolts by a torque wrench, manhours are multiplied by factor.

Note: The above manhours do not include scaffolding.

2. ERECTION OF MISCELLANEOUS STEEL STRUCTURES (PEP = 75%)

2.1 BASIC MANHOUR RATES - TOTAL

2.1.1 BUILDINGS AND CANOPY FRAMING

Cubic weight [kg/m3]	Rate [Mhr/ton]	Cubic weight [kg/m3]	Rate [Mhr/ton]	Cubic weight [kg/m3]	Rate [Mhr/ton]	Cubic weight [kg/m3]	Rate [Mhr/ton]
2		12		22		35	
4		14		24		40	
6		16		26		45	
8		18		28		50	
10		20		30		55	

$$\text{Cubic weight [kg/m}^3\text{]} = \frac{\text{Structure weight [kg]}}{\text{Width [m] x Length [m] x Height [m]}}$$

	Mhr/ton		
Type of structure	Light	Medium	Heavy
2.1.2 Equipment & bridging supports			
2.1.3 Towers for transmission lines			
2.1.4 Stairs structure			
2.1.5 Tower structure for chimney or similar			
2.1.6 Antennas and torches			
2.1.7 Single member support			
2.1.8 Bridging between the buildings			
2.1.9 Conveyor bridges			
2.1.10 Crane tracks outside buildings			
2.1.11 Bridge crane			
2.1.12 Portal crane			
2.1.13 Port crane			
2.1.14 Construction crane			
2.1.15 Stationary crane			
2.1.16 Piping bridges (outside oil refinieres)			

Structure: light to 30 kg/m; medium-weight 30 ÷ 60 kg/m; heavy above 60 kg/m

3. CORRECTION FACTORS

The rate for calculation is computed by multiplying the basic rate by a medium correction factor.

The medium correction factor is computed by adding up all selected factors and dividing them by 10.

K1 Weather impact

Month :	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
K1 :												

K2 Abnormal impact of temperature

Average temp. :	below - 10° C	(-10)° C ÷ (- 5)° C	(- 5)° C ÷ 30° C	above 30° C
K2 :				

kg/m x 0,672 = lbs/ft
kg/m3x 2,2046 = lbs/m3

K3 Impact of elevation at which the works are executed

Heght in [m] to:	15	25	35	45	60	75	80	100
K3 :								

K4 Impact of the job site ground

- hard and flat ground
- fill ground consolidated by a roller and provided with drainage
- loose ground with drainage
- fill ground without drainage
- levelled out ground without drainage
- muddy ground

K5 Impact of the structure engineering level

- documentation fully developed
- only erection process with written instruction
- documentation not developed

K6 Impact of installation joint type

- min. 90 % bolted joints
- min. 90 % welded joints
- min. 90 % riveted joints

K7 Impact of pre-assembling practicability

- pre-erection possible - smooth
- pre-erection possible - restricted
- pre-erection not possible

K8 Impact of the structure design

- very simple
- simple
- normal
- complex
- very complex

K9 Impact of the structure complexity

- welded plate structure
- rolled sections structure
- pipe structure

K10 Impact of the component bulking

- delivery in bulk
- basic assembling
- assembled for normal transport
- assembled for special transport

4. STEEL STRUCTURES IN OIL REFINERIES AND PETROCHEMICAL PLANTS (PEP = 75%)

4.1 LIGHT STRUCTURE (to 30 kg/m)

4.1.1	Ladders and step irons		[Mhr/ton]		
4.1.2	Floors - treads		[Mhr/ton]	or	[Mhr/ea]
4.1.3	Light platforms and landings		[Mhr/ton]		
4.1.4	Railing - straight		[Mhr/ton]	or	[Mhr/m]
	Railing - round		[Mhr/ton]	or	[Mhr/m]

4.2 MEDIUM-WEIGHT STRUCTURE (31 ÷ 60 kg/m)

4.2.1	Air coolers		[Mhr/ton]
4.2.2	Medium platforms and landings		[Mhr/ton]
4.2.3	Structure on towers		[Mhr/ton]
4.2.4	Staircases		[Mhr/ton]
4.2.5	Torch structure		[Mhr/ton]
4.2.6	Pipe supports, trestles, supports on prepared foundations		[Mhr/ton]

4.3 HEAVY STRUCTURE (above 60kg/m)

4.3.1	Pipe racks		[Mhr/ton]
4.3.2	Kiln structure		[Mhr/ton]
4.3.3	Reactor and regenerator structure		[Mhr/ton]
4.3.4	Large workshops		
	- span to 10 m		[Mhr/ton]
	- 10 ÷ 20 m		[Mhr/ton]
	- above 20 m		[Mhr/ton]

4.4 MISCELLANEOUS STRUCTURES

4.4.1	Floor grids		[Mhr/m^2]
4.4.2	Chequered plate flooring		
	- fabrication		[Mhr/m^2]
	- installation		[Mhr/m^2]
4.4.3	Lining of large workshops and hangars		
	- corrugated sheets		[Mhr/m^2]
	- sandwich elements - roof		[Mhr/m^2]
	- sandwich elements - fasade		[Mhr/m^2]

4.5 PIPE HANGERS AND SUPPORTS

4.5.1	Fabrication		[kg/Mhr]
4.5.2	Erection		[kg/Mhr]
4.5.3	Spring supports erection		[kg/Mhr]

(Classification of steel structures acc. to UHDE Dortmund)

5. ERECTION AND DISMANTLING OF MISCELLANEOUS STEEL STRUCTURES

(PEP = 75%)

5.1 ERECTION OF STEEL STRUCTURES - ACC. TO THE WEIGHT

Structure weight	Unloading and on-site hauling [Mhr/ton]	Bulking, raising, positioning and temporary bolting [Mhr/ton]	Structure fastening [Mhr/ton]		TOTAL [Mhr/ton]
to 20 tons			welding of		
			bolted joint		
20 ÷ 50 tons			welding of		
			bolted joint		
50 ÷ 100 tons			welding of		
			bolted joint		
100 ÷ 250 tons			welding of		
			bolted joint		
250 ÷ 500 tons			welding of		
			bolted joint		
500 ÷ 750 tons			welding of		
			bolted joint		
750 ÷ 1000 tons			welding of		
			bolted joint		
1000 ÷ 1500 tons			welding of		
			bolted joint		
1500 ÷ 3000 tons			welding of		
			bolted joint		
3000 ÷ 5000 tons			welding of		
			bolted joint		
above 5000 tons			welding of		
			bolted joint		

Above man hours do not include painting and scaffolding.

5.2 MISCELLANEOUS STRUCTURES

5.2.1 STRAN STEEL FRAMING

- stud system [Mhr/m ^{2}]
- rafter system [Mhr/m ^{2}]
- joist system [Mhr/m ^{2}]

Man hours do not include covering, painting and scaffolding.

5.2.2 STEEL OVERHEAD PIPE, BRIDGES, ETC.

- unloading [Mhr/ton]
- bulking, hoisting, positioning and temporary bolting [Mhr/ton]

fastening:

- welded design [Mhr/ton]
- bolted design [Mhr/ton]

Total:-welded design [Mhr/ton]

- bolted design [Mhr/ton]

Man hours do not include covering, painting and scaffolding.

5.2.3 DOCK AND CANOPY FRAMING

- unloading [Mhr/ton]
- raising, positioning and temporary bolting [Mhr/ton]
- fastening:
- welded design [Mhr/ton]
- bolted design [Mhr/ton]

Total: - welded design [Mhr/ton]
- bolted design [Mhr/ton]

Man hours do not include covering, painting and scaffolding.

5.2.4 PLATFORMS AND FLOORS

- unloading [Mhr/ton]
- erection:
- platform framing [Mhr/ton]
- catwalk framing [Mhr/ton]
- chequered floor plate [kg/Mhr] or [Mhr/ton]

Man hours do not include painting and scaffolding.

5.2.5 BAR JOISTS, PARTITION FRAMING, MONORAILS AND EQUIPMENT SUPPORTS

a) bar joists
- unloading [Mhr/ton]
- erection and fastening [Mhr/ton]

Total: [Mhr/ton]

b) partition framing
- unloading [Mhr/ton]
- fabrication cutting out [Mhr/ton]
- erection and fastening [Mhr/ton]

Total: [Mhr/ton]

c) monorails
- unloading [Mhr/ton]
- erection and fastening [Mhr/ton]

Total: [Mhr/ton]

d) equipment supports
- unloading [Mhr/ton]
- fabrication cutting out [Mhr/ton]
- erection and fastening [Mhr/ton]

Total: [Mhr/ton]

Man hours do not include erection of equipment, painting and scaffolding.

5.2.6 STAIRS & LADDERS

- unloading miscellaneous steel items [Mhr/ton]

a) stairs:
- fabrication of all sizes [Mhr/ton]
- field erection 915 mm (3' 0") wide [Mhr/ton]
- field erection 1067 mm (3' 6") wide [Mhr/ton]
- field erection 1220 mm (4' 0") wide [Mhr/ton]
- landing fabrication [Mhr/ton]

b) ladders

- fabrication of straight ladders [Mhr/ton]
- fabrication of ships ladders [Mhr/ton]
- fabrication of safety cages [Mhr/ton]
- erection of straight ladders [Mhr/ton]
- erection of ships ladders [Mhr/ton]
- erection of safety cages [Mhr/ton]
- rung erection ø19 mm (3/4″) [Mhr/ton]

Man hours do not include painting and scaffolding.

5.2.7 HANDRAILS

a) Standard Pipe Handrails - 1067 mm (3' 6″) High

- fabrication 1 1/4″ & 1 1/2″ - straight runs [kg/Mhr] or [Mhr/ton]
- fabrication 1 1/4″ & 1 1/2″ - angled runs [kg/Mhr] or [Mhr/ton]
- erection 1 1/4″ pipe - straight free standing [Mhr/m]*
- erection 1 1/4″ pipe - angled free standing [Mhr/m]*
- erection 1 1/2″ pipe - straight free standing [Mhr/m]*
- erection 1 1/2″ pipe - angled free standing [Mhr/m]*

b) Single Pipe Handrail - Wall Attached:

- fabrication 1 1/4″ & 1 1/2″ pipe [kg/Mhr] or [Mhr/ton]
- erection 1 1/4″ pipe [Mhr/m]*
- erection 1 1/2″ pipe [Mhr/m]*
- erection of wall brackets [Mhr/ea]

c) Standard Angled Iron Handrail - 1067 mm (3' 6″) High

- fabrication - straight runs [kg/Mhr] or [Mhr/ton]
- fabrication- angled runs [kg/Mhr] or [Mhr/ton]
- erection 50x50x6 mm - straight free standing [Mhr/m]*
- erection 50x50x6 mm - angled free standing [Mhr/m]*
- erection 50x50x6 mm - straight free standing [Mhr/m]*
- erection 50x50x6 mm - angled free standing [Mhr/m]*

d) STANDARD TOE OR KICK PLATES

3,5 mm x 150 (6″) [Mhr/m]
4,76 mm x 150 (6″) [Mhr/m]
6,35 mm x 150 (6″) [Mhr/m]

[Mhr/m]* refers to the length of handrail and not the length of a pipe or a section.
- Straight runs are those with all connecting members at 90° angles.
- Angles runs are those with all connecting members at an angle larger or smaller than 90°.
- For erection of handrails made of light tubes and solid round and flat sections, use the man hours for angled handrails.
- For handrails with expanded metal panels, increase angle iron man hours thirty (30) percent.
- Man hours do not include painting.

kg/Mhr x 2,2046 = lbs/Mhr
Mhr/m x 0,3048 = Mhr/ft

5.2.8 DOOR, LOUVER AND DUCT FRAMES

a) Door Frames

- unloading [kg/Mhr] or [Mhr/ton]
- fabrication [kg/Mhr] or [Mhr/ton]
- installation [kg/Mhr] or [Mhr/ton]

b) Louver Frames

- unloading	[kg/Mhr]	or	[Mhr/ton]
- fabrication	[kg/Mhr]	or	[Mhr/ton]
- erection	[kg/Mhr]	or	[Mhr/ton]

c) Duct Frames

- unloading	[kg/Mhr]	or	[Mhr/ton]
- fabrication	[kg/Mhr]	or	[Mhr/ton]
- erection	[kg/Mhr]	or	[Mhr/ton]

Man hours do not include painting and scaffolding.

kg/Mhr x 2,2046 = lbs/Mhr

5.2.9 MISCALLANEOUS IRON & STEEL

a) Bins & Hoppers

- unloading	[kg/Mhr]	or	[Mhr/ton]
- fabrication	[kg/Mhr]	or	[Mhr/ton]
- erection	[kg/Mhr]	or	[Mhr/ton]

b) Miscallaneous Hangers

- fabrications	[kg/Mhr]	or	[Mhr/ton]
- erection	[kg/Mhr]	or	[Mhr/ton]

c) Metal Thresholds

- Installation	[Mhr/ea]

d) Wheel Guards

- installation	[Mhr/ea]

e) Trench Framing

- Unloading	[kg/Mhr]	or	[Mhr/ton]
- Fabrication	[kg/Mhr]	or	[Mhr/ton]
- Installation	[kg/Mhr]	or	[Mhr/ton]

f) Trench Covers

- Plates installation	[Mhr/m^2]
- Grating installation	[Mhr/m^2]

g) Curb Angles

- unloading	[kg/Mhr]	or	[Mhr/ton]
- fabrication	[kg/Mhr]	or	[Mhr/ton]
- installation	[kg/Mhr]	or	[Mhr/ton]

h) Steel Curbing

- unloading	[kg/Mhr]	or	[Mhr/ton]
- fabrication	[kg/Mhr]	or	[Mhr/ton]
- installation	[kg/Mhr]	or	[Mhr/ton]

i) Pipe Sleeves

- fabrication	[kg/Mhr]	or	[Mhr/ton]
- installation	[kg/Mhr]	or	[Mhr/ton]

j) Anchor Bolts

- fabrication	[kg/Mhr]	or	[Mhr/ton]
- installation	[kg/Mhr]	or	[Mhr/ton]

k) Ledger Angles

- unloading	[kg/Mhr]	or	[Mhr/ton]
- fabrication	[kg/Mhr]	or	[Mhr/ton]
- installation	[kg/Mhr]	or	[Mhr/ton]

Man hours do not include painting and scaffolding.

5.2.10 STEEL GRATING

- Installation of floor grids

Grating Bar Size	Weight [kg/m^2]	[Mhr/m^2]
19,05 x 4,76 mm	28,80	
25,04 x 3,18 mm	25,39	
25,04 x 4,76 mm	37,11	
31,3 x 3,18 mm	30,76	
31,3 x 4,76 mm	44,92	
38,1 x 3,18 mm	36,13	
38,1 x 4,76 mm	53,22	
44,45 x 4,76 mm	61,52	
50,8 x 4,76 mm	69,82	
57,15 x 4,76 mm	77,64	
63,5 x 4,76 mm	85,94	

- Fabrication and modification of floor grids:
  - straight and diagonal cutting [Mhr/m]
  - circular cutting [Mhr/m]
  - straight and diagonal banding [Mhr/m]
  - circular banding [Mhr/m]
  - welding of curb angles [Mhr/m]
  - rounding of curbs by grinding [Mhr/m]

Man hours do not include painting and scaffolding.

5.2.11 SIDING OF LARGE WORKSHOPS AND HANGARS

- section sheets [Mhr/m^2]
- section aluminium plates [Mhr/m^2]
- stainless steel sheets [Mhr/m^2]
- insulation boards (sandwich) [Mhr/m^2]

Man hours do not include sealing and scaffolding.

5.3 REMOVAL OF STEEL STRUCTURE AND MISCELLANEOUS ITEMS

- Steel structure [Mhr/ton]
- Miscellaneous steel items [Mhr/ton]
- Machinery:
  - light [Mhr/ton]
  - heavy [Mhr/ton]
- Pipes (C.S.)
  - to 2" [Mhr/m]
  - 3" ÷ 6" [Mhr/m]
  - 8" ÷ 12" [Mhr/m]
  - 14" ÷ 16" [Mhr/m]
  - 18" ÷ 24" [Mhr/m]
  - 26" ÷ 36" [Mhr/m]
- Railroads:
  - Ties and tracks [Mhr/m]
  - Turnouts [Mhr/ea]
- Miscellaneous
  - Fence of three strand barbed wire [Mhr/m]
  - Fence of five strand barbed wire [Mhr/m]
  - Chain link fence [Mhr/m]
  - Guard rail [Mhr/m]

Man hours do not include loading, transport and unloading and scaffolding.

kg/m^{2}x 0,2048 = lbs/ft
Mhr/m^{2}x 0,0929 = Mhr/sqft
Mhr/m x 0,3048 = Mhr/ft
kg/Mhr x 2,2046 = lbs/ft

IV. ERECTION OF EQUIPMENT IN PETROCHEMICAL INDUSTRY

Productivity Efficiency Percentage (PEP) = 75%

1. STATIONARY EQUIPMENT (towers, heat exchangers, reactors, regenerators, small storage tanks, air coolers, etc.)

These man hours include the erection of equipment delivered as a whole or in sections that are completed but not fully assembled because of their overall dimensions (transport).

Man hours include:

- Unloading
- Hauling from storage to the place of erection
- Hoisting by usual hoisting means
- Putting up to the design elevation
- Positioning of connection points
- Position inspection

TIME ALLOWANCE FOR ERECTION OF EQUIPMENT AT ELEVATION

All stated below, man hours for erection of equipment are applicable when the equipment base is at an elevation of up to 2 m above the site zero level.

Apply the following factors for higher elevations:

Elevation	Factor
0 ÷ 2 m	
2 ÷ 4 m	
4 ÷ 6 m	
6 ÷ 10 m	
above 10 m	

1.1 All Equipment to 0,5 ton [Mhr/ea] or [kg/Mhr]

1.2 Towers above 0,5 ton [Mhr/ea] + [Mhr/ton]

1.3 Towers consisting of more pieces: [Mhr/ea] + [Mhr/ton] + joint
Joint: [Mhr/m] of joint circumference

1.4 Package Unit
to 10 tons : [Mhr/ea] + [Mhr/ton]
above 10 tons : [Mhr/ea] + [Mhr/ton]

1.5 Other Equipment
0,5 ÷ 2 tons : [Mhr/ea] + [Mhr/ton]
2,1 ÷ 10 tons : [Mhr/ea] + [Mhr/ton]
10,1 ÷ 20 tons : [Mhr/ea] + [Mhr/ton]
above 20 tons : [Mhr/ea] + [Mhr/ton]

1.6 Bridge Cranes
- Erection of crane track (rails) [Mhr/m]
- Erection of crane with a trolley and a drive [Mhr/m] span

1.7 Lifts
[Mhr/m^2] shaft + Mhr per meter of elevation

1.8 Electrostatic Precipitators

Weight [ton]	Effect [kg/Mhr]
to 100 ton/unit	
100 ÷ 250 ton/unit	
above 250 ton/unit	

1.9 Marine loading arms
(acc. to John S. Page)

- assembling and erection [Mhr/ea]

Load. arm diam. inch	Total length of loading arm (meters)								
	to 6	6 ÷ 9	9 ÷ 12	12 ÷ 15	15 ÷ 18	18 ÷ 21	21 ÷ 24	24 ÷ 27	27 - 30
4″									
6″									
8″									
10″									
12″									
14″									
16″									
18″									
20″									
24″									

NOTE: I find above man hours for loading arms too stringent, so I suggest they are increased by ÷ %.

2. ROTARY EQUIPMENT (pumps, compressors, fans, blowers, mixers, etc.)

These man hours include the following:

- Hauling from storage to the place of erection
- Placing onto previously built foundations
- Vertical positioning
- Machine positioning and inspection
- Installation of guards and covers
- Completion with pertaining parts

m x 3,281 = ft
kg/Mhr x 2,2046 = lbs/Mhr
Mhr/m x 0,3048 = Mhr/ft

2.1 CENTRIFUGAL PUMPS

2.1.1 MAN HOURS BASED ON POWER [kW]

Power [kW]	[Mhr/kW]		[Mhr/ea]	Minimum hours
to 10 kW		+		
10 ÷ 50 kW		+		
50 ÷ 100 kW		+		
100 ÷ 150 kW				
150 ÷ 200 kW				
200 ÷ 250 kW				
above 250 kW				

- Pumps supplied with a coupling on one pedestal x
- Pumps and drive motors supplied separately x
- Pumps, drive motors and reduction gears supplied separately x
- Vertical pumps x
- Fans x
- Blowers x
- Gear pumps x
- Mixers x
- Compressors to 200 kW x

2.1.2 MAN HOURS BASED ON WEIGHT [kg]

Weight [kg]	Effect [kg/Mhr]	Min. [Mhr/ea]
to 100		
101 ÷ 200		
201 ÷ 300		
301 ÷ 400		
401 ÷ 500		
501 ÷ 600		
601 ÷ 700		
701 ÷ 800		
801 ÷ 900		
901 ÷ 1000		
1001 ÷ 1250		
1251 ÷ 1500		
1501 ÷ 2000		
2001 ÷ 2500		
above 2500		

- vertical pumps [kg/Mhr] x
- fans [kg/Mhr] x
- blowers [kg/Mhr] x
- gear pumps [kg/Mhr] x
- mixers [kg/Mhr] x
- compressors [kg/Mhr] x

kg x 0,4536 = lbs
kg/Mhr x 2,2046 = lbs/Mhr

NOTE: If the data on power and weight are available, perform the calculation on both bases and take the mean value.

2.1.3 MAN HOURS BASED ON THE CAPACITY [m³/hr]
(FOR LIQUID MEDIA ONLY)

[m³/hr]	Mhrx [m³/hr]	[m³/hr]	Mhrx [m³/hr]
to 10		160,1÷ 170	
10,1 ÷ 20		170,1÷ 180	
20,1 ÷ 30		180,1÷ 190	
30,1 ÷ 40		190,1÷ 200	
40,1 ÷ 50		200,1÷ 210	
50,1 ÷ 60		210,1÷ 220	
60,1 ÷ 70		220,1÷ 230	
70,1 ÷ 80		230,1÷ 240	
80,1 ÷ 90		240,1÷250	
90,1 ÷ 100		250,1÷260	
100,1 ÷ 110		260,1÷270	
110,1 ÷ 120		270,1÷280	
120,1 ÷ 130		280,1÷290	
130,1 ÷ 140		290,1÷300	
140,1 ÷ 150		300,1÷750	
150,1÷ 160		above 750	

Conversion of Units

l/s x 3,6 = m^3/hr	l/min x 0,06 = m^3/hr
US gallons per minute:	US gpm x 0,227 = m^3/hr
Cubic feet per minute:	cfpm x 1,7 = m^3/hr
Cubic feet per hour:	cfphr x 0,283 = m^3/hr

2.2 COMPRESSORS

2.2.1 COMPRESSORS DRIVEN BY ELECTRIC MOTOR

to 200 kW	Acc. to Table 2.1.1				
201 ÷ 300 kW		[Mhr/kW]	(min.		Mhr)
301 ÷ 500 kW		[Mhr/kW]	(min.		Mhr)
501 ÷ 750 kW		[Mhr/kW]	(min.		Mhr)
751 ÷ 1000 kW		[Mhr/kW]	(min.		Mhr)
1001 ÷ 1500 kW		[Mhr/kW]	(min.		Mhr)
1501 ÷ 2250 kW		[Mhr/kW]	(min.		Mhr)
2251 ÷ 3000 kW		[Mhr/kW]	(min.		Mhr)
3001 ÷ 4000 kW		[Mhr/kW]	(min.		Mhr)
4001 ÷ 5000 kW		[Mhr/kW]	(min.		Mhr)
above 5000 kW		[Mhr/kW]	(min.		Mhr)

2.2.2 COMPRESSORS DRIVEN BY GAS TURBINE

to 250 kW		[Mhr/kW]	(min.		Mhr)
251 ÷ 350 kW		[Mhr/kW]	(min.		Mhr)
351 ÷ 450 kW		[Mhr/kW]	(min.		Mhr)
451 ÷ 600 kW		[Mhr/kW]	(min.		Mhr)
601 ÷ 750 kW		[Mhr/kW]	(min.		Mhr)
751 ÷ 900 kW		[Mhr/kW]	(min.		Mhr)
901 ÷ 1100 kW		[Mhr/kW]	(min.		Mhr)
1101 ÷ 1300 kW		[Mhr/kW]	(min.		Mhr)
1301 ÷ 1500 kW		[Mhr/kW]	(min.		Mhr)
1501 ÷ 1750 kW		[Mhr/kW]	(min.		Mhr)
1751 ÷ 2000 kW		[Mhr/kW]	(min.		Mhr)
2001 ÷ 2500 kW		[Mhr/kW]	(min.		Mhr)
2501 ÷ 3000 kW		[Mhr/kW]	(min.		Mhr)
3001 ÷ 4000 kW		[Mhr/kW]	(min.		Mhr)
above 4000 kW		[Mhr/kW]	(min.		Mhr)

3. TOWERS & VESSELS - INSTALLATION OF INTERIOR COMPONENTS & EQUIPMENT

3.1 INSTALLATION OF TRAYS AND DEMISTERING PADS

Tower Diameter	[Mhr/m^2]						[kg/Mhr]
[mm]	1.	2.	3.	4.	5.	6. *	6.
to 1000							
1001 ÷ 1200							
1201 ÷ 1400							
1401 ÷ 1600							
1601 ÷ 1800							
1801 ÷ 2000							
2001 ÷ 2250							
2251 ÷ 2500							
2501 ÷ 2750							
2751 ÷ 3000							
3001 ÷ 3250							
3251 ÷ 3500							
above 3500							

1. Single downflow valve type trays
2. Double downflow valve type trays
3. Single downflow bubble cap type trays
4. Double downflow bubble cap type trays
5. Sieve or perforated type trays
6. Demisting pads*

*If the bottom and roof of a demisting pads are already installed, the man hours should be decreased by %.

3.2 VESSELS & TOWER PACKING

Packing the vessels and towers with different solid packings in bulk condition:

towers : [Mhr/ea] + [Mhr/m^3] or [Mhr/ton]
vessels : [Mhr/ea] + [Mhr/m^3] or [Mhr/ton]

3.3 OPENING AND CLOSING OF MANHOLES ON VESSELS AND TOWERS

Manhole Size	[Mhr/ea]
to 14″	
16″	
18″	
20″	
24″	
28″	
30″	
32″	
36″	
40″	
42″	

Class :

150#x 1,0
300#x 1,15
600#x 1,30

Mhr/m^{2}x 0,0929 = Mhr/sqft
Mhr/m^{3}x 0,02831 = Mhr/cuft
kg/Mhr x 2,2046 = lbs/Mhr

3.4 ERECTION OF PLATFORMS, LADDERS AND FLOOR GRIDS ON VESSELS AND TOWERS (PREDRESSING)

3.4.1 Erection average effect :

[kg/Mhr]

3.4.2Estimate of quantit y of platforms, ladders and floor grids
It is calculated per [m^2] of the shell surface area (without bottom and roof).

Elevation	[kg/m^2]*	[Mhr/m^2]*
to 10 m		
10,1 ÷ 15 m		
15,1 ÷ 20 m		
20,1 ÷ 25 m		
25,1 ÷ 30 m		
30,1 ÷ 35 m		
35,1 ÷ 40 m		
40,1 ÷ 45 m		
45,1 ÷ 50 m		
50,1 ÷ 55 m		
55,1 ÷ 60 m		
above 60 m		

* These data should be regularly monitored and occasionally revised.

4. EQUIPMENT SCAFFOLDING

4.1 Tubular scaffold (for each piece of equipment separately)

	to 10 m^3	10 ÷ 50 m^3	50 ÷ 100 m^3	100 ÷ 500 m^3	500 ÷ 1000 m^3	above 1000 m^3
Scaffold erection [Mhr/m^3]or [Mhr/m^2]						
Scaffold dismantling [Mhr/m^3]or [Mhr/m^2]						
Total						

Elevation factor at which the scaffold is erected or dismantled:

0 ÷ 5 m	
5 ÷ 10 m	
10 ÷ 15 m	
15 ÷ 20 m	
20 ÷ 25 m	
25 ÷ 30 m	
above 30 m	

kg/Mhr x 2,2046 = lbs/Mhr
kg/m^2x 0,2048 = lbs/sqft
Mhr/m^2x 0,0929 = Mhr/sqft
Mhr/m^3x 0,02831 = Mhr/cuft
m^3x 35,32 = cuft

4.2 Patent Scaffolding

Sections:

Length : 7 feet; 2,1 m
Width : 5 feet; 1,5 m
Height : 5 feet; 1,5 m

	Manhours per section					
Length	One or Two Sections High			More Than Two Sections High		
	Erection	Dismantling	Total	Erection	Dismantling	Total
One to Two Sections Long						
Three to Five Sections Long						
Six and More Sections Long						

V. STORAGE TANKS - CYLINDRICAL AND SPHEROIDAL

Productivity Efficiency Percentage (PPE) = 85%

1. APPROXIMATE WEIGHTS AND ERECTION EFFECTS OF CYLINDRICAL STORAGE TANKS

(The weights are based on already designed storage tanks, mostly pursuant to API-650. Nowadays, storage tanks are also designed according to other standards so some 75% storage tanks have smaller weight.)

RATED VOLUME [m^3]	Fixed Roof			Floating Roof		Fixed + Floating Roof	
	Weight c. [kg]	Conventional [kg/Mhr]	Bygging* [kg/Mhr]	Weight c. [kg]	Erection [kg/Mhr]	Weight c. [kg]	Erection [kg/Mhr]
50	4.715						
100	8.100						
150	9.740						
200	11.440			14.350		12.850	
250	12.400			17.600		15.300	
300	14.000			20.700		17.450	
400	16.800			26.625		21.000	
5 00	19.950			31.800		22.500	
600	22.750			36.500		26.300	
700	23.800			40.600		29.700	
800	26.400			44.150		33.000	
900	29.000			47.325		36.300	
1.000	35.980			50.000		40.800	
1.200	36.820			53.300		44.900	
1.400	52.470			57.100		51.000	
1.500	59.295			60.000		54.500	
1.800	48.600			67.500		58.000	
2.000	52.000			72.800		62.400	
2.200	56.650			78.200		67.400	
2.400	61.200			83.600		72.400	
2.500	63.800			86.300		75.00	
2.600	66.300			88.100		77.000	
3.000	75.000			96.900		86.000	
3.500	87.200			107.800		97.500	
4.000	99.200			119.600		109.400	
4.500	111.100			131.000		121.000	
5.000	123.000			143.000		131.200	
5.500	135.000			157.900		145.600	
6.000	147.000			172.800		160.000	
6.500	158.900			174.400		170.000	
7.000	170.000			190.400		188.000	
7.500	182.600			201.800		200.000	
8.000	194.400			217.600		215.000	
10.000	241.000			261.000		262.000	
11.000	288.000			278.100		283.500	
12.000	351.000			295.200		305.000	
13.000	420.000			353.600		342.500	
15.000	474.000			372.000		380.000	

RATED VOLUME [m³]	Fixed Roof			Floating Roof		Fixed + Floating Roof	
	Weight c. [kg]	Conventional [kg/Mhr]	Bygging* [kg/Mhr]	Weight c. [kg]	Erection [kg/Mhr]	Weight c. [kg]	Erection c. [kg/Mhr]
20.000	566.000			449.000		460.000	
22.500	594.000			500.700		540.000	
25.000	622.500			552.500			
30.000	684.000			660.000			
35.000	742.000			766.500			
40.000	804.000			872.000			
50.000	976.000			1.002.100			
60.000	1.148.300			1.151.500			
70.000				1.360.500			
80.000				1.520.600			
90.000				1.710.000			
100.000				1.890.000			

*Bygging a method of erection by hydraulic jacks

- a series of identical storage tanks: each next storage tank x up to the maximum % effect increase

Effect of storage tank erection with a steel berm (double shell and bottom)

- Inside tank is calculated acc. to man hours in the table
- Effect for the berm acc. to man hours in the table x
- If the total weight is known, then acc. to man hours in the table x

m^3x35,32 = cu ft
kg x 0,4536 = lbs
kg/Mhr x 2,2046 = lbs/Mhr

1.1 STATISTICAL PARTICIPATION OF STORAGE TANK COMPONENTS IN TOTAL WEIGHT

Based on the analysis of 33 cylindrical storage tank projects of total 16.500 tons, 300 m^3 to 80.000 m^3, an average participation of the components in the storage tank total weight is as follows:

- Bottom c. %
- Shell c. %
- Roof c. % (of which: steel sections %, roofing plates %)
- Supporting structures c. %
- Nozzlesand manholes c. %

Storage tanks with a berm:

The berm weight is c. % of the inside storage tank weight of which % accounts for the shell and c. % for the bottom.

2. ERECTION OF CYLINDRICAL STORAGE TANKS - DETAILS

The above table defines approximate effects of complete erection of cylindrical storage tanks according to the volume, type and method of erection. It is often the case that a very detailed erection estimate is required for already completed projects. This could be done if you follow this chapter. For some storage tank components, man hours are given only for erection without welding. In that case the welding should be computed and estimated according to the man hours for welding under the Chapter WELDING AND FLAME CUTTING. Similarly, the following correction factors should be considered:

1. Impact of average outside temperature

- 5° C to	+10° C	factor
10° C to	30° C	factor
30° C to	40° C	factor
above 40° C		factor

2. Impact of the job site ground

- Hard and flat ground — factor
- Fill ground consolidated by a roller provided with drainage — factor
- Fill ground, not consolidated provided with drainage — factor
- Fill ground consolidated by a roller without drainage — factor
- Ground levelled out without drainage — factor

mm x 0,03937 = inch
m x 3,281 = ft
Mhr/m^{2}x 0,0929 = Mhr/sq ft
kg/Mhr x 2,2046 = lbs/Mhr
Mhr/m x 0,3048 = Mhr/ft

2.1 PRELIMINARY WORKS

- Unloading plates [Mhr/ton]
- Material disposal [Mhr/ton]

- Inspection and take over of foundation, measurement, and other:

Tank diameter	[Mhr/m^2]
to 15 m	
16 ÷ 25 m	
26 ÷ 40 m	
40 ÷ 50 m	
above 50 m	

2.2 STORAGE TANK BOTTOM

2.2.1 Installation of tank bottom

plate thicknness	Installation w/o welding [kg/Mhr]	Installation and welding* [kg/Mhr]
6 mm		
6,5 mm		
7 mm		
8 mm		

- Annular ring to be computed with the effect for the central part decreased by 25 %

* welding: 10 % SMAW; 90 % automated machine

2.2.2 Corrosion protection of plates (underside)

Tank diameter	[Mhr/m^2]
to 15 m	
16 ÷ 30 m	
31 ÷ 50 m	
above 50 m	

2.2.3 Weld vacuuming on the tank bottom

[Mhr/m]

2.3 STORAGE TANK SHELL

2.3.1Shell Erection - Con ventional
(from bottom to top) [Mhr/plate]

	Plate thickness [mm]															
Course	36	32	28	24	20	16	15	14	13	12	11	10	9	8	7	6
1.																
2.																
3.																
4.																
5.																
6.																
7.																
8.																
9.																
10.																

- Correction factors according to the plate length:

Length [m]	to 5	6	7	8	9	10	12
Factor							

- Welding not included.

2.3.2Erection of shell plates (by h ydraulic jacks)
("Bygging" hydraulic jacks, from top to bottom)

	Plate Thickness [mm]													
	27	24	20	16	15	14	13	12	11	10	9	8	7	6
[Mhr/plate]														

- Correction factor according to the plate length as under item 2.3.1
- Welding not included
- Installation of hydraulic jacks [Mhr/ea]
- Removal of hydraulic jacks [Mhr/ea]

2.3.3Weld grinding on the inner side of shell
(storage tank with a floating roof)

[Mhr/m] or [m/Mhr]

mm x 0,03937 = inc
m x 3,281 = ft
Mhr/m^{2}x 0,0929 = Mhr/sq ft
kg/Mhr x 2,2046 = lbs/Mhr
Mhr/m x 0,3048 = Mhr/ft

2.4 WIND BINDINGS - RINGS FOR SHELL STIFFENING

2.4.1Top angle piece	Erection w/o welding	Erection and welding (SMAW)
- Placing angle piece with conventionally installed shell and no walkway	[Mhr/m]	[Mhr/m]
- Placing angle piece with conventionally installed shell and a walkway	[Mhr/m]	[Mhr/m]

- Placing angle piece with a shell installed by hydraulic jacks

[Mhr/m] [Mhr/m]

2.4.2 Primary windscreen with a walkway

Erection w/o welding	Erection and welding
[kg/Mhr]	[kg/Mhr]

2.4.3 Secondary and additional windscreens

2.4.3.1Placing windscreens with conv entionally erected shell

	Erection w/o Welding		Erection and Welding (SMAW)	
	w/o reinforec.	with reinforc.	w/o reinforc.	with reinforc.
1st windscreen, from the bottom up	[Mhr/m]	[Mhr/m]	[Mhr/m]	[Mhr/m]
2nd windscreen, from the bottom up	[Mhr/m]	[Mhr/m]	[Mhr/m]	[Mhr/m]
3rd windscreen, from the bottom up	[Mhr/m]	[Mhr/m]	[Mhr/m]	[Mhr/m]

2.4.3.2Placing windscreens when a shell is er ected by hydraulic jacks

	Erection w/o Welding		Erection and Welding (SMAW)	
	w/o reinforc.	with reinforc.	w/o reinforc.	with reinforc.
all windscreens not used as walkways	[Mhr/m]	[Mhr/m]	[Mhr/m]	[Mhr/m]

2.5 FIXED ROOF

2.5.1 Erection of roof and support structure

2.5.1.1Erection of the structure with a con ventionally installed shell

Erection w/o welding	Erection and welding *
[kg/Mhr]	[kg/Mhr]

2.5.1.2Structure er ection with a shell installed by hydraulic jacks

Erection w/o welding	Erection and welding*
[kg/Mhr]	[kg/Mhr]

mm x 0,03937 = inc
m x 3,281 = ft
Mhr/m²x 0,0929 = Mhr/sq ft
kg/Mhr x 2,2046 = lbs/Mhr
Mhr/m x 0,3048 = Mhr/ft

2.5.2 Installation of roofing plates

plate thickness[mm]	Erection w/o welding effect [kg/Mhr]	Erection and welding * [kg/Mhr]
5,00		
5,50		
6,00		
6,50		

* welding: 50 % SMAW; 50 % semiautomatic (MAG)

2.6 FLOATING ROOF

2.6.1 Erection of plates for the floating roof lower slab

2.6.1.1 For raising to the surface (water/air)

plate thickness [mm]	Erection w/o welding effect [kg/Mhr]	Erection and welding* [kg/Mhr]
5,0		
5,50		
6,0		
6,50		
7,0		

* welding: 10 % SMAW; 50 % MAG; 40 % automated machine

2.6.1.2On a "spider net" steel structure

Above effects to be increased by ____ %

- "spider net" installation not included (Item 2.6.10)

2.6.2 Erection of concentric rings, radial partitions and supporting channels

Storage tank diameter	Erection w/o welding effect [kg/Mhr]	Erection and welding * [kg/Mhr]
to 20 m		
20÷ 30m		
30÷ 40m		
above 40m		

* welding: 50 % SMAW; 50 % MAG

mm x 0,03937 = inch
m x 3,281 = ft
Mhr/m^{2}x0,0929 = Mhr/sq ft
kg/Mhr x 2,2046 = lbs/Mhr
Mhr/m x 0,3048 = Mhr/ft

2.6.3 Erection of roofing plates (upper slab)

plate thickness [mm]	Erection w/o welding efect [kg/Mhr]	Erection and welding* [kg/Mhr]
5,0		
5,50		
6,0		
6,50		
7,0		

* welding: 20 % SMAW; 40 % MAG; 40 % automated machine

2.6.4 Installation of sleeves and reinforcements for the floating roof supports (legs)

Erection w/o welding	Erection and welding (SMAW)
____ [Mhr/ea]	____ [Mhr/ea]

2.6.5 Installation of manholes on the floating roof

	Erection w/o welding	Erection and welding (SMAW)
- manhole to the storage tank through the floating roof	____ [Mhr/ea]	____ [Mhr/ea]
- manhole to the floating roof chambers	____ [Mhr/ea]	____ [Mhr/ea]

- welding not included

2.6.6 Foam wall installation

Erection and welding
[kg/Mhr]

mm x 0,03937 = inch
m x 3,281 = ft
Mhr/m^{2}x 0,0929 = Mhr/sq ft
kg/Mhr x 2,2046 = lbs/Mhr
Mhr/m x 0,3048 = Mhr/ft

2.6.7 Preparation and raising the floating roof to the surface

Storage tank capacity					
to 10.000 m^3	=	[Mhr/ea]	+	Mhr/1000m^3	
10.000 ÷ 20.000 m^3	=	[Mhr/ea]	+	Mhr/1000m^3	
20.000 ÷ 30.000 m^3	=	[Mhr/ea]	+	Mhr/1000m^3	
30.000 ÷ 50.000 m^3	=			Mhr/1000m^3	
above 50.000m^3	=			Mhr/1000m^3	

2.6.8 Installation of floating roof supports (legs)

Erection and welding (SMAW)
[Mhr/ea]

2.6.9 Placing the packers under the legs

Erection and welding (SMAW)
[Mhr/ea]

2.6.10 Erection of supporting structure ("spider net")

The supporting structure ("spider net") is generally made of the remaining pipes or sections. It is made to the elevation at which the floating roof is supported on its supports or min. 1500 mm.

To estimate the quantity of the supporting structure, the roof load of 110 ÷ 130 kg/m^2 should be considered (total roof weight to be divided by the lower slab surface area).

- Steel structure quantity: c. ÷ [kg/m^2]
- Erection and dismantling effect: [kg/Mhr]

m^3 x 35,32 = cuft
kg/m^2 x 0,2048 = lbs/sqft

2.7 AUXILIARY STRUCTURE

2.7.1 Erection and welding of spiral stairs and landings
[kg/Mhr]

2.7.2 Erection and welding of inclined stairs and landings
[kg/Mhr]

2.7.3 Erection and welding of vertical stairs and ladder cages
[kg/Mhr]

2.7.4 Erection and welding of sliding stairs with a bearing and a guide
[kg/Mhr]

2.7.5 Erection and welding of a foam ejector holder
[kg/Mhr]

2.7.6 Erection and welding of prefabricated railings
[kg/Mhr]

2.8 CONNECTIONS AND OPENINGS

2.8.1 Manholes on the shell (generally welded during prefabrication)

Manhole Ø	Installation [Mhr/ea]	Installation and welding (SMAW) [Mhr/ea]
20″		
24″		
30″		
36″		

2.8.2 Cleaning door (generally welded during prefabrication)

Dimensions		Installation [Mhr/ea]	Installation and welding (SMAW) [Mhr/ea]
8″ x 16″	(203,2 x 406,4)		
24″ x 24″	(609,6 x 609,6)		
36″ x 48″	(914,4 x 1219,2)		
48″ x 48″	(1219,2 x 1219,2)		

2.8.3 Connection points with a flange on the shell

Ø	[Mhr/ea]	Ø	[Mhr/ea]
1 1/2″		24″	
2″		26″	
3″		28″	
4″		30″	
6″		32″	
8″		34″	
10″		36″	
12″		38″	
14″		40″	
16″		42″	
18″		44″	
20″		46″	
22″		48″	

- Welding included

2.8.4 Connection points with a thread on the shell

Ø	[Mhr/ea]
3/4″	
1″	
1 1/2″	
2″	
3″	

- Welding included

2.8.5 Manholes on the roof

Ø	Installation [Mhr/ea]	Installation and welding (SMAW) [Mhr/ea]
20″ (508,0)		
24″ (609,6)		

2.8.6 Connection points with a flange on the roof

Ø	[Mhr/ea]
1 1/2″	
2″	
3″	
4″	
6″	
8″	
10″	
12″	

2.8.7 Connection points with a thread on the roof

Ø	[Mhr/ea]
3/4″	
1″	
1 1/2″	
2″	
3″	
4″	

- Welding included

2.9 STORAGE TANK EQUIPMENT

2.9.1 Floating roof guide railing

Installation and welding
[kg/Mhr]

2.9.2 Installation of floating roof drainage
- Installation of precipitation drain valve with a lever [Mhr/ea]
- Installation of a flexible steel pipe assembly [kg/Mhr]
- Installation of a flexible drain hose of syntheticmaterial [Mhr/ea]

2.9.3 Installation of air vent valves
- on fixed roof [Mhr/ea]
- on floating roof [Mhr/ea]

2.9.4 Installation of sampling and inspection holes
[Mhr/ea]

2.9.5 Placing davits and welding [kg/Mhr]

2.9.6 Installation of level indicators
-for fixed roof [Mhr/package]
- for floating roof [Mhr/ package]
- connections not included

kg/Mhr x 2,2046 = lbs/Mhr

2.9.7 Erection and welding of a floating roof seal

1. General American Transportation
   Corporation / Wiggins
   - "Safety seal" [Mhr/m]
2. Pittsburgh Des Moines Steel Comp.
   - "Hydroseal" [Mhr/m]
   - "Hammond Tubeseal" [Mhr/m]
   - "Hammond Spring - Tite seal" [Mhr/m]
3. Chicago Bridge & Iron Company
   - Seal "SR - 1" [Mhr/m]
   - Seal "SR - 3" [Mhr/m]
   - Seal "SR - 5" [Mhr/m]
   - Seal "SR - 7" [Mhr/m]
   - Seal "SR - 8" [Mhr/m]
   - Seal "SR - 9" [Mhr/m]

2.9.8 Installation of the storage tank bottom heating

Pipe Diam.	[Mhr/m]
1 1/2"	
2"	
3"	

- Bending, welding, supporting and tests included.

2.9.9 Installation of an energy-saving heater [kg/Mhr]

- Welding also included

2.10 FINISHING WORKS

2.10.1 Storage Tank Hydrostatic Testing

Volume	Hours	
to 5.000 m^3	[Mhr/ea] +	Mhr/1000m^3
5.000 ÷ 10.000 m^3	[Mhr/ea] +	Mhr/1000m^3
10.000 ÷ 20.000 m^3	[Mhr/ea] +	Mhr/1000m^3
20.000 ÷ 30.000 m^3		Mhr/1000m^3
30.000 ÷ 40.000 m^3		Mhr/1000m^3
40.000 ÷ 50.000 m^3		Mhr/1000m^3
above 50.000 m^3		Mhr/1000m^3

2.10.2 Storage Tank Final Cleaning

- Hydrostatic testing performed with water from the hydrant network [Mhr/m^2] tank bottom surface area
- Hydrostatic testing performed with silt water [Mhr/m^2] tank bottom surface area

1000 m^3 = 35320 cu ft
Mhr/m x 0,3048 = Mhr/ft
kg/Mhr x 2,2046 = lbs/Mhr
Mhr/m^2 x 0,0929 = Mhr/sq ft

3. ERECTION OF SPHERICAL AND SPHEROIDAL STORAGE TANKS

For this kind of works I neither had available nor was familiar with any bibliography that would provide me with practical parameters and man hours for a technical calculation. Only John S. Page (USA) provided some tables for spheroidal storage tanks to 800.000 gallons (3.028 m^3) and spherical storage tanks to 200.000 gallons (757 m^3). I found his manhour calculation too stringent. They allow for too few hours for erection.

During my practice I had to make the calculations for such storage tanks many times. I did it in the following way:

1. Unloading & storing material ÷ [Mhr/ton]

2. Shell welding

Calculate the weld runs and determine the hours according to the tables under the Chapter VI/4 Welding of Spherical Storage Tanks

3. Assembling prefabricated plates and supports of tank

Shell welding manhours x

4. Placing and welding the connections and equipment

Use man hours for cylindrical storage tanks and other respective items

5. Hydrostatic Testing

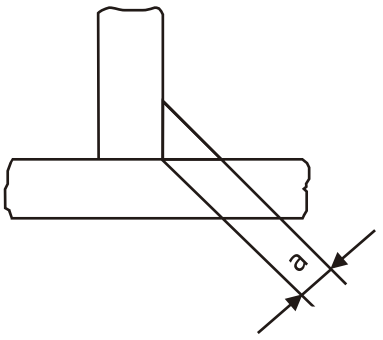
[Mhr/m^3] hours at least

VI. WELDING AND FLAME CUTTING

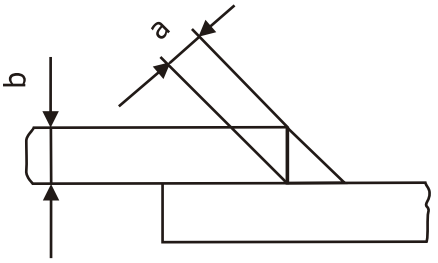
Productivity efficiency percentage (PEP) = 70%

1. MANUAL ARC WELDING OF CYLINDRICAL TANKS - SMAW

(Man hours for calculation)



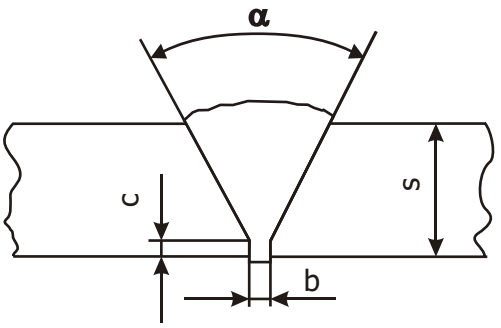
1.1 Fillet joint



Overlap joint

Plate thickn. "b"	Weld reinforc. "a"	Deposit weight	FILLET 2F		VERTICAL 3F		OVERHEAD 4F	
[mm]	[mm]	[kg/m]	[m/Mhr]	[Mhr/m]	[m/Mhr]	[Mhr/m]	[m/Mhr]	[Mhr/m]
3	2,1	0,07						
4	2,8	0,09						
5	3,5	0,13						
6	4,2	0,18						
7	5,0	0,25						
8	5,6	0,33						
9	6,4	0,41						
10	7,1	0,5						
12	8,5	0,75						
14	8,9	1,04						
15	10,6	1,18						
16	11,3	1,33						
18	12,7	1,62						
20	14,1	2,14						
22	15,6	2,52						
24	17	2,9						
25	17,5	3,1						

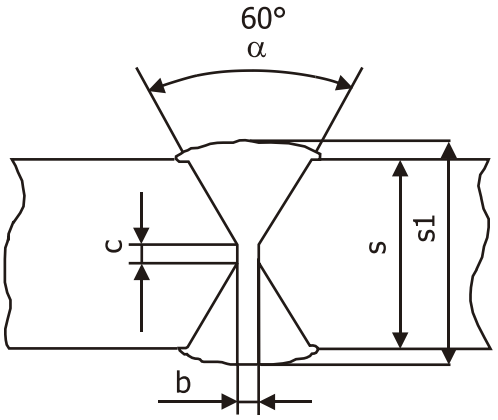
mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft



1.2 Single "V" butt joint

Plate thickn. "s" [mm]	Distance "b" [mm]	Angle "	Deposit weight [kg/m]	HORIZONTAL 1G		VERTICAL 3G		HORIZ. VERTIC. 2G		OVERHEAD 4G	
				[m/M hr]	[M hr/m]	[m/M hr]	[M hr/m]	[m/M hr]	[M hr/m]	[m/M hr]	[M hr/m]
3	1	60°	0,08								
4	1,5	60°	0,12								
5	2	60°	0,2								
6	2	60°	0,26								
7	2	60°	0,33								
8	2	60°	0,41								
9	3	60°	0,53								
10	3	60°	0,67								
11	3	60°	0,78								
12	3	60°	0,9								
14	3	60°	1,15								
16	3	60°	1,41								
18	3	60°	1,96								
20	3	60°	2,14								
22	3	60°	2,58								
25	3	60°	3,2								
28	3	60°	3,87								

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

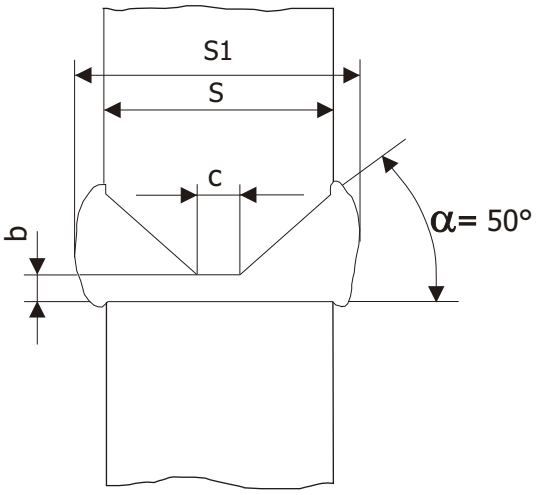


1.3.Double "V" butt joint

Plate thickn. "s" [mm]	Distance "b" [mm]	Deposit weight [kg/m]	VERTICAL 3G		HORIZ.-VERTIC. 2G	
			[m/Mhr]	[Mhr/m]	[m/Mhr]	[Mhr/m]
10	3	0,45				
11	3	0,51				
12	3	0,57				
14	3	0,77				
15	3	0,86				
16	3	0,94				
18	3	1,12				
20	3	1,34				
22	3	1,56				
24	3	1,76				
25	3	2,13				
26	3	2,26				
28	3	2,53				
30	3	2,85				
32	3	3,13				
34	3	3,45				
36	3	3,79				
40	3	4,57				

NOTE : Double ”V” butt joint can also appear under different angles, also under irregular. In that cases standard is calculated with value for single ”V” butt joint.

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft



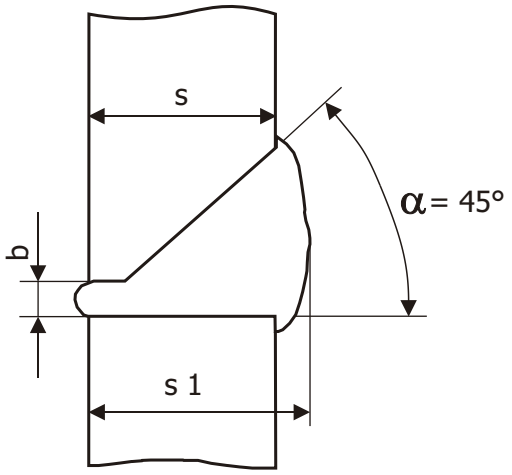
Area = (0,25 x s1 x 2tg ") + (s x b)

1.4 Double bevel butt joint

Plate s	Angle	MEASURES [mm]			Area	Deposit Weight	HORIZ . - VERTICAL 2G	
mm	"	b	c	s1	[mm¸]	[kg/m]	[m/Mhr]	[Mhr/m]
10	50°	3	2	13	81	0,63		
12	50°	3	2	15	104	0,82		
14	50°	3	2	18	139	1,09		
15	50°	3	2	19	153	1,2		
16	50°	3	2	20	168	1,32		
18	50°	3	2	22	199	1,56		
20	50°	3	2	24	233	1,83		
22	50°	3	2	26	269	2,11		
25	50°	3	2	29	327	2,57		
30	50°	3	2	36	479	3,76		
35	50°	3	2	41	609	4,78		
40	50°	3	2	46	755	5,93		

NOTE : When horizontal joints of the tank shell are welded by SMAW process, two different thickness mostly are used. In that case a mean value is used for operating time.

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft



1.5 Single bevel butt joint

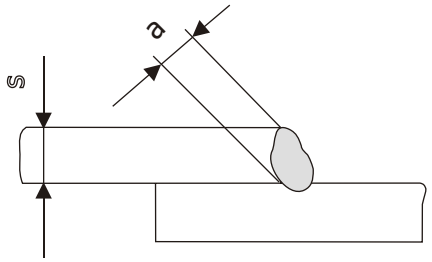
"s" [mm]	"b" [mm]	Weight [kg/m]	HORIZ. - VERTICAL (2G)	
			[Mhr/m]	[m/Mhr]
5	1 ÷ 2	0,244		
6	1 ÷ 2	0,313		
7	1 ÷ 2	0,41		
8	2 ÷ 3	0,58		
9	2 ÷ 3	0,686		
10	2 ÷ 3	0,8		
11	2 ÷ 3	0,922		
12	2 ÷ 3	1,079		
12	2 ÷ 3	1,31		
14	2 ÷ 3	1,464		
15	2 ÷ 3	1,624		
16	2 ÷ 3	1,793		
18	2 ÷ 3	2,154		
20	2 ÷ 3	2,547		
22	2 ÷ 3	2,971		
24	2 ÷ 3	3,426		

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

2. SUBMERGED ARC WELDING

(Data for calculation)

2.1 Welding machine **"Lincoln Lt-3"**



2.1.1 Welding of overlap joint

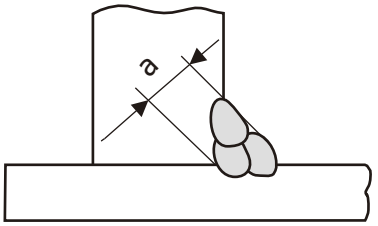
Wire EPP - 2 ø4 mm

s [mm]	a [mm]	v [cm/min]	Number of Passes	[Mhr/m]	[m/Mhr]
5	3,5	85	1		
5,5	4	75	1		
6	4,5	65	1		
6,5	5	54	1		
7	5,5	42	1		

Wire EPP - 2 ø3 mm

s [mm]	a [mm]	v [cm/min]	Number of Passes	[Mhr/m]	[m/Mhr]
5	3,5	80	1		
5,5	4	70	1		
6	4,5	60	1		
6,5	5	50	1		
7	5,5	38	1		

v = travel speed



2.1.2 Welding of fillet joint
(bottom shell, internal site)

Wire EPP - 2 ø 4 mm

a [mm]	v [cm/min]	Number of Passes	[Mhr/m]	[m/Mhr]
8	18	3		
9	14	3		

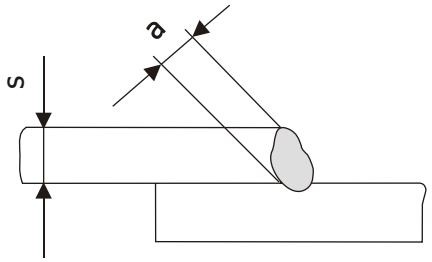
Wire EPP - 2 ø3 mm

a [mm]	v [cm/min]	Number of Passes	[Mhr/m]	[m/Mhr]
8	13,5	3		
9	10,5	3		

v = travel speed

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

2.2 Machine welding, **"ESAB A-2T"**



2.2.1 Welding of overlap joint

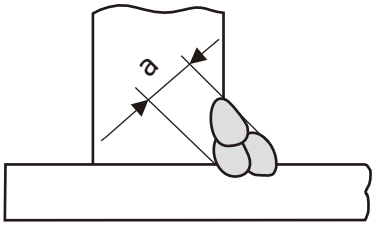
Wire EPP - 2 ø 4 mm

s [mm]	a [mm]	v [cm/min]	Number of Passes	[Mhr/m]	[m/Mhr]
5	3,5	85	1		
5,5	4	75	1		
6	4,5	65	1		
6,5	5	55	1		
7	5,5	50	1		

Wire EPP - 2 ø 3 mm

s [mm]	a [mm]	v [cm/min]	Number of Passess	[Mhr/m]	[m/Mhr]
5	3,5	80	1		
5,5	4	70	1		
6	4,5	60	1		
6,5	5	50	1		
7	5,5	45	1		

v **=** travel speed



2.2.2 Welding of fillet joint
(bottom shell, inside of tank)

Wire EPP - 2 ø 4 mm

a [mm]	v [cm/min]	Number of Passes	[Mhr/m]	[m/Mhr]
8	18	3		
9	14	3		

Wire EPP - 2 ø 3 mm

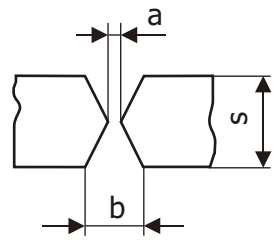
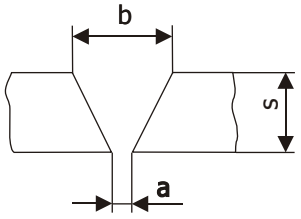
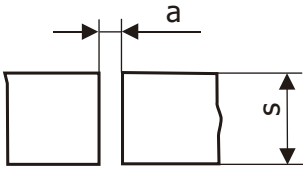
a [mm]	v [cm/min]	Number of Passes	[Mhr/m]	[m/Mhr]
8	13,5	3		
9	10,5	3		

v = travel speed

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

2.3 Welding with Vertomatic **"ARCOS"**

Gas shielded, flux cored welding rod - outershield

s		a	b	v	Mhr/Vertical Weld				
					Height of One Vertical Weld [mm]				
mm	TYPE OF JOINT	mm	mm	cm/min	to 1600	1800	2000	2200	⩾ 2400
36		3	17	6.3					
35		3	16.6	6.5					
32		3	15.6	6.8					
30		2	13.6	7.2					
28		2	12.7	7.5					
25		2	11.5	8.3					
24		2	11.1	8.7					
22		2	10.3	9.1					
20		2	9.5	10					
20		3	19	11.7					
16		2	15	14.9					
15		2	12.4	15.8					
14		2	11.6	17					
13		2	10.7	18.3					
12		2	10	19.9					
11		2	9.1	20					
10		2	8.3	20					
20		13		7					
16		12		8.7					
15		11		9.2					
14		11		9.9					
13		11		10.7					
12		11		11.6					
11		11		11.7					
10		11		11.7					
9		11		13.1					
8		11		14.7					
7		11		16.8					

v = travel speed

When calculating the welding time for one tank shell, the following to be added:

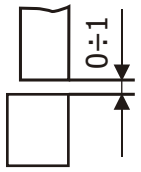
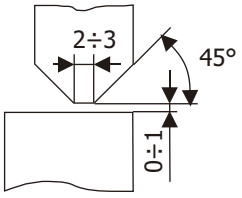
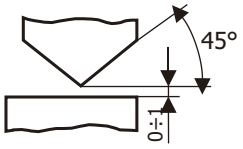
- Lifting welding machine on tank shell — Mhr
- Taking off welding machine from tank shell — Mhr
- Shifting welding machines from one tank shell to another tank shell — Mhr

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

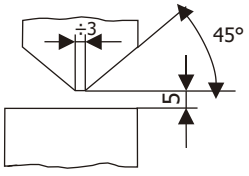
2.4 Welding with Circomatic **"ARCOS"**

When calculating the welding time for each horizontal joint, to be added:

Positioning and taking off welding machine: [redacted] Mhr

TYPE OF JOINT	plate mm	number of passes	travel speed [cm/min]	rate [m/Mhr]	rate [Mhr/m]
	6 / 6	1	60÷75	[redacted]	[redacted]
	6 / 8	1	60÷70	[redacted]	[redacted]
	8 / 10	1	60÷65	[redacted]	[redacted]
	10 / 13	1	55÷60	[redacted]	[redacted]
	13 / 16	1	50÷55	[redacted]	[redacted]
	16 / 18	1	45÷50	[redacted]	[redacted]
	18 / 22	2	22÷27	[redacted]	[redacted]
	22 / 25	3	12÷15	[redacted]	[redacted]
	27 / 30	4	9÷11	[redacted]	[redacted]
	35 / 40	6	6÷8	[redacted]	[redacted]

Root pass, SMAW using Ductilend 55 stick welding rod

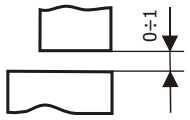
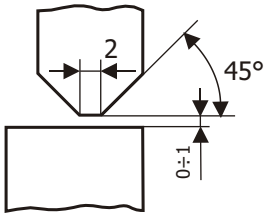
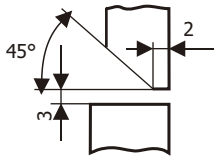
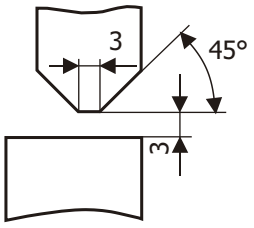
	22 / 25	5	8÷10	[redacted]	[redacted]
	27 / 30	6	6÷8	[redacted]	[redacted]
	35 / 40	9	4,5÷5,5	[redacted]	[redacted]

Root pass will be calculated acc. to the man hour for SMAW.

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

2.5 Welding with Circomatic **"ESAB"**

Welding with flux-cored welding rods outershield.

TYPE OF JOINT		Plate mm	Number of Passes	Travel Speed [cm/min]	Rate [m/Mhr]	Rate [Mhr/m]
	BEFORE FILLING WITH SAW, FIRST PASS WILL BE WELDED BY SMAW OR GMAW PROCESS	8 / 10	2	30÷35		
		10 / 12	2	30÷35		
		12 / 14	4	14÷20		
		14 / 17	6	10÷15		
		17 / 20	6	9÷12		
		20 / 23	8	6÷9		
		23 / 26	10	5÷8		
		26 / 30	12	4÷6		
	ROOT PASS FULL PENETRATION - SMAW	8 / 8	2	34÷36		
		8 / 10	2	34÷36		
		10 / 13	4	17÷20		
		13 / 16	4	16÷19		
		16 / 18	4	15÷18		
		18 / 21	6	9÷11		
		21 / 24	7	7÷10		

Root pass full penetration will be calculated according to SMAW or GMAW process.

When calculating the welding time for each horizontal joint, to be added:

- Each shifting of welding machine (the number of shifting is defined by weld eng.) — Mhr
- Positioning and taking off — Mhr
- When two welding machines are used - (simultaneos from both sides) - positioning and taking off — Mhr

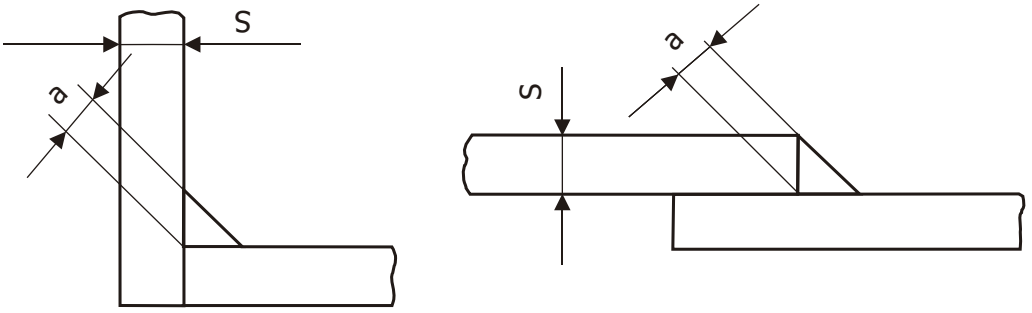
mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

3. WELDING WITH SEMIAUTOMATIC (GMAW)

(Data for calculation)

3.1 Semiautomatic - GMAW (CO_2)

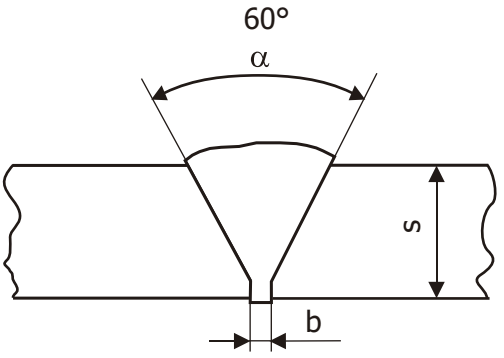
3.1.1 Welding of fillet joints



s mm	a mm	Deposit Weight [kg/m]	HORIZONTAL (2F)		VERTICAL (3F)	
			[Mhr/m]	[m/Mhr]	[Mhr/m]	[m/Mhr]
3	2,1	0,07				
4	2,8	0,09				
5	3,5	0,13				
6	4,2	0,18				
7	5	0,25				
8	5,6	0,33				
9	6,4	0,41				
10	7,1	0,5				
12	8,5	0,75				
14	8,9	1,04				
16	11,3	1,33				
18	12,7	1,62				
20	14,1	2,14				
22	15,6	2,52				
24	17	2,9				

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

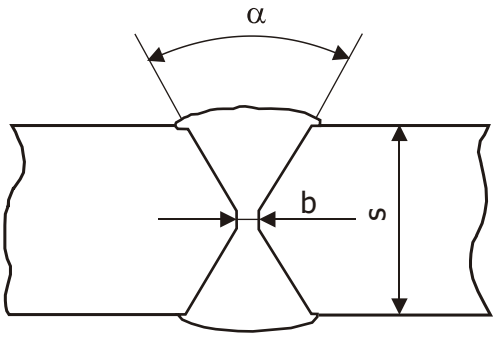
3.1.2 Welding of single "V" butt joint



s mm	Angle "	b mm	Deposit Weight [kg/m]	HORIZONTAL (1G)		VERTICAL (3G)	
				[Mhr/m]	[m/Mhr]	[Mhr/m]	[m/Mhr]
4	60°	1,5	0,12				
5	60°	2	0,2				
6	60°	2	0,26				
7	60°	2	0,33				
8	60°	2	0,41				
9	60°	3	0,53				
10	60°	3	0,67				
11	60°	3	0,78				
12	60°	3	0,9				
14	60°	3	1,15				
16	60°	3	1,41				
18	60°	3	1,76				
20	60°	3	2,14				

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

3.1.3 Welding of double "V" butt joint



α = 60°

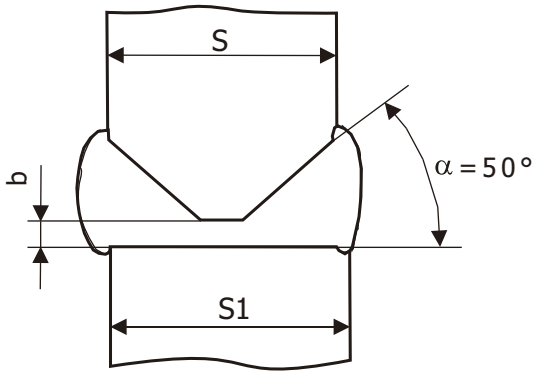
s mm	b mm	Deposit Weight [kg/m]	VERTICAL (3G)	
			[Mhr/m]	[m/Mhr]
12	3	0,57		
14	3	0,77		
15	3	0,86		
16	3	0,94		
20	3	1,34		
22	3	1,56		
24	3	1,76		
25	3	2,13		
26	3	2,25		
28	3	2,53		
30	3	2,85		
32	3	3,13		
34	3	3,45		
36	3	3,79		
40	3	4,57		

α = 45°

s mm	b mm	Deposit Weight [kg/m]	VERTICAL (3G)	
			[Mhr/m]	[m/Mhr]
12	3	0,39		
14	3	0,52		
15	3	0,59		
18	3	0,77		
20	3	0,92		
22	3	1,07		
24	3	1,2		
25	3	1,46		
26	3	1,55		
28	3	1,73		
30	3	1,95		
32	3	2,14		
34	3	2,37		
36	3	2,6		
40	3	3,13		

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

3.1.4 Welding of double-bevel butt joint



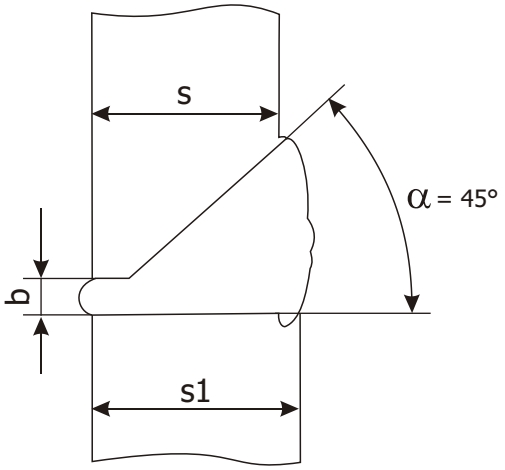
mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

When horizontal joints of the tank shell are welded two different thicknesses mostly occur (S ≠ S1) in which case a mean value is used for the man hour time.

s mm	b mm	Deposit Weight [kg/m]	HORIZ.-VERTIC. (2G) [Mhr/m]	[m/Mhr]
10	0 ÷ 1	0,47		
	1 ÷ 2	0,55		
	2 ÷ 3	0,63		
11	0 ÷ 1	0,54		
	1 ÷ 2	0,63		
	2 ÷ 3	0,72		
12	0 ÷ 1	0,62		
	1 ÷ 2	0,71		
	2 ÷ 3	0,8		
13	0 ÷ 1	0,74		
	1 ÷ 2	0,84		
	2 ÷ 3	0,94		
14	0 ÷ 1	0,82		
	1 ÷ 2	0,93		
	2 ÷ 3	1,04		
15	0 ÷ 1	0,96		
	1 ÷ 2	1,08		
	2 ÷ 3	1,2		
16	0 ÷ 1	1,06		
	1 ÷ 2	1,18		
	2 ÷ 3	1,31		
18	0 ÷ 1	1,27		
	1 ÷ 2	1,43		
	2 ÷ 3	1,6		
20	0 ÷ 1	1,5		
	1 ÷ 2	1,68		
	2 ÷ 3	1,86		
22	0 ÷ 1	1,75		
	1 ÷ 2	1,94		
	2 ÷ 3	2,14		
24	0 ÷ 1	2,08		
	1 ÷ 2	2,27		
	2 ÷ 3	2,46		

s mm	b mm	Deposit Weight [kg/m]	HORIZ. - VERTIC. (2G) [Mhr/m]	[m/Mhr]
25	0 ÷ 1	2,3		
	1 ÷ 2	2,49		
	2 ÷ 3	2,69		
26	0 ÷ 1	2,59		
	1 ÷ 2	2,81		
	2 ÷ 3	3,03		
27	0 ÷ 1	2,75		
	1 ÷ 2	2,98		
	2 ÷ 3	3,2		
28	0 ÷ 1	2,92		
	1 ÷ 2	3,14		
	2 ÷ 3	3,36		
30	0 ÷ 1	3,26		
	1 ÷ 2	3,5		
	2 ÷ 3	3,73		
32	0 ÷ 1	3,62		
	1 ÷ 2	3,88		
	2 ÷ 3	4,13		
34	0 ÷ 1	4,0		
	1 ÷ 2	4,27		
	2 ÷ 3	4,54		
35	0 ÷ 1	4,2		
	1 ÷ 2	4,48		
	2 ÷ 3	4,75		
36	0 ÷ 1	4,4		
	1 ÷ 2	4,69		
	2 ÷ 3	4,97		
38	0 ÷ 1	4,82		
	1 ÷ 2	5,12		
	2 ÷ 3	5,42		
40	0 ÷ 1	5,26		
	1 ÷ 2	5,57		
	2 ÷ 3	5,89		

3.1.5 Welding of single bevel butt joint



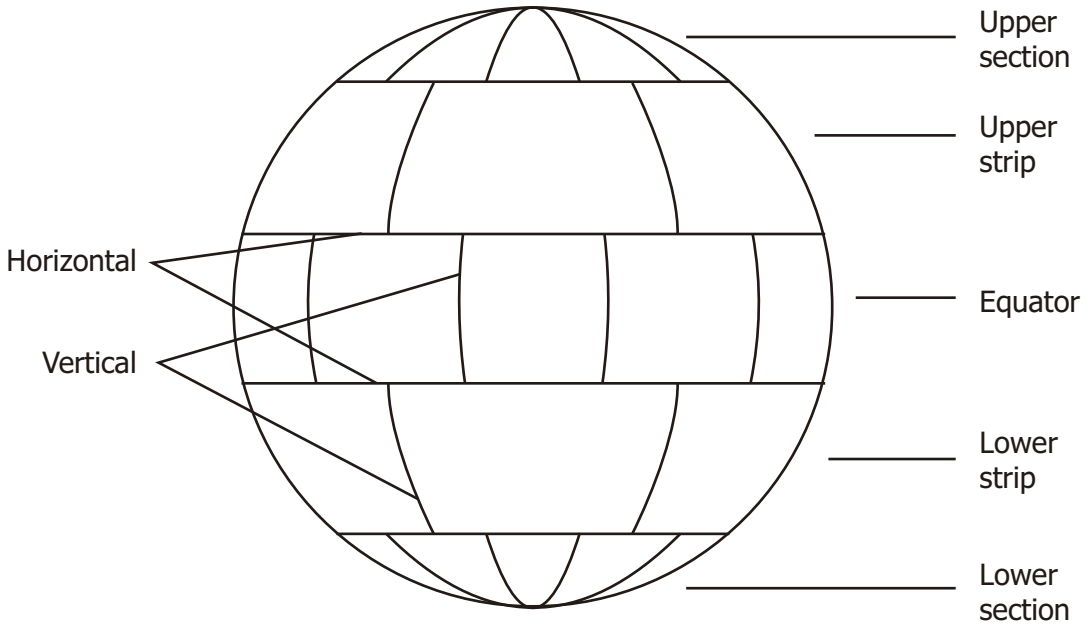
mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

When the tank shell horizontal joints are welded, two different thickness of plate are mostly used (S ≠ S1). In that case a mean value is used for manhour calculation.

s mm	b mm	Deposit Weight [kg/m]	HORIZ. - VERTIC. (2G) [Mhr/m]	[m/Mhr]
5	0 ÷ 1	0,205		
	1 ÷ 2	0,244		
6	0 ÷ 1	0,267		
	1 ÷ 2	0,315		
7	0 ÷ 1	0,355		
	1 ÷ 2	0,41		
8	0 ÷ 1	0,455		
	1 ÷ 2	0,517		
	2 ÷ 3	0,58		
9	0 ÷ 1	0,545		
	1 ÷ 2	0,615		
	2 ÷ 3	0,685		
10	0 ÷ 1	0,643		
	1 ÷ 2	0,721		
	2 ÷ 3	0,8		
11	0 ÷ 1	0,749		
	1 ÷ 2	0,835		
	2 ÷ 3	0,922		
12	0 ÷ 1	0,891		
	1 ÷ 2	0,985		
	2 ÷ 3	1,079		
13	0 ÷ 1	1,106		
	1 ÷ 2	1,208		
	2 ÷ 3	1,31		
14	0 ÷ 1	1,244		
	1 ÷ 2	1,354		
	2 ÷ 3	1,464		
15	0 ÷ 1	1,389		
	1 ÷ 2	1,506		
	2 ÷ 3	1,624		
16	0 ÷ 1	1,542		
	1 ÷ 2	1,667		
	2 ÷ 3	1,793		

s mm	b mm	Deposit Weight [kg/m]	HORIZ. - VERTIC. (2G) [Mhr/m]	[m/Mhr]
18	0 ÷ 1	1,872		
	1 ÷ 2	2,013		
	2 ÷ 3	2,154		
20	0 ÷ 1	2,233		
	1 ÷ 2	2,39		
	2 ÷ 3	2,547		
22	0 ÷ 1	2,625		
	1 ÷ 2	2,798		
	2 ÷ 3	2,971		
24	0 ÷ 1	3,049		
	1 ÷ 2	3,237		
	2 ÷ 3	3,426		
25	0 ÷ 1	3,273		
	1 ÷ 2	3,469		
	2 ÷ 3	3,665		
26	0 ÷ 1	3,505		
	1 ÷ 2	3,709		
	2 ÷ 3	3,913		
27	0 ÷ 1	3,744		
	1 ÷ 2	3,956		
	2 ÷ 3	4,168		
28	0 ÷ 1	3,991		
	1 ÷ 2	4,211		
	2 ÷ 3	4,431		
30	0 ÷ 1	4,509		
	1 ÷ 2	4,744		
	2 ÷ 3	4,98		
32	0 ÷ 1	5,059		
	1 ÷ 2	5,31		
	2 ÷ 3	5,561		
34	0 ÷ 1	5,64		
	1 ÷ 2	5,907		
	2 ÷ 3	6,174		

4. WELDING OF SPHERICAL STORAGE TANKS



4.1 Manual welding of slices of lower and upper section

Plate Thickness [mm]	Deposit Weight [kg/m]	Rate [Mhr/m]	Plate Thickness [mm]	Deposit Weight [kg/m]	Rate [Mhr/m]	Plate Thickness [mm]	Deposit Weight [kg/m]	Rate [Mhr/m]
14	0,73		24	1,82		32	3,04	
15	0,79		25	1,94		34	3,48	
16	0,93		26	2,12		35	3,65	
17	1,0		27	2,26		36	3,97	
18	1,11		28	2,43		37	4,1	
20	1,31		29	2,54		38	4,23	
22	1,56		30	2,73		40	4,77	

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

4.2 Manual welding of vertical joint of Equator, upper and lower section

Plate Thickness [mm]	EQUATOR [Mhr/m]	UPPER STRIP [Mhr/m]	LOWER STRIP [Mhr/m]
14			
15			
16			
17			
18			
20			
22			
24			
25			
26			
27			
28			
29			
30			
32			
34			
35			
36			
38			
40			

mm x 0,03937 = inch
kg/m x 0,672 = lbs/ft
m/Mhr x 3,281 =ft/Mhr
Mhr/m x 0,3048 = Mhr/ft

4.3 Manual welding of horizontal joints

Plate Thickness	LOWER SECTION LOWER STRIP	LOWER STRIP EQUATOR	EQUATOR UPPER STRIP	UPPER STRIP UPPER SECTION
[mm]	[Mhr/m]	[Mhr/m]	[Mhr/m]	[Mhr/m]
14				
15				
16				
17				
18				
20				
22				
24				
25				
26				
27				
28				
29				
30				
32				
34				
35				
36				
38				
40				

5. MANUAL GAS CUTTING AND GAS CONSUMPTION

Plate Thickness	Cutting Speed	Rate	Oxygen	Acetylene
[mm]	[m/hr]	[Mhr/m]	[kg/m]*	[kg/m]*
3			0,0323	0,0064
4			0,04	0,0073
5			0,0466	0,0082
6			0,0525	0,009
7			0,0625	0,0097
8			0,0715	0,0104
9			0,079	0,0111
10			0,0875	0,0117
11			0,096	0,0123
12			0,106	0,0121
13			0,115	0,0135
14			0,126	0,014
15			0,1375	0,0145
16			0,14	0,015
17			0,1525	0,0155
18			0,1745	0,0161
19			0,186	0,0167
20			0,197	0,0174
21			0,207	0,018
22			0,2175	0,0188
23			0,226	0,0195
24			0,237	0,0202
25			0,244	0,0208
26			0,252	0,0215
27			0,259	0,0221
28			0,266	0,0227
29			0,273	0,0233
30			0,279	0,0238
31			0,285	0,0244
32			0,29	0,0249
33			0,295	0,0256
34			0,3	0,0259
35			0,304	0,0264
36			0,308	0,0268
37			0,311	0,0272
38			0,314	0,0277
39			0,316	0,0281
40			0,318	0,0285

mm x 0,03937 = inch
m/hr x 3,281 = ft/hr
Mhr/m x 0,3048 = Mhr/ft
kg/m x 0,672 = lbs/ft

* Theoretical consumption of gas for machine gas cutting
(acc. to Živčić-Remenar)
The consumption of gas for manual cutting is c. % higher.
To estimate the oxygen and acetylene needed for manual gas cutting double the above values.

NOTE: Man hours [Mhr/m] are used for cutting only to 30 m. Man hours for larger lengths to be estimated according to the cutting speed [m/hr].

VII. CORROSION PROTECTION

Productivity Efficiency Percentage (PEP) = 80%

1. SAND BLASTING AND PAINTING OF PIPING			SURFACE AREA OF PIPING ELEMENTS						RATES FOR PIPES					
			Pipe 1m	Elbow r=1,5d	TEE	Reducer	Flange	Valve	Blast and First Coat	Two Middle Coats	Covering Coat	TOTAL Four Coats	TOTAL Four Coats	
Dn-mm	ø-Inch	OD-mm	[m²]	[m²]	[m²]	[m²]	[m²]	[m²]	[Mhr/m²]	[Mhr/m²]	[Mhr/m²]	[Mhr /m²]	[Mhr/m]	ø-Inch
15	1/2″	21,3	0,067	0,003	0,003	0,002	0,012	0,030						1/2″
20	3/4″	26,7	0,083	0,005	0,004	0,003	0,017	0,036						3/4″
25	1″	33,4	0,105	0,008	0,007	0,005	0,020	0,043						1″
32	1 1/4″	42,2	0,132	0,013	0,011	0,006	0,023	0,054						1 1/4″
40	1 1/2″	48,3	0,151	0,017	0,015	0,009	0,030	0,065						1 1/2″
50	2″	60,3	0,19	0,027	0,023	0,013	0,035	0,147						2″
65	2 1/2″	73	0,24	0,039	0,035	0,019	0,046	0,185						2 1/2″
80	3″	88,9	0,28	0,058	0,050	0,022	0,056	0,173						3″
100	4″	114,3	0,36	0,097	0,082	0,033	0,080	0,297						4″
125	5″	141,3	0,44	0,120	0,124	0,050	0,096	0,390						5″
150	6″	168,3	0,53	0,210	0,178	0,067	0,120	0,460						6″
200	8″	219,1	0,69	0,472	0,302	0,094	0,170	0,660						8″
250	10″	273	0,86	0,552	0,470	0,138	0,230	0,890						10″
300	12″	323,9	1,02	0,776	0,661	0,186	0,260	1,190						12″
350	14″	355,6	1,12	0,936	0,797	0,333	0,300	1,570						14″
400	16″	406,4	1,28	1,222	1,040	0,410	0,350	1,790						16″
450	18″	457	1,43	1,545	1,307	0,490	0,390	2,220						18″
500	20″	508	1,60	1,910	1,626	0,732	0,420	2,520						20″
550	22″	559	1,75	2,312	1,957	0,800	0,460	3,220						22″
600	24″	610	1,92	2,754	2,342	0,878	0,490	3,920						24″
650	26″	660	2,07	3,223	2,732	1,136	0,520	3,800						26″
700	28″	711	2,24	3,741	3,185	1,230	0,560	3,850						28″
750	30″	762	2,39	4,297	3,642	1,312	0,600	4,330						30″
800	32″	813	2,56	4,891	4,163	1,405	0,630	4,820						32″
850	34″	864	2,71	5,524	4,683	1,488	0,670	5,320						34″
900	36″	914	2,88	6,182	5,265	1,581	0,700	5,820						36″
950	38″	965	3,03	6,891	5,848	1,663	0,740	6,450						38″
1000	40″	1016	3,20	7,639	6,502	1,757	0,780	7,100						40″
1050	42″	1067	3,35	7,639	7,149	2,144	0,800							42″
1100	44″	1118	3,52	8,425	7,871	2,252	0,840							44″
1150	46″	1168	3,66	10,095	8,550	2,342	0,980							46″
1200	48″	1219	3,83	10,996	9,338	2,451	0,920							48″
1350	54″	1372	4,31	13,930	11,827	2,758	1,020							54″
1500	60″	1524	4,79	17,187	14,600	3,065	1,120							60″

1.1 RATES FOR PIPING ELEMENTS

- Pipes: above table
- Elbows: [Mhr/m^2]x
- Tees: [Mhr/m^2]x
- Reducers: [Mhr/m^2]x
- Flanges: [Mhr/m^2]x
- Valves: [Mhr/m^2]x

1.2 MATERIAL CONSUMPTION - acc. to Item 2 (page 104)

m^2 x 10764 = sq ft
Mhr/m^2 x 0,0929 = Mhr/sq ft
Mhr/m x 0,3048 = Mhr/ft

2. SAND BLASTING AND PAINTING OF STEEL STRUCTURES

2.1 Sand blasting and primer: [Mhr/m^2] + [Mhr/m^2] = [Mhr/m^2]

Material Consumption:

— siliceous sand for the purity grade SA 2 1/2
÷ [kg/m^2]

or: — corrund (Al_2O_3) for the purit y grade SA 2 1/2
÷ [kg/m^2]

or: — ground dross for the purity grade SA 2 1/2
÷ [kg/m^2]

or: — hot (metal sand)
÷ [kg/m^2]

2.2 Next Coats

2.2.1	Up to 100 microns:	by brush	[Mhr/m^2]
		by spray gun	[Mhr/m^2]
	Material consumption:	colour	[kg/m^2]
2.2.2	Above 100 microns:	by brush	[Mhr/m^2]
		by spray gun	[Mhr/m^2]
	Material consumption:		[kg/m^2]

NOTE:
1. Consumption of the abrasive material depends on the corrosion pitting of the structure, wind, space and the possibility of regeneration of the abrasive used.
2. Paint consumption depends on the corrosion pitting, coat thickness, wind, and the manufacturer's instructions.

2.3 Time allowances for job conditions

2.3.1 Work at elevations

to 2 m	—	no allowances
2 ÷ 4 m	—	+ %
4 ÷ 10 m	—	+ %
above 10m	—	+ %

2.3.2 Work inside

- with ventilation	+ %
- no ventilation	+ %

2.3.3 Work in lumbered rooms (space obstruction) + %

2.4 MEASUREMENT AND CALCULATION OF QUANTITIES FOR CORROSION PROTECTION

2.4.1 Machines, motors, pumps, conveyors

A surface area of parallelopiped shape x

2.4.2 Steel Structure

- Heavy structure	(above 60 kg/m):	÷ [m^2/ton]
- Medium-weight structure	(31 ÷ 60 kg/m):	÷ [m^2/ton]
- Light structure	(to 30 kg/m):	÷ [m^2/ton]

- Floor grids:	length x width x
- Ladders and step iron:	length x width
- Mesh railings:	length x height x
- Flat sheets:	actual painting area
- Corrugated sheets:	actual painting area x

2.4.3 Pipe Supports

- for piping	to 4"	[m^2/ton]
- for piping	above 4"	[m^2/ton]

3. SAND BLASTING AND PAINTING OF STO RAGE TANKS

3.1 Outer surfaces of storage tank

- Sand blasting	SA 2 ½ :	[Mhr/m2]
- First coat	75 µ :	[Mhr/m2]
- Second coat	40 µ :	[Mhr/m2]
- Third coat	125 µ :	[Mhr/m2]
- Fourth finishing coat	50 µ :	[Mhr/m2]
Total =	290 µ :	[Mhr/m2]

3.2 Inner surfaces of storage tank

- Sand blasting	SA 2 ½ :	[Mhr/m2]
- First coat	40 µ :	[Mhr/m2]
- II + III + IV coat	400 µ :	[Mhr/m2]
Total =	440 µ :	[Mhr/m2]

NOTE: These man hours refer to the climate conditions prev ailing in the Centr al Europe.

VIII. THERMAL INSULATION

Productivity Efficiency Percentage (PEP) =85%

Generally, specialized companies make calculations for insulation. This rule also applies if insulation accounts for a large portion of a project. When the scope of insulation is not so great or the bidding time is very tight, an estimator for the mechanical works should also provide the calculation elements for the insulation. That is why I worked out the manhour rates for insulation based on the manhour rates of several specialized German insulation contractors.

1. THERMAL INSULATION FOR PIPING

Prefabrication of the insulation holders, sheet cutting, placing mineral wool, aluminium foil cladding, installation of sheets and sealing with durable elastic compound.

1.1 Pipe insulation

Manhours per linear metre [Mhr/m]

Piping		Insulation Thickness [mm]							
ND	Ø	30	40	50	60	80	100	120	150
25	1″								
32	1 1/4″								
40	1 1/2″								
50	2″								
65	2 1/2″								
80	3″								
100	4″								
125	5″								
150	6″								
200	8″								
250	10″								
300	12″								
350	14″								
400	16″								
450	18″								
500	20″								
600	24″								
700	28″								
800	32″								
900	36″								
1000	40″								

- Insulation of pipes and fittings, except for pipe bends is included.
- Insulation of valves not included.
- Scaffolding not included.

mm x 0,03937 = inch
Mhr/m x 0,3048 = Mhr/ft

1.2 Insulation of pipe bends

[Mhr / ea]

Piping		Insulation Thickness [mm]							
ND	Ø	30	40	50	60	80	100	120	150
25	1″								
32	1 1/4″								
40	1 1/2″								
50	2″								
65	2 1/2″								
80	3″								
100	4″								
125	5″								
150	6″								
200	8″								
250	10″								
300	12″								
350	14″								
400	16″								
450	18″								
500	20″								
600	24″								
700	28″								
800	32″								
900	36″								
1000	40″								

1.3 Valve Insulation

ND	Ø	[Mhr/ea]	ND	Ø	[Mhr/ea]	Factors acc. to Insulation Thickness	
25	1″		300	12″		30 mm	x
32	1 1/4″		350	14″		40 mm	x
40	1 1/2″		400	16″		50 mm	x
50	2″		450	18″		60 mm	x
65	2 1/2″		500	20″		80 mm	x
80	3″		600	24″		100 mm	x
100	4″		700	28″		120 mm	x
125	5″		800	32″		150 mm	x
150	6″		900	36″			
200	8″		1000	40″			
250	10″						

1.4 Piping insulation based on the surface area

1.4.1 Surface area calculation

The pipe surface area is calculated by adding two insulation thicknesses to the pipe diameter.

$$A = \frac{(d_o + 2t) \times 3{,}14}{1000} \quad [m^2]$$

d_o = pipe OD [mm]

t = insulation thickness [mm]

- Pipe bend surface area

$$A = (d_o + 2t)(2\dot{q} + t) \times \quad [m]^2$$

d_o = pipe OD [m]
t = insulation thickness [m]

- Valve surface area

Surface area of 1 m pipe x

1.4.2 Manhour rates [Mhr/m²]

Insulation Thickness [mm]	30	40	50	60	80	100	120	150
[Mhr /m²]								

Included:
- pipes
- all fittings
- valves
- insulation holders

Not includes:
- scaffolding

1.4.3 Division based on the operations

- Insulation holders %
- Mineral wool and al. foil %
- Sheets %

- Prefabrication %
- Erection %

- Prefabrication %
- Erection %

2. THERMAL INSULATION OF VESSELS AND KILNS

2.1 Insulation with mineral wool, smooth aluminium sheets, durable elastic sealing including substructure

Insulation Thickness	[Mhr/m²]
80 mm	
100 mm	
120 mm	
150 mm	
180 mm	

2.2 Insulation with mineral wool, trapezoidal galvanised E 40 sheets, 1-mm thickness, both side painting, durable elastic sealing substructure included.

Insulation thickness	[Mhr/m²]
80 mm	
100 mm	
120 mm	
150 mm	
180 mm	

Scaffolding not included.

mm x 0,03937 = inch
m x 3,281 = ft
m² x 10,764 = sq ft
Mhr/m² x 0,0929 = Mhr/sq ft

IX. ESTIMATES

1. ESTIMATE OF SCAFFOLDS

Quick estimates of scaffolding and the scaffolds are very difficult to make and not reliable. Estimators usually do not have the drawings, the dimensions and what is most important they do not have enough time to perform a proper calculation. Therefore, they have to make quick estimates of the quantities starting first with a decision on who is going to undertake the scaffolding. Will they subcontract this job to a specialist firm or do the scaffolding themselves?

It is also necessary to see who will use the scaffolds. Will they be used for erection only, or for painting and insulation works as well?

If there are several users, the rental period is longer but in that case the expenses can be shared.

1. ESTIMATES OF SCAFFOLDING WHEN CONTRACTED TO A SPECIALIST FIRM

The most usual categorization and the rates of the scaffolding specialist firms are:

a) Scaffold Erection

- standing scaffolds	[m^3]	- cantilever scaffolds	[m^3]
- hanging scaffolds	[m^3]	- platform floors	[m^2]

b) Scaffold Dismantling

- same categorization as for erection

c) Rental

- same categorization per week and month

The price of erection and dismantling of scaffolding varies by its height every ____ ÷ ____ m. When estimating the scaffolding quantity, the quantity for erection in [m^3] and an average erection height are determined.

1.1 PIPING IN PLANTS

- Quantity: ____ ÷ ____ [m^3/t] piping weight
- Type :
  - standing scaffolds ____ ÷ ____ %
  - hanging scaffolds ____ ÷ ____ %
  - cantilever scaffolds ____ ÷ ____ %
  - platforms landings ____ ÷ ____ %

1.2 PIPING ON PIPERACKS

- Quantity:
  - Option I Pipe rack surface area ____ [m^2] scaffold
  - Option II ____ [m^3/t] piping weight
- Type :
  - standing scaffold ____ %
  - hanging scaffold ____ – ____ %
  - cantilevel scaffold ____ ÷ ____ %
  - platforms floors ____ ÷ ____ %
- Height: ____ ÷ ____
- Rental: average ____ ÷ ____ months

1.3 STEEL STRUCTURES

- Quantity: ____ ÷ ____ [m^3/t] structure weight
- Type :
  - standing ____ ÷ ____ %
  - hanging ____ ÷ ____ %
  - cantilever ____ ÷ ____ %
  - platforms floors ____ ÷ ____ %
- Height: average ____ m
- Rental: average ____ ÷ ____ weeks

m^3 x 35,32 = cu ft
m^2 x 10764 = sq ft

1.4 EQUIPMENT IN PETROCHEMICAL PLANTS

When estimating the scaffolding for equipment erection one should know who is going to use the scaffolding. For instance, no scaffolding is required for erection of towers, but it is required for erection of connection piping, electrical installations, insulation or painting. The best way is to calculate all the equipment individually for each unit. Similarly, one should also determine the type of scaffolding, its height, and the rental time.

When the scaffolding is used for the equipment erection only, it could be calculated in the following way:

- Quantity: ÷ [m³/ton] equipment weight
- Type: standing %
  platform floors %
- Height: ÷ m
- Rental: month

2. ESTIMATE OF SCAFFOLDING WHEN DONE BY AN ERECTION COMPANY

This kind of scaffolding erection is used less and less. If used, the scope of scaffolding should be estimated in the same way as for the first case.

2.1 PIPING IN PLANTS: ÷ [m³/ton] piping quantity

2.2 PIPING ON PIPERACKS: Option I Pipe rack surface area = [m²] scaffold
Option II [m³/ton] piping quantity

2.3 STEEL STRUCTURES: ÷ [m³/ton] structure quantity

2.4 EQUIPMENT IN PETROCHEMICAL INDUSTRY: ÷ [m³/ton] equipment quantity
(If used for the equipment erection only)

When the scaffolding quantity is calculated in [m³] or [m²], which is more or less the sam e we should estimate the material needed for tubular or patent scaffolding.

2.5 TUBULAR SCAFFOLDING

There are sets of tubular scaffolding with a list of material needed such as tubes and clamps for 500 m³ (Iron Works Sisak). If it is expected that the scaffolding will be erected and dismantled several times during the works execution, the following calculations should be considered:

2.5.1 Tubular scaffold material

Total scaffolding: $\frac{[m^3] + [m^2]}{\quad} = m^3 \text{ or } m^2$

The scaffolding quantity to round up to hundred (100).

$m^3 \times 35{,}32 = \text{cu ft}$
$m^2 \times 10764 = \text{sq ft}$

2.5.2 Planking tops for scaffolding

Scaffold quantity / [redacted] = m^3 planking tops

2.6 SCAFFOLDING LABOUR

Determine the number of scaffolding hours by calculating:
Erection + dismantling = [redacted] [Mhr/m^3] or m^2 x elevation factor (for average elevation)

(See "Equipment Scaffolding", page 72 - 73)

After that, determine the labour needed for scaffolding and the means of transport.

2. ESTIMATE OF WELDING ROD CONSUMPTION AND ADDITIONAL WELDING MATERIAL

1. PIPING

1.1 WELD DEPOSIT [kg/weld]

ø	Sch 10	Sch 20	Sch 30	Std	Sch 40	Sch 60	XS	Sch 80	Sch 120	Sch 160	XXS
2″	0,009			0,026	0,026		0,043	0,043		0,104	0,213
3″	0,011			0,057	0,057		0,085	0,085		0,255	0,375
4″	0,017			0,086	0,086		0,208	0,208	0,383	0,562	0,835
6″				0,303	0,303		0,558	0,558	0,821	1,215	1,58
8″		0,161	0,39	0,39	0,39	0,717	0,717	0,717	1,565	2,576	2,03
10″		0,186	0,493	0,45	0,45	0,83	0,83	1,215	2,345	3,674	3,27
12″		0,239	0,576	0,576	1,061	1,56	1,061	2,554	3,81	6,776	3,81
14″	0,263	0,393	0,625	0,635	1,17	1,719	1,17	3,0	5,19	8,77	
16″	0,3	0,449	0,726	0,726	1,34	2,935	1,338	3,783	5,92	11,59	
18″	0,337	0 505	1,501	0,807	1,5	3,28	1,5	5,4	9,58	17,0	
20″	0,376	0 907	1,67	0,907	1,22	4,042	1,67	9,743	12,52	19,61	
22″	0,413	0 992	1,84	0,998	1,412	5,2	1,84	10,72	15,94	24,56	
24″	0,45	1,089	2,255	1,089	3,42	7,2	2,0	12,67	21,42	31,33	
26″	0,73	2,172		1,18			2,172				
28″	1,27	2,336	3,43	1,27			2,336				
30″	1,36	2,506	3,674	1,36			2,504				
32″	1,459	2 671	3,92	1,45	4,563		2,671				
34″	1,542	2 84	4,164	1,54	4,844		2,84				
36″	1,633	3,003	4,409	1,633	6,554		3,003				

kg/weld x 2,2046 = lbs/weld

1.2 PIPING IN PLANTS

The most difficult job for installation of this t ype of piping is to estimate welding rod consumption with regard to the piping weight.

Since this estimate is not used for the welding rod procurement but f or calculation of price only, higher departures than the actual needs are allowed.

1.2.1 If the number of welds is known then they are calculated according to the T able 1.1 with a final increase of ÷ % (for smaller modifications, repairs, losses, etc.).

1.2.2 If the number of welds is not known and it cannot be deter mined within a reasonable time, then the calculation should be done as follows:

Welding rod weight = ÷ % piping weight or ÷ [kg/ton]
(Higher percentage is inversely proportionate to the pipe weight in relation to the total weight of piping).

1.2.3 Piping quantity per inchdiameter (ID)
Welding rod weight = [kg/ID]

1.3 PIPING BETWEEN PLANTS AND PIPING ON PIPERACKS

1.3.1 If the piping quantities are listed according to their diameters then the weld is assumed to come on average every 6 meters of the piping length. The number of joints estimated to be multiplied by the values from Table 1.1 and increased by %.

1.3.2 If only the total piping weight is known:

Welding rod weight = % of the piping weight or [kg/ton]

1.4 PIPING (C.S.) - TOWN NETWORKS

- The best way is to estimate the number of joints and to use the Table 1.1 for the quantity of welding rod, and to apply the increase of %.

1.5 PIPELINES

- For this type of pipelines the number of joints on the header line should alwa ys be calculated. The calculation will be done with the weights from Table 1.1 increased by %.

1.6 PIPE SUPPORTS

1.6.1 Support Fabrication

Welding rod weight = ÷ % support weight or ÷ [kg/ton]

1.6.2 Support Installation

Welding rod weight = ÷ % support weight or ÷ [kg/ton]

2. STEEL STRUCTURES

	Fabrication	Erection
- Heavy structure	%or [kg/ton]	%or [kg/ton]
- Medium-weight structure	%or [kg/ton]	%or [kg/ton]
- Light structure	%or [kg/ton]	%or [kg/ton]

3. CYLINDRICAL STORAGE TANKS

Welding rod weight = ÷ % storage tank weight

4. EQUIPMENT IN PETROCHEMICAL INDUSTRY

Welding rod weight= ÷ % equipment weight

kg/ton x 2,2046 = lbs/ton

3. ESTIMATE OF CONSUMPTION OF TECHNICAL GAS AND GRINDING PLATES

		P I P I N G						
		In plants	Piping between plants and town networks	Pipelines	Pipe supports	Erection of steel structures	Equipiment petrochemical plants	Cylindr storage tanks
Oxygen	[kg/ton]							
Acetylene	[kg/ton]							
Argon (2.*)	[kg/ton]							
Grinding & cutting plates	[pc/ton]							

1. The quantities of other technical gas such as hydrogen, nitrogen, and CO_2 are negligible and I leave it up to the estimator to estimate their quantities or not.

2.* The quantity of argon depends on the welding method and use of different types of materials. The above data of ÷ kg/t is taken into account when there is some % of stainless steel and when the root on carbon steel is welded by TIG process.
If the quantity of stainless steel is known, than the calculation is done by ÷ kg/ton.

3. Technical Gas Data:

- Oxygen 40 l bottle, 150 bar = 6 m^3 = kg
  50 l bottle, 200 bar = 10 m^3 = kg

- Acetylene 40 l bott le, 15 bar= 6,5 m^3 = kg
  50 l bottle, 15 bar= 8,1 m^3 = kg

- Argon 40 l bottle, 150 bar = 6,4 m^3 = kg
  40 l bottle, 200 bar = 8,8 m^3 = kg
  50 l bottle, 200 bar = 10 m^3 = kg

- CO_2 40 l bottle, 60 bar= 6m^3 = kg

- Propane small bottle (27,2 l) = kg (max.)
  large bottle (79 l) = kg (max.)

- Butane small bottle (27,2 l) = kg (max.)
  large bottle (79 l) = kg (max.)

- Nitrogen 40 l bott le, 150 bar = 6 m^3 = kg
  50 l bottle, 200 bar = 10 m^3 = kg

4. Calculating the quantities of nitrogen or air required for pressure testing

The quantity of nitrogen or air is calculated by the following formula:

$$m = \frac{(p_2 - p_1) \times V \times 100.000}{T \times R} \text{ [kg]}$$

kg x 2,2046 = lbs

where:
- m = gas weight [kg]
- p_2 = final pressure [bar]
- p_1 = starting pressure [bar]
- V = system volume (to be tested) [m^3]
- T = temperature [K] (= °C + 273,15)
- R = gas constant [J/kgK]
- R_{air} = 287 ,0 [J/kgK]
- $R_{nitrogen}$ = 296,7 [J/kgK]

EXAMPLE: A 50 m^3 system should be tested to 10 bars. The pressure can be increased to 6 bars by air compressor. Outside temperature is c. 17 °C (290 °K). How much nitrogen and how many bottles do we need?

$$m = \frac{(10 - 6) \times 50 \times 100.000}{290 \times 296,7} = 232,44 \text{ kg}$$

the number of 40 l bottles, 150 bar : 232,44 / 7,55 = 31 bottles

4. ESTIMATE OF ELECTRICITY CONSUMPTION

The client often requires an estimate of electricity consumption it has to provide and the estimator must fulfil that request. If he finds that the contractor will use its own power sources from generators and generating sets, then he will estimate only the part of electricity consumption from the power grid. The total power requirements should be calculated on the basis of an estimate of the welding rods needed.

1. Piping

1.1 In plants	[kWh/kg] welding rod quantity
1.2 Piping between plants	[kWh/kg] welding rod quantity
1.3 Pipelines	[kWh/kg] welding rod quantity

2. Erection of steel structure	[kWh/kg] welding rod quantity
3. Equipment erection	[kWh/kg] welding rod quantity
4. Storage tank erection	[kWh/kg] welding rod quantity

kWh/kg x 0,4536 = kWh/lbs

5. ESTIMATE OF CONSUMPTION OF FUEL AND LUBRICANT

The manufacturer provides the technical data on fuel consumed by the machinery. Such data can be used only if the motor operates continuously under the load foreseen by the manufacturer. However, this is not the case in practice because there are stoppages in operation and the machinery operates under different loads. Below is an estimate of the percentage use of the machinery and the means of transport that the estimator can evaluate at his discretion.

1. FUEL CONSUMPTION

Machinery/Means	Fuel	Consumption	% use	l/day	l/month
1. Power Plant 125 kW	Diesel oil	l/h	%		
2. Diesel Welding Set 400 A	Diesel oil	l/h	÷ %	÷	÷
3. Diesel Compressor 7 m^3/min	Diesel oil	l/h	÷ %	÷	÷
4.Pipe Laying Machine	Diesel oil	l/h	%		
5. Tractor 53 kW (72 HP)	Diesel oil	l/h	%		
6. Tractor 88 kW (120 HP)	Diesel oil	l/h	%		
7. Fork Lift 3 t	Diesel oil	l/h	%		
8. Fork Lift 5 t	Diesel oil	l/h	%		
9. Tank truck	Diesel oil	l/100 km	÷ km/day	÷	÷
10. Truck 7,5 t	Diesel oil	l/100 km	÷ km/day	÷	÷
11. Truck 10 t	Diesel oil	l/100 km	÷ km/day	÷	÷
12. Trailer truck	Diesel oil	l/100 km	- km/day	÷	÷
13. Pickup	Gasoline	l/100 km	÷ km/day	÷	÷
14. Passenger van 8 + 1 seat	Gasoline	l/100 km	÷ km/day	÷	÷
15. Passenger car	Gasoline	l/100 km	÷ km/day	÷	÷

NOTE: The fuel consumption for other machinery (cranes, shovels, dredgers and the like) is not calculated because the price of fuel and lubricants is already contained in the rental fee.

2. LUBRICANT CONSUMPTION

Since oil and grease are also used for other purposes at the job site and not only for the machinery, the price of lubricants can be calculated as % of the fuel prices.

l x 0,2642 = U.S. gal

6. TOOL COST ESTIMATE AT THE JOB SITE

It is not either possible or necessary to make detailed lists of small tools to be used at the job site. In practice, only 50% of tools is purchased for a specific job and c. 50% of tools is used from the previous job sites. It can also be taken into account that c. 60 ÷ 70 % of tools will be left in good condition and reused (or sold).
For that reason, the cost of tools should be calculated in the following way:

Type of job
1. Piping.....[US$/h] in 2002
1.1 in plants.....
1.2 piping between plants.....
1.3 pipeline.....
2. Erection of steel structure.....
3. Equipment erection.....
4. Storage tank erection *.....
*There are more tools and devices used at erection of storage tanks that are not included in this table.

7. ESTIMATE OF SAFETY AT WORK MEANS

The means for safety at work are:

1. For personal protection2. F or protection at different jobs

- protective clothing	- protection masks	- welding aprons
- protective shoes	- welding masks	- welding gloves
- protective gloves	- glass	- welding clothes
- protective goggles	- goggles	- belts
- raincoats or overalls	- rubber boots	- waistcoats
- protective helmets	- etc.	

The estimator should evaluate the yearly costs per each labourer for maximum number of labourers.
Costs per labourer/year:

- climate similar to Croatia - US$
- climate colder than in Croatia - US$
- climate warmer than in Croatia - US$

8. ESTIMATE OF ERECTION TIME

When the erection time is not mentioned in the call for tenders, the estimator should estimate it. In the magazine "3 R" of April 1985, there is a formula for calculating the time required for erection of piping:

$$D = t_m^{0,3}$$

where D = erection time in weeks (50 hour week)
t_m = hours requir ed acc. to the calculation

My opinion is that this formula should be used to calculate the erection time only for the works up to 10.000 hours . For the works above 10.000 hours the erection time should be increased by c. 20% in the following way:

$$D = t_m^{0,3} \times$$

The table below contains the erection time in weeks (a 50 hour week) for a range from 1.000 to 1.000.000 hours of work.

Total Manhours	Erection time	
	Weeks	Months
1.000		
1.500		
2.500		
4.000		
6.500		
10.000		
15.000		
25.000		
40.000		
65.000		
100.000		
150.000		
250.000		
400.000		
650.000		
1.000.000		

9. SELECTION OF HOISTING MACHINERY (CRANES, FORK LIFTS, ETC.)

When determining manhour rates, the costs of hoisting equipment have a significant impact. It is therefore very important to make a careful and realistic estimate of the type of crane, number of cranes and the time of use of the crane, forklift and the like. It is not a problem to determine the type of individual hoisting machine, the time and the power required for hoisting a given piece of equipment but this job is much more difficult when it has to be done for the entire project. During all the years of my service, I never found any trace of that issue. Talking to colleagues of mine I heard different opinions and methods for making estimates. Some make estimates based on weight and they consider that a crane should lift between 150 and 300 kg/hour. Others take into account the number of labourers and say that one crane should be sufficient for serving 6 to 20 labourers. There are no tables for any of these methods. I thought something should be done about it so I tried to describe the way I did it in my calculations and estimates hoping that younger colleagues would elaborate this better in future.

When selecting the cranes care should be taken of the crane type because of very different rental costs. As for the operating costs, the cranes can be grouped from the cheapest to the most expensive.

TYPE CAP OF CRANE	CAPACITY								
	10 t	20 t	30 t	45 t	60 t	80 t	100 t	150 t	>150 t
BUILDING CRANES TOWER	4	4	5	5	—	—	—	—	—
PORTAL CRANES	1	1	1	1	1	—	—	—	—
MOBILE CRANE PROJECTION	3	3	2	3	3	2	2 ÷ 3	2	3
MOBILE CRANE trussed boom	2	2	4	4	4	3	2 ÷ 3	3	2
CATERPILLAR trussed boom	—	—	3	2	2	1	1	1	1

(They are grouped according to "Montage Gerätebuch", Issue 1985)

The most suitable trucks for up to 2-ton cargo are those with a hydraulic jack. Forklifts are very suitable for the cargoes from 2 to 8 tons.

To make an optimum selection of the cranes, it is important to fully familiarize with the project for which a calculation is made. The estimator should devise a concept of the erection method and possible erection technique as well as probable work organization. Before selecting the cranes, an average number of production labourers should be determined.

9.1 SELECTION OF THE LARGEST CRANE

Any erection project should be firstly identified the heaviest equipment and cargoes. Thereupon, the crane type and capacity are selected (or a combination of two cranes) thus identifying the largest and the most expensive crane. Care should be taken of the place of erection, elevation, possible access to the crane, access roads, rental possibilities, lifting technology, working time, etc.

The time for using the largest crane should be estimated by lifting the heaviest pieces of equipment (above tons if possible). In this case the next largest crane that will stay longer at the job site could be of smaller capacity (c. ÷ tons) and as a result thereof its monthly rental fee would be lower as well.

9.2 PIPING IN PLANTS

9.2.1 PREFABRICATION

The use of a crane is not important during the piping prefabrication. The use of one forklift of ÷ tons could be considered. From time to time, a smaller crane of to tons and HIAB truck could be used of which for prefabrication and for erection.

Twenty five labourers should be allocated to one piece of lifting equipment.

9.2.2 ERECTION

At piping erection, the larger the piping diameter the greater need for a crane. The cranes of larger capacity are required for larger outreach and height otherwise relatively smaller cranes could satisfy the requirements.

Twenty labourers per crane.

One truck with HIAB for ÷ labourers but only its .

Crane capacity to be determined as follows:

 % to t
 % to t
 % to t

9.2.3 PREFABRICATION AND ERECTION

For technical calculations, both prefabrication and erection are considered together. This type of calculation applies when there are not enough data or time to make a calculation, which is the most often case.

The means for hoisting should be determined in the following way:

- forklift 3 ÷ 5 t labourers per forklift
- truck with "HIAB" labourers per truck
- mobile crane labourers per crane of which
  - % - to t capacity
  - % - to t "
  - % - to t "

9.3 PIPING BETWEEN PLANTS

Lower capacity cranes will mostly satisfy the requirements for erection of this kind of piping. The scope of prefabrication is smaller, and therefore the calculation should be made as follows:

- truck with "HIAB" labourers per truck
- car crane labourers per crane of which
  - %-to t capacity
  - %- to t capacity

9.4 PIPELINES

At pipeline laying special cranes are used for unloading, loading, pipe stringing and performance of special points. Generally, car crane renting should be avoided whenever a continuous work is not possible. This refers particularly to the works on right-of-ways where the pipe layers and trucks with HIAB are used. Consequently, estimator can rely on crane for some activities only, which should be elaborated separately. All manuals for calculations of pipeline erection provide for special elaboration of each activity from pipe transport to pressure testing.

9.5 ERECTION OF STEEL STRUCTURES

Erection of steel structures is not actually possible without cranes. The costs of machinery account for the largest portion of the man-hour rate. The use of truss boom cranes and particularly tower building cranes is possible. The truss boom cranes are suitable because of lower rental costs and the tower building cranes for their very high efficiency and outreach.

The cranes should be calculated as follows:

- heavy steel structure ÷ labourers per crane
- medium-weight steel structure ÷ labourers per crane
- light steel structure ÷ labourers per crane

9.6 INSTALLATION OF PROCESS EQUIPMENT

At installation of process equipment firstly we should identify the largest crane (item 9.1.) and then decrease the total number of hours and the average number of labourers for the foreseen heavy equipment respectively.

The cranes for other equipment to be calculated as follows:

1 crane on ÷ labourers of which:
- %- for the second largest cr ane (c. ÷ t)
- %- for t cr anes
- %- for t cr anes

9.7 ERECTION OF CYLINDRICAL STORAGE TANKS

Special attention should be paid to the selection of a crane for erection of cylindrical storage tanks. This type of crane cannot be selected according to the number of labourers but according to the type, diameter, height, arrangement, and the number of storage tanks, etc.

A mobile crane with a truss boom of maximum -ton capacity is the most adequate when we install one storage tank. If there is a group or a series of storage tanks, we should consider using tower cranes of sufficient reach and on tracks, if possible and necessary.

If there are several storage tanks, we shall need another smaller crane for loading and unloading the plates and getting them closer. Generally, an adequate erection concept is required and each activity should be supported with an adequate crane.

On average, ÷ labourers should be allocated per one crane.

When erecting spherical storage tanks (balls) the same measures for crane selection apply.

10. UNLOADING, HANDLING AND SORTING OF THE MATERIAL

Almost all manhour rates include the erection activities from withdrawal of the material and equipment from the investor's store to the completion according to detail design. We shall often come across a request in tendering documents to offer unloading, handling and sorting of the material. (The quantity/volume ratio see page 213.)

10.1	MATERIAL FOR PIPING			
	- Unloading:			[Mhr/ton]
	- Handling and sorting:			
	Piping in plants	60 %	and above	[Mhr/ton]
	Piping between plants	60 %	and above	[Mhr/ton]
	Pipeline	60 %	and above	[Mhr/ton]
10.2	STEEL STRUCTURE			
	- Unloading:			[Mhr/ton]
	- Handling and sorting:			
	Heavy structure	(above 60 kg/m)		[Mhr/ton]
	Medium-weight structure	(31 ÷ 60 kg/m)		[Mhr/ton]
	Light structure	(to 30 kg/m)		[Mhr/ton]
10.3	PROCESS EQUIPMENT			
	- Unloading:			
	Bulk material (packings)			[Mhr/ton]
	Equipment	to 5 [t/pc]		[Mhr/ton]
	Equipment	5 ÷ 10[t/pc]		[Mhr/ton]
	Equipment	above 10 [t/pc]		[Mhr/ton]
	- Handling and sorting:			
	Bulk material (packings)			[Mhr/ton]
	Equipment	to 5 [t/pc]		[Mhr/ton]
	Equipment	5 ÷ 10[t/pc]		[Mhr/ton]
	Equipment - Sorting near foundationabov	e 10 [t/pc]		[Mhr/ton]
	Equipment - Sorting at store	above 10 [t/pc]		[Mhr/ton]
10.4	CYLINDRICAL STORAGE TANKS			
	- Unloading:			[Mhr/ton]
	- Handling and sorting:	near foundation		[Mhr/ton]
	- Handling and sorting:	in store		[Mhr/ton]

11. TEMPORARY WORKS, SPACE REQUIRED AND CONNECTIONS AT THE SITE

	OPTION 1	OPTION 2
1. TEMPORARY WORKS	OFFICE BUILDINGS & CANOPIES [m^2]	CONTAINERS [pc.]
1.1 MANAGEMENT SITE OFFICES	Average number of staff x ____ =.....m^2	1 container for ____ office workers
1.2 SITE OFFICES	No of foremen x ____ =.....m^2	1 container for ____ foremen
1.3 LOCKER ROOM	Maximum number of workers x 0,3 = ...m^2	1 container for ____ direct labourers
1.4 TOOLS STORE	Average number o workers x ____ =.....m^2	1 office + 1 cargo container for ____ direct labourers
1.5 ENCLOSED STORE	Average number of workers x ____ =.....m^2	1 cargo container for ____ direct labourers
1.6 SANITARY FACILITIES	1 container for ____ workers	
1.7 MESS ROOMS	Average number of workers x ____ =.....m^2	1 container for ____ workers
1.8 PREFABRICATION HANGAR	Average number of workers x ____ =.....m^2	
1.9 MAINTENANCE WORKSHOP	____ m^2 for each maintenance worker (electrician, mechanic)	1 container for ____ maintenance workers (electrician, mechanic)
1.10 CANOPIES FOR TECHNICAL GAS	Average number of workers x ____ =.....m^2	
1.11 ENCLOSED STORE FOR CAPITAL EQUIPMENT	On principle, the investor is responsible for providing such store) The store area to be determined as follows: Total weight of erection equipment (piping + steel structure + equipment) in tons x ____ m^2/ton	

2. AREA NEEDED	METHOD OF CALCULATING THE AREA IN [m^2]
2.1 OUTDOOR AREA FOR THE JOB SITE MANAGEMENT SITE OFFICE BUILDINGS	A sum of net area from each item: 1.1 + 1.3 + 1.6 + 1.7 increased ___ times
2.2 OUTDOOR AREA FOR WORKSHOPS AND BULKING OF EQUIPMENT	A sum of net area from each item: 1.4 + 1.8 + 1.9 + 1.10 increased ___ times
2.3 OUTDOOR AREA FOR SORTING PREFABRICATED ITEMS	Double the area of item ___
2.4 OUTDOOR STORE AT THE JOB SITE	Generally, every job site has a few plants. On each plant the contractor needs a fenced area for storing the capital equipment and consumables. The area for that purpose would be: ___ ÷ ___ m^2
2.5 OUTDOOR AREA FOR PARKING MACHINERY	Job sites to: ___ direct labourers ___ m^2 ___ direct labourers ___ m^2 above: ___ direct labourers ___ m^2
2.6 OUTDOOR REA FOR STORING CAPITAL EQUIPMENT	1,5 m^2 per ton of capital equipment

3. CONNECTIONS NEEDED	METHOD OF ESTIMATE
3.1 POWER CONNECTIONS	1 main connection: maximum number of welding rectifiers x ___ kVA Connections at the plants: at least ___ off ___ kVA power connection for each plant
3.2 PROCESS WATER CONNECTIONS	If there is a hydrant network: determine the quantity required. If there is no hydrant network: determine the quantity needed, storing in water storage tanks or supply by tank lorries.
3.3 DRINKING WATER CONNECTIONS	Quantity: ___ ÷ ___ litre/man/day Connections: every sanitary facility ___ ÷ ___
3.4 SEWERAGE CONNECTIONS	___ connection for each sanitary facility
3.5 TELEPHONE LINES	___ telephone lines at least

12. ESTIMATE OF THE NUMBER OF WELDS AND RADIOGRAMS FOR PIPING

Data on the number of welds are not often given in the call for tenders. Of course, this cannot be calculated without complete detail documentation. To make a technical calculation an estimator needs the data on the number of welds. If he wants to estimate the quantity of radiograms, he should know only the quantity of butt welds and if he wants to calculate precisely the quantity of welding rods and electric power, he should know the quantity of all types of welds. The estimate of the quantity of other types of welds such as nozzle welds and socket welds, the estimator can base on the butt welds quantity.

The quantity of butt welds can be estimated in several ways:

1. ESTIMATE OF BUTT WELDS BASED ON A LIST OF MATERIAL
   - PIPES, FITTINGS AND FLANGES

1.1. Piping in plants

- Pipe		weld/24 m
- Bends		weld/piece
- Tees		weld/piece
- Pipe caps		weld/piece
- Reducers		weld/piece
- Weldolets		weld/piece
- Neck flanges		weld/piece

1.2. Piping between plants piperacks and sleeper ways

- pipes to 3"	1	weld/ m
- pipes 4"- 6"	1	weld/ m
- pipes 8"-10"	1	weld/ m
- pipes 12"-14"	1	weld/ m
- pipes above 16"	1	weld/ m

- fittings and flanges: as for the piping in a plant (item 1.1.)

1.3. Combined piping (in plants and between the plants)

If there are no separate lists of materials for piping in the plant and for the piping between the plants, but we know there are both of them, the quantity of butt welds should be calculated as follows:

Pipes: calculate 1 weld to the lengths that are twice the length of the piping between the plants (item 1.2.). If the estimator can estimate proportional relations of two kinds of piping then he can make the calculation with other piping lengths as well.

- Fittings and flanges: As for the piping in plants (item 1.1)

2. ESTIMATE OF BUTT WELDS BASED ON A LIST OF MATERIAL
   - FITTINGS AND FLANGES ONLY

- Bends		weld/piece
- Tees		weld/piece
- Pipe caps		weld/piece
- Reducers		weld/piece
- Weldolets		weld/piece
- Neck flanges		weld/piece

The pipe-to-pipe welds are not considered because it is deemed that the quantity of such welds is deemed to be similar to the number of fitting-to-fitting welds.

This is the most widely used method for estimating the butt welds. I know from experience that this method is not a reliable one. If applied, it should be calculated in the following way:

- Piping in the plant: decrease the weld number by c. ÷ %
- Combined piping (in plants and between the plants): increase by c. ÷ %

3. ESTIMATE OF BUTT WELDS BASED ON THE PIPING LENGTHS

- MEASURED ON THE LINE AXIS

Diameter	1 butt weld/length [m]			
	Plant	Line	Combined	Town network
to 1 1/2"	*			
2"				
3"				
4"				
6"				
8"				
10"				
12"				
14"				
16"				
18"				
20"				
24"				
28"				
30"				
32"				
above 34"				

*In the case of to 11/2" piping, the fittings are mostly with the socket welds and therefore there are fewer butt welds.

m x 3,2281 = ft

4. ESTIMATE OF TOTAL WELDS (ALL TYPES)

This estimate can be used for calculation of welding rod consumption (item 2, page 112) and the power consumption costs (item 4, page 115).

Once the quantity of butt welds is calculated by any of previously described methods, the quantity of other welds can be calculated as well. This is done in such a way that the quantity of butt welds is increased by the following percentage:

- Piping in plants: ÷ %
- Piping between plants (piperacks and sleeper ways): ÷ %
- Combined piping: ÷ %
- Town networks: ÷ %

5. ESTIMATE OF RADIOGRAMS ON THE PIPING

The number of radiograms depends on the media, working pressure, working temperature, materials and special safety regulations. Generally, the estimator i.e. the process engineer determines the percentage of radiographic tests and include them in the piping line list. The percentages are different and can vary from 5% to almost 200%. (200% is in special cases when highly alloyed materials are used and the radiography is required before and after thermal treatment of the weld).

The following table is mostly used to determine the percentage of radiographic inspection.

TYPE OF STEEL	WORKING TEMPERATURE [°C]	Class 3		Class 2		Class 1	
		125 lb	150 lb	150 lb	300 lb	600 lb	⩾900 lb
CARBON - STEEL	20 ÷ 100	0 %	5 %	5 %	5 %	10%	100%
	101 ÷ 300	0 %	5 %	5 %	10%	30%	100%
	301 ÷ 400			10%	30%	30%	100%
C - STEEL LOW TEMPERATURE	- 45 ÷ - 21	——		5 %	10%	30%	100%
Mo - STEEL	- 20 ÷ 300	——		5 %	10%	30%	100%
	301 ÷ 450	——		10%	30%	100%	100%
CrMo - STEEL	- 20 ÷ 450	——		30%	30%	100%	100%
	451 ÷ 580	——		30%	100%	100%	100%
AUSTENITE STEEL (STAINLESS) -	- 99 ÷ 500	0 %	5 %	10%	30%	30%	100%
	501 ÷ 700	——		30%	30%	100%	100%
	196 ÷ - 100	——		30%	100%	100%	100%

Source: Code for Pressure Piping, Petroleum Refinery Section ANSI B31.3, Chapter VI

If we know the quantity of butt welds according to their diameter, material and class, then it will not be difficult to determine the number of welds to be tested. In most cases, however this information is not available and cannot be determined within the scheduled time. Because of that the estimator will monitor and develop statistics of the projects executed, he will ask for professional opinions of more experienced colleagues, and decide for an average percentage of radiography. When the estimator determines the percentage, he will calculate the number of radiograms according to the table below.

The number of radiograms and lengths of films according to API - STD.1104
("ZIT" - Institute for Welding, Testing and Technology - Zagreb)

Outside diameter		Number of radiograms	Film size
to 1 1/2"	(40 mm)	(ellipse)	10 X 12 cm
2"- 3 1/2"	(50-90 mm)	(ellipse)	10 X 16 cm
4" - 5"	(100-140 mm)		10 X 16 cm
6" - 7"	(150-190 mm)		10 X 24 cm
8" - 11"	(200-280 mm)		10 X 32 cm
12" - 13"	(300-360 mm)		10 X 40 cm
14" - 18"	(360-450 mm)		10 X 48 cm
20" (500 mm) and more: Number of films depends on diameter			10 X 48 cm
20" - 22"	(500-550 mm)		10 X 48 cm
24" - 28"	(600-700 mm)		10 X 48 cm
30" - 34"	(750-850 mm)		10 X 48 cm
36" - 40"	(900-1000 mm)		10 X 48 cm
42" - 46"	(1050-1150 mm)		10 X 48 cm
48" - 52"	(1200-1300 mm)		10 X 48 cm

When the quantity of radiograms is calculated, it should be increased by:

%	for weld repair
%	for incorrectly issued orders
%	or undefined needs and samples
%	for certifying processes and welders
%	**Total**

X. PIPING ABOVE GROUND

ESTIMATE POINTS OF BASIC ERECTION ITEMS

The estimate points of basic erection items are used for payment and monitoring of the works progress during erection of piping above ground. One estimate point equals one man hour (Mhr) at Productivity Efficiency Percentage (PEP) of 90% for unit quantity and for carbon steel.

The tables contain the values of erection items for dimension used most frequently in erection of piping. Any intermediate value can be calculated for the needs of an estimate or derived by interpolation.

Under the section EXPLANATION TO THE ERECTION ITEMS, the estimate points and the related activities are given for items 1.1 to 7.5.

The same section (items 8.1 ÷ 8.8) provides the method for calculating the activities derived from basic items.

The influence of different material is calculated by the material multiplier factors (factors for different kind of materials) (f) for items 2.2 to 3.8. By way of an exception, the factors (k) on the page 142 are used for items 1.1 to 1.3.

The section FORMS FOR CALCULATION OF MAN-HOUR RATES contains the erection items on which basis the time required for installation of each piping element is calculated. These forms have been used to calculate all man hour rates in the section.

EXPLANATION TO THE ERECTION ITEMS
(Basic Erection/Installation Items)

1.0 PIPING

1.1 PIPE INSTALLATION IN PLANTS

Withdrawal from the store, hauling to the erection site, alignment, temporary supporting and fastening are calculated on the basis of listed lengths excluding fittings, flanges, valves, etc.

Compensation: per linear meter of pipe

1.2 PIPE INSTALLATION ON PIPERACKS

The work is identical to PIPE INSTALLATION IN PLANTS.

Compensation: per linear meter of pipe

1.3 PIPE DISMANTLING

Dismantling works including necessary reconditioning work for parts to be reutilized, hauling to a storing place and unloading.

Compensation: per linear meter of pipe

2.0 FITTING

Valid only for welded fittings. Not valid for parts such as weldolets, sockolets, nipolets, einforced nozzles, half couplings, etc. Similarly, not valid for fittings with a socket joint and thread. If reductions are made on the pipe directly, it is considered as a fitting with two welds). The rate for reducer is taken for the biggerr diameter. Fittings are considered only those MITRE BENDS that are delivered ready for installation, which means they are listed in the bill of material as a finished part. Mitre bends contracted for field fabrication will be considered as pipes from which the bends must be made. If this is the case, the calculation should be made according to the table (pipe laying, welds, pressure test).

2.1 ADJUSTMENT OF FITTINGS WITH ONE CONNECTION END

Adjustment of fittings with one connection end, a pipe cap or a flange for instance, is included in welding so it is not compensated separately.

2.2 ADJUSTMENT OF FITTINGS WITH TWO CONNECTION ENDS

It includes measurement, angularity and ovality check of ends, if necessary correction work matching by cutting, bevelling, cleaning and fitting. This refers to pipe elbow, bend, reduction and mitre elbow (bends made from pipe segments).

Compensation: per item

2.3 ADJUSTMENT OF FITTINGS WITH THREE CONNECTION ENDS

It includes a check of dimension, check o f ovality of ends, check of one angularity , if necessary correction works (possible cutting as well) matching by cutting, bevelling, cleaning and fitting. It refers to T-piece and Y-piece.

Compensation: per item

3.0 PIPE WELD MAKE-ON AND WELDING

It includes all necessar y preheating and possible protection from inclement weather . Heat treatment in terms of stress relieving not included.

3.1 BUTT WELD MAKE-ON AND WELDING

Measurement, placing and sortin g of pies, marking of cut ting line, cut ting, deburring, remo val of paint, cleaning, alignment, adjustment, temporary supporting, tack welding, check, and welding, It includes also possible stress relieving at flanges.

Compensation: per weld

- Weld joint at installation of prefabricated sections:

  2 x Item 3.1

3.2 FILLET (SOCKET) WELD - MAKE-ON AND WELDING

It includes the same activities as for BUT T WELD . It applies to the items with socket weld end connection (sock et weld flanges, sock et couplings, etc.). Following fix ed wall thicknesses ar e valid f or different outside diameters of pipes:

to DN < 80 or < 3":

- all materials

PN to 160 bar	or 3000 lbs :	t = 3.9 mm
PN to 320 bar	or 6000 lbs :	t = 6.4 mm

Above DN to 80 or 3" :

- Cr Ni Ti - steels

		(Schedule)
PN to 100 bar	or to 600 lbs :	t = Sch10S
PN abov e 100 bar	or abov e 600 lbs :	t = STD

- all other material

PN to 100 bar	or to 600 lbs :	t = STD
PN above 100 bar	or above 600 lbs :	t = XS

Slip-on flanges according to ANSI B16.5 and plain flanges according to DIN 2655 and 2656 will be compensated twice.
Compensation: per weld

3.3 MITRE WELD MAKE-ON AND WELDING

As for BUTT JOINT
Compensation: per weld

3.4 NOZZLE WELD MAKE-ON AND WELDING

Header line measurement, marking of bore, cutting of bore, paint cleaning, matching up branch, tack-welding, levelling, alignment, welding. Nozzles without reinforcement are considered according to the outside diameter and the branch wall thickness. Nozzles with reinforcement are considered according to the larger outside diameter and larger wall thickness. This value is then added the value of the REINFORCEMENT PAD. The value for inclined nozzle joints is increased by 50%.
Compensation: per weld

3.5 WELDOLET, NIPOLET - INSTALLATION AND WELDING

Header line measurement, marking of bore, cutting of bore, grinding, removal of paint, matching-up weldolet, sockolet, etc., tack-welding, levelling and welding. For calculation of a joint with a branch connection, take the outside diameter and the wall thickness of the branch connection. With nipolets, sockolets and thredolets to DN 80 or 3", the following will be used instead of the connecting branch wall thickness:

PN to 3000 lbs :	t = 4.3 mm
PN to 6000 lbs :	t = 6.0 mm

Wall thickness as for SOCKET JOINT is valid above DN 80 or 3".
Compensation: per item

3.6 REINFORCEMENT PAD MAKE-ON AND WELDING

Fabrication of reinforcement pad according to to drawing: cutting out from the remaining pipe (pipe same as header line), edge working, drilling and threading of vent hole, matching-up, tack welding, welding closing of vent hole with mastic. Factor for this item is considered for outside diameter of branch connecting and the wall thickness of reinforcement pad. For a complete reinforced branch connection with pad NOZZLE JOINT should be added.
Compensation: per item

3.7 SEAL RING MAKE-ON AND WELDING (ACC. TO DIN 2695)

Cleaning of seal ring faces, positioning of seal ring, tack welding and welding. After connecting two flanges and tightening: tack welding and welding of interfacing seal rings. Because of welding, the bolts will be removed and retightened.

Compensation: per item (without flanged joint)
Basis for the number of factors is a standardized wall thickness of 4 mm. They are printed in the tables only once per diameter of pipe. The flange joint is compensated subject to the nominal pressure.

3.8 INSERT RING (FOR ALUMINIUM ONLY)

Cutting of insert rings to necessary length and matching up, welding of longitudinal seams and tack welding to the pipe.
Compensation: per item

Basis for the number of factors is a standardized wall thickness of 4 mm. They are printed in the tables only once per diameter of pipe.

3.9 WELD CUTTING FOR MODIFICATIONS

Measurement, marking of cutting line, removal of paint, machine cutting, removal of remaining welding seam, and preparation of the cutting face for joining.
Compensation: per item - cutting.

This item is considered once only for each weld to be cut. It is used only when the piping parts are reutilized.

3.10MA TERIAL MULTIPLIER FACTORS (f)

All values in the tables are valid for carbon steel. For different kind of materials a special table is given under the section MATERIAL MULTIPLIER FACTORS (3.10). It is calculated by multiplying the carbon steel value by the factor (f) from the table 3.10. Valid for items 3.1 to 3.8 only.

4.0 FLANGED AND THREADED JOINTS, BENDING OF PIPES

4.1 ÷ 4.3 FLANGED JOINT

Cleaning of flange faces, preparation and positioning of gasket, lubrication of bolts with graphite grease, fitting and tightening of bolts.
Compensation: per joint

This item includes all flanged joints regardless of the flange type. Values for higher pressure are obtained by multiplying item 4.3 value by the following factors:

Item 4.3 x 1,3 for PN 160	ANSI 900
Item 4.3 x 1,7 for PN 250	ANSI 1500
Item 4.3 x 2,2 for PN 320 ÷ 400	ANSI 2500

4.4 INSTALLATION OF MEASURING ORIFICES, BLANKING PLATES, etc.

Make-on as for FLANGED JOINT. Additional installation of all intermediate rings and plates such as blanking plates, measuring rings, safety rings, measuring orifices and the like. This item is only an addition to the flanged joint values.

4.5 PIPE BENDING

1. (For pipes to DN 50 or 2")

Pipe measurement, bending according to the standards.

2. (For pipes above DN 50 or 2" to DN 200 or 8")

These pipes are mostly bent for fire protection of cylindrical storage tanks.

Values are compensated per [m of bending angle].

4.6 PREPARATION OF THREADED ENDS

Pipe handling, placement, measurement, marking the spooling length, cutting, threading, thr ead and cut deburring.
Compensation: per item

4.7 THREADED CONNECTION MAKE-ON

Thread cleaning, preparation of thread according to specification, screwing in, and tightening.
Compensation: per joint

This item will also be compensated for dismantling of threaded connection (unions with gasket, etc.).

4.8 DISASSEMBLING Item 4.1 ÷ 4.4 and 4.7

Joint disconnection, dismantling, tr ansport of dismantled material to the advised storing place and unloading.
Compensation: per item

5.0 VALVES

5.1 VALVE INSTALLATION (WITH AND WITHOUT HAND DRIVE)

Valves, gate v alves, cocks, f aucets, non-return v alves, dampers, str ainers, level indicators, lev el controllers, floats, etc. Checking, blowing ou t, remo val of possible f oreign objects, check open/close operations, supporting, fastening of hand wheel or installation of hand wheelsor handles.
Compensation: per item

5.2 VALVE INSTALLATION WITH ACTUATORS (SOLENOID, AIR)

A valve with an actuat or means all pneumatic-, mot or or manual gear oper ated valves for open-close oper ations. Activities are the same as f or the V ALVES. This item is compensated only f or complete valves including actuator.
Compensation: per item

5.3 BUTTERFLY VALVE INSTALLATION WITH ACTUATOR

As for VALVE WITH ACTUATOR
Compensation: per item
For this position, only one flanged joint will be compensated.

5.4 BUTTERFLY VALVE INSTALLATION

As for VALVE.
Compensation: per item
Same as under BUTTERFLY VALVE WITH ACTUATOR.

5.5 CONTROL VALVE INSTALLATION

As for VALVE.
Additional: special protection and dismantling for pressure tests
Compensation: per item

5.6 SAFETY VALVE INSTALLATION

As for VALVE.
Additional: dismantling for calibration and reassembling. For safety valves, it will be compensated according to the nominal diameter of the pressure side (inlet).
Compensation: per item

5.7 HYDRANT INSTALLATION

As for VALVE.
Compensation: per item

5.8 SPINDLE EXTENSION

According to the dimensions it refers to the extensions between 1 and 3 meters.
Compensation: per item

5.9 DISMANTLING OF VALVES

The scope of works includes: dismantling, cleaning by blowing or purging, transport and unloading at an intermediate storage place. Disassembling of connections will be compensated as for DISASSEMBLY OF PIPE CONNECTIONS.
Compensation: per item

6.0 PRESSURE TESTING

6.1 PRESSURE TEST

Pressure test with water and water mixtures, air, inert gas, or steam. It includes the make-on of provisional connections for filling and draining, installation of blanking plates, removal of items exempted from pressure test, filling and venting of system, pressure increase to specified level. Pressure and leak test to be applied to all welds, flange and threaded joints - following the regulation. In case of pneumatic or gas test all connections are to be leak tested with a foaming agent. Carrying out the inspection of tests following the regulations, draining of system, removal of blanking plates, installation of parts, which were removed prior to pressure test and installation of flange unions with specified gaskets, bolts and nuts have to be tightened. Unlock spring hangers and spring supports. Remove temporary piping test components.
Compensation: per meter of pipe

6.2 SERVICE TEST

Service test is a leak test with air or gas at a low pressure setting. It is done when not performed with the pressure test and when required by the specification.
Compensation: per meter of pipe

7.0 MISCELLANEOUS

7.1 SUPPORTS - FABRICATION AND WELDING

Fabrication, matching up, welding. Fabricated from the remaining pipes.
Compensation: per item

7.2 SUPPORT INSTALLATION (WITHOUT FABRICATION)

Installation of supplied supports fabricated by other contractors, bolting, placing the insulating parts, complete welding and possible adjustment. Removal of temporary supports included as well.

The values are the manhour rates that is the man hours per kg respectively.

7.3 INSTALLATION OF SPRING HANGERS AND SUSPENSIONS

The installation is the same as for the SUPPORT INSTALLATION. In addition adjustment of prestressing.

7.4 GRINDING OF EXCESS MATERIAL ON WELDING ROOTS

Careful grinding of excess material on welding roots of specified welds, removing grinding dust. This is particularly used with rubber-lined piping and with installation of measuring flanges.
Compensation: per weld

7.5 INSTRUMENT CONNECTION - DRILLING

Drilling, deburring of instrument connection in pipe according to the given bore in flange, removal of drilling chips.
Compensation: per drilled hole

8.0 ACTIVITIES DERIVED FROM BASIC ITEMS

8.1 PIPES

In the following items, only the lengths of straight run pipes included in the bill of quantities are compensated (cutting lengths as listed).
Fittings, flanges and the like will not be compensated.

8.1.1 PIPE HANDLING AND CUTTING IN PREFABRICATION

Make-on: Prefabrication as for Item 1.1. Transport to a spools storing place.

Compensation: [redacted] x number of points Item 1.1 = [hours per meter of pipe]

It is compensated only if the installation is not done by the prefabrication labour.

8.1.2 INSTALLATION OF PREFABRICATED SPOOLS

Make-on: Installation as for Item 1.1. Transport from the spools storing place to the place of installation.

Compensation:

Ø 2″ ÷ 5″	[redacted] x no of points Item 1.1	=	[hours per linear meter of pipe]
Ø 6″ ÷ 10″	[redacted] x no of points Item 1.1	=	[hours per linear meter of pipe]
Ø 12″ ÷ 14″	[redacted] x no of points Item 1.1	=	[hours per linear meter of pipe]
Ø above 16″	[redacted] x no of points Item 1.1	=	[hours per linear meter of pipe]

Valves and pipe supports will be compensated separately.
It will be compensated only if another company does the prefabrication.

- Alternative: Activity 8.2.4

8.1.3 SPATIAL SHIFTING OF PIPES

Make-on: Spatial shifting of already installed piping, dismantling and installation of holders, installation of additional steel packers.

Compensation: [redacted] x no of points Item 1.1 (1.2)

8.1.4 MAKE-ON OF OUTSIDE PIPE FOR A DOUBLE-WALL PIPING (JACKETED PIPING)

Make-on: Cutting, placement, positioning the outside pipe with double-wall piping (jacketed piping).

Compensation: x no of points Item1.1 (1.2)

It is compensated only if the installation is not done by the prefabrication labour.

8.1.5 MAKE-ON AND INSTALLATION OF LINE PIPING DN 20/25 ON JACKETED PIPING

Make-on: As for Item 1.1

Compensation: x no of points Item 1.1 (1.2) for union fittings between the jacketed pipes

x no of points Item 1.1 (1.2) for union fittings on valves and fittings

8.2 MISCELLANEOUS FITTINGS

8.2.1 HALF COUPLINGS

The connecting seam between a half coupling and a header pipe is a fillet weld. To allow for the additional work as drilling the hole etc. a butt weld according to Item 3.1 will be compensated. The following points for nominal diameter of half-coupling or adequate outside diameter of connecting pipe (not the header pipe) and wall thickness are used:

PN to 3000 lbs :	t = 10,6 mm
PN to 6000 lbs :	t = 13,8 mm

NOTE: The wall thicknesses considered for compensation are fictitious. There are no points for these thicknesses. Therefore, the points for the closest thickness are taken and divided with that thickness and multiplied by fictitious thickness of 10.6 mm or 13.8 mm dependent on the half-coupling category. The result is the points for a joint between the half coupling and the header pipe. Item 3.2 is followed for compensation of next socket joint of pipe.

Compensation: Points per item

8.2.2 WELD COMPENSATOR

Make-on: Measurement, positioning, supporting of weld compensators

Compensation: x no of points Item 2.2

8.2.3 WELD METER RUNS

Make-on: Measurement, placement positioning and supporting of weld meter runs

Compensation: x no of points Item 2.2

8.2.4 PREFABRICATED OF SPOOLS FOR WELDING

Make-on: Finding of prefabricated piping sections, transport, measurement, placement, positioning, supporting, and fastening

Compensation: x no of points Item 2.2 [Mhr/spool]

Valves and pipe supports are compensated separate.

It is compensated only if another company does the prefabrication.

- Alternative: Activity 8.1.2

8.2.5 MEASURING ORIFICES - MEASURING FLANGES

This item includes the operations for performance of a flanged measuring orifice, which is assembled at the site from individual parts excluding the measuring orifice plates and the meter runs delivered as an assembly. Weld both flanges according to the existing specification of the measuring orifice and grind the excess material on the welding roots. Drill holes for instrument connection for slip-on flanges and remove drilling chips, weld outgoing instrument connections and close off (watertight welding) the flange hole not used, make-on of flange joint by installing a measuring orifice.
(Battery limits of the works marked on drawing)

Compensation of instrument connection assembly:

x Item 4.1 (4.2 or 4.3) + Item 4.4

In addition the points for the following to be included:

Grinding of excess material on the welding root along the flange seam according to the nominal diameter of the flange.

x Item 7.4

Grinding and removal of drilling chips on the measuring line connection according to the nominal diameter of flange.

x Item 7.5

8.3 WELDING

8.3.1 TACK WELDING ON VALVE SIMULATORS

Make-on: as Item 3.1
Compensation: x no of points Item 3.1

8.3.2 LONGITUDINAL WELDS ON PIPE HALF SHELLS

Make-on: As Item 3.1
Compensation: x no of points Item 3.1 for both longitudinal welds

8.3.3 THERMOMETER BRANCH (TI)

Welding of a thermometer branch to a pipe DN 150 and above is compensated instead of a nozzle joint x socket joint of corresponding Item 3.2 (s = 6,4 mm).

Compensation: Points per item

8.3.4 PREFABRICATED WELDS AT INSTALLATION OF PREFABRICATED SECTIONS (SPOOLS)

Performance: As Item 3.1
Compensation: x no of points Item 3.1

8.4 FLANGED JOINTS

8.4.1 REPLACEMENT OF BOLTS

Performance: Take out of bolts, preparing them f or reutilization, bolt greasing, placing, and tightening.
Compensation: x no of points of corresponding Item 4 .1, 4.2 or 4 .3

8.5 VALVES

8.5.1 ROTATING THE VALVE INSTALLED

Make-on: Positioning, supporting, fastening

Compensation: x no of points Item 5.1, 5.2, 5.3, 5.4, 5.5, 5.6 or 5.7

8.5.2 EXPANSION JOINTS WITH FLANGED ENDS

Make-on: As Item 5.1

Compensation: x no of points Item 5.1

8.6 WALL PASS FOR PIPES

Make-on: Fabrication and installation of wall passes. Use of larger diameter pipes or sheet metal bending, wall breaking, setting the pass in position and fastening.
Compensation: x no of points Item 3.1 for corresponding diameter of he header line

8.7 MISCELLANEOUS

8.7.1 FABRICATION AND INSTALLATION OF PIPE HOLDERS, HANGERS AND SUPPORTS (to 100 kg per item)

Make-on: as Item 7.2 inclusive of fabrication according to the Client's drawings.
Compensation: x no of points Item 7.2 if the Client supplies the material

x no of points Item 7.2 if the Client supplies the material

8.7.2 DISMANTLING OF PIPE HOLDERS, HANGERS AND SUPPORTS

Performance: Dismantling holders and return the usable parts to the store.
Compensation: x no of points of corresponding Pos 7.2

8.7.3 HOLE DRILLING IN CONCRETE

Performance: Drilling a hole and inserting a screw anchor
Compensation: x points for holes to 10 mm

x points for holes 12 ÷ 16 mm

x points for holes above 16 mm

8.8 EXTRAS

8.8.1 CHANGE IN BILL OF QUANTITIES BEFORE THE CLIENT'S APPROVAL FOR FABRICATION

Compensation: The change in bill of quantities is compensated by points per piping item.

8.8.2 CHANGE IN ISOMETRY PRIOR TO THE CLIENT'S APPROVAL FOR FABRICATION

Compensation: The change in isometry is compensated by points per pipe item

8.8.3 HAND DRAFTING OF ISOMETRY ACCORDING TO THE CLIENT'S INSTRUCTION

Hand drafting (sketches) of isometry including a bill of quantities is calculated with points per sketch and bill.

8.8.4 INSTALLATION OF MISSING MATERIAL

Make-on: Subsequent installation of the piping parts in already prefabricated and installed piping.

Compensation: Subsequent installation of the piping parts is compensated by x number of points of corresponding installation item and the installation and/or welding item.

8.8.5 PIPING MODIFICATION

Make-on: Modification works on already installed piping at the Client's request. As-built documentation of the modifications made in isometry and bill of items.

Compensation:

OPTION I: Modification on finished and installed piping is paid according to the calculation x number of points of that item. For handling only the straight run pipes are considered.

OPTION II: Calculation according to the table "Man hours for piping modification at site," Page 48

8.8.6 SAND BLASTING HANDLING, PRIMER COAT ON PIPING, AND PIPE SUPPORTS

Performance: Designation of prefabricated sections and pipe supports on the protected side.
Preparation of piping for sandblasting and application of primer. Protection of sealing surfaces and bevelled welding edges against damage and protection against ingress of sand into the piping.

Transport of piping to the sandblasting and painting site.
Co-ordination and work with sandblasting/painting company.

Compensation: Sandblasting handling and corrosion primer is compensated at [Mhr/ton] of prefabricated material.

8.8.7 UNDERGROUND PIPING

This refers to the piping laid in an excavated trench in the plant but it is not valid for pipelines. They are calculated as the piping above ground with a % increase. A precondition is that the pipes are already wrapped in which case there is no need to calculate separately the wrapping of joints separately.
If the pipes are not prewrapped, the insulation shall be calculated separately.

8.8.8 FACTORS FOR CALCULATION OF MAN HOURS FOR PREFABRICATION AND INSTALLATION OF PIPING

The estimate points for basic erection items and the rates derived for the piping elements will give the total values for prefabrication and for installation. Sometimes the rates are requested to be given separate for prefabrication and separate for installation, which is done in the following way:

1. PIPES (Item 1.1; 1.2)

Pipe handling is one installation item, which is performed both in prefabrication and in installation. That is why the estimate points and the rates have to be divided.

Prefabrication: (%) factor
Installation: (%) factor

2. FITTINGS (Item 2.2; 2.3)

Prefabrication: factor
Installation: factor

3. JOINTS - WELDING (Item 3.1 3.9)

Prefabrication: factor
Installation: factor

4. FLANGES AND OTHER (Item 4.1 4.7)

Prefabrication: factor
Installation: factor

5. VALVES INSTALLATION (Item 5.1 5.8)

Prefabrication: factor (exception)
Installation: factor

6. TESTS (Item 6.1; 6.3)

Prefabrication: factor
Installation: factor

7. MISCELLANEOUS

- (Item 7.1)
Prefabrication: factor
Installation: factor

- (Item 7.2; 7.3)
Prefabrication: no
Installation: factor

- (Item 7.4; 7.5)
Prefabrication: factor
Installation: factor

8. **OPTION**: According to the unit rates per each component, a division to prefabrication and installation, page 49.

TABLE Item. 3.10 (pages 147 ÷ 202)
MULTIPLIER FACTORS FOR DIFFERENT KIND OF MATERIALS FOR ITEMS 3.1 TO 3.8 (f)

Group of materials (GM)	
Carbon steel (CS)	
Chrom-molybden alloy steel (CR)	÷
Copper alloy (CU)	
Low temp. alloy steel (N), (N1), (TT)	÷
Stainless steel (CN)	
High temp. alloy steel (W), (W1), (W2), (W3)	÷
Nickel alloy (NI)	
Aluminium alloy (AL)	

(f)	GM	DIN - MATERIAL	WS - No	ASTM - material
CARBON STEEL				
	CS	St 35	1,0308	A53
		St 35,8	1,0305	A106 Gr. A, A234 Gr. WPA
		St 37-2 RSt 37-2	1,0112 1,0038	A53 Gr. A A135
		RRoSt 37 -2	1,0174	A283 Gr. B, C (killed) A285 Gr. B (killed)
		St 42-2	1,0132	A53 Gr. B
		RSt 42-2	1,0042	A135 Gr. B A181 Gr. Class 60
		St 45	1,0408	A53
		St 45.8	1,0405	A106 Gr. B, A234 Gr. WPB
		C 21 C 22 C 22.8	1,0432 1,0402 1,046	A105 A181, A234 A105, A181 Gr. II
		H II	1,0425	A671 Gr. CA55, CB60 CB65
STAINLESS STEEL				
	CN	X2 CrNi 19 11 (X2 CrNi 18 9)	1,4306	A182 Gr. F304L, A269 Gr. TP304L, A312 Gr. TP304L, A403 Gr.WP304L
		X2 CrNiMo 17 13 2 (X2 CrNiMo 18 10)	1,4404	A269 Gr. TP316L, A312 Gr. TP316L,
		X2 CrNiMo 18 14 3 (X2 CrNiMo 18 12)	1,4435	AISI Gr. 316L
		X2 CrNiMoN 17 13	1,491	AISI Gr. 316N
		X5 CrNi 18 10 (X5 CrNi 18 9)	1,4301	A182 Gr. F304, A269 Gr. TP304, A312 Gr.TP304, A358 Gr. 304, A403 Gr.WP304, WP304H

(f)	GM	DIN - MATERIAL	WS - No	ASTM - material
STAINLESS STEEL				
	CN	X5 CrNiMo 17 12 2 (X5 NiCrMo 18 10)	1,4401	A182 Gr. F316, A269 Gr. TP316, A312 Gr. TP316, A358 Gr. 316
		X2 CrNiMoN 22 5 X5 NiCrMoCuNb 20 18	1,4462 1,4505	A789 ? ?
		X6 CrNiNb 18 10 (X10 CrNiNb 18 9)	1,455	A182 Gr. F347, A269 Gr TP347, A358 Gr. 347, A358 Gr. 348, A403 Gr. WP347, A403 Gr. WP348
		X6 CrNiTi 18 10 X10 CrNiNb 18 9)	1,4541	A182 Gr. F321, A269 Gr. TP321, A312 Gr. TP321, A358 Gr. 321, A403 Gr. WP321, A403 Gr. WP321H
		X6 CrNiMoTi 17 12 2 (X10 CrNiMoTi 18 10)	1,4571	A312 Gr. TP316H, A403 Gr. WP316
		X10 CrNiTi 18 10	1,6903	AISI Gr. 321

(f)	GM	DIN - MATERIAL	WS - No	ASTM - material
Cr - Mo ALLOY STEEL				
	CR	X20 CrMoV 12 1	1,4922	?
		All customary steels with head alloying element "Cr", referes to key for steels.		

(f)	GM	DIN - MATERIAL	WS - No	ASTM - material
COPPER ALLOY				
	CU	CUNI 10 FE	2,0872	B466 - C70600
		CUNI 30 FE	2,0882	SB111 - C71500 B466 - C71500

(f)	GM	DIN - MATERIAL	WS - No	ASTM - material
LOW TEMPERATURE STEEL				
	N	10 Ni 14	1,5637	A333 Gr. 3, A334 Gr. 3, A350 Gr. LF3, A420 Gr. WPL3
		14 Ni 6	1,5622	A333 Gr. 9, A334 Gr. 9, A403 Gr. TP316H
	N1	X8 Ni 9	1,5622	A333 Gr. 8, A334 Gr. 8, A420 GR. WPL8
	TT	TTSt E29	1,0488	A333 Gr. 6, A334 Gr. 6, A420 Gr. WPL6
		TTStE35 TTSt 35V TTSt 41V TTSt E41	1,0356 1,0356 1,0437 1,0437	A333 Gr. 1, A334 Gr. 1 A350 Gr. LF1 A350 Gr. LF2 A420
		TTSt E36	1,0566	A671 GR. CD70, A691 Gr. CMSH70

(f)	GM	DIN - MATERIAL	WS - No	ASTM - material
HIGH TEMPERATURE ALLOY STEEL				
	W	10 CrMo 11	1,7276	A182 Gr. F5A
		10 CrMo 9 10	1,738	A182 Gr. F22 A234 Gr. WP22 A335 Gr. P21 A335 Gr. P22
		12 CrMo 19 5	1,7362	A182 Gr. F5, A234 Gr. WP5, A335 Gr. P5b, A335 Gr. P5d
		15 NiCuMoNb 5 17 CrMoNb 10 20CrMoV 13 5 X8 CrNiNb 16 13 X8 CrNiMoNb 16 16 X8 CrNiMoVNb 16 13	1,6368 1,7766 1,7779 1,4961 1,4981 1,4988	? ? ? ? ? ?
		X12 CrMo 9 1	1,7386	A182 Gr. F9 A213 Gr. T9
	W1	15 Mo 3	1,5415	A182 Gr. F1, A335 Gr. WP1, A335 Gr. P1, A691 Gr. CM65
	W2	13 CrMo 44	1,7335	A182 Gr. F12 A234 Gr. WP11, A335 Gr. P2, A335 Gr. P11 A335 Gr. P12, A691 Gr. 1CR
	W3	14 MoV 6 3	1,7715	?

	GM	DIN - MATERIAL	WS - No	ASTM - material
ALUMINIUM ALLOY				
	AL	ALMG 3 ALMG 4.5 Mn ALMG 5	3,3535	Alloy 5052-0 Alloy 5083-0 ?

	GM	DIN - MATERIAL	WS - No	ASTM - material
NICKEL ALLOY				
	NI	X10 NiCrAlTi 32 20 NiCr 21 Mo NiCr 22 Mo 9 Nb	1,4876 2,4858 2,4856	Incoloy 800 Incoloy 825 Incoloy 625

FORMS FOR CALCULATION OF MANHOUR RATES
(Derived Erection Items)

Productivity Efficiency Percentage (PEP) = 80%

1.0 PIPES

1.1 IN PLANT

Item 1.1 x k + Item 3.1/24 x k + Item 6.1 + Item 6.3 = [Mhr/m]

1.2 ON PIPE RACK

Item 1.2 x k + Item 3.1/6 x k + Item 6.1 + Item 6.3 = [Mhr/m]

1.3 STEAM TRACING
(Item 1.1 x k + Item 3.1/6 x k + Item 6.1 + Item 6.3) x 2,5 = [Mhr/m]

MATERIALS	(k)
carbon steel	1,00
stainless steel	1,10
alloy steel	1,10
prewrapped (undergr. install.)	1,15
galvanised	0,70
aluminium	0,85

Mhr/m x 0,3048 = Mhr/ft

2.0 FITTINGS

2.1 PIPE BENDS ELBOWS 45° and 90°

(Item 2.2 + Item 3.1 x 1,8) x f = [Mhr/ea]

2.2 PIPE CAPS

(Item 2.2/2 + Item 3.1) x f = [Mhr/ea]

2.3 TEE - PIECES

2.3.1STRAIGHT TEES

(Item 2.3 + Item 3.1 x 2,75) x f = [Mhr/ea]

2.3.2REDUCED TEES

(Item 2.3 + Item 3.1 x 2,5) x f = [Mhr/ea]

2.4 REDUCERS CONCENTRIC AND ECCENTRIC

(Item 2.2 + Item 3.1 for Ø + Item 3.1 for ø) x f = [Mhr/ea]

MATERIALS (f)

See section **FACTORS FOR DIFFERENT MATERIALS FOR ITEMS 3.1 TO 3.8 (f) page 139 ÷ 141**

3.0 FLANGES

3.1 NECK

(Item 3.1 + Item 4.1 ÷ 4.3) x f = [Mhr/ea]

3.2 SLIP-ON, PLAINE

(Item 3.2 x 2 + Item 4.1 ÷ 4.3) x f = [Mhr/ea]

3.3 SOCKET

(Item 3.2 + Item 4.1 ÷ 4.3) x f= [Mhr/ea]

3.4 FREE FLANGE + CIRCUMFERENCE (Bördel)

(Item 3.1 + Item 4.1 ÷ 4.3) x 0,9 x f = [Mhr/ea]

3.5 BLIND FLANGE

Item 4.1 ÷ 4.3 x 1,3 = [Mhr/ea]

3.6 MEASURING ORIFICE ASSEMBLY

(Item 4.1 ÷ 4.3 + Item 3.1 + Item 7.4 + Item 7.5 + Item 4.4) x 2 x f = [Mhr/joint]

3.7 FLANGES - handling only

20% of [Mhr/ea]

4.0 SMALL FITTINGS

4.1 WELDOLETS, SOCKOLETS, NIPOLETS

Item 2.2 + Item 3.5 x f = [Mhr/ea]

4.2 HALF COUPLINGS FOR WELDING

Item 2.2 + Item 3.5 x 0,85 x f = [Mhr/ea]

4.3 FITTINGS WITH SOCKET ENDS

4.3.1 WITH ONE END

(Item 2.2 x 0,5 + Item 3.2 (for "XS")) x f = [Mhr/ea]

4.3.2 WITH TWO ENDS

(Item 2.2 + Item 3.2 (for "XS") x 2) x f = [Mhr/ea]

4.3.3 WITH THREE ENDS

(Item 2.3 + Item 3.2 (for "XS") x 3) x f = [Mhr/ea]

4.4 FITTINGS WITH THREADED ENDS

4.4.1 WITH ONE END

Item 4.6 x 0,5 + Item 4.7 = [Mhr/ea]

4.4.2 WITH TWO ENDS

Item 4.6 + Item 4.7 x 2 = [Mhr/ea]

4.4.3 WITH THREE ENDS

Item 4.6 x 1,5 + Item 4.7 x 3 = [Mhr/ea]

5.0 VALVES

5.1 WITH FLANGED ENDS

5.1.1VAL VES, GATES, COCKS, NON-RETURN VALVES, DAMPERS, FILTERS, STRAINER

Item 5.1 x VF = [Mhr/ea]

5.1.2CONTROL V ALVES

Item 5.5 x VF = [Mhr/ea]

5.1.3SAFET Y VALVES

Item 5.6 x VF = [Mhr/ea]

5.1.4HYDRANTS

Item 5.7 x VF = [Mhr/ea]

VF - Factor for installation of flanged v alves		ND to 100 ø to 4"	ND 125 ÷ 200 ø5" ÷ 8"	ND above 200 ø above 10"
NP 6 ÷ 16	150 #	1,00	1,00	1,00
NP 25 ÷ 40	300 #	1,21	1,15	1,10
NP 64	400 #	1,41	1,29	1,16
NP 100	600 #	1,44	1,32	1,21
NP 160	900 #	1,66	1,45	1,33
NP 250	1500 #	1,90	1,60	1,46
NP 320	2500 #	2,19	1,76	1,61

5.2 WITH WELDING ENDS BUTT WELD

5.2.1NP 6 ÷ 100, LB 150 ÷ 600

(Item 3.1 (for "STD") x 2 + Item 5.1) x f = [Mhr/ea]

5.2.2NP 160 , LB 900

(Item 3.1 (for "XS") x 2 + Item 5.1) x f = [Mhr/ea]

5.2.3NP 250 ÷ 320 , LB 1500 ÷ 2500

(Item 3.1 (for "XXS") x 2 + Item 5.1) x f = [Mhr/ea]

5.3 WITH WELDING ENDS SOCKET WELD

(Item 3.2 (for "XS") x 2 + Item 5.1) x f = [Mhr/ea]

5.4 WITH THREADED ENDS

Item 4.7 x 2 + Item 5.1 = [Mhr/ea]

6.0 PIPE EXPANSION JOINTS AND FLOWRATE METERS

6.1 WITH FLANGED ENDS

(Item 4.1 ÷ 4.3 x 2 + Item 5.1) x 1.5 = [Mhr/ea]

6.2 WITH WELDING ENDS

(Item 2.2 + Item 3.1) x 2,3 x f = [Mhr/ea]

7.0 OTHER INSTALLATION WORKS

7.1 MAKE-ON OF BRANCH CONNECTION

7.1.190° BRANCH C ONNECTION

Item 3.4 x f = [Mhr/joint]

7.1.290° BRANCH C ONNECTION WITH REINFORCEMENT

(Item 3.4 + Item 3.6) x f = [Mhr/joint]

7.1.3INCLINED BRANCH C ONNECTION

Item 3.4 x 2 x f= [Mhr/joint]

7.1.4INCLINED BRANCH C ONNECTION WITH REINFORCEMENT

(Item 3.4 + Item 3.6) x 2 x f = [Mhr/joint]

7.1.5EXTRUDED BRANCH C ONNECTION

Item 3.4 x 2,5 x f = [Mhr/joint]

7.2 PIPE BENDING

7.2.1BENDING BY A PIPE BENDING MACHINE

Item 4.5 = [Mhr/bending]

7.2.2BENDING ALON G RADIUS (r - above 2000 mm)

Item 4.5 = [Mhr/m]

m = length of pipe bent part

7.3 STRESS RELIEVE IN CONNECTION PIPING ON ROTARY EQUIPMENT

Item 5.1 x 3 = [Mhr/ea]

7.4 FIELD FABRICATION OF CONCENTRIC AND ECCENTRIC REDUCERS

7.4.1CONCENTRIC REDUCER

Item 3.5 = [Mhr/ea]

7.4.2 ECCENTRIC REDUCER

Item 3.5 x 1,2 = [Mhr/ea]

7.5 FABRICATION OF MITRE BENDS FROM PIPES

Item 3.3 x 1,2 = [Mhr/joint]

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	6 = 1/8"			8 = 1/4"			10 = 3/8"					
		Outer diameter ø [mm]	10,3			13,7			17,1					
		Wall thickness t = [mm]	1,2	1,7	2,4	1,7	2,2	3,0	1,7	2,0	2,3	2,6	2,9	3,2
		Schedule	10S	40 STD	80 XS	10S	40 STD	80 XS	5S		40 STD			80 XS
Item	Unit	Build-in Items || [kg/m]	0,27	0,36	0,47	0,50	0,63	0,79	0,65	0,75	0,84	0,93	1,02	1,10
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,56			0,57			0,57					
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	0,70			0,71			0,71					
4.3	each	" " " " NP100 bar, ANSI 600 lbs	0,78			0,79			0,80					
4.4	each	ORIFICE PLATE INSERTING	0,11			0,11			0,11					
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,19			0,19			0,20					
4.6	piece	PIPE THREADING	0,10			0,11			0,11					
4.7	each	MAKING ON THREADED CONNECTION	0,09			0,09			0,10					
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,10			0,13			0,16					
5.2	piece	VALVE WITH DRIVE - INSTALLING	0,14			0,18			0,22					
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,06			0,08			0,10					
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,02			0,03			0,03					
5.5	piece	CONTROL VALVE	0,39			0,51			0,64					
5.6	piece	SAFETY VALVE	0,44			0,58			0,72					
5.7	piece	HYDRANT	0,19			0,26			0,32					
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	0,56	0,78	1,00	0,56	0,78	1,00	0,56	0,78	1,00			
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,04			0,04			0,04					
6.2	m	SERVICE TEST	0,03			0,03			0,03					
7.1	piece	SUPPORT FABRICATION	0,26			0,26			0,26					
7.2	kg	SUPPORT INSTALLATION	0,21			0,21			0,21					
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,11			0,11			0,11					
7.5	piece	GAUGE CONNECTION DRILLING	0,10			0,11			0,11					

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	10 = 3/8"		15 = 1/2"									
		Outer diameter ø[mm]	17,1		21,3									
		Wall thickness t = [mm]	4,0	4,5	1,7	2,0	2,1	2,3	2,6	2,8	2,9	3,2	3,7	3,9
		Schedule	5S		10S			40 STD			80 XS			
Item	Unit	Build-in Items || [kg/m]	1,29	1,40	0,82	0,95	1,00	1,08	1,20	1,28	1,32	1,43	1,61	1,68
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,57		0,59									
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	0,71		0,74									
4.3	each	" " " " NP100 bar, ANSI 600 lbs	0,80		0,82									
4.4	each	ORIFICE PLATE INSERTING	0,11		0,12									
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,20		0,22									
4.6	piece	PIPE THREADING	0,11		0,12									
4.7	each	MAKING ON THREADED CONNECTION	0,10		0,10									
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,16		0,24									
5.2	piece	VALVE WITH DRIVE - INSTALLING	0,22		0,34									
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,10		0,14									
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,03		0,05									
5.5	piece	CONTROL VALVE	0,64		0,96									
5.6	piece	SAFETY VALVE	0,72		1,08									
5.7	piece	HYDRANT	0,32		0,48									
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m			0,56	0,78	1,00							
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,04		0,05									
6.2	m	SERVICE TEST	0,028		0,03									
7.1	piece	SUPPORT FABRICATION	0,26		0,26									
7.2	kg	SUPPORT INSTALLATION	0,21		0,20									
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,11		0,12									
7.5	piece	GAUGE CONNECTION DRILLING	0,11		0,12									

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	15 = 1/2"										20 = 3/4"	
		Outer diameter ø[mm]	21,3										26,7	
		Wall thickness t = [mm]	4,0	4,3	4,8	5,6	6,0	6,3	7,1	7,5	10,6	13,8	1,7	2,1
		Schedule	160					XXS			5S	10S		
Item	Unit	Build-in Items || [kg/m]	1,71	1,81	1,96	2,17	2,27	2,33	2,49	2,56	2,80		1,05	1,28
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,59										0,60	
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	0,74										0,75	
4.3	each	" " " " NP100 bar, ANSI 600 lbs	0,82										0,84	
4.4	each	ORIFICE PLATE INSERTING	0,12										0,12	
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,22										0,24	
4.6	piece	PIPE THREADING	0,12										0,13	
4.7	each	MAKING ON THREADED CONNECTION	0,10										0,11	
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,24										0,32	
5.2	piece	VALVE WITH DRIVE - INSTALLING	0,34										0,44	
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,14										0,19	
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,05										0,06	
5.5	piece	CONTROL VALVE	0,96										1,26	
5.6	piece	SAFETY VALVE	1,08										1,42	
5.7	piece	HYDRANT	0,48										0,63	
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m											0,55	0,77
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,05										0,05	
6.2	m	SERVICE TEST	0,03										0,03	
7.1	piece	SUPPORT FABRICATION	0,26										0,25	
7.2	kg	SUPPORT INSTALLATION	0,20										0,20	
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,12										0,12	
7.5	piece	GAUGE CONNECTION DRILLING	0,12										0,13	

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	20			= 3/4" 20								
		Outer diameter ø[mm]				26,7			26,9					
		Wall thickness t = [mm]	2,9	3,9	4,3	5,6	6,0	7,1	7,8	10,6	13,8	2,0	2,3	2,6
		Schedule	40 STD	80 XS		160			XXS					
Item	Unit	Build-in Items || [kg/m]	1,70	2,20	2,38	2,92	3,07	3,44	3,64	4,21	4,40	1,23	1,40	1,56
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,60									0,60		
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	0,75									0,75		
4.3	each	" " " " NP100 bar, ANSI 600 lbs	0,84									0,84		
4.4	each	ORIFICE PLATE INSERTING	0,12									0,12		
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,24									0,24		
4.6	piece	PIPE THREADING	0,13									0,13		
4.7	each	MAKING ON THREADED CONNECTION	0,11									0,11		
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,32									0,32		
5.2	piece	VALVE WITH DRIVE - INSTALLING	0,44									0,44		
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,19									0,19		
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,06									0,06		
5.5	piece	CONTROL VALVE	1,26									1,26		
5.6	piece	SAFETY VALVE	1,42									1,42		
5.7	piece	HYDRANT	0,63									0,63		
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	0,99									0,55	0,77	0,99
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,05									0,05		
6.2	m	SERVICE TEST	0,03									0,03		
7.1	piece	SUPPORT FABRICATION	0,25									0,25		
7.2	kg	SUPPORT INSTALLATION	0,20									0,20		
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,12									0,12		
7.5	piece	GAUGE CONNECTION DRILLING	0,13									0,13		

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	20				25 = 1"							
		Outer diameter ø[mm]	26,9				33,4							
		Wall thickness t = [mm]	2,9	3,6	4,5	6,3	1,7	2,8	3,4	3,9	4,3	4,5	6,0	6,4
		Schedule					5S	10S	40 STD			80 XS		160
Item	Unit	Build-in Items || [kg/m]	1,72	2,07	2,49	3,20	1,33	2,12	2,52	2,84	3,09	3,21	4,06	4,27
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,60				0,62							
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	0,75				0,78							
4.3	each	" " " " NP100 bar, ANSI 600 lbs	0,84				0,87							
4.4	each	ORIFICE PLATE INSERTING	0,12				0,13							
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,24				0,27							
4.6	piece	PIPE THREADING	0,13				0,15							
4.7	each	MAKING ON THREADED CONNECTION	0,11				0,13							
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,31				0,39							
5.2	piece	VALVE WITH DRIVE - INSTALLING	0,44				0,55							
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,19				0,24							
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,06				0,08							
5.5	piece	CONTROL VALVE	1,26				1,57							
5.6	piece	SAFETY VALVE	1,42				1,76							
5.7	piece	HYDRANT	0,63				0,78							
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m					0,55	0,77	0,98					
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,05				0,05							
6.2	m	SERVICE TEST	0,03				0,04							
7.1	piece	SUPPORT FABRICATION	0,25				0,25							
7.2	kg	SUPPORT INSTALLATION	0,20				0,20							
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,12				0,13							
7.5	piece	GAUGE CONNECTION DRILLING	0,13				0,15							

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	25 = 1"				25							
		Outer diameter ø[mm]	33,4				33,7							
		Wall thickness t = [mm]	7,1	9,1	10,6	13,8	2,0	2,3	2,6	3,2	4,0	5,0	5,6	6,3
		Schedule		XXS										
Item	Unit	Build-in Items || [kg/m]	4,61	5,46	5,97	6,68	1,57	1,78	2,00	2,41	2,93	3,54	3,89	4,26
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,62				0,62							
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	0,78				0,78							
4.3	each	" " " " NP100 bar, ANSI 600 lbs	0,87				0,87							
4.4	each	ORIFICE PLATE INSERTING	0,13				0,13							
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,27				0,27							
4.6	piece	PIPE THREADING	0,15				0,15							
4.7	each	MAKING ON THREADED CONNECTION	0,13				0,13							
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,39				0,39							
5.2	piece	VALVE WITH DRIVE - INSTALLING	0,55				0,55							
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,24				0,24							
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,08				0,08							
5.5	piece	CONTROL VALVE	1,57				1,57							
5.6	piece	SAFETY VALVE	1,76				1,76							
5.7	piece	HYDRANT	0,78				0,78							
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m					0,55	0,77	0,98					
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,05				0,05							
6.2	m	SERVICE TEST	0,04				0,04							
7.1	piece	SUPPORT FABRICATION	0,25				0,25							
7.2	kg	SUPPORT INSTALLATION	0,20				0,20							
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,13				0,13							
7.5	piece	GAUGE CONNECTION DRILLING	0,15				0,15							

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	25		32 = 1 1/4"									
		Outer diameter ø[mm]	33,7		42,2									
		Wall thickness t = [mm]	7,1		1,7	2,8	3,6	3,9	4,0	4,3	4,5	4,9	6,0	6,4
		Schedule			5S	1 0S	40 STD					80 XS		160
Item	Unit	Build-in Items || [kg/m]	4,66		1,70	2,72	3,43	3,69	3,77	4,02	4,19	4,51	5,36	5,66
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,62		0,66									
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	0,78		0,82									
4.3	each	" " " " NP100 bar, ANSI 600 lbs	0,87		0,92									
4.4	each	ORIFICE PLATE INSERTING	0,13		0,13									
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,27		0,32									
4.6	piece	PIPE THREADING	0,15		0,17									
4.7	each	MAKING ON THREADED CONNECTION	0,13		0,14									
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,39		0,50									
5.2	piece	VALVE WITH DRIVE - INSTALLING	0,55		0,70									
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,24		0,30									
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,08		0,10									
5.5	piece	CONTROL VALVE	1,57		1,99									
5.6	piece	SAFETY VALVE	1,76		2,24									
5.7	piece	HYDRANT	0,78		1,00									
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m			0,59	0,81	1,03							
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,05		0,06									
6.2	m	SERVICE TEST	0,04		0,04									
7.1	piece	SUPPORT FABRICATION	0,25		0,25									
7.2	kg	SUPPORT INSTALLATION	0,20		0,20									
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,13		0,13									
7.5	piece	GAUGE CONNECTION DRILLING	0,15											

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	32 = 1 1/4"				32							
		Outer diameter ø[mm]	42,2				42,4							
		Wall thickness t = [mm]	7,1	9,7	10,6	13,8	2,0	2,3	2,6	2,9	3,6	4,5	5,6	6,3
		Schedule			XXS									
Item	Unit	Build-in Items || [kg/m]	6,15	7,78	8,27	9,68	2,00	2,28	2,56	2,83	3,45	4,21	5,09	5,62
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,66				0,66							
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	0,82				0,82							
4.3	each	" " " " NP100 bar, ANSI 600 lbs	0,92				0,92							
4.4	each	ORIFICE PLATE INSERTING	0,13				0,13							
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,31				0,31							
4.6	piece	PIPE THREADING	0,17				0,17							
4.7	each	MAKING ON THREADED CONNECTION	0,14				0,14							
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,50				0,50							
5.2	piece	VALVE WITH DRIVE - INSTALLING	0,70				0,70							
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,30				0,30							
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,10				0,10							
5.5	piece	CONTROL VALVE	1,99				1,99							
5.6	piece	SAFETY VALVE	2,24				2,24							
5.7	piece	HYDRANT	1,00				1,00							
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m					0,59	0,81	1,03					
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,06				0,06							
6.2	m	SERVICE TEST	0,04											
7.1	piece	SUPPORT FABRICATION	0,25				0,25							
7.2	kg	SUPPORT INSTALLATION	0,20				0,20							
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,13				0,13							
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	40 = 1 1/2"										
		Outer diameter ø[mm]	48,3										
		Wall thickness t = [mm]	1,7	2,0	2,3	2,6	2,8	3,2	3,7	3,9	4,3	4,5	5,0	5,1
		Schedule	5S				10S		40 STD					80 XS
Item	Unit	Build-in Items || [kg/m]	1,96	2,29	2,61	2,93	3,15	3,56	4,07	4,28	4,67	4,87	5,35	5,44
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,69											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	0,86											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	0,96											
4.4	each	ORIFICE PLATE INSERTING	0,14											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,36											
4.6	piece	PIPE THREADING	0,20											
4.7	each	MAKING ON THREADED CONNECTION	0,17											
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,61											
5.2	piece	VALVE WITH DRIVE - INSTALLING	0,86											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,37											
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,12											
5.5	piece	CONTROL VALVE	2,45											
5.6	piece	SAFETY VALVE	2,76											
5.7	piece	HYDRANT	1,23											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	0,63	0,85	1,07									
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,07											
6.2	m	SERVICE TEST	0,05											
7.1	piece	SUPPORT FABRICATION	0,25											
7.2	kg	SUPPORT INSTALLATION	0,20											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,14											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	40 = 1 1/2"							50 = 2"				
		Outer diameter ø[mm]	48,3					60,3						
		Wall thickness t = [mm]	6,0	6,3	7,1	8,8	10,2	10,6	13,8	1,7	2,0	2,6	2,8	2,9
		Schedule			160		XXS			5S			10S	
Item	Unit	Build-in Items || [kg/m]	6,27	6,53	7,22	8,58	9,60	9,87	11,8	2,46	2,88	3,70	3,98	4,11
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,69							0,73				
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	0,86							0,91				
4.3	each	" " " " NP100 bar, ANSI 600 lbs	0,96							1,02				
4.4	each	ORIFICE PLATE INSERTING	0,14							0,15				
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,36							0,43				
4.6	piece	PIPE THREADING	0,20							0,24				
4.7	each	MAKING ON THREADED CONNECTION	0,17							0,20				
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,61							0,75				
5.2	piece	VALVE WITH DRIVE - INSTALLING	0,86							1,05				
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,37							0,45				
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,12							0,15				
5.5	piece	CONTROL VALVE	2,45							3,00				
5.6	piece	SAFETY VALVE	2,76							3,38				
5.7	piece	HYDRANT	1,23							1,50				
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m								0,68	0,90	1,12		
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,07							0,07				
6.2	m	SERVICE TEST	0,05							0,05				
7.1	piece	SUPPORT FABRICATION	0,25							0,24				
7.2	kg	SUPPORT INSTALLATION	0,20							0,19				
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,14							0,15				
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter[mm= inch]	50 = 2"											
		Outer diameter ø[mm]	60,3											
		Wall thickness t = [mm]	3,2	3,6	3,9	4,3	4,5	5,5	5,6	6,0	6,3	7,1	8,7	10,6
		Schedule			40 STD			80 XS					160	
Item	Unit	Build-in Items || [kg/m]	4,51	5,04	5,43	5,95	6,20	7,44						
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,73											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	0,91											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	1,02											
4.4	each	ORIFICE PLATE INSERTING	0,15											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,43											
4.6	piece	PIPE THREADING	0,24											
4.7	each	MAKING ON THREADED CONNECTION	0,20											
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,75											
5.2	piece	VALVE WITH DRIVE - INSTALLING	1,05											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,45											
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,15											
5.5	piece	CONTROL VALVE	3,00											
5.6	piece	SAFETY VALVE	3,38											
5.7	piece	HYDRANT	1,50											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m												
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,07											
6.2	m	SERVICE TEST	0,05											
7.1	piece	SUPPORT FABRICATION	0,24											
7.2	kg	SUPPORT INSTALLATION	0,19											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,15											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	50 = 2"		65 = 2 1/2"						65			
		Outer diameter ø[mm]	60,3		73,0						76,1			
		Wall thickness t = [mm]	11,1	13,8	2,1	3,1	5,2	7,0	9,5	14,0	2,0	2,3	2,9	3,2
		Schedule	5S	10S	40 STD	80 XS	160	XXS						
Item	Unit	Build-in Items || [kg/m]	13,5	15,8	3,68	5,35	8,71	11,4	14,9	20,4	3,66	4,19	5,24	5,76
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,73		0,80						0,80			
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	0,91		1,00						1,00			
4.3	each	" " " " NP100 bar, ANSI 600 lbs	1,02		1,12						1,12			
4.4	each	ORIFICE PLATE INSERTING	0,15		0,16						0,16			
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,43		0,51						0,51			
4.6	piece	PIPE THREADING	0,24		0,31						0,31			
4.7	each	MAKING ON THREADED CONNECTION	0,20		0,26						0,26			
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,75		0,96						0,96			
5.2	piece	VALVE WITH DRIVE - INSTALLING	1,05		1,34						1,34			
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,45		0,57						0,57			
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,15		0,19						0,19			
5.5	piece	CONTROL VALVE	3,00		3,82						3,82			
5.6	piece	SAFETY VALVE	3,38		4,30						4,30			
5.7	piece	HYDRANT	1,50		1,91						1,91			
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m			0,75	0,97	1,19				0,75	0,97	1,19	
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,07		0,08						0,08			
6.2	m	SERVICE TEST	0,05		0,06						0,06			
7.1	piece	SUPPORT FABRICATION	0,24		0,24						0,24			
7.2	kg	SUPPORT INSTALLATION	0,19		0,17						0,17			
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,15		0,16						0,16			
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	65								80 = 3"			
		Outer diameter ø[mm]	76,1								88,9			
		Wall thickness t = [mm]	3,5	3,6	4,0	5,0	5,6	6,3	7,1	8,0	2,0	2,1	2,3	2,5
		Schedule									5S			
Item	Unit	Build-in Items || [kg/m]	6,27	6,44	7,12	8,78	9,75	10,9	12,1	13,5	4,29	4,50	4,92	5,33
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,80								0,88			
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	1,00								1,10			
4.3	each	" " " " NP100 bar, ANSI 600 lbs	1,12								1,23			
4.4	each	ORIFICE PLATE INSERTING	0,16								0,18			
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,51								0,59			
4.6	piece	PIPE THREADING	0,31								0,40			
4.7	each	MAKING ON THREADED CONNECTION	0,26								0,34			
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	0,96								1,15			
5.2	piece	VALVE WITH DRIVE - INSTALLING	1,34								1,61			
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,57								0,69			
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,19								0,23			
5.5	piece	CONTROL VALVE	3,82								4,60			
5.6	piece	SAFETY VALVE	4,30								5,18			
5.7	piece	HYDRANT	1,91								2,30			
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m									0,83	1,04	1,26	
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,08								0,09			
6.2	m	SERVICE TEST	0,06								0,07			
7.1	piece	SUPPORT FABRICATION	0,24								0,23			
7.2	kg	SUPPORT INSTALLATION	0,17								0,16			
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,16								0,18			
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	80 = 3"											
		Outer diameter ø[mm]	88,9											
		Wall thickness t = [mm]	2,6	3,1	3,2	3,6	4,5	5,5	5,6	6,3	7,1	7,6	8,8	11,1
		Schedule		10S			40 STD				80 XS		160	
Item	Unit	Build-in Items || [kg/m]	5,54	6,57	6,77	7,58	9,38	11,3	11,5	12,8	14,3	15,3	17,4	21,3
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,88											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	1,10											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	1,23											
4.4	each	ORIFICE PLATE INSERTING	0,18											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,59											
4.6	piece	PIPE THREADING	0,40											
4.7	each	MAKING ON THREADED CONNECTION	0,34											
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	1,15											
5.2	piece	VALVE WITH DRIVE - INSTALLING	1,61											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,69											
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,23											
5.5	piece	CONTROL VALVE	4,60											
5.6	piece	SAFETY VALVE	5,18											
5.7	piece	HYDRANT	2,30											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m												
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,09											
6.2	m	SERVICE TEST	0,07											
7.1	piece	SUPPORT FABRICATION	0,23											
7.2	kg	SUPPORT INSTALLATION	0,16											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,18											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	80 = 3"		100 = 4"									
		Outer diameter ø[mm]	88,9		114,3									
		Wall thickness t = [mm]	15,2		2,0	2,1	2,6	2,9	3,1	3,6	4,0	5,0	5,6	6,0
		Schedule	XXS			5S			10S					40 STD
Item	Unit	Build-in Items || [kg/m]	27,7		5,55	5,82	7,17	7,98	8,51	9,84	10,9	13,5	15,0	16,0
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,88		0,96									
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	1,10		1,21									
4.3	each	" " " " NP100 bar, ANSI 600 lbs	1,23		1,35									
4.4	each	ORIFICE PLATE INSERTING	0,18		0,19									
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,59		0,74									
4.6	piece	PIPE THREADING	0,40		0,52									
4.7	each	MAKING ON THREADED CONNECTION	0,34		0,44									
4.8	multipl	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	1,15		1,38									
5.2	piece	VALVE WITH DRIVE - INSTALLING	1,61		1,93									
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,69		0,83									
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,23		0,28									
5.5	piece	CONTROL VALVE	4,60		5,50									
5.6	piece	SAFETY VALVE	5,18		6,19									
5.7	piece	HYDRANT	2,30		2,75									
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m			0,90	1,12	1,34							
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,09		0,11									
6.2	m	SERVICE TEST	0,07		0,07									
7.1	piece	SUPPORT FABRICATION	0,23											
7.2	kg	SUPPORT INSTALLATION	0,16		0,15									
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,18		0,19									
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	100 = 4"									125		
		Outer diameter ø[mm]	114,3									139,7		
		Wall thickness t = [mm]	6,3	7,1	8,0	8,6	10,0	11,1	12,5	13,5	17,1	2,6	2,9	3,2
		Schedule		80 XS		120		160	XXS					
Item	Unit	Build-in Items || [kg/m]	16,8	18,8	21,0	22,4	25,8	28,3	31,4	33,6	41,0	8,80	9,80	10,8
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	0,96									1,08		
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	1,21									1,35		
4.3	each	" " " " NP100 bar, ANSI 600 lbs	1,35									1,51		
4.4	each	ORIFICE PLATE INSERTING	0,19									0,22		
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,74									0,85		
4.6	piece	PIPE THREADING	0,52									0,69		
4.7	each	MAKING ON THREADED CONNECTION	0,44									0,59		
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	1,38									1,64		
5.2	piece	VALVE WITH DRIVE - INSTALLING	1,93									2,30		
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,83									0,99		
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,28									0,33		
5.5	piece	CONTROL VALVE	5,50									6,57		
5.6	piece	SAFETY VALVE	6,19									7,39		
5.7	piece	HYDRANT	2,75									3,28		
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m										0,99	1,21	1,43
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,11									0,12		
6.2	m	SERVICE TEST	0,07									0,08		
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,15									0,13		
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,19									0,22		
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	125											
		Outer diameter ø[mm]	139,7											
		Wall thickness t = [mm]	3,6	4,0	4,5	5,0	5,6	6,3	7,1	8,0	8,8	10,0	11,0	12,5
		Schedule												
Item	Unit	Build-in Items || [kg/m]	12,1	13,4	15,0	16,6	18,5	20,8	23,2	26,0	28,4	32,0	35,0	39,3
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	1,08											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	1,35											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	1,51											
4.4	each	ORIFICE PLATE INSERTING	0,22											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,85											
4.6	piece	PIPE THREADING	0,69											
4.7	each	MAKING ON THREADED CONNECTION	0,59											
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING												
5.2	piece	VALVE WITH DRIVE - INSTALLING	2,30											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,99											
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,33											
5.5	piece	CONTROL VALVE	6,57											
5.6	piece	SAFETY VALVE	7,39											
5.7	piece	HYDRANT	3,28											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m												
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,12											
6.2	m	SERVICE TEST	0,08											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,13											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,22											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	125		125 = 5"							150 = 6"		
		Outer diameter ø[mm]	139,7		141,3							168,3		
		Wall thickness t = [mm]	14,2		2,8	3,4	6,6	9,5	12,7	15,9	19,1	2,0	2,8	2,9
		Schedule			5S	10S	40 STD	80 XS	120	160	XXS		5S	
Item	Unit	Build-in Items || [kg/m]	44,0		9,58	11,6	22,0	30,9	40,3	49,2	57,6	8,21	11,4	11,8
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	1,08		1,08							1,19		
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	1,35		1,35							1,49		
4.3	each	" " " " NP100 bar, ANSI 600 lbs	1,51		1,51							1,67		
4.4	each	ORIFICE PLATE INSERTING			0,22		0,22							0,24
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,85		0,85							0,95		
4.6	piece	PIPE THREADING	0,69		0,69							0,88		
4.7	each	MAKING ON THREADED CONNECTION	0,59		0,59							0,75		
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	1,64		1,64							1,88		
5.2	piece	VALVE WITH DRIVE - INSTALLING	2,30		2,30							2,63		
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	0,99		0,99							1,13		
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,33		0,33							0,38		
5.5	piece	CONTROL VALVE	6,57		6,57							7,50		
5.6	piece	SAFETY VALVE	7,39		7,39							8,44		
5.7	piece	HYDRANT	3,28		3,28							3,75		
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m			0,99	1,21	1,43					1,07	1,29	1,51
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,12		0,12							0,13		
6.2	m	SERVICE TEST	0,08		0,08							0,09		
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,13		0,13							0,12		
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,22		0,22							0,24		
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	150 = 6"										
		Outer diameter ø[mm]	168,3										
		Wall thickness t = [mm]	3,4	3,6	4,0	4,5	5,0	5,6	6,3	7,1	8,0	8,8	10,0	11,0
		Schedule	10S							40 STD				80 XS
Item	Unit	Build-in Items || [kg/m]	13,8	14,6	16,2	18,2	20,2	22,5	25,2	28,3	31,7	34,7	39,1	42,7
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	1,19											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	1,49											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	1,67											
4.4	each	ORIFICE PLATE INSERTING	0,24											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,95											
4.6	piece	PIPE THREADING	0,88											
4.7	each	MAKING ON THREADED CONNECTION	0,75											
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	1,88											
5.2	piece	VALVE WITH DRIVE - INSTALLING	2,63											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	1,13											
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,38											
5.5	piece	CONTROL VALVE	7,50											
5.6	piece	SAFETY VALVE	8,44											
5.7	piece	HYDRANT	3,75											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m												
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,13											
6.2	m	SERVICE TEST	0,09											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,12											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,24											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	150 = 6"					200 = 8"						
		Outer diameter ø[mm]	168,3					219,1						
		Wall thickness t = [mm]	12,5	14,3	16,0	18,3	21,9	2,8	3,2	3,6	3,8	4,5	5,6	5,9
		Schedule	120		160	XXS	5S			10S				
Item	Unit	Build-in Items || [kg/m]	48,1	54,4	60,2	67,8	79,2	15,0	17,1	19,2	20,2	23,8	29,5	31,1
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	1,19					1,54						
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	1,49					1,92						
4.3	each	" " " " NP100 bar, ANSI 600 lbs	1,67					2,16						
4.4	each	ORIFICE PLATE INSERTING	0,24					0,31						
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	0,95					1,20						
4.6	piece	PIPE THREADING	0,88											
4.7	each	MAKING ON THREADED CONNECTION	0,75											
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	1,88					2,50						
5.2	piece	VALVE WITH DRIVE - INSTALLING	2,63					3,50						
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	1,13					1,50						
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,38					0,50						
5.5	piece	CONTROL VALVE	7,50					10,00						
5.6	piece	SAFETY VALVE	8,44					11,25						
5.7	piece	HYDRANT	3,75					5,00						
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m						1,33	1,55	1,77				
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,13					0,17						
6.2	m	SERVICE TEST	0,09					0,12						
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,12					0,12						
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,24					0,31						
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	200 = 8"											
		Outer diameter ø[mm]	219,1											
		Wall thickness t = [mm]	6,3	6,4	7,0	8,0	8,2	8,8	10,3	12,7	14,2	15,1	16,0	18,3
		Schedule		20	30		40 STD		60	80 XS		100		120
Item	Unit	Build-in Items || [kg/m]	33,1	33,6	36,7	41,7	42,7	45,7	53,1	64,7	71,8	76,1	80,2	90,7
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	1,54											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	1,92											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	2,16											
4.4	each	ORIFICE PLATE INSERTING	0,31											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	1,20											
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	2,50											
5.2	piece	VALVE WITH DRIVE - INSTALLING	3,50											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	1,50											
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,50											
5.5	piece	CONTROL VALVE	10,00											
5.6	piece	SAFETY VALVE	11,25											
5.7	piece	HYDRANT	5,00											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m												
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,17											
6.2	m	SERVICE TEST	0,12											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,12											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,31											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	200 = 8"				250 = 10"							
		Outer diameter ø[mm]	219,1				273,0							
		Wall thickness t = [mm]	20,6	22,2	23,0	28,0	2,9	3,2	3,4	3,6	4,0	4,2	5,0	5,6
		Schedule	140	XXS	160				5S			10S		
Item	Unit	Build-in Items || [kg/m]	101	108	111	132	19,3	21,3	22,6	23,9	26,6	27,9	33,1	37,0
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	1,54				1,92							
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	1,92				2,39							
4.3	each	" " " " NP100 bar, ANSI 600 lbs	2,16				2,68							
4.4	each	ORIFICE PLATE INSERTING	0,31				0,38							
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2	1,20											
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	2,50				4,25							
5.2	piece	VALVE WITH DRIVE - INSTALLING	3,50				5,95							
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	1,50				2,55							
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,50				0,85							
5.5	piece	CONTROL VALVE	10,00				17,00							
5.6	piece	SAFETY VALVE	11,25				19,13							
5.7	piece	HYDRANT	5,00				8,50							
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m					1,58	1,80	2,02					
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,17				0,20							
6.2	m	SERVICE TEST	0,12				0,14							
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,12				0,10							
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,31				0,38							
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	250 = 10"											
		Outer diameter ø[mm]	273,0											
		Wall thickness t = [mm]	6,3	6,4	7,1	7,8	8,0	8,8	9,3	10,0	11,0	12,0	12,7	14,2
		Schedule		20		30			40 STD				80S 60	XS
Item	Unit	Build-in Items || [kg/m]	41,5	42,1	46,6	51,1	52,3	57,4	60,6	64,9	71,2	77,3	81,6	90,7
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	1,92											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	2,39											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	2,68											
4.4	each	ORIFICE PLATE INSERTING	0,38											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	4,25											
5.2	piece	VALVE WITH DRIVE - INSTALLING	5,95											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	2,55											
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,85											
5.5	piece	CONTROL VALVE	17,00											
5.6	piece	SAFETY VALVE	19,13											
5.7	piece	HYDRANT	8,50											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m												
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,20											
6.2	m	SERVICE TEST	0,14											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,10											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,38											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	250 = 10"										300 = 12"	
		Outer diameter ø[mm]	273,0										323,9	
		Wall thickness t = [mm]	15,1	16,0	17,5	18,0	18,3	20,0	21,4	22,2	25,4	28,6	3,2	3,6
		Schedule	80				100		120		140 XXS	160		
Item	Unit	Build-in Items || [kg/m]	96,2	102	110	113	115	125	133	137	155	173	25,3	28,5
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	1,92										2,31	
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	2,39										2,89	
4.3	each	" " " " NP100 bar, ANSI 600 lbs	2,68										3,24	
4.4	each	ORIFICE PLATE INSERTING	0,38										0,46	
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	4,25										5,10	
5.2	piece	VALVE WITH DRIVE - INSTALLING	5,95										7,14	
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	2,55										3,06	
5.4	piece	BUTTERFLY VALVE - INSTALLING	0,85										1,02	
5.5	piece	CONTROL VALVE	17,00										20,40	
5.6	piece	SAFETY VALVE	19,13										22,95	
5.7	piece	HYDRANT	8,50										10,20	
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m											1,84	2,06
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,20										0,24	
6.2	m	SERVICE TEST	0,14										0,17	
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,10										0,10	
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,38										0,46	
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	300 = 12"											
		Outer diameter ø[mm]	323,9											
		Wall thickness t = [mm]	4,0	4,6	5,0	5,6	6,4	7,1	8,0	8,4	8,8	9,5	10,3	11,0
		Schedule	5S	10S			20			30		40S STD 40		
Item	Unit	Build-in Items || [kg/m]	31,6	36,3	39,4	44,0	50,2	55,5	62,4	65,4	68,5	73,8	79,8	85,0
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	2,31											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	2,89											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	3,24											
4.4	each	ORIFICE PLATE INSERTING	0,46											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	5,10											
5.2	piece	VALVE WITH DRIVE - INSTALLING	7,14											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	3,06											
5.4	piece	BUTTERFLY VALVE - INSTALLING	1,02											
5.5	piece	CONTROL VALVE	20,40											
5.6	piece	SAFETY VALVE	22,95											
5.7	piece	HYDRANT	10,20											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	2,28											
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,24											
6.2	m	SERVICE TEST	0,17											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,10											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,46											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	300 = 12"										350 = 14"	
		Outer diameter ø[mm]	323,9										355,6	
		Wall thickness t = [mm]	12,7	14,3	16,0	17,5	20,0	21,4	22,2	25,4	28,6	33,3	3,2	3,6
		Schedule	80S XS	60		80		100		120 XXS	140	160		
Item	Unit	Build-in Items || [kg/m]	97,6	109	122	132	150	160	165	187	209	239	27,8	31,3
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	2,31										2,73	
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	2,89										3,42	
4.3	each	" " " " NP100 bar, ANSI 600 lbs	3,24										3,83	
4.4	each	ORIFICE PLATE INSERTING	0,46										0,55	
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	5,10										5,95	
5.2	piece	VALVE WITH DRIVE - INSTALLING	7,14										8,33	
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	3,06										3,57	
5.4	piece	BUTTERFLY VALVE - INSTALLING	1,02										1,19	
5.5	piece	CONTROL VALVE	20,40										23,80	
5.6	piece	SAFETY VALVE	22,95										26,78	
5.7	piece	HYDRANT	10,20										11,90	
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m											2,09	2,31
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,24										0,27	
6.2	m	SERVICE TEST	0,17										0,19	
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,10										0,10	
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,46										0,55	
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	350 = 14"											
		Outer diameter ø[mm]	355,6											
		Wall thickness t = [mm]	4,0	4,8	5,0	5,6	6,4	7,1	7,9	8,8	9,5	11,1	12,7	14,2
		Schedule	5S	10S			10		20		30 STD	40	XS	
Item	Unit	Build-in Items || [kg/m]	34,7	41,6	43,3	48,4	55,2	61,1	67,8	75,4	81,2	94,4	108	120
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	2,73											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	3,42											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	3,83											
4.4	each	ORIFICE PLATE INSERTING	0,55											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	5,95											
5.2	piece	VALVE WITH DRIVE - INSTALLING	8,33											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	3,57											
5.4	piece	BUTTERFLY VALVE - INSTALLING	1,19											
5.5	piece	CONTROL VALVE	23,80											
5.6	piece	SAFETY VALVE	26,78											
5.7	piece	HYDRANT	11,90											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	2,53											
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,27											
6.2	m	SERVICE TEST	0,19											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,10											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,55											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	350 = 14"									400 = 16"		
		Outer diameter ø[mm]	355,6									406,4		
		Wall thickness t = [mm]	15,1	17,5	19,1	22,2	23,8	25,0	27,8	31,8	35,7	3,6	4,0	4,2
		Schedule	60		80		100		120	140	160			5S
Item	Unit	Build-in Items || [kg/m]	127	146	159	183	195	204	225	254	282	35,8	39,7	41,7
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	2,73									3,17		
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	3,42									3,97		
4.3	each	" " " " NP100 bar, ANSI 600 lbs	3,83									4,44		
4.4	each	ORIFICE PLATE INSERTING	0,55									0,63		
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	5,95									6,80		
5.2	piece	VALVE WITH DRIVE - INSTALLING	8,33									9,52		
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	3,57									4,08		
5.4	piece	BUTTERFLY VALVE - INSTALLING	1,19									1,36		
5.5	piece	CONTROL VALVE	23,80									27,20		
5.6	piece	SAFETY VALVE	26,78									30,60		
5.7	piece	HYDRANT	11,90									13,60		
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m										2,35	2,57	2,79
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,27									0,31		
6.2	m	SERVICE TEST	0,19									0,21		
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,10									0,08		
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,55									0,63		
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	400 = 16"										
		Outer diameter ø[mm]	406,4										
		Wall thickness t = [mm]	4,8	5,6	6,4	7,1	7,9	8,8	9,5	11,0	12,7	14,2	16,0	16,7
		Schedule	10S		10		20		30 STD		40 XS			60
Item	Unit	Build-in Items || [kg/m]	47,6	55,4	63,2	70,0	77,7	86,4	93,1	107	123	138	154	161
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	3,17											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	3,97											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	4,44											
4.4	each	ORIFICE PLATE INSERTING	0,63											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	6,80											
5.2	piece	VALVE WITH DRIVE - INSTALLING	9,52											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	4,08											
5.4	piece	BUTTERFLY VALVE - INSTALLING	1,36											
5.5	piece	CONTROL VALVE	27,20											
5.6	piece	SAFETY VALVE	30,60											
5.7	piece	HYDRANT	13,60											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m												
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,31											
6.2	m	SERVICE TEST	0,21											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,63											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	400 = 16"									450 = 18"		
		Outer diameter ø[mm]	406,4									457,0		
		Wall thickness t = [mm]	17,5	20,0	21,4	22,2	25,0	26,2	31,0	36,5	40,5	3,6	4,0	4,2
		Schedule	80			100	120	140	160			5S		
Item	Unit	Build-in Items || [kg/m]	168	191	203	211	235	246	287	333	366	40,3	44,7	47,0
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	3,17									3,63		
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	3,97									4,53		
4.3	each	" " " " NP100 bar, ANSI 600 lbs	4,44									5,08		
4.4	each	ORIFICE PLATE INSERTING	0,63									0,73		
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	6,80									7,65		
5.2	piece	VALVE WITH DRIVE - INSTALLING	9,52									10,71		
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	4,08									4,59		
5.4	piece	BUTTERFLY VALVE - INSTALLING	1,36									1,53		
5.5	piece	CONTROL VALVE	27,20									30,60		
5.6	piece	SAFETY VALVE	30,60									34,43		
5.7	piece	HYDRANT	13,60									15,30		
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m										2,60	2,82	3,04
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,31									0,34		
6.2	m	SERVICE TEST	0,21									0,24		
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08									0,08		
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,63									0,73		
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	450 =18"											
		Outer diameter ø[mm]	457,0											
		Wall thickness t = [mm]	4,8	5,6	6,4	7,1	7,9	8,8	9,5	11,1	12,7	14,3	16,0	17,5
		Schedule	10S		10		20		STD	30	XS	40		
Item	Unit	Build-in Items || [kg/m]	53,6	62,4	71,2	78,9	87,6	97,4	105	122	139	156	174	190
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	3,63											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	4,53											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	5,08											
4.4	each	ORIFICE PLATE INSERTING	0,73											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	7,65											
5.2	piece	VALVE WITH DRIVE - INSTALLING	10,71											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	4,59											
5.4	piece	BUTTERFLY VALVE - INSTALLING	1,53											
5.5	piece	CONTROL VALVE	30,60											
5.6	piece	SAFETY VALVE	34,43											
5.7	piece	HYDRANT	15,30											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m												
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,34											
6.2	m	SERVICE TEST	0,24											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,73											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING			Nominal diameter [mm=inch]	450 = 18"								500 = 20"			
			Outer diameter ø[mm]	457,0								508,0			
			Wall thickness t = [mm]	19,1	22,2	23,8	25,0	29,4	34,9	39,7	45,2	2,9	4,0	4,5	4,8
			Schedule	60		80		100	120	140	160				5S
Item	Unit	Build-in Items	[kg/m]	207	238	255	267	310	364	409	460	36,2	49,8	55,9	59,6
1.1	m	PIPE - LAYING IN FIELD													
1.2	m	PIPE - LAYING ON RACK													
1.3	m	PIPE - DISMANTLING													
2.2	piece	TWO - END FITTING - ALIGNMENT													
2.3	piece	THREE - END FITTING - ALIGNMENT													
3.1	each	BUTT WELD													
3.2	each	FILLET (SOCKET) WELD													
3.3	each	MITRE WELD													
3.4	each	NOZZLE WELD													
3.5	piece	WELDOLET, NIPOLET - WELDING													
3.6	piece	SADDLE REINFORCEMENT - WELDING													
3.7	each	SEAL RING - WELDING													
3.8	piece	INSERT RING (ONLY FOR ALU)													
3.9	piece	WELD CUTTING IN ALTERATIONS													
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8													
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs		3,63								4,10			
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs		4,53								5,12			
4.3	each	" " " " NP100 bar, ANSI 600 lbs		5,08								5,74			
4.4	each	ORIFICE PLATE INSERTING		0,73								0,82			
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2													
4.6	piece	PIPE THREADING													
4.7	each	MAKING ON THREADED CONNECTION													
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7													
5.1	piece	VALVE - INSTALLING		7,65								8,50			
5.2	piece	VALVE WITH DRIVE - INSTALLING		10,71								11,90			
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING		4,59								5,10			
5.4	piece	BUTTERFLY VALVE - INSTALLING		1,53								1,70			
5.5	piece	CONTROL VALVE		30,60								34,00			
5.6	piece	SAFETY VALVE		34,43								38,25			
5.7	piece	HYDRANT		15,30								17,00			
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m										2,86	3,08	3,30	
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8													
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)		0,34								0,38			
6.2	m	SERVICE TEST		0,24								0,26			
7.1	piece	SUPPORT FABRICATION													
7.2	kg	SUPPORT INSTALLATION		0,08								0,08			
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2													
7.4	piece	WELD ROOT GRINDING		0,73								0,82			
7.5	piece	GAUGE CONNECTION DRILLING													

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	500 = 20"											
		Outer diameter ø[mm]	508,0											
		Wall thickness t = [mm]	5,0	5,5	6,3	6,4	7,1	8,0	8,8	9,5	10,0	11,0	12,7	14,2
		Schedule		10S		10				20 STD			30 XS	
Item	Unit	Build-in Items || [kg/m]	62,1	68,2	78,0	79,3	87,8	98,8	108	117	123	135	155	173
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	4,10											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	5,12											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	5,74											
4.4	each	ORIFICE PLATE INSERTING	0,82											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	8,50											
5.2	piece	VALVE WITH DRIVE - INSTALLING	11,90											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	5,10											
5.4	piece	BUTTERFLY VALVE - INSTALLING	1,70											
5.5	piece	CONTROL VALVE	34,00											
5.6	piece	SAFETY VALVE	38,25											
5.7	piece	HYDRANT	17,00											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m												
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,38											
6.2	m	SERVICE TEST	0,26											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,82											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter[mm=inch]	500 = 20"											
		Outer diameter ø[mm]	508,0											
		Wall thickness t = [mm]	15,1	16,0	17,5	20,0	20,6	22,2	25,0	26,2	32,5	38,1	44,4	50,0
		Schedule	40				60			80	100	120	140	160
Item	Unit	Build-in Items || [kg/m]	184	194	212	241	248	266	298	312	382	442	508	565
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	4,10											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	5,12											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	5,74											
4.4	each	ORIFICE PLATE INSERTING	0,82											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	8,50											
5.2	piece	VALVE WITH DRIVE - INSTALLING	11,90											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	5,10											
5.4	piece	BUTTERFLY VALVE - INSTALLING	1,70											
5.5	piece	CONTROL VALVE	34,00											
5.6	piece	SAFETY VALVE	38,25											
5.7	piece	HYDRANT	17,00											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m												
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,38											
6.2	m	SERVICE TEST	0,26											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,82											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	550 = 22"											
		Outer diameter ø[mm]	559,0											
		Wall thickness t = [mm]	4,5	4,8	5,0	5,5	6,4	7,1	8,0	8,8	9,5	11,0	12,7	14,2
		Schedule		5S		10S	10				20 STD		30 XS	
Item	Unit	Build-in Items || [kg/m]	61,6	65,7	68,4	75,2	87,3	96,8	109	120	129	149	171	191
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	4,58											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	5,73											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	6,42											
4.4	each	ORIFICE PLATE INSERTING	0,92											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	9,35											
5.2	piece	VALVE WITH DRIVE - INSTALLING	13,09											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	7,48											
5.4	piece	BUTTERFLY VALVE - INSTALLING	3,74											
5.5	piece	CONTROL VALVE	37,40											
5.6	piece	SAFETY VALVE	42,08											
5.7	piece	HYDRANT	18,70											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	3,11	3,33	3,55									
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,41											
6.2	m	SERVICE TEST	0,29											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,92											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	550 = 22"										600 = 24"	
		Outer diameter ø[mm]	559,0										610,0	
		Wall thickness t = [mm]	15,9	17,5	20,0	22,2	25,0	28,6	34,9	41,3	47,6	54,0	4,0	4,5
		Schedule	40			60		80	100	120	140	160		
Item	Unit	Build-in Items || [kg/m]	213	234	266	294	330	375	452	528	601	673	59,9	67,3
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	4,58										5,08	
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	5,73										6,35	
4.3	each	" " " " NP100 bar, ANSI 600 lbs	6,42										7,11	
4.4	each	ORIFICE PLATE INSERTING	0,92										1,02	
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	9,35										10,20	
5.2	piece	VALVE WITH DRIVE - INSTALLING	13,09										14,28	
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	7,48										8,16	
5.4	piece	BUTTERFLY VALVE - INSTALLING	3,74										4,08	
5.5	piece	CONTROL VALVE	37,40										40,80	
5.6	piece	SAFETY VALVE	42,08										45,90	
5.7	piece	HYDRANT	18,70										20,40	
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m											3,37	3,59
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,41										0,45	
6.2	m	SERVICE TEST	0,29										0,31	
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08										0,08	
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	0,92										1,02	
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	600 = 24"											
		Outer diameter ø[mm]	610,0											
		Wall thickness t = [mm]	5,0	5,5	5,6	6,3	6,4	7,1	8,0	8,8	9,5	10,0	12,7	14,3
		Schedule		5S			10				20 STD		XS	30
Item	Unit	Build-in Items || [kg/m]	74,7	82,1	83,6	93,9	95,4	106	119	131	141	148	187	210
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	5,08											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	6,35											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	7,11											
4.4	each	ORIFICE PLATE INSERTING	1,02											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	10,20											
5.2	piece	VALVE WITH DRIVE - INSTALLING	14,28											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	8,16											
5.4	piece	BUTTERFLY VALVE - INSTALLING	4,08											
5.5	piece	CONTROL VALVE	40,80											
5.6	piece	SAFETY VALVE	45,90											
5.7	piece	HYDRANT	20,40											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	3,81											
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,45											
6.2	m	SERVICE TEST	0,31											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	1,02											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING														
		Nominal diameter [mm=inch]	600 = 24"											
		Outer diameter ø[mm]	610,0											
		Wall thickness t = [mm]	16,0	17,5	20,0	22,2	24,6	25,0	31,0	38,9	46,0	52,4	59,5	
		Schedule		40			60		80	100	120	140	160	
Item	Unit	Build-in Items || [kg/m]	235	256	291	322	356	361	443	549	641	721	809	
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	5,08											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	6,35											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	7,11											
4.4	each	ORIFICE PLATE INSERTING	1,02											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	10,20											
5.2	piece	VALVE WITH DRIVE - INSTALLING	14,28											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	8,16											
5.4	piece	BUTTERFLY VALVE - INSTALLING	4,08											
5.5	piece	CONTROL VALVE	40,80											
5.6	piece	SAFETY VALVE	45,90											
5.7	piece	HYDRANT	20,40											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m												
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,45											
6.2	m	SERVICE TEST	0,31											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	1,02											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	650 = 26"											
		Outer diameter ø[mm]	660,0											
		Wall thickness t = [mm]	5,0	5,6	6,3	7,1	7,9	8,8	9,5	11,0	12,7	14,2	17,5	22,2
		Schedule					10		STD		20 XS			
Item	Unit	Build-in Items || [kg/m]	80,9	90,5	102	114	127	142	153	176	203	226	278	35
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	5,59											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	6,99											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	7,83											
4.4	each	ORIFICE PLATE INSERTING	1,12											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	11,05											
5.2	piece	VALVE WITH DRIVE - INSTALLING	15,47											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	8,84											
5.4	piece	BUTTERFLY VALVE - INSTALLING	4,42											
5.5	piece	CONTROL VALVE	44,20											
5.6	piece	SAFETY VALVE	49,73											
5.7	piece	HYDRANT	22,10											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	3,63	3,84	4,06									
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,48											
6.2	m	SERVICE TEST	0,34											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	1,12											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	700 = 28"											
		Outer diameter ø[mm]	711,0											
		Wall thickness t = [mm]	4,0	5,0	5,6	6,0	6,3	7,1	7,9	8,8	9,5	10,0	11,0	12,7
		Schedule						10		STD			20 XS	
Item	Unit	Build-in Items || [kg/m]	69,8	87,2	97,5	104	110	123	137	153	165	173	190	219
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	6,11											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	7,64											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	8,56											
4.4	each	ORIFICE PLATE INSERTING	1,22											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	11,90											
5.2	piece	VALVE WITH DRIVE - INSTALLING	16,66											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	9,52											
5.4	piece	BUTTERFLY VALVE - INSTALLING	4,76											
5.5	piece	CONTROL VALVE	47,60											
5.6	piece	SAFETY VALVE	53,55											
5.7	piece	HYDRANT	23,80											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	3,88	4,10	4,32									
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,52											
6.2	m	SERVICE TEST	0,37											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	1,22											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	700 = 28"				750 = 30"							
		Outer diameter ø[mm]	711,0				762,0							
		Wall thickness t = [mm]	14,2	15,9	17,5	20,0	5,6	6,3	6,4	7,1	7,9	8,8	9,5	11,0
		Schedule		30					5S		10		STD	
Item	Unit	Build-in Items || [kg/m]	244	273	300	341	105	118	119	132	147	164	177	204
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	6,11				6,65							
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	7,64				8,31							
4.3	each	" " " " NP100 bar, ANSI 600 lbs	8,56				9,31							
4.4	each	ORIFICE PLATE INSERTING	1,22				1,33							
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	11,90				12,75							
5.2	piece	VALVE WITH DRIVE - INSTALLING	16,66				17,85							
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	9,52				10,20							
5.4	piece	BUTTERFLY VALVE - INSTALLING	4,76				5,10							
5.5	piece	CONTROL VALVE	47,60				51,00							
5.6	piece	SAFETY VALVE	53,55				57,38							
5.7	piece	HYDRANT	23,80				25,50							
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m					4,13	4,35	4,57					
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,52				0,55							
6.2	m	SERVICE TEST	0,36				0,39							
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08				0,08							
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	1,22				1,33							
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	750 = 30"					800 = 32"						
		Outer diameter ø[mm]	762,0					813,0						
		Wall thickness t = [mm]	12,7	14,2	15,9	17,5	20,0	4,0	5,0	5,6	6,0	6,3	7,1	7,9
		Schedule	20 XS		30									10
Item	Unit	Build-in Items || [kg/m]	235	262	293	322	366	79,9	99,8	112	120	125	141	157
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	6,65					7,19						
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	8,31					8,99						
4.3	each	" " " " NP100 bar, ANSI 600 lbs	9,31					10,07						
4.4	each	ORIFICE PLATE INSERTING	1,33					1,44						
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	12,75					13,60						
5.2	piece	VALVE WITH DRIVE - INSTALLING	17,85					19,04						
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	10,20					10,88						
5.4	piece	BUTTERFLY VALVE - INSTALLING	5,10					5,44						
5.5	piece	CONTROL VALVE	51,00					54,40						
5.6	piece	SAFETY VALVE	57,38					61,20						
5.7	piece	HYDRANT	25,50					27,20						
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m						4,39	4,61	4,83				
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,55					0,59						
6.2	m	SERVICE TEST	0,39					0,41						
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08					0,08						
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	1,33					1,44						
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	800 = 32"										850 = 34"	
		Outer diameter ø[mm]	813,0										864,0	
		Wall thickness t = [mm]	8,8	9,5	10,0	11,0	12,7	14,2	15,9	17,5	20,0	22,2	6,3	7,1
		Schedule		STD			20 XS		30	40				
Item	Unit	Build-in Items || [kg/m]	175	188	198	218	251	280	313	344	392	434	133	150
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	7,19										7,75	
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	8,99										9,68	
4.3	each	" " " " NP100 bar, ANSI 600 lbs	10,07										10,85	
4.4	each	ORIFICE PLATE INSERTING	1,44										1,55	
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	13,60										14,45	
5.2	piece	VALVE WITH DRIVE - INSTALLING	19,04										20,23	
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	10,88										11,56	
5.4	piece	BUTTERFLY VALVE - INSTALLING	5,44										5,78	
5.5	piece	CONTROL VALVE	54,40										57,80	
5.6	piece	SAFETY VALVE	61,20										65,03	
5.7	piece	HYDRANT	27,20										28,90	
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m											4,64	4,86
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,59										0,62	
6.2	m	SERVICE TEST	0,41										0,43	
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08										0,08	
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	1,44										1,55	
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	850 = 34"									900 = 36"		
		Outer diameter ø[mm]	864,0									914,0		
		Wall thickness t = [mm]	7,9	8,8	9,5	11,0	12,7	14,2	15,9	17,5	20,0	4,0	5,0	5,6
		Schedule	10		STD		20 XS		30	40				
Item	Unit	Build-in Items || [kg/m]	167	186	200	232	267	298	333	366	417	89,9	112	126
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	7,75									8,31		
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	9,68									10,39		
4.3	each	" " " " NP100 bar, ANSI 600 lbs	10,85									11,64		
4.4	each	ORIFICE PLATE INSERTING	1,55									1,66		
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	14,45									15,30		
5.2	piece	VALVE WITH DRIVE - INSTALLING	20,23									21,42		
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	11,56									12,24		
5.4	piece	BUTTERFLY VALVE - INSTALLING	5,78									6,12		
5.5	piece	CONTROL VALVE	57,80									61,20		
5.6	piece	SAFETY VALVE	65,03									68,85		
5.7	piece	HYDRANT	28,90									30,60		
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	5,08									4,90	5,12	5,34
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,62									0,66		
6.2	m	SERVICE TEST	0,43									0,46		
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08									0,08		
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	1,55									1,66		
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	900= 36"											
		Outer diameter ø[mm]	914,0											
		Wall thickness t = [mm]	6,3	7,1	7,9	8,0	8,8	9,5	10,0	11,0	12,7	14,2	15,9	17,5
		Schedule			10			STD			20 XS		30	
Item	Unit	Build-in Items || [kg/m]	141	159	177	179	197	212	223	245	283	316	353	387
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	8,31											
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	10,39											
4.3	each	" " " " NP100 bar, ANSI 600 lbs	11,64											
4.4	each	ORIFICE PLATE INSERTING	1,66											
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	15,30											
5.2	piece	VALVE WITH DRIVE - INSTALLING	21,42											
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	12,24											
5.4	piece	BUTTERFLY VALVE - INSTALLING	6,12											
5.5	piece	CONTROL VALVE	61,20											
5.6	piece	SAFETY VALVE	68,85											
5.7	piece	HYDRANT	30,60											
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m												
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,66											
6.2	m	SERVICE TEST	0,46											
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08											
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	1,66											
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	900 = 36"			1000 = 40"								
		Outer diameter ø[mm]	914,0			1016,0								
		Wall thickness t = [mm]	19,1	20,0	22,2	5,0	5,6	6,3	7,1	8,0	8,8	9,5	10,0	11,0
		Schedule	40									STD		
Item	Unit	Build-in Items || [kg/m]	422	442	489	125	140	157	177	199	219	236	248	273
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	8,31			9,47								
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	10,39			11,84								
4.3	each	" " " " NP100 bar, ANSI 600 lbs	11,64			13,26								
4.4	each	ORIFICE PLATE INSERTING	1,66			1,89								
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	15,30			17,00								
5.2	piece	VALVE WITH DRIVE - INSTALLING	21,42			23,80								
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	12,24			13,60								
5.4	piece	BUTTERFLY VALVE - INSTALLING	6,12			6,80								
5.5	piece	CONTROL VALVE	61,20			68,00								
5.6	piece	SAFETY VALVE	68,85			76,50								
5.7	piece	HYDRANT	30,60			34,00								
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m				5,41	5,63	5,85						
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,66			0,73								
6.2	m	SERVICE TEST	0,46			0,51								
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08			0,08								
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	1,66			1,89								
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	1000 = 40"							1050 = 42"				
		Outer diameter ø[mm]	1016,0							1067,0				
		Wall thickness t = [mm]	12,5	12,7	14,2	16,0	17,5	20,0	22,2	6,3	7,1	8,0	8,8	9,5
		Schedule		XS										STD
Item	Unit	Build-in Items || [kg/m]	310	315	351	395	431	492	545	165	186	209	230	248
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	9,47							10,06				
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	11,84							12,58				
4.3	each	" " " " NP100 bar, ANSI 600 lbs	13,26							14,09				
4.4	each	ORIFICE PLATE INSERTING	1,89							2,01				
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	17,00							17,85				
5.2	piece	VALVE WITH DRIVE - INSTALLING	23,80							24,99				
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	13,60							14,28				
5.4	piece	BUTTERFLY VALVE - INSTALLING	6,80							7,14				
5.5	piece	CONTROL VALVE	68,00							71,40				
5.6	piece	SAFETY VALVE	76,50							80,33				
5.7	piece	HYDRANT	34,00							35,70				
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m								5,66	5,88	6,10		
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,73							0,76				
6.2	m	SERVICE TEST	0,51							0,53				
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08							0,08				
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	1,89							2,01				
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	1050=42"				1100 = 44"			1200 = 48"				
		Outer diameter ø[mm]	1067,0				1118,0			1219,0				
		Wall thickness t = [mm]	11,0	12,7	14,2	17,5	7,1	9,5	12,7	7,1	9,5	10,3	12,7	15,9
		Schedule		XS				STD	XS		STD		XS	
Item	Unit	Build-in Items || [kg/m]	287	331	369	454	195	260	347	212	284	307	378	472
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	10,06				10,66			11,89				
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	12,58				13,33			14,86				
4.3	each	" " " " NP100 bar, ANSI 600 lbs	14,09				14,93			16,65				
4.4	each	ORIFICE PLATE INSERTING	2,01				2,13			2,38				
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	17,85				18,70			20,40				
5.2	piece	VALVE WITH DRIVE - INSTALLING	24,99				26,18			28,56				
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	14,28				14,96			16,32				
5.4	piece	BUTTERFLY VALVE - INSTALLING	7,14				7,48			8,16				
5.5	piece	CONTROL VALVE	71,40				74,80			81,60				
5.6	piece	SAFETY VALVE	80,33				84,15			91,80				
5.7	piece	HYDRANT	35,70				37,40			40,80				
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m					5,92	6,14	6,36	6,43	6,65	6,87		
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,76				0,80			0,87				
6.2	m	SERVICE TEST	0,53				0,56			0,61				
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08				0,08			0,08				
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	2,01				2,13			2,38				
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	1200			1300=52"			1350=54"			1400		
		Outer diameter ø[mm]	1220,0			1321,0			1372,0			1420,0		
		Wall thickness t = [mm]	5,0	8,0	10,0	20,0	9,5	12,7	7,9	9,5	12,7	15,9	6,3	7.1
		Schedule					STD	XS		STD	XS			
Item	Unit	Build-in Items || [kg/m]	150	239	229	593	308	410	266	320	426	532	220	248
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	11,89				13,15		13,79				14,44	
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	14,86				16,44		17,24				18,04	
4.3	each	" " " " NP100 bar, ANSI 600 lbs	16,65				18,41		19,30				20,21	
4.4	each	ORIFICE PLATE INSERTING	2,38				2,63		2,76				2,89	
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	20,40				22,10		22,95				23,80	
5.2	piece	VALVE WITH DRIVE - INSTALLING	28,56				30,94		32,13				33,32	
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	16,32				17,68		18,36				19,04	
5.4	piece	BUTTERFLY VALVE - INSTALLING	8,16				8,84		9,18				9,52	
5.5	piece	CONTROL VALVE	81,60				88,40		91,80				95,20	
5.6	piece	SAFETY VALVE	91,80				99,45		103,28				107,10	
5.7	piece	HYDRANT	40,80				44,20		45,90				47,60	
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	6,43	6,65	6,87		6,94	7,16	7,19	7,41	7,63		7,45	7,67
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	0,87				0,94		0,97				1,01	
6.2	m	SERVICE TEST	0,61				0,66		0,68				0,70	
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08				0,08		0,08				0,08	
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	2,38				2,63		2,76				2,9	
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	1400									1400 = 56"		
		Outer diameter ø[mm]	1420,0									1422,0		
		Wall thickness t = [mm]	8,0	8,8	10,0	11,0	12,5	14,2	16,0	17,5	20,0	9,5	12,7	14,3
		Schedule										STD	XS	
Item	Unit	Build-in Items || [kg/m]	279	307	348	383	434	493	555	606	691	331	442	497
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	14,44									14,44		
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	18,04									18,04		
4.3	each	" " " " NP100 bar, ANSI 600 lbs	20,21									20,21		
4.4	each	ORIFICE PLATE INSERTING	2,89									2,89		
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	23,80									23,80		
5.2	piece	VALVE WITH DRIVE - INSTALLING	33,32									33,32		
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	19,04									19,04		
5.4	piece	BUTTERFLY VALVE - INSTALLING	9,52									9,52		
5.5	piece	CONTROL VALVE	95,20									95,20		
5.6	piece	SAFETY VALVE	107,10									107,10		
5.7	piece	HYDRANT	47,60									47,60		
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	7,89									7,45	7,67	7,89
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	1,01									1,01		
6.2	m	SERVICE TEST	0,70									0,70		
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08									0,08		
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	2,89									2,89		
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	1500					1500 = 60"				1600		
		Outer diameter ø[mm]	1520,0					1524,0				1620,0		
		Wall thickness t = [mm]	8,0	8,8	10,0	12,5	14,2	9,5	12,7	14,3	15,9	5,0	8,0	8,8
		Schedule						STD	XS					
Item	Unit	Build-in Items || [kg/m]	299	328	373	465	528	355	474	533	592	199	318	350
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	15,75					15,75				17,09		
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	19,69					19,69				21,36		
4.3	each	" " " " NP100 bar, ANSI 600 lbs	22,05					22,05				23,93		
4.4	each	ORIFICE PLATE INSERTING	3,15					3,15				3,42		
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	25,50					25,50				27,20		
5.2	piece	VALVE WITH DRIVE - INSTALLING	35,70					35,70				38,08		
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	20,40					20,40				21,76		
5.4	piece	BUTTERFLY VALVE - INSTALLING	10,20					10,20				10,88		
5.5	piece	CONTROL VALVE	102,00					102,00				108,80		
5.6	piece	SAFETY VALVE	114,75					114,75				122,40		
5.7	piece	HYDRANT	51,00					51,00				54,40		
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	7,96	8,18	8,40			7,96	8,18	8,40		8,47	8,69	8,91
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	1,08					1,08				1,15		
6.2	m	SERVICE TEST	0,75					0,75				0,80		
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08					0,08				0,08		
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	3,15					3,15				3,42		
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	1600				1600 = 64"				1700 = 68"			
		Outer diameter ø[mm]	1620,0				1626,0				1727,0			
		Wall thickness t = [mm]	10,0	12,5	14,2	16,0	9,5	12,7	14,3	15,9	9,5	12,7	14,3	
		Schedule					STD	XS			STD	XS		
Item	Unit	Build-in Items || [kg/m]	398	496	563	634	379	506	569	632	403	538	605	
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING- WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	17,09				17,09				18,46			
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	21,36				21,36				23,07			
4.3	each	" " " " NP100 bar, ANSI 600 lbs	23,93				23,93				25,84			
4.4	each	ORIFICE PLATE INSERTING	3,42				3,42				3,69			
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	27,20				27,20				28,90			
5.2	piece	VALVE WITH DRIVE - INSTALLING	38,08				38,08				40,46			
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	21,76				21,76				23,12			
5.4	piece	BUTTERFLY VALVE - INSTALLING	10,88				10,88				11,56			
5.5	piece	CONTROL VALVE	108,80				108,80				115,60			
5.6	piece	SAFETY VALVE	122,40				122,40				57,80			
5.7	piece	HYDRANT	54,40				54,40				57,80			
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m					8,47	8,69	8,91		8,98	9,20	9,42	
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	1,15				1,15				1,22			
6.2	m	SERVICE TEST	0,80				0,85							
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08				0,08				0,08			
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	3,42				3,42				3,69			
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	1800			1800 = 72"			1900 = 76"			1950 = 78"		
		Outer diameter ø[mm]	1820,0			1829,0			1930,0			1981,0		
		Wall thickness t = [mm]	10,0	14,2	17,5	9,5	12,7	14,3	9,5	12,7	14,3	9,5	12,7	14,3
		Schedule				STD	XS		STD	XS		STD	XS	
Item	Unit	Build-in Items || [kg/m]	447	633	779	427	570	641	451	601	676	462	617	694
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	19,85			19,85			21,26			21,98		
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	24,81			24,81			26,58			27,48		
4.3	each	" " " " NP100 bar, ANSI 600 lbs	27,79			27,79			29,77			30,77		
4.4	each	ORIFICE PLATE INSERTING	3,97			3,97			4,25			4,40		
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	30,60			30,60			32,30			33,15		
5.2	piece	VALVE WITH DRIVE - INSTALLING	42,84			42,84			45,22			46,41		
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	24,48			24,48			25,84			26,52		
5.4	piece	BUTTERFLY VALVE - INSTALLING	12,24			12,24			12,92			13,26		
5.5	piece	CONTROL VALVE	122,40			122,40			129,20			132,60		
5.6	piece	SAFETY VALVE	137,70			137,70			145,35			149,18		
5.7	piece	HYDRANT	61,20			61,20			64,60			66,30		
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	9,49	9,71	9,93	9,49	9,71	9,93	10,00	10,22	10,44	10,25	10,47	10,69
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	1,29			1,29			1,36			1,39		
6.2	m	SERVICE TEST	0,90			0,90			0,95			0,97		
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08			0,08			0,08			0,08		
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	3,97			3,97			4,25			4,40		
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	2000				2000 = 80"			2050 = 82"		
		Outer diameter ø[mm]	2020,0				2032,0			2083,0		
		Wall thickness t = [mm]	11,0	12,5	16,0	20,0	9,5	12,7	14,3	9,5	12,7	14,3
		Schedule					STD	XS		STD	XS	
Item	Unit	Build-in Items || [kg/m]	546	620	792	988	474	633	712	486	649	730
1.1	m	PIPE - LAYING IN FIELD										
1.2	m	PIPE - LAYING ON RACK										
1.3	m	PIPE - DISMANTLING										
2.2	piece	TWO - END FITTING - ALIGNMENT										
2.3	piece	THREE - END FITTING - ALIGNMENT										
3.1	each	BUTT WELD										
3.2	each	FILLET (SOCKET) WELD										
3.3	each	MITRE WELD										
3.4	each	NOZZLE WELD										
3.5	piece	WELDOLET, NIPOLET - WELDING										
3.6	piece	SADDLE REINFORCEMENT - WELDING										
3.7	each	SEAL RING - WELDING										
3.8	piece	INSERT RING (ONLY FOR ALU)										
3.9	piece	WELD CUTTING IN ALTERATIONS										
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8										
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	22,70				22,70			23,43		
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	28,38				28,38			29,29		
4.3	each	" " " " NP100 bar, ANSI 600 lbs	31,78				31,78			32,80		
4.4	each	ORIFICE PLATE INSERTING	4,54				4,54			4,69		
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2										
4.6	piece	PIPE THREADING										
4.7	each	MAKING ON THREADED CONNECTION										
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7										
5.1	piece	VALVE - INSTALLING	34,00				34,00			34,85		
5.2	piece	VALVE WITH DRIVE - INSTALLING	47,60				47,60			48,79		
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	27,20				27,20			27,88		
5.4	piece	BUTTERFLY VALVE - INSTALLING	13,60				13,60			13,94		
5.5	piece	CONTROL VALVE	136,00				136,00			139,4		
5.6	piece	SAFETY VALVE	153,00				153,00			156,8		
5.7	piece	HYDRANT	68,00				68,00			69,70		
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	10,51	10,73	10,95		10,51	10,73	10,95	10,76	10,98	11,20
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8										
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	1,43				1,43			1,46		
6.2	m	SERVICE TEST	1,00				1,00			1,02		
7.1	piece	SUPPORT FABRICATION										
7.2	kg	SUPPORT INSTALLATION	0,08				0,08			0,08		
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2										
7.4	piece	WELD ROOT GRINDING	4,54				4,54			4,69		
7.5	piece	GAUGE CONNECTION DRILLING										

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING		Nominal diameter [mm=inch]	2100 = 84"			2200								
		Outer diameter ø[mm]	2134,0			2220,0								
		Wall thickness t = [mm]	9,5	12,7	14,3	10,0	12,5	14,2	16,0	17,5	20,0			
		Schedule	STD	XS										
Item	Unit	Build-in Items || [kg/m]	498	665	748	546	681	773	871	952	1086			
1.1	m	PIPE - LAYING IN FIELD												
1.2	m	PIPE - LAYING ON RACK												
1.3	m	PIPE - DISMANTLING												
2.2	piece	TWO - END FITTING - ALIGNMENT												
2.3	piece	THREE - END FITTING - ALIGNMENT												
3.1	each	BUTT WELD												
3.2	each	FILLET (SOCKET) WELD												
3.3	each	MITRE WELD												
3.4	each	NOZZLE WELD												
3.5	piece	WELDOLET, NIPOLET - WELDING												
3.6	piece	SADDLE REINFORCEMENT - WELDING												
3.7	each	SEAL RING - WELDING												
3.8	piece	INSERT RING (ONLY FOR ALU)												
3.9	piece	WELD CUTTING IN ALTERATIONS												
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8												
4.1	each	FLANGE BOLTING-UP NP 6 ÷ 16 bar, ANSI 150 lbs	24,16		24,16	25,64								
4.2	each	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	30,20		30,20	32,05								
4.3	each	" " " " NP100 bar, ANSI 600 lbs	33,82		33,82	35,90								
4.4	each	ORIFICE PLATE INSERTING	4,83		4,83	5,13								
4.5	bend	PIPE BENDING FOR below 45°, FOR > 45° x 2												
4.6	piece	PIPE THREADING												
4.7	each	MAKING ON THREADED CONNECTION												
4.8	multipl.	DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7												
5.1	piece	VALVE - INSTALLING	35,70		35,70	37,40								
5.2	piece	VALVE WITH DRIVE - INSTALLING	49,98		49,98	52,36								
5.3	piece	BUTTERFLY VALVE WITH DRIVE - INSTALLING	28,56		28,56	29,92								
5.4	piece	BUTTERFLY VALVE - INSTALLING	14,28		14,28	14,96								
5.5	piece	CONTROL VALVE	142,80		142,80	149,60								
5.6	piece	SAFETY VALVE	160,65		160,65	168,30								
5.7	piece	HYDRANT	71,40		71,40	74,80								
5.8	piece	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	11,02	11,24	11,46	11,53	11,75	11,97						
5.9	piece	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8												
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	1,50		1,50	1,57								
6.2	m	SERVICE TEST	1,05		1,05	1,10								
7.1	piece	SUPPORT FABRICATION												
7.2	kg	SUPPORT INSTALLATION	0,08		0,08	0,08								
7.3	kg	SPRING SUSP. AND HANG. - BUILD-IN AS ITEM 7.2												
7.4	piece	WELD ROOT GRINDING	4,83		4,83	5,13								
7.5	piece	GAUGE CONNECTION DRILLING												

8. ESTIMATE POINTS FOR BUILD-IN ITEMS OF ABOVE-GROUND PIPING	Nominal diameter [mm/inch]
	Outer diameter ø[mm]
	Wall thickness t [mm]
	Schedule

8. AUFMASSFAKTORS VON MONTAGEPOSITIONEN OBERIRD. ROHRLEITUNGEN	Nennweite [mm/"]
	Auß.Durchm. ø[mm]
	Wanddicke t [mm]
	Schedule

8. CJEVOVODI NADZEMNO VRIJED. BODOVI OSNOVNIH MONTAŽNIH POZICIJA	NO / NV [mm/"]
	Vanj. promj. ø[mm]
	Debli. stij. t [mm]
	Schedule

Item	Unit	Buildin Items || [kg/m]	Pos	Einh.	Montageposition || [kg/m]	Poz.	Jed.mj.	Montažna pozicija || [kg/m]
1.1	m	PIPE LAYING IN FIELD	1.1	m	ROHR VERLEGEN IM FELD	1.1	m	CIJEV - POLAGANJE U POSTROJENJU
1.2	"	" " " " ON RACK	1.2	"	" " " " ROHRBRÜCKE	1.2	"	" " - " " NA CJEV. MOSTU
1.3	"	" " DISMANTLING	1.3	"	" " DEMONTIEREN	1.3	"	" " - DEMONTAŽA
2.2	piece	TWOEND FITTING ALIGNMENT	2.2	stück	FORMSTÜCK MIT ZWEI ENDEN EINPASSEN	2.2	kom	FITING S DVA KRAJA - UPASIVANJE
2.3	"	THREEEND " " " "	2.3	"	" " MIT DREI ENDEN " "	2.3	"	" " S TRI KRAJA - " "
3.1	each	PIPE BUTT WELD	3.1	verb.	RUNDNAHT AUSFÜHRUNG UND SCHWEISSUNG	3.1	spoj	SUČEONI SPOJ - IZVEDBA I ZAVARIVANJE
3.2	"	" " (SOCKET) " "	3.2	"	KEHLNAHT " "	3.2	"	USADNI SPOJ (SOCKET) - " " " "
3.3	"	" " MITRE " "	3.3	"	SEGMENTNAHT " "	3.3	"	SEGMENTNI SPOJ - " " " "
3.4	"	" " NOZZLE " "	3.4	"	T STUTZENNAHT " "	3.4	"	UBODNI SPOJ - " " " "
3.5	piece	WELDOLET, NIPOLET WELDING	3.5	stück	WELDOLET, NIPOLET SCHWEISSEN	3.5	kom	WELDOLET, NIPOLET - UGRADNJA I ZAVARIVANJE
3.6	"	SADDLE REINFORCEMENT WELDING	3.6	"	V RING SCHWEISSEN	3.6	"	SEDLASTO OJAČANJE - IZRADA I ZAVARIVANJE
3.7	each	SEAL RING WELDING	3.7	verb.	SCHWEISSRING DICHTUNG	3.7	spoj	BRTVENI PRSTEN - IZVEDBA I ZAVARIVANJE
3.8	piece	INSERT RING (ONLY FOR ALU)	3.8	stück	EINLEGERING (NUR BEI ALU)	3.8	kom	USADNI PRSTEN (SAMO ZA ALUMINIJ)
3.9	"	WELD CUTTING IN ALTERATIONS	3.9	"	TRENNSCHNITT BEI ÄNDERUNGEN	3.9	"	ODREZIVANJE ZAVARA KOD PREINAČENJA
3.10	multipl.	MATERIAL MULTIPLIER FOR ITEM 3.1 TO 3.8	3.10	multipl.	WERKSTOFFMULTIPLIKATOR FÜR ITEM 3.1 BIS 3.8	3.10	faktor	FAKTOR ZA RAZL. MATERIJALE ZA POZ. 3.1 DO 3.8
4.1	each	FLANGE BOLTINGUP NP 6 ÷ 16 bar, ANSI 150 lbs	4.1	verb.	FLANSCHVERB. NP 6 ÷ 16 bar, ANSI 150	4.1	spoj	PRIRUBNIČKI SPOJ NP 6 ÷ 16 bar, ANSI 150
4.2	"	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400 lbs	4.2	"	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400	4.2	"	" " " " NP 25 ÷ 64 bar, ANSI 300 ÷ 400
4.3	"	" " " " NP100 bar, ANSI 600 lbs	4.3	"	" " " " NP100 bar, ANSI 600	4.3	"	" " " " NP100 bar, ANSI 600
4.4	"	ORIFICE PLATE INSERTING	4.4	"	STECKSCHEIBE EINSETZEN	4.4	"	UGRADNJA MJERNE BLENDE, ŠTEKŠAJBE I SL.
4.5	bend	PIPE BENDING FOR to 45°, FOR above 45° x 2	4.5	biegung	ROHR BIEGEN FÜR BIS 45°, FÜR > 45° x 2	4.5	savijanje	SAVIJANJE CIJEVI ZA DO 45°, ZA > 45° x 2
4.6	piece	PIPE THREADING	4.6	stück	GEWINDE SCHNEIDEN	4.6	kom	NAREZIVANJE NAVOJA
4.7	each	MAKING ON THREADED CONNECTION	4.7	verb.	GEWINDE EINDICHTEN	4.7	spoj	NAVOJNI SPOJ - IZVEDBA
4.8		DISASSEMBLY : 0,7 x PTS. ITEM 4.1 TO 4.4 AND 4.7	4.8		DEMONTAGE : 0,7 x FAKT. ITEM 4.1 BIS 4.4 UND 4.7	4.8		DEMONTAŽA : 0,7 x VRIJED. POZ. 4.1 DO 4.4 i 4.7
5.1	piece	VALVE INSTALLING	5.1	stück	ARMATUR EINBAUEN	5.1	kom	ARMATURA (VENTILI) - UGRADNJA
5.2	"	VALVE WITH DRIVE " "	5.2	"	ARMATUR M. ANTRIEB " "	5.2	"	" " S POGONOM (EM, PNEUM.) - " "
5.3	"	BUTTERFLY VALVE WITH DRIVE INSTALLING	5.3	"	EINKL. ARMAT. M. ANTRIEB " "	5.3	"	LEPTIR ZAKLOPKA " " " " - " "
5.4	"	BUTTERFLY VALVE " "	5.4	"	EINKLEMM ARMATUR " "	5.4	"	" " " " - UGRADNJA
5.5	"	CONTROL VALVE	5.5	"	STEUERUNGSVENTIL	5.5	"	REGULACIJSKI VENTIL
55.6	"	SAFETY VALVE	5.6	"	SICHERHEITSVENTIL	5.6	"	SIGURNOSNI " "
5.7	"	HYDRANT	5.7	"	HYDRANT	5.7	"	HIDRANT
5.8	"	VALVE SPINDLE EXTENSION LENGHTS 1-2-3 m	5.8	"	SPINDELVERLÄNGERUNG BL=1/2/3 MET.	5.8	"	PRODUŽENJE VRETENA VENTILA DUŽINA 1-2-3 m
5.9	"	DISASSEMBLY : 0,7 x PTS. ITEM. 5.1 TO 5.8	5.9	"	DEMONTAGE : 0,7 x FAKT. ITEM 5.1 BIS 5.8	5.9	"	DEMONTAŽA : 0,7 x VRIJEDNOSTI POZ. 5.1 DO 5.8
6.1	m	PRESSURE TEST (WATER, AIR, STEAM, GAS)	6.1	m	DRUCKPROBE MIT WASSER ODER GAS	6.1	m	TLAČNA PROBA (VODA, ZRAK, PARA, PLIN)
6.2	"	SERVICE TEST	6.2	"	DICHTHEITSPROBE (SERVICETEST)	6.2	"	SERVISNI TEST
7.1	piece	SUPPORT FABRICATION	7.1	stück	VERSTEIFUNGSSTEG ANFERTIGEN	7.1	kom	POTPORANJ - IZRADA I ZAVARIVANJE
7.2	kg	SUPPORT INSTALLATION	7.2	kg	HÄLTERUNGEN (UNTERST.) MONT.	7.2	kg	MONTAŽA SUPORTA (BEZ IZRADE)
7.3	"	SPRING SUSP. AND HANG. - B.IN AS ITEM 7.2	7.3	"	FEDERHÄNGER U. BÖCKE MONT. WIE ITEM 7.2	7.3	"	OPR. NOSAČI I OVJESI - MONTAŽA NORM. KAO 7.2
7.4	piece	WELD ROOT GRINDING	7.4	stück	SCHW. WURZEL ÜBERH. AUSSCHL.	7.4	kom	BRUŠENJE POVIŠENOG KORIJENA ZAVARA
7.5	"	GAUGE CONNECTION DRILLING	7.5	"	MESSLEITUNGABGANG DURCHBOHREN	7.5	"	MJERNI PRIKLJUČCI - BUŠENJE

XI. WEIGHT FACTORS

(acc. to LURGI Company from Germany)

1. PIPING

1.1 PIPING IN PLANTS - ALL DIAMETERS

1.1.1 PREFABRICATION

- Withdrawal of material from store	%
- Cutting and tack welding	%
- Welding	%
- Small parts, alignment and welding	%
	%

1.1.2 ERECTION

- Transport	%
- Hoisting, tack welding, installation of valves and other small parts	%
- Welding	%
- Supporting	%
	%

1.1.3 TESTING

- Inspection of piping and removal of defects	%
- Pressure test and purging	%
- Final inspection and takeover	%
	%

1.2 PIPING IN PLANTS above 2”

1.2.1 PREFABRICATION

- Withdrawal of material from the store	%
- Cutting and tack welding	%
- Welding	%
- Small parts, alignment and welding	%
	%

1.2.2 ERECTION

- Transport	%
- Hoisting, tack welding, installation of valves and other small parts	%
- Welding	%
- Supporting	%
	%

1.2.3 TESTING

- Inspection of piping and removal of defects	%
- Pressure tests	%
- Final inspection and takeover	%
	%

1.3 PIPING IN PLANTS to 2"

1.3.1 ERECTION

- Withdrawal of material from the store and transport	%
- Cutting, tack welding and welding	%
- Valve installation	%
- Supporting	%
	%

1.3.2 TESTING

	%
- Inspection of piping and removal of defects	%
- Final inspection and takeover	%
	%

1.4 LINE PIPING ON PIPE RACKS AND SLEEPER WAYS

1.4.1 PREFABRICATION

- Withdrawal of material from the store	%
- Cutting and tack welding	%
- Welding	%
- Small parts, alignment and welding	%
	%

1.4.2 ERECTION

- Transport	%
- Laying, tack welding, installation of valves and other small parts	%
- Welding	%
- Supporting	%
	%

1.4.3 TESTING

- Inspection of piping and removal of defects	%
- Pressure tests	%
- Final inspection and takeover	%
	%

1.5 UNDERGROUND PIPING - OPTION 1

1.5.1 EARTH WORKS - SEPARATE

- Excavation	%
- Backfilling	%
	%

1.5.2 PREFABRICATION

- Withdrawal of material from the store	%
- Cutting and tack welding	%
- Welding	%
- Small parts, alignment and welding	%
	%

1.5.3 INSTALLATION

- Transport	%
- Laying, tack welding, installation of valves and other small parts	%
- Welding	%
- Supporting	%
	%

1.5.4 TESTING

- Preliminary inspection	%
- Pressure testing	%
- Corrosion protection, puncture test	%
- Final inspection and take over	%
	%

1.6 UNDERGROUND PIPING - OPTION 2

1.6.1 EARTH WORKS - INCLUDED

- Excavation	%
- Backfilling	%
	%

1.6.2 PREFABRICATION

- Withdrawal of material from the store	%
- Cutting and tack welding	%
- Welding	%
- Small parts, alignment and welding	%
	%

1.6.3 INSTALLATION

- Transport	%
- Laying, tack welding, installation of valves and other small parts	%
- Welding	%
- Supporting	%
	%

1.6.4 TESTING

- Preliminary inspection	%
- Pressure testing	%
- Corrosion protection and puncture tests	%
- Final inspection and take over	%
	%

1.7 PIPING STEAM TRACING

1.7.1 PREFABRICATION

- Steam manifolds	%
- Condensate collectors	%
- Connecting piping to 1 1/2”	%
	%

1.7.2 INSTALLATION

- Steam manifolds	%
- Condensate collectors	%
- Connection piping to 1 1/2"	%
- Steam pipe bundles	%
- Condensate pipe bundles	%
- Steam tracing	%
	%

1.7.3 TESTING

- Preliminary inspection	%
- Pressure testing and take over	%
	%

2. STEEL STRUCTURES

2.1 LARGE WORKSHOP STRUCTURES WITH A CRANE TRACK

- Columns, beams, joists	%
- Roof supports	%
- Doors and windows	%
- Crane supports and rails	%
- Stairs, ladders, walkways, railings	%
- Positioning and bolting	%
- Inspection, possible repairs and finishing	%
- Final inspection and take over	%
	100 %

2.2 LARGE WORKSHOP STRUCTURE WITHOUT CRANE TRACK

- Columns, beams, joists	%
- Roof supports	%
- Doors and windows	%
- Crane supports and rails	%
- Stairs, ladders, walkways, railings	%
- Positioning and bolting	%
- Inspection, possible repair and finishing	%
- Final inspection and take over	%
	100 %

2.3 PROCESS PLANT BUILDING STRUCTURES

- Columns, beams, joists	%
- Platform girders (Bühnenträger)	%
- Platform plating (Bühnenbeläge)	%
- Stairs, ladders, platforms	%
- Railings	%
- Doors and windows	%
- Positioning and bolting	%
- Inspection and possible repair and finishing	%
- Final inspection and take over	%
	100 %

2.4 BUNKER BUILDINGS, BUNKER INCLUDED

- Columns, beams, joists	%
- Bunker erection	%
- Bunker welding	%
- Platform girder (Bühnenträger)	%

- Platform plating (Bühnenbeläge) ____ %
- Stairs, ladders, railings ____ %
- Doors and windows ____ %
- Positioning and bolting ____ %
- Inspection and possible repair and finishing ____ %
- Final inspection and take over ____ %

100 %

2.5 CRANE TRACKS EXTERIOR

- Columns, beams, joists ____ %
- Crane supports and rails ____ %
- Walkways, ladders, railings ____ %
- Positioning and bolting ____ %
- Inspection and possible repair and finishing ____ %
- Final inspection and take over ____ %

100 %

2.6 MACHINE SUPPORTING STRUCTURE

- Columns, beams, joists ____ %
- Walkways, ladders, railings ____ %
- Positioning and bolting ____ %
- Inspection and possible repairs and finishing ____ %
- Final inspection and take over ____ %

100 %

2.7 PROCESS EQUIPMENT SUPPORTING STRUCTURE

- Columns, beams, joists ____ %
- Platform girders (Bühnenträger) ____ %
- Platform plating (Bühnenbeläge) ____ %
- Stairs, ladders, railings ____ %
- Positioning and bolting ____ %
- Inspection and possible repairs and finishing ____ %
- Final inspection and take over ____ %

100 %

2.8 PIPE AND CABLE RACKS

- Columns, beams, joists ____ %
- Walkways, stairs, ladders railings ____ %
- Positioning and bolting ____ %
- Inspection and possible repairs and finishing ____ %
- Final inspection and take over ____ %

100 %

2.9 BELT CONVEYOR STRUCTURE

- Racks preliminary installation and columns ____ %
- Racks installation ____ %
- Walkways, stairs, ladders railings ____ %
- Positioning and bolting ____ %
-Inspection and possible repairs and finishing ____ %
- Final inspection and take over ____ %

100 %

2.10 STAIRS, WALKWAYS, PLATFORMS, LADDERS ONEQUIPMENT, STORAGE TANKS, ETC.

- Brackets, holders	%
- Scaffolds, supports, walkways	%
- Stairs, ladders, baskets, etc.	%
- Floor grids, ribbed sheets	%
- Railings	%
- Inspection and possible repairs and finishing	%
- Final inspection and take over	%
	100 %

3. **PROCESS EQUIPMENT**

3.1 TOWERS, REACTORS, HEAT EXCHANGERS, VESSELS

- Foundations steel structure preparation levelling of packers	%
- Hauling equipment to the place of installation	%
- Unloading equipment at the place of hoisting	%
- Hoisting and putting onto found ations	%
- Positioning, levelling, checking vertical position, etc.	%
- Anchor bolt tightening	%
- Inspection and possible repairs and finishing	%
- Final measurement, take over report, permission to connect the piping	%
	100 %

3.2 AIR COOLERS
without louvres

- Preparing the place for installation, unloading	%
- Steel structure erection	%
- Drive installation incl. motors	%
- Installation of chequered pipe bundles	%
- Finishing and remaining works, final inspection and take over	%
	100 %

3.3 AIR C OOLERS
with louvers

- Preparing the place of installation, unloading	%
- Steel structure erection	%
- Drive installation incl. motors	%
- Installation of chequered pipe bundles	%
- Installation of louvers and siding	%
- Finishing and remaining works, final inspection and take over	%
	100 %

3.4 OIL REFINERY KILNS

- Steel structure	%
- Enclosure (shell, bottom, top)	%
- Pipe system	%
- Welding	%
- Accessories: burner control dampers service and inspection doors explosion-proof dampers soot blowers	%
- Inspection, final inspection and take over	%
	100 %

3.5 ROTARY EQUIPMENT PUMPS AND COMPRESSORS

-Preparation and levelling of foundations	%
-Placing on foundations, tightening of anchor bolts, permission to connect the piping	%
-Positioning of drive coupling	%
-Final inspection and take over	%
	100%

4. **CYLINDRICAL STORAGE TANKS**
(All kinds of roofs)

-Bottom	%
-Shell with openings and connections	%
- Roof with openings and connections	%
-Equipment (stairs, platforms, heating, firefighting piping, railings, etc.)	%
-Final testing and take over	%
	100 %

XII. TECHNICAL CALCULATION - MANNER OF DATA COMPILING

When the call for tender is received and the installation/erection technology selected, and when man hours for the works ar e calculated, the estimator shall also provide the data required for calculation of a manhour rate. Each item is assigned the number of hours per each unit and the total number of hours which is written in a special place in the document.
He will provide written data for calculation of the manhour rate in the following way:
To be written on the top: name of project, name of client, place of works, date, and other data for the project identification.

1. QUANTITIES AND MAN HOURS REQUIRED

The estimator will record the quantity of works mostly in kg or tons. These quantities shall be given for a group of works, type of works, buildings, kind of material, size and the like. This is not always easy to do because of insufficient data contained in the call for tenders. Anyhow, the estimator shall make some sort of estimate or exact calculation of the quantities tons, kg, etc. Each group will be entered the basic data, rates or effect, and hours required. Finally, he shall state the total weight, hours required and the effect. Similarly, each group of works shall be assigned a productivity efficiency percentage (PEP) and finally an average PEP for all the works
(acc. to page11).

2. MANPOWER

- Works Schedule: If the time for execution of works is not stipulated in the call for tender or some other document, the estimator will estimate the time on the basis of his experience and from the tables on the page 118.

- Hours required: Item 1

- Hours per month: this should be agreed with the project manager.
Usually, it is 50 hours/week x 4,3 weeks = 215 hours/month

2.1 PRODUCTION MANPOWER

2.1.1 Average number: $\frac{\text{total hours}}{\text{month x hours/month}}$

2.1.2 Maximum number: Foresee maximum number at top production (c. + 30 %)

2.1.3 Manpower structure (at average number)

	Number
- Foreman	
- Fitters, highly skilled	
- Fitters, skilled	
- Welders, highly skilled	
- Welders, skilled	
- Others	
Total: (Average number)	

2.2 OFFICE STAFF

2.2.1 Management

	Number	Months
- Manager		
- Engineer		
- Tehnician		
- Others ...		
Total:		

2.2.2 Auxiliary staff in production

	Number	Months
- Drivers		
- Mechanics		
- Electricians		
- Store workers		
- Others		
Total:		

3. MACHINERY AND MEANS OF TRANSPORT

3.1 Cranes and forklifts
Capacity, number, months (weeks, days) of use

3.2 Means of transport - Vehicles
- Trucks
- Trailer trucks
- Tractors
- Trailers
- Buses
- Small buses
- Pickups
- Passenger cars
- Others

The number of vehicles and time of use

4. VITAL MEANS OF PRODUCTION

- Appurtances
- Generating sets
- Mobile power units
- Compressors
- Pumps
- Winches
- Etc.

5. TEMPORARY WORKS AT THE JOB SITE

- Workshops
- Camp facilities
- Containers

Estimate acc. to the table on pages 122 ÷123

6. AUXILIARY MATERIAL AND CONSUMABLES

- Welding rods estimate acc. to pages 112 ÷ 113
- Technical gas estimate acc. to page 114 ÷ 115
- Grinding and cutting discs estimate acc. to page 114
- Fuel and lubricants estimate acc. to page 116
- Other
- Contingencies: 10 ÷ 15 % to add to the above

7. TOOL COSTS AT THE JOB SITE

Estimate the costs according to the estimate on page 117.

8. SAFETY AT WORK COSTS

Estimate the costs according to the estimate on page 117.

9. POWER CONSUMPTION COST

According to the estimate on page 115

10. SCAFFOLDS AND SCAFFOLDING

Estimate according to the estimate on pages 109 ÷ 111

11. SPACE REQUIRED

Estimate according to the estimate on pages 122 ÷ 123

12. CONNECTIONS REQUIRED

Estimate according to the estimate on page 123

13. CERTIFICATION OF WELDERS

Estimate the number of certified welders.

14. TRANSPORT OVERALL DIMENSIONS AND WEIGHTS

Calculate the weight [ton] and the volume [m^3] with the data given in the table below.

14.1

TYPE	CAPACITY [t]	WEIGHT [t]	VOLUME [m^3]
Truck-mounted crane -Telescope	300	330	230
" "	150	132	180
" "	100	88,5	160
" "	60	47	140
" "	40	38	120
" "	32	36	90
" "	20	24,5	85
" "	18	24	80
" "	15	23	75
" "	12	20	70
" "	10	18	60
" "TATRA"	8	13	48
Forklift	5	6	17
"	3	4	8
Truck	10	7	62
"	5	5	57
"	3	3,8	40
"	1,5	2	30
" with "HIAB"	8	4	60
Bus 50 seats		12	94
Small bus 8+1 seats		3	20
Passenger car		1,2	14
Tractor 120 KS		7,5	17
" 75 KS		4,5	13,5
Trailer 20 T		7	96
" 10 T		5,6	26
Container 2 x 2,5 x 6 m		1,6	30

Weights and volumes are different and depend on the type and manufacturer of the means for hoisting and transportation.

14.2 MATERIALS

	Weight		Volume	
- Material for piping	1 ton	=	2,30	m^3
- Material for storage tanks (prefabrication)	1 ton	=	0,50	m^3
- Equipment for installation	1 ton	=	6,00	m^3
- Steel structure (prefabrication)	1 ton	=	2,00	m^3
- Other (including pipe supports)	1 ton	=	1,55	m^3

15. SERVICES BY OTHER CONTRACTORS

- Transport
- Connections
- Maintenance and servicing
- Geodetic measurement
- Security guard service
- Waste transport
- Etc.

16. WORKS SCHEDULE AND MANPOWER DIAGRAM

It is given if requested by call for tenders and in agreement with the project manager. The works schedule can be made in a form of a bar chart with concentrated number of activities (15 ÷ 20). If possible, include the manpower diagram at its bottom.

17. PROGRESS DIAGRAM - "S" - CURVE

It is made if requested by call for tenders and in agreement with the project manager.

The estimator's name and surname, his signature and date should be written at the end

XIII. MANHOURS FOR OVERHAULS IN PETROCHEMICAL PLANTS

1. PIPING ERECTION AND DISMANTLING UNIT MAN HOURS PER ACTIVITIES Productivity Ef ficiency Percentage PEP=90%		Nom. dia. [inch]	1/2"	1/2"	3/4"	3/4"	1"	1"	1 1/2"	1 1/2"	2"	2"	21/2"	21/2"	3"	3"
		Outer dia. ø[mm]	21,3	21,3	26,7	26,7	33,4	33,4	48,3	48,3	60,3	60,3	73,0	73,0	88,9	88,9
		Wall thick. t [mm]	2,77	3,73	2,90	3,91	3,40	4,55	3,70	5,16	3,90	5,54	5,20	7,00	5,50	7,60
		Schedule	40 STD	80 XS	40 STD	80 XS	40 STD	80XS	40 STD	80XS	40 STD	80 XS	40STD	80 XS	40 STD	80 XS
		Weight [kg/m]	1,28	1,61	1,70	2,20	2,52	3,21	4,07	5,44	5,43	7,44	8,71	11,40	11,3	15,3
Item	Unit	**A. PREFABRICATION AND ERECTION**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
1.1	m	PIPE LAYING WITHOUT PRIMER														
1.2	m	PIPE LAYING WITH PRIMER														
2.	m	LAYING OF PROCESS PIPE IN PROTECTION CONDUIT														
3.1	pc	INSTALLATION OF FITTING WITH ONE END - HANDLING														
3.2	pc	INSTALLATION OF FITTING WITH TWO ENDS - HANDLING														
3.3	pc	INSTALLATION OF FITTING WITH THREE ENDS - HANDLING														
4.	weld	BUTT WELD - MAKE-ON & WELDING														
5.	weld	SOCKET WELD - MAKE-ON & WELDING														
6.	weld	SEAL WELD (THREADED JOINT)														
7.	weld	MITRE WELD - MAKE-ON & WELDING														
8.	weld	WELDING NECK FLANGES														
9.1	weld	WELDING SLIP-ON FLANGES INCL. PRESSURE TEST														
9.2	weld	WELDING SLIP-ON FLANGES - NO PRESSURE TEST														
10.1	weld	WELDING MEASURING FLANGE INCL. PRESSURE TEST														
10.2	weld	WELDING MEASURING FLANGE - NO PRESSURE TEST														
11.1	weld	90^{o} BRANCH CONNECTION - NO REINFORCEMENT														
11.2	pc	COUPLING (MUFFE) - INSTALLATION AND WELDING														
11.3	pc	WELDOLET, etc. - INSTALLATION AND WELDING														
12.	weld	INCLINED BRANCH CONN. - NO REINFORCEMENT														
13.	weld	REINFORCEMENT PAD - FABRICATION & WELDING														
14.	pc	SADDLE NOZZLE (SWEEPOLET) - INSTALLATION & WELDING														
15.	ea	EXPANSION U-BEND - PRESTRESSING														
16.	ea	GRINDING OF WELD ROOT EXCESS														
17.1.	ea	REDUCER FABRICATION, 1 DN SMALLER														
17.2.	ea	REDUCER FABRICATION, 2 DN SMALLER														
17.3.	ea	REDUCER FABRICATION, 3 DN SMALLER														
18.1.	bend	PIPE BENDING < 45^{o}														
18.2.	bend	PIPE BENDING 45^{oo} 90														
18.3.	bend	PIPE BENDING 90^{o} -^{o}180														
19.1.	joint	FLANGED JOINT NP 6 - 16, 150#														
19.2.	joint	FLANGED JOINT NP 25 - 64, 300# - 400#														
19.3.	joint	FLANGED JOINT NP 100 - 160, 600# - 900#														
19.4.	joint	FLANGED JOINT NP 250 - 400, 1500# - 2500#														

1. PIPING ERECTION AND DISMANTLING **UNIT MAN HOURS PER ACTIVITIES** Productivity Ef ficiency Percentage PEP=90%		Nom. dia. [inch]	1/2"	1/2"	3/4"	3/4"	1"	1"	1 1/2"	1 1/2"	2"	2"	21/2"	21/2"	3"	3"
		Outer dia. ø[mm]	21,3	21,3	26,7	26,7	33,4	33,4	48,3	48,3	60,3	60,3	73,0	73,0	88,9	88,9
		Wall thick. t [mm]	2,77	3,73	2,90	3,91	3,40	4,55	3,70	5,16	3,90	5,54	5,20	7,00	5,50	7,60
		Schedule	40 STD	80 XS	40 STD	80 XS	40 STD	80XS	40 STD	80XS	40 STD	80 XS	40STD	80 XS	40 STD	80 XS
		Weight [kg/m]	1,28	1,61	1,70	2,20	2,52	3,21	4,07	5,44	5,43	7,44	8,71	11,40	11,3	15,3
Item	Unit	**A. PREFABRICATION AND ERECTION**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
20.1.	ea	INSTALLATION OF BLIND FLANGE NP 6 - 16, 150#														
20.2.	ea	INSTALLATION OF BLIND FLANGE NP 25 - 64, 300# - 400#														
20.3.	ea	INSTALLATION OF BLIND FLANGE NP 100 -160, 600# - 900#														
20.4.	ea	INSTALLATION OF BLIND FLANGE NP 250 -400, 1500#- 2500#														
21.	joint	FLANGED JOINT, TIGHTENING WITH TORQUE WRENCH factor at item 19.1. - 4 and 20.1. - 4														
22.1.	ea	RF - BLANKING PLATE 150# PLACING OR TAKING OUT														
22.2.	ea	RF - BLANKING PLATE 300#- 400# PLACING OR TAKING OUT														
22.3.	ea	RF - BLANKING PLATE 600#- 900# PLACING OR TAKING OUT														
22.4.	ea	RF - BLANKING PLATE 1500#-2500# PLACING OR TAKING OUT														
23.1.	ea	RTJ - BLANKING PLATE 150# PLACING OR TAKING OUT														
23.2.	ea	RTJ - BLANKING PLATE 300#-400# PLACING OR TAKING OUT														
23.3.	ea	RTJ - BLANKING PLATE 600#-900# PLACING OR TAKING OUT														
23.4.	ea	RTJ - BLANKING PLATE 1500#-2500# PLACING OR TAKING OUT														
24.	ea	BLANKING PLATE SPECTACLE, PLACING OR TAKING OUT factor to items 22.1. - 4. and 23.1. ÷ 23.4.														
25.1.	ea	MEASURING ORIFICE 150# - INSTALLATION														
25.2.	ea	MEASURING ORIFICE 300#-400# - INSTALLATION														
25.3.	ea	MEASURING ORIFICE 600#-900# - INSTALLATION														
25.4.	ea	MEASURING ORIFICE 1500#-2500# - INSTALLATION														
26.1.	pc	INSTALLATION OF VALVE WITH FLANGED END NP 6 - 16, 150#														
26.2.	pc	INSTALLATION OF VALVE WITH FLANGED END NP 25-64, 300# - 400#														
26.3.	pc	INSTALLATION OF VALVE WITH FLANGED END NP100-160, 600# - 900#														
26.4.	pc	INSTALLATION OF VALVE WITH FLANGED END NP250-400,1500#-2500#														
27.	pc	INSTALLATION OF MOTOR DRIVE VALVE factor to items 26.1. ÷ 26.4														
28.	pc	INSTALLATION OF SAFETY VALVES factor to items 26.1. ÷ 26.4														
29.	pc	INSTALLATION OF CONTROL VALVES factor to items 26.1. ÷ 26.4														
30.1.	ea	DRAIN OR VENT VALVE WITH ONE REINF NOZZLE MAKE-ON & WELD.														
30.2.	ea	DRAIN OR VENT VALVE WITH TWO REINF.NOZZLES MAKE-ON.&WELD.														
31.	ea	MAKE-ON OF BRANCH CONNECTION -" HOT TAP"														
32.	ea	DRILLING PROCESS PIPE FOR "HOT TAP"														

1. PIPING ERECTION AND DISMANTLING
UNIT MAN HOURS PER ACTIVITIES
Productivity Efficiency Percentage PEP=90%

		Nom. dia. [inch]	1/2"	1/2"	3/4"	3/4"	1"	1"	1 1/2"	1 1/2"	2"	2"	21/2"	21/2"	3"	3"
		Outer dia. ø[mm]	21,3	21,3	26,7	26,7	33,4	33,4	48,3	48,3	60,3	60,3	73,0	73,0	88,9	88,9
		Wall thick. t [mm]	2,77	3,73	2,90	3,91	3,40	4,55	3,70	5,16	3,90	5,54	5,20	7,00	5,50	7,60
		Schedule	40 STD	80 XS	40 STD	80 XS	40 STD	80XS	40 STD	80XS	40 STD	80 XS	40 STD	80 XS	40 STD	80 XS
		Weight [kg/m]	1,28	1,61	1,70	2,20	2,52	3,21	4,07	5,44	5,43	7,44	8,71	11,40	11,3	15,3
Item	Unit	**A. PREFABRICATION AND ERECTION**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
33.1.	test	PREPARATION OF EQUIPMENT FOR PRESSURE TESTING														
33.2.	m	SYSTEM PRESSURE TEST, LENGTH TO - 100m														
33.3.	m	SYSTEM PRESSURE TEST, LENGTH FROM 100 TO 200m														
33.4.	m	SYSTEM PRESSURE TEST, LENGTH FROM 200 TO 500m														
33.5.	m	SYSTEM PRESSURE TEST, LENGTH ABOVE - 500m														
33.6.	m^3	VESSEL PRESSURE TEST, VOLUME TO 10m3														
33.7.	m^3	VESSEL PRESSURE TEST, VOLUME 10 -15m3														
33.8.	m^3	VESSEL PRESSURE TEST, VOLUME ABOVE 15m3														
34.	m	PRESSURE TEST WITH AIR OR NITROGEN														
35.	ea	PIPE THREADING														
36.	ea	FABRICATION OR DISASSEMBLING OF THREADED JOINT														
37.	ea	WELD ANNEALING BY GAS BURNER														
38.1.	m	PROCESS PIPE STEAM TRACING														
38.2.	m	SUPPLY OR RETURN PIPE OF STEAM TRACING														
38.3.	ea	FITTING TRACING (freezing protection)														
38.4.	ea	FLANGED JOINT TRACING 2" and above														
38.5.	ea	VALVE TRACING 2" and above - (FROSTSCHUTZ), flanges included														
38.6.	ea	VALVE TRACING 2" and above, flanges included														
38.7.	ea	VALVE TRACING under 2", flanges included														
38.8.	joint	FLANGED JOINT ON TRACER LINE														
38.9.	m	INSTALLATION OF STEAM TRACING PIPING WITH SPACERS														
39.1.	ea	STEAM MANIFOLDS FOR 4 CONNECTIONS														
39.2.	ea	STEAM MANIFOLDS - ADDITION TO CONNECTION ABOVE 4 CONNECT.														
39.3.	ea	CONDENSATE COLLECTORS FOR 4 CONNECTIONS														
39.4.	ea	CONDENSATE COLLECTORS ALLOW. PER CONNEC. ABOVE 4 CONECT.														
40.	m	STEAM TRACING ON Cr Ni PROCESS PIPE factor to items 38.1. ; 38.3. - 38. 7.														
41.	ea	INSTALLATION OR REMOVAL OF BLANKING PLATES AT PIPE END														
42.	ea	INSTALLATION OR REMOVAL OF DIRT MESH IN PIPING														
43.	ea	WELD PICKLING ON STAINLESS STEEL														
44.	ea	EXECUTION OF PASSES THROUGH WALLS OR SLABS														
45.1.	cut	PIPE CUTTING - COLD														
45.2.	cut	PIPE CUTTING - GAS BURNER														
46.1.	kg	PIPE SUPPORTS - FABRICATION														
46.2.	kg	PIPE SUPPORTS - ERECTION														

1. PIPING ERECTION AND DISMANTLING **UNIT MAN HOURS PER ACTIVITIES** Productivity Ef ficiency Percentage PEP=90%		Nom. dia. [inch]	1/2"	1/2"	3/4"	3/4"	1"	1"	1 1/2"	1 1/2"	2"	2"	21/2"	21/2"	3"	3"
		Outer dia. ø[mm]	21,3	21,3	26,7	26,7	33,4	33,4	48,3	48,3	60,3	60,3	73,0	73,0	88,9	88,9
		Wall thick. t [mm]	2,77	3,73	2,90	3,91	3,40	4,55	3,70	5,16	3,90	5,54	5,20	7,00	5,50	7,60
		Schedule	40 STD	80 XS	40 STD	80 XS	40 STD	80XS	40 STD	80XS	40 STD	80 XS	40STD	80 XS	40 STD	80 XS
		Weight [kg/m]	1,28	1,61	1,70	2,20	2,52	3,21	4,07	5,44	5,43	7,44	8,71	11,40	11,3	15,3
Item	Unit	**B. PIPING DISMANTLING**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
47.1.	m	PIPE DISMANTLING FOR REUTILIZATION														
47.2.	m	PIPE DISMANTLING FOR USEFUL WASTE														
48.1.	ea	FLANGED JOINT DISMANTLING FOR REUTILIZATION 150#														
48.2.	ea	FLANGED JOINT DISMANTLING FOR REUTILIZ. 300# - 400#														
48.3.	ea	FLANGED JOINT DISMANTLING FOR REUTILIZ. 600# - 900#														
48.4.	ea	FLANGED JOINT DISMANTLING FOR REUTILIZ. 1500#-2500#														
49.	ea	FLANGED JOINT DISMANTLING FOR USEFUL WASTE factor to items 48.1 ÷ 48.4.														
50.	ea	BLIND FLANGE DISMANTLING FOR REUTILIZATION factor to items 20.1. ÷ 20.4.														
51.	ea	FLANGED JOINT DISMANTLING FOR USEFUL WASTE factor to items 20.1. ÷ 20.4. or 50.														
52.1.	ea	DISMANTLING VALVE FOR REUTILIZATION 150#														
52.2.	ea	DISMANTLING VALVE FOR REUTILIZATION 300# - 400#														
52.3.	ea	DISMANTLING VALVE FOR REUTILIZATION 600# - 900#														
52.4.	ea	DISMANTLING VALVE FOR REUTILIZATION 1500#-2500#														
53.	ea	DISMANTLING VALVE FOR USEFUL WASTE factor to items 52.1. ÷ 52.4.														
54.	ea	DISMANTLING VALVE WITH MOT. DRIVE FOR REUTILIZ. factor to items 52.1. ÷ 52.4.														
55.	ea	DISMANTLING VALVE WITH MOT. DRIVE FOR USEFUL WASTE factor to items 52.1. ÷ 52.4.														
56.	ea	DISMANTLING SAFETY VALVES FOR USEFUL WASTE factor to items 52.1. ÷ 52.4.														
57.	ea	DISMANTLING SAFETY VALVES FOR USEFUL WASTE factor to items 52.1. ÷ 52.4.														
58.	ea	DISMANTLING CONTROL VALVE FOR REUTILIZATION factor to items 52.1. ÷ 52.4.														
59.	ea	DISMANTLING CONTROL VALVE FOR USEFUL WASTE factor to items 52.1. ÷ 52.4.														

1. PIPING ERECTION AND DISMANTLING
UNIT MAN HOURS PER ACTIVITIES
Productivity Efficiency Percentage PEP=90%

		Nom. dia. [inch]	4"	4"	6"	6"	8"	8"	8"	10"	10"	10"	12"	12"	12"
		OD ø[mm]	114,3	114,3	168,3	168,3	219,1	219,1	219,1	273,1	273,1	273,1	323,9	323,9	323,9
		Wall thickness t [mm]	6,00	8,60	7,10	11,00	7,09	8,20	12,70	7,80	9,30	12,70	8,38	9,50	12,70
		Schedule	40 STD	80 XS	40 STD	80 XS	30	40 STD	80 XS	30	40 STD	80S 60	XS30	40SSTD	80S XS
		Weight [kg/m]	16,0	22,4	28,3	42,7	36,7	42,7	64,7	51,1	60,6	81,6	65,4	73,8	97,6
Item	Unit	**A. PREFABRICATION AND ERECTION**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
1.1	m	PIPE LAYING WITHOUT PRIMER													
1.2	m	PIPE LAYING WITH PRIMER													
2.	m	LAYING OF PROCESS PIPE IN PROTECTION CONDUIT													
3.1	pc	INSTALLATION OF 1-END FITTINGS END - HANDLING													
3.2	pc	INSTALLATION OF 2-END FITTINGS - HANDLING													
3.3	pc	INSTALLATION OF 3-END FITTINGS - HANDLING													
4.	weld	BUTT WELD - MAKE-ON AND WELDING													
5.	weld	SOCKET WELD - MAKE-ON AND WELDING													
6.	weld	SEAL WELD (ON THREADED JOINT)													
7.	weld	MITRE WELD - MAKE-ON AND WELDING													
8.	weld	WELDING NECK FLANGES													
9.1	weld	WELDING SLIP-ON FLANGES & PRESSURE TEST													
9.2	weld	WELDING SLIP-ON FLANGES - NO PRESSURE TESTING													
10.1	weld	WELDING MEASURING FLANGE & PRESSURE TEST													
10.2	weld	WELDING MEASURING FLANGE - NO PRESSURE TEST													
11.1	weld	BRANCH CONN. 90^{o} - NO REINFORCEMENT													
11.2	pc	COUPLING INSTALLATION AND WELDING													
11.3	pc	WELDOLET I.T.D. INSTALLATION AND WELDING													
12.	weld	INCLINED BRANCH CONNECTION - NO REINFORCEMENT													
13.	weld	SADDLE REINFORCEMENT PERFORMANCE & WELDING													
14.	pc	SADDLE NOZZLE (SWEEPOLET) - INSTALL. & WELDING													
15.	ea	EXPANSION U-BEND- PRESTRESSING													
16.	ea	GRINDING OF WELD ROOT EXCESS													
17.1.	ea	REDUCER FABRICATION, 1 DN SMALLER													
17.2.	ea	REDUCER FABRICATION, 2 DN SMALLER													
17.3.	ea	REDUCER FABRICATION, 3 DN SMALLER													
18.1.	bend	PIPE BENDING < 45^{o}													
18.2.	bend	PIPE BENDING 45^{oo} 90													
18.3.	bend	PIPE BENDING 90^{oo}180													
19.1.	joint	FLANGED JOINT NP 6 - 16, 150#													
19.2.	joint	FLANGED JOINT NP 25 64, 300# - 400#													
19.3.	joint	FLANGED JOINT NP 100 160, 600# - 900#													
19.4.	joint	FLANGED JOINT NP 250 400, 1500# - 2500#													

1. PIPING ERECTION AND DISMANTLING **UNIT MAN HOURS PER ACTIVITIES** Productivity Efficiency Percentage PEP=90%		Nom. dia. [inch]	4"	4"	6"	6"	8"	8"	8"	10"	10"	10"	12"	12"	12"
		OD ø[mm]	114,3	114,3	168,3	168,3	219,1	219,1	219,1	273,1	273,1	273,1	323,9	323,9	323,9
		Wall thickness t [mm]	6,00	8,60	7,10	11,00	7,09	8,20	12,70	7,80	9,30	12,70	8,38	9,50	12,70
		Schedule	40 STD	80 XS	40 STD	80 XS	30	40 STD	80 XS	30	40 STD	80S 60 XS	30	40S STD	80S XS
		Weight [kg/m]	16,0	22,4	28,3	42,7	36,7	42,7	64,7	51,1	60,6	81,6	65,4	73,8	97,6
Item	Unit	**A. PREFABRICATION AND ERECTION**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
20.1.	ea	INSTALLATION OF BLIND FLANGE NP 6 - 16, 150#													
20.2.	ea	INSTALLATION OF BLIND FLANGE NP 25 - 64, 300# - 400#													
20.3.	ea	INSTALLATION OF BLIND FLANGE NP 100 -160, 600# - 900#													
20.4.	ea	INSTALLATION OF BLIND FLANGE NP 250 -400, 1500#- 2500#													
21.	joint	FLANGED JOINT, TIGHTENING WITH A TORQUE WRENCH factor to items 19.1. - 4 and 20.1. - 4													
22.1.	ea	RF - BLANKING PLATE 150# PLACING OR TAKING OUT													
22.2.	ea	RF - BLANKING PLATE 300#- 400# PLACING OR TAKING OUT													
22.3.	ea	RF - BLANKING PLATE 600#- 900# PLACING OR TAKING OUT													
22.4.	ea	RF - BLANKING PLATE 1500#-2500# PLACING OR TAKING OUT													
23.1.	ea	RTJ - BLANKING PLATE 150# PLACING OR TAKING OUT													
23.2.	ea	RTJ - BLANKING PLATE 300#-400# PLACING OR TAKING OUT													
23.3.	ea	RTJ - BLANKING PLATE 600#-900# PLACING OR TAKING OUT													
23.4.	ea	RTJ - BLANKING PLATE 1500#-2500# PLACING OR TAKING OUT													
24.	ea	BLANKING PLATE - SPECTACLE, PLACING OR TAKING OUT factor to items 22.1. - 4. and 23.1. - 4.													
25.1.	ea	MEASURING ORIFICE 150# - INSTALLATION													
25.2.	ea	MEASURING ORIFICE 300#-400# - INSTALLATION													
25.3.	ea	MEASURING ORIFICE 600#-900# - INSTALLATION													
25.4.	ea	MEASURING ORIFICE 1500#-2500# - INSTALLATION													
26.1.	pc	INSTALLATION OF FLANGED-END VALVE NP 6 - 16, 150#													
26.2.	pc	INSTALLATION OF FLANGED-END VALVE NP 25-64, 300# - 400#													
26.3.	pc	INSTALLATION OF FLANGED-END VALVE NP100-160, 600# - 900#													
26.4.	pc	INSTALLATION OF FLANGED-END VALVE NP250-400,1500#-2500#													
27.	pc	INSTALLATION OF MOTOR DRIVE VALVE factor to items 26.1. ÷ 26.4													
28.	pc	INSTALLATION OF SAFETY VALVE factor to items 26.1. ÷ 26.4													
29.	pc	INSTALLATION OF CONTROL VALVE factor to items 26.1. ÷ 26.4													
30.1.	ea	DRAIN OR VENT VALVE WITH REINF. NOZZLES MAKE-ON & WELD.													
30.2.	ea	DRAIN OR VENT VALVE WITH 2 REINF. NOZZLES-MAKE-ON. & WELD.													
31.	ea	MAKE-ON OF BRANCH CONNECTION -" HOT TAP"													
32.	ea	DRILLING PROCESS PIPE FOR "HOT TAP"													

1. PIPING ERECTION AND DISMANTLING
UNIT MAN HOURS PER ACTIVITIES
Productivity Efficiency Percentage PEP=90%

		Nom. dia. [inch]	4"	4"	6"	6"	8"	8"	8"	10"	10"	10"	12"	12"	12"
		OD ø[mm]	114,3	114,3	168,3	168,3	219,1	219,1	219,1	273,1	273,1	273,1	323,9	323,9	323,9
		Wall thickness t [mm]	6,00	8,60	7,10	11,00	7,09	8,20	12,70	7,80	9,30	12,70	8,38	9,50	12,70
		Schedule	40 STD	80 XS	40 STD	80 XS	30	40 STD	80 XS	30	40 STD	80S 60 XS	30	40S STD	80S XS
		Weight [kg/m]	16,0	22,4	28,3	42,7	36,7	42,2	64,7	51,1	60,6	81,6	65,4	73,8	97,6
Item	Unit	**A. PREFABRICATION AND ERECTION**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
33.1.	test	PREPARATION OF EQUIPMENT FOR PRESSURE TESTING													
33.2.	m	SYSTEM PRESSURE TEST, LENGTH to - 100m													
33.3.	m	SYSTEM PRESSURE TEST, LENGTH from 100 - 200m													
33.4.	m	SYSTEM PRESSURE TEST, LENGTH from 200 - 500m													
33.5.	m	SYSTEM PRESSURE TEST, LENGTH above - 500m													
33.6.	m^3	VESSEL PRESSURE TEST, VOLUME to 10m3													
33.7.	m^3	VESSEL PRESSURE TEST, VOLUME from 10 to 15m3													
33.8.	m^3	VESSEL PRESSURE TEST, VOLUME above 15m3													
34.	m	PRESSURE TEST BY AIR OR NITROGEN													
35.	ea	PIPE THREADING													
36.	ea	FABRICATION OR DISASSEMBLING OF THREADED JOINT													
37.	ea	WELD ANNEALING BY GAS BURNER													
38.1.	m	PROCESS PIPE STEAM TRACING													
38.2.	m	SUPPLY OR RETURN PIPE OF STEAM TRACING													
38.3.	ea	FITTING TRACING													
38.4.	ea	FLANGED JOINT TRACING 2" and above													
38.5.	ea	VALVE TRACING 2" and above, - (FROSTSCHUTZ), flanges included													
38.6.	ea	VALVE TRACING 2" and above, flanges included													
38.7.	ea	VALVE TRACING under 2", flanges included													
38.8.	joint	FLANGED JOINT ON TRACER LINE													
38.9.	m	LAYING OF STEAM TRACING PIPING WITH SPACERS													
39.1.	ea	STEAM MANIFOLDS FOR 4 CONNECTIONS													
39.2.	ea	STEAM MANIFOLDS - ALLOWANCE PER EACH CONN. ABOVE 4 CONNEC.													
39.3.	ea	CONDENSATE COLLECTORS FOR 4 CONNECTIONS													
39.4.	ea	CONDENSATE COLLECTORS - ALLOWANCE PER EACH CONN. ABOVE 4 CONN.													
40.	m	STEAM TRACING ON Cr Ni PROCESS PIPE													
factor		to items 38.1. ; 38.3. - 38. 7.													
41.	ea	INSTALLATION OR REMOVAL OF CAPS AT PIPE END													
42.	ea	INSTALLATION OR REMOVAL OF DIRT MESH IN PIPING													
43.	ea	WELD PICKLING AT STAINLESS STEEL													
44.	ea	EXECUTION OF PASSES THROUGH WALLS OR SLABS													
45.1.	cut	PIPE CUTTING - COLD													
45.2.	cut	PIPE CUTTING - GAS BURNER													
46.1.	kg	PIPE SUPPORTS - FABRICATION													
46.2.	kg	PIPE SUPPORTS - ERECTION													

1. PIPING ERECTION AND DISMANTLING
UNIT MAN HOURS PER ACTIVITIES
Productivity Efficiency Percentage PEP=90%

		Nom. dia. [inch]	4"	4"	6"	6"	8"	8"	8"	10"	10"	10"	12"	12"	12"
		Outer dia. ø[mm]	114,3	114,3	168,3	168,3	219,1	219,1	219,1	273,1	273,1	273,1	323,9	323,9	323,9
		Wall thick. t [mm]	6,00	8,60	7,10	11,00	7,09	8,20	12,70	7,80	9,30	12,70	8,38	9,50	12,70
		Schedule	40 STD	80 XS	40 STD	80 XS	30	40 STD	80 XS	30	40 STD	80S 60XS	30	40S STD	80S XS
		Weight [kg/m]	16,0	22,4	28,3	42,7	36,7	42,7	64,7	51,1	60,6	81,6	65,4	73,8	97,6
Item	Unit	**B. PIPING DISMANTLING**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
47.1.	m	DISMANTLING PIPES FOR REUTILIZATION													
47.2.	m	DISMANTLING PIPES FOR USEFUL WASTE													
48.1.	ea	DISMANTLING FLANGED JOINT FOR REUTILIZATION 150#													
48.2.	ea	DISMANTLING FLANGED JOINT FOR REUTILIZATION 300# - 400#													
48.3.	ea	DISMANTLING FLANGED JOINT FOR REUTILIZATION 600#- 900#													
48.4.	ea	DISMANTLING FLANGED JOINT FOR REUTILIZATION 1500#-2500#													
49.	ea	DISMANTLING FLANGED JOINT FOR USEFUL WASTE factor to items 48.1. ÷ 48.4.													
50.	ea	DISMANTLING BLIND FLANGE FOR REUTILIZATION factor to items 20.1. ÷ 20.4.													
51.	ea	DISMANTLING BLIND FLANGE FOR USEFUL WASTE factor to items 20.1. ÷ 20.4. or 50.													
52.1.	ea	VALVE DISMANTLING FOR REUTILIZATION 150#													
52.2.	ea	VALVE DISMANTLING FOR REUTILIZATION 300# - 400#													
52.3.	ea	VALVE DISMANTLING FOR REUTILIZATION 600# - 900#													
52.4.	ea	VALVE DISMANTLING FOR REUTILIZATION 1500#-2500#													
53.	ea	VALVE DISMANTLING FOR USEFUL WASTE factor to items 52.1. ÷ 52.4.													
54.	ea	DISMANTLING MOTOR DRIVE VALVE FOR REUTILIZATION factor to items 52.1. ÷ 52.4.													
55.	ea	DISMANTLING MOTOR DRIVE VALVE FOR USEFUL WASTE factor to items 52.1. ÷ 52.4.													
56.	ea	DISMANTLING SAFETY VALVE FOR REUTILIZATION factor to items 52.1. ÷ 52.4.													
57.	ea	DISMANTLING SAFETY VALVE FOR USEFUL WASTE factor to items 52.1. ÷ 52.4.													
58.	ea	DISMANTLING CONTROL VALVE FOR REUTILIZATION factor to items 52.1. ÷ 52.4.													
59.	ea	DISMANTLING CONTROL VALVE FOR REUTILIZATION factor to items 52.1. ÷ 52.4.													

1. PIPING ERECTION AND DISMANTLING
UNIT MAN HOURS PER ACTIVITIES
Productivity Efficiency Percentage PEP=90%

		Nom. dia. [inch]	14"	14"	14"	16"	16"	16"	18"	18"	18"	20"	20"	20"	22"
		Outer dia. ø[mm]	355,6	355,6	355,6	406,4	406,4	406,4	457,2	457,2	457,2	508,0	508,0	508,0	559,0
		Wall thick. t [mm]	7,93	9,53	12,70	7,93	9,50	12,70	7,93	9,50	12,70	6,40	9,50	12,70	6,35
		Schedule	20	30 STD	XS	20	30 STD	40 XS	20	STD	XS	10	20 STD	30 XS	10
		Weight [kg/m]	67,8	81,2	108,0	77,7	93,1	123,0	87,6	105,0	139,0	78,0	117	155	87,3
Item	Unit	**A. PREFABRICATION AND ERECTION**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
1.1	m	PIPE LAYING WITHOUT PRIMER													
1.2	m	PIPE LAYING WITH PRIMER													
2.	m	LAYING OF PROCESS PIPE IN PROTECTION CONDUIT													
3.1	pc	INSTALLATION OF 1-END FITTINGS - HANDLING													
3.2	pc	INSTALLATION OF 2-END FITTINGS - HANDLING													
3.3	pc	INSTALLATION OF 3-END FITTINGS - HANDLING													
4.	weld	BUTT WELD MAKE-ON AND WELDING													
5.	weld	SOCKET WELD MAKE-ON AND WELDING													
6.	weld	SEAL WELD (AT THREADED JOINT)													
7.	weld	MITRE JOINT - MAKE-ON AND WELDING													
8.	weld	WELDING NECK FLANGES													
9.1	weld	WELDING SLIP-ON FLANGES & PRESSURE TEST													
9.2	weld	WELDING SLIP-ON FLANGES - NO PRESSURE TEST													
10.1	weld	WELDING MEASURING FLANGE & PRESSURE TEST													
10.2	weld	WELDING MEASURING FLANGE - NO PRESSURE TEST													
11.1	weld	NOZZLE WELD 90^{O} - NO REINFORCEMENT													
11.2	pc	COUPLING INSTALLATION & WELDING													
11.3	pc	WELDOLET ETC. INSTALLATION & WELDING													
12.	weld	NOZZLE WELD- BEVELLED NO REINFORCEMENT													
13.	weld	SADDLE REINFORCEMENT FABRICATION & WELDING													
14.	pc	SADDLE NOZZLE (SWEEPOLET) - INSTALLATION & WELD.													
15.	ea	EXPANSION U-BEND PRESTRESSING													
16.	ea	GRINDING WELD ROOT EXCESS													
17.1.	ea	REDUCER FABRICATION, 1 DN SMALLER													
17.2.	ea	REDUCER FABRICATION, 2 DN SMALLER													
17.3.	ea	REDUCER FABRICATION, 3 DN SMALLER													
18.1.	bend	PIPE BENDING < 45^{O}													
18.2.	bend	PIPE BENDING 45^{OO} 90													
18.3.	bend	PIPE BENDING 90^{OO}180													
19.1.	joint	FLANGED JOINT NP 6 - 16, 150#													
19.2.	joint	FLANGED JOINT NP 25 - 64, 300# - 400#													
19.3.	joint	FLANGED JOINT NP 100 - 160, 600# - 900#													
19.4.	joint	FLANGED JOINT NP 250 - 400, 1500# - 2500#													

1. PIPING ERECTION AND DISMANTLING
UNIT MAN HOURS PER ACTIVITIES
Productivity Efficiency Percentage PEP=90%

		Nom. dia. [inch]	14"	14"	14"	16"	16"	16"	18"	18"	18"	20"	20"	20"	22"
		Outer dia. ø[mm]	355,6	355,6	355,6	406,4	406,4	406,4	457,2	457,2	457,2	508,0	508,0	508,0	559,0
		Wall thick. t [mm]	7,93	9,53	12,70	7,93	9,50	12,70	7,93	9,50	12,70	6,40	9,50	12,70	6,35
		Schedule	20	30 STD	XS	20	30 STD	40 XS	20	STD	XS	10	20 STD	30 XS	10
		Weight [kg/m]	67,8	81,2	108,0	77,7	93,1	123,0	87,6	105,0	139,0	78,0	117,0	155,0	87,3
Item	Unit	**A. PREFABRICATION AND ERECTION**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
20.1.	ea	INSTALLATION OF BLIND FLANGE NP 6 - 16, 150#													
20.2.	ea	INSTALLATION OF BLIND FLANGE NP 25 - 64, 300# - 400#													
20.3.	ea	INSTALLATION OF BLIND FLANGE NP 100 -160, 600# - 900#													
20.4.	ea	INSTALLATION OF BLIND FLANGE NP 250 -400, 1500#- 2500#													
21. factor	joint	FLANGED JOINT, TIGHTENING WITH TORQUE WRENCH to items 19.1. - 4 and 20.1. 4													
22.1.	ea	RF - BLANKING PLATE 150# PLACING OR TAKING OUT													
22.2.	ea	RF - BLANKING PLATE 300#- 400# PLACING OR TAKING OUT													
22.3.	ea	RF - BLANKING PLATE 600#- 900# PLACING OR TAKING OUT													
22.4.	ea	RF - BLANKING PLATE 1500#-2500# PLACING OR TAKING OUT													
23.1.	ea	RTJ - BLANKING PLATE 150# PLACING OR TAKING OUT													
23.2.	ea	RTJ - BLANKING PLATE 300#-400# PLACING OR TAKING OUT													
23.3.	ea	RTJ - BLANKING PLATE 600#-900# PLACING OR TAKING OUT													
23.4.	ea	RTJ - BLANKING PLATE 1500#-2500# PLACING OR TAKING OUT													
24. factor	ea	BLANKING PLATE - SPECTACLE, PLACING OR TAKING OUT to items 22.1. - 4. and 23.1. - 4.													
25.1.	ea	MEASURING ORIFICE 150# - INSTALLATION													
25.2.	ea	MEASURING ORIFICE 300#-400# - INSTALLATION													
25.3.	ea	MEASURING ORIFICE 600#-900# - INSTALLATION													
25.4.	ea	MEASURING ORIFICE 1500#-2500# - INSTALLATION													
26.1.	pc	INSTALLATION OF FLANGED END VALVE NP 6 - 16, 150#													
26.2.	pc	INSTALLATION OF FLANGED END VALVE NP 25-64, 300# - 400#													
26.3.	pc	INSTALLATION OF FLANGED END VALVE NP100-160, 600# - 900#													
26.4.	pc	INSTALLATION OF FLANGED END VALVE NP250-400,1500#-2500#													
27.	pc	INSTALLATION OF MOTOR DRIVE VALVE factor to items 26.1. ÷ 26.4													
28.	pc	INSTALLATION OF SAFETY VALVES factor to items 26.1. ÷ 26.4													
29.	pc	INSTALLATION OF CONTROL VALVES factor to items 26.1. ÷ 26.4													
30.1.	ea	DRAIN OR VENT VALVE WITH 1 REINF. NOZZLE- MAKE-ON & WELD.													
30.2.	ea	DRAIN OR VENT VALVE WITH 2 REINF. NOZZLES MAKE-ON. & WELD													
31.	ea	MAKE-ON OF NOZZLE WELD -" HOT TAP"													
32.	ea	GRINDING OF PROCESS PIPE FOR "HOT TAP"													

1. PIPING ERECTION AND DISMANTLING
UNIT MAN HOURS PER ACTIVITIES
Productivity Efficiency Percentage PEP=90%

		Nom. dia. [inch]	14"	14"	14"	16"	16"	16"	18"	18"	18"	20"	20"	20"	22"
		Outer dia. ø[mm]	355,6	355,6	355,6	406,4	406,4	406,4	457,2	457,2	457,2	508,0	508,0	508,0	559,0
		Wall thick. t [mm]	7,93	9,53	12,70	7,93	9,50	12,70	7,93	9,50	12,70	6,40	9,50	12,70	6,35
		Schedule	20	30 STD	XS	20	30 STD	40 XS	20	STD	XS	10	20 STD	30 XS	10
		Weight [kg/m]	67,8	81,2	108,0	77,7	93,1	123,0	87,6	105,0	139,0	78,0	117,0	155,0	87,3
Item	Unit	**A. PREFABRICATION AND ERECTION**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
33.1.	test	PREPARATION OF EQUIPMENT FOR PRESSURE TESTING													
33.2.	m	SYSTEM PRESSURE TEST, LENGTH TO - 100m													
33.3.	m	SYSTEM PRESSURE TEST, LENGTH from 100 to 200m													
33.4.	m	SYSTEM PRESSURE TEST, LENGTH from 200 to 500m													
33.5.	m	SYSTEM PRESSURE TEST, LENGTH above 500m													
33.6.	m^{33}	VESSEL PRESSURE TEST, VOLUME to 10m													
33.7.	m^{33}	VESSEL PRESSURE TEST, VOLUME 10 -15m													
33.8.	m^{33}	VESSEL PRESSURE TEST, VOLUME above 15m													
34.	m	PRESSURE TEST BY AIR OR NITROGEN													
35.	ea	PIPE THREADING													
36.	ea	MAKE-ON OR DISASSEMBLING OF THREADED JOINT													
37.	ea	WELD ANNEALING BY GAS BURNER													
38.1.	m	PROCESS PIPE STEAM TRACING													
38.2.	m	SUPPLY OR RETURN PIPE OF STEAM TRACING													
38.3.	ea	FITTING TRACING													
38.4.	ea	FLANGED JOINT TRACING 2" and above													
38.5.	ea	VALVE TRACING 2" and above - (FROSTSCHUTZ), flanges included													
38.6.	ea	VALVE TRACING 2" and above, flanges included													
38.7.	ea	VALVE TRACING under 2", flanges included													
38.8.	joint	FLANGED JOINT ON TRACER LINE													
38.9.	m	LAYING STEAM TRACING PIPING WITH SPACERS													
39.1.	ea	STEAM MANIFOLDS FOR 4 CONNECTIONS													
39.2.	ea	STEAM MANIFOLDS - ALLOWANCE PER EACH CONN. ABOVE 4 CONN.													
39.3.	ea	CONDENSATE COLLECTORS FOR 4 CONNECTIONS													
39.4.	ea	CONDENSATE COLLECTORS - ALLOWANCE PER EACH CONN. ABOVE 4 CON.													
40.	m	STEAM TRACING ON Cr Ni PROCESS PIPE factor to items 38.1. ; 38.3. ÷ 38. 7.													
41.	ea	INSTALLATION OR REMOVAL OF CAPS AT PIPE END													
42.	ea	INSTALLATION OR REMOVAL OF DIRT MESH IN PIPING													
43.	ea	WELD PICKLING AT STAINLESS STEEL													
44.	ea	EXECUTION OF PASSES IN WALLS OR SLABS													
45.1.	cut	PIPE CUTTING - COLD													
45.2.	cut	PIPE CUTTING - GAS BURNER													
46.1.	kg	PIPE SUPPORTS - FABRICATION													
46.2.	kg	PIPE SUPPORTS - ERECTION													

1. PIPING ERECTION AND DISMANTLING
UNIT MAN HOURS PER ACTIVITIES
Productivity Efficiency Percentage PEP=90%

		Nom. dia. [inch]	14"	14"	14"	16"	16"	16"	18"	18"	18"	20"	20"	20"
		Outer dia. ø[mm]	355,6	355,6	355,6	406,4	406,4	406,4	457,2	457,2	457,2	508,0	508,0	508,0
		Wall thick. t [mm]	7,93	9,53	12,70	7,93	9,50	12,70	7,93	9,50	12,70	6,40	9,50	12,70
		Schedule	20	30 STD	XS	20	30 STD	40 XS	20	STD	XS	10	20 STD	30 XS
		Weight [kg/m]	67,8	81,2	108,0	77,7	93,1	123,0	87,6	105,0	139,0	78,0	117	155
Item	Unit	B. DISMANTLING OF PIPING	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
47.1.	m	DISMANTLING PIPES FOR REUTILIZATION												
47.2.	m	DISMANTLING PIPES FOR USEFUL WASTE												
48.1.	ea	DISMANTLING FLANGED JOINT FOR REUTILIZATION 150#												
48.2.	ea	DISMANTLING FLANGED JOINT FOR REUTILIZATION 300# - 400#												
48.3.	ea	DISMANTLING FLANGED JOINT FOR REUTILIZATION 600# - 900#												
48.4.	ea	DISMANTLING FLANGED JOINT FOR REUTILIZATION 1500#-2500#												
49.	ea	DISMANTLING FLANGED JOINT FOR USEFUL WASTE factor to items 48.1. ÷ 48.4.												
50.	ea	DISMANTLING BLIND FLANGE FOR REUTILIZATION factor to items 20.1. ÷ 20.4.												
51.	ea	DISMANTLING BLIND FLANGE FOR USEFUL WASTE factor to items 20.1. ÷ 20.4. or 50.												
52.1.	ea	DISMANTLING VALVE FOR REUTILIZATION 150#												
52.2.	ea	DISMANTLING VALVE FOR REUTILIZATION 300# - 400#												
52.3.	ea	DISMANTLING VALVE FOR REUTILIZATION 600# - 900#												
52.4.	ea	DISMANTLING VALVE FOR REUTILIZATION 1500#-2500#												
53.	ea	DISMANTLING VALVE FOR USEFUL WASTE factor to items 52.1. ÷ 52.4.												
54.	ea	DISMANTLING MOTOR DRIVE VALVE FOR REUTILIZATION factor to items 52.1. ÷ 52.4.												
55.	ea	DISMANTLING MOTOR DRIVE VALVE FOR USEFUL WASTE factor to items 52.1. ÷ 52.4.												
56.	ea	DISMANTLING SAFETY VALVES FOR REUTILIZATION factor to items 52.1. ÷ 52.4.												
57.	ea	DISMANTLING SAFETY VALVES FOR USEFUL WASTE factor to items 52.1. ÷ 52.4.												
58.	ea	DISMANTLING CONTROL VALVE FOR REUTILIZATION factor to items 52.1. ÷ 52.4.												
59.	ea	DISMANTLING CONTROL VALVE FOR USEFUL WASTE factor to items 52.1. ÷ 52.4.												

1. PIPING ERECTION AND DISMANTLING
UNIT MAN HOURS PER ACTIVITIES
Productivity Efficiency Percentage PEP=90%

		Nom. dia. [inch]	22"	22"	22"	24"	24"	24"	26"	28"	30"	32"	36"
		Outer dia. ø[mm]	559,0	559,0	559,0	609,6	609,6	609,6	660,0	711,2	762,2	812,8	914,0
		Wall thick. t [mm]	6,35	9,53	12,70	6,35	9,50	12,70	9,53	9,53	9,53	9,53	9,53
		Schedule	10	20 STD	30 XS	10	20 STD	XS	STD	STD	STD	STD	STD
		Weight [kg/m]	87,3	129	171	95,4	141	187	153	165	177	188	212
Item	Unit	**A. PREFABRICATION AND ERECTION**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
1.1	m	PIPE LAYING WITHOUT PRIMER											
1.2	m	PIPE LAYING WITH PRIMER											
2.	m	LAYING PROCESS PIPE IN PROTECTION CONDUIT											
3.1	pc	INSTALLATION OF FITTING WITH 1 END - HANDLING											
3.2	pc	INSTALLATION OF FITTING WITH 2 ENDS - HANDLING											
3.3	pc	INSTALLATION OF FITTING WITH 3 ENDS - HANDLING											
4.	weld	BUTT JOINT MAKE-ON & WELDING											
5.	weld	SOCKET WELD MAKE-ON & WELDING											
6.	weld	SEAL WELD (AT THREADED JOINT)											
7.	weld	MITRE WELD - MAKE-ON & WELDING											
8.	weld	WELDING NECK FLANGES											
9.1	weld	WELDING SLIP-ON FLANGES & PRESSURE TESTING											
9.2	weld	WELDING SLIP-ON FLANGES NO PRESSURE TESTING											
10.1	weld	WELDING MEASURING FLANGE & PRESSURE TESTING											
10.2	weld	WELDING MEASURING FLANGE - NO PRESSURE TESTING											
11.1	weld	BRANCH CONNECTION 90º - NO REINFORCEMENT											
11.2	pc	COUPLING - INSTALLATION & WELDING											
11.3	pc	WELDOLET ETC. INSTALLATION & WELDING											
12.	weld	INCLINED BRANCH CONNECTION NO REINFORCEMENT											
13.	weld	SADDLE REINFORCEMENT MAKE-ON & WELDING											
14.	pc	SADDLE NOZZLE (SWEEPOLET) - INSTALLATION & WELD.											
15.	ea	EXPANSION U-BEND PRESTRESSING											
16.	ea	GRINDING WELD ROOT EXCESS											
17.1.	ea	REDUCER FABRICATION, 1 DN SMALLER											
17.2.	ea	REDUCER FABRICATION, 2 DN SMALLER											
17.3.	ea	REDUCER FABRICATION, 3 DN SMALLER											
18.1.	bend	PIPE BENDING < 45º											
18.2.	bend	PIPE BENDING 45º - 90º											
18.3.	bend	PIPE BENDING > 90º											
19.1.	joint	FLANGED JOINT NP 6 - 16, 150#											
19.2.	joint	FLANGED JOINT NP 25 - 64, 300# - 400#											
19.3.	joint	FLANGED JOINT NP 100 - 160, 600# - 900#											
19.4.	joint	FLANGED JOINT NP 250 - 400, 1500# - 2500#											

1. PIPING ERECTION AND DISMANTLING
UNIT MAN HOURS PER ACTIVITIES
Productivity Efficiency Percentage PEP=90%

		Nom. dia. [inch]	22"	22"	22"	24"	24"	24"	26"	28"	30"	32"	36"
		Outer dia. ø[mm]	559,0	559,0	559,0	609,6	609,6	609,6	660,0	711,2	762,2	812,8	914,0
		Wall thick. t [mm]	6,35	9,53	12,70	6,35	9,50	12,70	9,53	9,53	9,53	9,53	9,53
		Schedule	10	20 STD	30 XS	10	20 STD	XS	STD	STD	STD	STD	STD
		Weight [kg/m]	87,3	129	171	95,4	141	187	153	165	177	188	212
Item	Unit	**A. PREFABRICATION AND ERECTION**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
20.1.	ea	INSTALLATION OF BLIND FLANGE NP 6 - 16, 150#											
20.2.	ea	INSTALLATION OF BLIND FLANGE NP 25 - 64, 300# - 400#											
20.3.	ea	INSTALLATION OF BLIND FLANGE NP 100 -160, 600# - 900#											
20.4.	ea	INSTALLATION OF BLIND FLANGE NP 250 -400, 1500#- 2500#											
21.	joint	FLANGED JOINT, TIGHTENING WITH TORQUE WRENCH factor to items 19.1. - 4 and 20.1. ÷ 21.4											
22.1.	ea	RF - BLANKING PLATE 150# PLACING OR TAKING OUT											
22.2.	ea	RF - BLANKING PLATE 300#- 400# PLACING OR TAKING OUT											
22.3.	ea	RF - BLANKING PLATE 600#- 900# PLACING OR TAKING OUT											
22.4.	ea	RF - BLANKING PLATE 1500#-2500# PLACING OR TAKING OUT											
23.1.	ea	RTJ - BLANKING PLATE 150# PLACING OR TAKING OUT											
23.2.	ea	RTJ - BLANKING PLATE 300#-400# PLACING OR TAKING OUT											
23.3.	ea	RTJ - BLANKING PLATE 600#-900# PLACING OR TAKING OUT											
23.4.	ea	RTJ - BLANKING PLATE 1500#-2500# PLACING OR TAKING OUT											
24.	ea	BLANKING PLATE - SPECTACLE, PLACING OR TAKING OUT factor to items 22.1. - 4. and 23.1. - 4.											
25.1.	ea	MEASURING ORIFICE 150# - INSTALLATION											
25.2.	ea	MEASURING ORIFICE 300#-400# - INSTALLATION											
25.3.	ea	MEASURING ORIFICE 600#-900# - INSTALLATION											
25.4.	ea	MEASURING ORIFICE 1500#-2500# - INSTALLATION											
26.1.	pc	INSTALLATION OF FLANGED END VALVE NP 6 - 16, 150#											
26.2.	pc	INSTALLATION OF FLANGED END VALVE NP 25-64, 300# - 400#											
26.3.	pc	INSTALLATION OF FLANGED END VALVE NP100-160, 600# - 900#											
26.4.	pc	INSTALLATION OF FLANGED END VALVE NP250-400,1500#-2500#											
27.	pc	INSTALLATION OF MOTOR DRIVE VALVE factor to items 26.1. ÷ 26.4											
28.	pc	INSTALLATION OF SAFETY VALVES factor to items 26.1. ÷ 26.4											
29.	pc	INSTALLATION OF CONTROL VALVES factor to items 26.1. ÷ 26.4											
30.1.	ea	DRAIN OR VENT VALVE WITH 1 REINF. NOZZLE- MAKE-ON & WELD.											
30.2.	ea	DRAIN OR AIR VENT WITH 2 REINF. NOZZLES MAKE-ON & WELD.											
31.	ea	MAKE-ON OF BRANCH CONNECTION -" HOT TAP"											
32.	ea	GRINDING OF PROCESS PIPE FOR "HOT TAP"											

1. PIPING ERECTION AND DISMANTLING
UNIT MAN HOURS PER ACTIVITIES
Productivity Efficiency Percentage PEP=90%

		Nom. dia. [inch]	22"	22"	22"	24"	24"	24"	26"	28"	30"	32"	36"
		Outer dia. ø[mm]	559,0	559,0	559,0	609,6	609,6	609,6	660,0	711,2	762,2	812,8	914,0
		Wall thick. t [mm]	6,35	9,53	12,70	6,35	9,50	12,70	9,53	9,53	9,53	9,53	9,53
		Schedule	10	20 STD	30 XS	10	20 STD	XS	STD	STD	STD	STD	STD
		Weight [kg/m]	87,3	129	171	95,4	141	187	153	165	177	188	212
Item	Unit	**A. PREFABRICATION AND ERECTION**	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u	Mhr/u
33.1.	test	PREPARATION OF EQUIPMENT FOR PRESSURE TEST											
33.2.	m	SYSTEM PRESSURE TEST, LENGTH to - 100m											
33.3.	m	SYSTEM PRESSURE TEST, LENGTH from 100 to 200m											
33.4.	m	SYSTEM PRESSURE TEST, LENGTH from 200 to 500m											
33.5.	m	SYSTEM PRESSURE TEST, LENGTH above - 500m											
33.6.	m^{33}	VESSEL PRESSURE TEST, VOLUME to 10m											
33.7.	m^{33}	VESSEL PRESSURE TEST, VOLUME 10 ÷ 15m											
33.8.	m^{33}	VESSEL PRESSURE TEST, VOLUME above 15m											
34.	m	PRESSURE TEST BY AIR OR NITROGEN											
35.	ea	PIPE THREADING											
36.	ea	MAKE-ON OR DISASSEMBLING OF THREADED JOINT											
37.	ea	WELD ANNEALING BY GAS BURNER											
38.1.	m	PROCESS PIPE STEAM TRACING											
38.2.	m	SUPPLY OR RETURN PIPE OF STEAM TRACING											
38.3.	ea	FITTING TRACING											
38.4.	ea	FLANGED JOINT TRACING 2" and above											
38.5.	ea	VALVE TRACING 2" and above, (Frostschutz), flanges included											
38.6.	ea	VALVE TRACING 2" and above, flanges included											
38.7.	ea	VALVE TRACING under2", flanges included											
38.8.	joint	FLANGED JOINT ON TRACER LINE											
38.9.	m	LAYING OF STEAM TRACING PIPING WITH SPACERS											
39.1.	ea	STEAM MANIFOLDS FOR 4 CONNECTIONS											
39.2.	ea	STEAM MANIFOLDS - ALLOWANCE PER EACH CONN. ABOVE 4 CONN.											
39.3.	ea	CONDENSATE COLLECTORS FOR 4 CONNECTIONS											
39.4.	ea	CONDENSATE COLLECTORS - ALLOWANCE PER EACH CONN. ABOVE 4 C.											
40.	m	Cr Ni PROCESS PIPE STEAM TRACING											
factor		to items 38.1. ; 38.3. ÷ 38. 7.											
41.	ea	INSTALLATION OR REMOVAL OF CAPS AT PIPE END											
42.	ea	INSTALLATION OR REMOVAL OF DIRT MESH IN PIPING											
43.	ea	PICKLING STAINLESS STEEL WELD											
44.	ea	EXECUTION OF PASSES THROUGH WALLS OR SLABS											
45.1.	cut	PIPE CUTTING - COLD											
45.2.	cut	PIPE CUTTING - GAS BURNER											
46.1.	kg	PIPE SUPPORTS - FABRICATION											
46.2.	kg	PIPE SUPPORTS - ERECTION											

2. MAN HOURS FOR OVERHAUL OF EQUIPMENT IN PETROCHEMICAL PLANTS (PEP = 90%)

1. HEAT EXCHANGERS

1.1. Type - STANDARD (HAARNADEL) : Mhr for 10mm of heat exchanger diameter

1.2. Type - WITH A FLOAT HEAD (SCHWIMMKOPF): Mhr for 10mm of heat exchanger diameter

1.3. Type - REBOILER WITH EXPANSION (TYP REBOILER MIT KOMPENSATOR):
Mhr for 10mm of heat exchanger diameter
WORKS INCLUDED:
- Opening and disassembling of heat exchanger head
- Extraction of pipe bundle
- Transport of pipe bundle to cleaning
- Cylinder washing
- Bolt cleaning and lubrication with graphite grease
- Reassembling and completing
- Pressure tests of the assembly
- Possible removal of branch piping and reinstallation

1.4. PLACEMENT OR REMOVAL OF BLANKING PLATES
MAN HOURS FOR PIPING OVERHAUL [ITEM. 22.1. ÷ 22.4] X

1.5. SPECIAL PRESSURE TESTING OF PIPE BUNDLE AND PIPE CLOSING
TO CALCULATE AT OVERHEADS HOUR OR:

1.5.1. PRESSURE TESTS: Mhr for 10 mm of heat exchanger diameter
1.5.2. PIPE CLOSING - PLUG: Mhr for each pipe

2. PRESSURE VESSELS

2.1. OPENING OR CLOSING OF MANHOLES ON VESSELS AND TOWERS

DN 500 - 20"	[Mhr/ea]
DN 600 - 24"	[Mhr/ea]
DN 700 - 28"	[Mhr/ea]
DN 800 - 32"	[Mhr/ea]
DN 900 - 36"	[Mhr/ea]
DN 1000 - 40"	[Mhr/ea]

2.2. OPENING PASSAGES, CLEANING, INSIDE INSPECTION, CLOSING AND PRESSURE TESTING

to 1m^3	[Mhr/ea]
1 - 2m^3	[Mhr/m^3]
2 - 3m^3	[Mhr/m^3]
3 - 4m^3	[Mhr/m^3]
4 - 5m^3	[Mhr/m^3]
5 - 10m^3	[Mhr/m^3]
10 - 25m^3	[Mhr/m^3]
25 - 50m^3	[Mhr/m^3]
50 - 75m^3	[Mhr/m^3]
above 75m^3	[Mhr/m^3]

2.3. DISMANTLING PLATES AND DEMISTERS AND REASSEMBLING
TO CALCULATE ACC. TO TABLE 3.1 ON PAGE 71
(CHAPTER IV: ERECTION OF EQUIPMENT IN PETROCHEMICAL PLANTS)

2.4. INSTALLATION OR REMOVAL OF BLANKING PLATES
MAN HOURS FOR PIPING OVERHAUL [ITEM 22.1. ÷ 22.4] X

3. WORK AT HIGHER ELEVATION (ABOVE A STABLE FLOOR)

VALID FOR PIPING AND EQUIPMENT OVERHAUL

ELEVATION	FACTOR
in a canal	
0 - 3 m	
3 - 6 m	
6 - 9 m	
9 - 12 m	
12 - 15 m	
above 15 m	

XIV. MAN HOURS FOR PIPING AND STEEL STRUCTURES IN "TECHNIP" TENDERS

A. PIPING BETWEEN PLANTS AND IN PLANTS

1. CALCULATION FACTORS

Calculate a uniform factor for each item by multiplying below factors and enter it in front of each item.

1.1. MATERIAL MULTIPLIERS

- MATERIAL:	Factor
- Carbon steel	
- Galvanized C. S .	
- Killed C.S.	
- C.S. cement lined	
- C.S. ebonite lined	
- C.S. teflon lined	
- C.S. rubber lined	
- C.S. epoxy lined	
- Alloy steel carbon moly (0,5 Mo)	
- Alloy steel 1 Cr - 0,5 Mo	
- Alloy steel 1,25 Cr - 0,5 Mo	
- Alloy steel 2,25 Cr - 1,0 Mo	
- Alloy steel 3 Cr - 1,0 Mo	
- Alloy steel 5 Cr - 0,5 Mo	
- Alloy steel 9 Cr - 0,5 Mo	
- Alloy steel 12 Cr	
- Alloy steel 2,5 Ni	
- Alloy steel 3,5 Ni	
- Alloy steel 9 Ni	
- C.S. or Alloy Wet H2 S nace	
(Calculated to the previous factor)	

- MATERIAL	Factor
- Stainless steel AISI 304-304H-304L	
- Stainless steel AISI 309-309S	
- Stainless steel AISI 310-310S	
- Stainless steel AISI 316 + Titanium	
- Stainless steel AISI 317-317L	
- Stainless steel AISI 321-347H	
- Stainless steel AISI 329	
- Stainless steel AISI 347	
- Aluminium alloys welded (BW/SW)	1,50
- Aluminium alloys - threaded (THD)	1,00
- Cooper alloys	
- Nickel alloys	
Monel	
Inconel	
Incoloy	
Hastelloy	
- Titanium	
- Jacketed C.S.	
- Jacketed inox /C.S.	
- Jacketed inox	
- GR 1: HPVC(high vinylpolyethylene)	
- GR 2: KS Resin (Vinyl ester resin)	

1.2. FACTORS FOR UNDERGROUND INSTALLATION
(Calculated to the material mulpltipliers)
- Prewrapped pipes: no prewrapping ; with prewrapping
- Not wrapped pipes: no prewrapping ; with prewrapping

1.3. FACTORS FOR % RADIOGRAPHIC INSPECTIONS (NDE /RT)
(Calculated to the material multipliers)

Cost (NDE/RT) not included		Cost (NDE/RT) included
to 10% -		
20% -		
50% -		
100% -		

1.4. FACTOR FOR HEAT TREATMENT (PWHT)
If heat treatment is foreseen, calculate with the factor of to the material multipliers.
This factor includes the man hours for PWHT

2. PIPES (PEP = 75%)

2.1. MAN HOURS - TABLE FOR PIPES, page 37
Take the manhour [Mhr/ton] for 1-mm wall thickness for relative average diameter and enter it in the pipe weight column. Multiply the average wall thickness by the manhour and total weight in tons.
If each item is not identified the wall thickness, it shall be estimated.

2.2. PREFABRICATION / INSTALLATION RATIO: acc. to table on page 49

3. FITTINGS (PEP = 75%)

3.1. MAN HOURS - TABLES FOR FITTINGS, page 38
Procedure as under item 2.1.

3.2. PREFABRICATION / INSTALLATION RATIO: acc. to table on page 49

4. FLANGES

4.1. MAN HOURS - TABLE FOR FLANGES, page 30 and 31 (PEP = 80%)
Manhour [Mhr/kg] to be selected for the nearest diameter and assumed pressure.
If the quantity is given in tons [Mhr/kg] multiply by 1000.
If the calculation is based on PEP = 75%, the manhour should be multiplied by 1,07.

4.2. PREFABRICATION / INSTALLATION RATIO: acc. to table on page 49

5. BRANCH CONNECTION (N° OF BRANCH), PREFABRICATION 100% (PEP = 75 %)

5.1. BRANCH 90°, BW /SW to 1 1/2" - Mhr /ea

5.2. BRANCH 90°, BW

2" - 6" -	X aver. Ø = Mhr/ ea
6" - 10" -	X aver. Ø = Mhr/ ea
10"- 14" -	X aver. Ø = Mhr/ ea
14"- 20" -	average Ø = Mhr/ ea
above 20" -	Xaver. Ø = Mhr/ ea

5.3. BRANCH 45°, BW, VALUES UNDER 5.2 TO BE INCREASED %

6. VALVES, 100% INSTALLATION (PEP = 75 %)

6.1. WITH FLANGED ENDS (FLG.) Table for valves on page 39
Manhour [Mhr/kg] to be selected for the nearest diameter and assumed pressure.
If the quantity is given in tons [Mhr/kg], multiply by 1000.

6.2. WITH WELDING ENDS

6.2.1. FOR BUTT WELDING (BW):
Triple the man hours acc. to item 6.1.

6.2.2. SOCKET WELDING AND THREADED JOINTS (SW/THD)
Since in practice the most frequently used valves are < 2" and pressure 300-800#,
I suggest the calculation is made with the manhour:

[Mhr/ kg] or [Mhr/ ton] (PEP = 75%)

6.3. CONTROL AND SAFETY VALVES (ON/OFF)
Man hours acc. to item 6.1 to be increase times or [Mhr/ kg]

7. MISCELLANEOUS, INSTALLATION 100% (PEP = 75%)
This item includes all other unlisted piping elements.
The effect of installation [kg/Mhr] is equal to the average diameter in inches.

Calculate as follows: $\frac{1}{\text{aver. Ø}} = \frac{\text{Mhr}}{\text{kg}}$ or $\frac{1000}{\text{aver. Ø}} = \frac{\text{Mhr}}{\text{ton}}$ or aver. Ø $= \frac{\text{kg}}{\text{Mhr}}$

8. PIPING SUPPORTS

8.1. MAN HOURS (PEP = 75%)

8.1.1. BASED ON AVERAGE DIAMETER:
The effect of fabrication and installation [kg/Mhr] is equal to the average diameter in inches.

Calculate as follows: $\frac{\text{kg}}{\text{Mhr}}$ = aver.Ø or $\frac{1}{\text{aver. Ø}} = \frac{\text{Mhr}}{\text{kg}}$ or = $\frac{1000}{\text{aver. Ø}} = \frac{\text{Mhr}}{\text{ton}}$

A DIVISION OF HOURS TO FABRICATION & INSTALLATION HOURS SPLIT UP

	FABRICATION	INSTALLATION
to 2"	.%	.%
2,1" - 4,0"	.%	.%
4,1" - 8,0"	.%	.%
8,1" - 15"	.%	.%
above 15"	.%	.%

8.1.2. BASED ON UNIT WEIGHT OF SUPPORTS (PEP =75%)

		FABRICATION [Mhr/kg]	INSTALLATION [Mhr/kg]	TOTAL [Mhr/kg]
- Small supports	to 1,5 kg/pc.	------		
- Supports	1,51 - 5,0 kg/pc.			
- Supports	5,01 - 25 kg/pc.			
- Supports	25,01 - 50 kg/pc.			
- Supports	50,01 -100 kg/pc.			
- Supports	above 1,5 kg/pc.			
- Spring supports		------		

B. STEEL STRUCTURE ERECTION

Productivity Efficiency Percentage (PEP) = 75%

Item	STEEL STRUCTURE	Unit	Mhr/ Unit
1811.01E	Steel piperack Structure - Type I	kg	
1811.02E	Steel piperack Structure - Type II	kg	
1812.01E	Steel process Structure - Type I	kg	
1812.02E	Steel process Structure - Type II	kg	
1813.01E	Steel shelter Structure - Type I	kg	
1813.02E	Steel shelter Structure - Type II	kg	
1815.01E	Steel structure - Type III	kg	
1814.16E	Steel structure - Type IV	kg	
1814.08E	Steel grating for straight platforms	kg	
1814.09E	Steel grating for circular platforms	kg	
1814.10E	Stair steps in steel grating	u	
1814.11E	Chequered plate for straight platform	kg	
1814.12E	Chequered plate for circular platform	kg	
1814.05E	Straight railing	kg	
1814.06E	Sloped railing	kg	
1814.07E	Circular railing	kg	
1814.14E	Vertical ladder with safety cage	kg	
1814.15E	Vertical ladder without safety cage	kg	
1821.01E	Steel sheeting for roofing	sqm	
1821.02E	Steel sandwich panels for roofing	sqm	
1822.01E	Steel sheeting for siding	sqm	
1822.02E	Steel sandwich panels for siding	sqm	
1822.03E	Fiberglass translucid sheeting	sqm	
1823.04E	Galvanized steel gutter	m	
1823.05E	Steel downspout	m	
1823.06E	Cast iron downspout terminal	u	
	Steel Structures-Type 1 (Trestle) (M)	kg	
	Steel Structures-Type 2 (Pipe rack) (H)	kg	
	Steel Structures-Type 2 (Structures) (H)	kg	
	Steel Structures-Type 3 (Platforms) (L)	kg	
	Steel Structures-Type 4 (Count. sad.) (L)	kg	
	Handrails, straight (L)	kg	
	Handrails for sloped stair (L)	kg	
	Handrails circular (L)	kg	
	Galvanized grating straight flooring	kg	
	Galvanized grating circular flooring	kg	
	Galvanized grating stair steps	kg	
	Chequered plate straight flooring (L)	kg	
	Corrugated steel plate for flooring (L)	kg	
	Chequered plate circular flooring (L)	kg	
	Chequered plate stair steps (L)	kg	
	Ladders with safety cage (L)	kg	
	Ladders without safety cage (L)	kg	
	Roofing Corr. Prep. Galv. Steel Sheet 8/10	sqm	
	Roofing type Prep. Galv. Sandwich Panels	sqm	
	Siding Corr. Prep. Galv. Steel Sheet 8/10	sqm	
	Siding type Prep. Galv. Sandwich Panels	sqm	
	Fiberglass translucid double sheet & frame	sqm	
	Galvanized steel standard doors	sqm	
	Galvanized steel sliding doors	sqm	
	Galvanized steel rolling doors	sqm	
	Galvanized steel window	sqm	
	Metal louvers type adjustable	sqm	
	Continuous ridge vent on top roof	m	

XV. APPENDIX

1. ISO R7 DIN 2448/2458 SUMMARY OF PIPE SCHEDULED SIZES, WALL THICKNESS AND UNIT MASS [kg/m]

Dn-mm	OD-mm	Wall thick. Std|Ext	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	6,3	7,1	8	8,8	10	11	12,5
15	21,3	2\2	0,95	1,08	1,2	1,32	1,43	1,57	1,71	1,86	2,01								
20	26,9	2\2,3	1,23	1,4	1,56	1,72	1,87	2,07	2,26	2,49	2,7	2,94	3,2						
25	33,4	2\2,6	1,55	1,76	1,97	2,18	2,38	2,65	2,9	3,21	3,5	3,84	4,21	4,61					
32	42,4	2\2,6	1,99	2,27	2,55	2,82	3,09	3,44	3,79	4,21	4,61	5,08	5,61						
40	48,3	2,3\2,6	2,28	2,61	2,93	3,25	3,56	3,97	4,37	4,86	5,34	5,9	6,53	7,21	7,95	8,57	9,45	10,1	11
50	60,3	2,3\2,9	2,88	3,29	3,7	4,11	4,51	5,03	5,55	6,19	6,82	7,55	8,39	9,32	10,3	11,2	12,4	13,4	14,7
65	73	2,6\2,9	3,5	4,01	4,51	5,01	5,51	6,16	6,81	7,6	8,38	9,31	10,4	11,5	12,8	13,9	15,5	16,8	18,7
65	76,1	2,6\2,9	3,65	4,19	4,71	5,24	5,75	6,44	7,11	7,95	8,77	9,74	10,8	12,1	13,4				
80	88,9	2,9\3,2	4,29	4,91	5,53	6,15	6,76	7,57	8,38	9,37	10,3	11,5	12,8	14,3	16	17,4	19,5	21,1	23,6
100	114,3	3,2\3,6	5,54	6,35	7,16	7,97	8,77	9,83	10,9	12,2	13,5	15	16,8	18,8	21	22,9	25,7	28	31,4
125	139,7	3,6\4			8,79	9,78	10,8	12,1	13,4	15	16,6	18,5	20,7	23,2	26	28,4	32	34,9	39,2
150	168,3	4\4,5				11,8	13	14,6	16,2	18,2	20,1	22,5	25,2	28,2	31,6	34,6	39	42,7	48
200	219,1	4,5\6,3				17	19,1	21,2	23,8	26,4	29,5	33,1	37,1	41,6	45,6	51,6	56,5	63,7	
250	273	5\6,3					21,3	23,9	26,5	29,8	33	36,9	41,4	46,6	52,3	57,3	64,9	71,1	80,3
300	323,9	5,6\7,1				25,3	28,4	31,6	35,4	39,3	44	49,3	55,5	62,3	68,4	77,4	84,9	96	
350	355,6	5,6\8					27,8	31,3	34,7	39	43,2	48,3	54,3	61	68,6	75,3	85,2	93,5	106
400	406,4	6,3\8,8					35,8	39,7	44,6	49,5	55,4	62,2	69,9	78,6	86,3	97,8	107	121	
450	457	6,3\10						40,3	44,7	50,2	55,7	62,3	70	78,8	88,6	97,3	110	121	137
500	508	6,3\11						44,8	49,7	55,9	62	69,4	77,9	87,7	98,6	108	123	135	153
550	559	6,3\12,5								61,5	68,3	76,4	85,9	96,6	109	119	135	149	168
600	610	6,3\12,5								67,2	74,6	83,5	93,8	106	119	130	148	162	184
650	660	7,1\14,2									80,8	90,4	102	114	129	141	160	176	200
700	711	7,1									87,1	97,4	109	123	139	152	173	190	215
750	762	8										104	117	132	149	163	185	204	231
800	813	8									99,6	112	125	141	159	175	198	218	247
850	864	8,8											133	150	169	186	211	231	262
900	914	10									112	125	141	159	179	196	223	245	278
Dn-mm	OD-mm	Wall thick. Std|Ext	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	6,3	7,1	8	8,8	10	11	12,5

Above weights are for carbon and alloy steel pipe only. For austenitic stainless steel multiply by 1.02.
For ferritic stainless multiply by 0.95.

kg/m x 0. 67197 = lbs/ft

(CONTINUATION ISO R7 DIN 2448/2458 PIPES)

Dn-mm	OD-mm	Wall thick. Std|Ext	14,2	16	17,5	20	22,2	25	28	30	32	36	40	45	50	55	60	65	70
15	**21,3**	**2\2**																	
20	**26,9**	**2\2,3**																	
25	**33,7**	**2\2,6**																	
32	**42,4**	**2\2,6**																	
40	**48,3**	**2,3\2,6**																	
50	**60,3**	**2,3\2,9**	16,1																
65	**73**	**2,6\2,9**	20,6																
65	**76,1**	**2,6\2,9**																	
80	**88,9**	**2,9\3,2**	26,2	28,8															
100	**114,3**	**3,2\3,6**	35,1	38,8	41,8														
125	**139,7**	**3,6\4**	43,9																
150	**168,3**	**4\4,5**	54	60,1	65,1	73,1	80												
200	**219,1**	**4,5\6,3**	71,8	80,1	87	98,2	108	120	132										
250	**273**	**5\6,3**	90,6	101	110	125	137	153	169										
300	**323,9**	**5,6\7,1**	108	121	132	150	165	184	204	217	230								
350	**355,6**	**5,6\8**	120	134	146	166	183	204	226	241	255	284							
400	**406,4**	**6,3\8,8**	137	154	168	191	210	235	261	278	295	329	361						
450	**457**	**6,3\10**	155	174	190	216	238	266	296	316	335	374	411	457					
500	**508**	**6,3\11**	173	194	212	241	266	298	331	354	376	419	462	514	565				
550	**559**	**6,3\12,5**	191	214	234	266	294	329	367	391	416	464	512	570	628	684			
600	**610**	**6,3\12,5**	209	234	256	291	322	361	402	429	456	510	562	627	691	753	814		
650	**660**	**7,1\14,2**	226	254	277	316	349												
700	**711**	**7,1**	244	274	299	341													
750	**762**	**8**	262	294	321	366													
800	**813**	**8**	280	314	343	391	433												
850	**864**	**8,8**	298	335	365	416													
900	**914**	**10**	315	354	387	441	488												
Dn-mm	**OD-mm**	**Wall thick. Std|Ext**	**14,2**	**16**	**17,5**	**20**	**22,2**	**25**	**28**	**30**	**32**	**36**	**40**	**45**	**50**	**55**	**60**	**65**	**70**

Above weights are for carbon and alloy steel pipe only. For austenitic stainless steel multiply by 1.02.
For ferritic stainless multiply by 0.95.

kg/m x 0. 67197 = lbs/ft

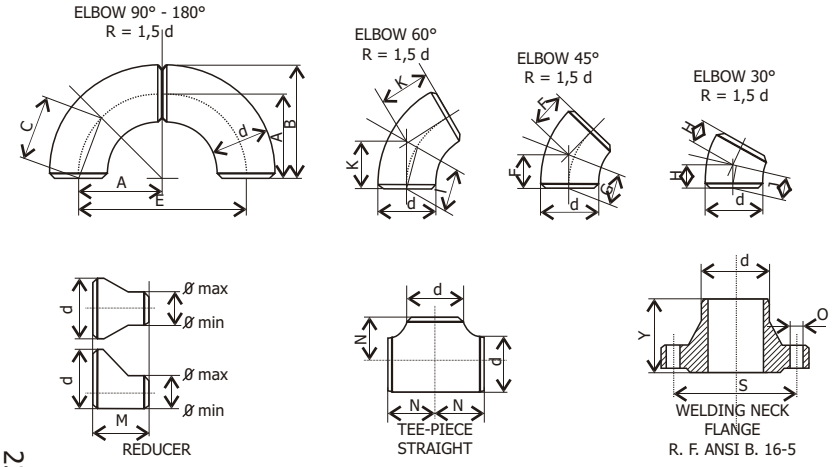
2. ANSI B 36.10 SUMMARY OF PIPE SCHEDULED SIZES, WALL THICKNESS AND UNIT MASS

wall thickness	1,73	[mm] x 0.03937 = inch
unit mass	0,36	[kg/m] x 0.67197 = lbs/ft

Dn	OD[mm]	5 S	10 S	10	20	30	STD 40 S	40	60	XS 80 S	80	100	120	140	160	XXS
1/8"	10,3		1,24 0,28				1,73 0,36			2,41 0,46						
1/4"	13,71		1,65 0,49				2,24 0,63			3,02 0,80						
3/8"	17,14		1,65 0,63				2,31 0,85			3,2 1,10						
1/2"	21,34	1,65 0,80	2,11 1,00				2,77 1,27			3,73 1,62					4,78 1,94	7,47 2,55
3/4"	26,67	1,65 1,03	2,11 1,28				2,87 1,68			3,91 2,19					5,56 2,90	7,82 3,63
1"	33,40	1,65 1,29	2,77 2,08				3,38 2,50			4,55 3,23					6,35 4,18	9,09 5,45
1 1/4"	42,16	1,65 1,65	2,77 2,69				3,56 3,38			4,85 4,46					6,35 5,58	9,70 7,76
1 1/2"	48,26	1,65 1,90	2,77 3,12				3,68 4,05			5,08 5,41					7,14 7,22	10,16 9,55
2"	60,32	1,65 2,38	2,77 3,94				3,91 5,44			5,54 7,49					8,74 11,08	11,07 13,45
2 1/2"	73,02	2,11 3,70	3,05 5,26				5,16 8,68			7,01 11,42					9,52 14,88	14,02 20,41
3"	88,90	2,11 4,50	3,05 6,45				5,49 11,29			7,62 15,27					11,13 20,98	15,24 27,67
4"	114,30	2,11 5,81	3,05 8,34				6,02 16,07			8,56 22,31			11,13 28,25		13,49 33,48	17,12 41,02
5"	141,30	2,77 9,45	3,40 11,56				6,55 21,78			9,52 30,95			12,7 40,24		15,88 49,11	19,05 57,42
6"	168,30	2,77 11,31	3,40 13,82				7,11 28,26			10,97 42,56			14,27 54,20		18,26 67,22	21,95 79,18
8"	219,10	2,77 14,78	3,76 19,94		6,35 33,03	7,04 36,72	8,18 42,53		10,31 52,88	12,70 64,63		15,09 75,80	18,26 90,32	20,62 101,04	23,01 111,32	22,22 107,87
10"	273,00	3,40 22,62	4,19 27,83		6,35 41,70	7,8 51,00	9,27 60,29		12,7 81,46	12,7 81,46	15,09 95,95	18,26 114,59	21,44 132,74	25,40 154,94	28,58 172,14	25,40 154,94
12"	323,85	3,96 33,00	4,57 36,00		6,35 49,81	8,38 65,07	9,52 73,82	10,31 79,67	14,27 108,97	12,7 97,36	17,47 131,70	21,44 159,52	25,40 186,77	28,58 206,96	33,34 238,11	25,40 186,77
14"	355,60	3,96 34,23	4,78 41,18	6,35 54,63	7,92 67,95	9,52 81,28	9,52 81,28	11,13 94,31	15,09 126,49	12,7 107,28	19,05 157,94	23,82 194,82	27,79 224,42	31,75 253,14	35,71 281,38	
16"	406,40	4,19 41,60	4,78 47,33	6,35 62,58	7,92 77,88	9,52 93,21	9,52 93,21	12,7 123,18	16,64 159,98	12,7 123,18	21,44 203,16	26,19 245,32	30,96 286,44	36,52 332,62	40,49 364,85	
18"	457,20	4,19 46,83	4,78 53,18	6,35 70,53	7,92 87,81	11,13 122,12	9,52 105,14	14,27 155,90	19,05 205,62	12,7 139,07	23,82 254,19	29,36 309,44	34,92 363,19	39,67 408,01	45,24 459,18	
20"	508,00	4,78 59,22	5,54 68,50	6,35 78,47	9,52 117,07	12,7 154,97	9,52 117,07	15,09 183,12	20,62 247,79	12,7 154,97	26,19 310,90	32,54 381,04	38,10 440,93	44,45 587,54	50,01 564,14	
22"	558,80			6,35 86,49	9,52 129,01	12,7 171,01	9,52 129,01		22,22 294,06	12,7 171,01	28,6 373,58	34,92 451,14	41,28 526,70	47,62 600,27	53,98 671,85	
24"	609,60	5,54 82,60	6,35 94,37	6,35 94,37	9,52 140,94	14,27 209,54	9,52 140,94	17,48 254,74	24,61 354,64	12,7 186,75	30,96 441,10	38,89 546,92	46,02 639,18	52,37 718,94	59,54 806,61	
26"	660,40			7,92 127,58	12,7 202,65		9,52 152,87			12,7 202,65						
28"	711,20			7,92 137,50	12,7 218,51	15,88 271,90	9,52 164,63			12,7 218,51						
30"	762,00			7,92 147,33	12,7 234,44	15,88 291,81	9,52 176,78			12,7 234,44						
32"	812,80			7,92 156,58	12,7 250,33	15,88 311,67	9,52 188,66	17,48 352,28		12,7 250,33						
34"	863,60			7,92 166,82	12,7 266,35	15,88 331,54	9,52 200,59	17,48 363,91		12,7 266,35						
36"	914,40			7,92 177,12	12,7 282,12	15,88 351,41	9,52 212,52	19,05 420,17		12,7 282,12						

Above weights are for carbon and alloy steel pipe only. For austenitic stainless steel multiply by 1.02.
For ferritic stainless multiply by 0.95.

3. DIMENSIONS - TABLE MANUAL



ANSI B 36.10 SUMMARY OF PIPE SCHEDULED SIZE - WALL THICKNESS [mm]

DN [inch]	OD d	Schedule					STD and	Schedule		XS and			Schedule			XXS
	[mm]	5S	10S	10	20	30	40S	40	60	80S	80	100	120	140	160	
1/2"	21,3	1,65	2.11				2,77			3,73					4,78	7,47
3/4"	26,7	1.65	2.11				2.87			3,91					5,56	7,82
1"	33,4	1.65	2.77				3.38			4,55					6,35	9,09
1 1/4"	42,2	1.65	2.77				3.56			4,85					6,35	9,70
1 1/2"	48,3	1.65	2.77				3.68			5,08					7,14	10,16
2"	60,3	1.65	2.77				3.91			5,54					8,74	11,07
2 1/2"	73,0	2.11	3.05				5.16			7,01					9,52	14,02
3"	88,9	2.11	3.05				5.49			7,62					11,13	15,24
4"	114,3	2.11	3.05				6.02			8,56			11,13		13,49	17,12
5"	141,3	2.77	3.40				6.55			9,52			12,70		15,88	19,05
6"	168,3	2.77	3.40				7.11			10,97			14,27		18,26	21,95
8"	219,1	2.77	3.76		6.35	7,04	8.18		10,31	12,70		15,09	18,26	20,62	23,01	22,22
10"	273,0	3.40	4.19		6.35	7,80	9.27		12,70	12,70	15,09	18,26	21,44	25,40	28,58	25,40
12"	323,8	3.96	4.57		6.35	8,38	9.52	10.31	14,27	12,70	17,47	21,44	25,40	28,58	33,34	25,40
14"	355,6	3.96	4.78	6.35	7.92	9,52	9.52	11.13	15,09	12,70	19,05	23,82	27,79	31,75	35,71	
16"	406,4	4.19	4.78	6.35	7.92	9,52	9.52	12.70	16,64	12,70	21,44	26,19	30,96	36,52	40,49	
18"	457,2	4.19	4.78	6.35	7.92	11,13	9.52	14.27	19,05	12,70	23,82	29,36	34,92	39,67	45,24	
20"	508,0	4.78	5.54	6.35	9.52	12,70	9.52	15.09	20,62	12,70	26,19	32,54	38,10	44,45	50,01	
24"	609,6	5.54	6.35	6.35	9.52	14,27	9.52	17.48	24,61	12,70	30,96	38,89	46,02	52,37	59,54	

DN [mm]	OD d	A	B	C	E	F	G	H	J	K	L	M	ø max	ø min	N	O 150#	O 300#	S 150#	S 300#	Y 150#	Y 300#	GASKET 150#	GASKET 300#	NR. OF BORE 150#	NR. OF BORE 300#	STUD BOLTS 150#	STUD BOLTS 300#
1/2"	21,3	38	48	29	76	16	15	10	10	22	-	--		-	25	16	16	60,3	66,7	47,6	52,4	48x21	54x21	4	4	12x65	12x70
3/4"	26,7	29	43	22	57	11	11	8	8	17	15	38	1/2"	3/8"	29	16	20	69,9	82,5	52,4	57,1	57x27	67x27	4	4	12x65	16x75
1"	33,4	38	56	29	76	22	15	10	10	22	20	51	3/4"	3/8"	38	16	20	79,4	88,9	55,6	61,9	67x33	73x33	4	4	12x70	16x85
1 1/4"	42,2	48	70	37	95	25	19	-	13	-	25	51	1"	1/2"	48	16	20	88,9	98,4	57,1	65,1	76x42	83x42	4	4	12x70	16x85
1 1/2"	48,3	57	83	44	114	29	22	15	15	33	30	63	1 1/4"	1/2"	57	16	23	98,4	114,3	61,9	68,3	86x49	95x49	4	4	12x75	20x95
2"	60,3	76	106	58	152	35	30	20	20	44	39	76	1 1/2"	3/4"	64	20	20	120,6	127	63,5	69,8	105x60	111x60	4	8	16x85	16x90
2 1/2"	73,0	95	132	73	191	44	37	-	25	-	49	89	2"	1"	76	20	23	139,7	149,2	69,8	76,2	124x73	130x73	4	8	16x90	20x100
3"	88,9	114	159	87	229	51	44	32	30	66	59	89	2 1/2"	1 1/4"	86	20	23	152,4	168,3	69,8	79,4	137x89	149x89	4	8	16x95	20x110
4"	114,3	152	210	116	305	64	59	41	40	88	79	102	3"	1 1/2"	105	20	23	190,5	200	76,2	85,7	175x114	181x114	8	8	16x95	20x115
5"	141,3	190	262	145	381	79	74	-	50	-	98	127	4"	2"	124	23	23	215,9	234,9	88,9	98,4	197x141	216x141	8	8	20x100	20x120
6"	168,3	229	313	175	457	95	89	61	60	132	119	140	5"	2 1/2"	143	23	23	241,3	269,9	88,9	98,4	222x168	251x168	8	12	20x100	20x125
8"	219,1	305	414	233	610	127	119	82	80	176	158	152	6"	4"	178	23	26	298,4	330,2	101,6	111,1	279x219	308x219	8	12	20x110	22x140
10"	273,0	381	518	292	762	159	149	102	99	220	197	178	8"	4"	216	26	29	361,9	387,3	101,6	117,5	340x273	362x273	12	16	22x120	24x160
12"	323,8	457	619	350	914	190	178	123	119	264	237	203	10"	5"	254	26	32	431,8	450,8	114,3	130,2	410x324	422x324	12	16	22x120	30x170
14"	355,6	533	711	408	1067	222	208	143	139	308	276	330	12"	6"	279	29	32	476,2	514,3	127	142,9	451x356	486x356	12	20	24x135	30x180
16"	406,4	610	813	467	1219	254	238	163	159	352	316	356	14"	8"	305	29	35	539,7	571,5	127	146	515x406	540x406	16	20	24x140	33x190
18"	457,2	686	914	525	1372	286	268	183	179	396	355	381	16"	10"	343	32	35	577,8	628,5	139,7	158,7	550x457	595x457	16	24	30x150	33x195
20"	508,0	762	1016	583	1524	318	297	204	199	440	394	508	18"	12"	381	32	35	635	685,8	144,5	161,9	605x508	655x508	20	24	30x160	33x210
24"	609,6	914	1219	700	1829	381	357	245	239	528	473	508	22"	16"	432	35	42	749,3	812,8	152,4	168,3	720x610	775x610	20	24	33x180	39x235

4. STEEL STRUCTURE - SURFACES OF SECTIONS in m²/m

Painting areas = areas for cleaning***) in sqm per meter in lenght

Developed ⊔- shape (with application of section factor U/A for fire protection calculation)

I PE DIN 1025

80	0,328
100	0,4
120	0,475
140	0,551
160	0,623
180	0,698
200	0,768
220	0,848
240	0,922
270	1,04
300	1,16
330	1,25
360	1,35
400	1,47
450	1,61
500	1,74
550	1,88
600	2,01

I PE o and PE v

180 o	0,71
200 o	0,78
220 o	0,86
240 o	0,93
270 o	1,05
300 o	1,17
330 o	1,27
360 o	1,37
400 o	1,48
400 v	1,49
450 o	1,62
450 v	1,64
500 o	1,76
500 v	1,78
550 o	1,89
550 v	1,92
600 o	2,05
600 v	2,07

I PBS *)

360/380 x	14	2,17
	24	2,26
500/350 x	12	2,30
	21	2,39
600/350 x	13	2,50
	21	2,57
700/380 x	14,5	2,82
	21	2,88
1000/400 x	16,5	3,49
	21	3,53
800 (h = 788)		2,69
(h = 800)		2,73
1000 (h = 990)		3,10
(h = 1012)		3,14

I PES

	(h = 503,2)	1,75
	(h = 506,2)	1,77
550	(h = 553)	1,88
	(h = 556,2)	1,89
600	(h = 603,2)	2,02
	(h = 606,4)	2,03
750	(h = 738)	2,31
*)	(h = 766)	2,39

*) Intermediate value interpolate

**) For all greater thickness areas will be increased fo around 0.002 m² per each milimeter

H P DIN 1019 **)

80 x 6	0,19
100 x 7	0,24
120 x 7	0,28
140 x 7	0,32
160 x 7	0,37
180 x 8	0,41
200 x 9	0,46
220 x 10	0,5
240 x 10	0,55
260 x 10	0,59
280 x 11	0,64
300 x 11	0,68
320 x 12	0,73
340 x 12	0,77
370 x 13	0,84
400 x 14	0,91
430 x 15	0,98

I DIN 1025

80	0,3
100	0,37
120	0,44
140	0,5
160	0,58
180	0,64
200	0,71
220	0,78
240	0,84
260	0,91
280	0,97
300	1,03
320	1,09
340	1,15
360	1,21
380	1,27
400	1,33
425	1,41
450	1,48
475	1,55
500	1,63
550	1,80
600	1,92

I PB DIN 1025 (HE - B)

100	0,57
120	0,69
140	0,81
160	0,92
180	1,04
200	1,15
220	1,27
240	1,38
260	1,50
280	1,62
300	1,73
320	1,77
340	1,81
360	1,85
400	1,93
450	2,03
500	2,12
550	2,22
600	2,32
650	2,42
700	2,52
800	2,71
900	2,91
1000	3,11

I PBI DIN 1025 (HE - A)

100	0,56
120	0,68
140	0,79
160	0,91
180	1,02
200	1,14
220	1,26
240	1,37
260	1,48
280	1,60
300	1,72
320	1,76
340	1,79
360	1,83
400	1,91
450	2,01
500	2,11
550	2,21
600	2,31
650	2,41
700	2,50
800	2,70
900	2,90
1000	3,10

I PBv DIN 1025 (HE - M)

100	0,619
120	0,738
140	0,857
160	0,97
180	1,09
200	1,2
220	1,32
240	1,46
260	1,57
280	1,69
300	1,83
320 305	1,78
320	1,87
340	1,9
360	1,93
400	2
450	2,1
500	2,18
550	2,28
600	2,37
650	2,47
700	2,56
800	2,75
900	2,93
1000	3,13

⊔ DIN 1026

30x15	0,103
30	0,174
40x20	0,142
40	0,199
50 x 25	0,181
50	0,232
60 x 30	0,215
65	0,273
80	0,312
100	0,372
120	0,434
140	0,489
160	0,546
180	0,611
200	0,661
220	0,718
240	0,775
260	0,834
280	0,89
300	0,95
320	0,982
350	1,05
380	1,11
400	1,18

L DIN 1028

20	0,077
25	0,097
30	0,116
35	0,136
40	0,155
45	0,174
50	0,194
55	0,213
60	0,233
65	0,252
70	0,272
75	0,291
80	0,311
90	0,351
100	0,39
110	0,43
120	0,469
130	0,508
140	0,547
150	0,586
160	0,625
180	0,705
200	0,785
250	0,983

L DIN 1029

30x20	0,097
40x20	0,117
40x25	0,127
45x30	0,146
50x30	0,156
50x40	0,177
60x30	0,175
60x40	0,195
65x50	0,224
70x50	0,235
75x50	0,244
75x55	0,254
80x40	0,234
80x60	0,274
80x65	0,283
90x60	0,294
100x50	0,292
100x65	0,321
100x75	0,341
120x80	0,391
130x65	0,381
130x90	0,43
150x75	0,441
150x100	0,489
160x80	0,469
180x90	0,528
200x100	0,587

⊥ DIN 1027

30	0,2
40	0,23
50	0,25
60	0,28
80	0,34

T PS DIN 59051

20	0,08
25	0,1
30	0,12
35	0,14
40	0,16

Kranschienen A DIN 536 Bl. 1

45	0,38
55	0,45
65	0,52
75	0,586
100	0,612
120	0,688

O DIN 2440 DIN 2441

10,2	0,032
13,5	0,042
17,2	0,054
21,3	0,067
26,9	0,085
33,7	0,106
42,4	0,133
48,3	0,152
60,3	0,189
76,1	0,239
88,9	0,279
101,6	0,319
108	0,339
114,3	0,359
133	0,418
139,7	0,439
159	0,5
165,1	0,519
168,3	0,53
193,7	0,61
219,1	0,7
244,5	0,77
273	0,86
323,9	1,02
355,6	1,12
406,4	1,28
457,2	1,44
508	1,6
558,8	1,78
609,6	1,92
711,2	2,23
812,8	2,55
914,4	2,87
1016	3,19

T DIN 1024

20	0,075
25	0,094
30	0,114
35	0,133
40	0,153
45	0,171
50	0,191
60	0,229
70	0,268
80	0,307
90	0,345
100	0,383
120	0,459
140	0,537

T B DIN 1024

30	0,171
35	0,201
40	0,233
50	0,287
60	0,345

□ DIN 59410

40 x 2,9	0,155
4	0,153
50 x 2,9	0,195
4	0,193
60 x 2,9	0,235
4	0,233
5	0,231
70 x 3,2	0,275
4	0,273
5	0,271
80 x3,6	0,314
4,5	0,312
5,6	0,31
90 x 3,6	0,354
4,5	0,352
5,6	0,35
100 x 4	0,393
5	0,391
6,3	0,389
120 x4	0,469
5,6	0,467
6,3	0,465
140 x 5	0,547
7,1	0,543
8,8	0,539
160 x 6	0,618
8	0,613
10	0,606
180 x 6,3	0,698
8	0,693
10	0,686
200 x 6,3	0,778
8	0,773
10	0,766
220 x 6,3	0,858
8	0,853
10	0,846
260 x 7,1	1,02
8,8	1,01
11	1,00
280 x 8	1,09
10	1,09
13	1,08
320 x 10	1,25
13	1,24
16	1,23
360 x 10	1,41
13	1,40
16	1,39
400 x 13	1,56
16	1,55
20	1,53

L S DIN 1022

20	0,08
25	0,1
30	0,12
35	0,14
40	0,16
45	0,18
50	0,2

□ DIN 59410

50 x 30 x 2,9	0,155
4	0,153
60 x 40 x 2,9	0,195
4	0,193
70 x 40 x 2,9	0,215
4	0,213
80 x 40 x 2,9	0,235
4	0,233
5	0,231
90 x 50 x 3,2	0,275
4	0,273
5	0,271
100 x50 x 3,6	0,294
4,5	0,292
5,6	0,29
100 x 60 x 3,6	0,314
4,5	0,312
5,6	0,31
120 x 60 x 4,5	0,35
5	0,348
6,3	0,345
140 x 80 x 4	0,43
5	0,428
6,3	0,425
160 x 90 x 4,5	0,485
5,6	0,481
7,1	0,476
180 x 100 x 5,6	0,541
7,1	0,536
8,8	0,53
200 x 120 x 6,3	0,618
8	0,613
10	0,606
220 x 120 x 6,3	0,658
8	0,653
10	0,646
260 x 140 x 6,3	0,778
8	0,773
10	0,766
260 x 180 x 6,3	0,858
8	0,853
10	0,846
280 x 180 x 7,1	0,896
8,8	0,89
11	0,882
280 x 220 x 8	0,973
10	0,966
13	0,957
320 x 180 x 8,8	0,97
10	0,966
13	0,957
320 x 220 x 8,8	1,05
10	1,05
13	1,04
360 x 220 x 10	1,13
13	1,12
16	1,11
400 x 260 x 11	1,28
14	1,27
18	1,26

***) For sandblasting, four (4) standards of preparation grade (cleaning/grade of surface prepare.) Sa 1, Sa 2, Sa 2 ½, Sa 3 and two preparation grades process of scraping, wire-brushing and grinding (St 2, St 3) manual or machine and preparation grade F1 for burning. As well, and Be for pickling will conform with DIN 55 928, Part 4 standard.

5. CONVERSIONS BETWEEN ENGLISH AND (SI) STANDARD UNITS

QUANTITY

Length	millimeter (mm)	inch (in)	1 inch = 25.4 mm
Pressure*	bar (bar g, or bar a)	pounds/sq. in. (psig or psial)	1 bar = 14.5 psi
Pressure**	mm or mercury (mm Hg)	inches of mercury (in Hg)	1 in.Hg = 25.4 mm Hg
Flow***	liters per minute (l/min)	U.S. gallons per minute (U.S. GPM)	1 U.S. GPM = 3.79 l/min
Flow+	cubic decimeters/sec (dm^3/sec)	cubic feet per minute (cfm)	1 dm^3/sec = 2.12 cfm
Force	Newton (N)	pound (f) or lb (f) (force)	1 lb (f) = 4.44 N
Mass	kilogram (Kg)	pound (m) or lb (m) (mass)	1 Kg = 2.2 lb (m)
Time	second (sec)	second (sec)	-
Volume***	liter (l)	gallon (U.S. gal)	1 U.S. gal = 3.79 l
Temperature	degrees Celsius (°C)	degrees Fahrenheit (°F)	°C = 5/9 (°F -32)
Torque	Newton-meters (Nm)	pounds (f) inches [lbs(f)-in]	1 Nm = 8.88 lb (f)-in
Power	kilowatt (kw)	horsepower (HP)	1 kw = 1.34 HP
Shaft speed	revolutions per minute (rpm)	revolutions per minute (rpm)	-
Frequency	Hertz (Hz)	cycles per second (cps)	1 Hz = 1 cps
Displacement	millimeters/revolution (ml/rev)	cubic inches per revolution (cipr) or (cir)	1 ml/rev = 0.061 cipr
Kinematic viscosity	centistokes (cSt)	Saybolt Universal Seconds (SUS or SSU)	cSt = (4.635) (SSU)++
Velocity	meter per second (m/s)	feet per second (fps)	1 m/s = 3.28 fps

NOTES:

*Pressure above atmospheric. **Pressure below atmospheric. ***Liquid. +Gas. ++@38°C; Factor is 4.667@99°C

LENGTH

mm	x	0.03937	=	inches	x	25.4	=	mm
cm	x	0.3937	=	inches	x	2.54	=	cm
meters	x	39.37	=	inches	x	0.254	=	cm
meters	x	3.281	=	feet	x	0.3048	=	meters
meters	x	1.0936	=	yards	x	0.9144	=	meters
Km	x	3280.8	=	feet	x	0.0003048	=	Km
Km	x	1093.6	=	yards	x	0.0009144	=	Km
Km	x	0.6214	=	miles	x	1.609	=	Km
Km	x	0.5397	=	sea miles	x	1.853	=	Km

AREA

sq mm	x	0.00155	=	sq inches	x	645.2	=	sq mm
sq cm	x	0.155	=	sq inches	x	6.452	=	sq cm
sq meters	x	10.764	=	sq feet	x	0.0929	=	sq met.
sq meters	x	1.196	=	sq yards	x	0.8361	=	sq met.
sq Km	x	0.3861	=	sq milesyardsx		2.59	=	sq Km
hectares	x	2.471	=	acres	x	0.4047	=	hectares

VOLUME

cu cm	x	0.061023	=	cu inches	x	16.387	=	cu cm
cu cm	x	0.3381	=	fl ounces	x	29.57	=	cu cm
liters	x	61.023	=	cu inches	x	0.016387	=	liters
liters	x	0.03531	=	cu feet	x	28.317	=	liters
liters	x	0.2642	=	U.S. gal	x	3.785	=	liters
liters	x	0.22	=	Imperial gal	x	4.544	=	liters
cu meters	x	35.314	=	cu feet	x	0.02832	=	cu met.
cu meters	x	6.3226	=	barrel (oil)	x	0.158162	=	cu met.
cu meters	x	6.1104	=	barrel (Eng.)	x	0.163656	=	cu met.

MASS (WEIGHT)

grams	x	15.432	=	grains	x	0.0648	=	grams
grams	x	0.0353	=	oz. avoir-dupois	x	28.35	=	grams
Kg	x	35.27	=	oz. avoir-dupois	x	0.02835	=	Kg
Kg	x	2.2046	=	lbs	x	0.4536	=	Kg
Kg	x	0.001102	=	U.S. tons	x	907.2	=	Kg
Kg	x	0.000984	=	long tons	x	1016.048	=	Kg
tons (metric)	x	19.684	=	cwt (Eng.)	x	0.0508	=	tons (metric)
tons (metric)	x	22.046	=	cwt (US)	x	0.04536	=	tons (metric)

PRESSURE

qr/sq cm	x	0.01422	=	p.s.i. (lb/sq in)	x	70.31	=	qr/sq cm
Kg/sq cm	x	14.22	=	p.s.i. (lb/sq in)	x	0.07031	=	Kg/sq cm
Atmosphere	x	14.70	=	p.s.i. (lb/sq in)	x	0.06804	=	Atmosphere
Atu	x	14.22	=	p.s.i. (lb/sq in)	x	0.07031	=	Atu
bar	x	14.5	=	p.s.i. (lb/sq in)	x	0.069	=	bar

UNIT VOLUME

liters/min	x	0.2642	=	U.S. gpm	x	3.785	=	liters/min
liters/min	x	0.03531	=	cfm	x	28.317	=	liters/min
liters/hr	x	0.0044	=	U.S. gpm	x	227.1	=	liters/hr
cu m/min	x	35.314	=	cfm	x	0.02832	=	cu m/min
cu m/hr	x	0.5886	=	cfm	x	1.6992	=	cu m/hr
cu m/hr	x	4.4028	=	U.S. gpm	x	0.2271	=	cu m/hr

POWER

Watts	x	0.00134	=	hp	x	745.7	=	Watts
Kw	x	1.3410	=	hp	x	0.7457	=	Kw
Kw	x	0.948	=	Btu/sec	x	1.05486	=	Kw
Kw	x	0.5272	=	Ctu/sec	x	1.8967	=	Kw
cheval vap.	x	0.9863	=	hp	x	1.0139	=	cheval vap.

WORK/TORQUE

mkp (mkg)	x	7.233	=	ft lbs	x	0.1383	=	mkp (mkg)
mkp (mkg)	x	86.80	=	inch - lbs	x	0.0115	=	mkp (mkg)
cmkp (cmkg)	x	0.868	=	inch - lbs	x	1.15	=	cmkp (cmkg)
Kw/hr	x	0.000293	=	Btu	x	3413	=	Kw/hr
Kw/hr	x	0.0001628	=	Ctu	x	6143	=	Kw/hr

MISCELLANEOUS

Circumference of cyrcle	=	3.1416 x dia	=	6.2832 x radius
Area of Circle	=	$0.7854 \times (\text{dia})^2$	=	$3.1416 \times (\text{radius})^2$
Area Sphere	=	$3.1416 \times (\text{dia})^2$		
Volume of Sphere	=	$0.5236 \times (\text{dia})^2$		
1 lb per sq in is equivalent to 0.06804 atmospheres				