FLUOR
ESTIMATING

STANDARD UNIT WORK HOURS

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INTRODUCTION

PURPOSE

The purpose of this manual is to provide a unit work hour base for the preparation of construction estimates.

APPLICATION

The unit work hours in this manual represent Fluor Daniel standards. It is the estimator's responsibility to apply his/her knowledge and experience in the adjustment of these units, to obtain total erection hours.

The Standard Unit Work Hours also provide a consistent base of reference so that estimators of every sector and office can communicate intelligently and effectively.

ACKNOWLEDGEMENT

The work hour units in this manual represent the collective efforts of Fluor Daniel Construction history.

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BASIS OF WORK HOUR UNITS

- The unit work hours are based from projects located in the United States and Canada.
- The unit work hours are **neutral** with respect to weather and geographic location and must be adjusted to reflect site-specific conditions.
- A grass roots condition (level and dry).
- Mild climate (i.e., 40°- 85° F).
- Project work site to be less than 5,000 feet above sea level.
- Seismic zone of 0.
- All work areas are free of contamination.
- All work to be performed during daylight hours.
- Workweek is 40 hours per week (4-10 hour workdays or 5-8 hour workdays).
- Maximum height of work limited to 20 feet above floor/grade. Minimum headroom = 8'0".
- Workspace per each worker ranges from 250 to 350 square feet.
- Maximum haul distance from storage/laydown area is 1,000 feet.
- Brass alley/gate 2000 feet or less from work area.
- Engineering deliverables and material deliveries are received according to project schedule.
- Skilled craft is available.
- Skilled field staff is available.
- Construction equipment and small tools are available.
- General foreman, operators, and truck drivers that are required for work activities are included in the unit work hours.
- Scaffolding **is not** included in the unit work hours.
- Rework for design errors **is not** included.
- Surveyors **are not** included.
- Show up time **is not** included in the unit work hours.
- Tool and warehouse workers **are not** included in the unit work hours.

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EARTHWORK UNIT WORK HOURS

DESCRIPTION	WH's	UOM
A. GENERAL SITEWORK		
Clear Brush		
Light	6.0	ACRE
Medium	8.0	ACRE
Heavy	10.0	ACRE
Clear, Grub and Remove Trees, including stumps (Based on an average of 100 trees per acre, 8" diameter or less – excludes load, haul and disposal off site)	20.0	ACRE
Strip Topsoil – 6" depth		
Up to 4,000 CY	0.05	CY
For additional CY's above 4,000 (Maximum haul on site – 500 feet)	0.03	CY
Scarify and Compact to 6" deep	0.03	SQ.YD.
Cut and Fill (Maximum 500 foot travel/haul)	0.05	CY
Construct Earthfill Dikes	0.3	CY
In Plant Roads – base course only		
8" aggregate – crushed rock	0.015	SQ.YD.
12" sub base – select fill	0.022	SQ.YD.
B. MASS AREA EXCAVATION	0.15	CY
C. INDIVIDUAL FOUNDATION EXCAVATION		
100% Machine Excavation (Medium soil – common earth and loam) (Excavated material placed next to excavation site. For excess excavated material haul, see Load, Haul and Dump activity)		
Structures	0.5	CY
Buildings	0.5	CY
Equipment	0.5	CY
Pipe Supports	0.5	CY
Basins and Pits	0.5	CY
Manholes	0.5	CY
Reservoirs and Ponds	0.3	CY
Trenching	0.3	CY

For dirt placed in waiting truck for haul and dump, add 20% to above units.

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EARTHWORK UNIT WORK HOURS

DESCRIPTION	WH's	UOM
C. INDIVIDUAL FOUNDATION EXCAVATION – con't.		
100% Hand Excavation (Medium soil – common earth and loam)	2.5	CY
100% Hand Trenching (Medium soil – common earth and loam)	2.2	CY
100% Machine Backfill/Compaction (Medium soil – common earth and loam)	0.6	CY
100% Hand Backfill/Compaction (Medium soil – common earth and loam)	2.0	CY
Bedding (for pipe) (Work hour unit is for the placement and compaction of the bedding. It is a combination of machine and hand work)	0.4	CY
Finish Grading (for Process Areas - includes 100% handwork around individual equipment foundations)	0.1	SQ.YD.
Fine Grading (for Paving - applies to In-plant roads and parking areas)	0.02	SQ.YD.
Site Finish – gravel/stone – 6" thick (Based on gravel being dry, loose and weighing 100 pounds/CF)	0.05	SQ.YD.
Patch Asphalt (4" thick maximum)	0.8	SQ.YD.
Load, Haul and Dump – excess excavation (1 mile haul maximum)	0.1	CY

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EARTHWORK UNIT WORK HOURS

NOTES

1. All unit work hours are based on average crew mixes and equipment types and sizes.
   For more definitive estimates, refer to Means, Richardson or other recognized estimating publications.

2. Unit work hours include time for equipment operators, laborers, Foreman and General Foreman.

3. For medium soil (common earth and loam), use work hour units as shown.

4. Soil adjustments:

Soil Type:	Multiplier
Light Soil (Sand)	**0.8**
Medium Soil (Common earth and loam)	**1.0**
Heavy or Hard Soil (Compacted loam/stiff clay)	**1.4**
Hard Pan or Shale	**1.6**

5. Swell/Compaction factors:

Soil Type:	Adder:
Light Soil (Sand)	**15%**
Medium Soil (Common earth and loam)	**20%**
Heavy or Hard Soil (Compacted loam/stiff clay)	**25%**
Hard Pan or Shale	**35%**

6. For the cubic yardage of excavation that has a high water content, use a **1.8** multiplier. This allows for excavated material that falls back into excavated site.

7. Make appropriate adjustments to base work hour units when soil conditions become more densely filled with boulder material.

8. All sitework clearing based on onsite disposal (see various categories for allowable distances).

9. For any activities required which are not included in this section, see Means, Richardson or other recognized estimating publications.

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CONCRETE UNIT WORK HOURS

DESCRIPTION	FORMWORK WH's	FORMWORK UOM	PLACE & FINISH WH's	PLACE & FINISH UOM
A. FORMWORK/PLACE & FINISH				
Area Paving	0.35	SQ.FT.	2.7	CY
Blocks – Large (over 3 CY)	0.25	SQ.FT.	1.5	CY
Blocks – Small (3 CY or less)	0.30	SQ.FT.	2.5	CY
Catch Basins	0.50	SQ.FT.	4.0	CY
Columns	0.35	SQ.FT.	3.7	CY
Curb	0.30	SQ.FT.	3.5	CY
Curb & Gutter	0.40	SQ.FT.	3.5	CY
Electrical Envelope (Duct Bank)	0.20	SQ.FT.	0.5	CY
Elevated Beams	0.40	SQ.FT.	3.7	CY
Elevated Slabs (Float Finish)	0.40	SQ.FT.	2.0	CY
Fireproofing (Steel Beams/Columns)	0.35	SQ.FT.	10.0	CY
Grade Beam	0.30	SQ.FT.	0.7	CY
Grade Beam – Exposed w/ Finish	0.30	SQ.FT.	1.6	CY
Horizontal Shell/Pipe Sleeper – Footing	0.30	SQ.FT.	0.6	CY
Horizontal Shell/Pipe Sleeper – Wall/Pier	0.40	SQ.FT.	2.4	CY
Manholes	0.50	SQ.FT.	4.0	CY
Mass Pours (25+ CY)	0.25	SQ.FT.	0.9	CY
Miscellaneous Small Pads	0.50	SQ.FT.	4.0	CY
Mud Mats	0.05	SQ.FT.	1.8	CY
Octagon Pad	0.45	SQ.FT.	1.5	CY
Octagon Pier	0.50	SQ.FT.	3.0	CY
Piers	0.40	SQ.FT.	2.4	CY
Pile Caps	0.35	SQ.FT.	0.6	CY
Pits & Trenches - Bottoms	0.35	SQ.FT.	1.0	CY
Pits & Trenches - Walls	0.45	SQ.FT.	3.0	CY
Retaining Walls – Footings	0.30	SQ.FT.	0.6	CY
Retaining Walls – Walls	0.40	SQ.FT.	2.0	CY
Ring Walls/Curved Structures	0.40	SQ.FT.	0.7	CY
Sidewalk – 4" to 6" thick	0.35	SQ.FT.	3.0	CY
Slab on Grade (Float Finish)	0.35	SQ.FT.	2.7	CY
Sono Tubes	0.40	LF	3.0	CY
Spread Footings	0.30	SQ.FT.	0.6	CY
Stairs – Formed	0.45	SQ.FT.	3.3	CY
Stairs – Pan Type	N/A		7.0	CY
Steam Turbine Pedestal	1.00	SQ.FT.	4.5	CY
Tie Beam	0.30	SQ.FT.	0.7	CY
Walls – Buildings	0.30	SQ.FT.	2.0	CY

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CONCRETE UNIT WORK HOURS

DESCRIPTION	FORMWORK WH's	UOM	INSTALL WH's	UOM
A. FORMWORK/PLACE & FINISH – con't.				
Block Outs	2.00	SQ.FT.	N/A	
Field Fireproofed Joints of Prefabbed Fireproofed Members	included		20.0	EA
Grout	0.50	SQ.FT.	4.0	CF
Styrofoam Perimeter Insulation	N/A		0.1	SQ.FT.
Vapor Barrier	N/A		0.004	SQ.FT.
B. **EMBEDDED ITEMS**	WH's	UOM	WH's	UOM
Rebar				
Install (Shop Fabricated)				
Slabs/Mats/Area Paving/Etc.	20.0	TON	0.010	POUND
Equipment Foundations/Footings/Walls/Etc.	26.0	TON	0.013	POUND
Columns/Piers/Trenches/Elevated/Etc.	32.0	TON	0.016	POUND
Field Fabrication Adder	16.0	TON	0.008	POUND
Anchor Bolts				
1-1/8" diameter and below (3'-0" max length)	0.60	EA		
1-1/4" through 2" diameter (5'-0" max length)	1.20	EA		
All diameters greater than 2"	0.04	LB		
Angle, Plate and Misc.	0.04	LB		
Wire Mesh (42 pounds per 100 SQ.FT. max weight)	0.005	SQ.FT.		
Dowels (For Construction Joints)	0.07	EA		
Drill & Epoxy Grout Dowels in Existing Concrete	0.40	EA		
Roughing Concrete (Includes Bonding Agent)	0.20	SQ.FT.		
Pipe Sleeves	0.04	LB		
Water Stop	0.10	LF		

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CONCRETE UNIT WORK HOURS

NOTES

1. All work hour units include unload, storage and handling to erection site.

2. Any requirements for cribbing are not included.

3. Formwork base unit work hours include fabrication, installation, stripping, oiling and cleaning.
   - Fabrication based on the use of plywood with lumber backup
   - Installation includes construction joints, keyways, chamfer strips and expansion joints

4. All accessory labor is included in formwork and embedded item units.
   - Formwork accessories include form oil, snap ties, nails, brackets, etc.
   - Rebar accessories include tie wire, rebar chairs, etc.

5. Formwork base unit work hours do not include any reuse of forms.

   - Reusing forms 1 time after original use – multiply formwork fabrication work hours by **0.85**
   - Reusing forms 2 times after original use – multiply formwork fabrication work hours by **0.75**
   - Reusing forms 3 times after original use – multiply formwork fabrication work hours by **0.70**

   Fabrication portion of total formwork unit work hours is approximately 40% but can vary by type.

6. Place and finish base unit work hours include a normal float finish. Special finishes will require the addition of the following work hour units:

	WH's	UOM
Broom	**0.025**	SQ.FT.
Steel Trowel	**0.03**	SQ.FT.
Patch & Rub	**0.11**	SQ.FT.

7. Place and finish base unit work hours include normal pour methods. Special pour methods will require the addition of the following work hour units:

Buggy	Multiply standard units times **3.0**

8. Install base unit work hours for grout includes the three main categories – cement, non-shrink and epoxy.
   Cement grout is basically cement, sand and water and is typically flowable, requiring formwork.
   Non-shrink grout is usually a dry pack type, non-flowable, requiring no formwork.
   Epoxy grout is technically non-shrink but is flowable, requiring formwork.

9. Anchor bolt weights for diameters greater than 2" :

2-1/4"	13.519	pounds per LF
2-1/2"	16.690	pounds per LF
2-3/4"	20.195	pounds per LF
3"	24.033	pounds per LF

10. For any activities required which are not included in this section, see Means, Richardson or other recognized estimating publications.

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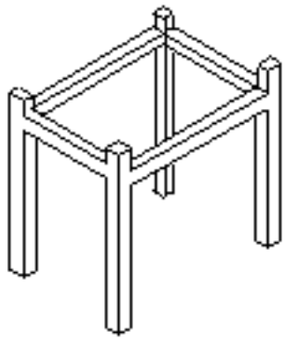
ESTIMATING CONCRETE TYPES

TYPE 01

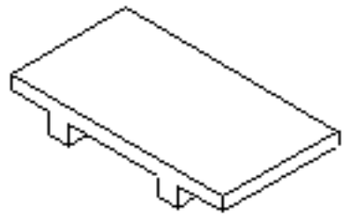
CONCRETE STRUCTURES
PIPE SUPPORTS
COLUMNS AND BEAMS



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	55	SMCS/CM	6.7
- Back-Up	BUBF/SFCS	3.0	BUCM/SMCS	0.08
Rebar	LBS/CY	400	Kg/CM	240
Accessories	% Concrete	26%	% Concrete	26%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.38	WH/SMCS	4.09
Rebar Install	WH/LB	0.016	WH/Kg	0.035
Concrete - Pour And Finish	WH/CY	3.7	WH/CM	4.84
Average Labor	WH/CY	31.00	WH/CM	40.55

TYPE 02

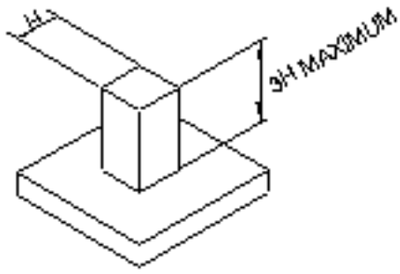
ELEVATED SLABS



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		1%		1%
Formwork				
- Contact Surface	SFCS/CY	55	SMCS/CM	6.7
- Back-Up	BUBF/SFCS	3.0	BUCM/SMCS	0.08
Rebar	LBS/CY	300	Kg/CM	180
Accessories	% Concrete	26%	% Concrete	26%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.40	WH/SMCS	4.31
Rebar Install	WH/LB	0.016	WH/Kg	0.035
Concrete - Pour And Finish	WH/CY	2.0	WH/CM	2.62
Average Labor	WH/CY	28.80	WH/CM	37.67

TYPE 03

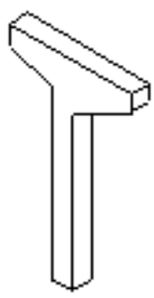
PADS AND PIERS, COLUMN
AND PIPE SUPPORT FOOTINGS



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	40	SMCS/CM	4.9
- Back-Up	BUBF/SFCS	1.5	BUCM/SMCS	0.04
Rebar	LBS/CY	110	Kg/CM	65
Accessories	% Concrete	32%	% Concrete	32%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.35	WH/SMCS	3.77
Rebar Install	WH/LB	0.014	WH/Kg	0.031
Concrete - Pour And Finish	WH/CY	1.2	WH/CM	1.57
Average Labor	WH/CY	16.74	WH/CM	21.90

TYPE 04

TEE SUPPORTS
HORIZONTAL SHELLS
PIPE SUPPORTS



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	65	SMCS/CM	7.9
- Back-Up	BUBF/SFCS	3.0	BUCM/SMCS	0.08
Rebar	LBS/CY	300	Kg/CM	180
Accessories	% Concrete	26%	% Concrete	26%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.38	WH/SMCS	4.09
Rebar Install	WH/LB	0.016	WH/Kg	0.035
Concrete - Pour And Finish	WH/CY	3.7	WH/CM	4.84
Average Labor	WH/CY	33.20	WH/CM	43.42

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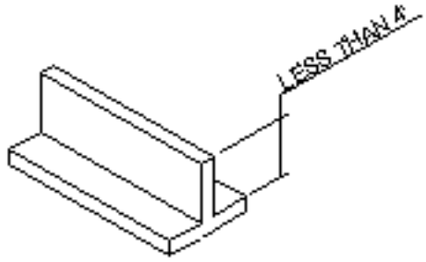
ESTIMATING CONCRETE TYPES

TYPE 05

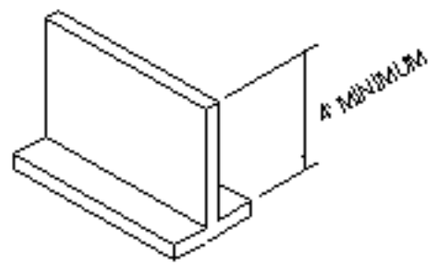
HORIZONTAL SHELLS
AND PIPE SLEEPERS



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	40	SMCS/CM	4.9
- Back-Up	BUBF/SFCS	2.5	BUCM/SMCS	0.06
Rebar	LBS/CY	125	Kg/CM	75
Accessories	% Concrete	40%	% Concrete	40%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.35	WH/SMCS	3.767
Rebar Install	WH/LB	0.014	WH/Kg	0.031
Concrete - Pour And Finish	WH/CY	1.5	WH/CM	1.962
Average Labor	WH/CY	17.25	WH/CM	22.56

TYPE 06

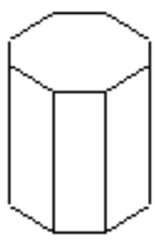
HORIZONTAL SHELLS



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	40	SMCS/CM	4.9
- Back-Up	BUBF/SFCS	3.0	BUCM/SMCS	0.08
Rebar	LBS/CY	135	Kg/CM	80
Accessories	% Concrete	50%	% Concrete	50%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.38	WH/SMCS	4.09
Rebar Install	WH/LB	0.015	WH/Kg	0.033
Concrete - Pour And Finish	WH/CY	2.0	WH/CM	2.616
Average Labor	WH/CY	19.23	WH/CM	25.15

TYPE 07

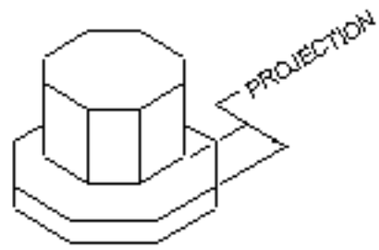
OCTAGON PADS



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		2%		2%
Formwork				
- Contact Surface	SFCS/CY	15	SMCS/CM	1.8
- Back-Up	BUBF/SFCS	1.7	BUCM/SMCS	0.04
Rebar	LBS/CY	40	Kg/CM	25
Accessories	% Concrete	32%	% Concrete	32%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.45	WH/SMCS	4.844
Rebar Install	WH/LB	0.013	WH/Kg	0.029
Concrete - Pour And Finish	WH/CY	1.5	WH/CM	1.962
Average Labor	WH/CY	8.77	WH/CM	11.47

TYPE 08

OCTAGON PADS AND PIERS



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		2%		2%
Formwork				
- Contact Surface	SFCS/CY	15	SMCS/CM	1.8
- Back-Up	BUBF/SFCS	2.0	BUCM/SMCS	0.05
Rebar	LBS/CY	110	Kg/CM	65
Accessories	% Concrete	35%	% Concrete	35%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WMH/SFCS	0.50	WH/SMCS	5.382
Rebar Install	WH/LB	0.016	WH/Kg	0.035
Concrete - Pour And Finish	WH/CY	2.3	WH/CM	3.008
Average Labor	WH/CY	11.56	WH/CM	15.12

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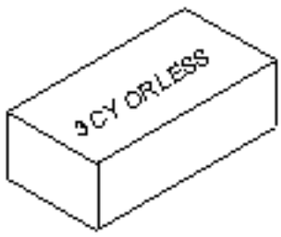
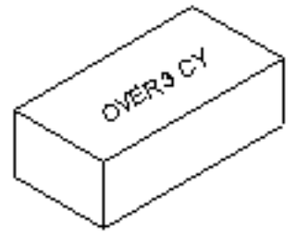
ESTIMATING CONCRETE TYPES

TYPE 09
SMALL BLOCKS, PUMPS AND
SMALL COMPRESSORS



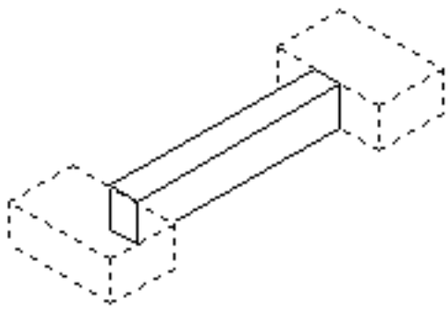
MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		2%		2%
Formwork				
- Contact Surface	SFCS/CY	25	SMCS/CM	3.0
- Back-Up	BUBF/SFCS	1.0	BUCM/SMCS	0.03
Rebar	LBS/CY	20	Kg/CM	15.0
Accessories	% Concrete	10%	% Concrete	10%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.30	WH/SMCS	3.23
Rebar Install	WH/LB	0.013	WH/Kg	0.029
Concrete - Pour And Finish	WH/CY	2.5	WH/CM	3.27
Average Labor	WH/CY	10.26	WH/CM	13.42

TYPE 10
LARGE BLOCKS,
LARGE COMPRESSORS AND
TURBINES



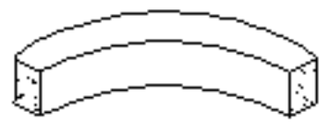
MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		2%		2%
Formwork				
- Contact Surface	SFCS/CY	15	SMCS/CM	1.8
- Back-Up	BUBF/SFCS	1.7	BUCM/SMCS	0.04
Rebar	LBS/CY	70	Kg/CM	40
Accessories	% Concrete	26%	% Concrete	26%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.25	WH/SMCS	2.69
Rebar Install	WH/LB	0.013	WH/Kg	0.029
Concrete - Pour And Finish	WH/CY	1.5	WH/CM	1.96
Average Labor	WH/CY	6.16	WH/CM	8.06

TYPE 11
GRADE BEAMS



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	25	SMCS/CM	3.0
- Back-Up	BUBF/SFCS	1.0	BUCM/SMCS	0.03
Rebar	LBS/CY	200	Kg/CM	120
Accessories	% Concrete	5%	% Concrete	5%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.30	WH/SMCS	3.23
Rebar Install	WH/LB	0.013	WH/Kg	0.029
Concrete - Pour And Finish	WH/CY	0.70	WH/CM	0.916
Average Labor	WH/CY	10.80	WH/CM	14.13

TYPE 12
TANK RING WALLS

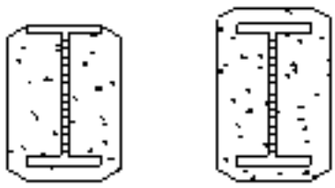


MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	55	SMCS/CM	6.7
- Back-Up	BUBF/SFCS	1.5	BUCM/SMCS	0.04
Rebar	LBS/CY	80	Kg/CM	50
Accessories	% Concrete	9%	% Concrete	9%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.40	WH/SMCS	4.306
Rebar Install	WH/LB	0.016	WH/Kg	0.035
Concrete - Pour And Finish	WH/CY	0.70	WH/CM	0.916
Average Labor	WH/CY	23.98	WH/CM	31.36

FLUOR

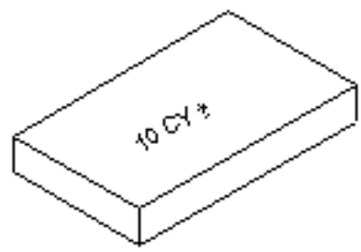
ESTIMATING CONCRETE TYPES

TYPE 13
STRUCTURAL FIREPROOFING
POURED IN PLACE



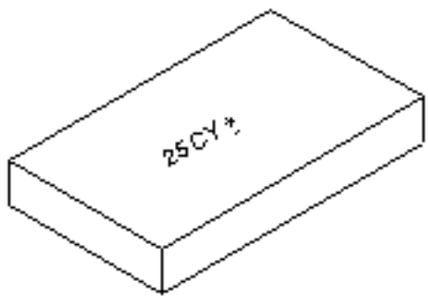
MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	100	SMCS/CM	12.2
- Back-Up	BUBF/SFCS	2.3	BUCM/SMCS	0.06
Rebar	LBS/CY	50	Kg/CM	30
Accessories	% Concrete	9%	% Concrete	9%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.35	WH/SMCS	3.77
Rebar Install	WH/LB	0.016	WH/Kg	0.035
Concrete - Pour And Finish	WH/CY	10.0	WH/CM	13.08
Average Labor	WH/CY	45.80	WH/CM	59.90

TYPE 14
MEDIUM POURS, MATS,
PILE CAPS AND OTHER SHAPES



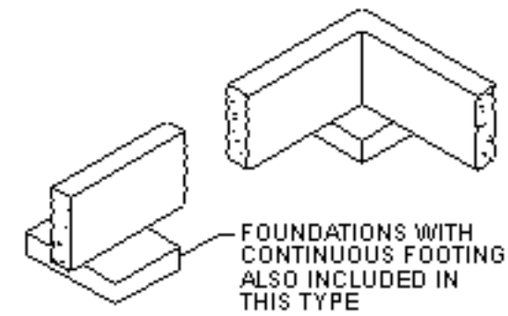
MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	20	SMCS/CM	2.4
- Back-Up	BUBF/SFCS	1.5	BUCM/SMCS	0.04
Rebar	LBS/CY	150	Kg/CM	90
Accessories	% Concrete	14%	% Concrete	14%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.35	WH/SMCS	3.768
Rebar Install	WH/LB	0.013	WH/Kg	0.029
Concrete - Pour And Finish	WH/CY	0.60	WH/CM	0.78
Average Labor	WH/CY	9.55	WH/CM	12.49

TYPE 15
MASS POURS, LARGE MATS,
PILE CAPS AND OTHER SHAPES



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	10	SMCS/CM	1.2
- Back-Up	BUBF/SFCS	1.5	BUCM/SMCS	0.04
Rebar	LBS/CY	150	Kg/CM	90
Accessories	% Concrete	9%	% Concrete	9%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.25	WH/SMCS	2.69
Rebar Install	WH/LB	0.01	WH/Kg	0.022
Concrete - Pour And Finish	WH/CY	0.90	WH/CM	1.18
Average Labor	WH/CY	4.90	WH/CM	6.41

TYPE 16
BUILDING FOUNDATIONS

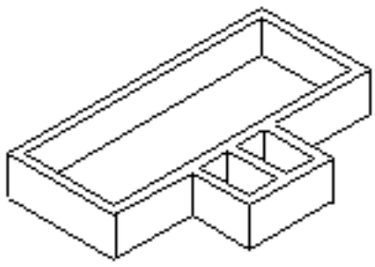


MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	40	SMCS/CM	4.9
- Back-Up	BUBF/SFCS	2.5	BUCM/SMCS	0.05
Rebar	LBS/CY	75	Kg/CM	45
Accessories	% Concrete	9%	% Concrete	9%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.30	WH/SMCS	3.23
Rebar Install	WH/LB	0.013	WH/Kg	0.029
Concrete - Pour And Finish	WH/CY	1.1	WH/CM	1.439
Average Labor	WH/CY	14.08	WH/CM	18.41

FLUOR

ESTIMATING CONCRETE TYPES

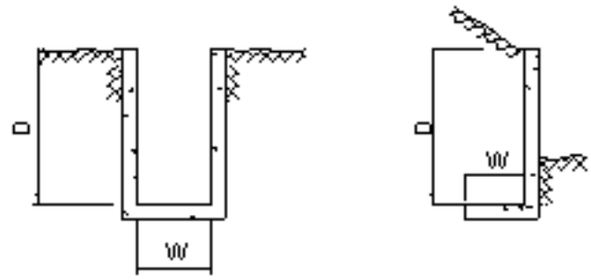
TYPE 17
COOLING TOWER BASINS
AND SEPARATORS



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	35	SMCS/CM	4.2
- Back-Up	BUBF/SFCS	1.5	BUCM/SMCS	0.04
Rebar	LBS/CY	140	Kg/CM	85
Accessories	% Concrete	23%	% Concrete	23%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.38	WH/SMCS	4.09
Rebar Install	WH/LB	0.013	WH/Kg	0.029
Concrete - Pour And Finish	WH/CY	1.6	WH/CM	2.092
Average Labor	WH/CY	16.72	WH/CM	21.87

TYPE 18
TRENCHES AND RETAINING WALLS

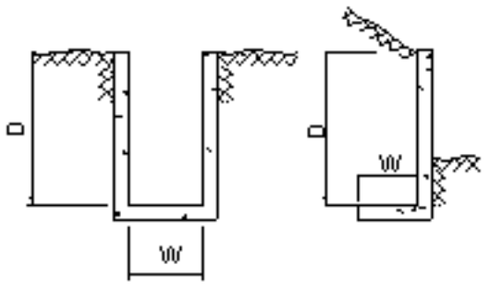
W/D < 2 D = 6'- 0" OR LESS



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	60	SMCS/CM	7.3
- Back-Up	BUBF/SFCS	2.0	BUCM/SMCS	0.05
Rebar	LBS/CY	80	Kg/CM	50
Accessories	% Concrete	44%	% Concrete	44%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.41	WH/SMCS	4.414
Rebar Install	WH/LB	0.016	WH/Kg	0.035
Concrete - Pour And Finish	WH/CY	2.2	WH/CM	2.878
Average Labor	WH/CY	28.08	WH/CM	36.73

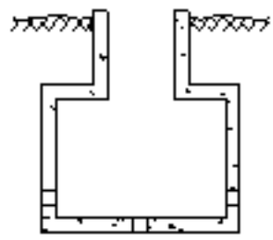
TYPE 19
TRENCHES AND RETAINING WALLS

W/D < 2 D - Greater Than 6'- 0
FOR W/D > 2 USE TYPE 17



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	60	SMCS/CM	7.3
- Back-Up	BUBF/SFCS	2.5	BUCM/SMCS	0.06
Rebar	LBS/CY	110	Kg/CM	65
Accessories	% Concrete	35%	% Concrete	35%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.43	WH/SMCS	4.629
Rebar Install	WH/LB	0.016	WH/Kg	0.035
Concrete - Pour And Finish	WH/CY	2.6	WH/CM	3.401
Average Labor	WH/CY	30.16	WH/CM	39.45

TYPE 20
CATCH BASINS, MANHOLES
AND VALVE BOXES

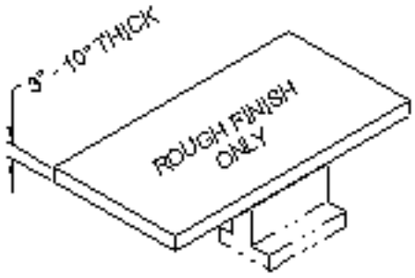


MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	65	SMCS/CM	7.9
- Back-Up	BUBF/SFCS	2.8	BUCM/SMCS	0.07
Rebar	LBS/CY	120	Kg/CM	70
Accessories	% Concrete	150%	% Concrete	150%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.50	WH/SMCS	5.382
Rebar Install	WH/LB	0.016	WH/Kg	0.035
Concrete - Pour And Finish	WH/CY	4.0	WH/CM	5.232
Average Labor	WH/CY	38.42	WH/CM	50.25

FLUOR

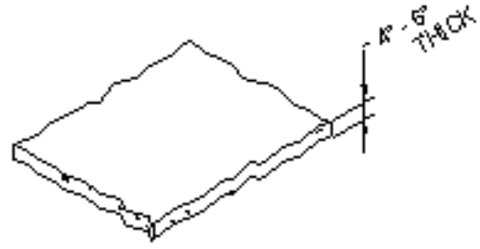
ESTIMATING CONCRETE TYPES

TYPE 21
GROUND FLOOR SLABS
BUILDINGS STRUCTURES



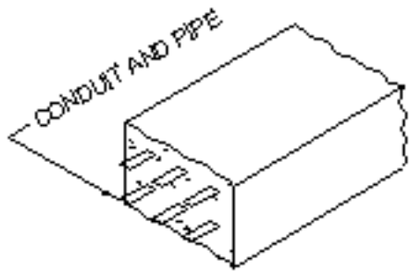
MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		5%		5%
Formwork				
- Contact Surface	SFCS/CY	5	SMCS/CM	0.6
- Back-Up	BUBF/SFCS	1.0	BUCM/SMCS	0.03
Rebar	LBS/CY	80	Kg/CM	47.5
Accessories	% Concrete	7%	% Concrete	7%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.35	WH/SMCS	3.77
Rebar Install	WH/LB	0.01	WH/Kg	0.022
Concrete - Pour And Finish	WH/CY	2.7	WH/CM	3.53
Average Labor	WH/CY	5.25	WH/CM	6.87

TYPE 22
AREA PAVING



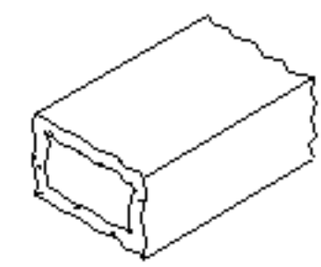
MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		5%		5%
Formwork				
- Contact Surface	SFCS/CY	3	SMCS/CM	0.4
- Back-Up	BUBF/SFCS	1.0	BUCM/SMCS	0.03
Rebar	LBS/CY	50	Kg/CM	29.7
Accessories	% Concrete	7%	% Concrete	7%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.35	WH/SMCS	3.77
Rebar Install	WH/LB	0.01	WH/Kg	0.022
Concrete - Pour And Finish	WH/CY	2.7	WH/CM	3.53
Average Labor	WH/CY	4.25	WH/CM	5.56

TYPE 23
ENVELOPES



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		2%		2%
Formwork				
- Contact Surface	SFCS/CY	15	SMCS/CM	1.8
- Back-Up	BUBF/SFCS	1.0	BUCM/SMCS	0.03
Rebar	LBS/CY	20	Kg/CM	15
Accessories	% Concrete	2%	% Concrete	2%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.20	WH/SMCS	2.15
Rebar Install	WH/LB	0.013	WH/Kg	0.029
Concrete - Pour And Finish	WH/CY	0.50	WH/CM	0.65
Average Labor	WH/CY	3.76	WH/CM	4.92

TYPE 24
UNDERGROUND DUCTS AND
HEATERS FURNACES

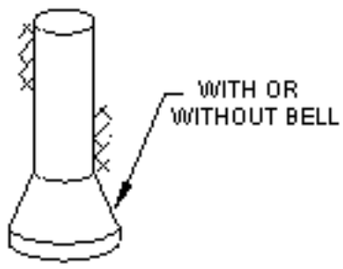


MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		3%		3%
Formwork				
- Contact Surface	SFCS/CY	40	SMCS/CM	4.9
- Back-Up	BUBF/SFCS	2.0	BUCM/SMCS	0.03
Rebar	LBS/CY	200	Kg/CM	120
Accessories	% Concrete	2%	% Concrete	2%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	0.40	WH/SMCS	4.31
Rebar Install	WH/LB	0.016	WH/Kg	0.035
Concrete - Pour And Finish	WH/CY	2.3	WH/CM	3.008
Average Labor	WH/CY	21.50	WH/CM	28.12

FLUOR

ESTIMATING CONCRETE TYPES

TYPE 25
CAISSONS AND SHORT CAST IN PLACE PILES IN DRILLED HOLES



MATERIAL	ENGLISH UNITS		METRIC UNITS	
Overpour Quantity		20%		20%
Formwork				
- Contact Surface	SFCS/CY	00	SMCS/CM	00
- Back-Up	BUBF/SFCS	00	BUCM/SMCS	00
Rebar	LBS/CY	80	Kg/CM	50
Accessories	% Concrete	5%	% Concrete	5%
LABOR				
Formwork - Fabricate, Install, Strip, And Clean	WH/SFCS	00	WH/SMCS	00
Rebar Install	WH/LB	0.013	WH/Kg	0.029
Concrete - Pour And Finish	WH/CY	2.0	WH/CM	2.62
Average Labor	WH/CY	3.04	WH/CM	3.98

TYPE 26
GROUTING

EQUIPMENT	UNIT	AVERAGE QUANTITY ALLOWANCE ENGLISH	AVERAGE QUANTITY ALLOWANCE METRIC
Column Footings Pipe Support Footings Vessel On Legs Similar	Each Col Each Col Each Leg	3.0 CF	0.09 CM
Pumps Small Compressors Small Vessels Horizontal Shells Similar	Each Each Each Each Supl	7.0 CF	0.20 CM
Vessels Large Pumps Similar	Each Each	27.0 CF	0.76 CM
Large Compressors Large Turbines Similar	Each Each	81.0 CF	2.29 CM
Labor - Pour And Finish		4.0 WH/CF	141 WH/CM

Material - No Overpour Quantity Required

TYPE 27
SPECIAL - TO BE DETERMINED BY PROJECT

FLUOR

ESTIMATING CONCRETE TYPES

NOTES:

1. Overpour quantity and accessories allowance effect material cost only.

2. The following are some examples of composite buildups from individual unit work hours:

TYPE 06 - HORIZONTAL SHELLS

Based on 75% Pier and 25% Footing:

Formwork = (0.40 x 0.75) + (0.30 x 0.25) = 0.375 = 0.38

Rebar = (0.016 x 0.75) + (0.013 x 0.25) = 0.01525 = 0.015

Concrete = (2.4 x 0.75) + (0.6 x 0.25) = 1.95 = 2.0

TYPE 18 - TRENCHES AND RETAINING WALLS

Based on 60% Walls and 40% Bottom

Formwork = (0.45 x 0.60) + (0.35 x 0.40) = 0.41

Rebar = 0.016

Concrete = (3.0 x 0.60) + (1.0 x 0.40) = 2.2

TYPE 20 - CATCH BASINS, MANHOLES AND VALVE BOXES

Based on exact work hour units

Formwork = 0.50

Rebar = 0.016

Concrete = 4.0

FLUOR

STRUCTURAL STEEL UNIT WORK HOURS

DESCRIPTION	WEIGHT	WH's	UOM	WH's	UOM
A. STRUCTURES, PIPE RACKS, PLATFORMS, WALKWAYS, ETC.					
Light Steel	0-20 PLF	23	TON	----	----
Medium Steel	21-40 PLF	19	TON	----	----
Heavy Steel	41-60 PLF	16	TON	----	----
Extra-Heavy Steel	61-UP PLF	12	TON	----	----
Vessel Platform Framing	20 PSF	30	TON	0.30	SQ.FT.
Attached to equipment (does not include grating or handrail)					
Handrails - Angle (2-rail)		40	TON		
w/ Toe Plate	17 PLF			0.34	LF
w/o Toe Plate	13 PLF			0.26	LF
Handrails - Pipe (2-rail)		80	TON		
w/ Toe Plate	10 PLF			0.40	LF
w/o Toe Plate	7 PLF			0.28	LF
Handrails - Pipe (3-rail)		80	TON		
w/ Toe Plate	13 PLF			0.52	LF
w/o Toe Plate	10 PLF			0.40	LF
Ladders		90	TON		
w/ Cage	20 PLF			0.90	LF
w/o Cage	11 PLF			0.49	LF
Safety Gates				4.0	EA
Stairs (Assembled)	132 PLF (Vert)	20	TON	0.86	RISER
Checkered Plate, 1/4"	11.25 PSF	20	TON	0.11	SQ.FT.
Checkered Plate, 3/8"	16.35 PSF	18	TON	0.15	SQ.FT.
Grating, 1-1/4" x 3/16"	9.2 PSF	33	TON	0.15	SQ.FT.
Trench Grating, 18" Wide Cast Iron	27.3 PSF	12	TON	0.16	SQ.FT.
B. BUILDING MISC. STEEL					
Bar Joist		16	TON	----	----
Trusses (Pre-fabricated)		10	TON	----	----
Metal Decking		---	------	0.02	SQ.FT.
Girts and Sag Rods		30	TON	----	----
C. OTHER MISC. STEEL		40	TON	----	----

FLUOR

STRUCTURAL STEEL UNIT WORK HOURS

NOTES

1. The structural steel unit work hours are based on shop fabricated steel and field bolted connections. They include unload, storage and handling to erection site.

2. For field welded connections, add **15%** to the standard unit work hours.

3. Structure height erection adjustment factors:
   0 - 20 foot high - no adjustment
   21 - 50 foot high - add **10%** to total work hours
   51 - 100 foot high - add **15%** to total work hours
   101 foot high and above - add **20%** to total work hours

4. For shop fireproofed steel, include weight of fireproofing with steel, to calculate total installed weight. For special handling and protection during erection, add **10%** to total erection work hours for this category.

5. Miscellaneous steel for Shoes, Guides & Hangers; Cable Trays; Instrument Supports and Stands; etc., are included in their respective accounts.

6. Anchor bolts and other embedded items are covered in the Concrete account.

7. Take off handrails, ladders, stairways, grating and checkered plate separately from structural shapes.

8. Pipe rack steel must be taken off by weight category, separately from steel structures.

9. For ladder takeoffs, need to add **3 LF** for elevation level to be accessed.

10. Take off metal floor deck/roof deck in square feet. Add **10%** for waste.

11. Primary and secondary members and bracing in a steel structure are to be a part of the takeoff. If connection plates, seat angles, and the like are not taken off, an allowance is to be added to the total takeoff weights for these items as follows:

Light Steel	**15%**
Medium Steel	**10%**
Heavy Steel	**8%**
Extra Heavy Steel	**5%**

Steel items other than shapes are as follows with their allowance for connections and waste:

Handrails	**included**
Ladders	**included**
Stairs (assembled)	**included**
Checkered Plate	**10%**
Grating	**10%**

FLUOR

STRUCTURAL STEEL UNIT WORK HOURS

NOTES – con't.

12. All **%** adds are averages subject to change depending on job conditions and/or information available.

13. The unit of weight used in the charts is the 2,000 pound ton.

14. All WH's/LF shown are based on respective weights per LF and total WH's per ton for individual categories.

15. Definition of weights:

Light Steel	0-20	Pounds per LF
Medium Steel	21-40	Pounds per LF
Heavy Steel	41-60	Pounds per LF
Extra-Heavy Steel	61 & up	Pounds per LF
Vessel Platform Framing		
Attached to equipment		
without grating and handrail	20	Pounds per Square Foot
with grating and handrail	30	Pounds per Square Foot
Handrails – Angle (2-rail)		
with Toe Plate	17	Pounds per LF
without Toe Plate	13	Pounds per LF
Handrails – Pipe (2-rail)		
with Toe Plate	10	Pounds per LF
without Toe Plate	7	Pounds per LF
Handrails – Pipe (3-rail)		
with Toe Plate	13	Pounds per LF
without Toe Plate	10	Pounds per LF
Ladders		
with Cage	20	Pounds per LF
without	11	Pounds per LF
Stairs (assembled – excludes landings)	132	Pounds per LF – Vertical
Standard stair includes handrail, checkered plate tread and stringer, 2'-6" wide, 38.5 degrees slope, 7-3/4" rise, 9-3/4" run. (75 PLF X cosec 38.5 degrees) + 10% = 132 PLF.		
Checkered Plate, 1/4"	11.25	Pounds per Square Foot
Checkered Plate, 3/8"	16.35	Pounds per Square Foot
Grating, 1-1/4" X 3/16"	9.2	Pounds per Square Foot
Trench Grating, 18" wide Cast Iron	27.3	Pounds per Square Foot

FLUOR

STRUCTURAL STEEL UNIT WORK HOURS

NOTES – con't.

16. Typical structural steel makeup by category:

Heavy Equipment Structures:

Heavy Steel	34%
Medium Steel	25%
Light Steel	13%
Grating	12%
Stairs	1%
Handrails – pipe	9%
Ladders	6%

Average Equipment Structures:

Heavy Steel	13%
Medium Steel	34%
Light Steel	21%
Grating	14%
Stairs	2%
Handrails – pipe	10%
Ladders	6%

Service Structures under 35'

Medium Steel	6%
Light Steel	39%
Grating	26%
Stairs	2%
Handrails – pipe	17%
Ladders	10%

Service Structures over 35'

Heavy Steel	7%
Medium Steel	17%
Light Steel	37%
Grating	19%
Stairs	2%
Handrails – pipe	11%
Ladders	7%

Vertical Vessel Platforms

Platform Framing	32%
Grating	28%
Handrails – pipe	16%
Ladders	24%

Rectangular Platforms

Platform Framing	21%
Grating	35%
Handrails – pipe	22%
Ladders	22%

Pipe Racks & T-Supports

Heavy Steel	14%
Medium Steel	45%
Light Steel	41%

Misc. Brackets & Supports

Misc.	100%

Floor Framing (not part of steel structure)

Medium Steel	19%
Light Steel	24%
Grating	47%
Stairs	2%
Handrails – pipe	8%

Walkways & Stiles

Light Steel	44%
Grating	19%
Stairs	13%
Handrails – pipe	24%

Trusses

Medium Steel	30%
Light Steel	70%

Trussed Towers (Flare Structures, etc.)

Heavy Steel	39%
Medium Steel	18%
Light Steel	37%
Checkered Plate	2%
Handrails – pipe	1%
Ladders	3%

FLUOR

STRUCTURAL STEEL UNIT WORK HOURS

NOTES – con't.

16. Typical structural steel makeup by category – con't. :

Misc. Steel (Sump Covers, etc.)	
Medium Steel	5%
Light Steel	21%
Checkered Plate	56%
Handrails – pipe	18%

17. For any activities required which are not included in this section, see Means, Richardson or other recognized estimating publications.

FLUOR

ARCHITECTURAL UNIT WORK HOURS

The following publications and companies are available for further estimating information on buildings and building components:

MEANS BUILDING CONSTRUCTION COST DATA
100 Construction Plaza
P.O. Box 800
Kinston, MA 02364-0800
(800) 334-3509

RICHARDSON ENGINEERING SERVICES, INC.
1742 S. Fraser Drive
P.O. Box 9103
Mesa, AZ 85214-9103
(602) 497-2062

or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

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H. OTHER PROCESSING EQUIPMENT – con't.

FLUOR

EQUIPMENT UNIT WORK HOURS

A. GENERAL NOTES

1. Be sure to define mechanical completion.

2. Work hours **do not** include maintenance required during storage, prior to erection. Typically this is included in the Construction Indirects account, however some special cases may require direct work hours. If so, consult with a Fluor Daniel Construction representative.

3. Grout work hours **not** included. Must be added to the appropriate Concrete account.

4. Sole plates **not** included. Must be added to the appropriate Concrete account (Embeds).

FLUOR

EQUIPMENT UNIT WORK HOURS

B. TANKS & VESSELS

1. STORAGE TANKS (SHOP FABRICATED)

CAPACITY IN GALLONS	UNLINED	JACKETED	GLASS LINED	BURIED
100	10	15	25	10
500	25	40	55	15
1,000	40	60	80	20
1,500	50	75	100	20
2,000	60	85	115	25
2,500	65	100	130	30
3,000	75	110	145	30
3,500	80	120	160	30
4,000	85	130	170	35
5,000	95	145	190	40
6,000	105	160	210	40
7,000	115	175	230	45
8,000	125	185	250	45
9,000	130	200	265	50
10,000	140	210	280	50
11,000	150	225	300	60
12,000	160	240	320	60
13,000	170	260	340	70
14,000	185	280	370	70
15,000	200	300	400	90
16,000	220	330	440	90
17,000	240	360	480	90
18,000	260	390	520	115
19,000	280	420	560	115
20,000	300	450	600	115

STORAGE TANK NOTES

1. Work hour units include receiving, unloading shop fabricated sections of sizes within shipping limits, retrieval, hauling, rigging to position, shimming to elevation, leveling and aligning.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hour units for **Unlined** category are based on fixed cone roofs. For floating roofs add **25%**.
4. Work hour units for **Glass Lined** category include holiday testing.
5. Work hour units for **Buried** category **do not** include excavation, backfill or concrete work as required.
6. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation or their connections.
7. **Field fabricated tanks are typically a subcontracted item.**
8. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

B. TANKS & VESSELS – con't.

2. PRESSURE VESSELS, COLUMNS & REACTORS

WEIGHT IN TONS	HORIZONTAL	VERTICAL
1 and below	35	40
2	55	60
3	65	80
4	80	90
5	90	105
10	135	155
15	170	200
20	200	235
30	255	300
50	340	405
75	430	510
100	510	605
125	580	690
150	645	770
175	705	840
200	760	910
250	865	1,035
300	960	1,155
350	1,050	1,260
400	1,135	1,365
450	1,215	1,460

PRESSURE VESSEL, COLUMN & REACTOR NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling and aligning.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hour units include time for opening manways and clean out.
4. Work hour units are based on reasonable access to erection site. If erection is to be in a congested area, this should be evaluated separately and the work hours adjusted.
5. Erection and dismantling time must be added for gin poles, if required.
6. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation or their connections.
7. Work hour units **do not** include erection of ladders or platforms.
8. Work hour units **do not** include field installation of trays, internals, packing or inspection.
9. Work hour units **do not** include crane set-up and removal time. Typically this is included in the Construction Indirects account, however some special cases may require direct work hours. If so, consult with a Fluor Daniel Construction representative.
10. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

B. TANKS & VESSELS – con't.

3. TRAYS, PACKING & CATALYST

TRAYS – WH's/EA

DIAMETER		SIEVE	SINGLE OR DOUBLE DOWNFLOW VALVE OR PERFORATED	SINGLE OR DOUBLE DOWNFLOW BUBBLE CAP
3'-0"	36"	5	6	8
3'-6"	42"	6	8	11
4'-0"	48"	7	10	13
4'-6"	54"	7	12	16
5'-0"	60"	8	15	19
5'-6"	66"	9	17	22
6'-0"	72"	10	19	25
6'-6"	78"	11	22	28
7'-0"	84"	12	25	32
7'-6"	90"	13	28	36
8'-0"	96"	14	30	39
8'-6"	102"	15	33	43
9'-0"	108"	17	37	48
9'-6"	114"	18	40	53
10'-0"	120"	20	43	56
10'-6"	126"	21	47	61
11'-0"	132"	23	50	65
11'-6"	138"	24	54	69
12'-0"	144"	27	57	74
12'-6"	150"	29	61	79
13'-0"	156"	31	64	82
13'-6"	162"	33	68	87
14'-0"	168"	35	71	91
14'-6"	174"	37	75	95
15'-0"	180"	39	78	100
15'-6"	186"	42	82	105
16'-0"	192"	44	85	108
16'-6"	198"	47	89	113
17'-0"	204"	49	92	117
17'-6"	210"	53	96	121

FLUOR

EQUIPMENT UNIT WORK HOURS

B. TANKS & VESSELS – con't.

3. TRAYS, PACKING & CATALYST – con't.

TRAYS – WH's/EA – con't.

DIAMETER		SIEVE	SINGLE OR DOUBLE DOWNFLOW VALVE OR PERFORATED	SINGLE OR DOUBLE DOWNFLOW BUBBLE CAP
18'-0"	216"	55	99	126
18'-6"	222"	58	103	131
19'-0"	228"	61	106	134
19'-6"	234"	64	110	139
20'-0"	240"	67	113	143
20'-6"	246"	70	117	147
21'-0"	252"	73	120	152
21'-6"	258"	77	124	157
22'-0"	264"	80	127	160
22'-6"	270"	84	131	165
23'-0"	276"	87	134	169
23'-6"	282"	91	138	173
24'-0"	288"	95	141	178
24'-6"	294"	98	145	183
25'-0"	300"	102	148	186
25'-6"	306"	106	152	191
26'-0"	312"	110	155	195
26'-6"	318"	114	159	199
27'-0"	324"	119	162	204
27'-6"	330"	123	166	209
28'-0"	336"	127	169	212
28'-6"	342"	132	173	217
29'-0"	348"	136	176	221
29'-6"	354"	141	180	225

PACKING	WH's/CF
Pall Rings, Raschig Rings, Intalox Saddles, etc.	0.35
Metallic Ball Type	0.50
Ceramic Ball Type	0.60

CATALYST	WH's/CF
All types	0.40

(Does not include temporary catalyst loading equipment setup.)

FLUOR

EQUIPMENT UNIT WORK HOURS

B. TANKS & VESSELS – con't.

3. TRAYS, PACKING & CATALYST – con't.

TRAYS, PACKING & CATALYST NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging, picking, setting, fastening and aligning of trays passed through manway.
2. Work hour units include an allowance for installation of seal pan under bottom tray.
3. Work hour units **do not** include installation of vessel or other internals.
4. Work hour units **do not** include time for opening manways and clean out. On new vessels, this time is included in the erection hours. On existing vessels, work hours **must** be added to cover these activities.
5. Work hour units **do not** include installation of scrubber or mist eliminator trayed sections. Hours for these applications should be calculated on a crew basis.
6. For tray adjustment, leveling and checking in the field, including tightening bolts and nuts, lost bolt replacement, etc., with the vessel erected, add the following:

Type	WH's/SF
Sieve Trays	**0.08**
Valve Trays	**0.12**
Bubble Cap Trays	**0.14**

Where SF = tray area in square feet

7. For field inspection of factory assembled trays, add the following:

Diameter	WH's/Tray
Up to 10'	**4**
> 10' up to 21'	**7**
> 21'	**10**

Plus 15 WH's each vessel for opening, purging, air supply and closing.
Hours for inspection include ease of access and required lighting.

8. Catalyst loading is a critical activity that varies by process systems and by licensors. Clients typically handle this themselves but may delegate it to Fluor Daniel. When it becomes a part of our scope of work, consult with Process Engineering about any specific licensor requirements.

9. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

C. HEAT TRANSFER

4. COOLING TOWERS

PACKAGED UNITS (see note 3)

COOLING CAPACITY IN TONS	WH's/EA
100	30
125	35
150	40
175	45
200	60
225	65
250	70
300	75
325	80
350	85
400	90
425	95
450	100
500	105

FIELD ERECTED (see notes 4 and 8)

GALLONS PER MINUTE (GPM)	WH's/EA
10,000 to 19,999	1,500
20,000 to 29,999	2,800
30,000 to 49,999	4,500
50,000 to 69,999	7,200
70,000 to 89,999	9,600
90,000 and above	12,000

FLUOR

EQUIPMENT UNIT WORK HOURS

C. HEAT TRANSFER – con't.

4. COOLING TOWERS – con't.

COOLING TOWER NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, assembling, erecting, aligning and anchoring.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours for **Packaged Units** include erection of prefabricated sections, shipped knocked-down, of sizes within shipping limits, inclusive of steel or fiberglass construction, fans, fan motors, controls, fill material, ladders and platforms, as required for a complete package.
4. Work hours for **Field Erected** include wood, steel or fiberglass frame, corrugated casing, grillage, fiberglass fan stacks, fiberglass fans, fan motors, controls, polyvinylchloride (PVC) plastic fill and stairs or ladders, as required for a complete assembly.
   Caution should be used when estimating field erection in this category. These work hours are not for detailed estimating but are instead provided as a general guideline and an aid for scheduling purposes. For a detailed estimate, specific components, materials of construction and process requirements must be identified and labored accordingly. See note 9 for other sources.
5. Work hour units **do not** include installation of concrete basin, support steel, piping, instrumentation, electrical power wiring or their connections.
6. Work hour units **do not** include installation of circulating water pumps.
7. Work hour units **do not** include installation of water treatment system.
8. **Field erected cooling towers are typically a subcontracted item.**
9. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

C. HEAT TRANSFER – con't.

5. HEAT EXCHANGERS

SHELL & TUBE

SQUARE FEET OF BARE TUBE SURFACE AREA	WH's
Up to 150	20
151 to 400	25
401 to 650	30
651 to 900	35
901 to 1,150	40
1,151 to 1,400	45
1,401 to 1,650	50
1,651 to 1,900	55
1,901 to 2,150	60
2,151 to 2,400	65
2,401 to 2,650	70
2,651 to 2,900	75
2,901 to 3,500	85
3,501 to 4,000	95
4,001 to 5,000	110
5,001 to 7,500	135
7,501 to 10,000	160
10,001 to 20,000	210
20,001 to 30,000	255
30,001 to 40,000	295
40,001 to 50,000	330
50,001 to 75,000	360
75,001 to 100,000	385

FLUOR

EQUIPMENT UNIT WORK HOURS

C. HEAT TRANSFER – con't.

5. HEAT EXCHANGERS – con't.

PLATE & FRAME

SQUARE FEET OF BARE TUBE SURFACE AREA	WH's
Up to 50	20
51 to 100	30
101 to 150	40
151 to 250	55
251 to 400	65
401 to 800	80
801 to 1,500	95
1,501 to 2,500	105
2,501 to 4,000	120
4,001 to 5,000	130
5,001 to 6,000	135
6,001 to 7,000	145
7,001 to 8,000	150
8,001 to 9,000	160
9,001 to 10,000	165
10,001 to 11,000	170
11,001 to 12,000	180

SPIRAL

SQUARE FEET OF BARE TUBE SURFACE AREA	WH's
Up to 100	30
101 to 150	40
151 to 200	50
201 to 400	60
401 to 600	70
601 to 800	80
801 to 1,000	90
1,001 to 1,500	100
1,501 to 2,000	115
2,001 to 3,000	135
3,001 to 4,000	150

FLUOR

EQUIPMENT UNIT WORK HOURS

C. HEAT TRANSFER – con't.

5. HEAT EXCHANGERS – con't.

AIR COOLED

SQUARE FEET OF BARE TUBE SURFACE AREA	WH's
1,000 to 2,000	230
2,001 to 4,000	350
4,001 to 7,000	540
7,001 to 10,000	720
10,001 to 20,000	1,080
20,001 to 30,000	1,500
30,001 to 40,000	1,800
40,001 to 50,000	2,280
50,001 to 60,000	2,600
60,001 to 70,000	2,900
70,001 to 80,000	3,200
80,001 to 90,000	3,400
90,001 to 100,000	3,600

HEAT EXCHANGER NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning and checking out of exchanger as required.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hour units in all categories are based on complete shop assembly. If field assembly is required, work hours should be calculated on a crew basis.
4. Maximum range given for square feet of bare tube surface area within each category is based on industry standards.
5. Work hours for **Air Cooled Exchangers** include shop-fabricated platforms and walkways for access to manifolds and motors.
6. For **Air Cooled Exchangers motor, gear and fan** field installation, use **50 WH** per fan motor.
7. For **Double Pipe or Hairpin Exchanger**, use **Shell & Tube** work hours.
8. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
9. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

C. HEAT TRANSFER – con't.

6. WATER CHILLERS (PACKAGED UNITS)

RECIPROCATING TYPE WITH AIR OR WATER COOLED CONDENSERS

COOLING CAPACITY IN TONS	WH's/EA
5	20
10	25
25	30
50	35
75	40
100	50
150	65
200	75
250	110

CENTRIFUGAL TYPE WITH WATER COOLED CONDENSERS

COOLING CAPACITY IN TONS	WH's/EA
Up to 200	60
> 200 to 500	70
> 500 to 800	80
> 800 to 1,000	90

WATER CHILLER NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
4. Work hour units **do not** include installation of chilled water/condenser water pumps.
5. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

D. BOILERS & HEATERS

7. STEAM BOILERS

PACKAGED UNITS (see note 4)

CAPACITY POUNDS OF STEAM PER HOUR	SHIPPING WT.LBS.	WH's
30,000	59,300	250
35,000	63,800	260
40,000	67,500	270
45,000	75,800	275
50,000	82,700	280
60,000	89,500	300
75,000	96,400	315
80,000	109,600	350
90,000	115,400	395
100,000	121,300	430
110,000	132,000	435
115,000	138,500	465
125,000	149,200	505
135,000	150,500	555
150,000	152,300	610
175,000	157,400	660
200,000	165,500	700
225,000	167,600	735

FIELD ERECTED (see notes 5 and 7)

CAPACITY POUNDS OF STEAM PER HOUR	WH's
60,000	4,800
80,000	6,400
100,000	8,000
200,000	16,000
300,000	24,000
400,000	32,000
500,000	40,000
600,000	48,000
700,000	56,000

FLUOR

EQUIPMENT UNIT WORK HOURS

D. BOILERS & HEATERS – con't.

7. STEAM BOILERS – con't.

STEAM BOILER NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning and checking out of boiler as required.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hour units are based on saturated steam – 100 to 1,000 PSIG.
4. Work hours for **Packaged Units** include erection of prefabricated skids, of sizes within shipping limits, inclusive of boiler and trim; burner for either oil, natural gas or combination of both; windbox; forced draft fan assembly; firing and control system (electric or pneumatic, single point); flame safety system; stack; feed water pumps; ladders and platforms; insulation; and refractory, as required for a complete package.
5. Work hours for **Field Erected** include boiler pressure components; by-pass system; waterwall pressure components; downtake system; superheater pressure components; backpass system; reheater pressure components; economizer pressure components; soot blowers; inner casing; outer casing and framing; buckstays and trusses; monitor roof; weather roof; pressurized roof; all ductwork and hoppers; stacks; supports and guides; drip castings and furnace bottom seals; air preheaters; doors and mounting arrangements; ladders and platforms; pulverizers and feeders (for coal fired); burners and registers; seal and aspirating air; stokers; thermocouples; firing and operating controls; fans and drivers; postweld heat treating; insulation and insulation supports; and refractory, as required for a complete assembly.
   Caution should be used when estimating field erection in this category. These work hours are not for detailed estimating but are instead provided as a general guideline and an aid for scheduling purposes. For a detailed estimate, specific components, materials of construction and process requirements must be identified and labored accordingly. See note 8 for other sources.
6. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
7. **Field erected boilers are typically a subcontracted item.**
8. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

D. BOILERS & HEATERS – con't.

8. FIRED HEATERS

CABIN ("BOX") TYPE

HEATER DUTY MM BTU's/HR	CS TUBE	ALLOY TUBE
10	1,800	2,700
15	2,400	3,300
20	2,800	3,800
25	3,300	4,500
30	3,700	5,000
40	4,400	6,000
50	5,000	7,000
60	5,600	7,800
70	6,200	8,600
80	6,700	9,100
90	7,200	9,600
100	7,700	10,500
150	9,800	13,500
200	11,500	16,000
250	13,500	18,500
300	15,000	21,000
400	17,500	25,000
500	20,500	29,000
600	23,000	32,000
700	25,000	35,000
800	27,000	38,000
900	29,000	41,000
1,000	32,000	44,000

FLUOR

EQUIPMENT UNIT WORK HOURS

D. BOILERS & HEATERS – con't.

8. FIRED HEATERS – con't.

VERTICAL CYLINDRICAL ("CAN") TYPE

HEATER DUTY MM BTU's/HR	CS TUBE	ALLOY TUBE
10	940	1,300
15	1,100	1,500
20	1,250	1,700
25	1,350	1,900
30	1,500	2,050
40	1,650	2,250
50	1,800	2,500
60	1,950	2,700
70	2,100	2,850
80	2,200	3,000
90	2,300	3,200
100	2,450	3,300
150	2,900	3,800
200	3,250	---
250	3,550	---
300	3,800	---

FIRED HEATER NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning and checking out of heater as required.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours are applicable for gas, oil or dual-fired type.
4. Work hours for **Fired Heaters** include the erection of structural steel frame and casing, header box, access and observation doors, ladders and platforms, radiant and convection tubes, crossovers, ductwork and stack, refractory on walls and roof, brick work, burners, steam/air atomizer, postweld heat treating and insulation, as required for a complete assembly.
5. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
6. Work hour units **do not** include induced draft fans w/ drivers, economizers, air preheat systems, waste heat recovery units or other ancillary equipment.
7. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

E. COMPRESSORS

9. BLOWERS & FANS

HORSE POWER	WH's/EA BLOWERS	FANS
1	20	20
3	25	30
5	35	30
7.5	40	35
10	45	40
15	55	45
20	65	50
25	70	55
30	80	55
40	90	60
50	100	65
75	120	75
100	135	80
150	165	90
200	190	100
250	210	105
300	230	110
400	260	120
500	290	130
600	315	---
800	360	---
1,000	395	---
1,250	440	---
1,500	480	---
2,000	600	---

BLOWER & FAN NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
4. Work hour units **do not** include installation of ductwork, transition pieces, dampers, expansion joints or other related ancillary items, which may be purchased and shipped from the same vendor who supplies the Blower or Fan.
5. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

E. COMPRESSORS – con't.

10. COMPRESSORS

CENTRIFUGAL

HP	MOTOR DRIVE	TURBINE DRIVE	GAS ENGINE DRIVE
5	40	60	110
10	55	90	170
15	70	120	220
20	80	130	240
25	90	150	280
30	100	170	320
50	190	320	600
75	220	370	690
100	250	420	780
150	290	530	980
200	320	610	1,200
250	340	700	1,300
300	350	780	1,450
400	380	910	1,750
500	400	1,050	2,000
600	420	1,150	2,200
700	440	1,250	2,400
800	460	1,350	2,600
900	470	1,450	2,800
1,000	480	1,500	3,000
1,500	680	1,900	------
2,000	840	2,500	------
3,000	1,250	2,800	------
4,000	1,400	3,400	------
5,000	1,750	3,800	------
6,000	2,000	4,200	------
7,000	2,300	4,500	------
8,000	2,500	4,800	------
9,000	2,800	5,200	------
10,000	3,000	5,500	------
15,000	4,200	------	------
20,000	5,300	------	------

FLUOR

EQUIPMENT UNIT WORK HOURS

E. COMPRESSORS – con't.

10. COMPRESSORS – con't.

RECIPROCATING

HP	MOTOR DRIVE
5	50
10	60
15	80
20	90
25	100
30	120
50	140
75	180
100	210
150	250
200	280
250	320
300	360
400	400
500	450
600	490
700	530
800	570
900	600
1,000	630
1,500	710
2,000	800
3,000	1,000
4,000	1,230
5,000	2,190
6,000	2,650
7,000	2,880
8,000	3,450
9,000	3,680
10,000	4,140
15,000	6,440
20,000	8,000

FLUOR

EQUIPMENT UNIT WORK HOURS

E. COMPRESSORS – con't.

10. COMPRESSORS – con't.

PACKAGED UNITS (CENTRIFUGAL OR RECIPROCATING)

HP	MOTOR DRIVE
Up to 30	25
> 30 to 100	50
> 100 to 300	75
> 300 to 600	100
> 600 to 1,000	125
1,500	140
2,000	170
2,500	210
3,000	250
3,500	300

COMPRESSOR NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours are applicable for either horizontal or vertical arrangement, as well as labyrinth, oil, contact or gas seals.
4. Work hours for **Centrifugal and Reciprocating Compressors** include the installation of the compressor, base plate, couplings and driver.
5. Work hours for **Turbine Drives** are applicable for either steam or gas.
6. Work hours for **Packaged Units** include erection of prefabricated skids, of sizes within shipping limits, inclusive of the compressor, driver, control panels, lube oil system, oil coolers, intercoolers, aftercoolers, etc., as required for a complete package.
7. Typically, 3,500 HP and below compressors can be delivered as a pre-assembled skid. Larger compressors would have to be delivered in multiple pieces, of sizes within shipping limits.
8. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
9. Work hour units **do not** include installation of vendor furnished interconnecting piping, oil coolers, lube oil console, auxiliary pumps, filters, gear box, intercoolers, aftercoolers, intakes, mechanical silencers, acoustical barriers or other related ancillary items, which may be purchased and shipped from the same vendor who supplies the Compressor.
10. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

F. PUMPS

11. PUMPS

HORIZONTAL CENTRIFUGAL

HP	MOTOR DRIVE	STEAM TURBINE DRIVE
Up to 10	25	---
15	30	---
25	35	---
30	40	---
50	45	---
60	50	---
75	60	---
100	70	---
125	80	---
150	90	---
200	110	140
250	120	160
300	180	230
400	200	260
500	230	300
800	320	430
1,000	370	490
1,250	430	560
1,750	580	770
2,000	640	840
2,500	730	950
3,000	940	1,230
5,000	1,290	1,680

VERTICAL CENTRIFUGAL IN-LINE

HP	MOTOR DRIVE
Up to 15	45
> 15 to 30	75
> 30 to 50	100
> 50 to 75	130
> 75 to 100	150
> 100 to 125	190

FLUOR

EQUIPMENT UNIT WORK HOURS

F. PUMPS – con't.

11. PUMPS – con't.

VERTICAL CENTRIFUGAL TURBINE

HP	MOTOR DRIVE
Up to 10	30
15	40
25	45
30	50
50	55
60	60
75	70
100	80
125	100
150	110
200	130
250	140
300	220
400	240
500	260
800	300
1,000	330
1,250	360
1,750	400
2,000	450
2,500	490
3,000	520
5,000	600

SUMP

HP	MOTOR DRIVE
Up to 15	70
> 15 to 30	110
> 30 to 50	150
> 50 to 75	200

VACUUM

HP	MOTOR DRIVE
Up to 3	20
> 3 to 30	30

FLUOR

EQUIPMENT UNIT WORK HOURS

F. PUMPS – con't.

11. PUMPS – con't.

PUMP NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours are applicable for single stage and two stage. For multi-stage horizontal centrifugal pumps, add **10%**.
4. Work hours are for pump and driver assembled on a common base.
5. **Centrifugal pumps** can be split into two main types in process plant service: **volute** pumps and **turbine** pumps. The former are more common (the volute, which is also called the *diffuser*, is shaped like a cone. It widens out and converts the velocity imparted to the liquid by the impeller, to feet of head). Turbine pumps have improved through the development of the innovative variable vane design that requires fewer moving parts.
6. **Positive displacement pumps** can be divided into two major categories: **reciprocating** and **rotating**. Reciprocating positive displacement pumps incorporate a plunger or piston that displaces, or feeds forward, a given volume of fluid per stroke. These can be identified in two basic classes: *Dynamic* pumps impart energy to the liquid in a steady fashion; *Displacement* pumps impart energy to the liquid in a pulsating fashion. **Metering** pumps are a subgroup of the positive displacement type and should be considered as precision instruments used to feed accurately a predetermined volume of liquid into a process or system. **Rotary** pumps consist of two meshing gears, where fluid is carried between the gear teeth and displaced when they mesh.
7. Work hours for **Vacuum pumps** are based on individual rotary piston, oil-sealed, single-stage mechanical type, the unit most commonly used for high-vacuum work (sometimes called a cam and piston pump).
8. API pumps differ from ANSI pumps in the following respects:
    - API pumps have greater corrosion allowances
    - API pumps have higher permissible nozzle loads
    - API pumps have more available stuffing box space
    - API pumps are furnished with wear rings; not always supplied with ANSI pumps
    - API pumps are centerline-mounted; ANSI pumps are often foot mounted
    - API pump bearing housings are generally fitted with higher load capacity bearings and higher life expectancy end seals
9. For vibration isolators, add the following:

HP up to 50	**10%**
HP > 50	**15%**

FLUOR

EQUIPMENT UNIT WORK HOURS

F. PUMPS – con't.

11. PUMPS – con't.

PUMP NOTES – con't.

10. For pump refurbishment of impeller, motor, base plate, bearing or seal, use the following guidelines:
    Based on new pump installation WH chart by driver HP –
    - Impeller removal and cleaning impeller casing - **25%**
    - Reinstall the impeller - **20%**
    - Pump realignment - **60%**
    - Coupling bolt-up, lubrication and test - **15%**
    - Motor -
        - remove **15%**
        - reinstall **25%**
    - Base plate modifications –
        - remove **6%**
        - reinstall **6%**
    - Bearings –
        - remove **6%**
        - reinstall **6%**
    - Seal –
        - remove **20%**
        - reinstall **25%**
11. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
12. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

G. MATERIAL HANDLING EQUIPMENT

12. CONVEYORS

OPEN BELT (see notes 3, 4, 5, 6 and 12)

WIDTH IN INCHES	WH's PER FOOT OF LENGTH LIGHT[1]	HEAVY[2]
12	1.5	1.6
18	2.0	2.5
24	2.4	3.5
30	2.9	4.5
36	3.3	5.6
42	3.6	6.6
48	4.0	7.7
54	4.3	8.9
60	4.7	10.0

MATERIAL WEIGHT:
LIGHT[1] – 60 pounds per cubic foot or less
HEAVY[2] – over 60 pounds per cubic foot

ROLLER (see notes 7, 8 and 9)

WIDTH IN INCHES	WH's PER FOOT OF LENGTH GRAVITY	POWERED
12	1.0	1.5
18	1.3	2.0
24	1.6	2.4
30	2.4	2.9
36	2.6	3.3
42	2.8	3.6
48	3.0	4.0
54	3.2	4.3
60	3.4	4.7

SCREW (see notes 10, 11 and 12)

DIAMETER IN INCHES	WH's PER FOOT OF LENGTH
6	3.0
9	3.5
12	4.0
14	4.2
16	4.4
18	4.6
20	4.8
24	5.0

FLUOR

EQUIPMENT UNIT WORK HOURS

G. MATERIAL HANDLING EQUIPMENT – con't.

12. CONVEYORS – con't.

BUCKET ELEVATORS (SPACED AND CONTINUOUS) (see notes 13 and 14)

LENGTH IN FEET	WH's PER FOOT OF LENGTH
Up to 25	8.0
26 to 30	7.0
31 to 40	6.0
41 to 70	5.0
71 to 100	4.0

CONVEYOR NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours for **Open Belt Conveyors** include the installation of "A" frames, truss sections with appropriate idlers, head pulley and drive, tail pulley (fixed or screw take-up), horizontal or vertical gravity take-up, snub and bend pulleys, holdback, belting, belt splicing, loading hopper and discharge hood, as required for a complete assembly.
4. Work hours for **Open Belt Conveyors do not** include the installation of covers or walkways. If required, add the following:
   Metal Conveyor Covers **25%**
   Metal Conveyor Covers and Walkways **100%**
   Work hours for walkways include the installation of steel framing, angle handrail and kneerail, toe plate and wooden walk, along the entire length of the conveyor, as required for a complete assembly.
   Where a walkway is required, a cover must also be installed.
5. **Belt Conveyors** that handle coal, ore and stone should not exceed 32.5 feet of vertical lift per 100 lineal feet of travel. See note 12 for additional information.
6. For weights of different materials for **Belt Conveyors**, see Richardson.
7. Work hours for **Roller Conveyors** include the installation of "H" stand supports, frame sections with bolted cross braces, end plate couplers, rollers and main drive section, as required for a complete assembly.
8. **Roller Conveyors** are ideal for conveying open and uneven bottom objects such as skids, buckets, drums and cans. They can also be used with flat bottom objects. A minimum of three rollers should always be under the smallest object being conveyed, so that the object will not tip over or get caught between rollers.
9. **Roller Conveyors** are typically installed in a level, horizontal position, with no noticeable vertical deflection.

FLUOR

EQUIPMENT UNIT WORK HOURS

G. MATERIAL HANDLING EQUIPMENT – con't.

12. CONVEYORS – con't.

CONVEYOR NOTES – con't.

10. Work hours for **Screw Conveyors** include the installation of "A" frames, conveyor trough and cover, flanged inlet, discharge spout (with hand slide or rack and pinion gate with flat slide), hanger bearing assemblies (ball or bobbitted/hard iron), coupling shaft, tail shaft, inlet bearing (ball or bobbitted), inlet bearing plate seal, trough end plate, flanged feet and saddles, drive assembly and screw shaft, as required for a complete assembly.
11. **Screw Conveyors** should not exceed 27 feet of vertical lift per 100 lineal feet of travel. See note 12 for additional information.
12. Work hours for **Belt and Screw Conveyors** are applicable to vertical lifts up to 20 feet per 100 lineal feet of travel. For vertical lifts over 20 feet per 100 lineal feet of travel, add **25%**.
13. Work hours for **Bucket Elevators** include the installation of conveyor drive assembly, head shaft, tail shaft, chain or belt, all casings (head section, tail section, standard and filler sections) and buckets, as required for a complete assembly.
14. **Bucket Elevators** typically do not exceed 100 feet in vertical lifting height. The use of spaced or continuous buckets as well as the use of belt or chain drive is determined by the type of material being conveyed and which configuration is best suited to handle the material.
15. There can be a significant reduction in conveying capacity depending upon the type of conveying system used and the type of material being conveyed.
16. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
17. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT

13. AGITATORS (see note 3)

HP	TOP ENTRY	SIDE ENTRY	BOTTOM ENTRY
1	10	30	40
3	20	45	65
5	25	55	80
7.5	35	60	90
10	40	65	105
15	50	75	120
25	65	90	150
30	75	100	165
50	100	120	200
60	110	125	215
100	150	150	265
125	170	160	295
150	190	175	315
200	225	190	355
250	255	205	390
300	285	220	420
350	315	230	450
400	340	245	475
450	365	255	495
500	385	265	520

AGITATOR NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours for **Agitators** include the installation of motor driver (Direct drive, Belt drive, Variable Frequency drive or Gear drive), baseplate, bearings, speed reducer, seals, shaft and impeller, as required for a complete assembly.
4. Larger HP with longer shafts may be shipped separately but are considered to be an assembled unit.
5. ***An agitator is defined as a device or an apparatus for stirring or shaking by giving motion; to move with an irregular, rapid or violent action.***
6. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
7. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

14. CENTRIFUGES (CENTRIFUGAL SEPARATORS)

BATCH (see note 3)

DIAMETER IN INCHES	BOTTOM DRIVEN	TOP SUSPENDED	AUTOMATIC
12 to 18	30	---	---
20	35	50	---
24	40	---	150
30	50	80	270
36	60	---	---
40	---	120	360
42	70	---	---
48	80	---	---
50	---	170	440
54	90	---	---
60	---	---	500

HIGH SPEED (see note 4)

DIAMETER IN INCHES	TUBULAR	DISC
4	90	---
5	150	---
6	260	---
10	---	175
15	---	260
20	---	300

CONVEYOR (see note 5)

DIAMETER IN INCHES	RECIPROCATING	SCROLL
15	280	335
20	350	430
25	385	480
30	440	565
40	525	700
50	630	825
60	---	930
75	---	1,100

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

14. CENTRIFUGES (CENTRIFUGAL SEPARATORS) – con't.

BOWL (see note 6)

DIAMETER IN INCHES	SOLID OR SCREEN
18	315
20	340
24	400
30	490
36	580
42	660
48	740
54	820

CENTRIFUGE NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours for **Batch Centrifuges** include the installation of basket and curb housing, curb housing spray fittings and manifold, rotating spray balls, plow for cake removal, skimmer, cover, inspection door with safety interlock, suspension system, feed tube, rinse tube, vent pipe, nitrogen purge connection and driver, as required for a complete assembly.
4. Work hours for **High Speed Centrifuges** include the installation of base, casing, rotors, discs, cooling coils, seals, cover and driver, as required for a complete assembly.
5. Work hours for **Conveyor Centrifuges** includes the installation of base, casing, hard surfaced conveyor, solid or screen bowl, cake posts with wear plates, plate dams, gearbox with safety guards and chutes, rinse type feed tube, backflush system, lube system, vibration isolators and driver, as required for a complete assembly.
6. Work hours for **Bowl Centrifuges** includes the installation of base, casing, rotors, discs, spindles, solid or screen bowl, cover, safety guards and driver, as required for a complete assembly.
7. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
8. For any activities required which are not included in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

15. CRYSTALIZERS

BATCH VACUUM (see note 3)

CAPACITY GALLONS	WH's
2000 & below	400
3000	410
4000	420
5000	440
6000	470
7000	500
8000	540

MECHANICAL (SCRAPED SURFACE) (see notes 4 and 5)

LENGTH LF	WH's
20	140
30	190
40	235
50	280
60	320
70	355
80	390
90	430
100	460
200	770
300	1,040
400	1,270
500	1,500
600	1,700
700	1,900
800	2,100
900	2,300
1,000	2,500

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

15. CRYSTALIZERS – con't.

CRYSTALIZER NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours for **Batch Vacuum Crystalizers** include the installation of a cone bottom agitated tank, steam jet ejectors and direct contact condenser, as required for a complete assembly.
4. Work hours for **Mechanical Crystalizers** include the installation of a 24-inch wide trough with a semi-circular bottom, a cooling jacket on the outside, a spiral ribbon scraper/mixer the length of the trough and motor driver, as required for a complete assembly.
5. **Mechanical Crystalizers** are manufactured in lengths of 10 to 40 feet. If lengths greater than 40 are required, the units are stacked one on top of another and the solution cascades from one level to the next.
6. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
7. For any activities required which are not in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

16. DRYERS

DRUM (see note 3)

SURFACE AREA	ATMOSPHERIC		VACUUM
SQ. FT.	SINGLE	DOUBLE	SINGLE
10	200	---	300
20	240	---	430
30	270	350	520
40	280	360	560
50	300	390	600
60	315	410	670
70	330	430	800
80	340	440	840
90	350	455	870
100	360	470	940
200	430	530	1,140
300	---	570	---
400	---	600	---

ROTARY (see note 4)

SURFACE AREA	DIRECT	INDIRECT
SQ. FT.	FIRED	FIRED
100	200	255
200	320	400
300	400	540
400	500	640
500	570	770
600	640	870
700	740	970
800	800	1,070
900	870	1,140
1,000	940	1,200
2,000	1,470	2,000

CAPACITY	
CU. FT.	VACUUM
100	600
200	800
300	940
400	1,040
500	1,140
600	1,200

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

16. DRYERS – con't.

SPRAY (see note 5)

EVAPORATION RATE IN LBS./HR.	WH's
1,000	800
2,000	1,175
3,000	1,200
4,000	1,275
5,000	1,300
6,000	1,575
7,000	1,650
8,000	1,700
9,000	1,750

TRAY (see note 6)

TRAY SQ. FT.	ATMOSPHERIC	VACUUM
40	50	80
60	55	95
100	60	110
150	70	120
200	75	135

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

16. DRYERS – con't.

DRYER NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours for **Drum Dryers** include the installation of the drum(s), frame, applicator rolls, endboards, main bearings, lubrication system, product removal knives, guide shields, feed device, vapor hood, dry material conveyor, drive mechanism and motor driver, as required for a complete assembly.
4. Work hours for **Rotary Dryers** include the installation of a rotating shell fitted with cast iron or steel tires, internal lifters, flights or louvers, rollers, roller bearings, support frame, inlet and outlet connections, with a chain or spur gear ring drive and motor diver, as required for a complete assembly.
5. Work hours for **Spray Dryers** include the installation of heater, filter, atomizer, fan, cyclone and motor driver, as required for a complete assembly.
6. Work hours for **Tray Dryers** include the installation of housing, frame, seals, tray supports, trays, fan and motor driver, as required for a complete assembly.
7. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
8. For any activities required which are not in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

17. DUST COLLECTORS

MECHANICAL (see note 3)

FLOW RATE CU. FT. PER MINUTE	CYCLONE	MULTIPLE CYCLONE
1,000 or less	35	50
2,500	40	55
5,000	45	60
10,000	50	70
20,000	60	80

SPRAY (see note 4)

FLOW RATE CU. FT. PER MINUTE	WASHER
1,000 or less	70
1,500	80
2,500	100
5,000	140
10,000	200
15,000	230
20,000	270

CLOTH BAY (see note 5)

FLOW RATE CU. FT. PER MINUTE	BAGHOUSE
1,000 or less	90
1,500	110
2,500	140
5,000	200
10,000	260
15,000	315
20,000	360

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

17. DUST COLLECTORS – con't.

PRECIPITATORS (see note 6)

FLOW RATE CU. FT. PER MINUTE	CENTRIFUGAL	ELECTRICAL LOW VOLTAGE	ELECTRICAL HIGH VOLTAGE
1,500 or less	75	50	---
2,500	100	80	---
5,000	150	150	---
7,000	175	200	450
10,000	200	270	500
15,000	260	400	550
20,000	300	500	600

DUST COLLECTOR NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning and checking out of dust collector as required.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours for **Mechanical Dust Collectors** include the installation of the cyclone (cylindrical shaped upper section and long tapering conical lower section), dust hopper, scroll outlet, weather cap and support frame, as required for a complete assembly.
4. Work hours for **Spray Dust Collectors** include the installation of the housing section, spray nozzles, collection hopper and support frame, as required for a complete assembly.
5. Work hours for **Cloth Bay Dust Collectors** include the installation of the cylindrical or rectangular enclosure, consisting of the clean air section, cloth filter tubes or bags section, dirty air section, shaker or pulse type cleaning system, collection hopper, product inlet and outlet, and support frame, as required for a complete assembly.
6. Work hours for **Precipitator Dust Collectors** include the installation of the shell, ductwork, fans, motor driver, wires, collection plates, rapper system, thermal insulation, collection hopper and support structure, as required for a complete assembly.
7. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
8. For any activities required which are not in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

18. EXTRACTORS (see note 3)

CAPACITY GALLONS PER MINUTE	CONTINUOUS CENTRIFUGAL
5	220
10	250
15	280
20	320
25	360
30	400
35	450
40	500

EXTRACTOR NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours for **Extractors** include the installation of the bowl (both cylindrical and conical parts), dewatering plates, axial screw – hard surface coated, main bearings, transmission and main motor with fan, as required for a complete assembly.
4. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
5. For any activities required which are not in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

19. FILTERS

PLATE & FRAME (see note 3)

FILTERING AREA SQ. FEET	WH's
75 or less	20
200	30
500	40
750	50
1,000	60
1,500	70

PRESSURE LEAF (see note 4)

FILTERING AREA SQ. FEET	WH's
50	75
60	80
70	85
80	90
90	95
100	100
200	120
300	140
400	155
500	170
600	180

ROTARY (see note 5)

FILTERING AREA SQ. FEET	DRUM	DISK
100	400	550
200	500	630
300	570	740
400	640	840
500	670	940
600	740	1,070
700	770	1,140
800	800	1,200
900	840	1,270
1,000	870	1,340
1,500	1,190	1,650
2,000	1,400	2,000

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

19. FILTERS – con't.

SEWAGE (see note 6)

FILTERING AREA SQ. FEET	WH's
100	255
200	290
300	310
400	335
500	350
600	360

SPARKLER (see note 7)

PLATE DIAMETER IN INCHES	WH's
15 or less	20
16 through 20	30
21 through 25	40
26 through 30	50
31 through 35	60

VIBRATING SCREENS (see note 8)

SCREEN AREA SQ. FEET	SINGLE DECK	DOUBLE DECK	TRIPLE DECK
30 or less	25	28	29
>30 to 50	30	33	35
>50 to 70	35	39	40
>70 to 100	40	44	46
>100 to 120	55	61	63
>120 to 160	60	66	69
>160 to 200	80	88	92

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

19. FILTERS – con't.

FLOTATION (see note 9)

CAPACITY CU. FT.	WH's
15 or less	30
20	35
25	40
30	45
40	50
50	60
60	65
70	75
80	80
90	90
100	100

FILTER NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours for **Plate & Frame Filters** include the installation of the filter press plates mounted on a skeleton frame, closed or open design, wash or pressure plate with different channel arrangement, with or without stay bosses, integrated heating or cooling coils, hydraulic press action and motor driver, as required for a complete assembly. The size and the number of plates required determine the filtration area.
4. Work hours for **Pressure Leaf Filters** include the installation of the vertical or horizontal tank, individually mounted filter leaves on an internal pipe manifold, leaf spacers, frames, drainage member, intermediate member, surface member, nozzles, manual or hydraulic cover lift and support frame, as required for a complete assembly. The filtration area is determined by the size and number of leaves required.
5. Work hours for **Rotary Filters** include the installation of either a multi compartment cylinder shell with internal filtrate piping, polypropylene filter cloth, feed box with inlet and drain nozzles (***DRUM***) or segmented disks with polypropylene filter bags (***DISK***), suction valve, rake agitated vat with stiffeners, discharge trough, base plate, bearing support, rotor and motor driver, as required for a complete assembly. The filtration area is determined by either the drum capacity or by the size and number of segmented disks.
6. Work hours for **Sewage Filters** include the installation of the multi compartment cylinder shell, internal filtrate piping, polypropylene filter cloth, feed box with inlet and drain nozzles, suction valve, discharge trough, driver consisting of rotor, drive motor base plate, worm gear reducer and two pillow block bearings with supports, as required for a complete assembly. Filtration area is determined by the cylinder capacity.

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

19. FILTERS – con't.

FILTER NOTES – con't.

7. Work hours for **Sparkler Filters** include the installation of the vertical tank, horizontally arranged filter plates, perforated support screens, interlocking cups, center rod, tie rods, filter media, inlet and outlet nozzles, and support legs, as required for a complete assembly. The diameter and number of plates determine filtration area.
8. Work hours for **Vibrating Screen Filters** include the installation of the base mounted unit, back plate at each deck and between decks, discharge lips, single shaft extension, V-belt drive with taper-lock hubs, eccentrically bored screen sheave bushings and motor driver, as required for a complete assembly. The width and length of a single screen determine filtration area. For suspended mounted units, add **25%** to the appropriate unit WH's.
9. Work hours for **Flotation Filters** include the installation of the eductor shell, disperser, coalescer, influent pipe, suction and discharge ports, skimmer screen and support legs, as required for a complete assembly, for either Induced Gas Flotation (IGF) or Dissolved Air Flotation (DAF) applications. Filtration capacity is determined by the size of the shell.
10. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
11. For any activities required which are not in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

20. MIXERS

PROPELLER (see note 3)

HP	PORTABLE	FIXED
2 or less	10	25
3-4	15	25
5-6	20	25
7-8	25	30
9-10	---	35
20	---	55
30	---	75
40	---	100
50	---	125
60	---	150
70	---	180
80	---	215
90	---	260
100	---	310

BLENDER (see note 4)

CU. FT.	SPIRAL RIBBON	ROTARY DRUM
20 or less	60	90
21 to 40	60	100
41 to 60	60	110
61 to 80	65	120
81 to 100	70	130
101 to 200	85	160
201 to 300	100	190
301 to 400	120	230

BATCH (see note 5)

CU. FT.	SIGMA BLADE	PAN
6 or less	80	170
7-8	100	180
9-10	110	190
15	135	210
20	155	225
30	190	260
40	215	300
50	235	---
60	250	---
70	260	---

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

20. MIXERS – con't.

MIXER NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours for **Propeller Mixers** include the installation of the shaft, impeller, mounting device, shaft sealing device and motor driver, as required for a complete assembly.
4. Work hours for **Blender Mixers** include the installation of the trough/drum, outboard bearings, packing glands, lubrication systems, gearbox, bearing supports, leg mounts and motor driver, as required for a complete assembly.
5. Work hours for **Batch Mixers** include the installation of the mixing chamber, end frames, rotor bearing assembly, dust-stop seals, discharge door, feed hopper, lubrication systems, gearbox, bedplate and motor driver, as required for a complete assembly.
6. ***A mixer is defined as a device, container or machine that combines or blends into one mass, two or more materials or products.***
7. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
8. For any activities required which are not in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

21. SIZE REDUCTION

CRUSHERS (see note 3)

HP	ROTARY	SAWTOOTH
5 or less	25	30
6-7	30	35
8-10	40	50
11-20	50	60
21-40	60	80

HP	SWING HAMMER	SWING JAW
5 or less	30	55
6-7	35	75
8-10	45	95
11-20	60	110
21-40	95	140
41-60	135	180
61-80	175	220
81-100	210	250
101-150	300	---
151-200	375	---
201-300	450	---

HP	SINGLE ROLL	GYRATORY
5 or less	120	---
6-7	150	---
8-10	180	---
11-20	220	285
21-40	270	320
41-60	320	370
61-80	360	440
81-100	---	470
101-150	---	540
151-200	---	600
200-250	---	650

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

21. SIZE REDUCTION – con't

MILLS (see note 4)

HP	ATTRITION	MICRO PULVERIZER	ROLLER
5	30	---	---
6	30	135	---
7	30	150	---
8	35	155	---
9	35	160	---
10	40	170	---
15	50	200	---
20	55	235	440
30	70	270	500
40	80	---	570
50	90	---	600
60	95	---	640
70	110	---	670
80	115	---	800
90	120	---	1,000
100	130	---	1,080
150	160	---	1,200
200	180	---	1,340
300	230	---	1,450
400	---	---	1,600

TONS PER HOUR	BALL MILL 1 ½"	¾"	½"	¼"
1	---	---	500	800
2	---	440	670	1,070
3	350	520	800	1,270
4	390	590	910	1,440
6	460	700	1,070	1,740
8	520	800	1,170	1,890
10	560	870	1,310	2,140
15	670	1,070	1,510	---
20	740	1,170	---	---
30	870	---	---	---
40	970	---	---	---
50	1,070	---	---	---

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

21. SIZE REDUCTION – con't

CUTTERS (see note 5)

HP	ROTARY KNIFE
5 or less	30
6-7	35
8-9	40
10	50
15	60
20	80
30	110
40	135
50	155
60	175
70	200
80	215

SIZE REDUCTION NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours for **Size Reduction Crushers** include the installation of the cones, shells, rollers, rotors, toggles, plates, crushing chamber, bearings, gearbox, lubrication systems, frame and motor driver, as required for a complete assembly.
4. Work hours for **Size Reduction Mills** include the installation of the feed chute assembly, mill chamber, dump chute assembly, lifter bars, grates, bearings, gearbox, lubrication systems, frame and motor driver, as required for a complete assembly.
5. Work hours for **Size Reduction Cutters** include the installation of the cutting chamber, rotor assembly, bearings, gearbox, lubrication system, frame and motor driver, as required for a complete assembly.
6. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
7. For any activities required which are not in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

EQUIPMENT UNIT WORK HOURS

H. OTHER PROCESSING EQUIPMENT – con't.

22. THICKNERS

CONTINUOUS TYPE (see note 3)

AREA SQ. FT.	WH's
100	120
200	130
400	150
600	160
800	180
1,000	190
2,000	240
3,000	270
4,000	300
5,000	330

THICKNER NOTES

1. Work hour units include receiving, unloading, retrieval, hauling, rigging to position, shimming to elevation, leveling, aligning, lubricating, bumping for rotation check and installing guards.
2. Work hour units include field-engineering time to establish centerlines and bench marks.
3. Work hours for **Continuous Type Thickeners** include the installation of the rake mechanism, feed well, bridge, drive head, worm gear and motor driver, as required for a complete assembly.
4. Work hour units **do not** include installation of foundation or anchoring system, support steel, piping, instrumentation, electrical power wiring or their connections.
5. For any activities required which are not in this section, see Page, Richardson or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

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PIPING UNIT WORK HOURS

TABLE OF CONTENTS – con't.

FLUOR

PIPING UNIT WORK HOURS

A. GENERAL NOTES

1. The piping erection work hours in this section may need to be supplemented with the following categories by means of a percentage adder, where they are deemed applicable:

    - Unload and store (initial delivery only)
    - Shoes, Guides & Hangers
        - Non-Engineered (base ells, angle, plate, u-bolts, etc.)
        - Engineered (spring supports)
    - Hydrotest/Punchout

2. Consideration for the following difficulties in the erection of piping systems may require additional work hours:

    - Multi-level piperacks
    - Unusual congestion
    - High elevation

3. Work hour units for piping are based on ***in-place*** operations, with an adjustment for ***weld bay*** applications. This appears as a note in the applicable sections. For definition purposes, ***in-place*** denotes an activity that takes place at the actual erection location. ***Weld bay*** on the other hand, denotes an activity that takes place in a controlled environment, usually away from the erection location. The adjustment takes into account the expected improvement in production. The ***weld bay*** adjustment is typically applicable to those projects where the execution philosophy determines that onsite fabrication is more cost effective than utilizing third-party fabrication facilities. This usually applies to international projects with remote locations. To determine when this philosophy is applicable, consult Project Management and appropriate Construction department representative.

4. When estimating linear feet (LF) of pipe, measurement **must** be taken through all fittings, flanges, valves, instruments, specialty items and any other in-line appurtenances.

5. For field erection of some materials, a factory representative may be required. If so, this cost must be added into the estimate. To verify installation requirements, consult Piping lead engineer.

6. If internal shot-blast cleaning of pipe is required in the field, this cost must be added into the estimate. ***This is typically a sub-contract cost.***

7. Work hour units **do not** include any time for assisting sub-contractors.

8. There are no specific tables in this section for flanged fitting steel piping systems. Where required, the appropriate pipe erection work hours (fabricated spools or straight run) should be used with the appropriate flange rating work hours for bolt-ups.

9. There are no specific tables in this section for flanged plastic-lined steel piping systems. These are specially engineered and always unique. To estimate the erection of these systems, use the pipe erection work hours for fabricated spools and the appropriate flange rating work hours for bolt-ups. Special supports and hangers are usually required for these applications. To verify fabrication and installation requirements, consult Piping lead engineer.

FLUOR

PIPING UNIT WORK HOURS

A. GENERAL NOTES – con't.

10. There are no specific tables in this section for jacketed piping systems. These are specially engineered and always unique. The jacketing application is usually for one of two purposes – to keep the medium in the core pipe at a consistent temperature or to act as a double containment system to control leaks. Temperature control is usually achieved through the use of steam or hot oil.

    - If jacketed system is flanged, use pipe erection work hours for fabricated spools at jacket size and the appropriate flange rating for bolt-ups at the jacket size.
    - If jacketed system is welded, use pipe erection work hours for fabricated spools at jacket size and applicable buttweld work hours for core size, wall thickness and metallurgy. Care should be taken with jacket welding – usually a one foot section has been cut out and split in half to allow access for the core pipe buttweld. After testing of the core pipe is complete, the jacket pipe must be welded around the circumference at each end and along the seam on both sides. The estimator must use the Longitudinal Welding work hour units for these types of welds. To verify fabrication and installation requirements, consult Piping lead engineer.

11. When erecting cement lined pipe, add **10%** to the base work hour units for special handling and additional weight.

12. For underground pressure piping systems, thrust blocks at each fitting location must be included as required per client specification.

13. For any excavation, backfill or concrete activities, see appropriate sections:

    - 000 310 1000 Earthwork Standard Unit Work hours
    - 000 310 1100 Concrete Standard Unit Work hours

14. For various installation details, see Fluor Daniel General Piping Specification – Piping Standard Details (Master Specification 000 250 50040).

FLUOR

PIPING UNIT WORK HOURS

A. GENERAL NOTES – con't.

STEEL PIPE DIMENSIONS & WEIGHTS – IMPERIAL AND METRIC

PIPE SIZE NOMINAL INCHES / MM	O.D.	SCHEDULE DESIGNATIONS ANSI/ASME			WALL THICKNESS INCH	WALL THICKNESS MM	WEIGHT LBS/ FOOT	WEIGHT KG/ METER
½	0.840	5		5S	0.065	1.65	0.5383	0.80
15	21.3	10		10S	0.083	2.11	0.671	1.00
		STD	40	40S	0.109	2.77	0.851	1.27
		XS	80	80S	0.147	3.73	1.088	1.62
		160			0.188	4.78	1.309	1.95
		XXS			0.294	7.47	1.714	2.55
¾	1.050	5		5S	0.065	1.65	0.6838	1.02
20	26.7	10		10S	0.083	2.11	0.8572	1.28
		STD	40	40S	0.113	2.87	1.131	1.68
		XS	80	80S	0.154	3.91	1.474	2.19
		160			0.219	5.56	1.944	2.89
		XXS			0.308	7.82	2.441	3.63
1	1.315	5		5S	0.065	1.65	0.8678	1.29
25	33.4	10		10S	0.109	2.77	1.404	2.09
		STD	40	40S	0.133	3.38	1.679	2.50
		XS	80	80S	0.179	4.55	2.172	3.23
		160			0.250	6.35	2.844	4.23
		XXS			0.358	9.09	3.659	5.45
1 ½	1.900	5		5S	0.065	1.65	1.274	1.90
40	48.3	10		10S	0.109	2.77	2.085	3.10
		STD	40	40S	0.145	3.68	2.718	4.05
		XS	80	80S	0.200	5.08	3.631	5.40
		160			0.281	7.14	4.859	7.23
		XXS			0.400	10.16	6.408	9.54
2	2.375	5		5S	0.065	1.65	1.604	2.39
50	60.3	10		10S	0.109	2.77	2.638	3.93
		STD	40	40S	0.154	3.91	3.653	5.44
		XS	80	80S	0.218	5.54	5.022	7.47
		160			0.344	8.74	7.462	11.11
		XXS			0.436	11.07	9.029	13.44
3	3.500	5		5S	0.083	2.11	3.029	4.51
80	88.9	10		10S	0.120	3.05	4.332	6.45
		STD	40	40S	0.216	5.49	7.576	11.27
		XS	80	80S	0.300	7.62	10.25	15.25
		160			0.438	11.13	14.32	21.31
		XXS			0.600	15.24	18.58	27.65

FLUOR

PIPING UNIT WORK HOURS

A. GENERAL NOTES – con't.

STEEL PIPE DIMENSIONS & WEIGHTS – IMPERIAL AND METRIC – con't.

PIPE SIZE NOMINAL INCHES / MM	O.D.	SCHEDULE DESIGNATIONS ANSI/ASME			WALL THICKNESS INCH	WALL THICKNESS MM	WEIGHT LBS/ FOOT	WEIGHT KG/ METER
4	4.500	5		5S	0.083	2.11	3.915	5.83
100	114.3	10		10S	0.120	3.05	5.613	8.35
		STD	40	40S	0.237	6.02	10.79	16.06
		XS	80	80S	0.337	8.56	14.98	22.29
		120			0.438	11.13	19.00	28.28
		160			0.531	13.49	22.51	33.50
		XXS			0.674	17.12	27.54	40.99
6	6.625	5		5S	0.109	2.77	7.585	11.29
150	168.3	10		10S	0.134	3.40	9.289	13.82
		STD	40	40S	0.280	7.11	18.97	28.23
		XS	80	80S	0.432	10.97	28.57	42.52
		120			0.562	14.27	36.39	54.16
		160			0.719	18.26	45.35	67.49
		XXS			0.864	21.95	53.16	79.12
8	8.625			5S	0.109	2.77	9.914	14.75
200	219.1	10		10S	0.148	3.76	13.40	19.94
		20			0.250	6.35	22.36	33.28
		30			0.277	7.04	24.70	36.76
		STD	40	40S	0.322	8.18	28.55	42.49
		60			0.406	10.31	35.64	53.04
		XS	80	80S	0.500	12.70	43.39	64.58
		100			0.594	15.09	50.95	75.83
		120			0.719	18.26	60.71	90.35
		140			0.812	20.62	67.76	100.84
		XXS			0.875	22.23	72.42	107.78
		160			0.906	23.01	74.69	111.16
10	10.750			5S	0.134	3.40	15.19	22.61
250	273.1			10S	0.165	4.19	18.70	27.83
		20			0.250	6.35	28.04	41.73
		30			0.307	7.80	34.24	50.96
		STD	40	40S	0.365	9.27	40.48	60.24
		XS	60	80S	0.500	12.70	54.74	81.47
		80			0.594	15.09	64.43	95.89
		100			0.719	18.26	77.03	114.64
		120			0.844	21.44	89.29	132.89
		140	XXS		1.000	25.40	104.13	154.97
		160			1.125	28.58	115.64	172.10

FLUOR

PIPING UNIT WORK HOURS

A. GENERAL NOTES – con't.

STEEL PIPE DIMENSIONS & WEIGHTS – IMPERIAL AND METRIC – con't.

PIPE SIZE NOMINAL INCHES / MM	O.D.	SCHEDULE DESIGNATIONS ANSI/ASME			WALL THICKNESS INCH	WALL THICKNESS MM	WEIGHT LBS/FOOT	WEIGHT KG/METER
12	12.750			5S	0.156	3.96	20.98	31.22
300	323.9			10S	0.180	4.57	24.20	36.02
		20			0.250	6.35	33.38	49.68
		30			0.330	8.38	43.77	65.14
		STD		40S	0.375	9.53	49.56	73.76
		40			0.406	10.31	53.52	79.65
		XS		80S	0.500	12.70	65.42	97.36
		60			0.562	14.27	73.15	108.87
		80			0.688	17.48	88.63	131.90
		100			0.844	21.44	107.32	159.72
		120	XXS		1.000	25.40	125.49	186.76
		140			1.125	28.58	139.67	207.86
		160			1.312	33.32	160.27	238.52
14	14.000			10S	0.188	4.78	27.73	41.27
350	355.6	10			0.250	6.35	36.71	54.63
		20			0.312	7.92	45.61	67.88
		STD	30	40S	0.375	9.53	54.57	81.21
		40			0.438	11.13	63.44	94.41
		XS		80S	0.500	12.70	72.09	107.29
		60			0.594	15.09	85.05	126.58
		80			0.750	19.05	106.13	157.95
		100			0.938	23.83	130.85	194.74
		120			1.094	27.79	150.90	224.58
		140			1.250	31.75	170.21	253.32
		160			1.406	35.71	189.10	281.43
16	16.00			10S	0.188	4.78	31.75	47.25
400	406.4	10			0.250	6.35	42.05	62.58
		20			0.312	7.92	52.27	77.79
		STD	30	40S	0.375	9.53	62.58	93.13
		XS	40	80S	0.500	12.70	82.77	123.18
		60			0.656	16.66	107.50	159.99
		80			0.844	21.44	136.61	203.31
		100			1.031	26.20	164.82	245.29
		120			1.219	30.96	192.43	286.38
		140			1.438	36.53	223.64	332.83
		160			1.594	40.49	245.25	364.99

FLUOR

PIPING UNIT WORK HOURS

A. GENERAL NOTES – con't.

STEEL PIPE DIMENSIONS & WEIGHTS – IMPERIAL AND METRIC – con't.

PIPE SIZE NOMINAL INCHES / MM	O.D.	SCHEDULE DESIGNATIONS ANSI/ASME			WALL THICKNESS INCH	WALL THICKNESS MM	WEIGHT LBS/ FOOT	WEIGHT KG/ METER
18	18.000			10S	0.188	4.78	35.76	53.22
450	457.2	10			0.250	6.35	47.39	70.53
		20			0.312	7.92	58.94	87.72
		STD		40S	0.375	9.53	70.59	105.06
		30			0.438	11.13	82.15	122.26
		XS		80S	0.500	12.70	93.45	139.08
		40			0.562	14.27	104.67	155.78
		60			0.750	19.05	138.17	205.63
		80			0.938	23.83	170.92	254.37
		100			1.156	29.36	207.96	309.50
		120			1.375	34.93	244.14	363.34
		140			1.562	39.67	274.22	408.11
		160			1.781	45.24	308.50	459.13
20	20.000			10S	0.218	5.54	46.06	68.55
500	508	10			0.250	6.35	52.73	78.48
		STD	20	40S	0.375	9.53	78.60	116.98
		XS	30	80S	0.500	12.70	104.13	154.97
		40			0.594	15.09	123.11	183.22
		60			0.812	20.62	166.40	247.65
		80			1.031	26.19	208.87	310.85
		100			1.281	32.54	256.10	381.14
		120			1.500	38.10	296.37	441.07
		140			1.750	44.45	341.09	507.63
		160			1.969	50.01	379.17	564.30
24	24.000	10		10S	0.250	6.35	63.41	94.37
600	609.6	STD	20	40S	0.375	9.53	94.62	140.82
		XS		80S	0.500	12.70	125.49	186.76
		30			0.562	14.27	140.68	209.37
		40			0.688	17.48	171.29	254.92
		60			0.969	24.61	238.35	354.72
		80			1.219	30.96	296.58	441.39
		100			1.531	38.89	367.39	546.77
		120			1.812	46.02	429.39	639.04
		140			2.062	52.37	483.10	718.97
		160			2.344	59.54	542.13	806.83

FLUOR

PIPING UNIT WORK HOURS

A. GENERAL NOTES – con't.

STEEL PIPE DIMENSIONS & WEIGHTS – IMPERIAL AND METRIC – con't.

PIPE SIZE NOMINAL INCHES / MM	O.D.	SCHEDULE DESIGNATIONS ANSI/ASME			WALL THICKNESS INCH	WALL THICKNESS MM	WEIGHT LBS/ FOOT	WEIGHT KG/ METER
30	30.000	10			0.312	7.92	98.93	147.23
750	762	STD		40S	0.375	9.53	118.65	176.58
		XS	20	80S	0.500	12.70	157.53	234.44
		30			0.625	15.88	196.08	291.82
36	36.000	10			0.312	7.92	118.92	176.98
900	914.4	STD		40S	0.375	9.53	142.68	212.34
		XS		80S	0.500	12.70	189.57	282.13
42	42.000	STD		40S	0.375	9.53	166.71	248.11
1050	1066.8	XS		80S	0.500	12.70	221.61	329.81
		30			0.625	15.88	276.18	411.02
		40			0.750	19.05	330.41	491.73
48	48.000	STD		40S	0.375	9.53	190.74	283.87
1200	1219.2	XS		80S	0.500	12.70	253.65	377.49

WEIGHT OF STEEL PIPE PER FOOT FORMULA:

IMPERIAL (OD – WT) x WT x 10.68 = LBS/LF

METRIC (OD – WT) x WT x 15.8945 = KG/METER

OR

LBS/LF x 1.48825 = KG/METER

KEY:
OD = OUTSIDE DIAMETER
WT = WALL THICKNESS
LBS = POUNDS
LF = LINEAR FEET
KG = KILOGRAMS

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE

1. HANDLING — WH's PER LF

FABRICATED SPOOLS

Pipe Size	LW	STD	XS	S/10	S/20	S/30	S/40	S/60	S/80	S/100	S/120	S/140	S/160	XXS
½"	0.2	0.2	0.2				0.2		0.2				0.2	0.2
¾"	0.2	0.2	0.2				0.2		0.2				0.2	0.2
1"	0.2	0.2	0.2				0.2		0.2				0.2	0.2
1 ½"	0.3	0.3	0.3				0.3		0.3				0.3	0.4
2"	0.3	0.3	0.3				0.3		0.3				0.3	0.4
3"	0.4	0.4	0.4				0.4		0.4				0.5	0.5
4"	0.5	0.5	0.5				0.5		0.5		0.7		0.7	0.7
6"	0.6	0.6	0.8				0.6		0.8		1.0		1.0	1.0
8"	0.7	0.7	0.9		0.7	0.7	0.7	0.9	0.9	1.1	1.1	1.1	1.1	1.1
10"	0.9	0.9	1.2		0.9	0.9	0.9	1.2	1.4	1.4	1.4	1.4	1.4	1.4
12"	1.1	1.1	1.5		1.1	1.1	1.5	1.8	1.8	1.8	1.8	1.8	1.8	1.8
14"	1.2	1.2	1.6	1.2	1.2	1.2	1.6	1.9	1.9	1.9	1.9	1.9	1.9	
16"	1.3	1.3	1.7	1.3	1.3	1.7	1.7	2.1	2.1	2.1	2.1	2.1	2.1	
18"	1.4	1.4	1.9	1.4	1.4	1.9	2.2	2.2	2.2	2.2	2.2	2.2	2.2	
20"	1.5	1.5	2.0	1.5	1.5	2.0	2.4	2.4	2.4	2.4	2.4	2.4	2.4	
24"		1.6	2.1	1.6	1.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	
30"		2.0	2.7	2.0	2.7	3.2	3.2							
36"		2.5	3.8	2.5	3.4	4.6	4.6							

	0.375"	0.500"	0.750"	1.000"	1.250"	1.500"	1.750"	2.000"
42"	3.1	4.1	5.0	5.0	5.0	5.0	5.0	5.0
48"	3.3	4.4	5.3	5.3	5.3	5.3	5.3	5.3
54"	3.4	4.5	5.4	5.4	5.4	5.4	5.4	5.4
60"	3.6	4.8	5.8	5.8	5.8	5.8	5.8	5.8
66"	3.7	4.9	5.9	5.9	5.9	5.9	5.9	5.9
72"	3.9	5.2	6.2	6.2	6.2	6.2	6.2	6.2

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

1. HANDLING – con't. **WH's PER LF**

STRAIGHT RUNS

Pipe Size	LW	STD	XS	S/10	S/20	S/30	S/40	S/60	S/80	S/100	S/120	S/140	S/160	XXS
½"	0.1	0.1	0.1				0.1		0.1				0.1	0.1
¾"	0.1	0.1	0.1				0.1		0.1				0.1	0.1
1"	0.1	0.1	0.1				0.1		0.1				0.1	0.1
1 ½"	0.2	0.2	0.2				0.2		0.2				0.2	0.2
2"	0.2	0.2	0.2				0.2		0.2				0.2	0.2
3"	0.2	0.2	0.2				0.2		0.2				0.3	0.3
4"	0.3	0.3	0.3				0.3		0.3		0.3		0.3	0.3
6"	0.3	0.3	0.4				0.3		0.4		0.5		0.5	0.5
8"	0.4	0.4	0.5		0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6
10"	0.5	0.5	0.6		0.5	0.5	0.5	0.6	0.7	0.7	0.7	0.7	0.7	0.7
12"	0.6	0.6	0.7		0.6	0.6	0.7	0.9	0.9	0.9	0.9	0.9	0.9	0.9
14"	0.6	0.6	0.8	0.6	0.6	0.6	0.8	1.0	1.0	1.0	1.0	1.0	1.0	
16"	0.7	0.7	0.9	0.7	0.7	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	
18"	0.7	0.7	1.0	0.7	0.7	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
20"	0.8	0.8	1.0	0.8	0.8	1.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
24"		0.8	1.1	0.8	0.8	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	
30"		1.0	1.3	1.0	1.3	1.6	1.6							
36"		1.3	1.9	1.3	1.7	2.3	2.3							

	0.375"	0.500"	0.750"	1.000"	1.250"	1.500"	1.750"	2.000"
42"	1.6	2.1	2.5	2.5	2.5	2.5	2.5	2.5
48"	1.7	2.2	2.7	2.7	2.7	2.7	2.7	2.7
54"	1.7	2.3	2.7	2.7	2.7	2.7	2.7	2.7
60"	1.8	2.4	2.9	2.9	2.9	2.9	2.9	2.9
66"	1.9	2.5	3.0	3.0	3.0	3.0	3.0	3.0
72"	2.0	2.6	3.1	3.1	3.1	3.1	3.1	3.1

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

1. HANDLING – con't.

HANDLING NOTES

1. Work hour units include unload, storage and handling to erection site.
2. Work hour units are for pipe erection only and **do not** include welding, bolt-ups or valve erection.
3. For unlisted sizes, use the next higher listing.
4. LW column represents Light Wall, typically S/5, S/5S, S/10 and S/10S with wall thickness **less than** ¼" thick (less than 0.250").
5. For pipe removal, multiply standard units by **50%** if piping will be disposed of or use **net** if piping will be reinstalled (remember to use units **again** for the reinstallation).
6. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

2. SCREWED JOINTS and SOCKETWELDS **WH's EACH**

SCREWED JOINTS

Pipe Size	All Ratings
½"	0.35
¾"	0.35
1"	0.45
1 ½"	0.65
2"	0.80
3"	1.35
4"	1.85
6"	2.60

SOCKETWELDS

Pipe Size	3000#	6000#	9000#
½"	0.6	0.6	0.8
¾"	0.6	0.7	1.0
1"	0.7	0.8	1.1
1 ½"	0.9	1.1	1.5
2"	1.0	1.2	1.7

SCREWED JOINT and SOCKETWELD NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.

2. Work hour units for screwed joints include handling, cutting, threading and joint make-on.

3. Work hour units for socketwelds include handling, cutting and socket welding.

4. Work hour units for socketwelds are ***in-place***. For ***weld bay***, multiply standard units by **80%**.

5. For seal welding screwed joints, multiply 3000# socketweld standard units by **50%**.

6. For alloy fabrication adjustments, see Alloy Material Adjustment section.

7. The correlation between class rating categories and pipe wall thickness is as follows:
   - 3000# wall thickness up to and including XS
   - 6000# wall thickness > XS up to and including S/160
   - 9000# wall thickness XXS

8. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS **WH's EACH**

BUTTWELDS

Pipe Size	LW	STD	XS	S/10	S/20	S/30	S/40	S/60	S/80	S/100	S/120	S/140	S/160	XXS
½"	0.7	0.7	0.8				0.7		0.8				1.0	1.1
¾"	0.7	0.7	0.8				0.7		0.8				1.0	1.1
1"	0.8	0.8	0.9				0.8		0.9				1.3	1.6
1 ½"	0.9	0.9	1.1				0.9		1.1				1.7	2.5
2"	1.1	1.1	1.4				1.1		1.4				2.2	3.0
3"	1.5	1.5	2.0				1.5		2.0				2.8	3.9
4"	1.6	2.0	2.6				2.0		2.6		3.6		4.3	5.8
6"	2.5	2.8	3.7				2.8		3.7		5.5		7.2	*9.5
8"	3.6	3.6	4.9		3.6	3.6	3.6	4.5	4.9	6.5	8.6	*11.0	*12.7	*11.9
10"	4.1	4.5	5.8		4.1	4.3	4.5	5.8	7.3	9.6	*13.3	*16.6	*19.7	*16.6
12"	4.9	5.2	6.9		4.9	5.1	5.9	7.5	9.4	*13.8	*17.7	*22	*27	*17.7
14"	5.3	6.1	8.3	5.3	5.7	6.1	7.1	9.5	*13.4	*18.0	*23	*27	*32	
16"	6.1	7.0	8.9	6.1	6.7	7.0	8.9	11.8	*16.6	*24	*29	*35	*40	
18"	6.8	7.8	10.5	6.8	7.8	9.3	11.5	*15.7	*22	*29	*36	*43	*49	
20"	7.6	8.6	11.2	7.6	8.6	11.2	13.0	*19.4	*27	*36	*44	*51	*57	
24"		10.0	13.4	9.2	10.0	14.7	17.6	*27	*33	*45	*55	*63	*75	
30"		12.5	16.7	11.4	16.7	21	24							
36"		15.0	20	13.7	20	25	30							

	0.375"	0.500"	0.750"	1.000"	1.250"	1.500"	1.750"	2.000"
42"	17.5	23	*35	*47	*59	*70	*82	*94
48"	20	27	*40	*54	*67	*80	*94	*107
54"	23	30	*45	*60	*75	*90	*106	*121
60"	25	34	*50	*67	*84	*101	*117	*134
66"	28	37	*55	*74	*92	*111	*129	*147
72"	30	40	*60	*80	*101	*121	*141	*161

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't.

BUTTWELD NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.
2. Work hour units include cutting, beveling and welding.
3. Work hour units are for welding ***in-place***. For ***weld bay***, multiply standard units by **80%**.
4. ** Indicates wall thickness equal to or greater than ¾" thick (0.750") and requires preheat and stress relief for carbon steel, high yield carbon steel and low temp carbon steel. See Preheat and Local Stress Relief sections for these operations.*
5. For other materials requiring preheat and stress relief, see Alloy Material Adjustment section.
6. For alloy fabrication adjustments, see Alloy Material Adjustment section.
7. LW column represents Light Wall, typically S/5, S/5S, S/10 and S/10S with wall thickness **less than** ¼" thick (less than 0.250").
8. For unlisted sizes, use the next higher listing.
9. For sizes above 72", the work hours are proportional to the largest size listed with the same wall thickness.
10. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't. **WH's EACH**

SLIP-ON FLANGE WELDS

Pipe Size	150#	300#	600#	900#	1500#	2500#
½"	0.5	0.6	0.7	---	1.2	1.8
¾"	0.5	0.6	0.7	---	1.2	1.8
1"	0.6	0.7	0.8	---	1.4	2.1
1 ½"	0.7	0.8	0.9	---	1.6	2.4
2"	0.8	0.9	1.1	---	1.9	2.9
3"	1.1	1.3	1.6	1.9	2.6	3.9
4"	1.5	1.7	2.1	2.6	3.5	5.2
6"	2.1	2.4	2.9	3.6	4.9	7.3
8"	2.7	3.1	3.7	4.7	6.3	9.4
10"	3.4	3.9	4.7	5.8	7.9	11.8
12"	3.9	4.5	5.4	6.7	9.1	13.6
14"	4.6	5.3	6.3	7.9	10.7	---
16"	5.3	6.0	7.2	9.1	12.2	---
18"	5.9	6.7	8.1	10.1	13.6	---
20"	6.5	7.4	8.9	11.1	15.0	---
24"	7.5	8.6	10.4	12.9	17.5	---
30"	9.4	10.8	12.9	16.2	---	---
36"	11.3	12.9	15.5	19.4	---	---
42"	13.1	15.1	18.1	---	---	---

SLIP-ON FLANGE WELD NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.

2. Work hour units include cutting, slipping on flange and welding at front and back.

3. Work hour units are for welding ***in-place***. For ***weld bay***, multiply standard units by **80%**.

4. In 900# flange rated systems, ½" through 2" flanges are always increased to 1500#.

5. For a list of materials requiring preheat and stress relief, see Alloy Material Adjustment section.

6. For alloy fabrication adjustments, see Alloy Material Adjustment section.

7. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't. **WH's EACH**

MITRE WELDS

Pipe Size	LW	STD	XS	S/10	S/20	S/30	S/40	S/60	S/80	S/100	S/120	S/140	S/160	XXS
½"	1.1	1.1	1.1				1.1		1.1				1.4	1.7
¾"	1.1	1.1	1.2				1.1		1.2				1.5	1.7
1"	1.2	1.2	1.3				1.2		1.3				1.9	2.3
1 ½"	1.3	1.3	1.6				1.3		1.6				2.6	3.7
2"	1.7	1.7	2.0				1.7		2.0				3.4	4.4
3"	2.3	2.3	3.0				2.3		3.0				4.2	5.9
4"	2.4	3.0	3.9				3.0		3.9		5.4		6.5	8.7
6"	3.8	4.2	5.6				4.2		5.6		8.3		10.8	*14.2
8"	5.4	5.4	7.4		5.4	5.4	5.4	6.8	7.4	9.8	12.9	*16.5	*19.0	*17.8
10"	6.1	6.8	8.7		6.2	6.5	6.8	8.7	11.0	14.4	*20	*25	*30	*25
12"	7.4	7.8	10.4		7.4	7.7	8.9	11.3	14.1	*21	*27	*33	*40	*27
14"	8.0	9.2	12.4	8.0	8.6	9.2	10.7	14.3	*20	*27	*34	*41	*48	
16"	9.2	10.5	13.4	9.2	10.0	10.5	13.4	17.7	*25	*35	*44	*52	*60	
18"	10.2	11.8	15.7	10.2	11.7	14.0	17.3	*24	*33	*44	*54	*64	*74	
20"	11.4	12.9	16.8	11.4	12.9	17.0	20	*29	*40	*54	*67	*77	*85	
24"		15.0	20.1	13.8	15.0	22	26	*40	*50	*68	*83	*94	*112	
30"		18.8	25	17.2	25	31	36							
36"		23	30	21	30	38	45							

	0.375"	0.500"	0.750"	1.000"	1.250"	1.500"	1.750"	2.000"
42"	26	35	*53	*70	*88	*106	*123	*141
48"	30	40	*60	*80	*101	*121	*141	*161
54"	34	45	*68	*90	*113	*136	*158	*181
60"	38	50	*75	*101	*126	*151	*176	*201
66"	41	55	*83	*111	*138	*166	*193	*221
72"	45	60	*90	*121	*151	*181	*211	*241

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't.

MITRE WELD NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.
2. Work hour units include layout, cutting, beveling and welding.
3. Work hour units are for welding ***in-place***. For ***weld bay***, multiply standard units by **80%**.
4. ** Indicates wall thickness equal to or greater than ¾" thick (0.750") and requires preheat and stress relief for carbon steel, high yield carbon steel and low temp carbon steel. See Preheat and Local Stress Relief sections for these operations.*
5. For other materials requiring preheat and stress relief, see Alloy Material Adjustment section.
6. For alloy fabrication adjustments, see Alloy Material Adjustment section.
7. LW column represents Light Wall, typically S/5, S/5S, S/10 and S/10S with wall thickness **less than** ¼" thick (less than 0.250").
8. For unlisted sizes, use the next higher listing.
9. For sizes above 72", the work hours are proportional to the largest size listed with the same wall thickness.
10. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't. **WH's EACH**

OLET WELDS

Outlet Size	Header Size	STD	3000#/ XS	6000#/ S/160	9000#/ XXS
½"	ALL	3.0	3.0	3.0	4.5
¾"	ALL	3.0	3.0	3.0	4.5
1"	ALL	3.0	3.0	3.0	4.5
1 ½"	ALL	3.0	3.0	6.0	6.0
2"	ALL	3.0	4.5	6.0	7.5
3"	ALL	4.5	4.5	7.5	9.0
4"	ALL	6.0	7.5	12.0	12.0
6"	ALL	7.5	10.5	18.0	*18.0
8"	ALL	7.5	12.0	*27	*27
10"	ALL	9.0	16.5	*35	*35
12"	ALL	12.0	21	*50	*50
14"	ALL	15.0	29	---	---
16"	ALL	19.5	35	---	---
18"	ALL	24	39	---	---
20"	ALL	29	45	---	---
24"	ALL	36	51	---	---

OLET WELD NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.

2. Work hour units include layout, cutting and welding.

3. Work hour units are for Thredolets (threaded branches up to 4"), Sockolets (socketweld branches up to 4"), Nipolets (plain-end or threaded-end nipple-type branch up to 2") and Weldolets (butt weld branches up to 24").

4. For Elbolets or Latrolets, multiply standard units by **1.5** (Elbolets are outlets on 90° elbows – threaded and socketweld up to 2", butt weld up to 4"; Latrolets are 45° branch connections – threaded and socketweld up to 2", butt weld up to 4").

5. For Sweepolets, multiply standard units by **3.0** (Sweepolets are similar to Weldolets but with more area replacement - butt weld branches up to 24").

6. Work hour unit selection should be based on the outlet size and wall thickness **except** when the header wall thickness is greater than the outlet wall thickness, in which case the selection should be based on the outlet size and the header wall thickness.

7. Work hour units are for welding ***in-place***. For ***weld bay***, multiply standard units by **80%**.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't.

OLET WELD NOTES – con't.

8. ** Indicates wall thickness equal to or greater than ¾" thick (0.750") and requires preheat and stress relief for carbon steel, high yield carbon steel and low temp carbon steel. See Preheat and Local Stress Relief sections for these operations.*

9. For other materials requiring preheat and stress relief, see Alloy Material Adjustment section.

10. For alloy fabrication adjustments, see Alloy Material Adjustment section.

11. For unlisted sizes, use the next higher listing.

12. The correlation between class rating categories and pipe wall thickness is as follows:

3000#	wall thickness up to and including XS
6000#	wall thickness > XS up to and including S/160
9000#	wall thickness XXS

13. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't. **WH's EACH**

NON-REINFORCED 90° NOZZLE WELDS (STUB-INS)

Pipe Size	LW	STD	XS	S/10	S/20	S/30	S/40	S/60	S/80	S/100	S/120	S/140	S/160	XXS
½"	1.4	1.4	1.6				1.4		1.6				2.0	2.3
¾"	1.6	1.6	1.7				1.6		1.7				2.1	2.3
1"	1.6	1.6	1.8				1.6		1.8				2.6	3.3
1 ½"	1.8	1.8	2.2				1.8		2.2				3.5	5.1
2"	2.3	2.3	2.9				2.3		2.9				4.7	6.1
3"	3.1	3.1	4.2				3.1		4.2				5.9	8.1
4"	3.4	4.2	5.5				4.2		5.5		7.5		9.0	12.0
6"	5.2	5.9	7.7				5.9		7.7		11.4		15.0	*19.8
8"	6.8	7.5	10.1		7.4	7.5	7.5	9.4	10.1	13.5	17.9	*23	*26	*25
10"	8.6	9.4	12.1		8.6	9.0	9.4	12.1	15.2	20	*27	*35	*42	*35
12"	10.1	10.8	14.3		10.1	10.7	12.2	15.6	19.5	*29	*36	*46	*55	*49
14"	10.9	12.7	17.2	11.1	11.8	12.7	14.8	19.8	*27	*38	*47	*56	*68	
16"	12.7	14.6	18.5	12.7	13.9	14.6	18.5	25	*35	*49	*61	*73	*83	
18"	14.0	16.4	22	14.2	16.3	19.4	24	*33	*46	*61	*75	*88	*103	
20"	15.9	17.9	23	15.9	17.9	24	27	*40	*56	*75	*92	*107	*118	
24"		21	27	19.1	21	30	36	*56	*69	*94	*114	*130	*156	
30"		26	35	24	35	44	49							
36"		31	42	29	42	52	62							

	0.375"	0.500"	0.750"	1.000"	1.250"	1.500"	1.750"	2.000"
42"	36	49	*73	*98	*122	*147	*170	*195
48"	42	56	*83	*112	*139	*168	*195	*224
54"	47	62	*94	*125	*157	*189	*220	*251
60"	52	70	*104	*139	*174	*209	*244	*278
66"	57	77	*114	*153	*191	*230	*268	*307
72"	62	83	*125	*168	*209	*251	*293	*334

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't.

NON-REINFORCED 90° NOZZLE WELD (STUB-IN) NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.
2. Work hour units include layout, cutting, beveling and welding of plain nozzles.
3. Work hour unit selection should be based on the wall thickness of the pipe used for the nozzle.
4. For size-on-size nozzle welds, multiply standard units by **1.3**.
5. Work hour units are for welding ***in-place***. For ***weld bay***, multiply standard units by **80%**.
6. ** Indicates wall thickness equal to or greater than ¾" thick (0.750") and requires preheat and stress relief for carbon steel, high yield carbon steel and low temp carbon steel. See Preheat and Local Stress Relief sections for these operations.*
7. For other materials requiring preheat and stress relief, see Alloy Material Adjustment section.
8. For alloy fabrication adjustments, see Alloy Material Adjustment section.
9. LW column represents Light Wall, typically S/5, S/5S, S/10 and S/10S with wall thickness **less than** ¼" thick (less than 0.250").
10. For unlisted sizes, use the next higher listing.
11. For sizes above 72", the work hours are proportional to the largest size listed with the same wall thickness.
12. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't. **WH's EACH**

NON-REINFORCED 45° NOZZLE WELDS (STUB-INS)

Pipe Size	LW	STD	XS	S/10	S/20	S/30	S/40	S/60	S/80	S/100	S/120	S/140	S/160	XXS
½"	1.8	1.8	2.0				1.8		2.0				2.5	2.9
¾"	2.0	2.0	2.1				2.0		2.1				2.6	3.0
1"	2.0	2.0	2.2				2.0		2.2				3.4	4.0
1 ½"	2.2	2.2	2.7				2.2		2.7				4.4	6.4
2"	3.0	3.0	3.5				3.0		3.5				5.9	7.7
3"	3.9	3.9	5.2				3.9		5.2				7.3	10.1
4"	4.3	5.2	6.8				5.2		6.8		9.4		11.2	15.1
6"	6.5	7.3	9.6				7.3		9.6		14.3		18.7	*25
8"	8.2	9.4	12.7		9.4	9.4	9.4	11.7	12.7	16.9	22	*29	*33	*31
10"	10.8	11.7	15.1		10.7	11.2	11.7	15.1	19.0	25	*35	*43	*51	*43
12"	12.7	13.5	17.9		12.7	13.3	15.3	19.5	25	*36	*46	*57	*69	*59
14"	13.7	15.9	22	13.8	14.8	15.9	18.5	25	*35	*47	*60	*70	*85	
16"	16.0	18.2	23	15.9	17.4	18.2	23	31	*43	*61	*75	*91	*104	
18"	17.6	21	27	17.7	20	24	30	*40	*57	*77	*94	*111	*129	
20"	19.9	22	29	19.8	22	30	34	*51	*69	*94	*116	*134	*147	
24"		26	35	24	26	38	46	*69	*87	*117	*143	*164	*195	
30"		33	44	30	44	55	62							
36"		39	52	35	52	65	78							

	0.375"	0.500"	0.750"	1.000"	1.250"	1.500"	1.750"	2.000"
42"	46	61	*91	*122	*152	*183	*213	*244
48"	52	70	*104	*139	*174	*209	*244	*278
54"	59	78	*117	*157	*196	*235	*274	*313
60"	65	87	*131	*174	*218	*261	*306	*348
66"	72	96	*144	*191	*239	*287	*335	*384
72"	78	104	*157	*209	*261	*313	*365	*419

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't.

NON-REINFORCED 45° NOZZLE WELD (STUB-IN) NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.
2. Work hour units include layout, cutting, beveling and welding of plain nozzles.
3. Work hour unit selection should be based on the wall thickness of the pipe used for the nozzle.
4. For size-on-size nozzle welds, multiply standard units by **1.3**.
5. Work hour units are for welding ***in-place***. For ***weld bay***, multiply standard units by **80%**.
6. ** Indicates wall thickness equal to or greater than ¾" thick (0.750") and requires preheat and stress relief for carbon steel, high yield carbon steel and low temp carbon steel. See Preheat and Local Stress Relief sections for these operations.*
7. For other materials requiring preheat and stress relief, see Alloy Material Adjustment section.
8. For alloy fabrication adjustments, see Alloy Material Adjustment section.
9. LW column represents Light Wall, typically S/5, S/5S, S/10 and S/10S with wall thickness **less than** ¼" thick (less than 0.250").
10. For unlisted sizes, use the next higher listing.
11. For sizes above 72", the work hours are proportional to the largest size listed with the same wall thickness.
12. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't. **WH's EACH**

REINFORCED 90° NOZZLE WELDS (STUB-INS)

Pipe Size	LW	STD	XS	S/10	S/20	S/30	S/40	S/60	S/80	S/100	S/120	S/140	S/160	XXS
½"	2.6	2.6	2.7				2.6		2.7				3.5	4.0
¾"	2.7	2.7	2.9				2.7		2.9				3.5	4.2
1"	2.9	2.9	3.1				2.9		3.1				4.7	5.7
1 ½"	3.1	3.1	3.9				3.1		3.9				6.2	9.0
2"	4.2	4.2	4.9				4.2		4.9				8.2	10.8
3"	5.5	5.5	7.3				5.5		7.3				10.1	14.2
4"	6.0	7.3	9.5				7.3		9.5		13.1		15.6	21
6"	9.1	10.1	13.5				10.1		13.5		20		26	*35
8"	12.0	13.1	17.8		13.0	13.1	13.1	16.4	17.8	24	31	*40	*47	*43
10"	15.1	16.4	21		15.0	15.6	16.4	21	26	35	*48	*60	*72	*60
12"	17.8	19.0	25		17.8	18.6	21	27	34	*51	*65	*81	*96	*78
14"	19.1	22	30	19.2	21	22	26	35	*49	*65	*83	*99	*117	
16"	22	25	33	22	24	25	33	43	*60	*86	*105	*126	*147	
18"	25	29	38	25	29	34	42	*57	*81	*107	*131	*155	*179	
20"	27	31	40	27	31	42	47	*70	*96	*131	*161	*187	*207	
24"		36	48	34	36	53	64	*96	*122	*164	*200	*229	*273	
30"		46	61	42	61	77	87							
36"		55	73	49	73	91	109							

	0.375"	0.500"	0.750"	1.000"	1.250"	1.500"	1.750"	2.000"
42"	64	86	*127	*170	*213	*256	*299	*342
48"	73	98	*147	*195	*244	*293	*342	*390
54"	82	109	*165	*220	*274	*329	*384	*439
60"	91	122	*183	*244	*306	*365	*426	*488
66"	100	134	*202	*268	*335	*403	*469	*537
72"	109	147	*220	*293	*365	*439	*512	*585

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't.

REINFORCED 90° NOZZLE WELD (STUB-IN) NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.
2. Work hour units include layout, cutting, beveling and welding, including the use of reinforcing pads or welding saddles, as specified.
3. Work hour unit selection should be based on the wall thickness of the pipe used for the nozzle **or** the thickness of the reinforcing pad/welding saddle, whichever is greater.
4. For size-on-size nozzle welds, multiply standard units by **1.3**.
5. Work hour units are for welding ***in-place***. For ***weld bay***, multiply standard units by **80%**.
6. ** Indicates wall thickness equal to or greater than ¾" thick (0.750") and requires preheat and stress relief for carbon steel, high yield carbon steel and low temp carbon steel. See Preheat and Local Stress Relief sections for these operations.*
7. For other materials requiring preheat and stress relief, see Alloy Material Adjustment section.
8. For alloy fabrication adjustments, see Alloy Material Adjustment section.
9. LW column represents Light Wall, typically S/5, S/5S, S/10 and S/10S with wall thickness **less than** ¼" thick (less than 0.250").
10. For unlisted sizes, use the next higher listing.
11. For sizes above 72", the work hours are proportional to the largest size listed with the same wall thickness.
12. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't. **WH's EACH**

REINFORCED 45° NOZZLE WELDS (STUB-INS)

Pipe Size	LW	STD	XS	S/10	S/20	S/30	S/40	S/60	S/80	S/100	S/120	S/140	S/160	XXS
½"	3.0	3.0	3.1				3.0		3.1				3.9	4.7
¾"	3.1	3.1	3.3				3.1		3.3				4.0	4.7
1"	3.3	3.3	3.6				3.3		3.6				5.3	6.5
1 ½"	3.6	3.6	4.4				3.6		4.4				7.2	10.3
2"	4.7	4.7	5.7				4.7		5.7				9.4	12.2
3"	6.2	6.2	8.3				6.2		8.3				11.7	16.3
4"	6.8	8.3	10.8				8.3		10.8		15.0		17.9	24
6"	10.4	11.7	15.3				11.7		15.3		23		26	*39
8"	13.8	15.0	20		15.0	15.0	15.0	18.7	20	27	36	*46	*53	*49
10"	17.2	18.7	21		17.0	17.9	18.7	24	26	40	*56	*69	*82	*69
12"	20	22	25		20	21	25	31	39	*57	*74	*92	*111	*87
14"	22	26	30	22	24	26	30	39	*56	*75	*95	*113	*134	
16"	26	29	33	23	27	29	36	49	*69	*99	*121	*144	*168	
18"	29	33	38	25	33	39	48	*65	*91	*122	*151	*177	*205	
20"	31	36	40	27	36	47	55	*81	*111	*150	*185	*213	*235	
24"		42	48	34	42	61	73	*111	*139	*187	*229	*261	*312	
30"		52	61	42	70	87	91							
36"		62	73	49	73	91	109							

	0.375"	0.500"	0.750"	1.000"	1.250"	1.500"	1.750"	2.000"
42"	64	86	*127	*170	*213	*256	*299	*342
48"	73	98	*147	*195	*244	*293	*342	*390
54"	82	109	*165	*220	*274	*329	*384	*439
60"	91	122	*183	*244	*306	*365	*426	*488
66"	100	134	*202	*268	*335	*403	*469	*537
72"	109	147	*220	*293	*365	*439	*512	*585

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't.

REINFORCED 45° NOZZLE WELD (STUB-IN) NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.
2. Work hour units include layout, cutting, beveling and welding, including the use of reinforcing pads or welding saddles, as specified.
3. Work hour unit selection should be based on the wall thickness of the pipe used for the nozzle **or** the thickness of the reinforcing pad/welding saddle, whichever is greater.
4. For size-on-size nozzle welds, multiply standard units by **1.3**.
5. Work hour units are for welding ***in-place***. For ***weld bay***, multiply standard units by **80%**.
6. ** Indicates wall thickness equal to or greater than ¾" thick (0.750") and requires preheat and stress relief for carbon steel, high yield carbon steel and low temp carbon steel. See Preheat and Local Stress Relief sections for these operations.*
7. For other materials requiring preheat and stress relief, see Alloy Material Adjustment section.
8. For alloy fabrication adjustments, see Alloy Material Adjustment section.
9. LW column represents Light Wall, typically S/5, S/5S, S/10 and S/10S with wall thickness **less than** ¼" thick (less than 0.250").
10. For unlisted sizes, use the next higher listing.
11. For sizes above 72", the work hours are proportional to the largest size listed with the same wall thickness.
12. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't.

LONGITUDINAL WELDS

Wall Thickness	WH's per Lineal Inch
0.375"	0.23
0.500"	0.33
0.750"	**0.52*
1.000"	**0.74*

LONGITUDINAL WELD NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.

2. Work hour units include layout, cutting, beveling and welding.

3. Work hour units are for welding ***in-place***. For ***weld bay***, multiply standard units by **80%**.

4. ** Indicates wall thickness equal to or greater than ¾" thick (0.750") and requires preheat and stress relief for carbon steel, high yield carbon steel and low temp carbon steel. See Preheat and Local Stress Relief sections for these operations.*

5. For other materials requiring preheat and stress relief, see Alloy Material Adjustment section.

6. For alloy fabrication adjustments, see Alloy Material Adjustment section.

7. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't.

PREHEAT

Pipe Size	LW	STD	XS	S/10	S/20	S/30	S/40	S/60	S/80	S/100	S/120	S/140	S/160	XXS
½"	0.14	0.14	0.16				0.14		0.16				0.20	0.22
¾"	0.14	0.14	0.16				0.14		0.16				0.20	0.22
1"	0.16	0.16	0.18				0.16		0.18				0.26	0.32
1 ½"	0.18	0.18	0.22				0.18		0.22				0.34	0.50
2"	0.22	0.22	0.28				0.22		0.28				0.44	0.60
3"	0.30	0.30	0.40				0.30		0.40				0.56	0.78
4"	0.32	0.40	0.52				0.40		0.52		0.72		0.86	1.16
6"	0.50	0.56	0.74				0.56		0.74		1.10		1.44	1.90
8"	0.72	0.72	0.98		0.72	0.72	0.72	0.90	0.98	1.30	1.72	2.20	2.54	2.38
10"	0.82	0.90	1.16		0.82	0.86	0.90	1.16	1.46	1.92	2.66	3.32	3.94	3.32
12"	0.98	1.04	1.38		0.98	1.02	1.18	1.50	1.88	2.76	3.54	4.40	5.40	3.54
14"	1.06	1.22	1.66	1.06	1.14	1.22	1.42	1.90	2.68	3.60	4.60	5.40	6.40	
16"	1.22	1.40	1.78	1.22	1.34	1.40	1.78	2.36	3.32	4.80	5.80	7.00	8.00	
18"	1.36	1.56	2.10	1.36	1.56	1.86	2.30	3.14	4.40	5.80	7.20	8.60	9.80	
20"	1.52	1.72	2.24	1.52	1.72	2.24	2.60	3.88	5.40	7.20	8.80	10	11	
24"		2.00	2.68	1.84	2.00	2.94	3.52	5.40	6.60	9.00	11	13	15	
30"		2.50	3.34	2.28	3.34	4.20	4.80							
36"		3.00	4.00	2.74	4.00	5.00	6.00							

	0.375"	0.500"	0.750"	1.000"	1.250"	1.500"	1.750"	2.000"
42"	3.50	4.60	7.00	9.40	12	14	16	19
48"	4.00	5.40	8.00	11	13	16	19	21
54"	4.60	6.00	9.00	12	15	18	21	24
60"	5.00	6.80	10	13	17	20	23	27
66"	5.60	7.40	11	15	18	22	26	29
72"	6.00	8.00	12	16	20	24	28	32

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't.

LOCAL STRESS RELIEF

Pipe Size	LW	STD	XS	S/10	S/20	S/30	S/40	S/60	S/80	S/100	S/120	S/140	S/160	XXS
½"	1.6	1.6	1.7				1.6		1.7				1.9	2.2
¾"	1.6	1.6	1.7				1.6		1.7				1.9	2.2
1"	1.9	1.9	2.1				1.9		2.1				2.3	2.6
1 ½"	2.5	2.5	2.7				2.5		2.7				3.0	3.4
2"	3.0	3.0	3.3				3.0		3.3				3.7	4.0
3"	4.3	4.3	4.7				4.3		4.7				5.2	5.7
4"	5.4	5.4	5.8				5.4		5.8		6.2		6.5	7.1
6"	7.6	7.6	8.2				7.6		8.2		8.8		9.4	10
8"	9.7	9.7	10		9.7	9.7	9.7	10	11	11	11	12	12	12
10"	12	12	13		12	12	12	13	13	14	14	15	15	15
12"	14	14	15		14	14	14	15	15	16	17	17	18	17
14"	15	15	16	15	15	15	15	16	17	18	18	19	20	
16"	17	17	18	17	17	17	18	18	19	20	21	22	23	
18"	19	19	20	19	19	19	20	21	22	23	24	24	25	
20"	21	21	22	21	21	22	22	23	24	25	26	27	28	
24"		25	26	25	25	26	26	28	29	30	32	33	34	
30"		32	32	32	32	33	34							
36"		38	38	38	38	39	40							

	0.375"	0.500"	0.750"	1.000"	1.250"	1.500"	1.750"	2.000"
42"	44	45	47	49	51	53	55	57
48"	50	51	53	56	58	60	62	65
54"	57	58	60	63	65	68	70	73
60"	63	64	67	70	72	75	78	81
66"	69	70	73	77	80	83	86	89
72"	76	77	80	83	87	90	94	97

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't.

PREHEAT & LOCAL STRESS RELIEF NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.
2. Work hour units include wrapping pipe with blanket, stringing out wires & connectors, monitoring of temperature and removal of blanket and wire harness.
3. Work hour units are for ***in-place*** welds. For ***weld bay***, multiply standard units by **80%**.
4. Preheat work hours are based on 20% of the corresponding carbon steel buttweld work hour units.
5. For a list of materials requiring preheat and stress relief, see Alloy Material Adjustment section.
6. For alloy fabrication adjustments, see Alloy Material Adjustment section.
7. LW column represents Light Wall, typically S/5, S/5S, S/10 and S/10S with wall thickness **less than** ¼" thick (less than 0.250").
8. For unlisted sizes, use the next higher listing.
9. For sizes above 72", the work hours are proportional to the largest size listed with the same wall thickness.
10. **Field stress relief is typically a subcontract item**. *These work hours can be used as an aid for scheduling purposes.*
11. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

3. WELDS – con't.

T.I.G. ROOT PASS

Pipe Size	All Wall Thicknesses	Pipe Size	All Wall Thicknesses
½"	0.23	16"	2.2
¾"	0.23	18"	2.5
1"	0.26	20"	2.7
1 ½"	0.29	24"	3.2
2"	0.32	30"	4.1
3"	0.47	36"	4.9
4"	0.58	42"	5.7
6"	0.84	48"	6.5
8"	1.1	54"	7.3
10"	1.5	60"	8.1
12"	1.8	66"	8.9
14"	2.0	72"	9.8

T.I.G. ROOT PASS NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.

2. Work hour units are applicable to buttwelds only. For olet welds, nozzle welds or other welds, multiply standard units by **2.0**.

3. Work hour units are applicable for all materials of construction. No alloy fabrication adjustments are required. Consult project specific welding specifications as well as Piping lead engineer for application requirements.

4. Work hour units include an internal nitrogen purge, where required. For an internal ***Argon purge***, multiply standard units by **1.25**.

5. Work hour units are for ***in-place*** welds. For ***weld bay***, multiply standard units by **80%**.

6. For unlisted sizes, use the next higher listing.

7. For sizes above 72", the work hours are proportional to the largest size listed with the same wall thickness.

8. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

4. PIPE BENDS

ALL WALL THICKNESSES THROUGH XS

Pipe Size	Five Dia. Radius thru 78" (6'-6") 90° or less	91° to 180°	181° to 270°	271° 360°	79" (6'-7") thru 156" (13'-0") Radius 90° or less	91° to 180°	181° to 270°	271° 360°
½"	2.0	2.7	4.7	5.5	3.9	7.8	11.7	15.6
¾"	2.2	3.3	5.5	6.5	4.4	8.8	13.3	17.7
1"	2.7	4.0	6.8	8.1	5.5	10.9	16.4	22
1 ½"	3.9	5.7	9.6	11.4	7.8	15.6	23	31
2"	4.7	7.2	11.8	14.3	9.4	18.7	29	38
3"	7.4	10.5	17.9	21	14.8	30	44	60
4"	9.4	13.7	23	27	18.7	38	56	75
6"	19.4	26	46	51	39	78	116	155

Pipe Size	157" (13'-1") thru 234" (19'-6") Radius 90° or less	91° to 180°	181° to 270°	271° 360°	235" (19'-7") thru 312" (26'-0") Radius 90° or less	91° to 180°	181° to 270°	271° 360°
½"	5.9	11.7	17.6	23	7.8	15.6	23	31
¾"	6.6	13.3	19.9	26	8.8	17.7	26	35
1"	8.2	16.4	25	33	10.9	22	33	44
1 ½"	11.7	23	35	47	15.6	31	47	62
2"	14.0	29	42	56	18.7	38	56	75
3"	22	44	66	88	30	60	88	118
4"	29	56	85	112	38	75	112	150
6"	59	116	174	231	78	155	233	309

PIPE BEND NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.

2. Work hour units include layout and bending.

3. For wall thicknesses greater than XS, multiply standard units by **1.3**.

4. Work hour units are for bending ***in-place***. For ***weld bay***, multiply standard units by **80%**.

5. For alloy fabrication adjustments, see Alloy Material Adjustment section.

6. Work hour units for field bends are in addition to the work hour units for handling the pipe. The actual bend is part of the linear footage quantity. The standard units for Handling – Fabricated Spools must be used for the erection of pipe bends.

7. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

5. COUPLINGS

Pipe Size	DRESSER Style 38	VICTAULIC Style 77
½"	0.8	---
¾"	0.9	0.6
1"	1.0	0.8
1 ½"	1.3	1.1
2"	1.8	1.2
3"	2.5	1.6
4"	3.0	1.9
6"	4.4	2.7
8"	5.3	3.4
10"	6.7	4.2
12"	7.6	4.9
14"	8.2	5.8
16"	9.5	6.5
18"	10.4	7.1
20"	11.7	7.9
24"	13.9	9.0
30"	17.0	1.3
36"	20	---
42"	23	---
48"	26	---
54"	29	---
60"	32	---
66"	36	---
72"	39	---

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

5. COUPLINGS – con't.

COUPLING NOTES

1. Work hour units include unload, storage and handling to erection site.

2. Work hour units include cutting, grooving, installation and bolt up.

3. For unlisted sizes, use the next higher listing.

4. Work hour units are provided for each manufacturer's most commonly used style, in the size range available. Other coupling manufacturers include Grayloc and Dur-o-lok. These different couplings **are not** interchangeable. Their use is for specific applications that must be identified. To determine which is applicable, consult Piping lead engineer.

5. In some instances, Dresser Couplings require the use of a Dresser Joint Harness. These are steel tie-bolts, diametrically opposite, which extend across the joint from lugs welded to the pipe on either side of the joint. Joint Harnesses are particularly effective on unanchored bends subject to pulsating pressures of sharp intensity. To verify installation requirements, consult Piping lead engineer. The standard unit work hours above **do not** include the installation of these and must be added to the estimate.

6. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

6. STEAM TRACING

BARE TUBING	WH's PER LF	
	COPPER	SS
½" OD	0.14	0.18
⅝" OD	0.16	0.20
¾" OD	0.18	0.22

TUBING FITTINGS	WH's/EACH (BRASS OR SS)		
	PIPE TO TUBE CONNECTOR (MALE OR FEMALE)	UNION	TEE
½" OD	0.20	0.22	0.29
⅝" OD	0.21	0.26	0.30
¾" OD	0.22	0.28	0.33

PRE-INSULATED TUBING	WH's PER LF	
	COPPER	SS
½" OD	0.11	0.13
⅝" OD	0.13	0.15
¾" OD	0.15	0.17

HEAT TRANSFER CEMENT WITH CHANNEL-TYPE COVER	WH's PER LF
	0.12

STEAM TRACING NOTES

1. Work hour units include unload, storage and handling to erection site.

2. Work hour units include layout, cutting and deburring, bending, compression joints and securing tubing to pipeline.

3. A common system will consist of one or more bare tubing tracers placed parallel to the line being protected. The tubing is kept in close contact with the pipeline by wiring or banding so that good heat transfer is achieved. Maximum heat transfer is achieved by bonding the tubing to the pipeline by means of heat transfer cement. To verify installation requirements, consult Piping lead engineer.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

6. STEAM TRACING – con't.

STEAM TRACING NOTES – con't.

4. The total linear footage of tubing required per pipeline is equal to the linear footage of pipe (as measured through all fittings, flanges, valves, instruments, specialty items and any other in-line appurtenances) **plus** the equivalent tubing length for each valve associated with the pipeline. This requirement is due to the valve being wrapped or coiled to ensure complete protection. Tubing unions are used in the tubing run at the valve flanges to allow for valve removal or replacement. The following table provides the approximate tubing length in feet for valves by size, based on an industry standard from a major manufacturer:

Pipe Size	LF per valve
1 ½" & below	1
2"	3
3"	4
4"	5
6"	8
8"	10
10"	12
12"	15
14"	21
16"	24
18"	28
20"	30
24"	36
30"	45
36"	54

5. The number of tracers required is determined by the combination of steam pressure, desired process temperature and diameter of the pipeline. When this information is available, refer to the project specific standard for the exact tracer quantity. The following table may be used as a generic go-by when the available steam pressure and/or desired process temperature is not known:

Pipe Size	No. of tracers
½" – 10"	1
12" – 14"	2
16" – 18"	3
20" – 24"	4
30" – 36"	5

The tracer quantity is a critical component of the steam tracing system cost because for each tracer there is a branch connection from a steam supply header or manifold that includes a valve, steam trap and strainer. This cost can be quite significant based on the overall number of tracers required. The branch connection on the condensate return manifold or header is only a valve, but this cost can become significant also.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

6. STEAM TRACING – con't.

STEAM TRACING NOTES – con't.

6. Due to maintaining the required process temperature and because of heat loss, the maximum tracer length is typically **200** feet. For example, a 500 foot long pipeline, single traced, would require three tracers (500 + 200 = 2.5 = 3). Each tracer is separately connected to a supply and return manifold or header.

7. A separate branch off of a steam supply manifold or header supplies each tracer. Initially, hot steam is "dry" but as it cools, it becomes "wet" or forms condensate. This condensate can be removed by trapping it to a drain system or to an individual branch on a condensate return manifold or header. **Pre-insulated tubing or "jumpers"** are used between the bare tubing tracers and both supply and return manifolds or headers.

8. Due to temperature limitations, copper tubing is typically used up to 400° F and stainless steel tubing used for higher temperatures. The following table provides the temperatures for various steam pressure systems:

Steam system	Temp° F
50#	298°
75#	320°
100#	338°
125#	353°
150#	366°
200#	388°
250#	406°
300#	422°

9. If any equipment and/or instruments require steam tracing, the required footage and tracer count must be quantified and added into the piping account.

10. The steam-traced line is typically insulated to further improve and maintain the heating capability of the tubing tracer. The terminations at each end of the jumpers (supply from steam manifold branch to tracer inlet & return from tracer outlet to condensate manifold branch) should be accounted for and included in the Insulation account.

11. Other types of tracing systems in the piping account include hot oil, glycol and brine. Electric tracing required for piping systems is included in the Electrical account.

12. For an all-inclusive work hour unit consisting of tubing (both bare and pre-insulated) and tubing fittings, for either copper or stainless steel material, inclusive of handling, bending, cutting and deburring, compression joints and securing to pipeline, use **0.40** WH's/LF.

13. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

7. COATING & WRAPPING

Pipe Size	PIPE WH's/LF	JOINTS WH's/EACH	FITTINGS WH's/EACH
1" & below	0.03	0.11	0.20
1 ½"	0.03	0.14	0.30
2"	0.04	0.17	0.30
3"	0.05	0.24	0.50
4"	0.05	0.32	0.60
6"	0.07	0.47	0.90
8"	0.10	0.64	1.3
10"	0.13	0.84	1.7
12"	0.16	1.03	2.1
14"	0.17	1.24	2.4
16"	0.19	1.34	2.6
18"	0.21	1.55	3.1
20"	0.24	1.77	3.5
24"	0.27	2.11	4.2
30"	0.35	2.79	5.3
36"	0.45	3.20	6.3
42"	0.53	3.87	7.4

COATING & WRAPPING NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.

2. Work hour units represent a standard TGF-3 (Tar, Glass, Felt – 3 applications of coal tar coating) Coal Tar Enamel System consisting of coal tar primer, 2 coats of coal tar enamel, fiberglass mat, 1 coat of coal tar enamel, felt wrap and kraft paper.

3. For holiday testing, use **0.04** WH's/LF.

4. For unlisted sizes, use the next higher listing.

5. Work hour units for field coating & wrapping are in addition to the work hour units for handling the pipe. The standard units for Handling – Straight Run must be used for the erection of coated & wrapped pipe.

6. Other types of coating & wrapping systems include Extruded High Density Polyethylene, Fusion Bonded Epoxy and Tape Wrap.

7. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

8. TESTING AND CLEANING

LIQUID DYE PENETRANT

Pipe Size	BUTT WELDS	ALL OTHER WELDS
3" & below	1.8	2.7
4" – 6"	2.0	3.0
8" – 10"	2.2	3.3
12" – 14"	2.4	3.6
16" – 18"	2.6	3.9
20" – 24"	2.8	4.2
30"	3.4	5.1
36"	3.6	5.4
42"	4.0	6.0
48"	4.6	6.9
54"	5.0	7.5
60"	5.4	8.1
66"	5.8	8.7
72"	6.2	9.3

LIQUID DYE PENETRANT NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.

2. Work hour units include securing of examination materials, application to examination area and interpretation of results.

3. For Reinforced Nozzle Welds, multiply standard units for All Other Welds by **1.25**.

4. For unlisted sizes, use the next higher listing.

5. For sizes above 72", the work hours are proportional to the largest size.

6. **Liquid Dye Penetrant is typically a subcontract item**. *These work hours can be used as an aid for scheduling purposes.*

7. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

8. TESTING AND CLEANING – con't.

CHEMICAL CLEANING

Pipe Size	WH's PER LF	Pipe Size	WH's PER LF
½"	0.12	20"	0.60
¾"	0.14	24"	0.65
1"	0.15	30"	0.73
1 ½"	0.18	36"	0.80
2"	0.21	42"	0.86
3"	0.25	48"	0.92
4"	0.28	54"	0.98
6"	0.34	60"	1.03
8"	0.39	66"	1.08
10"	0.44	72"	1.13
12"	0.48	78"	1.18
14"	0.50	84"	1.22
16"	0.53	90"	1.26
18"	0.57		

CHEMICAL CLEANING NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.

2. Work hour units include handling of cleaning materials, flushing lines with chemicals and distilled water.

3. There will be a **40-hour** minimum for this work.

4. For unlisted sizes, use the next higher listing.

5. **Chemical Cleaning is typically a subcontract item**. *These work hours can be used as an aid for scheduling purposes.*

6. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

9. ALLOY MATERIAL ADJUSTMENTS

	MATERIAL CLASSIFICATION GROUPS								
LABOR OPERATIONS	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
BENDS	1.25	1.25	1.25	1.25	1.25	1.25	2.75	1.75	1.25
WELDS	1.5	1.75	2.25	1.75	1.75	1.75	2.75	2.25	2.75
LOCAL STRESS RELIEF	1.25	1.25	1.25	---	---	---	---	---	---

GROUP 1
ASTM A335-P1 .50% Moly
ASTM A335-P2 .50-.70% Chrome
ASTM A335-P12 .85-1.10% Chrome
ASTM A335-P11 1.05-1.45% Chrome
ASTM A335-P3 1.50-2.00% Chrome

GROUP 2
ASTM A335-P3b 1.75-2.25% Chrome
ASTM A335-P22 2.00-2.50% Chrome
ASTM A335-P21 2.75-3.25% Chrome
ASTM A335-P5.b.c 4.00-6.00% Chrome

GROUP 3
ASTM A335-P7 6.00-8.00% Chrome
ASTM A335-P9 8.00-10.00% Chrome
Ferritic Chromes 10.00-15.00% Chrome
ASTM A333 Gr. 3 3.50% Nickel

GROUP 4
Stainless Steels
Types 304, 309, 310, 316, Duplex
(including "L" & "H" Grades)

GROUP 5
Copper and Brass

GROUP 6
Low Temp Carbon Steel (see Note 5)
ASTM A333 Gr. 1 (see Note 6)
ASTM A333 Gr. 4
ASTM A333 Gr. 9 (see Note 6)

GROUP 7
Hastelloy
Titanium
99% Nickel

GROUP 8
Stainless Steels – Types 317, 321, 347
Copper-Nickel
Monel
Inconel
Incoloy
Alloy 20
HF Modified

GROUP 9
Aluminum

FLUOR

PIPING UNIT WORK HOURS

B. STEEL PIPE – con't.

9. ALLOY MATERIAL ADJUSTMENTS – con't.

ALLOY MATERIAL ADJUSTMENT NOTES

1. Apply the appropriate multiplier above to the corresponding Carbon Steel labor operation.
2. Adjustments shown above apply to all wall thicknesses.
3. The molybdenum content in alloys listed in Groups 1 through 3 inclusive, shall not exceed 1%.
4. Adjustments for alloys other than those listed above will have to be researched. Consult Piping lead engineer.
5. Low Temp Carbon Steel type ASTM A333 Gr. 6 is standard Carbon Steel material and alloy adjustments **do not** apply.
6. Where standard Carbon Steel welding procedures and filler metal can be used, alloy adjustments **will not** apply to Low Temp Carbon Steel types ASTM A333 Gr. 1 and ASTM A333 Gr. 9. Consult Piping lead engineer.

FLUOR

PIPING UNIT WORK HOURS

C. OTHER PIPE

10. CAST/DUCTILE IRON PRESSURE PIPE

Pipe Size	Pipe Weight Per LF	PIPE WH's/LF	BELL & SPIGOT PUSH-ON GASKET JOINT WH's/EA	MECHANICAL JOINT WH's/EA	CUTS INTO MAINS WH's/EA
3"	11.4	0.33	0.50	0.90	12
4"	14.4	0.39	0.70	1.10	17
6"	22.2	0.49	1.05	1.70	22
8"	31.3	0.55	1.40	1.90	28
10"	40.8	0.64	1.75	2.45	33
12"	51.1	0.68	2.05	2.65	38
14"	63.4	0.75	2.40	3.20	47
16"	73.9	0.82	2.75	3.75	56
18"	84.9	0.86	3.10	3.95	63
20"	96.3	0.93	3.45	4.50	70
24"	120.2	1.03	4.15	5.25	84
30"	163.8	1.27	5.15	7.80	105
36"	223.6	1.44	6.20	9.30	---
42"	333.6	1.73	7.25	12.60	---
48"	432.9	1.89	8.25	14.35	---
54"	550.7	2.10	9.30	---	---

CAST/DUCTILE IRON PRESSURE PIPE NOTES

1. Work hour units include unload, storage and handling to erection site.

2. Work hour units for pipe are for erection only and **do not** include joint make-up.

3. Work hour units for joints include handling, cutting, and joint make-on.

4. Cast/Ductile Iron Pressure Pipe typically comes in 20-foot lengths.

5. If polyethylene encasement is required, use the following unit work hours:

3" through 12"	**0.10** WH's/LF
14" through 24"	**0.15** WH's/LF
30" through 54"	**0.20** WH's/LF

6. Weight per foot of pipe varies within each size by wall thickness as defined by ANSI Thickness Classifications (50, 51, 52, 53, 54, 55 or 56). ***The pipe weight per LF above is classification 53.***

7. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

C. OTHER PIPE – con't.

11. CAST IRON SOIL PIPE

Pipe Size	Pipe Weight Per LF	PIPE WH's/LF	NO-HUB CLAMP JOINT WH's/EA	HUB & SPIGOT COMPRESSION GASKET JOINT WH's/EA
1 ½"	2.7	0.23	0.58	---
2"	3.6	0.24	0.60	0.65
3"	5.2	0.27	0.68	0.75
4"	7.4	0.30	0.75	0.83
6"	11.0	0.38	0.95	1.00
8"	18.0	0.44	1.10	1.17
10"	25.8	0.55	1.38	1.58
12"	32.6	0.62	---	1.90
15"	48.4	0.70	---	2.30

Pipe Size	FLOOR & ROOF DRAINS WH's/EA	CLEAN-OUTS WH's/EA
2"	2.0	2.0
3"	2.0	3.0
4"	2.5	4.0
6"	3.0	5.0
8"	3.5	6.0

CAST IRON SOIL PIPE NOTES

1. Work hour units include unload, storage and handling to erection site.

2. Work hour units for pipe are for erection only and **do not** include joint make-up.

3. Work hour units for joints include handling, cutting, and joint make-on.

4. Cast Iron Soil Pipe typically comes in 5 and 10-foot lengths.

5. Cast Iron Soil Pipe is classified into two major types – hub & spigot and hubless (No Hub). Hubless cast iron soil pipe is made in only one class or thickness, ranging in size from 1 ½" to 10". Hub & Spigot cast iron soil pipe is available in two classes or thicknesses – Service (SV) and Extra Heavy (XH), ranging in size from 2" to 15". Because the additional wall thickness is added to the outside diameter of the Extra Heavy (XH), it and the Service (SV) pipe have different O.D.'s and are not readily interchangeable. The Hubless and Service (SV) pipe weigh about the same. ***The pipe weight per LF above is Service (SV)/No-Hub.***

6. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

C. OTHER PIPE – con't.

12. CONCRETE PIPE

NON-REINFORCED (ASTM C-14)

			BELL & SPIGOT	
Pipe Size	Pipe Weight Per LF	PIPE WH's/LF	RUBBER GASKET JOINT WH's/EA	MORTAR JOINT WH's/EA
4"	8.0	0.45	0.70	1.15
6"	25.0	0.57	0.90	1.35
8"	35.0	0.66	1.20	1.57
10"	48.0	0.75	1.50	1.77

REINFORCED (ASTM C-76, CLASS III)

Pipe Size	Pipe Weight Per LF	PIPE WH's/LF	BELL & SPIGOT RUBBER GASKET JOINT WH's/EA	TONGUE & GROOVE MORTAR JOINT WH's/EA
12"	101	0.73	1.70	2.35
15"	138	0.82	2.10	2.80
18"	178	0.90	2.50	3.35
21"	228	0.98	2.95	3.95
24"	282	1.05	3.35	4.50
27"	343	1.12	3.80	5.15
30"	406	1.18	4.20	5.70
33"	481	1.25	4.60	6.20
36"	559	1.31	5.05	6.80
39"	701	1.36	5.45	7.35
42"	786	1.42	5.90	8.00
45"	876	1.47	6.30	8.50
48"	972	1.53	6.70	9.05
51"	1,073	1.58	7.15	9.65
54"	1,323	1.63	7.55	10.20
60"	1,569	1.72	8.40	11.35
66"	1,837	1.82	9.25	12.50
72"	2,158	1.91	10.10	13.65
78"	2,452	1.99	10.90	14.70
84"	2,807	2.08	11.75	15.90
90"	3,170	2.16	12.60	17.00
96"	3,562	2.24	13.45	18.20

FLUOR

PIPING UNIT WORK HOURS

C. OTHER PIPE – con't.

12. CONCRETE PIPE – con't.

CONCRETE PIPE NOTES

1. Work hour units include unload, storage and handling to erection site.
2. Work hour units for pipe are for erection only and **do not** include joint make-up.
3. Work hour units for joints include handling, cutting, and joint make-on.
4. For unlisted sizes, use the next higher listing.
5. Concrete Pipe typically comes in the following lengths.

Non-Reinforced:	
4" & 6"	3-foot
8" & 10"	4-foot

Reinforced:	
12" & 15"	6-foot
18" & larger	7 ½-foot

6. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

C. OTHER PIPE – con't.

13. COPPER PIPE

Pipe Size	Pipe Weight Per LF	PIPE WH's/LF	SOLDER JOINT WH's/EA
½"	0.34	0.16	0.26
¾"	0.64	0.18	0.32
1"	0.84	0.20	0.37
1 ½"	1.36	0.26	0.45
2"	2.06	0.31	0.50
3"	4.00	0.41	0.93
4"	6.51	0.48	1.22
6"	13.9	0.72	1.60
8"	25.9	1.00	2.10

COPPER PIPE NOTES

1. Work hour units include unload, storage and handling to erection site.

2. Work hour units for pipe are for erection only and **do not** include joint make-up.

3. Work hour units for joints include handling, cutting, deburring and soldering.

4. For unlisted sizes, use the next higher listing.

5. Copper Pipe is available in seven types, according to ASTM standards: K, L, M, DWV (Drain, Waste and Vent), Medical Gas, ACR (Air Conditioning and Refrigeration Field Services) and G (Natural Gas and Propane Fuel Distribution). Each type represents a series of sizes with different wall thicknesses. Type K has thicker walls than Type L, and Type L walls are thicker than Type M, for any given diameter. ***The pipe weight per LF above is Type K.*** Types K, L and M are available in diameters up through 12".

6. The selection of solder depends primarily on the operating pressure and temperature of the system. The **50-50 tin-lead solder** is suitable for moderate pressures and temperatures. For higher pressures, or where greater joint strength is required, **95-5 tin-antimony solder** can be used. For continuous operation at temperatures exceeding 250°F or where the highest joint strength is required, brazing filler metals should be used.

7. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

C. OTHER PIPE – con't.

14. CORRUGATED METAL PIPE

Pipe Size	Pipe Weight Per LF	PIPE WH's/LF
8"	14.4	0.32
10"	18.0	0.42
12"	21.6	0.45
15"	27.0	0.49
18"	32.4	0.51
21"	37.8	0.58
24"	43.2	0.64
27"	48.6	0.77
30"	54.0	0.83
36"	64.8	1.22
42"	75.6	1.28
48"	86.4	1.46

CORRUGATED METAL PIPE NOTES

1. Work hour units include unload, storage and handling to erection site.

2. Corrugated Metal Pipe is produced from uncoated steel, galvanized steel, or aluminum coiled strip ranging from 18 gauge (0.0472") thick by 12" wide to 8 gauge (0.1654") thick by 36" wide. Pipe diameters range from ½" to 12'-0". ***The pipe weight per LF above is based on 8 gauge (6.875 pounds per square foot).*** This pipe is used for such applications as water drainage, flood control, storm sewers, concrete piling shells and culverts.

3. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

C. OTHER PIPE – con't.

15. HIGH DENSITY POLYETHYLENE (HDPE) PIPE

Pipe Size	Pipe Weight Per LF	PIPE WH's/LF	BUTT FUSION JOINT WH's/EA
2"	0.42	0.08	0.50
3"	0.92	0.10	1.20
4"	1.52	0.12	1.60
6"	3.29	0.18	2.35
8"	5.57	0.24	3.15
10"	8.65	0.31	4.00
12"	12.17	0.35	4.90
14"	14.68	0.39	5.80
16"	19.17	0.44	6.80
18"	24.26	0.55	7.80
20"	29.96	0.66	9.00
24"	43.14	0.94	10.50
30"	67.40	1.46	13.00
36"	97.06	2.06	16.00

HIGH DENSITY POLYETHYLENE (HDPE) PIPE NOTES

1. Work hour units include unload, storage and handling to erection site.

2. Work hour units for pipe are for erection only and **do not** include joint make-up.

3. Work hour units for joints include handling, cutting, heating and butt-fusion.

4. For unlisted sizes, use the next higher listing.

5. High Density Polyethylene (HDPE) Pipe is available in various Standard Dimension Ratio (SDR) classifications. Each SDR has its own pressure rating identification. The SDR system is a specific ratio of the nominal outside diameter to the minimum specified wall thickness. The nine basic classifications are SDR 7 (265 psi); SDR 9 (200 psi); SDR 11 (160 psi); SDR 13.5 (130 psi); SDR 15.5 (110 psi); SDR 17 (100 psi); SDR 21 (80 psi); SDR 26 (65 psi); and SDR 32.5 (50 psi). Each classification represents a series of sizes with different wall thicknesses. SDR 7 has thicker walls than SDR 9, SDR 9 walls are thicker than SDR 11, and so on, for any given diameter. ***The pipe weight per LF above is SDR 17.***

6. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

C. OTHER PIPE – con't.

16. POLYPROPYLENE PIPE

Pipe Size	Pipe Weight Per LF	PIPE WH's/LF	THREADED JOINT WH's/EA	THERMO-SEAL FUSION JOINT WH's/EA
½"	0.08	0.11	0.18	0.58
¾"	0.12	0.12	0.20	0.72
1"	0.17	0.14	0.23	0.90
1 ½"	0.40	0.16	0.33	1.11
2"	0.63	0.18	0.40	1.25
3"	1.28	0.23	0.68	1.62
4"	1.91	0.27	0.93	2.40
6"	4.04	0.37	-----	2.70

POLYPROPYLENE PIPE NOTES

1. Work hour units include unload, storage and handling to erection site.

2. Work hour units for pipe are for erection only and **do not** include joint make-up.

3. Work hour units for threaded joints include handling, cutting, threading and joint make-on.

4. Work hour units for fusion joints include handling, cutting, heating and thermo-seal fusion.

5. Threaded joints **are not** recommended above 4" in diameter.

6. When joining 6" polypropylene fusion systems, a fillet welding procedure is utilized.

7. Polypropylene Pipe is a polyolefin that is lightweight and generally high in chemical resistance. Its recommended temperature range is 0° to 200° F and is available in two Standard Dimension Ratio (SDR) classifications. Each SDR has its own pressure rating identification. The SDR system is a specific ratio of the nominal outside diameter to the minimum specified wall thickness. The two classifications are SDR 11 (160 psi) and SDR 32.5 (50 psi). Each classification represents a series of sizes with different wall thicknesses. SDR 11 has thicker walls than SDR 32.5, for any given diameter. ***The pipe weight per LF above is SDR 11.***

8. Poly VinyliDene Fluoride (**PVDF**), more commonly referred to as **KYNAR**, is a strong, tough and abrasive resistant fluorocarbon material. Its recommended temperature range is -40° to 320° F. Its weight per LF can vary higher than polypropylene but the work hour units above will apply to this material also.

9. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

C. OTHER PIPE – con't.

17. POLY VINYL CHLORIDE (PVC) PIPE

Pipe Size	Pipe Weight Per LF	PIPE WH's/LF	THREADED JOINT WH's/EA	SOLVENT CEMENT JOINT WH's/EA
½"	0.21	0.13	0.18	0.26
¾"	0.28	0.14	0.20	0.32
1"	0.41	0.16	0.23	0.41
1 ½"	0.69	0.19	0.33	0.51
2"	0.96	0.22	0.40	0.63
3"	1.95	0.28	0.68	0.79
4"	2.84	0.33	0.93	0.99
6"	5.43	0.47	-----	1.24
8"	8.25	0.65	-----	1.89
10"	12.24	0.89	-----	2.86
12"	16.83	1.11	-----	4.34
14"	19.96	1.50	-----	6.57
16"	25.55	2.03	-----	9.96

POLY VINYL CHLORIDE (PVC) PIPE NOTES

1. Work hour units include unload, storage and handling to erection site.

2. Work hour units for pipe are for erection only and **do not** include joint make-up.

3. Work hour units for threaded joints include handling, cutting, threading and joint make-on.

4. Work hour units for solvent cement joints include handling, cutting and joint make-on.

5. Threaded joints **are not** recommended above 4" in diameter.

6. Poly Vinyl Chloride (PVC) Pipe is characterized by high physical properties and resistance to corrosion and chemical attack by acids, alkalis, salt solutions and many other chemicals. It is attacked, however, by polar solvents such as ketones, some chlorinated hydrocarbons and aromatics. The maximum service temperature is 140° F and is available in either schedule 40 or 80. Each classification represents a series of sizes with different wall thicknesses. ***The pipe weight per LF above is S/80.***

7. Chlorinated Poly Vinyl Chloride (**CPVC**) is similar to PVC with chemical resistance the same or generally better. The maximum service temperature of CPVC is 210° F. Its weight per LF can vary slightly higher than PVC but the work hour units above will apply to this material also.

8. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

C. OTHER PIPE – con't.

18. FIBERGLASS REINFORCED PLASTIC (FRP) PIPE

Pipe Size	Pipe Weight Per LF	PIPE WH's/LF	EPOXY CEMENT SOCKET JOINT WH's/EA	BUTT WRAP JOINT WH's/EA
1"	0.71	0.12	0.40	---
1 ½"	0.99	0.15	0.50	---
2"	1.27	0.18	0.60	---
3"	1.84	0.22	0.90	---
4"	2.40	0.25	1.20	---
6"	4.46	0.35	1.90	---
8"	7.10	0.47	2.75	---
10"	10.33	0.62	3.95	---
12"	14.14	0.75	5.20	---
14"	21.03	0.80	---	5.50
16"	26.34	0.95	---	6.65
18"	32.23	1.40	---	8.05
20"	38.71	1.60	---	9.50
24"	57.11	1.80	---	11.00
30"	84.44	2.90	---	13.00
36"	122.54	3.60	---	15.50
42"	167.71	5.00	---	20.00
48"	219.95	6.40	---	28.50

FIBERGLASS REINFORCED PLASTIC (FRP) PIPE NOTES

1. Work hour units include unload, storage and handling to erection site.

2. Work hour units for pipe are for erection only and **do not** include joint make-up.

3. Work hour units for epoxy cement joints include handling, cutting and joint make-on.

4. Work hour units for butt wrap joints include handling, cutting and glass matte overlay.

5. Fiberglass Reinforced Plastic (FRP) Pipe is manufactured in a resin matrix reinforced with glass fibers. The resin systems vary from isophthalic polyesters and epoxy vinyl esters to specialty resins for custom applications. The glass reinforcement includes filament rovings and unidirectional and bi-directional woven products. Applications are varied across a wide range of services from mild sea water to heavy duty chemicals, at temperatures up to 250° F and pressures up to 200psig (13.8 bar). FRP pipe is available in either lightweight or extra-heavy wall. Each classification represents a series of sizes with different wall thicknesses. ***The pipe weight per LF above is extra-heavy.***

6. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

D. BOLT-UPS **WH's PER FLANGE**

FLANGE RATINGS

Pipe Size	150#	300#	600#	900#	1500#	2500#
½"	0.3	0.3	0.3	---	0.5	0.5
¾"	0.3	0.4	0.4	---	0.5	0.5
1"	0.3	0.4	0.4	---	0.6	0.6
1 ½"	0.3	0.5	0.5	---	0.7	0.7
2"	0.4	0.8	0.8	---	1.1	1.3
3"	0.4	1.0	1.0	1.1	1.5	1.6
4"	0.8	1.0	1.1	1.5	1.6	2.0
6"	1.0	1.5	2.0	2.2	2.4	2.6
8"	1.0	1.7	2.2	2.7	3.2	4.0
10"	1.7	2.6	3.3	3.6	3.7	5.0
12"	1.7	2.9	4.1	4.5	5.3	5.6
14"	2.0	3.7	4.5	5.0	6.0	---
16"	2.6	4.1	5.0	5.4	6.7	---
18"	2.9	4.9	5.4	6.2	7.4	---
20"	3.7	4.9	6.5	6.6	8.1	---
24"	4.1	5.9	7.4	8.4	9.4	---
30"	5.7	8.1	9.2	10.1	---	---
36"	7.9	10.6	11.8	12.8	---	---
42"	8.9	11.9	14.2	15.5	---	---
48"	10.9	13.2	15.7	17.2	---	---
54"	12.7	16.9	20.1	---	---	---
60"	15.0	19.9	23.7	---	---	---

BOLT-UP NOTES

1. Work hour units include handling of equipment, set-up, operation and disassemble, at erection site.
2. Work hour units include installation of gasket.
3. Work hour units for 30" and larger flanges are based on MSS SP-44.
4. In 900# flange rated systems, ½" through 2" flanges are always increased to 1500#.
5. For Ring Type Joint (RTJ) flange bolt-ups, multiply standard units by **1.2**.
6. For Orifice Flange Sets, multiply standard units by **2.0**.
7. For bolt-ups to an existing flange or equipment nozzle, multiply standard units by **2.0**.
8. For unbolting, multiply standard units by **50%** if piping will be disposed of or use **net** if piping will be reinstalled (remember to use units **again** for the reinstallation).
9. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

E. VALVE HANDLING **WH's/EACH**

SCREWED & SOCKETWELD ENDS

Pipe Size	All Ratings
½"	0.3
¾"	0.3
1"	0.3
1 ½"	0.5
2"	0.7

BUTTWELD ENDS

Pipe Size	150#	300#	600#	900#	1500#	2500#
½"	0.3	0.3	0.4	---	0.7	0.9
¾"	0.3	0.5	0.6	---	1.0	1.1
1"	0.3	0.5	0.6	---	1.1	1.3
1 ½"	0.5	0.7	0.9	---	1.7	2.0
2"	0.7	1.6	1.9	---	2.0	2.3
3"	1.3	2.5	3.9	4.4	4.9	5.6
4"	2.5	4.0	5.7	6.9	8.1	9.5
6"	3.7	6.9	9.5	10.2	10.8	12.5
8"	5.6	7.9	10.6	12.0	13.4	15.5
10"	6.9	10.0	13.6	15.4	17.2	20
12"	9.3	11.4	16.7	20	24	26
14"	9.9	11.7	22	---	---	---
16"	12.0	17.6	28	---	---	---
18"	13.4	19.2	39	---	---	---
20"	14.8	25	45	---	---	---
24"	19.2	36	61	---	---	---
30"	30	44	---	---	---	---
36"	44	64	---	---	---	---

FLUOR

PIPING UNIT WORK HOURS

E. VALVE HANDLING – con't. **WH's/EACH**

FLANGED ENDS

Pipe Size	150#	300#	600#	900#	1500#	2500#
½"	0.8	0.9	1.2	---	1.8	2.0
¾"	0.8	1.2	1.4	---	2.1	2.2
1"	0.8	1.2	1.6	---	2.4	2.6
1 ½"	1.0	1.6	2.0	---	3.2	3.7
2"	1.4	3.0	3.2	---	4.6	5.3
3"	1.9	4.2	5.4	6.5	8.3	9.4
4"	2.6	5.5	7.2	10.1	11.9	14.1
6"	5.3	8.9	12.2	12.6	15.6	17.1
8"	6.9	10.2	13.6	17.1	21	25
10"	9.4	13.9	18.3	21	26	32
12"	11.5	15.8	23	29	36	39
14"	12.5	17.6	28	38	---	---
16"	15.6	24	34	44	---	---
18"	17.6	27	45	---	---	---
20"	20	31	52	---	---	---
24"	25	43	67	---	---	---
30"	37	54	---	---	---	---
36"	54	77	---	---	---	---

BOLT-THROUGH TYPE

Pipe Size	150#	300#	600#
½"	0.2	0.3	0.4
¾"	0.2	0.4	0.5
1"	0.2	0.4	0.6
1 ½"	0.4	0.6	0.8
2"	0.6	1.4	1.6
3"	1.1	2.2	3.4
4"	2.0	3.5	4.9
6"	3.3	6.0	8.3
8"	4.9	6.8	9.2
10"	6.0	8.7	11.8
12"	8.1	9.9	14.5
14"	8.6	10.2	19.4
16"	10.4	15.3	24
18"	11.7	16.7	34
20"	12.9	21	39
24"	16.7	31	53
30"	26	38	---
36"	38	56	---

FLUOR

PIPING UNIT WORK HOURS

E. VALVE HANDLING – con't. **WH's/EACH**

PRESSURE SAFETY (PSV) / CONTROL (CV) VALVES

Pipe Size	150#	300#
½"	1.2	1.3
¾"	1.2	1.8
1"	1.2	1.8
1 ½"	1.5	2.5
2"	2.1	4.5
3"	2.9	6.3
4"	3.9	8.3
6"	7.9	13.4
8"	10.3	15.4
10"	14.1	21
12"	17.3	24
14"	18.8	26
16"	23	35
18"	26	40
20"	30	47
24"	37	65

VALVE HANDLING NOTES

1. Work hour units include unload, storage and handling to erection site.

2. Work hour units for Screwed & Socketweld End valves are for handling only and **do not** include the required screwed joints or socketwelds. See section B.2, Steel Pipe – Screwed Joints and Socketwelds for applicable unit work hours.

3. Work hour units for Buttweld End valves are for handling only and **do not** include the required buttweld. See section B.3, Steel Pipe – Welds, Buttwelds for applicable unit work hours. If material is alloy, see section B.9, Steel Pipe – Alloy Material Adjustments for applicable adjustment factor.

4. Work hour units for Flanged End valves include handling **and** applicable time for mating valve flange to line flange; to equipment nozzle; or to another valve flange. For applicable line flange unit work hours, see section D. Bolt-ups.

5. Work hour units for Bolt-Through Type valves are for handling only and **do not** include the required mating flange bolt-ups. See section D., Bolt-ups for applicable unit work hours.

6. Work hour units for Pressure Safety (PSV) / Control (CV) Valves include handling **and** applicable time for mating valve flange to line flange; to equipment nozzle; or to another valve flange. For applicable line flange unit work hours, see section D. Bolt-ups.

7. If Pressure Safety Valves (PSV's) are fit-up and removed for hydrotest, then reinstalled, multiply standard units by **2.75**.

FLUOR

PIPING UNIT WORK HOURS

E. VALVE HANDLING – con't.

VALVE HANDLING NOTES – con't.

8. For Diaphragm valves, Mechanical Joint valves or Motor Operated (MOV's) Valves, multiply Flanged End standard units by **1.5**.

9. Work hour units for 30" and larger flanged valves are based on MSS SP-44 flanges.

10. In 900# flange rated systems, ½" through 2" flanges are always increased to 1500#.

11. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

FLUOR

PIPING UNIT WORK HOURS

F. SPECIALTIES

For the following items with screwed or socketweld end connections, see section E. Valve Handling – Screwed & Socketweld Ends for applicable unit work hours:

ITEM	WH's/EA
Backflow Preventer	
• with double check valve in one body	Net
• with double check valve in two separate bodies	Multiply standard unit by **2.0**
• with double check valve in one body and two shut-off valves	Multiply standard unit by **3.0**
• with double check valve in two separate bodies and two shut-off valves	Multiply standard unit by **4.0**
Exhaust Head	Net
Flame Arrestor	Net
Flexible Hoses	Net
Separator	Net
Spray Nozzle	Net
Sprinkler Nozzle	Net
Steam Trap	Net
Y-Strainer	Net

For the following items with flanged or buttweld end connections, see section E. Valve Handling – Buttweld Ends or Flanged Ends for applicable unit work hours:

ITEM	WH's/EA
Backflow Preventer	
• with double check valve in one body	Net
• with double check valve in two separate bodies	Multiply standard unit by **2.0**
• with double check valve in one body and two shut-off valves	Multiply standard unit by **3.0**
• with double check valve in two separate bodies and two shut-off valves	Multiply standard unit by **4.0**
Exhaust Head	Net
Expansion Joint	Net
Flame Arrestor	Net
Flexible Hoses	Net
Hammer Blind	Net
Separator	Net
Steam Trap	Net
Tee Strainer	Net
Y-Strainer	Net

FLUOR

PIPING UNIT WORK HOURS

F. SPECIALTIES – con't.

Miscellaneous

ITEM	WH's/EA
Spectacle (line) Blind	Use flanged valve hours for same flange rating
Sample Cooler	10.0
Safety Eye Wash / Eye-Face Wash Combo	10.0
Safety Shower / Shower-Eye Wash Combo	20.0

- if any safety item requires complete enclosure, multiply standard unit by **2.0**

Fire Protection Equipment

• Fire Extinguishers – all sizes	2.0
• Fire Hydrant	10.0
• Fire Hydrant/Monitor Combo	20.0
• Fire Monitor	15.0
• Hose Cabinets – at grade	3.0
• Hose Cabinets – elevated	8.0
• Hose Rack	8.0
• Hose Reel	8.0
• Indicator Post	6.0

Valve Box

• ½" to 10" valve	5.0
• 12" & above	10.0

Manholes and Catch Basins – Precast Concrete with Frame & Cover **or** with Frame & Grate

	Inside Diameter			
Depth	36"	48"	60"	72"
4'-0"	15	19	26	39
5'-0"	17	22	30	46
6'-0"	19	25	35	53
7'-0"	21	28	40	60
8'-0"	23	31	45	67
9'-0"	25	35	50	74
10'-0"	28	39	55	81
12'-0"	33	46	65	96
14'-0"	38	53	76	111

Work hour units **do not** include excavation, installation of base or grouting of frames.

FLUOR

PIPING UNIT WORK HOURS

F. SPECIALTIES – con't.

SPECIALTY NOTES

1. Work hour units include unload, storage and handling to erection site.

2. Work hour units are for handling only and **do not** include the required joint connections. See the appropriate section for applicable unit work hours.

3. For any activities which are not included in this section, see Means, Richardson, or other recognized estimating publications.

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ELECTRICAL UNIT WORK HOURS

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ELECTRICAL UNIT WORK HOURS

A. GENERAL NOTES

1. For applicable installation details, see Fluor Daniel Standard Assemblies.

2. For any excavation, backfill or concrete activities, see appropriate sections:

   - 000 310 1000 Earthwork Standard Unit Work hours
   - 000 310 1100 Concrete Standard Unit Work hours

3. Voltage categories, per National Electric Code (NEC):

   - Low Voltage 600V and below
   - Medium Voltage > 600V and < 35KV
   - High Voltage 35KV and above

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT

1. TRANSFORMERS

DRY TYPE - SINGLE PHASE

	480 V PRIMARY		4160 V PRIMARY	
KVA	WT. LBS.	WH's	WT. LBS.	WH's
.250	13	3	---	--
.500	13	3	---	--
.750	20	3	---	--
1	26	4	---	--
1.5	36	5	---	--
2	40	5	---	--
3	64	6	---	--
5	75	6	---	--
7.5	114	7	---	--
10	142	8	---	--
15	158	10	---	--
25	252	12	280	14
37.5	320	15	360	17
50	388	17	430	19
75	530	20	590	22
100	638	24	730	26
167	1,140	32	1,140	34
250	1,350	32	1,530	36

DRY TYPE - THREE PHASE

	480 V PRIMARY		4160 V PRIMARY	
KVA	WT. LBS.	WH's	WT. LBS.	WH's
3	60	6	---	--
6	110	7	---	--
9	140	9	---	--
15	209	11	---	--
30	380	15	500	20
45	500	20	600	26
75	650	22	800	30
112.5	850	26	950	34
150	950	30	1,250	44
225	1,250	40	1,500	48
300	1,500	45	1,750	52
500	2,700	60	2,750	79
750	3,700	75	3,800	94

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

1. TRANSFORMERS – con't.

OIL FILLED - SINGLE PHASE

PRIMARY VOLTS – 4160/2400, 12470/7200 & 13200/7620

KVA	WT. LBS.	WH's
10	1,000	28
15	1,000	28
25	1,100	28
37.5	1,250	32
50	1,350	34
75	1,800	38
100	1,900	50
167	2,100	50

OIL FILLED - THREE PHASE

PRIMARY VOLTS – 15 KV AND BELOW

KVA	WT. LBS.	WH's
30	1,200	36
45	1,500	36
75	1,800	44
112.5	2,800	75
150	3,000	75
225	3,480	82
300	4,000	90
500	6,300	110

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

1. TRANSFORMERS – con't.

LIQUID IMMERSED SUB-STATION TYPE - THREE PHASE

OA/FUT. FA OR OA/FA

KVA	WT. LBS WITH OIL	WH's
500	6,300	110
750	7,500	110
1000	8,000	110
1500	10,200	140
2000	12,000	140
2500	13,400	140
3000	18,800	160
3750	27,000	200
5000	31,000	200
7500	44,000	250
10,000	50,000	250
12,000	79,500	265
15,000	91,900	285
20,000	102,000	295
25,000	120,300	315
30,000	138,500	330
40,000	170,500	360

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

1. TRANSFORMERS – con't.

TRANSFORMER NOTES

1. All work hour units include unload, storage and handling to erection site.

2. All work hour units represent outdoor installation. For indoor applications, make adjustments as necessary per specific project.

3. Any supports required are not included.

4. For field installation of oil:
   - Drum Loading – use **1.5** WH/Drum (1 drum = 55 gallons or 390 pounds)
   - Tank Car Loading – use **0.014** WH/Gallon

5. For field installation of high voltage bushings, radiators, fans, etc., add **50%** to the standard units. If some items are shipped attached to transformer, adjust percentage accordingly.

6. If transformer is shipped with oil, without high voltage bushings, radiators, fans, etc., an additional **7%** must be added to standard units for topping of oil in the field.

7. If transformer is shipped complete with oil and components attached, use standard units as shown.

8. For any activities which are not included in this section, see Means, Richardson, NECA or other recognized estimating publications.

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

2. SWITCHGEAR

OUTDOOR & INDOOR SWITCHGEAR, METAL-CLAD

SYSTEM KV	INTER-RUPTING MVA	MAXIMUM CURRENT	WH's	AUXILIARY METERING SECTION WH's
ROLLOUT TYPE				
2.4	150	450 AMPS	46	32
4.16 to 4.8	250	450 AMPS	46	40
7.2	250	200 AMPS	60	35
13.8	500	175 AMPS	70	48
35	680	1200 AMPS	85	60
69	850	1600 AMPS	100	75
STATIONARY TYPE				
2.4	125	450 AMPS	40	--
4.16 to 4.8	125	450 AMPS	40	--
7.2	125	200 AMPS	50	--
13.8	300	175 AMPS	60	--
35	680	1200 AMPS	75	--
69	850	1600 AMPS	90	--

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

2. SWITCHGEAR – con't.

INTEGRAL LOAD CENTER UNIT SUBSTATIONS

INCOMING LINE COMPARTMENT	5KV WH's	15KV WH's
Air Switch	17	20
Oil Filled Switch	21	24
Oil Fused Cutout	21	24
Terminal Compression/Clamp Type	17	20
Potheads 1 – 3/C	21	24
Potheads 2 – 3/C	26	29

TRANSFORMER SECTION (15KV AND BELOW)

KVA	DRY TYPE WH's	OIL FILLED WH's
112.5	34	75
150	44	75
225	48	82
300	52	90
500	79	110
750	94	110
1000	98	110
1500	125	140
2000	132	140
2500	132	140

OUTGOING COMPARTMENT

AIR CIRCUIT BREAKER	AMP RATING	WH's
	225	12
	600	12
	1600	24
	3000	42
	4000	60

DISTRIBUTION PANELBOARD	WH's
Basic Compartment	16
100 AMP Circuit Breaker	2
225 AMP Circuit Breaker	3
400 AMP Circuit Breaker	3
600 AMP Circuit Breaker	4
800 AMP Circuit Breaker	6
1200 AMP Circuit Breaker	8

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

2. SWITCHGEAR – con't.

INSTALL IN PLACE	600V WH's	5KV WH's	15KV WH's
Per Vertical Section	15	20	30

ADD FOR CIRCUIT BREAKER OR FUSIBLE SWITCH:

AMP	600V WH's
225	5
600	6
800	11
1200	12
1600	14
2000	16
3000	20
4000	26
6000	32

ADD FOR AIR OR ELECTRICALLY OPERATED CIRCUIT BREAKER:

AMP	600V WH's	5KV WH's	15KV WH's
225	5	--	--
600	6	8	--
800	10	12	14
1200	12	14	16
1600	12	14	18
2000	16	18	20
3000	26	26	30
4000	30	34	34
6000	--	36	36

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

2. SWITCHGEAR – con't.

SWITCHGEAR NOTES

1. All work hour units include unload, storage and handling to erection site.

2. All work hour units represent indoor installation. For outdoor applications, make the following adjustments:
   - For walk in type, add **12** WH's per vertical section
   - For non-walk in type, add **8** WH's per vertical section
   - Add guard posts as required

3. Any supports required are not included.

4. For any activities which are not included in this section, see Means, Richardson, NECA or other recognized estimating publications.

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

3. MOTOR CONTROL CENTERS (MCC's)

480 VOLT – 3 PHASE – NEMA CLASS 1

INSTALL IN PLACE	**WH's**
Per Vertical Section	15

ADDERS:

	Size 1 ½ HP thru 10 HP Motors	**Size 2 15 HP thru 25 HP Motors**	**Size 3 30 HP thru 50 HP Motors**	**Size 4 60 HP thru 100 HP Motors**	**Size 5 125 HP thru 200 HP Motors**	**Size 6 200 HP thru 400 HP Motors**
For combination magnetic starters (FVNR*) single speed:	2	2	3	3	4	5
For combination magnetic starters (FVNR*) two speed:	3	3	4	4	5	--
For reduced voltage, auto-transformer (combination):	--	4	5	5	6	6
For full voltage reversing starters, single speed:	3	3	4	4	5	6
For addition of starters to existing MCC's:	3	3	5	5	9	--
For starter hardware to existing MCC's:	1	1	2	2	3	--

	100 AMP 3 Pole	**225 AMP 3 Pole**	**400 AMP 3 Pole**	**600 AMP 3 Pole**	**800 AMP 3 Pole**	**1200 AMP 3 Pole**
For incoming line and feeder breakers and/or fused switches	2	2	3	3	4	6

***FVNR** = Full Voltage Non-Reversing

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

3. MOTOR CONTROL CENTERS (MCC's) – con't.

MEDIUM VOLTAGE – 3 PHASE – 3 WIRE – NEMA CLASS 1

FULLY FACTORY ASSEMBLED UNITS	2400 VOLT WH's	4800 VOLT WH's
Single Vertical Sections	20	25
Double Vertical Sections	24	30
ADD FOR STARTERS	**WH's**	**WH's**
200 thru 400 HP	8	12
500 thru 1250 HP	12	16
1500 thru 2500 HP	18	24

MOTOR CONTROL CENTER NOTES

1. All work hour units include unload, storage and handling to erection site.
2. For bolting section together, if required, add **1** WH per section.
3. For checkout and tighten internal connections, if required, add **1** WH per section.
4. For any activities which are not included in this section, see Means, Richardson, NECA or other recognized estimating publications.

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

4. MOTOR STARTERS

600V ENCLOSED NEMA 1 AND 3R

HP	NEMA SIZE	MANUAL	MAGNETIC NON-REVERSING	MAGNETIC REVERSING
Up to 2	00	2	3	5
3-5	0	3	4	6
7.5-10	1	4	5	7
15-25	2	5	7	9
30-50	3	--	9	12
60-75	4	--	12	14
100	4	--	15	18
200	5	--	20	24

600V ENCLOSED COMBINATION MAGNETIC
With Circuit Breaker or Switch

		NEMA 1 & 3R		EXPLOSION PROOF	
HP	NEMA SIZE	NON-REV	REV	NON-REV	REV
Up to 2	00	4	6	6	8
3-5	0	5	7	6	8
7.5-10	1	6	8	8	10
15-25	2	10	12	11	13
30-50	3	12	14	16	19
60-75	4	14	16	19	21
100	4	18	21	24	28
200	5	24	28	32	37

VARIABLE FREQUENCY DRIVES

HP	NEMA SIZE	STANDARD NEMA 1	CUSTOM ENGINEERED
3-5	0	10	14
7.5-10	1	12	17
15-20	2	18	26
25-40	3	24	34
50	3	30	43
60-75	4	36	51
100-150	4	40	57
200	5	48	69

FLUOR

ELECTRICAL UNIT WORK HOURS

C. ELECTRICAL EQUIPMENT – con't.

4. MOTOR STARTERS – con't.

MOTOR STARTER NOTES

1. All work hour units include unload, storage and handling to erection site.

2. Any supports required are not included.

3. For any activities which are not included in this section, see Means, Richardson, NECA or other recognized estimating publications.

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

5. PANELBOARD

120/240 VOLT – SURFACE OR FLUSH MOUNTED
15-30 AMP Single Pole Branch Circuit Breakers
Unassembled Panels
With Main Circuit Breaker or Main Lug Only

	SINGLE PHASE – 3 WIRE		THREE PHASE – 4 WIRE	
BREAKERS	**100 AMP**	**200 AMP**	**100 AMP**	**200 AMP**
8	5	--	5	--
12	7	--	8	--
16	10	--	10	--
20	12	--	--	--
22	--	13	14	--
24	--	--	17	--
30	--	18	--	20
32	--	19	--	21
36	--	21	--	24
42	--	25	--	27

277/480 VOLT – SURFACE OR FLUSH MOUNTED
15-30 AMP Single Pole Branch Circuit Breakers
Unassembled Panels
With Main Circuit Breaker or Main Lug Only

	THREE PHASE – 4 WIRE	
BREAKERS	**125 AMP**	**225 AMP**
8	7	--
12	10	--
16	12	--
20	15	--
22	17	--
24	19	--
30	22	--
32	--	24
36	--	26
42	--	30

MOUNTING BRACKET	**WH's**
8-16 Circuit Panelboard	2
20-30 Circuit Panelboard	3
32-42 Circuit Panelboard	4

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

5. PANELBOARD – con't.

POWER DISTRIBUTION PANELS – SURFACE MOUNTED
600-Volt, Three Phase

AMP	MAIN CIRCUIT BREAKER	MAIN LUG ONLY
225	9	8
400	11	10
600	17	15
800	22	20
1000	28	25
1200	33	30

ADD FOR BRANCH CIRCUIT BREAKER

AMP	ONE POLE	TWO POLE	THREE POLE
15-60	0.5	0.8	1
70-100	0.7	1.5	2
110-225	--	2	3
250-400	--	3	4
450-600	--	5	6
700-800	--	6	7

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

5. PANELBOARD – con't.

NON-HAZERDOUS AREA PANELS - NEMA 3, 4, 5
Single phase – 3 Wire Solid/Neutral 120/240 Volt
Three Phase – 4 Wire Solid Neutral 120/208 Volt
Preassembled Panels
Main Breaker Not Included

NUMBER OF CIRCUITS	WH's
2	3
4	4
6	5
8	6
10	7
12	9
14	10
16	12
18	13
20	14
22	15
24	17
30	20
42	24

ADD FOR MAIN CIRCUIT BREAKER

AMP	WH's
100	2
150	2
200	2
225	2

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

5. PANELBOARD – con't.

HAZERDOUS AREA PANELS - CLASS 1, DIVISION I & II
Single Phase – 3 Wire Solid/Neutral 120/240 Volt
Three Phase – 4 Wire Solid Neutral 120/208 Volt
Preassembled Panels
Main Breaker Not Included

NUMBER OF CIRCUITS	WH's
6	8
8	9
10	10
12	12
14	13
16	15
18	17
20	19
22	20
24	22

ADD FOR MAIN CIRCUIT BREAKER

AMP	WH's
100	3
150	3
200	4
225	4

PANELBOARD NOTES

1. All work hour units include unload, storage and handling to erection site.
2. All work hour units represent NEMA 1 classification, unless otherwise noted.
3. Any supports required are not included.
4. For any activities which are not included in this section, see Means, Richardson, NECA or other recognized estimating publications.

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

6. DISCONNECT

600V ENCLOSED NEMA 1 AND 3R

AMP	SAFETY SWITCH	CIRCUIT BREAKER
Up to 60	4	4
Up to 150	6	7
200	8	9
225	9	10
250	10	12
400	12	15
600	20	22
800	25	26
1200	30	34

600V ENCLOSED NEMA 7

AMP	SAFETY SWITCH	CIRCUIT BREAKER
30	4	4
40	--	5
50	--	5
60	5	5
70	--	6
90	--	6
100	6	7
125	--	8
150	8	9
175	--	10
200	9	11
225	--	13
250	--	15
300	--	18
400	--	21

DISCONNECT NOTES

1. All work hour units include unload, storage and handling to erection site.

2. Any supports required are not included.

3. For any activities which are not included in this section, see Means, Richardson, NECA or other recognized estimating publications.

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

7. BUS DUCT

THREE PHASE – TRANSFORMER TO SWITCHGEAR

	AMP	600V WH's	4.16KV WH's	13.8KV WH's	34.5KV WH's
Bus Duct Per Foot	600	0.7	0.8	0.9	1
	800	0.8	0.9	1	1.1
	1000	0.9	1	1	1.2
	1200	1	1	1.1	1.4
	1350	1	1.1	1.2	1.4
	1600	1.1	1.2	1.3	1.5
	2000	1.2	1.3	1.4	1.7
	2500	1.4	1.4	1.5	1.8
	3000	1.5	1.6	1.8	2.2
	4000	1.8	1.9	2	2.6
	5000	2.1	2.2	2.4	3
Elbow – 90 Degree	600	4	4.4	4.9	6.3
	800	4.4	4.9	5.4	7
	1000	4.8	5.3	5.8	7.6
	1200	5.2	5.8	6.3	8.2
	1350	5.6	6.2	6.8	8.9
	1600	6.4	7	7.8	10
	2000	7.6	8.4	9.3	12.1
	2500	9.2	10.2	11.1	14.5
	3000	11.2	12.3	13.5	17.6
	4000	13.6	15	16.5	21.4
	5000	16.8	18.5	20.3	26.4
Transformer Connection	600	4	4.4	4.9	6.3
	800	4.4	4.9	5.4	7
	1000	4.8	5.3	5.8	7.6
	1200	5.2	5.8	6.3	8.2
	1350	5.6	6.2	6.8	8.9
	1600	6.4	7.1	7.8	10.2
	2000	7.6	8.4	9.3	12.1
	2500	8.8	9.7	10.6	13.8
	3000	11.2	12.3	13.5	17.6
	4000	13.6	15	16.5	21.4
	5000	16.8	18.5	20.3	26.4

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

7. BUS DUCT – con't.

THREE PHASE – TRANSFORMER TO SWITCHGEAR – con't.

	AMP	600V WH's	4.16KV WH's	13.8KV WH's	34.5KV WH's
Switchgear Connection	600	2	2.2	2.5	3.2
	800	2.4	2.6	2.9	3.8
	1000	2.8	3.1	3.4	4.5
	1200	3.2	3.5	3.8	5
	1350	3.6	4	4.4	5.8
	1600	4	4.4	4.9	6.3
	2000	4.4	4.9	5.4	7
	2500	4.8	5.3	5.8	7.6
	3000	5.6	6.2	6.8	8.9
	4000	8	8.8	9.7	12.6
	5000	9.6	10.6	11.6	15.1
Wall Flanges (Set)	600	2	2.2	2.5	3.2
	800	2.2	2.5	2.7	3.5
	1000	2.4	2.7	2.9	3.8
	1200	2.6	2.9	3.2	4.1
	1350	2.8	3.1	3.4	4.5
	1600	3.2	3.6	3.9	5.1
	2000	3.8	4.2	4.7	6.1
	2500	4.4	4.9	5.3	6.9
	3000	5.6	6.2	6.8	8.8
	4000	6.8	7.5	8.3	10.7
	5000	8.4	9.3	10.2	13.2

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

7. BUS DUCT – con't.

PLUG-IN

100 AMP	WH's
Aluminum or Copper	
– 1 Phase, 3 Wire & Ground, 120/240 Volt (per LF)	0.10
– 3 Phase, 3 Wire & Ground, 600 Volt Max (per LF)	0.12
– 3 Phase, 4 Wire & Ground, 277/480 Volt (per LF)	0.14
Outlet Cover	0.20
End Closure	0.50
Wall Flange	0.50
Hangers and Supports (including clamp, rod, nuts, etc.)	1.25
Elbows	1.50
Tees	1.75
Cable Tap Box	3.00

CIRCUIT BREAKER TYPE

AMP	ONE POLE	TWO POLE	THREE POLE
15-60	1	1.5	2.2
70-100	1.5	2.3	3.2

FUSIBLE UNIT

AMP	480/277 VOLT 3 PHASE, 4 WIRE	600 VOLT 3 PHASE, 3 WIRE
30	1.6	1.4
60	2.7	2.2
100	4	3.2
200	5.8	4.5
400	10.5	8
600	15	12
800	19.5	16
1000	24	20
1200	28.5	24
1600	33	28

BUS DUCT NOTES

1. All work hour units include unload, storage and handling to erection site.

2. Any supports required are not included.

3. For any activities which are not included in this section, see Means, Richardson, NECA or other recognized estimating publications.

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

8. SUBSTATION COMPONENTS

LINE TRAP

	SIZE			
AMP	DIAMETER	LENGTH	WT. LBS.	WH's
400	22"	51"	255	4
800	28"	57"	430	6
1200	34"	63"	705	8
1600	37 ¼"	67 ½"	1,085	14
2000	41"	79"	1,480	22
3000	41"	79"	1,580	25

CAPACITORS

	KV	WT. LBS.	WH's
SINGLE UNIT			
	50	32	4
	100	48	5
	150	71	6
	200	88	7
THREE PHASE			
	300	355	16
	600	520	17
	900	685	20
	1200	850	24
	1500	1,020	26

COUPLING CAPACITOR POTENTIAL DEVICE

KV	SIZE	WT. LBS.	WH's
34.5	48"	745	22
46	52"	790	25
69	56"	875	26
115	71"	965	28
138	85"	1,105	29
161	96"	1,210	30
230	116"	1,385	32

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

8. SUBSTATION COMPONENTS – con't.

NEUTRAL GROUND RESISTOR

KV	100-400 AMP	200-600 AMP	400-500 AMP	500-1000 AMP
2.4	31	--	--	38
4	46	--	54	--
8	62	--	77	--
20	--	92	--	--

LIGHTNING ARRESTER

KV	WT. LBS.	WH's
3	56	2
6	57	3
9	59	5
12	61	6
21	83	12
37	125	17
60	515	19
96	710	21
108	725	22
120	780	23
132	806	24
144	860	25
168	1,050	27
198	1,070	29
228	1,275	31
300	1,288	35

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

8. SUBSTATION COMPONENTS – con't.

POTENTIAL TRANSFORMER

DRY TYPE – SINGLE PHASE

KV	WT. LBS.	WH's
4	75	3
7.2	101	4
14.4	105	8
23	235	9
34.5	275	10
46	520	12
69	560	19

OIL FILLED – SINGLE PHASE

115	1,205	25
138	1,560	27
161	2,100	31
230	2,500	32

OIL FILLED – THREE PHASE

92	4,500	72
115	4,540	79
138	6,500	86
161	6,500	86

CURRENT TRANSFORMER

KV	WT. LBS.	WH's
5	110	6
7.5	110	6
13.8	135	7
23	323	9
27	710	16
34.5	710	16
46	720	17
69	730	19
115	1,550	31
138	1,750	32
161	2,400	43
230	2,800	54

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

8. SUBSTATION COMPONENTS – con't.

DISCONNECT SWITCH

THREE POLE – MANUAL GROUP OPERATED

KV	600 AMP	1200 AMP	2000 AMP
15	17	23	25
34.5	25	29	34
46	29	33	36
69	34	36	40
115	42	45	48
138	54	57	63
161	66	70	77
230	83	87	92

SINGLE POLE – HOOK STICK OPERATED

KV	600 AMP	1200 AMP	2000 AMP
4	3	3	3
7.2	4	4	4
14.4	4	4	4
23	5	5	5
34.5	5	5	5
46	6	6	6
69	6	6	6

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

8. SUBSTATION COMPONENTS – con't.

CIRCUIT BREAKERS

OIL FILLED – THREE PHASE

KV	1200 AMP	1600 AMP	2000 AMP	3000 AMP	4000 AMP
14.4	29	--	--	31	35
23	37	--	--	42	48
34.5	46	--	--	54	62
46	65	--	--	69	73
69	83	86	116	--	--
115	166	169	181	210	--
138	189	196	200	208	--
161	212	215	223	--	--
230	--	--	--	231	--

SF6 METAL ENCLOSED SWITCHGEAR

INDOOR TYPE

KV Up to	AMPS Up to	BAY DIMENSIONS IN FEET Width	Height	Depth	WH's PER BAY
40.5	2500	2	8	9	40
145	3150	4	10	11	90
300	5000	4	12	16	120
550	6300	4	15	17	130

OUTDOOR TYPE

KV	AMPS	BAY DIMENSIONS IN FEET Width	Height	Depth	WH's PER BAY
72.5	3150	4	10	3	90
123	3150	6	11	3	90
145	3150	6	13	5	90
170	4000	7	14	5	105
245	4000	10	19	5	115
300	4000	19	14	13	150
362	4000	30	15	17	180
420	4000	30	18	17	195
550	4000	36	20	17	210

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

8. SUBSTATION COMPONENTS – con't.

INSULATORS

KV	SUSPENSION TYPE	POST TYPE
4	0.5	0.5
7.5	0.5	0.5
13.8	1	1.3
23	1	1.4
27	1	1.4
34.5	1	3.2
66	1.5	4.1
69	1.5	4.1
115	1.5	4.1
138	2.5	5.7
161	2.5	5.7
230	3	6.8

BARE COPPER CABLE – SINGLE CONDUCTOR (per LF)

AMP	SIZE	WT. LBS.	WH's
186	#2	.201	.030
245	1/0	.319	.039
283	2/0	.403	.043
332	3/0	.508	.048
385	4/0	.641	.052
430	250	.772	.057
524	350	1.082	.066
663	500	1.544	.078
860	750	2.316	.093
1025	1000	3.088	.100

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

8. SUBSTATION COMPONENTS – con't.

BARE ALUMINUM CABLE (ACSR) – SINGLE CONDUCTOR (per LF)

AMP	SIZE	WT. LBS.	WH's
140	4-6/1	.057	.020
185	2-6/1	.091	.024
240	1/0-6/1	.145	.031
275	2/0-6/1	.183	.037
315	3/0-6/1	.231	.042
360	4/0-6/1	.291	.048
455	266.8-26/7	.367	.052
530	336.4-26/7	.463	.058
585	397.5-26/7	.547	.063
660	477-26/7	.657	.069
725	556.5-26/7	.746	.074
785	636-26/7	.875	.081
845	715-26/7	.984	.087
905	795-26/7	1.094	.094
950	874.5-54/7	1.126	.096
955	900-54/7	1.158	.098
995	954-54/7	1.229	.103
1025	1033.5-54/7	1.330	.109
1175	1272-54/19	1.635	.127
1270	1431-54/19	1.840	.139
1360	1590-54/19	2.044	.151
1540	2034-72/7	2.162	.160
1600	2167-72/7	2.302	.174
1670	2312-76/19	2.526	.200
1755	2515-76/19	2.749	.220

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

8. SUBSTATION COMPONENTS – con't.

BARE ALUMINUM CABLE (AAC) – SINGLE CONDUCTOR (per LF)

AMP	SIZE	WT. LBS.	WH's
100	#4	.038	.018
137	#2	.061	.022
180	1/0	.097	.028
220	2/0	.122	.033
260	3/0	.154	.038
280	4/0	.195	.043
350	266.8	.250	.047
400	336.4	.316	.052
450	397.5	.422	.057
500	477	.447	.062
552	556.5	.522	.067
605	636	.596	.073
650	715.5	.671	.078
690	795	.746	.085
725	874.5	.821	.086
740	900	.845	.088
755	954	.896	.092
790	1000	.938	.099
903	1250	1.180	.116
1000	1500	1.402	.126
1035	1590	1.493	.136
1080	1750	1.643	.142
1175	2000	1.876	.153
1270	2500	2.368	.161
1360	3500	3.350	.201

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

8. SUBSTATION COMPONENTS – con't.

STATIC WIRE (per LF)

TYPE	SIZE	WH's
Extra High Strength (EHS)	3/8"	.070
Extra High Strength (EHS)	1/2"	.080
Copperweld (CWD)	#6	.053
Alumoweld	3-#7	.056

TUBULAR BUS BAR (per LF)

SIZE	ALUMINUM	COPPER
½"	.083	.111
¾"	.111	.120
1"	.129	.138
1 ¼"	.153	.166
1 ½"	.212	.231
2"	.221	.240
2 ½"	.231	.250
3"	.461	.499
4"	.554	.600
5"	.683	.740
6"	.841	.911

SUBSTATION COMPONENT NOTES

1. All work hour units include unload, storage and handling to erection site.

2. Any substation structural steel required is not included.

3. For SF6 Circuit Breakers, the following notes apply:
   - Each bay unit is shipped in prefabricated assemblies on solid wooden pallets
   - Each bay unit is fully assembled and tested at the factory and filled with SF6 gas
   - No gas work at site
   - Work hour units **do not** include busduct, high voltage or control terminations

4. Any supports required are not included.

5. For any activities which are not included in this section, see Means, Richardson, NECA or other recognized estimating publications.

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

9. GENERATORS

EMERGENCY GENERATORS

CAPACITY	OUTPUT (AMPS)				
KW	125V	250V	500V	WT. LBS.	WH's
5	40	20	10	404	17
10	80	40	20	592	21
15	120	60	30	940	27
20	160	80	40	1,125	30
25	200	100	50	1,500	37
30	240	120	60	1,800	42
35	28	140	70	2,100	48
50	400	200	100	2,200	50
60	480	240	120	2,300	52
75	600	300	150	2,600	67
90	720	360	180	2,700	69
100	800	400	200	2,755	70
125	1000	500	250	3,444	82
150	1200	600	300	5,970	92
200	1600	800	400	6,200	114
300	2400	1200	600	7,837	134
400	3200	1600	800	10,910	171
500	4000	2000	1000	11,675	180
750	6000	3000	1500	16,500	278
1000	8000	4000	2000	20,000	320
1200	9600	4800	2400	24,000	368

AUTOMATIC TRANSFER SWITCH

AMPS	WH's
30	7
60	8
100	11
150	13
225	15
250	15
400	19
600	30
800	37
1000	39
1200	42
1600	49
2000	58

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

9. GENERATORS – con't.

GENERATOR NOTES

1. All work hour units include unload, storage and handling to erection site.
2. Work hour units include setting generator in place, controls connected, batteries and charger installed.
3. Work hour units **do not** include exhaust system piping, fuel piping, underground fuel tank, additional cooling system, remote alarm annunciator, etc., as required.
4. Any supports required are not included.
5. For any activities which are not included in this section, see Means, Richardson, NECA or other recognized estimating publications.

FLUOR

ELECTRICAL UNIT WORK HOURS

B. ELECTRICAL EQUIPMENT – con't.

10. UNINTERRUPTABLE POWER SUPPLY (UPS)

SELF CONTAINED SYSTEM – UP TO 600V

KVA	WH's
1.0	5
1.5	6
2.0	7
2.5	8
3.0	9
5.0	10
7.5	13
10	15
15	20
20	25
30	32
40	40
50.0	50

UNINTERRUPTABLE POWER SUPPLY (UPS) NOTES

1. All work hour units include unload, storage and handling to erection site.

2. Any supports required are not included.

3. For any activities which are not included in this section, see Means, Richardson, NECA or other recognized estimating publications.

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS

11. CONDUIT, FITTINGS & ACCESSORIES

RIGID STEEL

CONDUIT (per LF)

SIZE	RSC[1] U/G	RSC[1] O/H	IMC[2] U/G	IMC[2] O/H
½"	.040	.070	.036	.063
¾"	.040	.080	.036	.072
1"	.060	.110	.054	.099
1 ¼"	.070	.120	.063	.108
1 ½"	.080	.140	.072	.126
2"	.100	.170	.090	.153
2 ½"	.130	.220	.117	.198
3"	.150	.280	.135	.252
3 ½"	.180	.320	.162	.288
4"	.250	.420	.225	.378
5"	.360	.600	.324	.540
6"	.450	.800	.405	.720

NOTES

1. **RSC[1]** – Rigid Steel Conduit & **IMC[2]** – Intermediate Metal Conduit
2. Conduit units **exclude** bends (factory or field), terminations and supports.

CONDUIT FITTINGS (FERALOY - MALLEABLE IRON)
Includes cover and gasket

	2-HUB (LB)		3-HUB (TEE)	
SIZE	NON-HAZ & DIV.2	DIV. 1	NON-HAZ & DIV.2	DIV. 1
½"	0.8	0.9	1.0	1.2
¾"	1.0	1.2	1.2	1.4
1"	1.2	1.4	1.5	1.7
1 ¼"	1.5	1.7	2.1	2.4
1 ½"	2.0	2.3	2.5	2.9
2"	2.5	2.9	3.0	3.5
2 ½"	3.5	4.0	4.7	--
3"	4.5	5.2	6.1	--
3 ½"	5.5	6.3	7.7	--
4"	6.5	7.5	8.6	--
5"	8.0	---	--	--
6"	12.0	---	--	--

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't

RIGID STEEL – con't.

CONDUIT CLAMPS

SIZE	RIGHT ANGLE/ PARALLEL
½"	0.10
¾"	0.10
1"	0.10
1 ¼"	0.15
1 ½"	0.15
2"	0.15
2 ½"	0.30
3"	0.40
3 ½"	0.40
4"	0.45
5"	0.50
6"	0.60

OTHER FITTINGS

	SEALING		UNIONS
SIZE	EYS-FEM	EYD-FEM	UNY
½"	0.8	0.8	0.6
¾"	0.9	1.0	0.8
1"	1.0	1.1	1.0
1 ¼"	1.2	1.4	1.2
1 ½"	1.4	1.5	1.5
2"	1.6	1.7	1.9
2 ½"	1.8	2.0	2.2
3"	2.1	2.3	2.5
3 ½"	2.5	2.7	2.7
4"	3.0	3.3	3.0
5"	4.0	--	4.5
6"	6.0	--	7.1

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't

RIGID STEEL – con't.

CONDUIT TERMINATIONS

	HUB		BUSHING	
SIZE	INSUL	GROUNDING	INSUL	GROUNDING
½"	0.6	0.7	0.3	0.5
¾"	0.8	0.9	0.4	0.6
1"	1.0	1.1	0.5	0.7
1 ¼"	1.2	1.3	0.5	0.8
1 ½"	1.5	1.6	0.5	0.8
2"	1.9	2.1	0.8	1.2
2 ½"	2.2	2.5	0.9	1.8
3"	2.5	2.7	1.2	2.2
3 ½"	2.7	2.9	1.2	2.7
4"	3.0	3.3	1.5	3.3
5"	4.5	5.0	2.1	4.1
6"	7.1	7.7	3.0	4.8

CONDUIT BENDS

	FACTORY		FIELD	
SIZE	U/G	O/H	U/G	O/H
1 ¼"	0.5	0.9	0.6	0.7
1 ½"	0.6	1.0	0.7	0.9
2"	0.8	1.4	0.8	1.0
2 ½"	1.2	2.0	1.0	1.3
3"	1.8	3.0	1.2	1.5
3 ½"	2.1	3.5	1.4	1.8
4"	2.7	4.5	1.6	2.0
5"	3.3	6.0	2.4	3.0
6"	4.8	8.0	3.2	4.0

NOTES

1. Labor units for factory bends are added into the estimate the same as conduit fittings.
2. Labor units for field bends are in addition to the linear conduit quantity. The actual bend is part of the conduit quantity, only labor is added.

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't

RIGID STEEL – con't.

FACTORY LONG RADIUS 90 ELBOW

	24" RADIUS		36" RADIUS		48" RADIUS	
SIZE	U/G	O/H	U/G	O/H	U/G	O/H
1"	0.6	0.9	0.8	1.1	0.9	1.3
1 ¼"	0.8	1.2	0.9	1.3	1.0	1.5
1 ½"	0.8	1.2	0.9	1.4	1.0	1.5
2"	1.1	1.7	1.2	2.1	1.3	2.3
2 ½"	1.8	3.1	2.0	3.3	2.2	3.5
3"	2.2	3.6	2.6	4.2	2.8	4.5
3 ½"	2.6	4.2	3.2	5.3	3.4	5.6
4"	3.2	4.9	3.7	6.2	4.0	6.5
5"	----	----	4.3	7.4	4.6	7.8
6"	----	----	5.5	9.4	5.8	9.8

FLEX SEALTITE & FLEX STEEL

	CONDUIT (per LF)		CONDUIT CONNECTORS INSULATED THROAT STRAIGHT		
			SEALTITE		STEEL
SIZE	SEALTITE	STEEL	PLAIN	GROUNDING	SQUEEZE
½"	.090	.060	0.2	0.2	0.1
¾"	.120	.075	0.2	0.3	0.2
1"	.150	.095	0.3	0.3	0.2
1 ¼"	.200	.150	0.3	0.4	0.3
1 ½"	.225	.200	0.4	0.5	0.3
2"	.250	.250	0.6	0.7	0.5
2 ½"	.350	.350	0.8	1.0	0.8
3"	.500	.400	1.0	1.2	1.0
4"	1.000	----	1.5	1.8	----

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't

RIGID STEEL – con't.

EXPANSION JOINTS

	4" MOVEMENT BONDING JUMPER		8" MOVEMENT BONDING JUMPER	
SIZE	WITHOUT	WITH	WITHOUT	WITH
½"	1.0	1.1	1.1	1.2
¾"	1.1	1.2	1.2	1.4
1"	1.2	1.4	1.4	1.5
1 ¼"	1.4	1.5	1.5	1.7
1 ½"	1.6	1.8	1.8	1.9
2"	1.8	2.1	2.0	2.3
2 ½"	2.5	2.7	2.5	3.0
3"	3.0	3.3	3.3	3.6
3 ½"	3.2	3.6	3.5	4.0
4"	3.8	4.2	4.2	4.7

EXPLOSION PROOF FLEX (CLASS 1, DIV. 1)

4" through 12" lengths

SIZE	WH's
½"	1.0
¾"	1.0
1"	1.2
1 ¼"	1.3
1 ½"	1.5
2"	2.0

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't.

ALUMINUM

CONDUIT (per LF)

SIZE	O/H
½"	.063
¾"	.072
1"	.099
1 ¼"	.108
1 ½"	.126
2"	.153
2 ½"	.198
3"	.252
3 ½"	.288
4"	.378
5"	.540
6"	.720

NOTE

1. Conduit units **exclude** bends (factory or field), terminations and supports.

CONDUIT FITTINGS
Includes cover and gasket

	2-HUB (LB)		3-HUB (TEE)	
SIZE	NON-HAZ & DIV.2	DIV. 1	NON-HAZ & DIV.2	DIV. 1
½"	0.8	0.9	1.0	1.2
¾"	1.0	1.2	1.2	1.4
1"	1.2	1.4	1.5	1.7
1 ¼"	1.5	1.7	2.1	2.4
1 ½"	2.0	2.3	2.5	2.9
2"	2.5	2.9	3.0	3.5
2 ½"	3.5	4.0	4.7	--
3"	4.5	5.2	6.1	--
3 ½"	5.5	6.3	7.7	--
4"	6.5	7.5	8.6	--
5"	8.0	---	--	--
6"	12.0	---	--	--

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't

ALUMINUM – con't.

CONDUIT CLAMPS

SIZE	RIGHT ANGLE/ PARALLEL
½"	0.10
¾"	0.10
1"	0.10
1 ¼"	0.15
1 ½"	0.15
2"	0.15
2 ½"	0.30
3"	0.40
3 ½"	0.40
4"	0.45
5"	0.50
6"	0.60

OTHER FITTINGS

	SEALING		UNIONS
SIZE	EYS-FEM	EYD-FEM	UNY
½"	0.8	0.8	0.6
¾"	0.9	1.0	0.8
1"	1.0	1.1	1.0
1 ¼"	1.2	1.4	1.2
1 ½"	1.4	1.5	1.5
2"	1.6	1.7	1.9
2 ½"	1.8	2.0	2.2
3"	2.1	2.3	2.5
3 ½"	2.5	2.7	2.7
4"	3.0	3.3	3.0
5"	4.0	--	4.5
6"	6.0	--	7.1

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't

ALUMINUM – con't.

CONDUIT TERMINATIONS

	HUB		BUSHING	
SIZE	INSUL	GROUNDING	INSUL	GROUNDING
½"	0.6	0.7	0.3	0.5
¾"	0.8	0.9	0.4	0.6
1"	1.0	1.1	0.5	0.7
1 ¼"	1.2	1.3	0.5	0.8
1 ½"	1.5	1.6	0.5	0.8
2"	1.9	2.1	0.8	1.2
2 ½"	2.2	2.5	0.9	1.8
3"	2.5	2.7	1.2	2.2
3 ½"	2.7	2.9	1.2	2.7
4"	3.0	3.3	1.5	3.3
5"	4.5	5.0	2.1	4.1
6"	7.1	7.7	3.0	4.8

CONDUIT BENDS

SIZE	FACTORY O/H	FIELD O/H
1 ¼"	0.6	0.6
1 ½"	0.7	0.7
2"	1.0	0.9
2 ½"	1.4	1.0
3"	2.0	1.3
3 ½"	2.4	1.5
4"	3.0	1.9
5"	4.5	2.3
6"	6.0	3.0

NOTES

1. Labor units for factory bends are added into the estimate the same as conduit fittings.
2. Labor units for field bends are in addition to the linear conduit quantity. The actual bend is part of the conduit quantity, only labor is added.

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't.

PVC COATED RIGID STEEL

CONDUIT (per LF)

SIZE	U/G	O/H
½"	.050	.080
¾"	.050	.100
1"	.070	.130
1 ¼"	.080	.140
1 ½"	.100	.170
2"	.120	.200
2 ½"	.160	.260
3"	.180	.340
3 ½"	.220	.380
4"	.300	.500
5"	.430	.720
6"	.540	.960

NOTE

1. Conduit units **exclude** bends (factory or field), terminations and supports.

CONDUIT FITTINGS
Includes cover and gasket

	2-HUB (LB)		3-HUB (TEE)	
SIZE	NON-HAZ & DIV.2	DIV. 1	NON-HAZ & DIV.2	DIV. 1
½"	1.0	1.1	1.2	1.4
¾"	1.2	1.4	1.4	1.7
1"	1.4	1.7	1.8	2.0
1 ¼"	1.8	2.0	2.5	2.9
1 ½"	2.4	2.8	3.0	3.5
2"	3.0	3.5	3.6	4.2
2 ½"	4.2	4.8	5.6	--
3"	5.4	6.2	7.3	--
3 ½"	6.6	7.6	8.6	--
4"	7.8	9.0	10.0	--

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't

PVC COATED RIGID STEEL - con't.

CONDUIT CLAMPS

SIZE	RIGHT ANGLE/ PARALLEL
½"	0.10
¾"	0.10
1"	0.10
1 ¼"	0.15
1 ½"	0.15
2"	0.15
2 ½"	0.30
3"	0.40
3 ½"	0.40
4"	0.45
5"	0.50
6"	0.60

OTHER FITTINGS

	SEALING		UNIONS
SIZE	EYS-FEM	EYD-FEM	UNY
½"	1.0	1.0	0.8
¾"	1.1	1.2	1.0
1"	1.2	1.3	1.2
1 ¼"	1.4	1.7	1.4
1 ½"	1.7	1.8	1.8
2"	1.9	2.0	2.3
2 ½"	2.2	2.4	2.6
3"	2.5	2.8	3.0
3 ½"	3.0	3.3	3.3
4"	3.6	4.0	3.6
5"	--	--	5.4
6"	--	--	8.5

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't

PVC COATED RIGID STEEL – con't.

CONDUIT TERMINATIONS

	HUB	
SIZE	INSUL	GROUNDING
½"	0.8	0.9
¾"	1.0	1.1
1"	1.2	1.3
1 ¼"	1.4	1.6
1 ½"	1.8	1.9
2"	2.3	2.5
2 ½"	2.6	3.0
3"	3.0	3.2
3 ½"	3.3	3.5
4"	3.6	4.0
5"	5.4	6.0
6"	8.5	9.2

CONDUIT BENDS

	FACTORY		FIELD	
SIZE	U/G	O/H	U/G	O/H
1 ¼"	0.6	1.1	0.6	0.8
1 ½"	0.7	1.2	0.7	1.1
2"	1.0	1.7	1.0	1.2
2 ½"	1.4	2.4	1.2	1.6
3"	2.2	3.6	1.4	1.8
3 ½"	2.5	4.2	1.7	2.2
4"	3.2	5.4	1.9	2.4
5"	4.0	7.2	2.9	3.6
6"	5.8	9.6	3.8	4.8

NOTES

1. Labor units for factory bends are added into the estimate the same as conduit fittings.
2. Labor units for field bends are in addition to the linear conduit quantity. The actual bend is part of the conduit quantity, only labor is added.

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't

PVC

CONDUIT (per LF)

	SCH. 40		SCH. 80	
SIZE	U/G	O/H	U/G	O/H
½"	.040	.070	.042	.074
¾"	.050	.080	.053	.084
1"	.070	.110	.074	.116
1 ¼"	.080	.120	.084	.126
1 ½"	.090	.140	.095	.147
2"	.110	.170	.116	.179
2 ½"	.140	.210	.147	.221
3"	.150	.220	.158	.231
3 ½"	.170	.260	----	----
4"	.220	.350	.231	.368
5"	.290	.470	.305	.494
6"	.380	.670	.399	.704

NOTE

1. Conduit units **exclude** bends (factory or field) and supports.

CONDUIT FITTINGS

SIZE	2-HUB (LB)	3-HUB (TEE)	FEMALE ADAPTER PVC to STL/ALUM U/G	BELL ENDS U/G
½"	0.6	0.8	0.2	---
¾"	0.7	1.0	0.2	---
1"	0.9	1.2	0.2	0.2
1 ¼"	1.2	1.5	0.4	0.2
1 ½"	1.5	1.8	0.4	0.2
2"	2.3	2.5	0.4	0.4
2 ½"	3.2	---	0.4	0.4
3"	4.6	---	0.6	0.6
3 ½"	6.0	---	0.8	0.8
4"	7.4	---	1.0	1.0
5"	---	---	1.4	1.4
6"	---	---	1.6	1.6

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't

PVC – con't.

CONDUIT CLAMPS

SIZE	RIGHT ANGLE/ PARALLEL
½"	0.10
¾"	0.10
1"	0.10
1 ¼"	0.15
1 ½"	0.15
2"	0.15
2 ½"	0.30
3"	0.40
3 ½"	0.40
4"	0.45
5"	0.50
6"	0.60

CONDUIT BENDS

	FACTORY			FIELD (HEAT BENDING)		
	SCH. 40		SCH. 80	SCH. 40		SCH. 80
SIZE	U/G	O/H	U/G	U/G	O/H	U/G
½"	0.2	0.4	---	0.2	0.4	---
¾"	0.3	0.4	---	0.3	0.4	---
1"	0.3	0.4	---	0.3	0.4	---
1 ¼"	0.3	0.5	0.4	0.3	0.5	0.4
1 ½"	0.4	0.6	0.5	0.4	0.6	0.5
2"	0.5	0.8	0.6	0.5	0.8	0.6
2 ½"	0.9	1.2	1.1	0.8	1.1	0.9
3"	1.1	1.5	1.4	0.9	1.2	1.0
3 ½"	1.5	1.8	1.7	1.0	1.3	1.2
4"	1.9	2.3	2.2	1.1	1.4	1.3
5"	2.5	3.0	---	1.8	2.2	---
6"	3.3	3.8	---	2.2	2.8	---

NOTES

1. Labor units for factory bends are added into the estimate the same as conduit fittings.
2. Labor units for field bends are in addition to the linear conduit quantity. The actual bend is part of the conduit quantity, only labor is added.

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't

PVC – con't.

PLASTIC SPACERS FOR UNDERGROUND DUCT

SIZE	BASE	INTERMEDIATE
2"	0.18	0.12
3"	0.23	0.15
4"	0.26	0.17
5"	0.30	0.20
6"	0.33	0.22

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

11. CONDUIT, FITTINGS & ACCESSORIES – con't.

ELECTRICAL METALLIC TUBING (EMT)

CONDUIT (per LF)

SIZE	O/H
½"	.045
¾"	.050
1"	.055
1 ¼"	.062
1 ½"	.070
2"	.080
2 ½"	.095
3"	.110
3 ½"	.130
4"	.160

CONDUIT FITTINGS
With cover

SIZE	2-HUB (LB)	3-HUB (TEE)	COMPRESSION CONNECTORS INSULATED THROAT	COMPRESSION COUPLINGS
½"	0.6	0.8	0.2	0.31
¾"	0.7	1.0	0.2	0.37
1"	0.9	1.2	0.3	0.43
1 ¼"	1.2	1.5	0.3	0.50
1 ½"	1.5	1.8	0.4	0.62
2"	2.3	2.5	0.5	0.75
2 ½"	3.2	---	0.6	0.87
3"	4.6	---	0.8	1.00
3 ½"	6.0	---	0.9	1.12
4"	7.4	---	1.1	1.25

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

12. CABLE TRAY

CABLE LADDER TRAY & FITTINGS – ALUMINUM 9" RS - 6" HSR

		WIDTH						
ITEM		**6"**	**9"**	**12"**	**18"**	**24"**	**30"**	**36"**
Straight section (per LF)		0.158	0.163	0.175	0.181	0.193	0.210	0.228
Elbow 45	12" R	1.8	2.0	2.2	2.4	2.7	3.1	3.5
Horz. Or Vert.	24" R	1.9	2.1	2.3	2.5	2.9	3.3	3.8
	36" R	2.0	2.2	2.4	2.6	3.1	3.5	4.1
Elbow 90	12" R	2.7	3.0	3.3	3.6	4.2	4.7	5.3
Horz. Or Vert.	24" R	2.8	3.1	3.4	3.8	4.4	5.0	5.6
	36" R	2.9	3.2	3.5	4.0	4.6	5.3	5.9
Tee Horz.	12" R	4.7	5.0	5.3	6.0	6.5	7.1	7.7
	24" R	5.0	5.3	5.6	6.3	6.9	7.5	8.1
	36" R	5.3	5.6	5.9	6.6	7.3	7.9	8.5
Cross Horz.	12" R	6.2	6.5	7.1	7.7	8.3	8.9	9.5
	24" R	6.6	6.9	7.5	8.1	8.8	9.4	10.0
	36" R	7.0	7.3	7.9	8.5	9.3	9.9	10.5
Reducer		---	2.5	2.8	3.3	3.8	4.4	5.0
Blind End		0.5	0.6	0.6	0.7	0.8	0.8	0.9
Ladder to Box Conn.		2.5	2.8	3.3	3.8	4.4	5.3	6.3
Cable Dropout		0.5	0.6	0.6	0.7	0.8	0.8	0.9

MISCELLANEOUS ADDERS:

Std Plate Connector	1.0/PR	Hold Down Clips	0.02/EA
Exp Connector	1.5/PR	Straight Barrier Strip	15/CFT
Adj Connector Vert	1.2/PR	Flex Barrier Strip	20/CFT
Adj Connector Horz	1.2/PR	Riser ELB Barrier Strip	1.2/EA
Bonding Jumper	0.2/EA		

For:	Straight Section: use above units times	Elbows, Tees, Crosses & Reducers: use above units times
6" HSR, 6" RS	1.05	1.05
6" HSR, 12" RS	0.94	0.95
4" HSR, 6" RS	0.84	1.00
4" HSR, 9" RS	0.80	0.95
4" HSR, 12" RS	0.76	0.90

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

12. CABLE TRAY – con't.

CABLE LADDER TRAY & FITTING COVERS – ALUMINUM

		WIDTH						
COVERS		**6"**	**9"**	**12"**	**18"**	**24"**	**30"**	**36"**
Straight section (per LF)		0.037	0.044	0.058	0.072	0.087	0.109	0.131
Elbow 45	12" R	0.10	0.12	0.14	0.17	0.21	0.23	0.28
Horz. Or Vert.	24" R	0.12	0.15	0.17	0.21	0.23	0.25	0.31
	36" R	0.12	0.15	0.17	0.21	0.25	0.28	0.34
Elbow 90	12" R	0.10	0.12	0.14	0.17	0.23	0.28	0.33
Horz. Or Vert.	24" R	0.12	0.15	0.17	0.21	0.25	0.31	0.37
	36" R	0.12	0.15	0.17	0.21	0.28	0.34	0.40
Tee Horz.	12" R	0.16	0.19	0.23	0.29	0.35	0.40	0.46
	24" R	0.18	0.19	0.25	0.31	0.37	0.43	0.50
	36" R	0.18	0.21	0.25	0.34	0.40	0.48	0.56
Cross Horz.	12" R	0.23	0.25	0.29	0.34	0.46	0.58	0.70
	24" R	0.25	0.25	0.31	0.37	0.50	0.62	0.75
	36" R	0.25	0.27	0.33	0.40	0.54	0.67	0.81
Reducer		---	0.15	0.17	0.21	0.25	0.31	0.37
Clamps		0.12	0.13	0.15	0.17	0.20	0.22	0.25

ADJUSTMENTS FOR OTHER MATERIALS:

For Aluminum Solid Bottom, adjust ladder tray & fitting units as follows:

Width	**Multiply by**
6"	**1.00**
9"	**1.07**
12"	**1.15**
18"	**1.30**
24"	**1.45**
30"	**1.53**
36"	**1.60**

For Galvanized Steel straight section tray, add **36%**. Use same units for **all** other items.
For Galvanized Steel straight section cover, add **15%**. Use same units for **all** other items.

For FRP, multiply by **96%**.

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

12. CABLE TRAY – con't.

CABLE TRAY SUPPORTS

TRAPEZE TYPE	WH's
6"	4.00
9"	4.10
12"	4.20
18"	4.30
24"	4.35
30"	4.40
36"	4.45

TOP OF PIPE BRIDGE	WH's
6" through 36"	2.10

SIDE OF PIPE BRIDGE	WH's
6"	2.15
9"	2.25
12"	2.45
18"	2.65
24"	2.75
30"	2.90
36"	3.20

WIREWAY

	WH's/LF		
SIZE	SCREWED COVER LAY-IN	FLANGED END W/KNOCKOUTS	JIC TYPE W/O KNOCKOUTS
2 ½" x 2 ½"	0.10	0.12	0.14
4" x 4"	0.12	0.14	0.16
6" x 6"	0.14	0.16	0.19
8" x 8"	0.17	0.20	0.22
12" x 12"	0.20	0.24	0.26

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE

600V

STRANDED CU THW (IN CONDUIT)

AWG	1/C WH's/LF O/H	U/G	WIRE TERMINATION PER CONDUCTOR (WH's/EA)
14	.009	.007	.20
12	.009	.007	.20
10	.011	.008	.20
8	.014	.011	.25
6	.015	.012	.35
4	.018	.014	.40
2	.021	.017	.50
1	.025	.019	.60
1/0	.030	.024	.70
2/0	.032	.025	.80
3/0	.039	.030	1.00
4/0	.042	.032	1.10
KCMIL			
250	.048	.037	1.30
350	.057	.045	1.50
500	.066	.051	1.80
750	.081	.063	2.00
1000	.093	.072	2.30

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

600V – con't.

STRANDED CU THW (T.C. CABLE)

AWG	3/C WH's/LF	4/C WH's/LF
8	.025	.033
6	.035	.047
4	.040	.053
2	.048	.064
1	.050	.067
1/0	.071	.095
2/0	.077	.103
3/0	.094	.125
4/0	.100	.133
KCMIL		
250	.105	.140
300	.108	.144
350	.110	.147
400	.130	.160
500	.140	.187
600	.160	.209
700	.180	.231
750	.190	.253

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

600V – con't.

STRANDED CU GALVANIZED STEEL INTERLOCKED ARMOR TYPE MC (XHHW) WITH PVC JACKET AND GROUND WIRE

No. Of Conductors	AWG	WT. per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	WH's/LF Hung	WH's/LF Direct Burial
3	8	530	0.89	.051	.064	.031
4	8	625	0.95	.056	.070	.034
3	6	685	0.97	.057	.071	.034
4	6	820	1.04	.065	.081	.039
3	4	895	1.07	.063	.079	.038
4	4	1,085	1.15	.071	.089	.043
3	2	1,235	1.19	.075	.094	.045
4	2	1,520	1.29	.083	.104	.050
3	1	1,495	1.32	.082	.103	.049
4	1	1,850	1.43	.090	.113	.051
3	1/0	1,755	1.41	.090	.113	.051
4	1/0	2,190	1.53	.098	.123	.056
3	2/0	2,080	1.50	.097	.121	.055
4	2/0	2,645	1.66	.105	.131	.060
3	4/0	3,060	1.75	.112	.140	.064
4	4/0	3,995	1.93	.124	.155	.071
	KCMIL					
3	250	3,685	1.91	.120	.150	.068
4	250	4,650	2.09	.131	.164	.072
3	350	4,845	2.13	.150	.188	.083
4	350	6,150	2.34	.162	.203	.089
3	500	6,605	2.44	.165	.206	.091
4	500	8,425	2.69	.184	.230	.101
3	750	9,500	2.90	.195	.244	.107
4	750	12,260	3.22	.227	.284	.125

NOTE

1. Use C-L-X type MC for conductors smaller than #8 AWG.

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

600V – con't.

STRANDED CU C-L-X TYPE MC (XHHW) ALUMINUM SHEATH WITH PVC JACKET

No. Of Conductors	AWG	WT. per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	WH's/LF Hung	WH's/LF Direct Burial
2	14	150	0.60	.033	.041	.020
3	14	180	0.64	.035	.044	.021
4	14	205	0.68	.037	.046	.022
5	14	235	0.72	.040	.050	.024
7	14	280	0.76	.043	.054	.026
9	14	345	0.85	.049	.061	.029
12	14	425	0.95	.056	.070	.034
19	14	570	1.03	.063	.079	.038
37	14	1,035	1.40	.090	.113	.054
2	12	180	0.64	.035	.044	.021
3	12	215	0.68	.037	.046	.022
4	12	255	0.72	.043	.054	.026
5	12	295	0.76	.045	.056	.027
7	12	345	0.81	.050	.063	.030
9	12	440	0.90	.056	.070	.034
12	12	545	1.03	.068	.085	.041
19	12	770	1.17	.075	.094	.045
37	12	1,395	1.53	.109	.136	.065
2	10	220	0.68	.037	.046	.022
3	10	270	0.72	.039	.049	.023
4	10	320	0.76	.044	.055	.026
5	10	365	0.76	.047	.059	.028
7	10	470	0.90	.052	.065	.031
9	10	585	0.99	.059	.074	.035
12	10	745	1.13	.072	.090	.043

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

600V – con't.

STRANDED CU C-L-X TYPE MC (XHHW) ALUMINUM SHEATH WITH PVC JACKET AND GROUND WIRE

No. Of Conductors	AWG	WT. per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	Hung	Direct Burial
3	12	235	0.68	.037	.046	.022
4	12	270	0.72	.043	.054	.026
3	10	310	0.76	.039	.049	.023
4	10	360	0.81	.044	.055	.026
3	8	415	0.85	.048	.060	.029
4	8	500	0.95	.053	.066	.032
3	6	555	0.99	.054	.068	.032
4	6	680	1.08	.062	.078	.037
3	4	740	1.03	.060	.075	.036
4	4	915	1.13	.067	.084	.041
3	2	1,055	1.17	.071	.089	.043
4	2	1,375	1.35	.079	.099	.047
3	1	1,330	1.35	.078	.098	.047
4	1	1,665	1.48	.086	.108	.049
3	1/0	1,575	1.45	.086	.108	.049
4	1/0	2,030	1.65	.093	.116	.053
3	2/0	1,890	1.58	.092	.115	.052
4	2/0	2,430	1.73	.100	.125	.057
3	4/0	2,825	1.82	.106	.133	.060
4	4/0	3,600	2.00	.118	.148	.067
	KCMIL					
3	250	3,300	2.00	.114	.143	.065
4	250	4,240	2.28	.124	.155	.068
3	350	4,410	2.28	.143	.179	.079
4	350	5,795	2.56	.154	.193	.085
3	500	6,145	2.56	.157	.196	.086
4	500	7,910	2.83	.175	.219	.096
3	750	8,935	3.06	.185	.231	.102
4	750	11,770	3.50	.216	.270	.119

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

600V – con't.

STRANDED CU THHN/THWN WITH PVC JACKET

No. Of Conductors	AWG	WT. per 1,000 LF	Approx. O.D. Inches	Tray	WH's/LF Conduit O/H	Conduit U/G
2	16	48	.305	.015	.015	.012
3	16	60	.320	.016	.016	.012
4	16	72	.340	.018	.018	.014
5	16	89	.370	.020	.020	.015
7	16	117	.400	.022	.022	.017
9	16	148	.465	.023	.023	.018
10	16	165	.500	.024	.024	.018
12	16	180	.520	.026	.026	.020
15	16	244	.585	.029	.029	.022
19	16	285	.635	.032	.032	.025
20	16	310	.665	.034	.034	.026
24	16	360	.730	.038	.038	.029
30	16	426	.775	.045	.045	.035
37	16	570	.885	.051	.051	.039
50	16	730	1.027	.058	.058	.045
2	14	62	.325	.018	.018	.014
3	14	80	.345	.019	.019	.015
4	14	97	.380	.020	.020	.015
5	14	120	.410	.022	.022	.017
7	14	153	.445	.024	.024	.018
9	14	200	.515	.027	.027	.021
10	14	231	.595	.029	.029	.022
12	14	267	.610	.031	.031	.024
15	14	330	.675	.034	.034	.026
19	14	396	.710	.037	.037	.028
20	14	463	.745	.039	.039	.030
24	14	494	.825	.041	.041	.032
30	14	637	.915	.047	.047	.036
37	14	766	.980	.056	.056	.043
50	14	1,020	1.15	.064	.064	.049
60	14	1,200	1.21	.075	.075	.058

NOTE

1. For #18 AWG, multiply #16 AWG units by **0.93**.

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

600V – con't.

STRANDED CU XHHW WITH PVC JACKET

No. Of Conductors	AWG	WT. per 1,000 LF	Approx. O.D. Inches	Tray	WH's/LF Conduit O/H	Conduit U/G
2	12	77	.370	.019	.019	.015
3	12	110	.385	.020	.020	.015
4	12	139	.420	.023	.023	.018
5	12	165	.460	.025	.025	.019
7	12	217	.500	.028	.028	.022
9	12	297	.615	.031	.031	.024
10	12	324	.665	.034	.034	.026
12	12	377	.685	.038	.038	.029
15	12	480	.760	.041	.041	.032
19	12	568	.800	.044	.044	.034
20	12	642	.885	.045	.045	.035
25	12	850	1.08	.050	.050	.039
30	12	910	1.13	.057	.057	.044
37	12	1,100	1.20	.068	.068	.052
2	10	120	.440	.020	.020	.015
3	10	160	.450	.021	.021	.016
4	10	210	.515	.024	.024	.018
5	10	273	.570	.026	.026	.020
7	10	362	.620	.029	.029	.022
9	10	461	.730	.033	.033	.025
12	10	573	.810	.040	.040	.031
16	10	836	1.01	.044	.044	.034
19	10	920	1.12	.046	.046	.035
25	10	1,260	1.21	.053	.053	.041
30	10	1,525	1.32	.060	.060	.046
37	10	1,900	1.43	.071	.071	.055

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

600V – con't.

STRANDED CU VFD TYPE TC (XLPE) DUAL SHIELDED (FOIL & 85% TCB) WITH PVC JACKET AND GROUND WIRE

No. Of Conductors	AWG	WT. per 1,000 LF	Approx. O.D. Inches	Tray	WH's/LF Conduit O/H	Conduit U/G
3	16	140	0.49	.030	.035	.017
3	14	190	0.56	.033	.039	.019
3	12	250	0.60	.039	.046	.022
3	10	293	0.67	.040	.047	.022
3	8	409	0.91	.048	.056	.027
3	6	602	1.00	.056	.066	.032
3	4	898	1.15	.060	.071	.034
3	2	1,100	1.31	.071	.084	.040

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

5 KV

1/C STRANDED CU WITH PVC JACKET IN CONDUIT
100% OR 133% INSULATION LEVEL

	WH's/LF			
	SHIELDED		NON-SHIELDED	
AWG	O/H	U/G	O/H	U/G
8	.021	.016	.018	.014
6	.023	.017	.021	.016
4	.026	.020	.023	.017
2	.032	.024	.029	.022
1	.034	.026	.032	.024
1/0	.037	.028	.034	.026
2/0	.041	.031	.039	.029
3/0	.045	.034	.043	.032
4/0	.050	.038	.047	.035
KCMIL				
250	.055	.041	.051	.038
350	.066	.050	.061	.046
500	.079	.059	.073	.055
750	.096	.072	.088	.066
1000	.110	.083	.101	.076

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

5 KV – con't.

3/C STRANDED CU EPR UNARMORED WITH PVC JACKET AND GROUND WIRE
100% OR 133% INSULATION LEVEL

SHIELDED

AWG	WT. per 1,000 LF	Approx. O.D. Inches	Tray	WH's/LF Conduit O/H	Conduit U/G
4	1,015	1.20	.060	.060	.045
2	1,325	1.32	.067	.067	.050
1/0	1,920	1.52	.082	.082	.062
2/0	2,260	1.62	.090	.090	.068
4/0	3,270	1.92	.105	.105	.079
KCMIL					
250	3,740	2.01	.112	.112	.081
350	4,980	2.24	.127	.127	.091
500	6,595	2.52	.150	.150	.108
750	9,585	2.98	.180	.180	.130

NON-SHIELDED

AWG	WT. per 1,000 LF	Approx. O.D. Inches	Tray	WH's/LF Conduit O/H	Conduit U/G
4	1,010	1.28	.059	.059	.044
2	1,335	1.41	.066	.066	.050
1/0	1,865	1.58	.080	.080	.060
2/0	2,185	1.67	.088	.088	.066
4/0	3,235	1.96	.103	.103	.077
KCMIL					
250	3,670	2.06	.110	.110	.079
350	4,855	2.29	.124	.124	.089
500	6,625	2.59	.147	.147	.106
750	9,585	3.05	.176	.176	.127

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

5 KV – con't.

3/C STRANDED CU EPR C-L-X TYPE MV-90 ALUMINUM SHEATH WITH PVC JACKET AND GROUND WIRE
100% OR 133% INSULATION LEVEL

SHIELDED

AWG	WT. per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	Hung	Direct Burial
4	1,395	1.75	.066	.083	.038
2	1,690	1.75	.078	.098	.044
1/0	2,270	1.95	.092	.115	.052
2/0	2,650	2.16	.100	.125	.057
4/0	3,630	2.34	.114	.143	.065
KCMIL					
250	4,040	2.34	.128	.160	.070
350	5,340	2.56	.157	.196	.086
500	7,710	3.37	.171	.214	.094
750	10,510	3.62	.200	.250	.110

NON-SHIELDED

AWG	WT. per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	Hung	Direct Burial
4	1,095	1.45	.065	.081	.037
2	1,475	1.65	.076	.095	.043
1/0	2,005	1.78	.090	.113	.051
2/0	2,390	2.00	.098	.123	.056
4/0	3,315	2.14	.112	.140	.064
KCMIL					
250	3,790	2.28	.125	.156	.069
350	5,115	2.58	.154	.193	.085
500	6,850	3.03	.167	.209	.092
750	10,030	3.44	.196	.245	.108

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

5 KV – con't.

3/C STRANDED CU EPR GALVANIZED STEEL INTERLOCKED ARMOR TYPE MV-90 WITH PVC JACKET AND GROUND WIRE 100% OR 133% INSULATION LEVEL

SHIELDED

AWG	WT. per 1,000 LF	Approx. O.D. Inches	Tray	WH's/LF Hung	Direct Burial
4	1,460	1.49	.069	.086	.039
2	1,805	1.64	.082	.103	.047
1/0	2,395	1.83	.097	.121	.055
2/0	3,060	2.02	.105	.131	.060
4/0	3,985	2.20	.120	.150	.068
KCMIL					
250	4,635	2.27	.135	.169	.074
350	5,800	2.52	.165	.206	.091
500	7,920	2.81	.180	.225	.099
750	10,790	3.26	.210	.263	.116

NON-SHIELDED

AWG	WT. per 1,000 LF	Approx. O.D. Inches	Tray	WH's/LF Hung	Direct Burial
4	1,265	1.42	.068	.085	.039
2	1,630	1.58	.080	.100	.046
1/0	2,235	1.75	.095	.119	.054
2/0	2,755	1.94	.103	.129	.059
4/0	3,790	2.19	.118	.148	.067
KCMIL					
250	4,245	2.21	.132	.165	.073
350	5,375	2.47	.162	.203	.089
500	7,455	2.86	.176	.220	.097
750	10,510	3.21	.206	.258	.113

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

15 KV

1/C STRANDED CU WITH PVC JACKET IN CONDUIT SHIELDED

100% INSULATION LEVEL

	WH's/LF	
AWG	**O/H**	**U/G**
2	.041	.031
1	.044	.033
1/0	.048	.036
2/0	.052	.039
3/0	.056	.042
4/0	.061	.046
KCMIL		
250	.064	.048
350	.075	.056
500	.089	.067
750	.110	.083
1000	.123	.092

133% INSULATION LEVEL

	WH's/LF	
AWG	**O/H**	**U/G**
2	.042	.032
1	.045	.034
1/0	.049	.037
2/0	.053	.040
3/0	.057	.043
4/0	.062	.047
KCMIL		
250	.065	.049
350	.077	.058
500	.091	.068
750	.112	.084
1000	.125	.094

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

15 KV – con't.

3/C STRANDED CU EPR UNARMORED WITH PVC JACKET AND GROUND WIRE SHIELDED

100% INSULATION LEVEL

AWG	WT. per 1,000 LF	Approx. O.D. Inches	Tray	WH's/LF Conduit O/H	Conduit U/G
2	1,848	1.88	.075	.075	.056
1	2,064	1.96	.080	.080	.060
1/0	2,435	2.04	.088	.088	.066
2/0	2,787	2.13	.095	.095	.071
4/0	3,707	2.37	.110	.110	.083
KCMIL					
250	4,134	2.47	.118	.118	.085
350	4,863	2.69	.132	.132	.095
500	7,169	3.03	.162	.162	.117

133% INSULATION LEVEL

AWG	WT. per 1,000 LF	Approx. O.D. Inches	Tray	WH's/LF Conduit O/H	Conduit U/G
1	2,353	2.16	.082	.082	.062
1/0	2,724	2.25	.090	.090	.068
2/0	2,988	2.35	.097	.097	.073
4/0	4,050	2.58	.112	.112	.084
KCMIL					
250	4,490	2.77	.120	.120	.086
350	5,932	2.99	.135	.135	.097
500	7,568	3.33	.165	.165	.119

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

15 KV – con't.

3/C STRANDED CU EPR C-L-X TYPE MV-90 ALUMINUM SHEATH WITH PVC JACKET AND GROUND WIRE SHIELDED

100% INSULATION LEVEL

AWG	WT. per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	Hung	Direct Burial
2	2,170	2.14	.086	.108	.049
1	2,490	2.28	.092	.115	.052
1/0	2,785	2.32	.100	.125	.057
2/0	3,230	2.44	.106	.133	.060
4/0	4,405	2.83	.128	.160	.073
KCMIL					
250	4,900	2.83	.143	.179	.079
350	6,500	3.25	.171	.214	.094
500	8,685	3.50	.185	.231	.102
750	11,840	4.20	.220	.275	.121

133% INSULATION LEVEL

AWG	WT. per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	Hung	Direct Burial
2	2,650	2.46	.088	.110	.051
1	2,965	2.56	.095	.119	.054
1/0	3,260	2.56	.103	.129	.059
2/0	3,710	2.83	.109	.136	.062
4/0	4,875	3.03	.132	.165	.075
KCMIL					
250	5,535	3.15	.147	.184	.081
350	7,060	3.44	.176	.220	.097
500	9,170	3.96	.191	.239	.105
750	12,415	4.37	.227	.284	.125

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

15 KV – con't.

3/C STRANDED CU EPR GALVANIZED STEEL INTERLOCKED ARMOR TYPE MV-90 WITH PVC JACKET AND GROUND WIRE SHIELDED

100% INSULATION LEVEL

AWG	WT. per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	Hung	Direct Burial
2	2,575	2.05	.090	.113	.051
1	2,905	2.14	.097	.121	.055
1/0	3,240	2.23	.105	.131	.060
2/0	3,640	2.32	.112	.140	.064
4/0	4,865	2.59	.135	.169	.077
KCMIL					
250	5,430	2.71	.150	.188	.083
350	6,890	2.98	.180	.225	.099
500	8,910	3.28	.195	.244	.071
750	12,210	3.73	.232	.290	.128

133% INSULATION LEVEL

AWG	WT. per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	Hung	Direct Burial
2	3,105	2.28	.093	.116	.053
1	3,300	2.34	.100	.125	.057
1/0	3,735	2.47	.108	.135	.062
2/0	4,270	2.56	.115	.144	.066
4/0	5,420	2.79	.139	.174	.079
KCMIL					
250	6,010	2.96	.155	.194	.085
350	7,475	3.21	.185	.231	.102
500	9,470	3.48	.210	.251	.111
750	12,835	3.93	.239	.299	.131

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

35 KV

1/C STRANDED CU WITH PVC JACKET IN CONDUIT SHIELDED

100% INSULATION LEVEL

	WH's/LF	
AWG	**O/H**	**U/G**
1/0	.060	.042
2/0	.065	.046
3/0	.070	.049
4/0	.076	.053
KCMIL		
250	.080	.056
350	.090	.063
500	.107	.075
750	.132	.092
1000	.148	.104

133% INSULATION LEVEL

	WH's/LF	
AWG	**O/H**	**U/G**
1/0	.061	.043
2/0	.066	.047
3/0	.071	.050
4/0	.078	.055
KCMIL		
250	.082	.057
350	.092	.064
500	.109	.076
750	.135	.095
1000	.151	.106

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

35 KV – con't.

3/C STRANDED CU EPR C-L-X TYPE MV-90 ALUMINUM SHEATH WITH PVC JACKET AND GROUND WIRE SHIELDED

100% INSULATION LEVEL

AWG	WT. per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	Hung	Direct Burial
1/0	4,605	3.34	.126	.158	.069
2/0	5,035	3.42	.137	.171	.075
4/0	6,450	3.81	.160	.200	.088
KCMIL					
250	7,095	3.85	.168	.207	.092
350	8,585	4.20	.185	.231	.096
500	10,635	4.45	.219	.274	.114

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

69 KV

1/C STRANDED CU WITH PVC JACKET IN CONDUIT SHIELDED

100% INSULATION LEVEL

	WH's/LF	
AWG	**O/H**	**U/G**
1/0	.076	.052
2/0	.082	.056
3/0	.087	.059
4/0	.094	.063
KCMIL		
250	.097	.065
350	.105	.071
500	.125	.085
750	.155	.104
1000	.172	.116

133% INSULATION LEVEL

	WH's/LF	
AWG	**O/H**	**U/G**
1/0	.078	.053
2/0	.084	.058
3/0	.089	.061
4/0	.097	.066
KCMIL		
250	.100	.067
350	.109	.072
500	.128	.086
750	.160	.109
1000	.177	.120

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

13. WIRE & CABLE – con't.

69 KV – con't.

3/C STRANDED CU EPR C-L-X TYPE MV-90 ALUMINUM SHEATH WITH PVC JACKET AND GROUND WIRE SHIELDED

100% INSULATION LEVEL

AWG	WT. per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	WH's/LF Hung	WH's/LF Direct Burial
1/0	6,654	4.52	.152	.190	.080
2/0	7,275	4.62	.165	.206	.087
4/0	9,320	5.15	.193	.241	.102
KCMIL					
250	10,252	5.21	.203	.249	.107
350	12,405	5.68	.223	.278	.112
500	15,367	6.02	.264	.330	.132

ECONOMIES OF SCALE FOR WIRE & CABLE

If more than **three** wires at a time are being pulled, deduct the following percentages from the labor of that grouping:

4-5 wires	**25%**
6-10 wires	**30%**
11-15 wires	**35%**
over 15 wires	**40%**

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

14. CABLE TESTING

HIGH POT	WH/CONDUCTOR
600V	1.0
5 & 15KV	2.0

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

15. TERMINATION KITS

CROSS-LINKED POLY, BUTYL OR OTHER RUBBER-LIKE INSULATED CABLE

SINGLE CONDUCTOR

AWG	5KV	15KV	35KV
8	1.5	1.8	5.0
6	1.7	2.0	5.0
4	1.8	2.2	5.0
2	2.1	2.5	5.0
1	2.3	2.8	6.0
1/0	2.4	2.9	6.0
2/0	2.6	3.1	6.0
3/0	2.8	3.4	7.0
4/0	3.0	3.6	7.0
KCMIL			
250	3.3	4.0	7.0
350	3.5	4.2	7.0
500	3.8	4.6	7.0
750	4.1	4.9	9.0
1000	4.4	5.3	9.0

THREE CONDUCTOR

AWG	5KV	15KV	35KV
8	3.0	3.6	10.0
6	3.4	4.0	10.0
4	3.6	4.4	10.0
2	4.2	5.0	10.0
1	4.6	5.6	12.0
1/0	4.8	5.8	12.0
2/0	5.2	6.2	12.0
3/0	5.6	6.8	14.0
4/0	6.0	7.2	14.0
KCMIL			
250	6.6	8.0	14.0
350	7.0	8.4	14.0
500	7.6	9.2	14.0
750	8.2	9.8	18.0
1000	8.8	10.6	18.0

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

15. TERMINATION KITS – con't.

MOTOR TERMINATIONS (PIGTAIL)

3 WIRE, THREE PHASE

HP	600V
5 and below	1.55
7.5	1.65
10	1.75
15	1.85
20	2.00
25	2.25
30	2.50
40	2.75
50	3.00
60	3.50
75	4.00
100	5.00
125	6.25
150	7.50
200	9.00

NOTE

1. Units shown include lugs and hardware.

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

16. SPLICE KITS

CROSS-LINKED POLY, BUTYL OR OTHER RUBBER-LIKE INSULATED CABLE

SINGLE CONDUCTOR

AWG	5KV	15KV	35KV
8	3.0	3.6	8.0
6	3.0	3.6	8.0
4	3.0	3.6	8.3
2	3.5	4.2	8.8
1	3.5	4.2	9.0
1/0	3.5	4.2	9.5
2/0	4.5	5.4	9.8
3/0	4.5	5.4	10.0
4/0	4.5	5.4	11.0
KCMIL			
250	5.0	6.0	12.0
350	5.0	6.0	13.0
500	5.0	6.0	14.0
750	6.5	7.8	15.0
1000	8.0	9.6	16.0

THREE CONDUCTOR

AWG	5KV	15KV	35KV
8	6.0	7.2	16.0
6	6.0	7.2	16.0
4	6.0	7.2	16.5
2	7.0	8.4	17.5
1	7.0	8.4	18.0
1/0	7.0	8.4	18.5
2/0	9.0	10.8	19.0
3/0	9.0	10.8	20.0
4/0	9.0	10.8	22.0
KCMIL			
250	10.0	12.0	24.0
350	10.0	12.0	26.0
500	10.0	12.0	28.0
750	13.0	15.6	30.0
1000	16.0	19.2	32.0

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

17. CABLE TERMINATOR

UNARMORED CABLE

MALE THREAD SIZE	CABLE O.D. RANGE IN INCHES	NON-HAZARDOUS
½"	0.125-0.625	0.5
¾"	0.625-0.750	0.7
1"	0.750-1.000	1.0
1 ¼"	1.000-1.188	1.2
1 ½"	1.188-1.375	1.5
2"	1.375-1.875	2.0
2 ½"	1.875-2.188	2.5
3"	2.188-2.500	3.5
3 ½"	2.500-3.000	4.0
4"	3.000-3.500	4.5
5"	3.500-4.250	5.0

ARMORED AND ALUMINUM SHEATHED CABLE

MALE THREAD SIZE	CABLE O.D. RANGE IN INCHES	NON-HAZARDOUS	CLASS I-DIV. II
½"	0.625-0.875	0.8	1.4
¾"	0.625-0.875	1.1	1.7
1"	0.750-1.000	1.7	2.4
1 ¼"	1.000-1.375	2.2	3.0
1 ½"	1.375-1.625	2.2	3.1
2"	1.625-1.875	3.3	4.3
2 ½"	1.875-2.188	4.4	5.6
3"	2.188-2.500	5.5	6.9
3 ½"	2.500-3.000	6.6	8.3
4"	3.000-3.500	7.7	9.7
5"	3.500-4.250	8.8	11.8

NOTE

1. Cable Terminator for Class I – Div. II includes seal.

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

18. ENCLOSURES

NEMA TYPE 12

SIZE	WH's
6 x 4 x 4	1.0
6 x 6 x 4	1.0
8 x 6 x 4	1.3
8 x 8 x 4	1.3
10 x 8 x 4	1.4
10 x 10 x 4	1.4
12 x 6 x 4	1.4
12 x 8 x 4	1.4
12 x 10 x 4	1.4
12 x 12 x 4	1.6
16 x 12 x 4	1.8
18 x 12 x 4	2.5
18 x 16 x 4	4.0
6 x 6 x 6	1.0
8 x 8 x 6	1.3
10 x 8 x 6	1.4
10 x 10 x 6	1.6
12 x 8 x 6	1.6
12 x 10 x 6	2.3
12 x 12 x 6	2.3
16 x 12 x 6	2.3
16 x 16 x 6	2.3
18 x 12 x 6	2.9
18 x 16 x 6	2.9
18 x 18 x 6	2.9
24 x 18 x 6	3.6
24 x 24 x 6	3.6
30 x 20 x 6	3.7
30 x 24 x 6	4.0
36 x 30 x 6	4.2

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

18. ENCLOSURES – con't.

NEMA TYPE 12 – con't.

SIZE	WH's
16 x 12 x 8	2.3
20 x 12 x 8	2.9
20 x 16 x 8	2.9
20 x 20 x 8	3.2
24 x 12 x 8	2.9
24 x 16 x 8	2.9
24 x 24 x 8	3.7
30 x 20 x 8	3.7
30 x 24 x 8	4.2
36 x 24 x 8	4.3
36 x 30 x 8	5.2
42 x 24 x 8	4.6
42 x 30 x 8	6.3
42 x 36 x 8	8.1
48 x 30 x 8	7.2
48 x 36 x 8	8.1

NEMA TYPE 3 & 3R

SIZE	WH's
6 x 6 x 4	1.1
8 x 8 x 4	1.3
10 x 10 x 6	1.7
12 x 12 x 6	2.4
18 x 12 x 6	2.7
18 x 18 x 8	3.0
24 x 18 x 8	3.5
24 x 24 x 8	4.0
30 x 18 x 10	4.0
30 x 30 x 10	5.0
36 x 24 x 10	5.0
36 x 36 x 10	8.0

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

18. ENCLOSURES – con't.

NEMA TYPE 4X

SIZE	WH's
6 x 6 x 4	1.5
8 x 8 x 4	2.5
10 x 10 x 6	3.0
12 x 12 x 6	3.5
18 x 12 x 6	5.0
30 x 24 x 6	19.0
18 x 18 x 8	9.0
24 x 18 x 8	12.0
24 x 24 x 8	16.0

NEMA TYPE 7 – CLASS I, GROUP D

SIZE	WH's
6 x 6 x 4	2.3
8 x 8 x 4	2.9
10 x 10 x 6	3.8
12 x 12 x 6	4.2
18 x 12 x 6	7.0
30 x 18 x 6	18.0
18 x 18 x 8	9.9
24 x 18 x 8	11.8
24 x 24 x 8	17.7
30 x 24 x 8	21.0

FLUOR

ELECTRICAL UNIT WORK HOURS

C. POWER FEEDERS AND MOTOR RUNS – con't.

18. ENCLOSURES – con't.

NEMA TYPE 9 – CLASS II, GROUP E, F & G

SIZE	WH's
8 x 4 x 4	1.5
8 x 6 x 4	1.8
10 x 8 x 4	2.0
10 x 10 x 6	2.5
12 x 10 x 6	2.7
12 x 12 x 6	3.0
16 x 12 x 6	3.5
16 x 16 x 6	5.0
12 x 12 x 8	3.2
16 x 12 x 8	4.0
20 x 16 x 8	7.0
20 x 20 x 8	8.0
24 x 20 x 8	10.0
24 x 24 x 10	12.0
30 x 24 x 10	14.0
36 x 24 x 10	17.0
36 x 30 x 12	20.0
48 x 36 x 12	24.0

CONDUIT OUTLET BOXES

DESCRIPTION	WH's
4" SQ x 2 1/8" Box – Steel w/ Flat Cover	0.5
4-11/16" SQ x 2 1/8" Box – Steel w/ Flat Cover	0.8
¾" x 3 1/8" Box – "GRFX" Feraloy w/ Cover & Gasket	2.2
1" x 3 1/8" Box – "GRFX" Feraloy w/ Cover & Gasket	2.5
¾" x 3 1/8" Box – "GRFX" Aluminum w/ Cover & Gasket	2.0
1" x 3 1/8" Box – "GRFX" Aluminum w/ Cover & Gasket	2.3

NOTES

1. For NEMA Type 1 units, multiply NEMA Type 12 units by **0.87**.
2. Conduit terminations at enclosure included in hub/bushing work hour units.
3. Supports not included.

FLUOR

ELECTRICAL UNIT WORK HOURS

D. LIGHTING

19. FIXTURES

INCANDESCENT	WH's
Pendant Mount – Vaportite	1.8
Stanchion Mount – Vaportite	2.0
Pendant Mount – Explosion Proof	2.2
Wall Mount – Weatherproof	1.6
Surface Mount	1.6
Recessed	2.2
Tower Beacon	4.5
Obstruction Marker	
Single fixture	3.0
Double Fixture	4.0
Strobe & Controller	40.0

NOTE

1. Unit work hours for Tower Beacon, Obstruction Markers and Strobe & Controller are based on installation at grade in horizontal position (cribbed).

FLUORESCENT	WH's
Ceiling or Pendant Mount	
Commercial:	
1-2 Tube	2.0
3-4 Tube	2.5
Industrial:	
1-2 Tube	2.5
3-4 Tube	3.0
Recessed	
Commercial:	
1-2 Tube	2.5
3-4 Tube	3.0
Industrial:	
1-2 Tube	3.0
3-4 Tube	3.5

FLUOR

ELECTRICAL UNIT WORK HOURS

D. LIGHTING – con't.

19. FIXTURES – con't.

MERCURY VAPOR/ HIGH PRESSURE SODIUM/ METAL HALIDE	**WH's**
Pendant Mount – Vaportite (250W Max)	2.1
Ceiling Mount – Vaportite (250W Max)	2.1
Wall Mount – Throughfeed – Vaportite (250W Max)	2.0
Stanchion Mount – Vaportite (250W Max)	2.2
Pendant Mount – Explosion Proof (250W Max)	3.0
Stanchion Mount – Explosion Proof (250W Max)	3.0
Low Bay (250W Max)	2.7
High Bay:	
Single Lamp (400W Max)	3.0
Twin Lamp (400W Max)	4.5
Single Lamp (1000W Max)	4.0
Floodlight:	
400W Max	4.0
1000W Max	7.0
Street Lighting (400W Max)	4.0

NOTES

1. For clean room fixtures, add **20%**.
2. Fixture work hours include lamp.

FLUOR

ELECTRICAL UNIT WORK HOURS

D. LIGHTING – con't.

20. POLES, BRACKETS & MISC

POLES	WH's
Steel and Aluminum – 40 Foot Max	12.0

BRACKETS	WH's
Steel Pole Top for Floodlights	
2 and 3	1.0
4	2.0
Wood Pole Mounting for Floodlights	
1	2.0
2	3.0
3	4.0
4	5.0
Upsweep Steel Pole Top Mounting for Streetlight	
4 Feet Long	3.0
6 feet long	4.0
8 feet long	5.0
Upsweep Steel Pole Side Mounting for Streetlight	
4 Feet Long	3.0
6 feet long	4.0
8 feet long	5.0
10 feet long	6.0
Upsweep Wood Pole Mounting for Streetlight	
4 Feet Long	3.0
6 feet long	4.0
8 feet long	5.0

MISC	WH's
Photo Electric Control and Mounting Bracket	4.0

NOTE

1. For wood pole setting, see Pole Line section.

FLUOR

ELECTRICAL UNIT WORK HOURS

D. LIGHTING – con't.

21. WIRING DEVICES

RECEPTACLES	**WH's**
Convenience	
125V, 15A, Single & Duplex	0.5
125V, 20A, Single	0.5
125/250V, 50A, Single	1.0
125/250V, 20A, Single, Explosion Proof	2.5
Power	
480V, 60A, Explosion Proof	3.0
Welding	
480V, 60A	4.0
Plate Cover	0.1

SWITCHES	**WH's**
Single Pole Toggle, 120/277V, 20A	0.5
Double Pole Toggle, 120/277V, 20A	1.0
3-Way Toggle, 120/277V, 20A	0.7
Tumbler, 120/277V, 20A, Explosion Proof	1.5

CONTACTORS

For lighting and heating – NEMA 1 Enclosed, up to 600V

Amps	**2 Pole**	**3 Pole**	**4 Pole**	**6 Pole**	**8 Pole**
20	1.6	1.8	2.0	2.4	2.8
30	1.8	2.0	2.2	2.6	3.0
60	2.8	3.2	3.6	--	4.0
100	3.8	4.2	4.6	--	--
200	5.0	5.5	6.0	--	--
300	7.0	8.0	--	--	--
400	9.0	10.0	--	--	--

FLUOR

ELECTRICAL UNIT WORK HOURS

D. LIGHTING – con't.

21. WIRING DEVICES – con't.

GANG BOXES

Iron FS and FD threaded

Item	1-Gang	2-Gang	3-Gang
½" One Hub	0.60	0.65	0.70
¾" One Hub	0.70	0.75	0.80
1" One Hub	0.85	0.90	0.95
½" Two Hubs	0.80	0.85	0.90
¾" Two Hubs	0.95	1.00	1.05
1" Two Hubs	1.15	1.20	1.25
½" Three Hubs	1.00	1.05	1.10
¾" Three Hubs	1.20	1.25	1.30
1" Three Hubs	1.45	1.50	1.55
½" Four Hubs	1.20	---	---
¾" Four Hubs	1.45	---	---
1" Four Hubs	1.75	---	---

FLUOR

ELECTRICAL UNIT WORK HOURS

D. LIGHTING – con't.

22. EMERGENCY & EXIT LIGHTING

EMERGENCY FIXTURES	WH's
Remote	
Single Head	0.60
Double Head	0.70
Power Pack	
36 Watt	0.95
54 Watt	1.05
80 Watt	1.15
110 Watt	1.25
160 Watt	1.45
200 Watt	1.65
Surface Mounted	
36 Watt	1.10
54 Watt	1.30
80 Watt	1.40
110 Watt	1.50
160 Watt	1.70
200 Watt	1.90

EXIT FIXTURES	WH's
1 Face	
Surface Mounted	0.75
Pendant Mounted	0.81
2 Face	
Surface Mounted	0.85
Pendant Mounted	0.90
Low Level	
Slave Type	
Surface Mounted	0.80
Recessed	0.90
Self-Powered	
Surface Mounted	0.90
Recessed	1.05

FLUOR

ELECTRICAL UNIT WORK HOURS

D. LIGHTING – con't.

23. BOLLARD & LANDSCAPE LIGHTING

BOLLARD LIGHTS (Round or Square)	36" HIGH	42" HIGH
Incandescent up to 150 Watt	1.40	1.45
HID 35-50 Watt	2.10	2.10
HID 70-100 Watt	2.25	2.30
HID 150 Watt	2.35	2.45
Fluorescent		
1-PL26	1.20	1.65
2-PL26	1.30	1.75

LANDSCAPE FIXTURES	WH's
Low Voltage and 120V	
Recessed in ground	
50 Watt	1.67
100 Watt	1.77
200 Watt	1.97
Spike Mounted	0.40
J-Box Mounted	0.99
Post Mounted Incandescent	
1-Lamp Sphere	1.57
2-Lamp Sphere	1.72
4-Lamp Sphere	1.97
Post Mounted HID Fixtures	
300 Watt	1.97
500 Watt	2.36
1000 Watt	2.96

NOTE

1. Post-mounted landscape fixtures do not include the post.

FLUOR

ELECTRICAL UNIT WORK HOURS

E. GROUNDING

ITEM	WH's/EA
Copper Weld Ground Rod	
(½", 5/8" or ¾" diameters)	
8 feet long	2.00
10 feet long	2.25
Ground Rod Clamp	
(½", 5/8" or ¾" diameters)	0.75
Cadweld Connections (Exothermic Welds)	
2 Bus	1.25
3 Bus	1.50
4 Bus	1.75
Rail to Rail Bond (Railroad)	2.00

Bare Copper Wire

AWG	WH's/LF
12	0.008
10	0.011
8	0.012
6	0.015
4	0.017
2	0.018
1	0.019
1/0	0.022
2/0	0.023
3/0	0.025
4/0	0.032
KCMIL	
250	0.038
300	0.043
350	0.047
400	0.050
500	0.054
600	0.059
750	0.068

NOTES

1. The above Cadweld connection units include mold, mold handles and charge.
2. The above bare copper wire units are for installation in a trench only.
3. The above bare copper wire units reflect the main grounding electrode system. Where short runs are required the units must be increased. Also increase units for grounding installed other than in trench, i.e., cable tray, exposed along building wall, etc.

FLUOR

ELECTRICAL UNIT WORK HOURS

F. INSTRUMENT WIRING

600V AND BELOW	WH's/LF O/H	U/G
Wire – Stranded CU		
1/C #12/14	.009	.007
Instrument Cable – Stranded CU		
PVC Unshielded w/ PVC Jacket		
1-PR #16/#18	.018	.014
1-TR #16/#18	.020	.015
PVC Shielded w/ Drain Wire & PVC Jacket		
1-PR #16/#18	.020	.015
1-TR #16/#18	.023	.018
Thermocouple – Type JX/KX/TX		
1-PR #16/#18	.018	.014

Wire Termination	WH's/EA
1/C #12/#14/#16/#18/#20	.20
1-PR #16/#18 Unshielded	.32
1-PR #16/#18 Shielded	.40
1-TR #16/#18 Unshielded	.40
1-TR #16/#18 Shielded	.50

FLUOR

ELECTRICAL UNIT WORK HOURS

F. INSTRUMENT WIRING – con't.

MULTI-PAIR CABLE – THERMOCOUPLE EXTENSION WIRE

PVC INSULATED – OVERALL SHIELD – PVC JACKET

20 GAUGE TWISTED PAIRS

No. Of Pairs	WT. Per 1,000 LF	Approx. O.D. Inches	WH's/LF O/H	WH's/LF U/G
4	78	0.360	.022	.017
8	140	0.470	.028	.021
10	173	0.490	.030	.023
12	190	0.540	.033	.025
16	251	0.620	.040	.031
20	301	0.650	.047	.037
24	355	0.730	.049	.038
36	492	0.840	.058	.045
50	680	0.970	.064	.049

PVC INSULATED – SHIELDED PAIRS – OVERALL SHIELD - PVC JACKET

20 GAUGE TWISTED PAIRS

No. Of Pairs	WT. Per 1,000 LF	Approx. O.D. Inches	WH's/LF O/H	WH's/LF U/G
4	127	0.500	.025	.020
8	234	0.685	.033	.025
12	347	0.860	.038	.029
16	417	0.950	.047	.037
20	528	1.030	.055	.043
24	588	1.130	.058	.045
36	857	1.325	.066	.051

FLUOR

ELECTRICAL UNIT WORK HOURS

F. INSTRUMENT WIRING – con't.

MULTI-PAIR CABLE – THERMOCOUPLE EXTENSION WIRE – con't.

PVC INSULATED – OVERALL SHIELD – PVC INNER & OUTER JACKET INTERLOCKED ARMOR

18 GAUGE TWISTED PAIRS

No. Of Pairs	WT. Per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	WH's/LF Direct Burial
4	265	0.750	.033	.020
8	465	1.140	.041	.025
12	530	1.250	.051	.030
16	725	1.360	.060	.036
20	820	1.460	.070	.043
24	980	1.560	.074	.044
36	1,330	1.790	.086	.052

PVC INSULATED – SHIELDED PAIRS - OVERALL SHIELD – PVC INNER & OUTER JACKET - INTERLOCKED ARMOR

18 GAUGE TWISTED PAIRS

No. Of Pairs	WT. Per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	WH's/LF Direct Burial
4	314	0.720	.038	.023
8	457	0.833	.051	.030
12	575	1.010	.056	.035
16	682	1.072	.070	.043
24	942	1.280	.086	.052
36	1,182	1.430	.099	.060

FLUOR

ELECTRICAL UNIT WORK HOURS

F. INSTRUMENT WIRING – con't.

MULTI-PAIR CABLE – ELECTRONIC INSTRUMENT TYPE

PVC INSULATED – OVERALL SHIELD – PVC JACKET

18 GAUGE TWISTED PAIRS

No. Of Pairs	WT. Per 1,000 LF	Approx. O.D. Inches	WH's/LF O/H	WH's/LF U/G
4	120	0.510	.025	.020
8	221	0.660	.030	.023
12	320	0.780	.037	.029
16	381	0.850	.045	.035
24	590	1.050	.055	.043
36	820	1.230	.063	.048
50	950	1.320	.067	.052

PVC INSULATED – SHIELDED PAIRS – OVERALL SHIELD - PVC JACKET

18 GAUGE TWISTED PAIRS

No. Of Pairs	WT. Per 1,000 LF	Approx. O.D. Inches	WH's/LF O/H	WH's/LF U/G
4	152	0.520	.029	.022
6	216	0.660	.033	.025
8	274	0.720	.037	.029
10	325	0.805	.040	.031
12	370	0.850	.041	.032
16	495	0.960	.052	.040
20	585	1.085	.061	.047
24	670	1.210	.063	.048
36	1,120	1.400	.072	.056
50	1,190	1.540	.082	.063

FLUOR

ELECTRICAL UNIT WORK HOURS

F. INSTRUMENT WIRING – con't.

MULTI-PAIR CABLE – ELECTRONIC INSTRUMENT TYPE – con't.

PVC INSULATED – OVERALL SHIELD – PVC INNER & OUTER JACKET INTERLOCKED ARMOR

18 GAUGE TWISTED PAIRS

No. Of Pairs	WT. Per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	WH's/LF Direct Burial
4	279	0.692	.038	.023
8	359	0.786	.045	.026
12	446	0.895	.055	.033
16	566	1.010	.068	.040
24	697	1.110	.083	.049
36	925	1.280	.094	.056

PVC INSULATED – SHIELDED PAIRS - OVERALL SHIELD – PVC INNER & OUTER JACKET - INTERLOCKED ARMOR

18 GAUGE TWISTED PAIRS

No. Of Pairs	WT. Per 1,000 LF	Approx. O.D. Inches	WH's/LF Tray	WH's/LF Direct Burial
4	304	0.720	.043	.025
8	404	0.833	.055	.033
12	563	1.010	.062	.037
16	646	1.072	.077	.046
24	856	1.280	.094	.056
36	1,106	1.430	.108	.064

NOTES

1. U/G units are for pulling cable in conduit only.
2. For 16-gauge wire, add **9%** to 18-gauge units.

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS

24. FIBER OPTICS

PULL/INSTALL	WH's/LF
Up to 12-Fiber	.010
24-Fiber	.014
Innerduct	
1"	.03
1 ½"	.05
2"	.08

CONNECTIONS	WH's/EA
ST Coupling	.05
ST/SC Anarobic Connector	.10
Hot Melt Connector	.60
Up to 48 Port LIU	1.0
Connector Panel 10A	.05
24 Port Rack Mount	1.0
72 Port Rack Mount	2.0
3m Simplex Jumpers ST/ST	.10
3m Duplex Jumpers ST/ST	.10

MISCELLANEOUS	WH's/EA
Wire Management	1.0
Fanout of Fiber – Outdoor 6 strands	.75
Splices –	
Fusion	.30
Mechanical	.40
Array Splice	1.0
Encased (buried)	1.2
Terminations –	
Polishing required	.40
No polishing required	.30
FDDI Dual Connectors	.80
Test –	
Power Meter or OTDR (Optical Time Domain Reflectometer)	.12

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS – con't.

25. UNSHIELDED TWISTED PAIR (UTP) CABLE

PULL/INSTALL	WH's/LF
4 Pair CAT 3	.010
25 Pair CAT 3	.015
50 Pair CAT 3	.030
100 Pair CAT 3	.040
4 Pair CAT 5 PVC	.010
4 Pair CAT 5 Plenum	.015

BLOCKS	WH's/EA
All 110 Block w/ connector	1.0
Protection Modules	.05

JACKS	WH's/EA
RJ 11 Jack	.10
RJ 45 Jack	.20
Fiber Module	.01

PATCH PANELS	WH's/EA
CAT 5 Patch Block	1.0
Low Profile Cable Management	1.0

CONNECTORS	WH's/EA
In-line Couplers	.10
Male/Female Adapters	.20
3' CAT 5 Patch Cord	.05
25' CAT 5 Patch Cord	.10

TERMINATIONS	WH's/EA
Crossconnects/Pair	.10
4 Pair Terminate	.20
25 Pair Terminate	.50
50 Pair Terminate	1.0
100 Pair Terminate	1.5
4 Pair Continuity Test	.12
CAT 5 Test – 4 Pair LAN Certification	.25
25 Pair Continuity Test	.50
50 Pair Continuity Test	.80
100 Pair Continuity Test	1.7

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS – con't.

26. TELEPHONE EXCHANGE CABLE

TYPE PE 22 OSP CU

22 GAUGE TWISTED PAIRS

No. Of Pairs	WT. Per 1,000 LF	Approx. O.D. Inches	WH's/LF O/H
25	199	0.62	.042
50	340	0.79	.049
100	625	1.06	.071
200	1,160	1.41	.103
300	1,745	1.73	.127
600	3,320	2.39	.184
900	3,865	2.83	.225

TERMINATIONS	WH's/EA
25 pair groups/binders	.50

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS – con't.

27. SHIELDED (COAXIAL) CABLE

PULL/INSTALL	WH's/LF
2C Shielded 18ga	.010
RG Coaxial	.012

TERMINATIONS	WH's/EA
Coaxial	.10
RCA Connector	.20

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS – con't.

28. COMPUTER EQUIPMENT

HARDWARE	WH's/EA
Computer Processor only	1.0
Processor and Monitor	1.5
External Modem	.60
Desktop Scanner	1.0
External Tape Backup	.80
Bar Code Reader, hand-held	1.0
Printers	1.2
A/B Printer Switch	1.0
Plotter	3.0
Modular Cables	.20

NETWORK DEVICES	WH's/EA
Network Interface Card	1.0
LAN Hub Concentrator	2.0
Multiplexer	2.5
Bridge	4.0
Router	4.0
WAN Interface Card	4.0
Repeater	4.0

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS – con't.

29. SURVELLIENCE EQUIPMENT

GENERAL	WH's/EA
Video Camera	.80
Power Bracket	.50
Camera Control unit	.80
Standard Mounting	.60
Swivel Camera Mount	.70
Tamper-proof Mounting	1.5
Automatic Pan Mounting	1.5
Add or Replace Lens	.40

CAMERA LENSES	WH's/EA
Fixed	.25
Auto Iris	.60
Zoom	.60

CAMERA & ENCLOSURE	WH's/EA
Mount Indoor Light Duty	.75
Mount Indoor Heavy Duty	1.0
Mount Outdoor Light Duty	1.5
Mount Outdoor Heavy Duty	2.0
Parapet Mount	3.5
Pole Mount 20 ft. max	4.0
Mount-corner	1.5
Pan/Tilt Indoor Heavy Duty	2.0
Pan/Tilt Indoor Light Duty	1.5
Pan/Tilt Outdoor Heavy Duty	4.0
Pan/Tilt Outdoor Light Duty	3.5
Enclosure Dome Surface Mount	1.2
Enclosure Dome Ceiling Drop-in	1.5
Enclosure Dust-tight	1.5
Heater	.50
Blower	.25
Sun-shroud	.50
Wiper	.50

MONITORS	WH's/EA
9" Monitor	.90
12" Monitor	1.0
15" Monitor	1.1
19" Monitor	1.2
Monitor Mounting Bracket	1.0

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS – con't.

29. SURVELLIENCE EQUIPMENT – con't.

SWITCHES & SEQUENCERS	WH's/EA
4 Camera Switch, manual	1.2
8 Camera Switch, manual	1.5
4 Camera Sequencer	1.5
8 Camera Sequencer	1.8

MISCELLANEOUS	WH's/EA
Alarm Interface	6.0
Amplifier	1.2
Antenna	8.0
Coax Surge Suppressor	.75
Console	6.0
Coupler	.60
Digital Motion Detector	.50
Head End Equipment	6.0
Joy Stick	.75
Pan/Tilt Lens Zoom Control	2.3
Playback VCR	1.0
Power Supply	2.0
Programming per Channel	.25
Satellite Receiver – 4'	10.0
Satellite Receiver – 6'	12.0
Satellite Receiver – 8'	16.0
Screen Splitter	.60
Splitter	.60
Time Lapse Video Recorder	3.2
Time/Date/Character Generator	1.0
Video Motion Detector	1.0
Video Multiplexer 16 Channel	4.0
Video Processor 4 Inputs	1.3

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS – con't.

30. TELEPHONE EQUIPMENT

INSTALL	WH's/EA
Desk Phone (single or multi line)	.20
Central Console	1.5

	WH's/EA	
PROGRAMMING	SMALL SYSTEM	LARGE SYSTEM
Phone or Port*	2.0	3.0
Voice Mail per mail box	1.5	1.5
System Cards	2.0	4.0
System Cabinet	4.0	8.0

* A port can be voice lines, telephone lines or misc. lines.

PAGING SYSTEM	WH's/EA
Interface w/ phone system	4.0

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS – con't.

31. ACCESS CONTROL

CONTROL PANEL	WH's/EA
CPU/Computer	2.0
Input/Output Modem	2.0
Power Supply	2.0
Batteries	2.0
Software Load	4.0
Programming	16.0
Stand-alone Card Reader/ Controller/Door Strike	8.0
Reader Controller	2.0
2-Reader Control Panel	3.0
4-Reader Control Panel	4.0
8-Reader Control Panel	5.0

CARD READERS	WH's/EA
Card Reader, post mounted	1.0
Card Reader, wall mounted	.80
Palmprint Identifier	5.0
Proximity-card Reader unit	1.0
Remote Intercom unit	2.0
Swipe-card Reader unit	1.0
Telephone Door Security	10.0

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS – con't.

31. ACCESS CONTROL – con't.

DOOR DEVICES	WH's/EA
Bell/Horn	1.0
Door Closer	2.0
Door Contacts	.50
Door Lock Protector	1.0
Door Strike	3.0
Electric Door Strike –	
Replace existing non-electric	1.0
Install in door w/ none in place	2.5
Request-to-exit motion detector	1.0
Electric Hinge	2.0
Electric Mortise Lock, new	2.0
Electric Mortise Lock, refit	3.0
Key Switch	.70
Motion Sensor	1.0
NEMA Enclosure	1.0
Program Cards	.25
Relay/Sockets	.50
Touchpad Door Lock, new	2.0
Touchpad Door Lock, refit	3.0

MISC	WH's/EA
Anti-passback alarm contact –	
Surface mount	1.0
Flush mount	1.5
Build card database in existing software	.05
Computer hookup and setup – for use	
with access program	6.0
Elevator Interface – relay based driven	
by controller panel	5.0
Install software – DOS or Windows based	
access program	4.0
Layout artwork for photo badging or logo	
cards for local stamping	3.5
Perform system database backup or restoration	.75
Print photo badging or logo cards	
on local hot printer	.05
Upload system data to remove panels	.75

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS – con't.

32. INDUSTRIAL FACILITY PAGE/PARTY

INSTALL	WH's/EA
Auto Tel Interface/Coupler	8.0
Desk-Edge Station	5.0
Desk-Top Station	3.0
Flush Panel Station	6.0
Hazardous Speaker Amplifier – Class I, II & III, Div. 1	6.0
Horn/Bell Signal, Standard Volume, Explosion Proof 115V, AC	4.0
Horn/Siren Signal, Resonating, Explosion Proof, 120V, AC	6.0
Indoor Ceiling Speaker	3.0
Indoor Speaker Amplifier – Class I, Div. II	3.0
Indoor Wall Speaker	2.0
Indoor Wall Station – Class I, B,C & D; Class II & III, Div. 1	7.0
Indoor Wall Station - Class I, Div. 2	4.0
Line Balance – Class I, II & III, Div. 2	2.0
Outdoor Horn Speaker – Class I & II, F & G; Class III, Div. 2	4.0
Outdoor Wall Station – Class I, B, C & D; Class II & III, Div. 1	8.0
Priority Tone Generator	3.0
Weatherproof Speaker Amplifier – Class I, II & III, Div. 2	4.0
Weatherproof Wall Station – Class I, II & III, Div. 2	5.0

NOTE

1. For wire and terminations, see applicable section.

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS – con't.

33. LOCAL BUILDING PAGING SYSTEMS

INSTALL	WH's/EA
Amplifier	2.50
Antenna	7.50
Ceiling Speaker	0.75
Music Service	1.25
Paging Speaker	0.65
Wall Speaker	0.65

NOTE

1. For wire and terminations, see applicable section.

FLUOR

ELECTRICAL UNIT WORK HOURS

G. COMMUNICATIONS – con't.

34. MISCELLANEOUS

ITEM	WH'S/EA
Cabinet	4.0
Cable Support	20.0
Fire Retardant – 4' x 8'x ¾" Plywood	2.0
Firestopping	4.0
Labels	.10
Open Rack – 19" x 84"	2.0
Splice Cabinet	2.0
Splice Case	1.8
Splice Closure	1.0
Splice Tray	1.0
Wall Mounted Patch Panel	.70

NOTES

1. All work hour units include unload, storage and handling to erection site.

2. Any supports required are not included.

3. For any activities which are not included in this section, see Means, Richardson, NECA or other recognized estimating publications.

FLUOR

ELECTRICAL UNIT WORK HOURS

H. POLE LINE

WOOD POLE SETTING – CLASS II TREATED

LENGTH (FT.)	WH's
25	5.0
30	5.5
35	6.0
40	6.5
45	7.0
50	8.0
55	10.0
60	12.0
65	15.0

NOTE

1. Installation units include hauling up to two (2) miles.

3 CONDUCTOR ASSEMBLY ON WOODEN CROSS ARM

5KV THRU 35KV	SINGLE CIRCUIT WH's	DOUBLE CIRCUIT WH's
Tangent Pole Assembly	10	15
Corner Pole Assembly	35	60
Dead-end Pole Assembly	20	30
Single Down Guy Assembly	5	10

FLUOR

ELECTRICAL UNIT WORK HOURS

H. POLE LINE – con't.

POLE MOUNTED DISTRIBUTION – LINE TRANSFORMERS

KVA 1-PHASE	WH's
25	10
37 ½	12
50	15
75	18
100	22
167	26
250	32
333	40
500	52

KVA 3-PHASE	
15	20
30	30
45	34
75	38
112 ½	43
150	48
225	54
300	60
500	72

NOTE

1. Above units include necessary brackets and fasteners to mount transformers to existing pole.

FLUOR

ELECTRICAL UNIT WORK HOURS

H. POLE LINE – con't.

WIRE STRINGING – 5KV THRU 35KV (≤ 25 FOOT HEIGHT)

SINGLE ALUMINUM CONDUCTOR, STEEL REINFORCED (ACSR) – BARE

AMPS	SIZE	STRANDING	WT. Per 1,000 LF	WH's Per LF	WT. Per Mile	WH's Per Mile
140	4	6/1	57	.013	301	69
185	2	6/1	91	.014	480	74
240	1/0	6/1	145	.016	766	84
275	2/0	6/1	183	.018	966	95
315	3/0	6/1	231	.020	1,220	106
360	4/0	6/1	291	.022	1,536	116
455	266.8	26/7	367	.023	1,938	121
530	336.4	26/7	463	.025	2,445	132
585	397.5	26/7	547	.027	2,888	143
660	477.0	26/7	657	.029	3,469	153
725	556.5	26/7	766	.031	4,044	164
785	636.0	26/7	875	.034	4,620	180
845	715.0	26/7	984	.037	5,196	195
905	795.0	26/7	1,094	.040	5,776	211
950	874.5	54/7	1,126	.041	5,945	216
955	900.0	54/7	1,158	.042	6,114	222
995	954.0	54/7	1,229	.045	6,489	238
1025	1033.5	54/7	1,330	.049	7,022	259
1175	1272.0	54/19	1,635	.060	8,633	317
1270	1431.0	54/19	1,840	.068	9,715	359
1360	1590.0	54/19	2,044	.076	10,792	401
1540	2034.0	72/7	2,162	.080	11,415	422
1600	2167.0	72/7	2,302	.085	12,155	449
1670	2312.0	76/19	2,526	.093	13,337	491
1755	2515.0	76/19	2,749	.101	14,515	533

HEIGHT ADJUSTMENTS:

≤ 35 foot – multiply by **1.02**
≤ 45 foot – multiply by **1.05**
≤ 55 foot – multiply by **1.06**
≤ 65 foot – multiply by **1.10**
≤ 75 foot – multiply by **1.14**

FLUOR

ELECTRICAL UNIT WORK HOURS

H. POLE LINE – con't.

PRE-ASSEMBLED AERIAL CABLE

THREE TWISTED 1/C STRANDED CU SHIELDED WITH MESSENGER

	WH's/LF		
AWG	**600V**	**5KV**	**15KV**
8	.015	.017	----
6	.028	.031	----
4	.032	.035	.038
2	.036	.040	.043
1	.040	.044	.048
1/0	.048	.053	.058
2/0	.056	.062	.067
3/0	.064	.070	.077
4/0	.072	.079	.086
KCMIL			
250	.079	.087	.095
350	.086	.095	.103
500	.100	.110	.120
750	.120	.132	.144

MESSENGER HANGER ASSEMBLY

ITEM	**WH's**
Tangent Pole	0.5
Corner Pole	2.0
Dead-end Pole	1.5
Tee Splice (600V)	2.7
Straight Splice (600V)	1.7

FLUOR

ELECTRICAL UNIT WORK HOURS

H. POLE LINE – con't.

PRIMARY & SECONDARY PROTECTIVE DEVICES

PRIMARY	WH's
Pole Top Airbreak Switch – TPST – with Operating Mechanism & Rod	4
Enclosed Disconnect Switches	3
Open Disconnect Switches	3
Enclosed Cutouts – One Shot	3
Enclosed Cutouts – Two Shot	3
Enclosed Cutouts – Three Shot	3
Open Cutouts – One Shot	3
Open Cutouts – Two Shot	3
Open Cutouts – Three Shot	3
Oil Circuit Reclosers – Single Phase (70 pounds)	10
Oil Circuit Reclosers – Three Phase (315 pounds)	18
Heavy Duty Oil Circuit Reclosers – Single Phase (170 pounds)	14
Heavy Duty Oil Circuit Reclosers – Three Phase (700 pounds)	26
Oil Switch – Single-Phase – Remote Control	15
Oil Switch – One Single-Phase – Manual Gang Operated	15
Oil Switch – Two Single-Phase – Manual Gang Operated	30
Oil Switch – Three Single-Phase – Manual Gang Operated	60
Oil Switch – Remote Control	60
Oil Switch – Manual Operated	70
Lightning Arresters	5
SECONDARY	
Fuse Cutouts	3
Lightning Arresters	3

FLUOR

ELECTRICAL UNIT WORK HOURS

I. ELECTRIC HEAT TRACING

CONTROLLERS – UP TO 650° F (NEMA 4 & 7)

TYPE	WH's
Single Thermostat	4
Dual Thermostat	5
Thermostat Contactor (3-Pole)	5
Contactor (3-Pole) – 30/50/75 Amp	4

HEATING CABLE – SELF REGULATING CU BUS WIRE

		WH's/LF		
ORDINARY	N-Haz	Div-2 (1)	Div-2 (2)	Div-1
2-16 AWG, 150° F Max, 120/240 VAC, 3-10W	.040	.045	.050	.052
2-14 AWG, 250° F Max, 120/240 VAC, 5-20W	.042	.047	.052	.054
2-16 AWG, 225° F Max, 240 VAC, 10-15W	.040	.045	.050	.056
2-14 AWG, 225° F Max, 120/240 VAC, 15-20W	.042	.047	.052	.058
2-14 AWG, 300° F Max, 208/240/277 VAC, 5-20W	.042	.047	.052	.060
LONGLINE				
2-10 AWG, 150°F Max, 240 VAC, 2-9W	.045	.050	.055	.062

NOTES

1. N-Haz unit – Cable with Jacket only.
2. Div-2 (1) unit – Cable with Jacket and Shield.
3. Div-2 (2) unit – Cable with Jacket, Shield and Jacket.
4. Div-1 unit – Cable with Jacket, Braid and Alloy Sheath.

FLUOR

ELECTRICAL UNIT WORK HOURS

I. ELECTRIC HEAT TRACING – con't.

SELF REGULATING HEATING CABLE ACCESSORIES

ORDINARY	WH's
PWR Conn. Kit	
Without JB	
Non-Shielded Cables	0.5
Shield and Shield/Jacket Cables	0.7
With JB	
Non-Shielded Cables	1.0
Shield and Shield/Jacket Cables	1.2
Dual Entry with JB	
Non-Shielded Cables	1.5
Shield and Shield/Jacket Cables	1.7
Splice Kit Tee	
With ENCL	
Non-Shielded Cables	0.4
Shield and Shield/Jacket Cables	0.5
With ENCL	
Non-Shielded Cables	0.7
Shield and Shield/Jacket Cables	0.8
With ENCL	
Non-Shielded Cables	0.5
Shield and Shield/Jacket Cables	0.6
With ENCL	
Non-Shielded Cables	0.9
Shield and Shield/Jacket Cables	1.0
End Seal Kit (All Cables)	0.3
Gland Kit – to seal all entries of Shield/Jacket Cables for installation in Division 1 Area	1.2

LONGLINE	
PWR Conn. Kit Assembly for 3 Conductor Self Regulating Heating Cable	
Non-Shielded Cables	6.0
Shield and Shield/Jacket Cables	7.0
*Assembly includes: 1-PWR Box, 2-Phase Change over Box, 1-End Box	
PWR Conn. Splices – End Seal Kits for 1 Conductor Self Regulating Heating Cable	Use ORDINARY units

FLUOR

ELECTRICAL UNIT WORK HOURS

I. ELECTRIC HEAT TRACING – con't.

CONTROL DEVICES – SELF REGULATING AND HI-TEMP HEATING CABLES

THERMOSTAT	WH's
Ambient or Line Sensing Non-Adjustable 40° F NEMA 4X	3.0
Ambient Sensing Adjustable 15° to 140° F NEMA 4X	3.0
Line Sensing Adjustable	
25° to 325° F NEMA 4X	4.0
15° to 140° F NEMA 4X	4.0
75° to 325° F NEMA 7,9	4.0
50° to 1000° F NEMA 4,7,9	4.0

CONTACTOR	
3P-40A 480V NEMA 4X	4.0
3P-40A 480V NEMA 7	4.0
3P-100A 480V NEMA 4X	4.0

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION

GRAPHITE ANODES

BARE
(with 5 FT. of #8 HMW lead wire)

ANODE SIZE	WT. LBS.	WH's per ANODE
3" x 30"	13	2.3
3" x 60"	25	3.1
4" x 40"	32	3.8
4" x 80"	63	5.4

NOTE – WH's for bare anodes include coke breeze backfill.

COKE BREEZE BACKFILL DATA

ANODE SIZE	HOLE SIZE VERT.	VOL. CFT.	WT. LBS.
3" x 30"	12" x 54"	3.7	170
3" x 60"	12" x 84"	5.7	260
4" x 40"	16" x 64"	7.6	350
4" x 80"	16" x 104"	12.2	560

PRE-PACKAGED IN STEEL CAN
(with 5 FT. of #8 HMW lead wire)

ANODE SIZE	OVERALL DIMENSION	WT. LBS.	WH's per ANODE
3" x 30"	8" x 54"	100	1.5
3" x 60"	8" x 84"	155	2.3
4" x 40"	10" x 54"	150	3.1
4" x 80"	10" x 96"	260	4.6

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

DURICHLOR 51 ANODES

BARE
(with 5 FT. of #8 HMW lead wire)

ANODE TYPE	ANODE SIZE	WT. LBS.	WH's per ANODE
B	1" x 60"	12	3.1
C	1 ½" x 60"	25	3.1
CD	1 ½" x 60"	26	3.1
CDD	1 ½" x 60"	25	3.1
D	2" x 60"	44	3.8
M	2" x 60"	60	3.8
J	3" x 36"	80	3.1
E	3" x 60"	110	4.6
SM	4 ½" x 60"	220	7.7

NOTE – WH's for bare anodes include coke breeze backfill.

COKE BREEZE BACKFILL DATA

ANODE TYPE	ANODE SIZE	HOLE SIZE VERT.	VOL. CFT.	WT. LBS.
B	1" x 60"	8" x 84"	2.6	120
C	1 ½" x 60"	8" x 84"	2.6	120
CD	1 ½" x 60"	8" x 84"	2.6	120
CDD	1 ½" x 60"	8" x 84"	2.6	120
D	2" x 60"	10" x 84"	3.9	180
M	2" x 60"	10" x 84"	3.9	180
J	3" x 36"	12" x 54"	3.7	170
E	3" x 60"	12" x 84"	5.7	260
SM	4 ½" x 60"	16" x 84"	10.0	460

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

DURICHLOR 51 ANODES – con't.

PRE-PACKAGED IN STEEL CAN
(with 10 FT. of #8 HMW lead wire)

ANODE TYPE	ANODE SIZE	OVERALL DIMENSION	WT. LBS.	WH's per ANODE
B	1" x 60"	8" x 96"	174	2.3
C	1 ½" x 60"	8" x 96"	185	2.3
CD	1 ½" x 60"	8" x 96"	187	2.3
CDD	1 ½" x 60"	8" x 96"	188	2.3
D	2" x 60"	8" x 96"	206	3.1
M	2" x 60"	8" x 96"	217	3.1
J	3" x 36"	8" x 48"	180	2.3
E	3" x 60"	8" x 96"	275	3.8
SM	4 ½" x 60"	12" x 96"	410	6.2

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

MAGNESIUM ANODES

PRE-PACKAGED IN STEEL CAN
(with 10 FT. of #12 or #10 TW - OR - #8, #6 or #4 HMW lead wire)

DOW GALVOMAG

ANODE WT. LBS.	ANODE DIMENSION	OVERALL DIMENSION	OVERALL WT. LBS.	WH's per ANODE
3	3" x 3" x 4 ½"	6" x 6 ½"	9	0.8
5	3" x 3" x 7 ½"	6" x 9 ½"	14	0.8
9	3" x 3" x 13 ½"	6" x 15 ½"	23	1.5
17	3" x 3" x 25 ½"	6" x 28"	42	2.3
20	2" x 2" x 60"	5" x 64"	68	3.1
32	5" x 5" x 21"	8" x 23"	70	3.8
48	5" x 5" x 31"	8" x 34"	96	4.6

H-1 ALLOY GRADE I

ANODE WT. LBS.	ANODE DIMENSION	OVERALL DIMENSION	OVERALL WT. LBS.	WH's per ANODE
3	3" x 3" x 4 ½"	6" x 6 ½"	9	0.8
5	3" x 3" x 7 ½"	6" x 9 ½"	14	0.8
9	3" x 3" x 13 ½"	6" x 15 ½"	23	1.5
17	3" x 3" x 25 ½"	6" x 28"	42	2.3
20	2" x 2" x 60"	5" x 64"	68	3.1
32	5" x 5" x 21"	8" x 23"	70	3.8
50	8" D x 15"	10" x 18"	96	4.6

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

ZINC ANODES

PRE-PACKAGED IN STEEL CAN
(with 10 FT. of HMW lead wire)

SIZE: 1.4" x 1.4" x 60" / WT.: 33 LBS.
OVERALL DIMENSION: 4" x 68"

AWG	OVERALL WT. LBS.	WH's per ANODE
8	55	2.3
6	56	2.3
4	57	2.3
2	59	2.3
1	60	2.3
1/0	61	2.7
2/0	62	2.7
4/0	65	2.7
KCMIL		
250	67	3.1
300	68	3.1
350	70	3.1

SIZE: 2" x 2" x 45" / WT.: 45 LBS.
OVERALL DIMENSION: 6" x 56"

AWG	OVERALL WT. LBS.	WH's per ANODE
8	90	2.7
6	91	2.7
4	92	2.7
2	94	2.7
1	95	2.7
1/0	96	3.1
2/0	97	3.1
4/0	100	3.1
KCMIL		
250	102	3.5
300	103	3.5
350	105	3.5

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

ZINC ANODES – con't.

PRE-PACKAGED IN STEEL CAN
(with 10 FT. of HMW lead wire)

SIZE: 2" x 2" x 60" / WT.: 60 LBS.
OVERALL DIMENSION: 6" x 68"

AWG	OVERALL WT. LBS.	WH's per ANODE
8	120	3.1
6	121	3.1
4	122	3.1
2	124	3.1
1	125	3.1
1/0	126	3.5
2/0	127	3.5
4/0	130	3.5
KCMIL		
250	132	3.8
300	133	3.8
350	135	3.8

SIZE: 4" x 4" x 36" / WT.: 150 LBS.
OVERALL DIMENSION: 8" x 48"

AWG	OVERALL WT. LBS.	WH's per ANODE
8	220	4.6
6	221	4.6
4	222	4.6
2	224	4.6
1	225	4.6
1/0	226	5.0
2/0	227	5.0
4/0	230	5.0
KCMIL		
250	232	5.4
300	233	5.4
350	235	5.4

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

ALUMINUM ANODES

BARE
(GALVALUM with CORE TYPE "R")

ANODE NO.	ANODE DIMENSION	WT. LBS.	WH's per ANODE
G-17	2" x 2" x 36"	17	1.5
G-26	2" x 2" x 60"	26	2.3
G-30	3" x 3" x 34"	30	2.3
G-60-2	4" x 4" x 38"	60	3.1
G-60-1	5" x 5" x 24"	60	3.1
G-60	7" x 7" x 12"	60	3.1
G-90-2	4" x 4" x 57"	90	3.8
G-90-1	5" x 5" x 36"	90	3.8
G-90	7" x 7" x 18"	90	3.8
G-120-2	5" x 5" x 48"	120	4.6
G-120-1	7" x 7" x 24"	120	4.6
G-120	10" x 10" x 12"	120	4.6
G-240-1	7" x 7" x 48"	240	6.2
G-240	10" x 10" x 24"	240	6.2

NOTE – These anode's are for non-burial applications, therefore do not require backfill.

ANODE NOTE

1. All Anode work hours are based on typical installation at or near the surface. For deep groundbed installation add work hours as required by depth. See Means, Richardson or other recognized estimating publications.

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

RECTIFIERS

NON-HAZARDOUS

AIR COOLED – 1/C, 115V
BRIDGE TYPE – SELENIUM

MAX DC OUTPUT		WT.	PAD	POLE
VOLTS	AMPS	LBS.	MOUNTED	MOUNTED
8	4	70	1.5	3.8
8	12	80	1.9	4.2
8	22	95	2.3	5.0
8	50	130	3.1	6.9
8	100	230	5.4	12.3
8	120	240	5.8	13.5
12	4	75	1.9	4.2
12	12	85	1.9	4.6
12	22	100	2.3	5.4
12	50	140	3.1	7.7
12	100	270	6.2	14.6
12	120	290	6.9	16.1
18	4	80	1.9	4.2
18	12	90	2.3	5.0
18	22	110	2.7	5.8
18	50	160	3.8	8.5
18	100	290	6.5	15.8
18	120	310	7.3	17.3
24	4	85	1.9	4.6
24	12	95	2.3	5.0
24	22	130	3.1	6.9
24	50	230	5.4	12.3
24	100	320	7.3	17.3
24	120	370	8.1	21.5
30	4	90	1.9	5.0
30	12	100	2.3	5.4
30	22	140	3.1	7.7
30	50	260	6.2	13.8
30	100	380	8.8	20.4
30	120	400	9.6	22.3

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

RECTIFIERS – con't.

NON-HAZARDOUS – con't.

AIR COOLED – 3/C, 460V
BRIDGE TYPE – SELENIUM

MAX DC OUTPUT VOLTS	MAX DC OUTPUT AMPS	WT. LBS.	PAD MOUNTED	POLE MOUNTED
12	6	110	2.7	5.8
12	12	115	2.7	6.2
12	24	130	3.1	6.9
12	50	160	3.8	8.8
12	100	215	5.0	11.5
12	200	465	10.8	25.0
18	6	120	2.7	6.5
18	12	125	3.1	6.9
18	24	145	3.5	7.7
18	50	200	4.6	10.8
18	100	285	6.5	15.4
18	200	505	11.5	27.3
24	6	125	3.1	6.9
24	12	130	3.1	6.9
24	24	185	4.2	10.0
24	50	235	5.8	12.7
24	100	315	7.3	16.9
24	200	530	12.3	28.5
32	6	130	3.1	6.9
32	12	135	3.1	7.3
32	24	190	4.2	10.4
32	50	260	6.2	13.8
32	100	315	8.1	19.2
32	200	530	12.7	29.6
40	6	135	3.1	7.3
40	12	145	3.5	7.7
40	24	200	4.6	10.4
40	50	285	6.5	15.4
40	100	390	9.2	21.1
40	200	615	13.8	31.5

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

RECTIFIERS – con't.

NON-HAZARDOUS – con't.

OIL IMMERSED - 1/C, 115V
BRIDGE TYPE – SELENIUM

MAX DC OUTPUT		WT.	PAD	POLE
VOLTS	AMPS	LBS.	MOUNTED	MOUNTED
8	4	150	3.5	8.1
8	12	165	3.8	8.8
8	22	180	4.2	9.6
8	50	200	4.6	10.8
8	100	375	9.6	20.4
8	120	460	11.2	23.5
12	4	155	3.5	8.5
12	12	170	3.8	9.2
12	22	185	4.2	10.0
12	50	285	6.5	15.4
12	100	400	10.0	21.5
12	120	480	11.5	25.0
18	4	160	3.8	8.5
18	12	175	4.2	9.6
18	22	195	4.6	10.4
18	50	300	6.9	16.1
18	100	435	10.4	23.5
18	120	510	11.9	26.1
24	4	170	3.8	9.2
24	12	180	4.2	9.6
24	22	210	5.0	11.2
24	50	335	7.7	18.1
24	100	470	11.2	25.4
24	120	520	12.7	28.8
30	4	175	4.2	9.6
30	12	185	4.2	10.0
30	22	220	5.0	11.9
30	50	380	8.8	20.4
30	100	520	11.9	28.1
30	120	550	13.5	30.8

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

RECTIFIERS – con't.

NON-HAZARDOUS – con't.

OIL IMMERSED - 3/C, 460V
BRIDGE TYPE – SELENIUM

MAX DC OUTPUT		WT.	PAD	POLE
VOLTS	AMPS	LBS.	MOUNTED	MOUNTED
12	6	170	3.8	8.8
12	12	175	3.8	9.2
12	24	190	4.2	10.0
12	50	265	5.8	13.8
12	100	420	9.2	21.9
12	200	710	15.0	35.8
18	6	180	3.8	9.2
18	12	185	4.2	9.6
18	24	205	4.6	10.8
18	50	290	6.5	15.0
18	100	465	10.4	24.2
18	200	850	16.5	38.5
24	6	185	4.2	9.6
24	12	190	4.2	10.0
24	24	226	5.0	11.9
24	50	325	7.3	16.9
24	100	490	10.8	25.8
24	200	900	16.9	40.4
32	6	190	4.2	10.0
32	12	200	4.6	10.4
32	24	235	5.4	12.3
32	50	365	8.1	19.2
32	100	610	13.5	31.9
32	200	950	19.2	45.4
40	6	195	4.2	10.4
40	12	205	4.6	10.8
40	24	250	5.8	13.8
40	50	455	10.0	23.1
40	100	630	13.8	32.7
40	200	1,025	20.8	49.2

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

RECTIFIERS – con't.

EXPLOSION PROOF

OIL IMMERSED - 1/C, 115V
BRIDGE TYPE – SELENIUM

MAX DC OUTPUT		WT.	PAD	POLE
VOLTS	AMPS	LBS.	MOUNTED	MOUNTED
8	4	210	3.8	8.5
8	12	225	4.2	9.2
8	22	240	4.2	10.0
8	50	260	5.0	11.2
8	100	475	10.0	21.1
8	120	560	11.9	25.0
12	4	215	3.8	8.8
12	12	230	4.2	9.6
12	22	245	4.6	10.5
12	50	345	6.9	15.8
12	100	500	10.4	22.3
12	120	580	12.3	26.1
18	4	220	3.8	9.2
18	12	235	4.2	10.0
18	22	255	4.6	11.2
18	50	360	7.3	16.5
18	100	535	10.8	24.2
18	120	610	13.1	29.2
24	4	230	4.2	9.6
24	12	240	4.2	10.0
24	22	260	5.0	11.9
24	50	395	8.1	18.5
24	100	570	11.9	26.1
24	120	620	13.8	30.8
30	4	235	4.2	10.0
30	12	245	4.6	10.4
30	22	260	5.4	12.3
30	50	440	8.8	20.8
30	100	620	12.3	28.8
30	120	650	14.6	33.1

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

RECTIFIERS – con't.

EXPLOSION PROOF – con't.

OIL IMMERSED - 3/C, 460V
BRIDGE TYPE – SELENIUM

MAX DC OUTPUT		WT.	PAD	POLE
VOLTS	AMPS	LBS.	MOUNTED	MOUNTED
12	6	230	3.8	9.2
12	12	235	4.2	9.6
12	24	250	4.6	10.4
12	50	325	6.2	14.2
12	100	520	9.6	22.7
12	200	835	15.8	37.3
18	6	240	4.2	10.0
18	12	245	4.2	10.0
18	24	265	4.6	11.2
18	50	350	6.5	15.8
18	100	565	10.8	25.0
18	200	975	17.3	40.0
24	6	245	4.2	10.0
24	12	250	4.6	10.4
24	24	286	5.4	12.3
24	50	385	7.7	17.3
24	100	590	11.2	26.5
24	200	1,025	17.7	42.3
32	6	250	4.6	10.4
32	12	260	4.6	10.8
32	24	295	5.4	12.7
32	50	425	8.5	19.6
32	100	710	13.8	32.7
32	200	1,075	20.0	47.3
40	6	255	4.6	10.8
40	12	265	5.0	11.2
40	24	310	6.2	14.2
40	50	515	10.0	23.5
40	100	730	14.2	33.5
40	200	1,150	21.5	50.8

FLUOR

ELECTRICAL UNIT WORK HOURS

J. CATHODIC PROTECTION – con't.

CATHODIC PROTECTION CABLE

1/C STRANDED CU WITH HMW POLYETHYLENE INSULATION AND JACKET

AWG	DC RESISTANCE PER 1,000 FT. @ 25° C	WH's/LF
8	0.6540	.011
6	0.4100	.013
4	0.2590	.015
2	0.1620	.018
1	0.1290	.020
1/0	0.1020	.022
2/0	0.0811	.025
4/0	0.0509	.030
KCMIL		
250	0.0431	.034
300	0.0360	.037
350	0.0308	.039

NOTE

1. For Cadweld Connections:
   Cable-to-Cable, use **3.0** WH/EA.
   Cable-to-Pipe, use **3.0** WH/EA.

FLUOR

ELECTRICAL UNIT WORK HOURS

K. METRIC CONVERSIONS

ELECTRICAL CONDUCTOR AREAS

UNITED STATES			EUROPEAN (CLOSEST TO U.S. STANDARD)	
AWG	AREA CIRCULAR MILS	AREA SQ. MM	SIZE SQ. MM	AREA CIRCULAR MILS
18	1,620	0.82	0.75	1,480
16	2,580	1.30	1.0	1,974
14	4,110	2.08	1.5	2,961
12	6,530	3.30	2.5	4,935
10	10,380	5.25	4	7,896
8	16,510	8.36	6	11,844
6	26,240	13.29	10	19,740
4	41,740	21.14	16	31,584
3	52,620	26.65	25	49,350
2	66,360	33.61	-----	-----
1	83,690	42.39	35	69,090
1/0	105,600	53.49	50	98,700
2/0	133,100	67.42	-----	-----
3/0	167,800	85.00	70	138,180
4/0	211,600	107.19	95	187,530
KCMIL				
250	250,000	126.64	120	236,880
300	300,000	151.97	150	296,100
350	350,000	177.30	-----	-----
400	400,000	202.63	185	365,190
500	500,000	253.29	240	473,760
600	600,000	303.95	300	592,200
700	700,000	354.60	-----	-----
750	750,000	379.93	-----	-----

FLUOR

ELECTRICAL UNIT WORK HOURS

K. METRIC CONVERSIONS – con't.

CONDUIT INSIDE DIAMETERS

UNITED STATES			EUROPEAN	
TRADE SIZE	INCHES	MM	TRADE SIZE	MM
½"	0.622	15.8	11	16.4
¾"	0.824	20.9	16	19.9
1"	1.049	26.6	21	25.5
1 ¼"	1.380	35.0	29	34.2
1 ½"	1.610	40.9	36	44.0
2"	2.067	52.5	42	51.0
2 ½"	2.569	62.7	--	--
3"	3.068	77.9	--	--
3 ½"	3.548	90.1	--	--
4"	4.026	102.3	--	--
5"	5.047	128.2	--	--
6"	6.065	154.1	--	--

CABLE TRAY

WIDTH	
INCHES	MM
6"	150
12"	300
18"	450
24"	600
30"	750
36"	900

RUNG SPACE	
INCHES	MM
9"	230

RADIUS	
INCHES	MM
24"	600

FLUOR

CONTROL SYSTEMS UNIT WORK HOURS

TABLE OF CONTENTS

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CONTROL SYSTEMS UNIT WORK HOURS

A. FIELD MOUNTED INSTRUMENTS

	CATEGORY		Install (note 1)	Calibrate/ Test (note 2)	Loop Check (note 3)	Total	Bulk Req'd? (note 4)	Stand Req'd? (note 5)
	ANALYTICAL DEVICES							
	AC	Analyzer Controller	8.0	5.0	0.6	13.6	A/C	Y
	AE	Analyzer Element (Corrosion Coupon)	3.0	---	0.6	3.6	N	N
	AE/AT	CO_2 Analyzer	12.0	15.0	1.2	28.2	P/C	Y/N
	AE/AT	Gas Analyzer (Chromatograph, IR, etc.)	12.0	15.0	1.2	28.2	P/C	Y/N
	AE/AT	Area Gas Monitor (Comb., Toxic, etc.)	4.0	6.0	1.2	11.2	P/C	Y/N
	AE/AT	pH Analyzer	12.0	10.0	1.2	23.2	P/C	Y/N
	AE/AT	Dissolved Oxygen	12.0	10.0	1.2	23.2	P/C	Y/N
	AE/AT	Capacity Conductivity Probe (Xmtr)	8.0	3.0	1.2	12.2	C	Y
	AI	Analyzer Indicator (Receiver Gauge)	3.0	1.0	0.6	4.6	C	Y/N
	AT	Analyzer Transmitter	4.0	6.0	0.6	10.6	P/C	Y
	CE	Conductivity Element	4.0	1.0	0.6	5.6	N	N
	DE	Density Element	8.0	1.0	0.6	9.6	N	N
	DT	Density Transmitter	4.0	2.0	0.6	6.6	C	Y
	ME	Moisture Element	4.0	2.0	0.6	6.6	N	N
	MT	Moisture Transmitter	4.0	2.0	0.6	6.6	P/C	Y
	VE	Viscosity Element	2.5	1.0	0.6	4.1	N	N
	VT	Viscosity Transmitter	4.0	2.0	0.6	6.6	P/C	N
	FLOW DEVICES							
	FC	Flow Controller	8.0	4.0	0.6	12.6	A/P/C	Y
(note 6)	FE	Flow Element (Coriolis Flowmeter)	2.0	2.0	0.6	4.6	N	N
(note 6)	FE	Flow Element (Magnetic Flowmeter)	2.0	2.0	0.6	4.6	N	N
(note 6)	FE	Flow Element (Orifice Plate)	2.0	1.0	0.6	3.6	N	N
(note 6)	FE	Flow Element (Pitot Tube/Annubar)	2.0	1.0	0.6	3.6	N	N
(note 6)	FE	Flow Element (Positive Displacement)	2.0	2.0	0.6	4.6	N	N
(note 6)	FE	Flow Element (Turbine Meter)	2.0	2.0	0.6	4.6	N	N
(note 6)	FE	Flow Element (Venturi)	2.0	2.0	0.6	4.6	N	N
(note 6)	FE	Flow Element (Vortex Flowmeter)	2.0	2.0	0.6	4.6	N	N
(note 6)	FG	Flow Glass	2.0	---	0.6	2.6	N	N
(note 6)	FI	Flow Indicator (Process Rotameter)	2.0	1.0	0.6	3.6	N	N
	FI	Flow Indicator (Paddle Type)	3.0	1.0	0.6	4.6	N	N
	FI	Flow Indicator (Receiver Gauge)	3.0	1.0	0.6	4.6	C	Y/N
	FQ	Flow Totalizer	8.0	3.0	0.6	11.6	C	Y/N
	FS	Flow Switch	4.0	4.0	0.6	8.6	P/C	Y
(note 8)	FT	Flow Transmitter (Elec. Transducer)	4.0	2.0	0.6	6.6	C	Y/N
(note 7)	FT	Flow Transmitter (D/P Cell)	4.0	6.0	0.6	10.6	P/C	Y/N

FLUOR

CONTROL SYSTEMS UNIT WORK HOURS

A. FIELD MOUNTED INSTRUMENTS – con't.

	CATEGORY		Install (note 1)	Calibrate/ Test (note 2)	Loop Check (note 3)	Total	Bulks Req'd? (note 4)	Stand Req'd? (note 5)
	LEVEL DEVICES							
	LC	Level Controller	8.0	3.0	0.6	11.6	A/P/C	Y
(note 6)	LG	Level Gauge	2.0	---	0.6	2.6	N	N
	LI	Level Indicator (Float or Target)	10.0	4.0	0.6	14.6	P	Y
	LI	Level Indicator (Receiver Gauge)	3.0	1.0	0.6	4.6	C	Y/N
	LS	Level Switch (Float or Probe)	10.0	6.0	0.6	16.6	P/C	Y
(note 6)	LT	Level Transmitter (Displacer)	2.0	4.0	0.6	6.6	C	N
	LT	Level Transmitter (D/P)	4.0	6.0	0.6	10.6	P/C	Y/N
	LT	Level Transmitter (Radar)	16.0	4.0	0.6	20.6	C	N
	PRESSURE DEVICES							
	PC	Pressure Controller	8.0	5.0	0.6	13.6	A/P/C	Y
	PDI	Pressure Differential Indicator	4.0	3.0	0.6	7.6	P	Y
	PDIS	Pressure Diff. Indicating Switch	4.0	5.0	0.6	9.6	P/C	Y
	PDS	Pressure Differential Switch	4.0	2.0	0.6	6.6	P/C	Y
	PDT	Pressure Differential Transmitter	4.0	6.0	0.6	10.6	P/C	Y
	PI	Pressure Indicator (Local Gauge)	2.5	1.0	0.6	4.1	P	N
	PI	Pressure Indicator (Receiver Gauge)	3.0	1.0	0.6	4.6	C	Y/N
	PS	Pressure Switch	4.0	2.0	0.6	6.6	P/C	Y/N
(note 6)	PSE	Press. Safety Element (Rupt. Disc)	2.0	1.0	0.6	3.6	N	N
(note 6)	PSV	Pressure Safety Valve	2.0	6.0	0.6	8.6	N	N
	PT	Pressure Transmitter	4.0	5.0	0.6	9.6	P/C	Y
	TEMPERATURE DEVICES							
	TC	Temperature Controller	8.0	6.0	0.6	14.6	A/P/C	Y
	TE	Temperature Element	2.0	4.0	0.6	6.6	N	N
	TI	Temperature Indicator (Gauge)	2.0	2.0	0.6	4.6	N	N
	TI	Temperature Indicator (Rec. Gauge)	3.0	1.0	0.6	4.6	C	Y/N
	TS	Temperature Switch	3.0	1.0	0.6	4.6	C	Y/N
	TT	Temperature Transmitter	4.0	2.0	0.6	6.6	C	Y
(note 6)	TW	Thermowell	2.0	---	0.6	2.6	N	N
	RTD	Resistance Temperature Detector	3.0	4.0	0.6	7.6	C	N

FLUOR

CONTROL SYSTEMS UNIT WORK HOURS

A. FIELD MOUNTED INSTRUMENTS – con't.

	CATEGORY		Install (note 1)	Calibrate/ Test (note 2)	Loop Check (note 3)	Total	Bulks Req'd? (note 4)	Stand Req'd? (note 5)
	MISCELLANEOUS							
(note 6)	*CV	Control Valve	2.0	4.0	0.6	6.6	A	N
	*R	Recorder	8.0	3.5	0.6	12.1	A/P/C	Y
(note 9)	*Y	I/P Transducer	4.0	2.5	0.6	7.1	C	Y/N
(note 9)	*Y	Solenoid Valve	3.0	1.0	0.6	4.6	C	Y/N
	AE	Smoke Detector	4.0	2.0	0.6	6.6	C	N
	BE	Burner Element	2.5	1.0	0.6	4.1	N	N
	BS	Burner Switch	3.0	1.0	0.6	4.6	C	Y/N
(note 6)	CVC	Conservation Vents	2.0	---	0.6	2.6	N	N
	HC	Hand Controller (Manual Loader)	4.0	1.0	0.6	5.6	A/C	Y
	HS	Hand Switch	4.0	1.0	0.6	5.6	A/C	Y
	SE	Speed Element	4.0	1.0	0.6	5.6	C	N
	SS	Speed Switch	4.0	1.5	0.6	6.1	C	N
	ST	Speed Transmitter	4.0	1.5	0.6	6.1	C	N
	VS	Vibration Switch	4.0	1.5	0.6	6.1	C	Y/N
	WC	Weight Controller	8.0	4.0	0.6	12.6	C	Y
	WE	Weight Element (Cell)	6.0	4.0	0.6	10.6	C	N
	WI	Weight Indicator	6.0	2.0	0.6	8.6	C	Y/N
	WT	Weight Transmitter	6.0	2.0	0.6	8.6	C	Y/N
	XI	Receiver Gauge (Elec. Or Pneu.)	3.0	1.0	0.6	4.6	A/C	Y/N
	XIT	Torque Indicator Transmitter	8.0	1.0	0.6	9.6	C	N
(note 9)	ZI	Position Indicator	3.0	2.0	0.6	5.6	N	N
(note 9)	ZS	Limit Switch	3.0	2.0	0.6	5.6	C	N
(note 9)	ZT	Position Transmitter	4.0	4.0	0.6	8.6	C	Y/N

FLUOR

CONTROL SYSTEMS UNIT WORK HOURS

A. FIELD MOUNTED INSTRUMENTS – con't.

FIELD MOUNTED INSTRUMENT NOTES

1. All work hour units in the **Install** column include unload, storage, specification verification, handling to erection site and installation of device, unless otherwise indicated by note 6.

2. All work hour units in the **Calibrate/Test** column are for initial bench calibration of "non-smart" instrument devices. For factory calibrated "smart" instrument devices, an allowance of one (1) work hour should be used to verify factory calibration.

3. **Loop Check** work hours are assigned to all devices in an effort to accumulate total work hours to check an entire control loop, even though some devices don't actually require wiring, tubing or a control check.

4. For the **Bulks Req'd?** column, use the following legend:
   A = Air Supply Bulks
   P = Process Bulks
   C = Conduit/ Field Wiring (to Field Junction Box)
   N = None required

   To determine labor work hours for "Bulks" installation, refer to either Fluor Daniel Standard Assemblies and/or specific client approved "Instrument Installation Details".

5. For **Stand Req'd?** column, use the following legend:
   Y = Yes
   N = No
   Y/N = Dependent upon installation method – see "Instrument Installation Details" or consult Control Systems lead engineer.

6. The "handling to erection site" and "installation" labor for this in-line device is included in the Piping Account (section 1500). All other activities for the **Install** column (see note 1) are included in the Control Systems account (section 1700).

7. This device (D/P Cell Flow Transmitter) should be used with the following Flow Elements (FE's):
   FE – Orifice Plate
   FE – Pitot Tube/Annubar
   FE - Venturi

8. This device (Flow Transmitter – Electronic Transducer) should be used with the following Flow Elements (FE's):
   FE – Coriolis Meter
   FE – Magnetic Flowmeter
   FE – Positive Displacement Flowmeter
   FE – Turbine Meter
   FE – Vortex Flowmeter

FLUOR

CONTROL SYSTEMS UNIT WORK HOURS

A. FIELD MOUNTED INSTRUMENTS – con't.

FIELD MOUNTED INSTRUMENT NOTES – con't.

9. These installation hours are for individually shipped components. Typically these devices are furnished pre-mounted to an associated Control Valve, therefore no installation labor is required. To verify installation requirements, consult Control Systems lead engineer.

10. Any supports required are not included.

11. For any activities that are not included in this section, see Means, Richardson or other recognized estimating publications.

FLUOR

CONTROL SYSTEMS UNIT WORK HOURS

B. CONTROL SYSTEMS PANELS & RACKS

CONTROL ROOM EQUIPMENT (DCS & PLC's)

DCS	WH's/EA
Equipment Racks or Panels (Haul/Set)	20
Panelboard or Console in Main Control Room (Haul/Set)	16
Marshalling Rack Components (Rails/Terminals – Install)	.06
Interconnecting Cables (Marshalling Rack to DCS) -	
30 feet - pulled & terminated:	
8 pair cable	8
Ribbon cable w/ prefab connectors	2
Loop check (per DCS/RTU/PLC point)	0.6

PLC's	WH's/EA
PLC Components (Haul/Set)	16

LOCAL PANELS

CATEGORY	WH's/EA
Annunciator	0.6 per Point/Window
Local Instrument Panel (Haul/Set)	20
Local Field Junction Box (Haul/Set)	In Electrical Section 1600
Local Power Panel (Haul/Set)	In Electrical Section 1600

PANEL MOUNTED INSTRUMENTS (CONTROL ROOM OR LOCAL PANELS) (see note 1)

CATEGORY		Install (note 2)	Calibrate/ Test (note 3)	Loop Check (note 4)	Total
FLOW DEVICES					
FIC	Flow Indicator Controller	6.0	4.0	0.6	10.6
LEVEL DEVICES					
LA	Level Alarm	1.0	1.0	0.6	2.6
LI	Level Indicator	4.0	4.0	0.6	8.6
PRESSURE DEVICES					
PA	Pressure Alarm	1.0	1.0	0.6	2.6
PIC	Pressure Indicator Controller	6.0	3.0	0.6	9.6
PS	Pressure Switch	3.0	1.0	0.6	4.6
TEMPERATURE DEVICES					
TA	Temperature Alarm	1.0	1.0	0.6	2.6
TS	Temperature Switch	3.0	1.0	0.6	4.6

FLUOR

CONTROL SYSTEMS UNIT WORK HOURS

B. CONTROL SYSTEMS PANELS & RACKS – con't.

PANEL MOUNTED INSTRUMENTS (CONTROL ROOM OR LOCAL PANELS) – con't. (see note 1)

CATEGORY		Install (note 2)	Calibrate/ Test (note 3)	Loop Check (note 4)	Total
MISC					
HIC	Hand Indicator Controller (Manual Loader)	2.0	1.0	0.6	3.6
II	Current Indicator	2.0	1.0	0.6	3.6
IS	Current Switch	2.0	1.0	0.6	3.6
IT	Current Transmitter	2.0	4.0	0.6	6.6
KC	Time Controller	2.0	3.0	0.6	5.6
KI	Electronic Timer	2.0	1.0	0.6	3.6
KS	Timer Switch	2.0	1.0	0.6	3.6
XA	Unclassified Alarm	1.0	1.0	0.6	2.6
XI	Unclassified Indicator	4.0	4.0	0.6	8.6
XIC	Unclassified Indicator Controller	6.0	4.0	0.6	10.6
XS	Unclassified Switch	3.0	1.0	0.6	4.6

CONTROL SYSTEMS PANEL & RACK NOTES

1. Panel mounted devices are typically pre-installed by the panel vendor, therefore no installation labor is required. To verify installation requirements, consult Control Systems lead engineer. If installation is required, see note 2.

2. All work hour units in the **Install** column include unload, storage, handling to erection site, panel cutout and installation of device.

3. All work hour units in the **Calibrate/Test** column are for initial bench calibration of "non-smart" instrument devices. For factory calibrated "smart" instrument devices, an allowance of one (1) work hour should be used to verify factory calibration.

4. Loop Check work hours are assigned to all devices in an effort to accumulate total work hours to check an entire control loop, even though some devices don't actually require wiring, tubing or a control check.

5. Any supports required are not included.

6. For any activities that are not included in this section, see Means, Richardson or other recognized estimating publications.

FLUOR

CONTROL SYSTEMS UNIT WORK HOURS

C. TUBING & FITTINGS

AIR SUPPLY BULKS

PIPE	WH's/LF
¼" thru 1"	0.10
1 ½"	0.20

FITTINGS - THREADED	WH's/EA
ELLS and COUPLINGS	
¼" thru ¾"	0.70
1"	0.90
1 ½"	1.30
TEES and UNIONS	
¼" thru ¾"	1.05
1"	1.35
1 ½"	1.95
CAPS	
¼" thru ¾"	0.35
1"	0.45
1 ½"	0.65
NIPPLES (TBE)	
¼" x 3"	0.01
½" x 3"	0.02
¾" x 3"	0.03
1" x 3"	0.04
1 ½" x 3"	0.05
SWAGE NIPPLES	
½" x ¼"	0.02
¾" x ½"	0.03
1" x ¾"	0.04
1 ½" x 1"	0.05
PLUGS	
¼" thru ¾"	0.02
1"	0.04
1 ½"	0.05
VALVES	
¼" thru ¾"	1.00
1"	1.20
1 ½"	1.80
MISC	
Purge Rotameter	0.70
Air Filter/Regulator	0.70

FLUOR

CONTROL SYSTEMS UNIT WORK HOURS

C. TUBING & FITTINGS – con't.

PROCESS BULKS

TUBING (note 3)	WH's/LF COPPER	SS
¼"	0.10	0.14
⅜"	0.12	0.16
½"	0.14	0.18

TUBING FITTINGS (Brass or SS)	WH's/EA
FEMALE & MALE CONNECTORS	
¼" OD x NPT ¼"	0.14
⅜" OD x NPT ¼"	0.15
½" OD x NPT ¼"	0.16
¼" OD x NPT ½"	0.16
⅜" OD x NPT ½"	0.17
½" OD x NPT ½"	0.19
⅜" OD x NPT ¾"	0.19
½" OD x NPT ¾"	0.20
UNIONS	
¼"	0.18
⅜"	0.19
½"	0.22
TEES	
¼"	0.21
⅜"	0.23
½"	0.29

TUBING VALVES (Brass or SS)	WH's/EA
TUBE ENDS, MNPT x TUBE, or FNPT x TUBE	
¼" x ¼"	0.18
⅜" x ⅜"	0.20
½" x ½"	0.25
½" x ¾"	0.27

MANIFOLDS	WH's/EA
½" MANIFOLD/3-VALVE -THRD	1.25
½" MANIFOLD/3-VALVE -THRD x FLGD	1.00

PRE-INSULATED TUBE BUNDLES	WH's/LF
(1) ⅜" OD COPPER	0.09
(1) ⅜" OD STAINLESS	0.11
(1) ½" OD COPPER	0.11
(1) ½" OD STAINLESS	0.13
(1) ⅜" COPPER & (1) ⅜" STAINLESS	0.18
(1) ⅜" COPPER & (2) ⅜" STAINLESS	0.22
(1) ⅜" COPPER & (2) ½" STAINLESS	0.26

FLUOR

CONTROL SYSTEMS UNIT WORK HOURS

C. TUBING & FITTINGS – con't.

PROCESS BULKS – con't.

TUBING RACEWAY & FITTINGS	WH's/LF
1" TUBE TRACK	0.30
2" TUBE TRACK	0.40
4" TUBE TRACK	0.60

TUBING & FITTING NOTES

1. All work hour units include unload, storage and handling to erection site.
2. Threaded fittings for Air Supply Bulks include handling, cutting, threading and joint make-up.
3. Work hour units per LF for Tubing are for wall thickness up to and including 0.049". For heavier wall tubing, increase work hour units proportionally.
4. Tubing fittings for Process Bulks include handling, cutting, deburring and joint make-up.
5. Any supports required are not included.
6. For any activities that are not included in this section, see Means, Richardson or other recognized estimating publications.

FLUOR

CONTROL SYSTEMS UNIT WORK HOURS

D. MOUNTING BRACKETS, STANDS & WEATHER-PROOF HOUSING

	TYPE	HANDLE	INSTALL	TOTAL
(note 3)	Wall or Surface Bracket (Fireproofed Column)	1.2	5.4	6.6
	Floor Stand – Small or Medium Device	1.2	4.6	5.8
	Floor Stand – Large Device	2.2	4.6	6.8
	Weather-Proof Housing (Body Case)	1.2	2.0	3.2
	Weather-Proof Housing (Full Enclosure)	2.2	8.0	10.2
	Weather-Proof Housing (Gauge)	1.2	1.0	3.2
	Line Pipe – Saddle Mount	1.2	4.0	5.2

BRACKET, STAND & HOUSING NOTES

1. All work hour units include unload, storage and handling to erection site.

2. Any additional supports required are not included.

3. For Non-Fireproofed column, use **4.6** work hours for Install labor.

4. For any activities that are not included in this section, see Means, Richardson or other recognized estimating publications.

FLUOR

PAINT & INSULATION UNIT WORK HOURS

A. PAINT

WH's PER SQUARE FOOT

	SURFACE PREP			PRIMER, INTERMEDIATE
	SP-6	SP-10	SP-5	& FINISH COATS (EACH)
1. STRUCTURAL STEEL				
LIGHT (20# and below)	0.0191	0.0221	0.0263	0.0100
MEDIUM & HEAVY (over 20#)	0.0159	0.0180	0.0206	0.0067
2. PIPE & VESSELS				
ALL	0.0142	0.0160	0.0183	0.0062

PAINT NOTES

1. All work hour units include unload, storage and handling to erection site.
2. All work hour units are based on "yard work" at grade prior to erection by spray application.
3. For application by brush and/or roller instead of spray, add **60%** to the above work hour units.
4. For "in-place work", add the following to the above work hour units:

Grade to 20'	**100%**
Over 20' to 50'	**120%**
Over 50' to 100'	**135%**
Over 100'	**150%**

5. Explanation of Steel Structures Painting Council (SSPC) specifications for Surface Preparation (SP):

SP-6	Commercial Blast Cleaning	Blast cleaning until at least two thirds of each element of surface area is free of visible residue (for high humidity chemical atmosphere, marine, or other corrosive environment).
SP-10	Near White Blast Cleaning	Blast cleaning nearly to white metal cleanliness until at least 95 percent of each element of surface area is free of all visible residues (for high humidity chemical atmosphere where high cost of cleaning is warranted).
SP-5	White Metal Blast Cleaning	Removal of all visible rust, mill scale, paint, and foreign matter by blast cleaning by wheel or mozzle (dry or wet) using sand, grit, or shot (for very corrosive atmosphere where high cost of cleaning is warranted).

FLUOR

PAINT & INSULATION UNIT WORK HOURS

A. PAINT – con't.

PAINT NOTES – con't.

6. Painting structural steel can be estimated on a "Per Ton" basis only when the square feet per ton can be determined. ***There are no averages that apply.*** For a comprehensive listing of square feet per lineal foot for various structural shapes and sizes, see Richardson.

7. The LIGHT structural steel category includes flange, channel, tee and angle shapes; ladders; cages; plate; grating; and other miscellaneous steel items.

8. Pipe diameter to square feet conversion (based on pipe O.D.):

Nominal Size	SQ. FT. per LF
3" & below	use 1.00
4"	1.18
6"	1.74
8"	2.26
10"	2.82
12"	3.34
14"	3.67
16"	4.19
18"	4.72
20"	5.24
24"	6.29
30"	7.86
36"	9.43
42"	11.00
48"	12.57

9. Pipe equivalent linear footage (**ELF**) factors (**note** - when taking off linear feet (LF) of pipe, measurement **must** be taken through all fittings, flanges, valves, instruments, specialty items and any other in-line appurtenances):

Fittings, flanges and valves:

ITEM	LF/EA
Fittings	0.2 times diameter
Flanges	2.0
Valves	8.0

(Fittings limited to welded and screwed ells, tees, reducers and caps – no pipe nipples, plugs, olets, unions, etc.; Flanges limited to line and orifice – no blinds or figure 8's; Valves open to all types)

FLUOR

PAINT & INSULATION UNIT WORK HOURS

A. PAINT – con't.

PAINT NOTES – con't.

10. Vessel square footage calculation:

    Shell: greatest circumference times straight length or height

    Elliptical heads (noncircular – most common is a 2:1 ratio): greatest diameter squared (squaring provides coverage for the elliptical shape)

    Hemispherical heads (circular): diameter squared times pi (3.1416), then divide by two

11. For removal of paint coatings, multiply the appropriate work hour unit above times **3.0**. Disposal of material generated during the removal process is **not** included.

12. **Field painting is typically a subcontract item**. *These work hours can be used as an aid for scheduling purposes.*

13. For any activities that are not included in this section, see Means, Richardson or other recognized estimating publications.

FLUOR

PAINT & INSULATION UNIT WORK HOURS

B. INSULATION

3. PIPE — WH's PER LF

HOT

GLASS FIBER	SINGLE LAYER		THICKNESS	DOUBLE LAYER	
Pipe Size	**1"**	**2"**	**3"**	**4"**	**5"**
2" & below	0.18	0.22	0.24	0.35	0.37
3"	0.18	0.22	0.24	0.36	0.40
4"	0.20	0.22	0.24	0.37	0.43
6"	0.24	0.24	0.27	0.43	0.46
8"	0.25	0.27	0.31	0.46	0.50
10"	0.28	0.31	0.33	0.50	0.55
12"	0.31	0.33	0.37	0.55	0.58
14"	0.32	0.35	0.39	0.57	0.61
16"	0.36	0.39	0.40	0.61	0.66
18"	0.38	0.40	0.43	0.66	0.71
20"	0.40	0.43	0.47	0.71	0.76
24"	0.47	0.50	0.53	0.82	0.95
30"	---	0.87	1.15	1.45	1.61
36"	---	1.04	1.42	1.73	1.89

MINERAL WOOL	SINGLE LAYER		THICKNESS	DOUBLE LAYER
Pipe Size	**1"**	**2"**	**3"**	**4"**
2" & below	0.18	0.22	0.24	0.35
3"	0.18	0.22	0.24	0.36
4"	0.20	0.22	0.24	0.37
6"	0.24	0.24	0.27	0.43
8"	---	0.27	0.31	0.46
10"	---	0.31	0.33	0.50
12"	---	0.33	0.37	0.55
14"	---	0.35	0.39	0.57
16"	---	0.39	0.40	0.61
18"	---	0.40	0.43	0.66
20"	---	0.43	0.47	0.71
24"	---	0.48	0.50	0.77
30"	---	0.92	1.22	1.53
36"	---	1.09	1.50	1.82

FLUOR

PAINT & INSULATION UNIT WORK HOURS

B. INSULATION – con't.

3. PIPE – con't. **WH's PER LF**

HOT – con't.

CALCIUM SILICATE

	SINGLE LAYER			DOUBLE LAYER		
	THICKNESS					
Pipe Size	**1"**	**2"**	**3"**	**4"**	**5"**	**6"**
2" & below	0.18	0.22	0.24	0.35	0.37	0.40
3"	0.18	0.22	0.24	0.36	0.40	0.44
4"	0.20	0.22	0.24	0.37	0.43	0.46
6"	0.24	0.24	0.27	0.43	0.46	0.50
8"	---	0.27	0.31	0.46	0.50	0.55
10"	---	0.31	0.33	0.50	0.55	0.58
12"	---	0.33	0.37	0.53	0.58	0.63
14"	---	0.35	0.39	0.55	0.61	0.66
16"	---	0.39	0.40	0.61	0.66	0.71
18"	---	0.40	0.43	0.66	0.71	0.76
20"	---	0.43	0.47	0.71	0.76	0.81
24"	---	0.50	0.53	0.81	1.05	1.12
30"	---	0.97	1.28	1.61	1.79	1.95
36"	---	1.15	1.58	1.92	2.10	2.27

COLD

CELLULAR GLASS OR POLYURETHANE

	SINGLE LAYER			DOUBLE LAYER			
	THICKNESS						
Pipe Size	**1½"**	**2½"**	**3½"**	**4½"**	**5½"**	**6½"**	**7½"**
2" & below	0.31	0.31	0.40	0.57	0.66	0.73	0.77
3"	0.31	0.40	0.47	0.66	0.75	0.81	0.86
4"	0.35	0.42	0.52	0.72	0.80	0.85	0.95
6"	0.42	0.52	0.60	0.80	0.93	1.00	1.13
8"	0.52	0.60	0.65	0.93	1.03	1.18	1.22
10"	0.60	0.68	0.80	1.03	1.12	1.20	1.30
12"	0.68	0.80	0.88	1.12	1.21	1.37	1.46
14"	0.73	0.85	0.94	1.16	1.31	1.43	1.48
16"	0.85	0.94	1.02	1.31	1.40	1.48	1.55
18"	0.94	1.02	1.11	1.40	1.48	1.57	1.68
20"	1.02	1.11	1.21	1.48	1.59	1.71	1.83
24"	1.21	1.28	1.38	1.73	1.83	1.92	1.98
30"	1.52	1.63	1.72	2.02	2.11	2.19	2.28
36"	1.81	1.90	1.99	2.29	2.38	2.45	2.53

FLUOR

PAINT & INSULATION UNIT WORK HOURS

B. INSULATION – con't.

4. EQUIPMENT **WH's PER SQUARE FOOT**

HOT

GLASS FIBER

	VERTICAL				HORIZONTAL	
Thickness	**Shell**	**Exposed Heads with Metal Jacket**	**Concealed Heads with Insulation Cement**	**Irregular Surfaces w/ Fabric & Mastic**	**Shell**	**Heads with Metal Jacket**
1" SL	0.14	0.42	0.28	0.56	0.15	0.45
2" SL	0.16	0.48	0.32	0.64	0.18	0.54
3" SL	0.18	0.54	0.36	0.72	0.20	0.60
4" DL	0.26	0.78	0.52	1.04	0.29	0.87
5" DL	0.28	0.84	0.56	1.12	0.31	0.93
6" DL	0.30	0.90	0.60	1.20	0.33	0.99

MINERAL WOOL

	VERTICAL				HORIZONTAL	
Thickness	**Shell**	**Exposed Heads with Metal Jacket**	**Concealed Heads with Insulation Cement**	**Irregular Surfaces w/ Fabric & Mastic**	**Shell**	**Heads with Metal Jacket**
2" SL	0.17	0.51	0.34	0.68	0.20	0.50
3" SL	0.19	0.57	0.38	0.76	0.22	0.55
4" DL	0.27	0.81	0.54	1.08	0.32	0.80
5" DL	0.29	0.87	0.58	1.16	0.34	0.85
6" DL	0.32	0.96	0.64	1.28	0.35	0.88

***SL = Single Layer**
***DL = Double Layer**

***Irregular Surfaces include Pumps, Turbines, Compressors, etc.**

FLUOR

PAINT & INSULATION UNIT WORK HOURS

B. INSULATION – con't.

4. EQUIPMENT – con't. **WH's PER SQUARE FOOT**

HOT – con't.

CALCIUM SILICATE

	VERTICAL				HORIZONTAL	
Thickness	**Shell**	**Exposed Heads with Metal Jacket**	**Concealed Heads with Insulation Cement**	**Irregular Surfaces w/ Fabric & Mastic**	**Shell**	**Heads with Metal Jacket**
2" SL	0.20	0.50	0.40	0.80	0.24	0.72
3" SL	0.21	0.53	0.42	0.84	0.26	0.78
4" DL	0.26	0.65	0.52	1.04	0.40	1.20
5" DL	0.27	0.68	0.54	1.08	0.42	1.26
6" DL	0.29	0.73	0.58	1.16	0.45	1.35

COLD

CELLULAR GLASS OR POLYURETHANE

	VERTICAL				HORIZONTAL	
Thickness	**Shell**	**Exposed Heads with Metal Jacket**	**Concealed Heads with Insulation Cement**	**Irregular Surfaces w/ Fabric & Mastic**	**Shell**	**Heads with Metal Jacket**
1½" SL	0.32	0.96	0.64	1.28	0.34	0.85
2½" SL	0.35	1.05	0.70	1.40	0.37	0.93
3½" DL	0.53	1.59	1.06	2.12	0.56	1.40
4½" DL	0.56	1.68	1.12	2.24	0.59	1.48
5½" DL	0.61	1.83	1.22	2.44	0.64	1.60
6½" DL	0.63	1.89	1.26	2.52	0.66	1.65
7½" DL	0.66	1.98	1.32	2.64	0.70	1.75

***SL = Single Layer**
***DL = Double Layer**

***Irregular Surfaces include Pumps, Turbines, Compressors, etc.**

FLUOR

PAINT & INSULATION UNIT WORK HOURS

B. INSULATION – con't.

INSULATION NOTES

1. All work hour units include unload, storage and handling to erection site.

2. All work hour units are based on "in-place work" from Grade to 20'. For elevated work, add the following to the above work hour units:

Over 20' to 50'	**20%**
Over 50' to 100'	**35%**
Over 100'	**50%**

3. Applications below minus 150 degrees F are termed cryogenic; those above 1500 degrees F are termed refractory; these categories are **not** included in these work hour units.

4. The use of insulation materials to absorb noise emitted from piping and equipment is classified as noise abatement; this application is **not** included in these work hour units.

5. Insulation thickness for all materials are available in ½" increments. The use of whole sizes for HOT and half sizes for COLD was done intentionally to emphasize the differences between their respective applications. For any thickness required that is not listed, simply use the midpoint between the lower and higher thickness columns.

6. For all types of HOT Pipe insulation (Glass Fiber, Mineral Wool and Calcium Silicate), the work hour units are based on the following erection method:

   Pipe cover is secured with 16-gage wire on 9-inch centers. Weatherproof jacket with moisture barrier is secured with ½" wide by 0.015 inch thick SS bands and seals on 9-inch centers.

7. For all types of COLD Pipe insulation (Cellular Glass and Polyurethane), the work hour units are based on the following erection method:

   Joints are buttered with joint sealer. Pipe cover is secured with fiberglass tape on piping 4 inches OD (Outside Diameter) and smaller spaced on 9-inch centers. On piping above 4 inches OD, use ½" wide by 0.015 inch thick SS bands and seals spaced on 9-inch centers. Vapor barrier mastic (3/16" Total Wet Film) reinforced with polyester fabric. Weatherproof jacket with moisture barrier is secured with ½" wide by 0.015 inch thick SS bands and seals on 9-inch centers.

FLUOR

PAINT & INSULATION UNIT WORK HOURS

B. INSULATION – con't.

INSULATION NOTES – con't.

8. For all types of HOT Equipment insulation (Glass Fiber, Mineral Wool and Calcium Silicate), the work hour units are based on the following erection method:

   Shell cover (blanket or block) is applied with staggered joint arrangement. Top and bottom edges are securely tied over support rings with wire on 12-inch centers. Vertical and horizontal seams are laced together by interlocking the wire mesh and with wire ties where necessary. The insulation is secured in place with bands spaced on 12-inch centers.

   Head cover is shaped so that all sections closely fit the contour of the head and are laced together with wire, or are secured with bands on 12-inch centers at tangent line. Exposed head cover is secured with bands attached to a ¼" round steel rod, with a floating ring on the top and a circumferential band at the tangent line of the vessel head. Unexposed head cover is secured with wire to insulation supports provided by the vessel manufacturer.

   Weatherproof jacket on vertical equipment is supported on S-clips spaced on 4-foot centers. The jacketing for vertical and horizontal equipment is secured with bands spaced on 12-inch centers with one band at each circumferential lap. On vertical equipment, band loops are included on each band to prevent vertical movement. Weatherproof jacket on exposed vessel heads is a flat metal sheet cut into "pie" pieces and secured with screws on 3-inch centers.

9. For all types of COLD Equipment insulation (Cellular Glass and Polyurethane), the work hour units are based on the following erection method:

   Shell cover (block) is applied with staggered joint arrangement. Joints are buttered with joint sealer. In double layer applications, the inner layer is applied without joint sealer. Each layer is secured with bands on 12-inch centers. Outer layer joints are offset from inner layer joints. Vapor barrier is outer layer only. Joints are sealed with a foil-to-mylar 3-inch wide strip applied over the vapor barrier. Contraction joints are included as 1½" wide, packed with 2" of fiberglass blanket material, on 12-foot maximum centers.

   Head cover is shaped so that all sections closely fit the contour of the head. Joints are buttered with joint sealer. In double layer applications, the inner layer is applied without joint sealer. . Exposed head cover is secured with bands attached to a ¼" round steel rod, with a floating ring on the top and a circumferential band at the tangent line of the vessel head. Unexposed head cover is secured with wire to insulation supports provided by the vessel manufacturer.

   Weatherproof jacket on vertical equipment is supported on S-clips spaced on 4-foot centers. The jacketing for vertical and horizontal equipment is secured with bands spaced on 12-inch centers with one band at each circumferential lap. Each band is equipped with one breather spring.

FLUOR

PAINT & INSULATION UNIT WORK HOURS

B. INSULATION – con't.

INSULATION NOTES – con't.

10. Pipe equivalent linear footage (**ELF**) factors (**note** - when taking off linear feet (LF) of pipe, measurement **must** be taken through all fittings, flanges, valves, instruments, specialty items and any other in-line appurtenances):

    Fittings, flanges (per pair) and non-flanged valves:

Nominal size	LF/EA
1" & below	2.0
1½" thru 6"	3.0
Above 6"	0.5 times nominal size

    (Fittings limited to welded and screwed ells, tees, reducers and caps – no pipe nipples, plugs, olets, unions, etc.; Flanges limited to line and orifice – no blinds or figure 8's; Valves open to all types)

    Flanged valves and flanged fittings: one fitting **plus** one pair of flanges

    Pipe bends: 3 times the length of the bend

11. Vessel square footage calculation:

    Shell: greatest circumference (including insulation thickness on both sides) times straight length or height, plus one foot at each end.

    Elliptical heads (noncircular – most common is a 2:1 ratio): greatest diameter (including insulation thickness on both sides) squared
    (squaring provides coverage for the elliptical shape)

    Hemispherical heads (circular): diameter (including insulation thickness on both sides) squared times pi (3.1416), then divide by two

12. For removal of insulation, multiply the appropriate work hour unit above times **0.3**. Disposal of material generated during the removal process is **not** included.

13. **Field insulation is typically a subcontract item**. *These work hours can be used as an aid for scheduling purposes.*

14. For any activities that are not included in this section, see Means, Richardson or other recognized estimating publications.

FLUOR

DEMOLITION UNIT WORK HOURS

CAUTION! - This section should be used as a general guideline when developing work hours for a demolition scope of work. Typically, it is more accurate to develop demolition hours from a crew basis methodology, due to the potential volume fluctuations in any given category. Thus, the use of the units below could over- or under-exaggerate the true effort required. Also, the categories below represent only those areas in which there has been sufficient Fluor Daniel history to support their inclusion in this manual. For any activities not listed below, consult the appropriate erection work hour section for use as a guideline as well as consulting the appropriate construction department personnel.

DESCRIPTION	WH's	UNIT
A. GENERAL SITEWORK		
Bituminous Pavement, 3" thick	0.07	SY
Bituminous Pavement, 4" to 6" thick	0.11	SY
Chain Link Fence and Gates	0.14	LF
B. BUILDINGS		
Dust Partition, 6 mil. Poly, 2 X 4 Frame (Erect and dismantle)	0.05	SQ.FT.
Dust Partition, 5/8" plywood, 2 X 4 Frame (Erect and dismantle)	0.07	SQ.FT.
Masonry (minimum reinforcing)	0.32	CU.FT.
Steel Frame		
Light	17.0	TON
Medium	14.0	TON
Heavy	12.0	TON
Metal/Wood studs, drywall 2 sides	0.05	SQ.FT.
Wood Framing, Joists (total ceiling area)	0.025	SQ.FT.
Roofing – built up with gravel	0.05	SQ.FT.
Roofing – built up without gravel	0.03	SQ.FT.
Roofing – Metal	0.025	SQ.FT.
Metal Decking	0.02	SQ.FT.
Metal Siding	0.023	SQ.FT.
Metal Siding – New Penetrations	0.15	SQ.FT.
Drywall (one side only)	0.02	SQ.FT.

FLUOR

DEMOLITION UNIT WORK HOURS

DESCRIPTION	WH's	UNIT
C. CONCRETE		
Concrete Slab on Grade (by machine)	5.0	CY
Small Equipment Foundations (by jackhammer)	25.0	CY
Equipment Foundations in Existing Facilities (by jackhammer)	25.0	CY
Foundations Accessible by Major Equipment	10.0	CY
Haul and Dispose Onsite (within 1 mile radius)	0.25	CY
Sawcutting		
4" thick	0.15	LF
6" thick	0.20	LF
8" thick	0.25	LF

FLUOR

DEMOLITION UNIT WORK HOURS

D. PIPING

IN-PLACE PIPE CUTS **WH's EACH**

Pipe Size	STD	XS	S/10	S/20	S/30	S/40	S/60	S/80	S/100	S/120	S/140	S/160	XXS
½"	0.25	0.25				0.25		0.25				0.25	0.25
¾"	0.25	0.25				0.25		0.25				0.29	0.29
1"	0.25	0.25				0.25		0.25				0.36	0.36
1 ½"	0.25	0.25				0.25		0.25				0.49	0.49
2"	0.25	0.30				0.25		0.30				0.60	0.60
3"	0.34	0.42				0.34		0.42				0.84	0.84
4"	0.43	0.52				0.43		0.52		1.0		1.0	1.0
6"	0.60	0.73				0.60		0.73		1.5		1.5	*1.5
8"	0.76	0.92		0.76	0.76	0.76	0.92	0.92	1.8	1.8	*1.8	*1.8	*1.8
10"	0.92	1.1		0.92	0.92	0.92	1.1	1.1	2.2	*2.2	*2.2	*2.2	*2.2
12"	1.1	1.3		1.1	1.1	1.3	1.3	1.3	*2.6	*2.6	*2.6	*2.6	*2.6
14"	1.2	1.4	1.2	1.2	1.2	1.4	1.4	*1.4	*2.8	*2.8	*2.8	*2.8	
16"	1.3	1.6	1.3	1.3	1.3	1.6	1.6	*1.6	*3.2	*3.2	*3.2	*3.2	
18"	1.4	1.8	1.4	1.4	1.8	1.8	*1.8	*1.8	*3.5	*3.5	*3.5	*3.5	
20"	1.6	1.9	1.6	1.6	1.9	1.9	*1.9	*1.9	*3.9	*3.9	*3.9	*3.9	
24"	1.9	2.3	1.9	1.9	2.3	2.3	*2.3	*2.3	*4.5	*4.5	*4.5	*4.5	
30"	2.3	2.7	2.3	2.7	2.7	2.7							
36"	2.6	3.2	2.6	3.2	3.2	3.2							

PIPING DEMOLITION NOTES

1. Work hour units include flame cutting of pipe only.
2. ** Indicates wall thickness equal to or greater than ¾" thick (0.750").*
3. For handling of demolished pipe, see Piping Unit Work Hour's section, Handling Notes.
4. For unbolting of demolished pipe, see Piping Unit Work Hour's section, Bolt-up Notes.

FLUOR

TYPICAL COMPOSITE CREW MIXES

00 EARTHWORK CREWS

Crew Make Up	# Per Crew	Typical Work Activities
General Foreman	0.33	Load, Haul and Dump
Foreman	1.00	Excavation
Operator	3.00	Trenching
Truck Driver	6.00	Bedding
Labor/Utility Man	4.00	Backfill
	14.33	Compaction
		Finish Grading
		Site Finish

10 CONCRETE CREWS

General Foreman	0.33	Formwork
Foreman	1.00	Rebar
Carpenter	3.00	Wiremesh
Carpenter Apprentice	1.00	Embedded Items
Ironworker	3.00	Place and Finish
Ironworker Apprentice	2.00	
Cement Finisher	1.00	
Operator	0.50	
Truck Driver	0.25	
Labor/Utilityman	3.00	
	15.08	

20 STRUCTURAL STEEL CREWS

General Foreman	0.33	Structural Steel
Foreman	1.00	
Ironworker	6.00	
Ironworker Apprentice	2.00	
Operator	2.00	
Truck Driver	0.50	
Labor/Utilityman	1.00	
	12.83	

FLUOR

TYPICAL COMPOSITE CREW MIXES – con't.

Crew Make Up	# Per Crew	Typical Work Activities

30 ARCHITECTURAL/HVAC CREWS

None provided – this account is typically sub-contracted.
If required, see Means, Richardson or other recognized estimating publications.

40 EQUIPMENT CREWS

General Foreman	0.33	Equipment
Foreman	1.00	
Pipefitter	4.00	
Millwright	2.00	
Millwright Apprentice	2.00	
Boilermaker	2.00	
Boilermaker Apprentice	1.00	
Ironworker	0.50	
Operator	0.50	
Truck Driver	1.50	
	14.83	

50 PIPING CREWS

General Foreman	0.50	Piping
Foreman	1.50	
Pipefitter	3.00	
Pipefitter Apprentice	2.00	
Pipefitter Welder	5.00	
Operator	1.50	
Truck Driver	0.50	
Labor/Utilityman	1.00	
	15.00	

60 ELECTRICAL CREWS

General Foreman	0.33	Electrical Bulks and Equipment
Foreman	1.00	
Electrician	6.00	
Electrician Apprentice	3.00	
Truck Driver	0.50	
Labor/Utilityman	1.00	
	11.83	

FLUOR

TYPICAL COMPOSITE CREW MIXES – con't.

Crew Make Up	# Per Crew	Typical Work Activities
70 CONTROL SYSTEMS CREWS		
General Foreman	0.33	Instrumentation
Foreman	1.00	
Instrument Fitter	5.00	
Instrument Fitter Apprentice	1.00	
Truck Driver	0.25	
	7.58	
81 PAINTING CREWS		
General Foreman	0.33	Painting
Foreman	1.00	
Painter	8.00	
Painter Apprentice	4.00	
	13.33	
82 INSULATION CREWS		
General Foreman	0.33	Insulation
Foreman	1.00	
Insulator	5.00	
Insulator Apprentice	5.00	
	11.33	

FLUOR

FINAL PHASES OF CONSTRUCTION

The intent of this section is to provide the estimator with <u>generic</u> guidelines for the final phases of the construction work under a contract. It covers mechanical completion, turnover, commissioning, startup, performance testing and final acceptance.

I. OVERVIEW

SCOPE

There is a typical breakdown of the division of responsibilities between Fluor and the Client for operations during these final phases of the construction work. This section does not contain all items required to perform field checkout, and is not intended for such use. Where Fluor is the Managing Contractor, a further breakdown may be needed. Requirements in these final phases vary widely from contract to contract and specific contractual provisions have precedence over material herein. The Project Manager and the Construction Manager must be familiar with the requirements in their particular contract related to these final phases and plan and prepare for their execution well in advance of the completion of construction. The Proposal Manager must see that the scope of work and the estimate both cover these final phases of the work, when applicable, and are consistent with one another.

DEFINITIONS

Mechanical Completion generally means that the facility (plant, unit, system of any part thereof) has been erected in accordance with drawings, specifications, applicable codes and regulations, including all tests and checks necessary to permit commencement of commission and startup operations by the Client.

Turnover is the process of transferring principal responsibility of the plant, unit, or any part thereof, from Fluor to the Client. This activity generally involves formal transfer of care, custody and control to the Client.

Commissioning consists of activities associated with the operation of items of equipment or facilities in preparation for plant startup and introduction of feed stock. These activities are the Client's responsibility unless the contract specifically provides otherwise. Note that the word "commissioning" in electrical contracts has a different context. It means all work necessary to energize the equipment, normally performed by Fluor (or subcontractor) prior to turnover to the Client.

Startup commences when steps are taken to introduce feed stocks and bring the unit/plant to operating pressure and temperature. It is complete when the unit/facility is operating at design capacity and producing to specifications as determined by performance testing. Startup activities are the Client's responsibility unless the contract specifically provides otherwise.

Performance Tests are limited periods of operation of a facility/unit to demonstrate that it will produce product of the quality and quantity guaranteed by Fluor or a Licensor.

Final Acceptance is the documentation that the work under the contract has been completed and is accepted by the Client.

FLUOR

FINAL PHASES OF CONSTRUCTION

I. OVERVIEW – con't.

MECHANICAL COMPLETION

Mechanical completion is generally declared at the stage of the work where the construction crew has essentially completed the installation and a shift in primary emphasis and responsibility from Fluor Daniel to the Client is desired and agreed upon by the parties. Incomplete work and deficiencies, if any, will be identified with the declaration of mechanical completion. Any completed unit or definable entity may be agreed to be mechanically complete independently of the status of the remainder of the work. Prior to mechanical completion any commissioning/startup activities must be subordinated to the work of construction. After mechanical completion, the commissioning/startup operations will have priority over the construction work and the latter must necessarily be limited.

It is a requisite to mechanical completion that all equipment, piping, instrumentation and electrical systems be installed. It is desirable that all specification required adjustments and tests for which the construction crew is responsible be completed prior to declaring mechanical completion. For electrical systems, all tests, relay setting and checkouts must be completed prior to energization. However, some activities require that equipment be hot, energized, or actually running, so it is usual to retain a small crew of millwrights, electricians and others to accomplish that work after mechanical completion under the supervision of the Client during the commissioning or startup phase. Usually, mechanical completion is agreed upon while there is still some insulation and painting to be done, the area must still undergo final cleanup, scaffolding and temporary structures must be removed, and the construction crew and equipment must be demobilized.

The mechanical checkout is conducted by the construction group and usually verified by members of the Client team. It should include a review of reports of tests conducted by the construction group and subcontractors such as pressure tests, electrical measurements, loop checks, and rotational direction checks to assure that all items have been covered. Detailed inspection tours should be made to determine that: features affected by flow direction (such as meters) are properly oriented; facilities for by-passing, blocking and blinding are properly located; temporary blinds and other provisions required only for testing have been removed; and any other mechanical condition which may delay or complicate the startup has been properly accommodated. For some contracts, a licensor may be involved in checkout.

Fluor Daniel process and instrumentation personnel conduct the final P&ID check sometimes with members of the Client startup crew. It is a line-by-line, feature-by-feature check of the installation against the mechanical flow sheets and thoroughness is essential to minimize commissioning and startup difficulties and delays. It must be conducted prior to mechanical completion so the construction crew may correct any discrepancies uncovered.

It is generally advantageous that mechanical completion be agreed upon as early as practical, but it is a definite disadvantage to have any appreciable construction personnel finishing up construction work during commissioning or startup operations. The Project and Construction Managers must consider both factors before requesting or agreeing to a declaration of mechanical completion.

Notice of mechanical completion is usually formal notice to the Client that commissioning operations can commence.

FLUOR

FINAL PHASES OF CONSTRUCTION

I. OVERVIEW – con't.

TURNOVER

Turnover is the sequence of events leading to transfer of principal responsibility for a unit or system from the construction crew to a Client commissioning or startup crew. It is the demarcation between the construction phase and commissioning/startup operations. Under many contracts, this is the point at which transfer of care, custody and control is made to the Client. Transfer of care, custody and control of work done by subcontractors must be done as specified in the subcontract terms.

Even when the commissioning/startup is done by Fluor personnel, there should be a formal transfer and acceptance of responsibility at this point. Insurance coverage may be altered at this point and certain payments may also be dependent thereon. The Project Manager must see that any such matters related to this point of progress are properly administered.

COMMISSIONING

The commissioning phase of the work generally commences shortly before plant mechanical completion and terminated prior to the introduction of feed stock. It may include final checkout and cleanup, run-ins, charging of catalysts, flushing, purging, and energizing systems.

Crews for commissioning operations may consist entirely of Fluor personnel, entirely of Client's personnel, or a mixture of the two. General responsibility for this phase of the work will be established by the contract, but it is most important that the make-up of the crews for each activity be established early and that responsibilities for specific functions be agreed upon and established.

Flushing of the process equipment and piping with oil (water or other liquids in Chemical plants), and blowing out of air and steam lines to remove dirt, welding slag and other construction debris will reduce startup difficulties. The run-in of mechanical equipment, whether conducted by Fluor or Client crews, is an important prelude to startup. The manufacturers' recommendations should be closely followed and all possible adjustments of alarms, controls and auxiliary equipment should be made during the run-ins.

STARTUP

Startup commences when steps are taken to introduce feed stocks and to bring the system/unit/plant to operating pressure and temperature. It is complete when the unit/plant is operating at design capacity and producing to specifications as determined by performance testing. These operations are the responsibility of and accomplished under the direction of the Client.

Thorough planning and preparation are essential to a successful startup. Preparations should include a review of prior documentation to insure that mechanical and flowsheet checkout occurred prior to mechanical completion, that the equipment and piping has been thoroughly flushed, and that the commissioning phase is complete.

With thorough preparations having been made, the introduction of feed stocks, lighting-off of fires, and initiation of circulation can proceed. The Operating Manuals of the process designer and of vendors afford detailed instructions for each step of the startup, and the startup crew must become intimately familiar with them well in advance and during dry-runs and run-ins. The startup should proceed in orderly steps and with deliberate speed, with all feasible checking between each step.

FLUOR

FINAL PHASES OF CONSTRUCTION

I. OVERVIEW – con't.

PERFORMANCE TESTS

Performance test are usually run after the completion of startup operations and conducted by the Client's production crew with Fluor and any involved Licensor being represented. Performance tests may not be required under all contracts.

Performance tests, when required, are prerequisites to final acceptance, and often to final payments to Fluor. Frequently, there is little or no incentive for the Client to expedite performance test runs and the Project Manager must be diligent in his efforts to get them successfully completed.

It is necessary to take confirming data during the tests. Critical instruments should be calibrated immediately prior to the test run. There should be prior agreement on what data will be determined and reported, as well as the condition under which the test will be conducted. The methods of taking and analyzing samples often prove critical to the success of a test run. The means of calculating and evaluating results should also be agreed upon in advance.

FINAL ACCEPTANCE

Final Acceptance usually is initiated by a Project Manager prepared Notice of Completion letter to the Client stating that Fluor's work has been completed and requesting acceptance thereof.

Portions of the work may be subject to individual letters of acceptance if the Client wishes to take control of them in advance of overall completion. A formal acceptance of the overall work should be requested even if piece-meal acceptance of the many elements of work has been exercised. Fluor acceptance of (sub) contractor's work shall be as prescribed by the (sub) contract terms.

Final acceptance may be in order after mechanical completion, after initial operations, or only after completion of performance testing. In any case the Project Manager must prepare the letter requesting acceptance promptly when it is in order, and he must follow-up until the Client's acceptance is received.

FLUOR

FINAL PHASES OF CONSTRUCTION

II. CONSTRUCTION

GENERAL

Inspection and Testing

1) Inspect and check the work during the construction stage and perform such non-operational tests as are necessary to assure the integrity of the installation in accordance with Drawings, Specifications and vendor's instructions.
2) Witness tests conducted in accordance with 1) above as required and signify acceptance upon successful completion of each test.

Cleanup

1) Remove and dispose of all construction debris and leave all areas of the Work clean.
2) Remove all temporary supports, bracing, tiedown, rust preventatives, and like materials provided for protection during the shipping, storage and installation phases.

Lubrication and Prime Charges

1) Perform initial lubrication of all moving parts in accordance with vendor's instructions and standard practices.
2) Make initial charge of non-production materials such as refrigerants, desiccants, transformer oil, ion exchange resin and the like.

Vendor's Representatives

1) For Fluor purchased equipment/material, arrange for, control, and reimburse vendor specialists and representatives required to assure that the installations are made in accordance with design and vendor's instructions.
2) For Owner purchased equipment/material, arrange for, control, and reimburse vendor specialists and representatives required to assure the installations are made in accordance with design and vendor's instructions.

Approvals and Certifications

1) Obtain any permits and approvals from governmental and regulatory agencies required to be in the name of Contractor.
2) Obtain any permits and approvals from governmental and regulatory agencies required to be in the name of the owner

BUILDINGS

1) Checkout electrical and mechanical equipment such as lighting, fans and air conditioners to extent required to verify its operability.
2) Install furniture described on the drawings including laboratory benches and personnel lockers.

FLUOR

FINAL PHASES OF CONSTRUCTION

II. CONSTRUCTION – con't.

EQUIPMENT

Vessels/Tanks

1) Install internals (including support screens) and, if specified, conduct tray leakage or other tests to check integrity of field installed internals.
2) Pressure test, clean, and dry out after test.
3) Supply and install all packing for towers and drums including inert material as well as packing rings and balls.
4) Dry out, cure, or otherwise treat as required by specification linings of drums, towers and tanks *when such treatment is prerequisite to further work required for mechanical completion*.
5) Clean towers, drums and tanks, which have been opened and make final closures.
6) Inspect internals, witness tests and signify acceptance and authorization for final closure or waiver of closure (by Client).

Exchangers

1) Apply pressure tests, (if required), clean, dry, and close after tests.
2) Check fans of air coolers for direction of rotation, proper clearance and specified blade pitch and establish that vibration is within specified limits. Check for header movement clearance and removal of shipping clips.
3) Clean cooling tower basin, install screens in suction pit, check rotation of fans and pumps, and wet down tower if excessive drying-out of wooden parts is likely.

Fired Heaters and Boilers

1) Hydrotest all heaters and boilers which have not been shop tested.
2) Dry out, cure, or otherwise treat as specified any liners where damage may occur if action is deferred or where such action is requisite to other work, which must be completed before mechanical completion.
3) Perform functions set forth in item 2, above, when they can be deferred to the commissioning phase of the work (by Client).
4) Blow fuel lines and connect burner piping after check for cleanliness.
5) Check registers and dampers for ease of operation and positioning of indicators.

Compressors and Generators

1) After the machines and their drivers have been assembled and installed in accordance with the vendor's instructions, "bar-over" or otherwise mechanically rotate each machine as required for cold alignment and determine that it is free to rotate.
2) Check for and eliminate any loads imposed on the machine or piping or other connections.
3) Provide the specified oil for charging the lube and seal oil systems (by Client).
4) Flush lube and seal oil systems and replace dirty oil with new oil.
5) Set, checkout, and adjust the alarm and shutdown systems to the extent possible without power application.
6) Adjust tension of all springs and all compression washers on compressor discharge bottles and all compressor piping per drawings and specifications.

FLUOR

FINAL PHASES OF CONSTRUCTION

II. CONSTRUCTION – con't.

EQUIPMENT – con't.

Pumps

1) Rotate pumps by hand to ascertain that they turn freely.
2) After pumps and drivers have been set and grouted, align and connect the couplings.
3) Install any packing or mechanical seals not installed by the vendor, using temporary packing where it can be expected that flushing operations would damage the permanent material.
4) Replace temporary packing with permanent packing and replace mechanical seals damaged during flushing operations.
5) Check for and eliminate any loads imposed on the pumps by connections thereto when in the cold condition. When elimination of vertical loading is not practical because of support location, check horizontal loads only.

Material Handling and Other Process Equipment

1) Install all components of equipment and auxiliary parts furnished by vendors.
2) Rotate under no-load conditions, equipment such as filters and rotary mixers to determine operability.
3) Check direction of rotation of all rotating equipment.
4) Level and calibrate weight scales and weigh hoppers and set tare weight when applicable (tare is the weight of a container deducted from the total weight of the contents or load).
5) Under no-load conditions, perform running alignment of bag splitters, sewing machines and like packaging equipment and synchronize with conveying equipment.

Fire, Safety, and Miscellaneous Equipment

1) Test delivery of any new water wells drilled and flush wells when required (by Client).
2) Install any temporary piping required for the operation of new water wells.
3) Test and adjust, when necessary, all safety devices.
4) Test gas fire extinguisher system (C02 or Halon) and replace discharged cylinders with full cylinders. Test and recharge dry-type extinguisher systems.
5) Furnish full cylinders of fire extinguisher gas (by Client).
6) Prior to equipment testing, remove all safety devices such as rupture discs and safety valves, and replace after testing.
7) Install hose carts, portable extinguishers, hose stretchers, first aid kits, and similar fire and safety equipment that is Contractor furnished.
8) Inspect expansion joints, snubbers and spring or Teflon mounted equipment for proper alignment.

FLUOR

FINAL PHASES OF CONSTRUCTION

II. CONSTRUCTION – con't.

PIPING

1) Pressure test all piping not open to atmosphere, using water or other liquid, air or other gas, or the material conveyed in the line, as required by the pressure testing specification. Provide temporary supports and block spring hangers if required, and remove after hydrotesting.
2) Witness pressure testing and issue acceptance statement covering piping tested.
3) Adjust pipe hangers and guides to provide for slope, anchoring, free movement or cold springing as required in the specifications and drawings.
4) Prior to testing, remove any control valves, orifice plates, and like items that might be damaged in testing and reinstall after testing is completed as required by the specifications.
5) Install line vents and drains, temporary strainers, spectacle blinds, temporary blinds, and start-up bypasses in accordance with the drawings and specifications.
6) Remove blanks and install spectacle blinds to required position after pressure testing.
7) Provide purging material and purge lines in preparation for welding.
8) Make all piping tie-ins within the work area except those requiring 'hot taps". Obtain work permit if required.
9) Make all piping tie-ins outside the work area and tie-ins anywhere requiring "hot tap".
10) Test all welds and fittings of "hot tap" tie-ins in accordance with the pressure testing specification.
11) Adjust pipe spring hangers to indicated cold load settings after pressure tests and removal of shipping restraints. Record settings.
12) Install correct permanent packing and lubricant in valves and operators.
13) Check location and position of pipe guides, anchors and directional anchors.
14) Conduct chemical/mechanical cleaning operations as required by drawings/specifications where such operations can be done without using permanently installed equipment.

ELECTRICAL

1) Perform a dc high potential test on installed power cable rated above 1 kV in accordance with the specification covering electrical work.
2) Measure and record the insulation resistance of all power, control, and lighting circuits from phase to phase and from each phase to ground.
3) Measure and record the insulation resistance between the primary and secondary windings and between each winding and ground for each power transformer installed.
4) Measure and record phase to phase and phase to ground insulation resistance of each switchgear bus (also, verify the torque of bus splices) and phase to ground insulation resistance of associated control circuits.
5) Measure dielectric strength of insulating liquid in power transformers, circuit breakers, and disconnect switches. Also, check the nitrogen pad and liquid levels.
6) Set and test fault pressure relays and transformer taps.
7) Set and test all adjustable relays and direct action trip devices in accordance with the design.
8) Close and trip each circuit breaker and check operation of lockout devices, if provided.
9) Check operation of automatic transfer provisions under simulated fault and under-voltage conditions.
10) Check phase to phase and phase to ground insulation resistance of all motor control buses.
11) Set and check all alarm, shutdown, timer and sequential operation systems for proper operability, simulating actual operations where necessary.

FLUOR

FINAL PHASES OF CONSTRUCTION

II. CONSTRUCTION – con't.

ELECTRICAL – con't.

12) Measure insulation resistance of winding of all motors 5 HP or larger.
13) Dry out winding of transformers, generators and motors if insulation resistance tests indicate need.
14) Momentarily energize all 3-phase motors to check direction of rotation.
15) Test all electrical alarms by simulating abnormal conditions.
16) Install lamps (incandescent bulbs, fluorescent tubes, etc.) required to fill the fixtures and verify all lights burn and light switches operate properly. Test photocells for proper operation.
17) Conduct any tests required to determine illumination level.
18) Measure resistance to earth for each grounding system.
19) Check phase sequence and polarity and tag wiring in accordance with the drawings and specifications.
20) Check operating functions of any emergency and/or standby power system and battery chargers including the uninterruptible power supply systems.
21) Uncouple motors to be run in, run per vendor or design requirements, and recouple upon completion of that operation.
22) Install sealing compound in all seals.
23) Check operability of Contractor installed communications systems.
24) Record and report all tests conducted.
25) Energize and de-energize temporary facilities as required for above activities.
26) Witness such tests as required and promptly issue approvals upon successful conclusion thereof.

CONTROL SYSTEMS

1) Check instruments supplied against specification (type, range, material, etc.).
2) Install instruments and make all specified connections.
3) Perform pressure tests on instrument air piping and tubing.
4) Blow-out instrument air piping and tubing with dry air before reconnecting after pressure tests. Set instrument air pressure regulators.
5) Check entire instrumentation system for proper installation including tagging, supports, accessibility, correct material and ratings of fittings. Synchronize transmitter and receiver readings for each instrument.
6) "Stroke" control valves and adjust the valve movement and positioner action as required. Also check for proper direction of movement upon air failure and proper flow direction through the body.
7) Check instruments for proper electrical and mechanical operation.
8) Check instrument "loops" for continuity, completeness and identification, applying simulated signals when practical (loop continuity checks should be performed back to the DCS).
9) Fill manometers, draft gauges and like instruments with the proper fluids.
10) Test annunciator and individual alarms by simulating alarm conditions or, when this is not possible, by mechanically operating the contacts.
11) Test gas detectors, ionization detectors, and fire control panels.
12) Test and adjust as necessary, timers, switches, relays, pushbuttons, interlocks, and other electrical adjuncts of the instrumentation.

FLUOR

FINAL PHASES OF CONSTRUCTION

II. CONSTRUCTION – con't.

CONTROL SYSTEMS – con't.

13) Check, test, and adjust when necessary, instruments and instrument systems furnished as part of a vendor's "package" supply.
14) Set and test relief valves.
15) Perform preliminary instrument calibrations (bench calibration typically prior to installation).
16) Record and report all test data accumulated during the above actions.
17) Witness tests and operations as desired and signify acceptance upon successful completion of each test.

OTHER WORK

1) Complete all necessary insulation, painting, paving, fencing, and items of like nature.

III. COMMISSIONING

GENERAL

1) Schedule and issue permits for Fluor completion of any deferred insulation and paint touch up noted in turnover documents.

VENDOR REPRESENTATIVES

1) Arrange for, control and reimburse all vendors' specialists required during the commissioning and startup.

BUILDINGS

1) Conduct tests and adjusts air conditioner systems, ventilating systems and safety equipment.
2) Clean and commission toilets, basins, sewers, and water systems.

EQUIPMENT

Vessels

1) Supply and install all catalysts and material such as balls on which the catalyst is deposited.

Fired Heaters and Boilers

1) Accomplish boilout, chemical cleaning and flushing as required.

Compressors and Generators

1) Clean and flush lube and seal oil systems and recharge with clean oil, if desired.
2) Provide the specified oil for flushing and recharging the lube and seal oil systems.
3) Run in on air or other specified gas and adjust alarm and shutdown systems.

FLUOR

FINAL PHASES OF CONSTRUCTION

III. COMMISSIONING – con't.

EQUIPMENT – con't.

Pumps

1) Run in the pumps using the specified run in fluids. Check for vibration, balancing as necessary. Adjust governor, trips and other controls as required.

Material Process and Handling Equipment

1) Make such adjustments, under load conditions, as are required to assure running alignment.
2) Provide all water treatment chemicals except the initial charge of ion exchange resin and inert bed material in the water treating plant.

Fire, Safety, and Miscellaneous Equipment

1) Conduct capacity test of system for firewater load.
2) Clean and flush cooling tower basin and intake screens prior to start-up.
3) Fill water reservoirs and head towers and operate fire pumps to checkout fire fighting systems.

PIPING

1) Remove any control valves, orifice plates and like items which might be damaged by the flushing operations and replace after flushing is completed.
2) Install temporary blinds, strainers and connections required for flushing.
3) Clean lines, as required by specification or flow sheets, by blowing with air or steam, washing with water, flushing with oil, or by chemical cleaning.
4) Remove temporary strainers and blinds after line flushing operations.
5) Conduct "tightness test", when required, by pressurizing the system with steam or air just prior to introduction of process production stock.
6) Adjust and commission cathodic protection systems per specification.

ELECTRICAL

1) Perform final testing and setting of adjustable relays.
2) Energize and de-energize permanent electrical facilities.
3) Check spare circuit breakers for fit and interchangeability.

CONTROL SYSTEMS

1) Perform all final instrument calibrations.
2) Pressurize and energize the transmitting and control signal system.
3) Install sealing material for instruments requiring fluid seals.
4) Supply calibration gases for analyzers.
5) Check zero and calibrate analyzers.

FLUOR

FINAL PHASES OF CONSTRUCTION

IV. START-UP

GENERAL

Cleanup

1) Cleanup the areas as required during startup.

Lubrication and Prime Charges

1) Do all lubrication during startup phase of work.
2) Charge systems with glycol, freon, triethanolamine, chromate, methanol and other operating chemicals as required.

EQUIPMENT

Exchangers

1) Check vibration of fans and air coolers when at operating temperature and correct if excessive. Check and adjust belts.

Fired Heaters and Boilers

1) Purge, light off and put boilers and heaters in operation, including charging treated water to boilers.

Compressors and Generators

1) Uncouple rotating equipment to be hot aligned, perform alignment, and recouple.
2) Perform any doweling required after final alignment.

Pumps

1) Check the pumps and drivers for vibration, balancing as necessary after the pumps are at operating temperature.
2) Perform any doweling required after final adjustments have been made.

PIPING

1) Turn plot limit and other isolating blinds before start-up, when such blinds have not been turned previously.
2) Install car seals on block valves or any other valves where required.
3) Furnish purging media and purge all lines as required during start-up operations.
4) Adjust pipe hangers, holddowns, and guides to provide for slope, anchoring, or free movement as required by the specification and drawings, when system is at operating temperature.