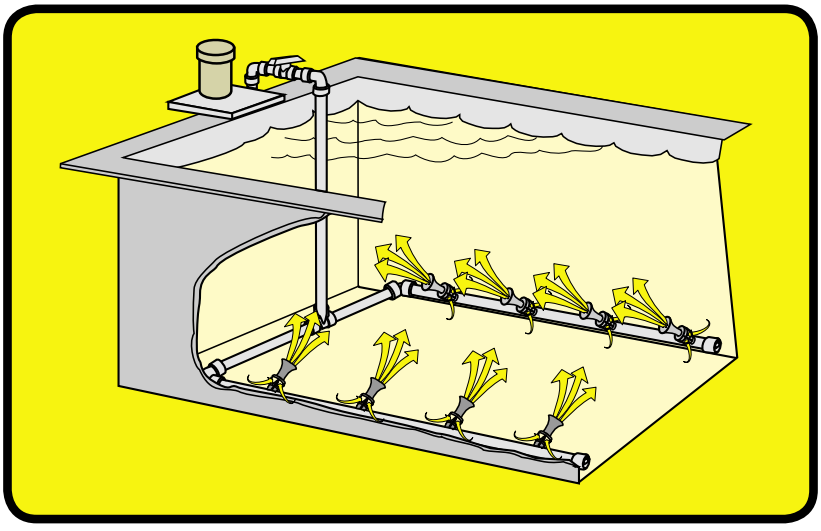
SER-DUCTOR®
PUMPED AGITATION

Efficient agitation and mixing of:
CLEANING / RINSING / PLATING / WASTE TREATMENT and OTHER PROCESS SOLUTIONS



A SER-DUCTOR system provides solution agitation with a centrifugal pump by drawing liquid from a tank and returning it to the tank through a sparger system, similar to that used for air agitation, with eductors strategically placed along the sparger pipe.

SER-DUCTOR agitation delivers 5 times the pump output at each nozzle.It effectively distributes the desired level of agitation to critical areas in your process tank. The system is driven by your choice of vertical, magnetic drive, self-priming or mechanical seal pump.

With SER-DUCTOR systems, solutions are agitated without the introduction of foreign matter such as airborne dirt or compressor oil, as is often the case with air agitation. Whether the solution is a cleaner, a rinse, a plating bath or other process solution, it is only this fluid that is recirculated by the SER-DUCTOR system.

SER-DUCTOR agitation in a process tank keeps particulate from settling to the tank bottom where it can form a layer of sludge that shortens the life of the solution, requires expensive dumps, new make-ups and costly downtime in between for manual cleanout of the tank bottom. By effectively keeping the "dirt" in suspension, the SER-DUCTOR system makes it easier for a filtration system on the tank to remove particles. This extends the life of the bath and greatly reduces the possibility of contamination being carried to other tanks in the process cycle where it can lead to costly rejects and even product failure.

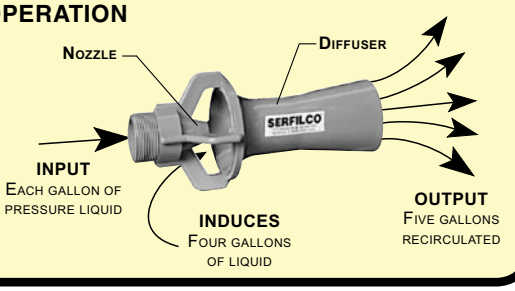
PROVEN BENEFITS OF SER-DUCTOR SYSTEMS IN PLATING APPLICATIONS

- Reduces airborne fume emissions by 90%
- Saves heating costs up to 25%
- Reduces brightener consumption 20%
- Saves metal as a result of more uniform brightness and thickness distribution
- Improves throw and deposit thickness in blind and through holes and recesses
- Permits increased current density, especially compared to air or cathode rod agitation, for faster plating rate
- Reduces carbonates in alkaline processes
- Reduces or eliminates gas-pitting
- Provides constant agitation because SER-DUCTOR systems don't clog

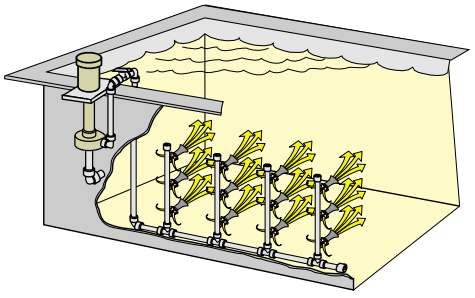
SER-DUCTOR® AGITATION SYSTEMS APPLICATIONS

PRINCIPLE OF OPERATION

Liquid pumped into the eductor nozzle exits at high velocity, drawing an additional flow of the surrounding solution through the eductor. This additional flow (induced liquid) mixes with the pumped solution and multiplies its volume five-fold. The source of the pumped liquid (input) can be a pump or filter chamber discharge.

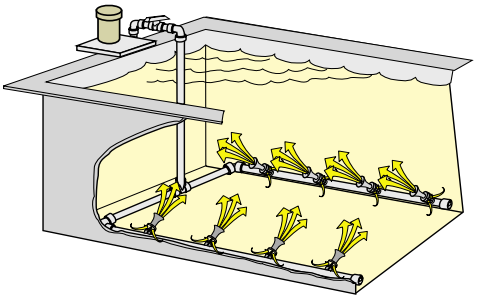


TYPICAL APPLICATIONS



For printed circuit boards and rack plating

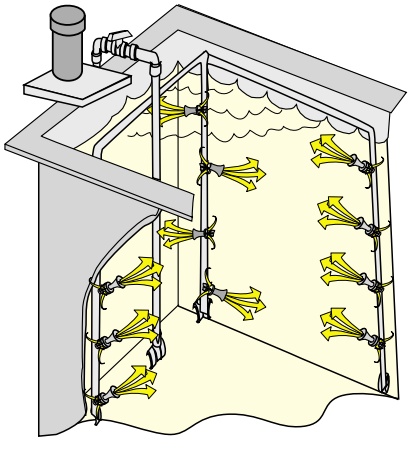
SER-DUCTOR agitation in printed circuit board manufacturing and rack plating applications enhances plating solution flow across the board surface. Carefully engineered clusters of eductor nozzles sweep away cathode films swiftly, allowing faster plating at lower voltages with much higher current densities. More even plating and significantly lower metal usage result. (The horizontal direction of eductors stationed along vertical distributor pipes is a typical SER-DUCTOR configuration for these applications.)



For parts cleaning in baskets or on racks

SER-DUCTOR agitation for bulk parts cleaning in baskets or for racked work improves solution flow through the work and assures greater impingement of fresh solution on the parts.

Additionally, in cleaner tank applications, SER-DUCTOR agitation prevents temperature stratification. It also keeps solids in suspension so they can be more easily removed by filtration. This extends bath life and reduces chemical make-up costs. (The moderately upward angle of these eductors along "wishbone" distributor piping provides the proper direction of solution flow.)



For mixing

Vigorous SER-DUCTOR agitation within the tank creates sufficient solution movement to eliminate solution strati-fication. This movement lends itself to mixing two or more liquids or to mixing a liquid and a powder. (A more extreme angle of eductor positioning is helpful in mixing bath components and assuring continuing uniformity of the solution.)

SER-DUCTOR® AGITATION SYSTEMS ORDERING INFORMATION

TO ORDER, use Price Code No.

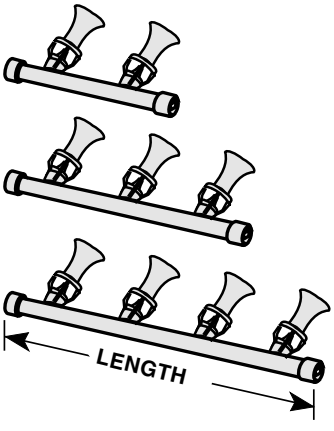
SER-DUCTOR NOZZLES

CONNS	DIMENSIONS		POLYPROPYLENE		CPVC		PVDF		316 STAINLESS STEEL		IRON	
MNPT	Length	Dia.	MODEL	PCN	MODEL	PCN	MODEL	PCN	MODEL	PCN	MODEL	PCN
1/4"	2-3/4"	1-1/4"	ME 1/4"	33-1930	MEC 1/4"	33-1930C	MEK 1/4"	33-1930K	—	—	—	—
3/8"	4-1/4"	2-1/8"	ME 3/8"	33-1732	MEC 3/8"	33-1732C	MEK 3/8"	33-1732K	MESS 3/8"	33-1732S	MES 3/8"	33-1732F
3/4"	6-3/8"	3"	ME 3/4"	33-1733	—	—	MEK 3/4"	33-1733K	MESS 3/4"	33-1733S	MES 3/4"	33-1733F
1"	8-1/2"	3-3/4"	ME 1"	33-1736	—	—	MEK 1"	33-1736K	MESS 1"	33-1736S	MES 1"	33-1736F
1-1/2"	9-7/8"	4-5/8"	ME 1-1/2"	33-1734	—	—	MEK 1-1/2"	33-1734K	MESS 1-1/2"	33-1734S	MES 1-1/2"	33-1734F

SER-DUCTOR COUPLING / NOZZLE ASSEMBLY

	1/4" PP NOZZLE	3/8" PP NOZZLE	3/4" PP NOZZLE
COUPLING SIZE - FNPT	PRICE CODE NO.	PRICE CODE NO.	PRICE CODE NO.
3/4"	33-7003	33-6098	—
1"	33-7004	33-6022	—
1-1/4"	33-7005	33-6099	33-6024
1-1/2"	—	33-7000	33-6025
2"	—	33-7001	33-6026

PRE-ENGINEERED SYSTEMS



PIPE SIZE	EDUCTORS		LENGTH[1]		PP/CPVC		PVDF/PVDF	
MNPT	No.	Size	Inches	Meters	Model	PCN	Model	PCN
1"	2	3/8"	24	.6	S-E1	33-6006	S-E1K	33-6006K
	3		36	.9	S-E2	33-6007	S-E2K	33-6007K
	4		48	1.2	S-E3	33-6008	S-E3K	33-6008K
1-1/4"	2	3/8"	24	.6	S-E4	33-6009	—	—
	3		36	.9	S-E5	33-6010		
	4		48	1.2	S-E6	33-6011		
1-1/4"	2	3/4"	24	.6	S-E7	33-6012	—	—
	3		36	.9	S-E8	33-6013		
	4		48	1.2	S-E9	33-6014		
1-1/2"	2	3/8"	24	.6	S-E16	33-6081	S-E16K	33-6081K
	3		36	.9	S-E17	33-6082	S-E17K	33-6082K
	4		48	1.2	S-E18	33-6083	S-E18K	33-6083K
1-1/2"	2	3/4"	24	.6	S-E10	33-6015	S-E10K	33-6015K
	3		36	.9	S-E11	33-6016	S-E11K	33-6016K
	4		48	1.2	S-E12	33-6017	S-E12K	33-6017K
2"	2	3/8"	24	.6	S-E19	33-6084	S-E19K	33-6084K
	3		36	.9	S-E20	33-6085	S-E20K	33-6085K
	4		48	1.2	S-E21	33-6086	S-E21K	33-6086K
2"	2	3/4"	24	.6	S-E13	33-6018	S-E13K	33-6018K
	3		36	.9	S-E14	33-6019	S-E14K	33-6019K
	4		48	1.2	S-E15	33-6020	S-E15K	33-6020K

[1] Eductors are spaced on 12" centers over the length of all SER-DUCTOR systems.
All SER-DUCTOR systems can be connected to achieve extended length assemblies.

PUMPS FOR SER-DUCTOR AGITATION SYSTEMS

'EH' vertical

SERFILCO also offers a variety of pumps to drive your SER-DUCTOR SYSTEM

'F' magnetic-coupled

'HE' horizontal

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MODEL NUMBER	PRICE CODE NUMBER	GPM @ TDH (ft.)[6]	SUCTION	DISCHARGE	MOTOR, TEFC, 60 Hz, 3450 RPM		MATERIALS OF CONSTRUCTION
					HP	PHASE	
VERTICAL SERIES 'EO' PUMPS[1]							
EO1 CV1-C.3	39-1221A	15 @ 27	1¼"	1¼"	1/3	1	CPVC
EO1 CV3-C.75	39-1223C	30 @ 28	1¼"	1¼"	¾	1	CPVC
EO1¼ CV4-D1.0	39-2224J	50 @ 35	1½"	1½"	1	3	CPVC
EO1¼ CV5-D1.5	39-2225K	70 @ 38	1½"	1½"	1½	3	CPVC
VERTICAL SERIES 'EH' PUMPS[2]							
EH1½- 1SC-D1.5	45-0112	60 @ 40	2"	1½"	1½	3	CPVC
EH1½- 2SC-D2.0	45-0123	80 @ 48	2"	1½"	2	3	CPVC
EH1½- 3SC-D3.0	45-0134	100 @ 52	2"	1½"	3	3	CPVC
EH1½- 4SC-D5.0	45-0145	140 @ 68	2"	1½"	5	3	CPVC
EH1½- 5SC-D7.5	45-0156	180 @ 45	2"	1½"	7½	3	CPVC
MAGNETIC-COUPLED SERIES 'M' PUMPS[3]							
1x¾ MPVCR 1AC-C.5	51-4111 A	25 @ 28	1"	¾"	½	1	Polypropylene
1½x1 MPVCR 2B-C.75	51-6221 B	45 @ 32	1½"	1"	¾	1	Polypropylene
1½x1 MPVCR 3B-D1.0	51-6321 F	60 @ 32	1½"	1"	1	3	Polypropylene
MAGNETIC-COUPLED SERIES 'F' PUMPS[4]							
1½x1¼ MPGC2-C.75	51-1026 A	40 @ 34	1½"	1¼"	¾	1	Polypropylene
1½x1¼ MPGC3-D1.5	51-1036 F	50 @ 44	1½"	1¼"	1½	3	Polypropylene
1½x1¼ MPGC4-D2.0	51-1047 G	60 @ 53	1½"	1¼"	2	3	Polypropylene
1½x1¼ MPGC5-D3.0	51-1057 H	70 @ 57	1½"	1¼"	3	3	Polypropylene
HORIZONTAL SERIES 'HE' PUMPS[5]							
HE2x1½ CE1V(M2)-D1.5	42-0112 A	60 @ 43	2"	1½"	1½	3	CPVC / Viton®
HE2x1½ CE2V(M2)-D2.0	42-0122 B	80 @ 48	2"	1½"	2	3	CPVC / Viton
HE2x1½ CE3V(M2)-D3.0	42-0132 C	100 @ 56	2"	1½"	3	3	CPVC / Viton
HE2x1½ CE4V(M2)-D5.0	42-0142 D	140 @ 68	2"	1½"	5	3	CPVC / Viton
HE2x1½ CE5V(M2)-D7.5	42-0152 E	170 @ 77	2"	1½"	7½	3	CPVC / Viton

[1-5] Request appropriate bulletin for complete specifications, including alternate materials of construction, flow curves, dimensions, etc.

[1] Bulletin P-312 [2] Bulletin P-301 [3] Bulletin P-509 [4] Bulletin P-621 [5] Bulletin P-201

[6] Total dynamic head (TDH) in feet ÷ 2.31 = PSI

GEAR DRIVE and DIRECT DRIVE

For blending two or more liquids, mixing liquids with solids, or waste treatment neutralization.

TYPICAL APPLICATIONS:

WASTE TREATMENT
FOOD PROCESSING
COSMETICS
CHEMICAL MANUFACTURING
PHARMACEUTICALS
PAINTS AND INKS

- **For tank sizes to 4500 gallons Pumping rate to 5600 GPM**
- **Single or dual propeller configurations**
- **Variable speed drive available for shear sensitive liquids**
- **Mixers for special applications available. Consult Sales Department**

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SPECIFICATIONS

Motor: 1750 RPM, TEFC

Gear housing: Heavy wall A-356-T6 heat-treated cast aluminum - polished before painting.

Mounting: Either universal C-clamp (standard) or rigid cup mount.

Shaft: 1" diameter 316L stainless steel, centerless ground and polished for vibration-free operation.

Dual chuck set screws allow for shaft removal without disassembling mixer.

Propellers: Square pitch, 3 blade marine propellers. Cast 316L stainless steel, machined and balanced for vibration-free performance.

Do not use on flammables or in a combustible atmosphere.
Consult Sales Dept. for mixers designed for this purpose.

GEAR DRIVE and DIRECT DRIVE MIXERS

TO ORDER, use Price Code Number

For gear or direct drive model, select mixer, single or dual propeller and motor from tables below.

EXAMPLE:	Mixer	+	Propeller	+	Motor	=	Model	=	PRICE CODE NO.
	SMG75	+	1	+	D	=	C -CLAMP MOUNT MODEL - SMG75-1-G.75	=	50-1041D

SERFILCO DOUBLE REDUCTION HELICAL GEAR DRIVE MIXERS, AGMA quality 8, provide smooth, quiet performance. They offer the ability to change mixer speeds from 310 RPM to 170 RPM (standard operating RPM is 310) by simply replacing the primary gear set. Heavy duty design offers more mixing capability than any other portable mixer. Standard shaft length is 36". Consult Sales Dept. for other lengths.

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GEAR DRIVE MIXER W/CLAMP MOUNT[3]

BASIC MODEL NUMBER	PUMPING RATE [1] (GPM)	APPROX. TANK SIZE (GAL.)	PRICE CODE NUMBER	PROPELLER DIAMETER (In.)		
				Single	Dual	Add
SMG25	1375	750-1200	50-101	12.5	11	-1 or -2 to MODEL & 1 or 2 to PRICE CODE NO.
SMG33	1730	1000-1500	50-102	13.5	11	
SMG50	2145	1500-2500	50-103	14.5	12.5	
SMG75	2620	2000-3000	50-104	15.5	13.5	
SMG100	3165	2500-3500	50-105	16.5	14.5	
SMG150	4105	3000-4000	50-106	18.0	15.5	
SMG200	5635	3500-4500	50-100	20.0	16.5	

+ TEFC MOTOR	115-230V/1/60		230-460V/3/50-60	
	Add to . . .		Add to . . .	
HP	MODEL	PRICE CODE NO.	MODEL	PRICE CODE NO.
.25	-G.25	A	-H.25	H
.33	-G.33	B	-H.33	J
.5	-G.5	C	-H.5	K
.75	-G.75	D	-H.75	L
1.0	-G1.0	E	-H1.0	M
1.5	-G1.5	F	-H1.5	N
2.0	-G2.0	G	-H2.0	P

Motor and gear box length - 22".

SERFILCO DIRECT DRIVE MIXERS utilize a precision-bored shaft chuck connected directly to a 56C frame motor. Permanently lubricated chuck support bearing and elastomeric lip seal with garter spring means no contamination from lubricants and no maintenance. Operating RPM is 1750. Minimum shaft length is 36". Consult Sales Dept. for other lengths.

DIRECT DRIVE MIXER W/CLAMP MOUNT[3]

BASIC MODEL NUMBER	PUMPING RATE [1] (GPM)	APPROX. TANK SIZE (GAL.)	PRICE CODE NUMBER	PROPELLER DIAMETER (In.)		
				Single	Dual	Add
SMD25	240	up to 250	50-107	4.0	3.5	-1 or -2 to MODEL & 1 or 2 to PRICE CODE NUMBER
SMD33	345	200-400	50-108	4.5	4.0	
SMD50	470	250-500	50-109	5.0	4.0	
SMD75	630	400-700	50-110	5.5	4.5	
SMD100	630	500-900	50-111	5.5	5.0	
SMD150	815	700-1200	50-112	6.0	5.5	
SMD200	1040	900-1400	50-113	6.5	5.5	
SMDA [2]	VARIABLE	100-1000	50-114	5.5	5.0	

+ TEFC MOTOR	115-230V/1/60		230-460V/3/50-60	
	Add to . . .		Add to . . .	
HP	MODEL	PRICE CODE NO.	MODEL	PRICE CODE NO.
.25	-G.25	A	-H.25	H
.33	-G.33	B	-H.33	J
.50	-G.50	C	-H.50	K
.75	-G.75	D	-H.75	L
1.0	-G1.0	E	-H1.0	M
1.5	-G1.5	F	-H1.5	N
2.0	-G2.0	G	H2.0	P
1.0	-AIR			R

Direct Drive motor height -17½" Air Drive height - 12"

[1] Data based on 100 CPS viscosity and specific gravity approximately equal to 1.0.
[2] Includes air flow control valve, filter oiler lubricator. For other conditions, consult Sales Dept.
[3] For optional swivel cup mount, add **C** to basic Model Number and change **1** to **2** after hyphen in Price Code Number.

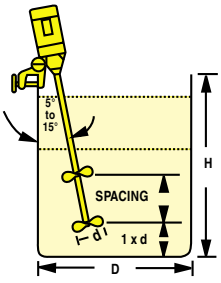
NOTE: When the tank height is greater than 1¼ times the tank diameter, dual propellers should be used to assure complete mixing. The second propeller is generally located midway between the bottom propeller and the liquid surface.
See Technical Bulletin TA-105 for selection guidelines.

MIXER SELECTION GUIDELINES

SELECTION GUIDELINES

The following guidelines and selection tables are based on mixing in vertical cylindrical tanks with flat, dished or shallow cone bottoms. Mixer selections may vary with tank shape, retention times, starting conditions, etc.

For liquid levels .5 to 1.1 times the tank diameter, a single propeller is suitable.

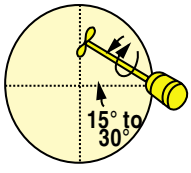


A single propeller may be located from .5 to 2.0 propeller diameters off the tank bottom. The optimum distance is one(1) diameter off the bottom. (Example: 10" diameter prop, should be approximately 10" off the tank bottom)

For liquid levels 1.1 to 1.6 times the tank diameter, dual propellers are recommended.

When dual propellers are required, spacing between gear-driven mixer propellers should be approximately two (2) propeller diameters: propeller spacing for direct-drive mixers should be 4 to 5 propeller diameters.

The mixer position in an unbaffled tank should be as shown for maximum turnover of liquid and optimum mixing. Positioning the propeller "on center" will produce a vortex which may help in wetting and dispersing light solids.



Mixer position in square and rectangular tanks is similar to cylindrical tanks. When L is more than 2 x W, consult your SERFILCO representative.

Proper matching of propeller and motor is usually based on the turnover, or pumping rate, for the application. (Polymer mixing is an exception.)

Pumping rate is arrived at by the following:

$$\frac{Q=N_Q\ N\ d^3}{231}$$

WHERE:

Q = pumping rate in gallons per minute

N = mixer speed in RPM

d = propeller diameter in inches

N_Q = pumping coefficient for propeller type (1.0 or "square" pitch marine propeller, N_Q =.5) standard (1.5 "steep" pitch marine propeller, N_Q =.77) optional

Propeller horsepower requirements can be calculated from:

$$\frac{HP=Np\ P\ N^3\ d^5}{1.53 \times 10^{13}}$$

WHERE:

HP = horsepower required

N = mixer speed in RPM

d = propeller diameter in inches

P = specific gravity of mixture

N_p= power coefficient for a class of propellers (1.0 or "square" pitch marine propellers, N_p=0.35) standard (1.5 "steep" pitch marine propellers, N_p = 0.85) optional

SELECTION TABLES

Two or More Liquids (Blending)

PRODUCT VISCOSITY	VOLUME (GALLONS)					
	30-50	75-100	200-400	500-750	1000-1500	2000-3000
Up to 100 cps	SMD25	SMD25	SMD33	SMD75	SMG33	SMG75
250-750 cps	SMD33	SMD50	SMD75	SMG33	SMG75	SMG150
1000-2500 cps	SMG25	SMG50	SMG50	SMG100	SMG150	SMG200
3000-4000 cps	SMG33	SMG50	SMG75	SMG100	SMG200	*
5000 cps	SMG100	SMG150	*	*	*	*
Shear Sensitive (Polymers)	*	SMG25V	SMG50V	SMG100V	SMG150V	*

Blend times for the selections above are generally 5-15 minutes. * Consult Sales Dept.
V =Variable speed

Liquid - Solids/Slurries

PERCENT SOLIDS BY WEIGHT	VOLUME (GALLONS)					
	30-50	75-100	200-400	500-750	1000-1500	2000-3000
5 - 10%	SMD25	SMD25	SMD50	SMD100	SMG33	SMG75
15 - 20%	SMD33	SMD75	SMD100	SMD200	SMG150	*
25 - 40%	SMD50	SMD100	SMG50	SMG100	*	*
50 - 75% (Ceramic slip)	SMG25	SMG50	SMG100	SMG150	*	*

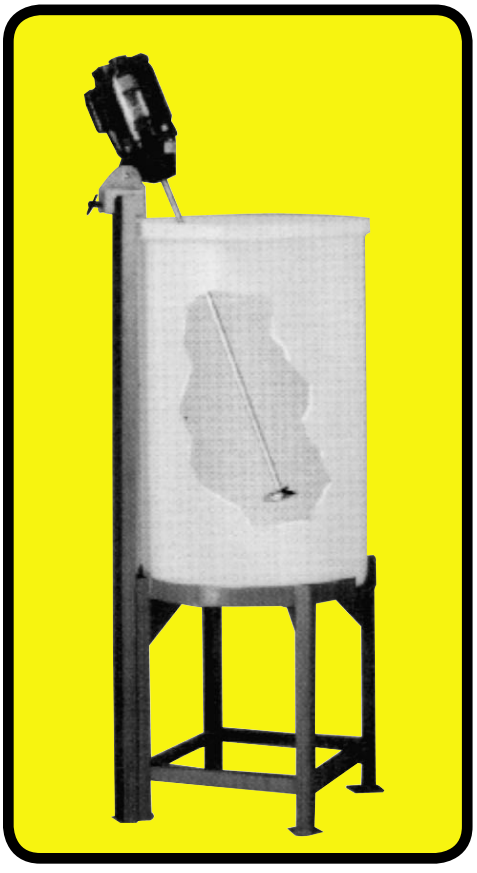
1. For "wetting" light solids, position mixer prop near center of tank to produce a vortex.
2. For "flocculation" or "solid dispersion" consult Sales Dept.
3. Whenever liquid depth to tank diameter ratio exceeds .75 use dual props.

Waste Treatment Mixer Selections

TANK VOLUME GALLONS	WASTE FLOW RATE (GPM)			
	10	25	50	100
100	*	SMD25	SMD33	SMD50
250	SMD25	SMD25	SMD33	SMD50
500	SMD33	SMD50	SMD100	SMG33
1000	SMG25	SMG25	SMG33	SMG50
2000	SMG33	SMG50	SMG50	SMG75
3000	SMG50	SMG75	SMG100	SMG100

* Consult Sales Dept.

MIXING STATIONS



- **Excellent for mixing, adding flocculating agents, waste treat, plating, chemical processing**
- **Pre-engineered packages**
- **7 sizes to choose from**
  Up to 250 Gallons
- **Chemical resistant**
- **Seamless — corrosion-resistant tanks -**
  Molded HDPE
- **Cone bottom for easy and complete emptying with optional drain**
- **For liquids to 160°F and 1.3 S.G., 500 CPS**

These mixing stations feature a heavy duty HDPE tank, epoxy painted steel tank stand with mixer mount. The mixers are direct drive to 1725 RPM for optimum tank mixing and blending. Motors are 115/230/1/60. Tank connections and valves ordered separately.

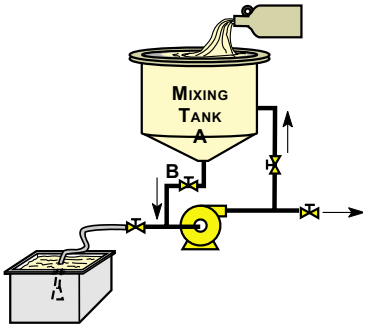
For custom inlet & outlet configurations, consult Application Engineering Dept.

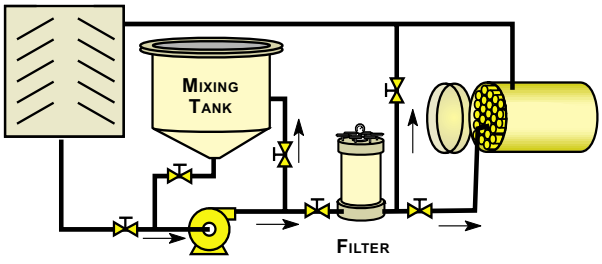
MODEL NUMBER	TANK SIZE		MIXER H.P.	PRICE CODE NO.
	GALLONS	DIA. x HT. (in.)	TEFC	
MS30	30	18 x 29	1/4	48-0974
MS55	55	22 x 36	1/4	48-0975
MS75	75	30 x 24	1/4	48-0976
MS100	100	30 x 36	1/3	48-0977
MS125	125	42 x 24	1/3	48-0978
MS200	200	31 x 65	1/3	48-0979
MS250	250	42 x 46	1/3	48-0980

PORTABLE DOLLY & MIXING TANK

For use with any end suction horizontal centrifugal pump to provide pumping, transferring, recirculating, cleaning or filtering.

- **CHEMICAL & FOOD PROCESSING TANKS**
- **PHOTOGRAPHIC SOLUTIONS**
- **ETCHING SOLUTIONS**
- **CLEANING SOLUTIONS**
- **WASTES**
- **ACIDS**
- **CHEMICALS**
- **PLATING**
- **FUME SCRUBBING**
- **COOLING TOWER**





PUMP PRIMING
Pumps can be primed by first recirculating solution between the mixing tank and the pump. Partially open valve B to remove air from the suction hose.

ADDING CHEMICALS TO SOLUTIONS
Chemical additions to solutions being pumped can be made directly by placing the chemicals in the mixing tank and opening valve A.

PRECOATING A FILTER
Provides a convenient way to add filter aid (precoating) to a filter support membrane and to provide additional filter aid and carbon as required.

CLEANING A TANK, BOILER or COOLING TOWER
Provides easy descaling, rinsing and flushing with or without a filter.

ADD TO PUMP MODEL NO.	DESCRIPTION	PRICE CODE NO.
-SV	MIXING TANK with piping, valves and base assembly. Consists of a 7.5 gallon (28 liter) polyethylene tank with cone bottom, polypropylene outlet strainer, PVC tank frame. CPVC union ball valves on suction and discharge, two 1" NPT CPVC union ball valves (tank inlet and outlet), CPVC piping, all mounted on an 18" x 33" (457mm x 838mm) vinyl coated steel stationary base. Includes pump installation and quick coupling hose adapter on suction and discharge. (Order pump separately.) Shipping weight – approximately 100 lbs. (45 kg) Order -SV system to match pump suction connection: with 1" NPT suction and discharge valves with 1½" NPT suction and discharge valves with 2" NPT suction and 1½" NPT discharge valves	 48-0972 48-0962A 48-0973
-P	PORTABLE with two fixed wheels, two swivel casters and pull handle. *Note:* If double seal is required, be sure to use self-contained water recirculating pump kit for flushing. (See separate bulletin.)	O-2042
HOSE	HOSE Select necessary length of hose and clamps for suction and discharge.	See separate bulletin

For SERFILCO pump selection, see Bulletins P-203 (HC/HK), P-201 (HE), P-504 (D), P-509 (M), P-621 (F)