Schutte & Koerting

Exhausters and Compressors

• Use Steam or Compressed Air To Provide Vacuum Or Pressure

APPLICATION

Schutte & Koerting Steam Jet Exhausters and Compressors are air and gas pumps which operate on the jet principle, at moderately high vacuum, using live steam or compressed air as the motive force.

They are standard, stock units - suitable for a wide range of services including pump priming (see page 5), exhausting, evacuating, cleaning, transporting, compressing, agitating, and general vacuum service.

Specifically, they are being used currently in power plants, process plants, manufacturing plants, pilot plants, and research and test laboratories for agitating fermentation tanks, drying drums, priming centrifugal pumps, lifting tar, pumping gases, exhausting air from vacuum pans and evaporators, exhausting tire molds, removing soot from boilers, forcing air into vats, handling corrosive gases, circulating steam in driers and for many other such services.

Because exhausters can be operated with compressed air, they can be used in places where steam is not available or where heating might be objectionable. When operated with compressed air, they can be used to move solids.

Since there are many applications for steam jet exhausters, these units are made in a wide range of sizes (see Table 1) and in various corrosion resistant materials to meet diverse requirements.

Schutte & Koerting also manufactures a complete line of vacuum pumps for similar services: filtration, distillation, impregnation, absorption, drying, mixing and vacuum transfer. These vacuum pumps will provide suction pressure from atmosphere to 10 microns Hg. absolute. Complete details on these type units are included in Bulletin 5E-H.

Fig. 430. S&K Steam Jet Exhauster with flanged connections.

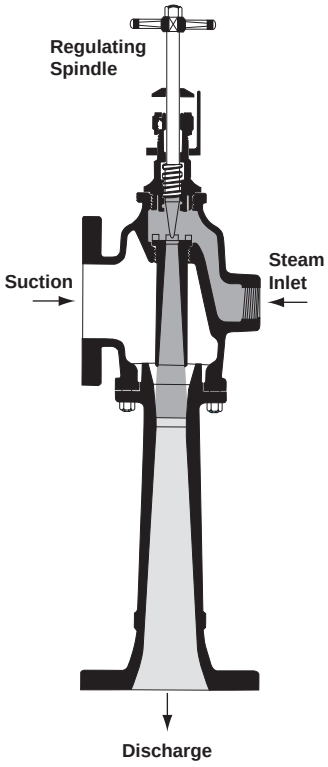


Fig. 430-A. Sectional drawing of an S&K Fig. 430 Steam Jet Exhauster with flanged connections. The Fig. 431 Exhauster is similar in construction except that connections are threaded.

Fig. 431. S&K Steam Jet Exhauster with threaded connections.

CONSTRUCTION

Steam Jet Exhausters consist of an expanding nozzle, diffuser, regulating spindle, and body arranged as shows in Fig. 430-A.

The regulating spindle is threaded and has a needle point so that the flow of steam into the exhauster nozzle can be regulated - thus enabling stock units to be used over a range of motive pressures. By permitting adjustment of the steam jet, desired vacuum and air handling capacities can be obtained with minimum consumption of live steam. This regulating spindle is not designed as a valve. Therefore, its use as a shut-off valve will shorten the operating life of the exhauster.

Fig. 430 and Fig. 431 Steam Jet Exhausters can be supplied in bronze, iron, steel, and other metals. Standard units in sizes ½ in., ¾ in., and 1 in. are all bronze. Sizes larger than 1 in. have iron bodies, tails and handwheels, with bronze nozzles, spindles, and stuffing boxes. Steel exhausters have steel bodies, stuffing boxes and tails; stainless steel nozzles and spindles.

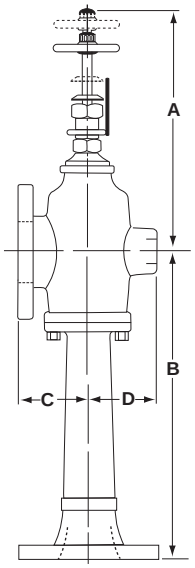


Fig. 430-B

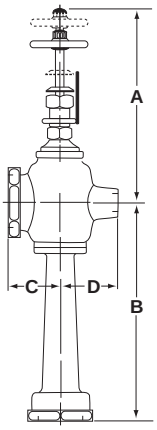


Fig. 431-A

OPERATION

In operation, live steam or air enters the exhauster through an inlet and flows through an expanding nozzle. Issuing from the nozzle at high velocity (about 2800 ft. per second), the jet discharges into the diffuser, produces a powerful suction which entrains air or vapors through the suction connection, and compresses the air or vapor enough to discharge against back pressure.

Table 1. Sizes and Dimensions of S&K Steam Jet Exhausters, Fig. 430 and Fig. 431.

Size (In Inches)	Connections (In Inches)		Pressure Ratings (PSI)						Dimensions (In Inches)				Weight (In Lbs.)
			Cast Iron @ 450° F		Bronze @ 400° F		Steel @ 500° F		A	B	C	D	
	Steam Inlet	Suction & Discharge	Motive	Body	Motive	Body	Motive	Body					
Fig. 431													
1/2	1/4	1/2	-	-	175	175	-	-	4 15/16	3 5/8	1 1/2	1 1/4	2 1/2
3/4	3/8	3/4	250	250	150	150	500	500	5 3/16	4 3/4	1 1/2	1 5/16	3
1	3/8	1	250	250	150	150	500	500	6 1/4	5 3/8	1 3/4	1 15/16	5
1 1/2	1/2	1 1/2	250	250	175	175	500	500	7 1/2	7 7/8	2 3/16	2 3/8	9
2	3/4	2	250	250	-	-	500	500	9 3/8	10 5/8	2 5/8	3	23
2 1/2	1	2 1/2	250	250	-	-	500	500	10 5/8	13 1/4	3	3 3/8	28
3	1 1/4	3	250	250	-	-	500	500	12 1/2	15 9/16	3 1/2	4 1/8	36
Fig. 430													
4	1 1/2	4	250	125	-	-	500	150	16	20 5/8	4 1/2	4 1/2	80
5	2	5	250	125	-	-	*	*	19 1/4	26 1/4	5 1/8	5 1/2	116
6	2 1/2	6	250	125	-	-	*	*	22 1/8	31 1/8	6	6 3/8	168
8	4	8	*	*	-	-	*	*	35 5/8	20 1/2	8 1/2	8 1/2	500

*Check factory; ratings available on application.

CAPACITIES

To find the size steam jet exhauster required to evacuate a closed tank or vessel in a given time, refer to Fig. 431-B. Read, from the curve corresponding to the steam pressure, the time required for a 1½" Fig. 431 Exhauster to produce specified vacuum in a 1 cu. ft. tank. The result, multiplied by the volume of the tank in cu. ft. will give the time in seconds in which the Fig. 431 Exhauster will produce the desired vacuum. This time, in seconds, divided by the specified time, in seconds, will give the capacity ratio. The proper size exhauster then can be selected from Table 4 by using the size corresponding to the nearest larger capacity factor.

With steam as the operating medium, to find the size steam jet exhauster required to handle a given volume of air at a given vacuum with a known steam pressure, refer to Fig. 431-C. Locate the point on the chart where the steam pressure line intersects the line indicating vacuum in inches of mercury to determine the capacity of std. cu. ft. of air per minute. The required capacity in cu. ft. per minute divided by the result obtained in cu. ft. of air per minute will give the capacity ratio. The proper size exhauster can then be selected from Table 4.

With air as the operating medium, the proper size air jet exhauster can be determined by using Fig. 431-D.

The capacities and steam and air consumptions shown are for optimum spindle setting. For the range of air pressures covered in Table 3 and Fig. 431-D, the optimum spindle setting is wide open. For operation with steam, as covered in Table 2 and Figs. 431-B and 431-C, the spindle setting is partially closed. To obtain optimum spindle setting, the spindle should first be closed. With operating steam pressure applied, the spindle should be opened gradually until the required vacuum is obtained. This setting will provide the minimum steam flow to give required results and is, therefore, the optimum spindle setting. After the spindle has been set at optimum position, the handwheel should be removed to prevent alteration.

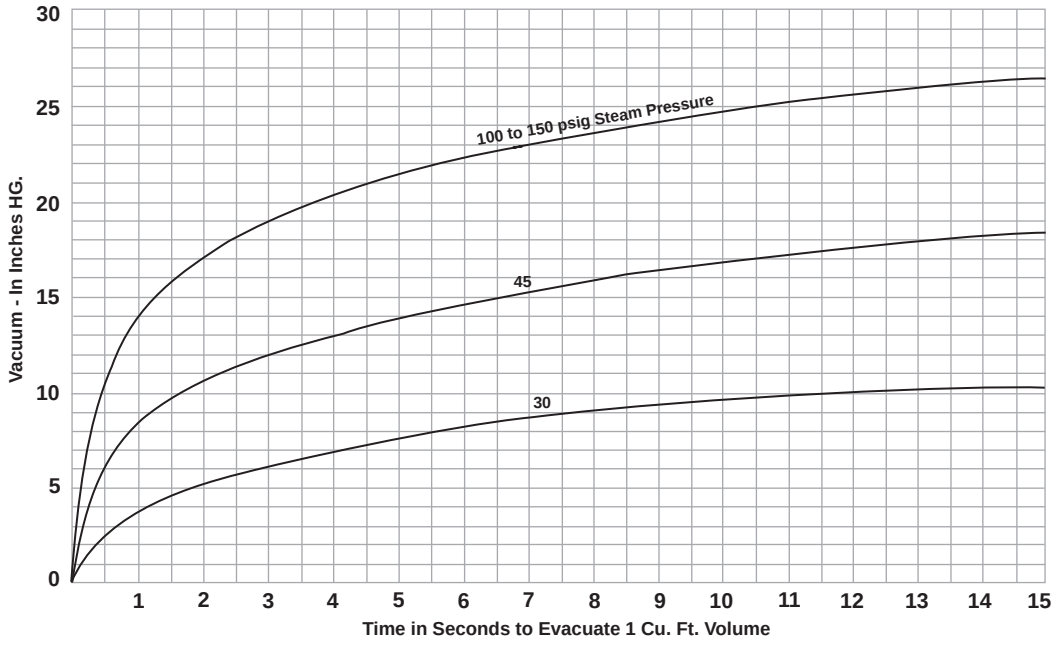


Fig. 431-B - Capacity of 1 1/2" Fig. 431 Steam Jet Exhauster Connected to Closed Tank.

Table 4 - Relative Evacuating and Air Handling Capacities of S&K Steam Jet Exhausters

Size Exhauster (In inches)	1/2	3/4	1	1 1/2	2	2 1/2	3	4	5	6	8
Capacity Ratios	0.141	0.282	0.472	1.0	1.805	2.83	3.99	7.06	11.40	15.95	28.50

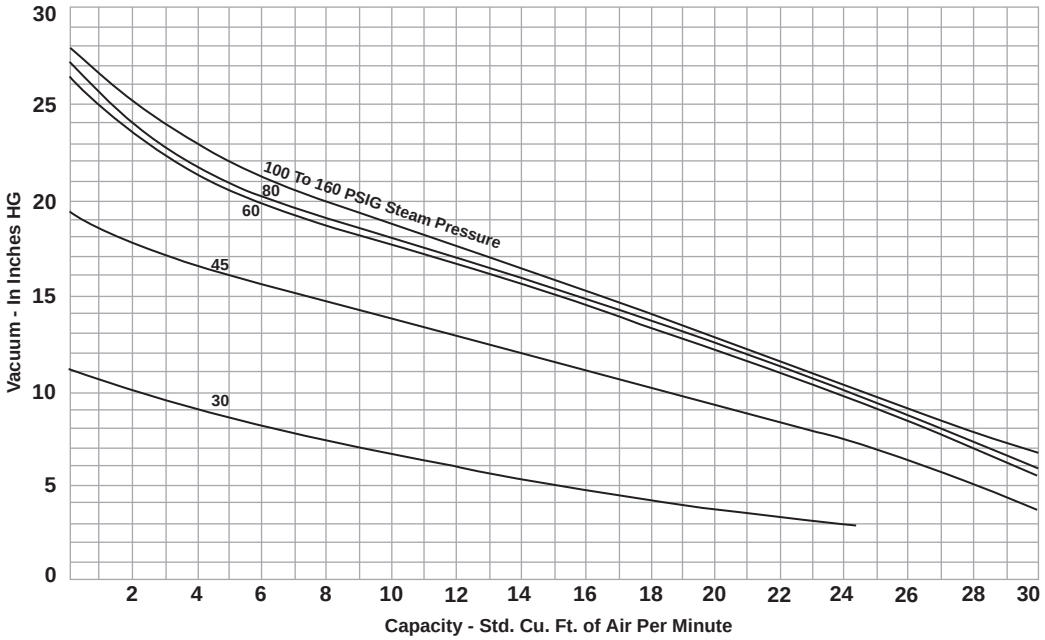


Fig. 431-C - Capacity of 1 1/2" Fig. 431 Steam Jet Exhauster Handling Air.

Table 2 - Steam Consumption of S&K 1 1/2" Fig. 431 Steam Jet Exhauster Handling Air (Spindle throttled to optimum position)

Steam Pressure, psig	30	45	60	80	100	120	140	160
Steam Flow, pph	135	178	229	182	160	125	79	72

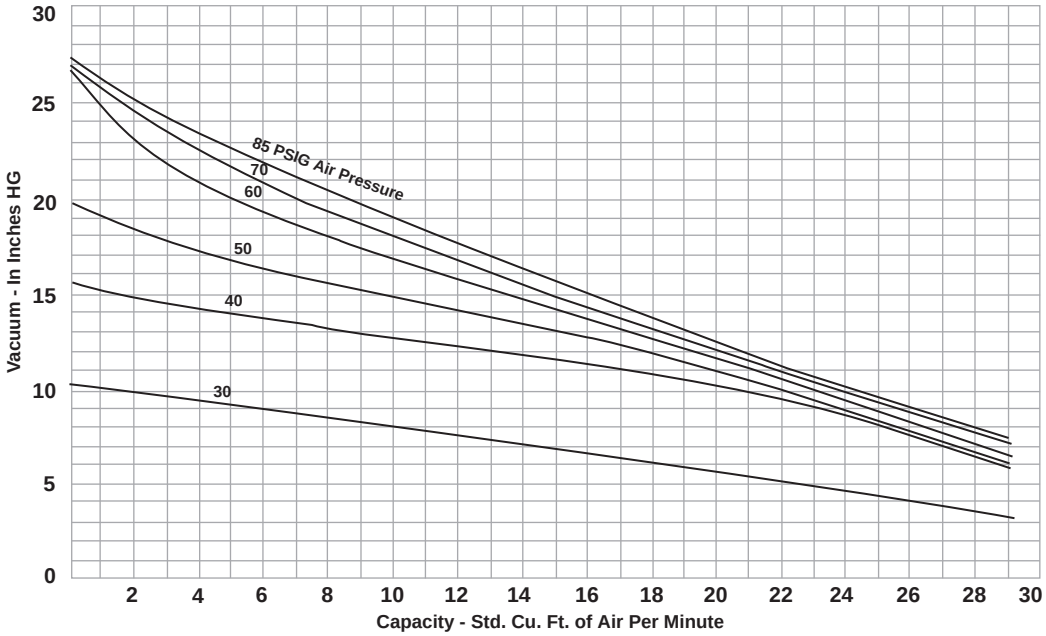


Fig. 431-D - Capacity of 1 1/2" Fig. 431 Air Jet Exhauster Handling Air.

Table 3 - Air Consumption of S&K 1 1/2" Fig. 431 Air Jet Exhauster Handling Air (spindle wide open)

Air Pressure, psig	30	40	50	60	70	85
Air Flow, pph	256	321	372	431	488	582

PUMP PRIMING WITH THE S&K STEAM JET EXHAUSTER

Fig. 431-E. Steam Jet Exhausters are widely used for priming centrifugal pumps. The exhauster is mounted on the casing of the pump as illustrated and is used to exhaust air from the pump casing and suction line before the pump is started. Most pumps are located so that the vacuum created in the suction line and casing varies from the equivalent to a 5 ft. lift to that of a 20 ft. lift. These are the limits specified in Table 5 which gives capacities in cubic feet per minute. To estimate the primer size required, divide the total volume in cubic feet of suction line and pump casing by the time in minutes allowed for priming (usually five minutes or less). This will determine the required capacity in cubic feet per minute. The lift and steam pressure being known, the proper size primer can be found opposite the nearest capacity figure in Table 5. Capacities are approximately the same when the exhauster is operated with compressed air. For water jet pump primers, refer to Bulletin 4P.

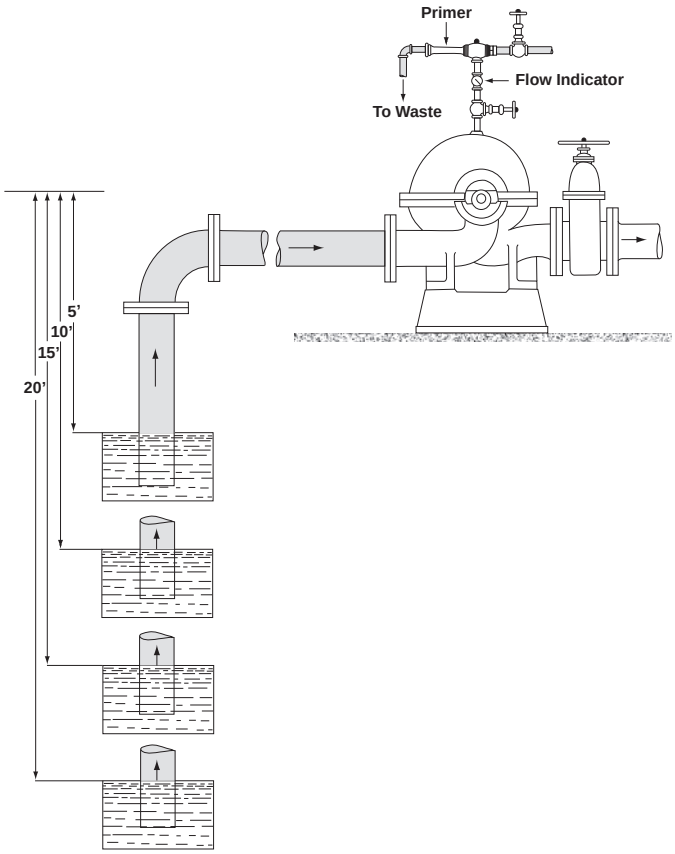


Table 5. Capacities of S&K Steam Jet Primers (in cu. ft. per min.)

Lift	Size Primer in Inches	Steam Pressures				
		50 lbs.	75 lbs.	100 lbs.	125 lbs.	150 lbs.
5 FT.	1/2	2.68	3.27	3.49	3.75	4.08
	3/4	5.93	7.24	7.73	8.30	9.04
	1	10.50	12.70	13.50	14.50	15.85
	1 1/2	21.40	26.20	27.90	30.00	32.70
	2	38.20	46.70	49.80	53.40	58.10
	2 1/2	60.40	73.50	78.60	84.80	92.00
	3	83.80	102.00	109.00	117.00	128.00
	4	149.00	182.00	194.00	209.00	228.00
	5	239.00	292.00	312.00	338.00	366.00
	6	335.00	408.00	437.00	469.00	511.00
	8	596.00	727.00	777.00	835.00	910.00
10 FT.	1/2	2.58	3.16	3.38	3.64	3.84
	3/4	5.70	6.99	7.50	8.07	8.50
	1	9.98	12.30	13.10	14.10	14.90
	1 1/2	20.60	25.30	27.10	29.20	30.80
	2	36.70	45.00	49.70	52.00	54.80
	2 1/2	57.00	71.00	76.20	82.00	86.50
	3	80.50	98.60	106.00	114.00	120.00
	4	143.00	176.00	188.00	203.00	214.00
	5	230.00	282.00	303.00	326.00	343.00
	6	322.00	395.00	423.00	456.00	480.00
	8	573.00	702.00	755.00	810.00	855.00
15 FT.	1/2	2.42	2.90	3.06	3.39	3.46
	3/4	5.36	6.43	6.76	7.50	7.67
	1	9.40	11.20	11.85	13.10	13.40
	1 1/2	19.40	23.20	24.50	28.00	27.80
	2	34.80	41.40	43.50	48.30	49.50
	2 1/2	54.50	65.40	68.80	76.20	78.00
	3	75.80	90.70	95.50	106.00	108.50
	4	135.00	163.00	170.00	188.00	193.00
	5	216.00	259.00	273.00	303.00	310.00
	6	303.00	363.00	382.00	423.00	433.00
	8	539.00	646.00	680.00	750.00	770.00
20 FT.	1/2	1.72	2.37	2.65	2.82	2.97
	3/4	3.81	5.24	5.86	6.25	6.56
	1	6.66	9.17	10.30	10.90	11.50
	1 1/2	13.78	18.95	21.20	22.60	23.80
	2	24.50	33.80	37.80	40.30	42.30
	2 1/2	38.80	53.30	59.60	63.50	66.80
	3	53.80	74.00	82.80	88.20	82.70
	4	95.70	132.00	147.10	157.00	165.00
	5	154.00	212.00	237.00	252.00	265.00
	6	215.00	296.00	331.00	353.00	371.00
	8	383.00	527.00	589.00	628.00	660.00

FIG. 517 ECONOMY STEAM JET PUMP

FOR EXHAUSTING, EVACUATING, AND GENERAL VACUUM SERVICE

The Fig. 517 Vacuum Pump is low in initial cost, but has lower efficiency than the Type 430 pump. It has a streamlined, one-piece body, with no moving parts to wear or break, nothing to get out of order, and nothing to require extensive maintenance. It is available in six sizes from ¾" to 3" in cast iron, bronze, and 316 stainless steel.

The pump operates on the steam jet principle, utilizing the energy of steam to create vacuum and handle process gases. Steam under pressure enters at the nozzle and produces a high velocity jet. This jet action creates a vacuum that draws in and entrains the suction gas. The mixture of steam and gas is discharged at atmospheric pressure. The simple design prevents solids from collecting and clogging the action. Also, pressure drop in the suction chamber is held to a minimum.

Fig. 517 Steam Jet Vacuum Pump has threaded pipe connections.

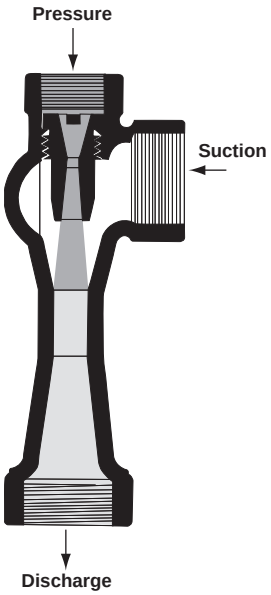


Fig. 517A Sectional view of Steam Jet Vacuum Pump

Table 6. Sizes, Dimensions, and Weights of Type 517 Steam Jet Vacuum Pumps

Size (Inches)	Dimensions in Inches			Approx. Weight (Lbs.)
	A	B	C	
3/4	1 3/8	3 3/8	1 1/4	1 1/4
1	1 1/2	4 3/16	1 5/8	2
1 1/2	2	6 1/2	2	5
2	2 1/4	7 5/8	2 1/4	6
2 1/2	2 11/16	9 1/4	3 1/8	11
3	3 1/8	11 1/4	3 1/2	20

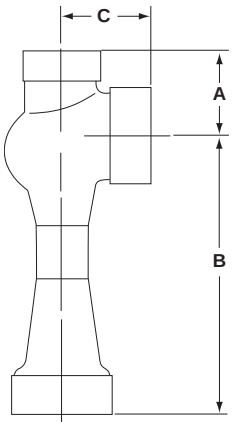
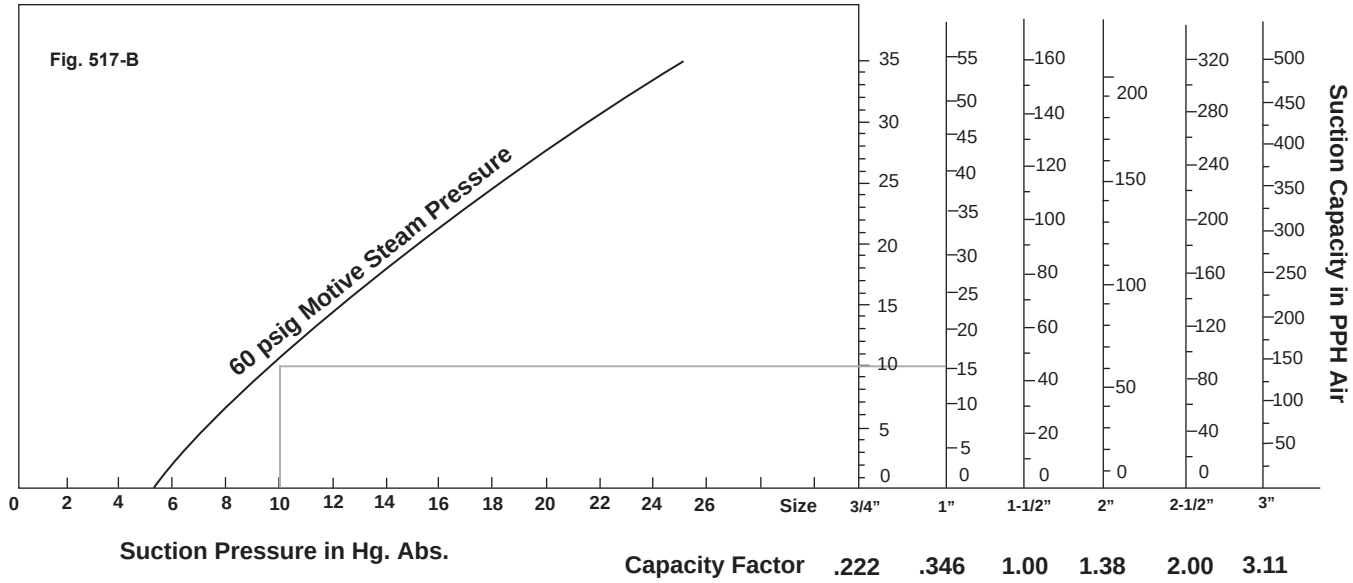


FIG. 517 STEAM JET VACUUM PUMPS
SIZE DETERMINATION AND STEAM CONSUMPTION



Operation With Optimum Steam Pressure of 60 psig

Note: Stock steam nozzle, style 60 available for operations to 30 psig steam pressures.

Example

Problem:

To handle 12 pph air at absolute pressure of 10" Hg. Steam pressure available up to 90 psig. Discharge pressure atmospheric.

Solution:

Run at optimum steam pressure of 60 psig. At the intersection of the 60 psig pressure line and 10" Hg. abs. read horizontally to right and intersect scales. Note that 1" Type 517 handles 15 pph air. Use this size. Fig. 517-C shows steam consumption is 90 pph.

Fig. 517-C

Size (In Inches)	3/4	1	1 1/2	2	2 1/2	3
Steam Consumption (PPH) at 60 psig	60	93	270	375	537	840