

Cost Correlations for Equipment

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All prices refer to North American prices for mid 1970 corresponding to a Marshall-Stevens index of 300. Most prices are for carbon steel (c/s) equipment although some are quoted for stainless steel (s/s) construction. More details are given by Woods (1974).

$$C_1 = C_2 \cdot \frac{(187.5 \cdot 100)}{110 \cdot 3452}$$

$$C_2 = C_{\text{carbon}} \cdot \left(\frac{\text{carbon steel}}{\text{stainless steel}} \right)^{0.7}$$

C₂ : C₁ (5.2 / 5.1)

	Size	Unit	Cost 10 ³ \$	Range	#	Error %
Activated sludge unit excl. disposal: Installed	1	capacity, 10 ⁶ US gal/d	54	0.01 - 10 ²	0.78	
Adsorber, L, carbon for waste water: Installed	1	capacity 10 ⁶ US gpd	420	0.025 - 10 ²	0.62	
G, air drying: Delivered	{ 40 }	capacity, cfm 100°F	{ 1.9 }	10 - 150	0.32	
Aeration Tank (only): Installed	{ 400 }	volume, 10 ³ ft ³	{ 5.8 }	150 - 1500	0.67	
Bag Filters, GS, shaker type: FOB incl motors	100	capacity, 10 ³ scfm	120	3 - 10 ³	0.77	
reverse jet: FOB excl compressor	10	capacity, 10 ³ scfm	5	1 - 50	0.79	50
Barometric condensers, c/s multijet: Del	10	water flow rate, US gpm	6.4	5 - 60	0.71	
Basins:	500		2.6	50 - 10 ⁴	0.60	40
Aeration: earthwork: Installed	10 ³	volume, 10 ³ US gal	90	100 - 2 × 10 ³	0.67	40
Chlorination contact, concrete: Installed	10 ²	volume, 10 ³ US gal	32	1 - 10 ³	0.63	
Equalization, earthwork: Installed	10 ²	volume, 10 ³ US gal	19	70 - 7 × 10 ⁷	0.51	
Evaporation, plastic lined: Installed	1	volume, 10 ⁷ US gal	115	0.3 - 5	0.64	30
Sludge storage and drying: Installed	1	volume, 10 ⁷ US gal	56	0.03 - 50	0.60	
Waste stabilization: Installed	1	volume, 10 ⁷ US gal	10	0.5 - 100	0.91	60
Blenders:						
Rotary double cone, c/s: FOB incl motor	30	capacity, ft ³	5.1	7 - 150	0.41	20
Twin shell c/s: FOB incl motor	30	capacity, ft ³	2.8	25 - 150	0.54	
Vertical spiral: FOB excl motor	300	capacity, ft ³	1.8	100 - 400	0.82	
Horizontal spiral ribbon: FOB incl motor	{ 3 }	capacity, ft ³	{ 2.5 }	1 - 18	0.19	
Pan: FOB incl motor	{ 50 }	capacity, ft ³	{ 5.2 }	18 - 400	0.46	
Blowers:	10	capacity, ft ³	9	1 - 40	0.74	
Centrifugal, 4 psi: Del excl motor	10	capacity, 10 ³ scfm	20	0.5 - 150	0.60	60
Rotary lobe, 10 psi: FOB incl motor	50	drive, hp.	3.3	5 - 300	0.55	
Rotary sliding vane: Del excl motor	3	capacity, 10 ² scfm	4	0.3 - 15	0.48	
Centrifuges:						
Sedimentation type:						
Tube c/s: FOB excl motor	4	tube diam., in	6.8	1.5 - 6	1.54	

Rotary sliding vane: Del excl motor
 Centrifuges: 3 capacity, 10² scfm 4 0.3 - 15 0.48
 Sedimentation type:
 Tube c/s: FOB excl motor 4 tube diam., in 6.8 1.5 - 6 1.54

	Size	Unit	Cost 10 ³ \$	Range	"	Error %
Disc bowl c/s: FOB excl motor	10	drive, hp	7.4	0.5 - 200	0.67	
Horizontal scroll discharge c/s: FOB excl motor	40	drive, hp	22	8 - 200	0.60	
Filtering type:						
Vertical basket top drive c/s: FOB excl motor	30	basket diam., in	8.2	10 - 80	1.00	
bottom drive c/s: FOB excl motor	20	filter area, ft ²	12	10 - 40	0.44	
Automatic batch horizontal basket c/s: FOB	20	filter area, ft ²	30	7 - 80	0.65	
Pusher conveyor c/s: FOB excl motor	30	basket diam., in	37	10 - 60	1.00	
Classifiers:						
Air cyclone: Del complete	3	capacity, ston/hr	13	1 - 10	0.42	
Cyclone, wet: Del	3	capacity, ston/hr	1.7	1 - 4	0.45	
Rake: tank size: Del incl motor	7	(width, ft)(length, ft) ^{0.2}	13.5	4.5 - 12	1.80	
Spiral: Del incl motor	50	spiral diam., in	12.5	25 - 75	1.53	
Coagulation unit: municipal waste: Installed	1	capacity, 10 ⁶ US gal/d	62	0.1 - 100	0.62	60
Compressors:						
centrifugal < 1000 psi: Del incl motor	{ 1 20 }	{ drive, 10 ² hp }	{ 18 145 }	{ 0.3 - 7 7 - 70 }	{ 0.82 0.40 }	{ 30 50 }
Station: installed incl land	30	drive, 10 ² hp	720	3 - 200	0.65	60
Compressor:						
Axial 5 stage:	{ 25 100 }	capacity, 10 ³ scfm	{ 220 370 }	10 - 50	0.25	
Delivered incl turbine	{ 100 200 }		{ 650 15 }	50 - 120	0.61	
Helical screw: FOB incl motor	1	drive, 10 ² hp	15	120 - 300	0.84	
Reciprocating < 1000 psi: FOB incl motor	3	drive, 10 ² hp	40	0.4 - 2.5	0.95	
Concentrators:				0.01 - 200	0.84	
Heavy media circuit: Delivered	10 ²	capacity, Mg/hr	110	25 - 200	0.18	
Spiral gravity: Delivered	10 ²	capacity, Mg/hr	60	1.3 - 2500	1.0	

	Size	Unit	Cost 10 ³ \$	Range	"	Error %
Conveyors:						
Belt: FOB excl motor	10 ⁷	(tons/hr)(length, ft) ^{2.5}	2	10 ⁵ - 10 ⁹	0.20	
Pneumatic, fluidizer unit: FOB	10	ton/hr.	4	2 - 40	0.40	
air supply: FOB	10	ton solids/hr.	3	2 - 20	0.30	
Roller: Delivered	10 ²	(length, ft)(width, in.)	0.052	10 - 500	0.90	
Screw c/s: Delivered excl motor	10 ⁴	(ton/hr)(length, ft) ^{1.6}	3	10 ³ - 5 × 10 ⁵	0.46	35
Cranes:						
Overhead bridge: Field erected	10	lifting capacity, ton	16	1 - 200	0.57	30
Crushers:						
Conc: FOB crusher only	10 ²	drive, hp	39	30 - 300	0.92	
Gyratory: FOB excl motor	{ 3 300}	drive, hp	{ 4 230}	1 - 30 120 - 1,000	0.50 1.19	50 40
Jaw: FOB excl motor	{ 10 100}	drive, hp	{ 10 85}	1 - 60 60 - 400	0.65 0.81	
Twin roll: FOB excl motor	{ 5 50}	drive, hp	{ 9 19}	1 - 20 1 - 300	0.94 0.61	60 60
Heavy duty	10	drive, hp	5.2	2 - 500	0.66	50
Pulverizer or impact: FOB excl motor	10	drive, hp	1	5 - 20	1.10	
Lump breaker: FOB excl motor	10	drive, hp				
Crystallizers:						
Batch vacuum c/s: Del. incl vacuum	2	working capacity, 10 ³ gal	30	0.5 - 10	0.68	
Conventional forced circulation c/s: FOB	100	crystal capacity, ton/d	85	10 - 1000	0.53	
Growth and classifying c/s: FOB	100	crystal capacity, ton/d	130	10 - 10 ⁴	0.62	100
Mechanical c/s: FOB	70	cooling area, ft ²	5.5	30 - 150	0.55	
Cyclones:						
Single high efficiency c/s: FOB	10	capacity, 10 ³ scfm	3	1 - 80	0.56	30
Multi: FOB	10	capacity, 10 ³ scfm	2	1 - 150	0.66	30
Deaerators:						
Vacuum type: FOB	200	capacity, US gpm	8.8	50 - 1000	0.43	

Single high efficiency c/s: FOB	10	capacity, 10 ³ scfm	3	1-80	0.56	30
Multi: FOB	10	capacity, 10 ³ scfm	2	1-150	0.66	3/
Deaerators:						
Vacuum type: FOB	200	capacity, US gpm	8.8	50-1000	0.43	

	Size	Unit	Cost 10 ³ \$	Range	n	Error %
Forced draft type: FOB	100	capacity, US gpm	5.4	50-800	0.45	
Dialysis: Installed	3	membrane area, 10 ³ ft ²	32	0.5-60	0.79	
Digester: anaerobic: Installed	{ 10 } { 300 }	volume, 10 ³ ft ³	{ 37 } { 480 }	1-35 35-600	0.41 0.97	
Distillation tower; complete tower-trays: Installed	4000	(actual) (feed, lb/yr) ^{0.65} trays	1000	300-30,000	1.0	26
Drives:						
Gear unit: FOB excl motor	{ 40 } { 500 }	(drive, (nominal) ^{0.5} hp at (reduction) ratio) rpm	{ 0.58 } { 3.6 }	4-150 150-2000	0.45 0.75	
V belt and pulley: FOB	10	drive, hp	0.14	2-30	0.88	
Sprockets and roller chain: FOB	10	drive, hp	0.055	2-10	0.21	
Dryers:						
Cone, jacketed vacuum s/s: FOB incl auxil	10	working capacity, ft ³	9.2	1-300	0.50	
Drum, atmos c/s: FOB excl. motor	100	surface area, ft ²	22	10-400	0.52	40
Fluidized bed, direct fired c/s: FOB incl auxil	10	(diam.) (fluidizing) ^{0.35} (ft) (velocity, ft/sec)	45	3-26	0.73	
Dryers:						
Rotary, indirect fired c/s: FOB incl motors	4	peripheral area, 10 ² ft ²	28	1-20	1.00	40
Rotary, direct fired c/s: FOB incl auxil	4	peripheral area, 10 ² ft ²	18	1-40	0.88	30
Installed	100	solid waste, ton/d	150	40-600	0.84	40
Rotary, steam tube c/s: FOB incl motor	10	heating area, 10 ² ft ²	18	4-70	0.75	30
Rotary, vacuum c/s: FOB incl auxil	1	peripheral area, 10 ² ft ²	23	0.2-10	0.49	30
Roto-louvre, atmos c/s: FOB incl auxil	2	peripheral area, 10 ² ft ²	35	0.5-10	0.62	10
Sand bed, for sludge: Installed	{ 20 } { 200 }	surface area, 10 ³ ft ²	{ 29 } { 220 }	5-43 43-1000	0.63 0.96	50
Shelf, vacuum c/s: FOB excl trays, vac. equip	1	tray area, 10 ² ft ²	5.1	0.15-10	0.56	
Spray ~150°C c/s: FOB	5	water evap/hr, 10 ³ lb	150	0.25-20	0.71	

	Size	Unit	Cost 10 ³ \$	Range	n	Error %
Tray-Truck c/s: FOB excl trays	1	tray area, 10 ² ft ²	4	0.20 - 15	0.37	
Tunnel c/s: FOB incl auxil excl motor	4	heated surface, 10 ² ft ²	64	1.5 - 15	0.93	20
Transported bed c/s: FOB incl auxil	1	water evap/hr, 10 ³ lb	40	0.60 - 20	0.42	30
Turbo c/s: Del incl motors	1	drying area, 10 ² ft ²	48	0.20 - 20	0.66	
Ejectors:						
Single stage; 100 psig steam: FOB ejector	3	(lb/hr air)/(mm Hg abs.)	0.80	0.2 - 30	0.50	70
Two stage: FOB incl condenser, piping	1	(lb/hr air)/(mm Hg abs.)	1.9	0.2 - 10	0.43	30
Multistage: FOB incl condenser, piping	10	(lb/hr air)/(mm Hg abs.)	5.0	0.2 - 100	0.26	40
Electrodialysis:						
Membranes, spacers, electrodes: FOB	40	area, 10 ³ ft ²	400	20 - 80	0.70	
Unit for 4000 ppm feed: Installed	1	capacity, 10 ⁶ US gal/d	1,600	0.02 - 100	0.82	
Electrostatic precipitators, G-S, FOB	{ 1 } { 20 }	gas flow, 10 ⁴ cfm at 40°C	{ 23 } { 115 }	0.1 - 8 8 - 100	0.39 0.81	40 40
Electrostatic separators: Del incl motor	10	capacity, 10 ³ lb/hr	12	2 - 70	0.60	
Elevators, bucket: Del excl motor	10 ³	(ton/h)(length, ft) ^{1.6}	3	10 ³ - 5 × 10 ³	0.46	35
Engines, gasoline: FOB	400	drive, hp	50	30 - 7000	0.82	70
Evaporators: Natural circulation c/s: FOB	50	heating area, ft ²	10	20 - 200	0.50	
Forced external circulation c/s: FOB	1	heating area, 10 ³ ft ²	65	0.2 - 5	0.74	40
Internal circulation, horizontal tube c/s: FOB	5	heating area, 10 ² ft ²	20	1 - 90	0.17	30
Vertical long tube; rising/falling film c/s: FOB	5	heating area, 10 ³ ft ²	21	1 - 60	0.55	60
Vertical basket c/s: FOB	10	heating area, 10 ² ft ²	23	0.1 - 1000	0.68	70
Vertical agitated film 316 s/s: FOB	{ 0.05 } { 1 }	heating area, 10 ² ft ²	{ 10 } { 45 }	0.01 - 0.18 0.18 - 2.5	0.36 0.62	30 30
Jacketed glass lined vessel: FOB	1	volume, 10 ² US gal	16	0.5 - 10	0.18	
Extractors: Podbielniak centrifugal: Del	{ 10 } { 25 }	capacity, US gpm	{ 15 } { 27 }	4 - 15 15 - 40	0.17 0.78	
Rotating disc, c/s: Del	10 ²	(height, ft)(diam., ft) ^{1.5}	3.5	3 - 2000	0.84	60
Vertical agitated, s/s: Del incl motor	10 ²	(height, ft)(diam., ft)	43	1 - 5000	0.81	

	Size	Unit	Cost 10 ³ \$	Range	μ	Error %
Horizontal mixer-settler unit, rubber lined: 1	10 ²	horiz. area, ft ²	30	15-600	0.67	30
Extruders, c/s: FOB incl variable speed drive	10	drivepower, hp	11	2-200	0.59	60
Fans: Centrifugal radial: Del excl motor	30	capacity, 10 ³ scfm	2.3	3-200	0.84	40
incl motor	30		4.5	3-100	0.92	40
Vane axial: FOB excl motor	10	capacity, 10 ³ scfm	5.2	4-40	0.65	60
incl motor	3		6.0	1-10	0.35	60
Propeller: FOB package incl motor	20	capacity, 10 ³ scfm	0.50	1-100	0.40	50
Feeders:						
S, rotary star: Del excl motor	10	diam., inches	1.3	3-10	0.66	
Apron: Del excl hopper, motor	400	(ton/hr)/(length, ft) ^{0.55}	12	50-5000	0.70	
Filters:						
Plate and frame c/s: Del	1	effective area, 10 ² ft ²	1.7	0.1-10	0.55	
Pressure leaf, vertical c/s: Del	1	effective area, 10 ² ft ²	5.1	0.3-15	0.57	30
horizontal c/s: Del	1	effective area, 10 ² ft ²	7.1	0.3-15	0.51	40
Vacuum rotary drum c/s: FOB incl motor	1	effective area, 10 ² ft ²	19	0.1-15	0.48	50
Vacuum rotary disk c/s: FOB incl motor	1	effective area, 10 ² ft ²	16	0.4-10	0.68	
Horizontal plate, c/s: Del filter	5	effective area, ft ²	3.2	1-10	0.62	
Horizontal tilting pan c/s: FOB	1	effective area, 10 ² ft ²	32	0.1-45	0.33	
Belt filter: s/s: FOB	200	effective area, ft ²	80	100-350	0.58	
Microstrainer c/s: Installed	10	capacity, 10 ⁶ US gal/d	300	0.3-100	0.84	
Deep bed: Installed	100	horiz. area, ft ²	72	1-20,000	0.63	
Filtration:						
Dissolved air for LS: Installed	1	capacity, 10 ⁶ US gal/d	35	0.1-10	0.47	
Induced draft for SS: Del	{0.4}	capacity, 100 ft ³	1.6	0.21-1	0.37	
	{2}		3.6	1-3	0.74	
Foam separators for waste water: Installed	1	capacity, 10 ⁶ US gal/d	56	0.25-5	0.80	
Furnaces:						
Box type direct fired c/s: Del	40	heat absorbed, 10 ⁶ Btu/h	54	10-400	0.75	40
Vertical cylinder direct fired c/s: FOB	10	heat absorbed, 10 ⁶ Btu/h	40	0.5-100	0.74	50
Multiple hearth c/s: Installed	1	capacity, 10 ³ lb/h	430	0.15-4	0.59	

	Size	Unit	Cost 10 ³ \$	Range	n	Error %
Fluid bed incinerated: Installed	{0.5} 3	capacity, 10 ³ lb/h	{270 900}	0.4-1 1-9	0.53 0.78	
Generators: turbine drive: FOB incl drive	10 ⁴	power output, kW	600	3000-50,000	0.73	20
Grit chamber for waste water: Installed	300	surface area, ft ²	18	50-1500	0.37	40
Heat Exchangers:						
Shell-tube, floating head c/s: Del	1	surface area, 10 ³ ft ²	6.5	0.02-20	0.59	40
Fixed tube \times 0.85; U-tube \times 0.87; kettle \times 1.35						
Shell-tube—finned tube floating head c/s: Del	{2} 6	total area, 10 ³ ft ²	{6.7 15}	0.7-3 3-10	0.57 0.78	20 20
Air cooled, finned c/s: FOB	3	bare tube area, 10 ³ ft ²	26	0.2-20	0.8	30
Plate coil c/s serpentine type: Del	{10} 30	surface area, ft ²	{0.033 0.063}	5-15 15-40	0.36 0.78	
Cascade, cast iron: Del	1	surface area, 10 ³ ft ²	0.40	0.4-2.5	1.0	20
Double pipe, c/s internal finned: Del	20	total area, ft ²	0.40	3-250	0.14	20
Plate 316 s/s: Del	{150} 350 700	surface area, ft ²	{5.5 13.0 22.0}	100-200 200-500 500-1000	0.65 0.65 0.90	
Plate-fin (lamella) c/s: Del	3	surface area, ft ²	3.0		1.00	100
Spiral plate (Rosenblad) c/s: Del	{1} 3 7	surface area, 10 ³ ft ²	{1.4 2.2 3.7}	0.4-2 2-4 4-7	0.27 0.48 0.72	
Spiral tube c/s: Del	{5} 30	coil area, ft ²	{0.12 0.47}	2.5-7.5 7.5-60	0.43 0.83	
Tank suction header c/s: FOB	2	surface area, 10 ³ ft ²	1.3	0.3-20	0.58	
Bayonet heater c/s: Del	3	surface area, ft ²	0.14	1-6	0.35	80
Mandrel wound Al: FOB	15	surface area, 10 ³ ft ²	180	10-20	0.76	
Cubic; graphite: FOB	70	surface area, ft ²	1.7	10-200	0.46	
Coils in a tank c/s: FOB excl tank	30	surface area, ft ²	0.29	1-300	0.33	
Thermal screw c/s: FOB excl motor	1	surface area, 10 ³ ft ²	10	0.1-4	0.78	40
Electric immersion c/s: FOB	50	energy, kW	0.70	10-200	0.87	

	Size	Unit	Cost 10 ³ \$	Range	n	Error %
Hopper, S, storage: FOB	100	volume, ft ³	0.060		0.91	
Hydraulic Press, c/s 100 psig: Del incl motor, drive	{100 400}	area, ft ²	{50 95}	5 - 280	0.23	
Hydrocyclones: FOB cyclone only	6	body diam, in.	0.45	280 - 800	1.00	
Ion exchange, rubber lined tank: FOB excl resin	10 ²	exchange volume, ft ³	15	1 - 100	1.07	
Complete water demineralizer: Installed	0.5	capacity, 10 ⁶ US gal/d	330	3 - 10 ¹	0.53	40
Jigs: Delivered incl motor and ragging	{10 ² 10 ³ }	capacity, Mg/d	{2.5 8.6}	0.25 - 1	1.00	
Kneaders: Double shaft sigma c/s: FOB incl motor	10	capacity, ft ³	21	40 - 350	0.17	
Vacuum tilting c/s: FOB incl motor	10	capacity, ft ³	32	700 - 1400	1.56	
Knives: Rotary: Delivered	30	drive, hp	5.5	0.6 - 70	0.53	40
Magnetic separators: permanent:				3 - 50	0.40	
				5 - 100	0.84	
Dry drum: FOB incl motor	{1 5}	(drum width)(diam) ^{1.25} ft	{1.7 3.5}	0.6 - 1.7	0.26	
Wet drum: 500 Gauss: Del incl motor	7	drum width, ft	8	1.7 - 10	0.66	
Pulley; tramp metal: FOB excl motor	4	(width, ft)(diam, ft) ^{1.65}	1.6	3 - 10	1.00	
Pulley; minerals processing: FOB excl motor	4	(width, ft)(diam, ft) ^{1.5}	2.1	0.8 - 12	0.86	20
Double gap plate: FOB	30	width, inches	0.54	1 - 20	0.82	30
Grate: 4 bank: FOB	10	pipe length, inches	2	6 - 50	1.02	
Rectangular, suspended, lift: FOB	24	length, inches	2.2	6 - 15	0.91	
Cross belted: FOB incl motor	30	belt width, inches	6.5	18 - 48	1.53	
Magnetic Separators: electromagnetic:				20 - 48	1.40	
Rectangular, suspended, lift: FOB						
in line x 1.85; cross belted x 1.87						
Induced roll, dry: FOB	5	power, kW	3.5	2 - 12	1.00	
High intensity, alternating polarity: FOB unit	0.9	power, kW	8	0.5 - 4	0.70	40
	{1.5 5}	power, kW	{7.2 13}	1.2 - 1.7 4 - 7	0.58 0.79	

	Size	Unit	Cost 10 ³ \$	Range	μ	Error %
Mills:						
Cage (impactor, micropulverizer) FOB excl motor	10	drive, hp	4	4-200	0.28	50
Swing hammer mill: FOB excl motor	{ 10 } { 100 }	drive, hp	{ 4 121 }	3-75	0.75	50
Roller mill (twin or ring): FOB excl motor	100	drive, hp	33	75-400	0.41	50
Attrition: Del incl drive	30	drive, hp	3.5	10-600	0.62	30
Autogenous, c/s: Del incl drive excl motor	{ 1 } { 10 }	drive, 100 hp	{ 100 1350 }	5-1000	0.63	
Ball: FOB excl liner, motor, balls	100	drive, hp	36	0.5-4	0.71	
Pebble: FOB incl liner, motor	10	drive, hp	5.5	4-60	0.31	
Rod, FOB excl rods, motor	100	drive, hp	37	5-6000	0.70	
Fluid energy: FOB incl auxil	1	air jet: 10 ³ scfm	42	3-2000	0.79	
Colloid: s/s: FOB incl motor	10	drive, hp	6.5	5-6000	0.74	
Two roll mill for blending: Del incl motor	100	drive, hp	27	0.8-1.4	0.88	
Mill Circuits:						
Ball, open: 100 mesh: Installed unit	5	capacity, ton/h	58	5-35	0.61	
Rod, open: 65 mesh: Installed unit	5	capacity, ton/h	38	50-300	0.72	
Mist Eliminators: FOB excl vessel	10	capacity, 10 ³ scfm	12	1-200	0.65	20
Mixers:						
Anchor, top entry, closed tank: FOB incl. motor	2	drive, hp	1.35	1-3	0.41	
Propeller, portable: FOB incl motor	2	drive, hp	0.6	0.25-7.5	0.58	30
Propeller, fixed, top entry, open: FOB incl motor	5	drive, hp	1.1	1-30	0.52	40
Propeller, fixed, top entry, closed: FOB incl motor	5	drive, hp	1.8	1-50	0.57	40
Propeller, side entry c/s: FOB incl motor	{ 2 } { 10 }	drive, hp	{ 0.92 1.55 }	1-5	0.19	
Mixers:						
Turbine, fixed, top entry, open: FOB incl motor	10	drive, hp	2.1	5-30	0.48	
fixed, top entry, closed: FOB incl motor	10	drive, hp	3.2	2-30	0.45	50
				2-200	0.56	20

	Size	Unit	Cost 10 ³ \$	Range	"	Error %
Planetary action mixer, c/s: Del incl motor	3	drive, hp	2.3	0.5 - 5		
Diffused air: Installed	{ 4 } { 30 }	air capacity, 10 ³ scfm	{ 46 } { 250 }	0.4 - 7.5 7.5 - 50	0.66 0.66 0.93	
Motors, electric:						
AC induction, 3 phase TEFC: FOB	1	drive, 10 ³ hp	2.1	0.5 - 2000	1.10	80
AC induction, wound rotor, TEFC: FOB	{ 10 } { 70 }	drive, hp	{ 3.7 } { 5.8 }	10 - 25 25 - 200	0	
AC synchronous, open: FOB	3	drive, 10 ³ hp	48	0.5 - 10	0.77	
DC, open: FOB	20	drive, hp	1.1	7 - 100	0.96	
Packed towers:					0.56	
Complete s/s incl Pall® rings: Installed	190	(height, ft)(diam., ft) ^{1.35}	90	1 - 100	1.07	
incl gauze packing: Installed	190	(height, ft)(diam., ft) ^{1.35}	270	0.6 - 250	1.00	
Piping network: typical straight run c/s: FOB \$/ft	6	nominal diam., in	0.0028	1 - 24	1.33	
Installed \$/ft: × 6 - 7						
Typical complex network: FOB \$/ft: × 2						
Installed \$/ft: × 13						
Pressure vessels:						
Horizontal drum c/s (150 psig): FOB	1	volume, 10 ³ US gal	1.9	0.1 - 80	0.62	
Vertical towers c/s (150 psig): FOB	100	(height, ft)(diam., ft) ^{1.35}	5	10 - 3000	0.81	40
Jacketed reactors c/s (150 psig): FOB incl mixer	1	volume, 10 ³ US gal	2.8	0.1 - 40	0.53	
Pumps: liquid						
Centrifugal c/s: FOB excl motor	{ 10 } { 100 }	drive, hp	{ 0.46 } { 1.3 }	0.5 - 40 40 - 400	0.3 0.67	50 50
Mixed flow c/s: FOB incl motor	20	capacity, 10 ³ US gpm	20	1 - 200	0.81	60
Axial c/s: FOB incl motor	20	capacity, 10 ³ US gpm	14	1 - 300	0.75	40
Peripheral (turbine) c/s: FOB incl motor	20	drive, hp	1.7	1 - 1000	0.46	40
Reciprocating c/s: FOB excl motor	{ 2 } { 20 } { 100 }	drive, hp	{ 1.9 } { 5.4 } { 14.5 }	0.3 - 3.4 3.4 - 35 35 - 350	0.26 0.49 0.70	40 40 40

	Size	Unit	Cost 10 ³ \$	Range	n	Error %
Diaphragm, s/s: FOB incl motor	10	capacity, US gpm	0.70	1-300	0.37	30
Rotary gear c/s: FOB incl motor	50	capacity, US gpm	0.48	10-1000	0.36	
	{ 40 }		{ 0.93	10-100	0.46	
Rotary moyno c/s: FOB excl motor	{ 200 }	capacity, US gpm	{ 2.1	100-400	0.56	50
	100	capacity, US gpm	0.85	10-1000	0.74	
Rotary sliding vane c/s: FOB excl motor						
Pump house:						
For water supply: Installed	100	drive incl standby, hp	40	10-20,000	0.66	40
	{ 0.5 }		{ 32.5	0.2-0.9	0.36	
For raw sewage: Installed	{ 2 }	capacity, 10 ⁶ US gpd	{ 65	0.9-3.5	0.60	
	{ 50 }		{ 180	3.5-400	0.84	
	30	power, kW	5.5	10-80	0.61	
	500	screen area, ft ²	3.0	150-700	0.62	
Rectifiers: AC to DC, uni-converter: FOB						
Screens: Single deck c/s: vibrating, std: Del incl motor						
Scrubbers:						
Wet cyclone, c/s: FOB excl fans	10	capacity, 10 ³ scfm	4	0.5-100	0.72	50
Venturi-jet, c/s: FOB excl fans	10	capacity, 10 ³ scfm	5	1-100	0.50	
Impingement baffle, c/s: FOB excl fans	10	capacity, 10 ³ scfm	4.5	1-70	0.68	
Packed tower, c/s: FOB excl fans	10	capacity, 10 ³ scfm	8.3	4-30	0.68	
Dynamic, c/s: FOB excl settler, motor	10	capacity, 10 ³ scfm	3.2	1-18	0.61	40
Settlers:						
No central rake: Installed	10	horiz. surf. area, 10 ³ ft ²	120	0.7-30	0.38	
Central rake: Installed	{ 0.4 }	horiz. surf. area, 10 ³ ft ²	{ 14	0.1-0.8	0.36	
	{ 10 }		{ 135	0.8-100	0.78	
API oil: Installed	1	capacity, 10 ⁶ US gal/d	64	0.3-3	0.84	
Silo, conical, c/s: FOB	1	volume, 10 ³ ft ³	0.11		0.67	
Starters:						
Single phase: FOB	3	drive, hp	0.043	1-8	0.26	50
Three phase: FOB	1	drive, 10 ² hp	0.70	0.1-20	1.0	80
Storage tanks:						
Spherical at 30 psig: Field erected	1	volume, 10 ² m ³	2.8	0.4-15	0.70	40
Spheroids at 15 psig: Field erected	3.78	volume, 10 ³ m ³	90	1.2-5	0.73	

	Size	Unit	Cost 10 ³ \$	Range	n	Error %
Underground cavity salt dome: mined cavern	3	volume, 10 ⁴ m ³	450	0.8 - 5	0.73	
Water towers: Installed	3	volume, 10 ⁴ m ³	1400	1.3 - 10	0.58	
API flat bottom, cone roof: FOB	1	volume, 10 ³ m ³	110	0.4 - 6	0.88	40
Field erected	1	volume, 10 ⁴ US gal	6.2	0.1 - 85	0.32	30
floating roof x 1.1; lifter roof x 1.3	1	volume, 10 ⁴ US gal	70	0.03 - 3	0.58	40
Surface aerators, c/s: FOB	20	drive, hp	8.5	1 - 200	0.55	
Tanks: atmospheric: horizontal cylinder, c/s: FOB	1	volume, 10 ³ US gal	1.4	0.1 - 40	0.57	
Vertical cylinder c/s: FOB	1	volume, 10 ³ US gal	1	0.1 - 20	0.30	20
Vertical, jacketed, c/s: FOB	1	volume, 10 ³ US gal	4.5	0.07 - 1.5	0.57	
Vertical, agitated, c/s: FOB incl motor	1	volume, 10 ³ US gal	3.7	0.1 - 20	0.50	
Trays:						
Sieve tray c/s: Delivered Cost/tray	10	diameter, ft	0.60	3 - 15	2.00	30
valve x 1.4; trough x 1.4; bubble cap x 2.8						
Tray unit: c/s						
Installed excl tower						
Trickling filters: Installed						
Turbines, c/s:						
Steam, single valve, single stage: FOB	10 ³	(height, ft)(diam., ft) ^{1.65}	4.5	20 - 60,000	0.88	50
Single valve, multistage: FOB	{ 10 }	filter volume, 10 ³ ft ³	{ 35	4 - 25	0.45	
Multivalve, multistage: FOB	{ 100 }		{ 160	25 - 300	0.79	
Gas driven: FOB	300	energy, kW	11	10 - 4000	0.51	
Combustion gas driven: FOB incl auxil	3000	energy, kW	100	1000 - 20,000	0.46	
Vacuum pumps, c/s:	3000	energy, kW	160	2000 - 20,000	0.35	
Rotary vane: FOB incl motor	5	energy, 10 ³ kW	250	1 - 30	0.80	
Rotary piston oil-sealed: FOB incl motor	5	energy, 10 ³ kW	520	0.65 - 15	0.55	
Rotary liquid piston: FOB excl motor	30	capacity, cfm	1.2	4 - 1000	0.43	50
Oil diffusion pump: FOB complete	100	capacity, cfm	2.2	1 - 4,000	0.55	30
	1000	capacity, cfm	4.7	200 - 10,000	0.75	
	0.2	capacity, 10 ³ cfm	0.285	0.01 - 3.5	0.22	
	20	capacity, 10 ³ cfm	2.7	3.5 - 50	0.81	

*Cost Correlations
for Auxiliaries*

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All prices refer to North American values for mid 1970 corresponding to a Marshall-Stevens index of 300.
More details are given by Woods (1974).

	Size	Unit	Cost 10 ³ \$	Range	"	Error %
Steam generation:						
gas-oil fired boiler, 250 psig: Delivered & field erected	20	capacity, 10 ⁴ lb/hr	1,000	2 - 200	0.80	50
steam boiled only, fired: Delivered	3	capacity, 10 ⁴ lb/hr	50	0.05 - 20	0.71	50
waste heat boiler, unfired: Delivered	3	capacity, 10 ⁴ lb/hr	52	1 - 60	0.82	
Dowtherm furnace unit:	3	capacity, 10 ⁴ lb/hr	48	0.1 - 20	0.62	
Del package unit	1	heat absorbed, 10 ⁶ BTU/hr	13.5	0.2 - 10	0.56	
Electrical power generation:						
portable incl steam generation & turbo: package FOR	40	capacity, kW	4.3	10 - 100	0.73	20
field erected unit ex steam:	4	capacity, MW	1,600	0.5 - 1,000	0.84	30
nuclear power unit	700	capacity, MW	3.2 x 10 ³	50 - 100	0.84	20
Refrigeration:						
packaged mechanical: Installed	100	capacity, tons	40	10 - 1000	0.73	30
steam vacuum: Installed	100	capacity, tons	45	20 - 1000	0.68	
low temp. Dewar: Installed	100	capacity, watts	400	9 - 1000	0.50	
Cooling tower, forced or induced draft:						
Installed	1	capacity, 10 ⁴ US gpm	90	0.1 - 10	0.87	
Water ex river, pumped & filtered: Installed	1	capacity, 10 ⁶ US gal/d	14	0.4 - 10	0.81	
ex surface water, pumped, filtered, chlorinated: I	1	capacity, 10 ⁶ US gal/d	400	0.2 - 100	0.68	
softening	1	capacity, 10 ⁶ US gal/d	180	30 - 1000	0.44	
demeralizing: Installed	10	capacity, 10 ⁴ US gal/d	45	1 - 40	1.19	
Waste disposal:						
waste water, municipal, secondary treat: Installed	1	capacity, 10 ⁶ US gal/d	450	0.2 - 30	0.81	
packaged extended aeration: Installed	1	capacity, 10 ⁴ US gal/d	35	0.1 - 100	0.63	60
packaged conventional activated sludge: Installed	1	capacity, 10 ⁶ US gal/d	580	0.01 - 10	0.62	
packaged contact stabilization: FOB	1	capacity, 10 ⁴ US gal/d	12	0.1 - 100	0.40	
via membrane ultrafiltration: Installed	30	capacity, 10 ⁴ US gal/d	29	0.8 - 8	0.78	

	Size	Unit	Cost 10 ³ \$	Range	n	Error %
septic tank and underground tile bed: Installed						
lagoon: Installed	4	capacity, 10 ³ US gal/d	13	1 - 20	0.82	
deep well disposal of liquid	10	capacity, 10 ⁴ US gal/d	28	1 - 60	0.71	
Sludge disposal	1	capacity, 10 ⁶ US gal/d	1500	0.4 - 5	0.81	
via digestion, filtering, disposal	1	capacity, 10 ⁶ US gal/d	80	0.2 - 4	0.62	
via digestion, filtering, furnace	18	capacity, 10 ³ lb/hr	1 × 10 ⁴			
Incinerators:						
municipal: Installed with recovery	300	capacity, ston/d	3700	100 - 2000	0.87	
Chimney, brick: Installed	1000	(height, ft) (diam, ft) ²	470	300 - 1500	1.23	
Inert gas generator unit: Package installed	1	capacity, 10 ⁴ scfh	73	0.1 - 10	0.57	