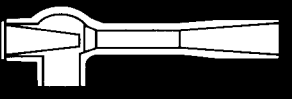
B400

- EDUCTORS
- SYPHONS
- MIXERS



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TYPE 464 AND 466 LIQUID JET EDUCTORS

MOTIVE INLET
High pressure water or other motive liquid enters the eductor.

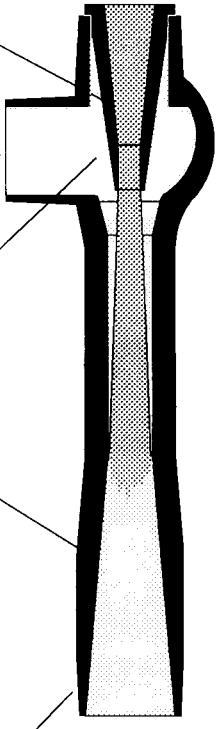
MOTIVE NOZZLE
The high pressure motive liquid is converted into a high velocity liquid jet stream.

SUCTION CONNECTION
Low pressure water or other liquid is drawn in by the ejector action of the motive liquid stream.

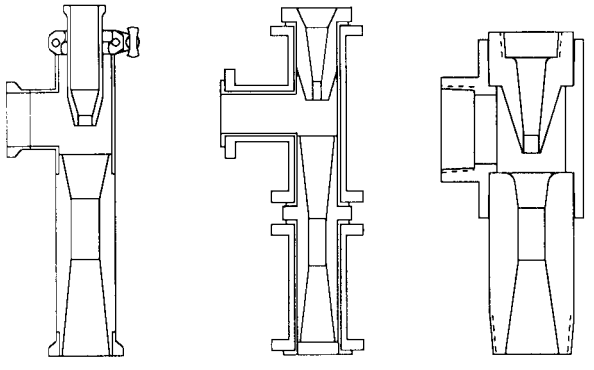
EDUCTOR BODY
The body is a low pressure region created by the high velocity motive liquid. Initial mixing occurs in the body.

VENTURI TAIL
A highly turbulent region where the mixing of the suction and motive liquids continues, and where the motive liquid energy is transferred to the suction liquid. The diverging section converts the velocity energy to a pressure intermediate to the suction and motive pressures.

DISCHARGE CONNECTION
The mixed liquid stream is discharged from the eductor.



Specialized Designs



464S 464PLF 464P

APPLICATION

Liquid jet eductors are used in various pumping and mixing applications. A high pressure motive liquid such as water or other liquid is used to entrain water or other liquid under vacuum. The intimate contact between the motive and suction liquid makes the eductor ideal for mixing applications. The eductor is especially useful in applications that are highly corrosive, erosive, or explosive, and for which a mechanical pump is not practical or is cost prohibitive. The eductor has no moving parts that require routine maintenance as mechanical pumps have, and when properly installed, the eductor is self priming. Type 464 Eductors are of cast design and are available in 1/4" through 1-1/2" sizes. Type 466 Eductors are fabricated in 2" and larger sizes.

The chemical, pharmaceutical, petrochemical, pulp and paper, food, marine, water and wastewater treatment, power, and many other industries have successfully utilized liquid jet eductors. Some typical applications include pumping out wells, sumps, pits, and bilges; chemical mixing, blending, and diluting operations; pumping of food products; reconstituting processes; slurry handling; back washing of filter beds; deep well pumping; and mixing of aqueous solutions of pesticides, herbicides, and fertilizers.

Refer to Bulletin 600 for liquid jet eductors used as exhausters to handle air or other gas.

Refer to Bulletin 200 for eductors used to convey solids with motive liquid, air, or other gas.

OPERATION / PERFORMANCE

The liquid jet eductor utilizes a high pressure motive liquid such as water or other liquid to lift, entrain, and pump a lower pressure liquid. The motive liquid enters the suction chamber of the eductor through a converging motive nozzle. The nozzle converts the pressure energy of the motive liquid into a high velocity jet. As the high velocity motive liquid mixes with the suction liquid, momentum present in the motive liquid is transferred to the suction liquid. The combined streams then enter the venturi tail section where mixing continues and velocity energy is converted to a pressure intermediate to the suction and motive pressures.

CONSTRUCTION

The liquid jet eductor consists of a one piece body and venturi tail and a removable motive nozzle. The eductor is available in almost any construction material including steel, stainless steel, Monel, Hastelloy, titanium, PVC, CPVC, Kynar, and Teflon. Connections are typically threaded or flanged, but special connections such as butt weld, socket weld, quick disconnect, or sanitary connections can be supplied.

SPECIALIZED EDUCTOR DESIGNS

EST is able to provide special eductor designs to fulfill unique application requirements. Several special eductor designs are described below.

SANITARY EDUCTOR, TYPE 464S

The sanitary eductor has sanitary connections and a sanitary finish inside and outside for use in food grade applications. The eductor is available in 304 or 316 stainless steel.

PLASTIC LINED FITTING EDUCTOR, TYPE 464PLF

The PLF Eductor is constructed from thermoplastic inserts machined to fit into standard lined pipe fittings. The eductor is typically used in highly corrosive applications where structural integrity is also a prime concern. The PLF Eductor is available in Teflon, PVC, Polypropylene, and Kynar. For more complete information on the PLF Eductor refer to page 7 of this bulletin.

PLASTIC EDUCTOR, TYPE 464P

The plastic eductor is also used in corrosive applications and is constructed in PVC, CPVC, Kynar, and polypropylene.

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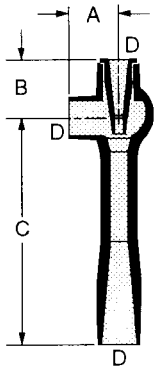
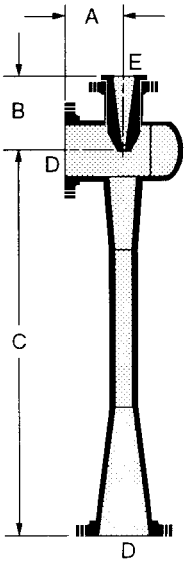
TYPE 464 AND 466
LIQUID JET EDUCTOR DIMENSIONS



TYPE 464
CAST EDUCTOR
1/4" TO 1-1/2" SIZE



TYPE 466
FABRICATED EDUCTOR
2" AND LARGER

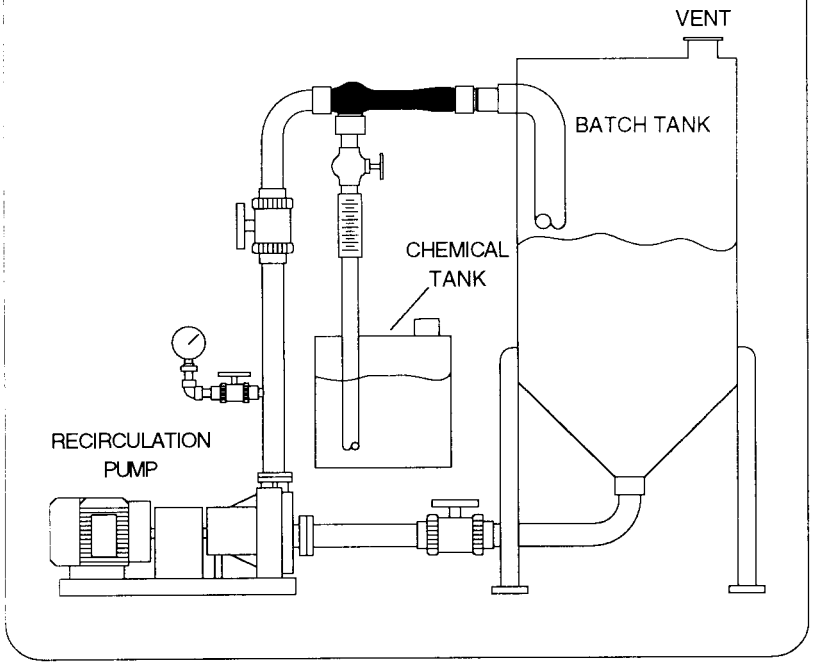
NOM. PIPE SIZE	DIMENSIONS, INCHES						WT. LBS.
	Qs*	A	B	C**	D	E	
1/4	0.7	1-1/4	1-3/8	1-11/16	1/4	----	1/4
1/2	3	1-5/8	1-5/8	3-1/4	1/2	----	1
3/4	6	1-13/16	1-3/4	4-3/4	3/4	----	2
1	11	2	2-1/4	6-1/4	1	----	4
1-1/2	25	2-3/8	2-5/8	9-1/2	1-1/2	----	11
2	45	5	5-5/8	12	2	2	22
2-1/2	71	5-3/4	6-3/8	16	2-1/2	2	32
3	102	6-1/8	6-3/4	20	3	2	45
4	182	7-1/8	7-3/4	27	4	2-1/2	65
5	285	8-3/8	9-1/8	32	5	4	90
6	410	9-1/8	9-7/8	40	6	4	115
8	730	11	11-3/4	52	8	6	170

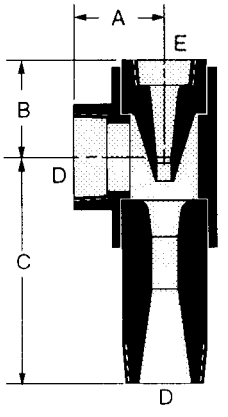
1. Type 464 Eductor sizes 1/4" through 1-1/2" typically have male pipe thread connections which can be fitted with threaded flanges.
2. Type 466 Eductors 2" and larger typically have flanged connections.

* Qs = Suction water flow rate at 80°F in gpm with a 10 foot suction lift and 20 foot discharge head, using 60 psig water in a MN (Medium Nozzle) Eductor.

** The C dimension may vary in the larger fabricated eductors.

Batch Mixing Of Chemicals





TYPE 464 P
PLASTIC EDUCTOR
1/2" TO 3" SIZE

NOM. PIPE SIZE	DIMENSIONS, INCHES					WT. LBS.
	A	B	C	D	E	
1/2	1-3/8	1-1/2	3-7/16	1/2	3/8	1/2
3/4	1-3/4	1-7/8	5	3/4	1/2	1/2
1	1-7/8	2-1/8	6-1/4	1	3/4	3/4
1-1/2	2-7/16	2-5/8	9-3/4	1-1/2	1	1-1/2
2	2-3/4	3-1/8	12-1/2	2	1-1/2	2-1/2
2-1/2	3-5/16	3-5/8	15	2-1/2	2	4
3	3-3/4	4-1/8	18-11/16	3	2	7

1. Male and female threaded connections are normal pipe thread.
2. The above dimensions are typical for PVC and CPVC construction.
3. The eductor is also available with flanged connections.

TYPE 464 AND 466 LIQUID JET EDUCTOR PERFORMANCE DATA

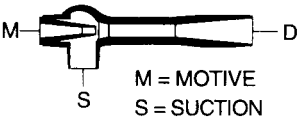
SUCTION LIFT (ft.) Hs	DISCHARGE HEAD (ft.) Hd	SUCTION CAPACITY Qs (gpm as water) MOTIVE PRESSURE (PSIG)																		
		10			20			40			60			80			100			
		SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	
0	0	5.2	5.5	8.9	13.6	10.8	15.3	19.3	18.2	15.7	19.6	18.3	15.7	19.6	18.4	15.5	19.7	18.2	15.3	
	10				2.5	2.5	8.5	12.8	13.3	15.7	19.2	18.3	15.7	19.6	18.4	15.5	19.7	18.2	15.3	
	20						1.7	6.1	8.4	14.6	13.6	15.5	15.7	19.3	18.4	15.5	19.7	18.2	15.3	
	30								3.1	9.3	7.9	11.2	15.7	13.8	17.4	15.5	19.7	18.2	15.3	
	40									4.2	2.5	7.1	14.0	8.7	13.5	15.5	15.9	18.2	15.3	
	50											3.2	10.2	3.4	9.4	15.5	11.2	17.4	15.3	
	60												6.5		5.3	14.6	6.1	13.3	15.3	
	70												2.7		1.2	10.9	1.4	9.5	15.3	
	80															6.9		5.4	12.8	
	90															3.4		1.3	10.1	
	100																		7.2	
	110																		4.2	
	120																		1.3	
	MOTIVE FLOW (GPM)	4.4	5.7	8.9	6.2	8.1	11.9	8.8	11.4	16.9	10.7	14.0	20.7	12.4	16.2	23.9	13.9	18.1	26.7	

SUCTION LIFT (ft.) Hs	DISCHARGE HEAD (ft.) Hd	SUCTION CAPACITY Qs (gpm as water) MOTIVE PRESSURE (PSIG)																		
		10			20			40			60			80			100			
		SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	
-5	0			7.1	11.4	7.1	13.8	17.2	16.8	13.8	18.2	16.8	13.8	17.9	16.8	13.9	18.2	16.5	14.1	
	10						7.0	10.7	11.9	13.8	16.8	16.8	13.8	17.9	16.8	13.9	18.2	16.5	14.1	
	20						0.3	3.8	6.9	13.6	11.4	13.3	13.8	17.2	16.8	13.9	18.2	16.5	14.1	
	30								1.6	8.2	5.6	9.0	13.8	12.0	16.4	13.9	18.2	16.5	14.1	
	40									3.1	0.3	4.7	12.9	6.8	12.3	13.9	13.8	16.5	14.1	
	50											0.7	10.3	1.6	8.4	13.9	9.1	15.9	14.1	
	60												5.4		4.3	13.3	6.1	11.9	14.1	
	70												1.6		0.3	9.7		8.0	14.1	
	80															5.7		3.9	12.0	
	90															2.2			9.4	
	100																		6.5	
	110																		3.5	
	120																		0.5	
	MOTIVE FLOW (GPM)	4.8	6.3	9.3	6.5	8.5	12.6	9.0	11.7	17.3	10.9	14.3	21.0	12.6	16.4	24.2	14.0	18.3	27.0	

SUCTION LIFT (ft.) Hs	DISCHARGE HEAD (ft.) Hd	SUCTION CAPACITY Qs (gpm as water) MOTIVE PRESSURE (PSIG)																		
		10			20			40			60			80			100			
		SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	
-10	0			5.2	8.6	1.3	12.1	15.2	14.9	12.5	16.1	15.0	11.9	16.2	15.0	12.7	16.2	14.9	12.8	
	10						5.2	8.6	10.0	12.5	14.9	15.0	11.9	16.2	15.0	12.7	16.2	14.9	12.8	
	20							1.7	4.8	12.5	9.5	11.4	11.9	15.3	15.0	12.7	16.2	14.9	12.8	
	30									7.3	3.9	6.9	11.9	10.0	15.0	12.7	16.2	14.9	12.8	
	40									1.7		2.6	11.9	4.8	11.1	12.7	12.3	14.9	12.8	
	50												6.1		7.1	12.7	7.7	14.5	12.8	
	60												4.2		3.0	12.1	2.9	10.4	12.8	
	70												0.4			8.6		6.5	12.8	
	80															4.6		2.4	11.4	
	90															1.0			8.7	
	100																		5.7	
	110																		2.8	
	120																			
	MOTIVE FLOW (GPM)	5.2	6.9	10.1	6.8	8.9	13.2	9.2	12.1	17.8	11.1	14.5	21.4	12.7	16.6	24.5	14.2	18.5	27.3	

SIZE	1/4	1/2	3/4	1	1-1/2	2	2-1/2	3	4	6	8
CAPACITY RATIO CR	.06	.25	.563	1	2.25	4	6.25	9	16	36	64

SN = Small Nozzle
MN = Medium Nozzle
LN = Large Nozzle



M = MOTIVE
S = SUCTION
D = DISCHARGE

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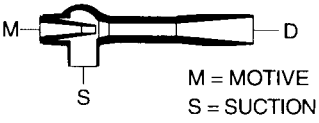
TYPE 464 AND 466 LIQUID JET EDUCTOR PERFORMANCE DATA

SUCTION LIFT (ft.) Hs	DISCHARGE HEAD (ft.) Hd	SUCTION CAPACITY Qs (gpm as water) MOTIVE PRESSURE (PSIG)																	
		10			20			40			60			80			100		
		SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN
-15	0						10.2	12.7	13.1	10.4	13.8	13.1	10.6	14.1	13.1	11.2	14.1	13.1	11.8
	10						3.1	5.9	8.7	10.4	12.3	13.1	10.6	14.1	13.1	11.2	14.1	13.1	11.8
	20								3.3	10.4	7.1	10.0	10.6	13.3	13.1	11.2	14.1	13.1	11.8
	30									6.1	1.6	5.4	10.6	8.1	13.1	11.2	14.1	13.1	11.8
	40									0.8		0.9	10.6	3.0	9.7	11.2	11.0	13.1	11.8
	50												6.7		5.6	11.2	6.3	13.1	11.8
	60												2.9		1.4	11.1	1.4	8.9	11.8
	70															7.4		5.0	11.8
	80															3.5		0.9	10.8
	90																		8.1
	100																		5.2
	110																		2.2
	120																		
	MOTIVE FLOW (GPM)	5.6	7.4	10.8	7.1	9.3	13.7	9.4	12.3	18.2	11.3	14.8	21.8	12.9	16.8	24.8	14.3	18.7	27.5

SUCTION LIFT (ft.) Hs	DISCHARGE HEAD (ft.) Hd	SUCTION CAPACITY Qs (gpm as water) MOTIVE PRESSURE (PSIG)																	
		10			20			40			60			80			100		
		SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN
-20	0						8.5	10.3	10.7	8.7	12.0	10.7	9.1	12.0	10.9	9.9	12.0	11.0	10.2
	10						1.7	3.5	6.4	8.7	10.2	10.7	9.1	12.0	10.9	9.9	12.0	11.0	10.2
	20								1.0	8.7	5.0	8.9	9.1	11.5	10.9	9.9	12.0	11.0	10.2
	30									4.0		4.3	9.1	6.1	10.9	9.9	12.0	11.0	10.2
	40												9.1	1.0	8.4	9.9	9.1	11.0	10.2
	50												5.5		4.1	9.9	4.4	11.0	10.2
	60												1.7			9.9		7.8	10.2
	70															6.7		3.9	10.2
	80															2.7			10.1
	90																		7.4
	100																		4.4
	110																		1.6
	120																		
	MOTIVE FLOW (GPM)	6.0	7.8	11.5	7.4	9.7	14.3	9.7	12.6	18.6	11.5	15.0	22.1	13.0	17.0	25.1	14.4	18.9	27.8

SUCTION LIFT (ft.) Hs	DISCHARGE HEAD (ft.) Hd	SUCTION CAPACITY Qs (gpm as water) MOTIVE PRESSURE (PSIG)																	
		10			20			40			60			80			100		
		SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN	SN	MN	LN
-25	0						6.8	7.8	8.4	6.8	9.5	8.4	6.9	9.5	8.7	7.8	8.9	8.4	8.0
	10						0.1	1.0	4.0	6.8	8.5	8.4	6.9	9.5	8.7	7.8	8.9	8.4	8.0
	20									6.8	3.1	7.5	6.9	9.5	8.7	7.8	8.9	8.4	8.0
	30									1.7		3.0	6.9	4.0	8.7	7.8	8.9	8.4	8.0
	40												6.9		6.3	7.8	6.8	8.4	8.0
	50												4.4		2.0	7.8	2.2	8.4	8.0
	60												0.7			7.8		6.8	8.0
	70															5.7		2.6	8.0
	80															1.7			8.0
	90																		6.5
	100																		3.5
	110																		0.6
	120																		
	MOTIVE FLOW (GPM)	6.3	8.3	12.2	7.7	10.0	14.8	9.9	12.9	19.0	11.7	15.2	22.5	13.2	17.3	25.4	14.6	19.1	28.1

SIZE	1/4	1/2	3/4	1	1-1/2	2	2-1/2	3	4	6	8
CAPACITY RATIO CR	.06	.25	.563	1	2.25	4	6.25	9	16	36	64



SN = Small Nozzle
MN = Medium Nozzle
LN = Large Nozzle

M = MOTIVE
S = SUCTION
D = DISCHARGE

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Eductor Sizing

Example for Water as the Suction and Motive Liquid:
An eductor is required to pump 21 gpm of water from a 15 foot deep sump and discharge an additional 20 feet vertically. The available motive water pressure is 60 psig. Choose an eductor size and determine the motive water rate required.

The following solutions show the available options from the performance tables:

A 1" small nozzle eductor will handle 7.1 gpm using 11.3 gpm of motive water. The required capacity ratio is 21/7.1 or 2.96. A 2" eductor has a CR of 4.0.
Use a 2" Type 464-SN Eductor to handle 4.0 x 7.1 = 28.4 gpm of suction using 4.0 x 11.3 = 45.2 gpm of motive water.
A 1" medium nozzle eductor will handle 10 gpm using 14.8 gpm of motive water. The required capacity ratio is 21/10 or 2.1. A 1-1/2" eductor has a CR of 2.25.
Use a 1-1/2" Type 464-MN Eductor to handle 2.25 x 10 = 22.5 gpm of suction using 2.25 x 14.0 = 33.3 gpm of motive water.
A 1" large nozzle eductor will handle 10.6 gpm using 21.8 gpm of motive water. The required capacity ratio is 21/10.6 or 1.98. A 1-1/2" eductor has a CR of 2.25.
Use a 1-1/2" Type 464-LN Eductor to handle 2.25 x 10.6 = 23.9 gpm of suction using 2.25 x 21.8 = 49.1 gpm of motive water.

All three eductor options will handle the required 21 gpm, but each eductor uses a different motive water flow rate. Both the medium and large nozzle eductors require a 1-1/2" eductor while the small nozzle eductor requires a 2" eductor. In most cases, the 1-1/2" Type 464-MN eductor is the best choice since it is less expensive than the 2" unit and uses the least amount of motive water.

A final check of the discharge piping head losses should be performed using the combined motive and suction flow rates. If the discharge head exceeds the capability of the eductor chosen, as shown in the performance table, the eductor must be resized using the new discharge pressure.

Correction for Solutions Other Than Water

Specific Gravity
Liquids with a specific gravity greater than one (1) require performance adjustments as the specific gravity affects the gpm and suction lift capabilities of the eductor. Refer these applications to EST Corporation.

Vapor Pressure
Increased vapor pressure adversely affects the eductor suction lift capability. The performance tables assume 80°F water. For water with elevated temperature and vapor pressure, or liquids with vapor pressure higher than that of 80°F water, refer the application to EST Engineers.

Viscosity
Viscosities higher than 100 centipoise adversely affect the flow characteristics of the fluids in the eductor and surrounding piping. Consult EST Corporation for applications with fluids exceeding 100 centipoise.

SEVERN TRENT SERVICES

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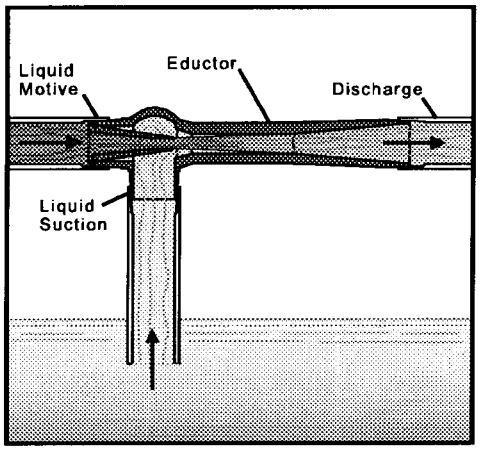
APPLICATION DATA SHEET
EDUCTORS, SYPHONS & MIXERS (Page 1 of 2)

Make a copy of this form to submit a detailed description of your application. This will enable EST to provide the best evaluation and recommendation to fulfill your requirements. This is an inquiry only - not an order - and involves no obligation.

Company _____ Phone ( )_____ Fax ( )_____
Address _____ E-mail _____
Customer Contact _____ Reference No._____ Date _____

☐ **Liquid Jet Eductors** (Liquid Motive & Liquid Suction)



Motive Conditions

Liquid type _____ Viscosity_____ (cps)
Specific Gravity _____ Pressure_____ (psig)
Temperature _____ (°F) Capacity(1) _____ (gpm)
Vapor pressure at operating temperature _____ (psia)

Suction Conditions

Liquid type _____ Viscosity_____ (cps)
Specific Gravity _____ Head(2) _____ (ft)
Temperature _____ (°F) Capacity(1)_____ (gpm)
Vapor pressure at operating temperature _____ (psia)

Discharge Conditions

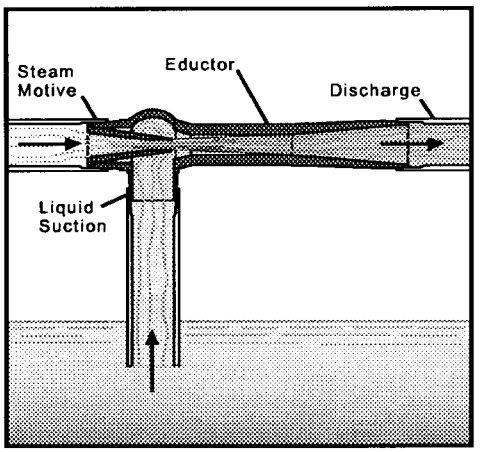
Pressure_____ (psig), or Head _____ (ft)

Comments _____

(1) Unless a specific capacity ratio is desired, specify only one capacity.
(2) Please specify positive (+) or negative (-) head. Negative head is considered a lift.

Please specify construction requirements on next page.

☐ **Steam Jet Syphons** (Steam Motive & Aqueous Liquid Suction)



Motive Conditions (Steam)

Pressure _____ (psig) Temperature_____ (°F)

Suction Conditions

Liquid type _____ Viscosity_____ (cps)
Specific Gravity _____ Head(1)_____ (ft)
Temperature _____ (°F) Capacity_____ (gpm)
Vapor pressure at operating temperature _____ (psia)

Discharge Conditions

Pressure_____ (psig), or Head_____ (ft)
Specify the allowable temperature rise _____ (°F)

Comments _____

(1) Please specify positive (+) or negative (-) head. Negative head is considered a lift.

Please specify construction requirements on next page.

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SEVERN TRENT SERVICES

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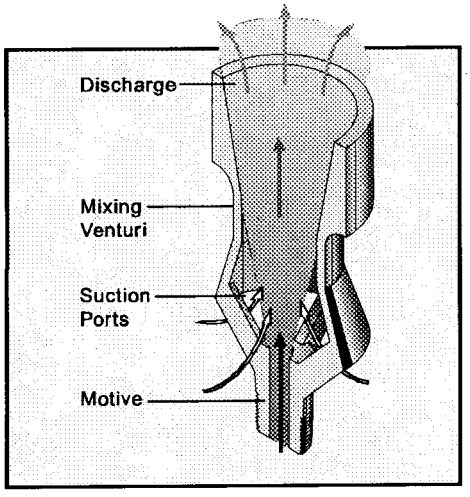
APPLICATION DATA SHEET
EDUCTORS, SYPHONS & MIXERS (Page 2 of 2)

☐ Tank Mixing Eductors



Motive Conditions

Liquid type _____ Viscosity _____ (cps)
Specific Gravity _____ Pressure _____ (psig)
Temperature _____ (°F) Capacity _____ (gpm)
Percent solids ____% Max. solid particle size _____ (inches)

Suction Conditions (Tank Contents)

Liquid type _____ Viscosity _____ (cps)
Specific Gravity _____ Head _____ (ft)
Temperature _____ (°F) Capacity _____ (gpm)
Percent solids ____% Max. solid particle size _____ (inches)
Setting velocity of solids _____ (ft/min)
Desired tank turnover time _____ (min)

Tank Data

Min. tank liquid level _____ (ft); Max. tank liquid level _____ (ft)
Tank orientation: ☐ Horizontal ☐ Vertical Tank operating pressure _____ (psig)
Tank geometry & dimensions: ☐ Rectangular ☐ Cylindrical ☐ Spherical
Length ____ (ft) Width ____ (ft) Height ____ (ft) Dia. ____ (ft)

Construction Requirements

Materials of Construction

☐ Carbon Steel ☐ Stainless Steel, specify type _____ ☐ Teflon ☐ PVC ☐ Other _____

Specialized Designs (Eductors & Syphons)

☐ Ceramic Lined ☐ Plastic Lined Fitting (PLF) ☐ Sanitary ☐ Other _____

Connections

☐ Threaded (NPT) _____ ☐ Flanged, Class _____ ☐ Sanitary ☐ Other _____

Additional Information, Schematics & Remarks (to further assist in the overall evaluation of your application)

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