# **PENBERTHY** SERIES LM, ELL, FL, GL, GH, U, L AND 2NC FOR PUMPING GASES

Practical, simple and cost-effective alternatives for process industries to purge gases from chambers, exhaust, evacuate or prime using liquid, steam or air operating media

## FEATURES

- Simple design with no moving parts to wear out.
- No lubrication required.
- Virtually maintenance-free.
- Easy to install without special structures or foundations.
- Self-priming.
- Cast, fabricated or non-metallic constructions.
- Variety of materials to suit specific characteristics of the process gases.
- Critical flow paths machined smoothly with no abrupt turns or steps, producing the most efficient flow during the motive function.

## GENERAL APPLICATION

Applications include creating vacuums, exhausting vapors from process systems, evacuating tanks and vessels, scrubbing a gas to remove contaminants, priming, fume removal, fluid concentration, humidifying and condensing, drying, distilling and deaerating gas.

## TECHNICAL DATA

| | |
|---|---|
| Materials: | Bronze, iron, carbon steel, 316 SS, PVC, PP, PVDF |
| Sizes: | ½" to 12" |
| Pressure range: | 20 to 200 psig (1.38 to 13.8 barg) |
| Temperature (max): | to 200°F (93°C) |


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# **PENBERTHY** SERIES LM, ELL, FL, GL, GH, U, L AND 2NC FOR PUMPING GASES
## MODELS OVERVIEW; OPERATION

### PRODUCT OVERVIEW

There are eight models of Penberthy jet pumps available for pumping gases:

Models LM and ELL are used for exhausting, evacuating and priming operations where a liquid operating medium is available. They are available with suction and discharge fittings ranging from ½" to 12", depending on the type of construction.

Model FL 'fume movers' also use a liquid operating medium and are available with suction and discharge fittings ranging from ½" to 4".

GL and GH models are used for exhausting, evacuating and priming applications using operating steam or air in sizes from ½" to 12".

Models U and L are single-stage ejectors which use steam as the operating medium. They are available in 16 capacities and suction sizes from 1" to 4".

The 2NC is a two-stage steam operated ejector with the same range of capacities and sizes as the U and L.

**TABLE 1 - MODEL SPECIFICATIONS**

| Model | LM | ELL | FL | GL | GH |
|---|---|---|---|---|---|
| Motive medium | Liquid | Liquid | Liquid | Steam, gas | Steam, gas |
| Motive medium pressure range | 20-200 psig (140-1380 kPag) | 20-200 psig (140-1380 kPag) | 20-100 psig (140-690 kPag) | 60-120 psig (415-830 kPag) | 20-80 psig (140-550 kPag) |
| Application range, inches Hg Abs(kg/cm² Abs) | 1-27 (.03-.93) | 1-27 (.03-.93) | 27-30 (.93-1.04) | 6-30 (.18-1.04) | 6.5-30 (.2-1.04) |
| Functions | Evac/Exh/Prime | Evac/Exh/Prime | Exh | Evac/Exh/Prime | Evac/Exh/Prime |

**TABLE 2 - MODEL SPECIFICATIONS**

| Model | U | L | 2NC |
|---|---|---|---|
| Motive medium | Steam | Steam | Steam |
| Motive medium pressure range | 80-200 psig (550-1380 kPag) | 80-200 psig (550-1380 kPag) | 100-200 psig (690-1380 kPag) |
| Application range, inches Hg Abs(kg/cm² Abs) | 6-12 (.18-.36) | 3-6 (.09-.18) | 0.5-3 (.002-.09) |
| Functions | Evac/Exh | Evac/Exh | Evac/Exh |

### OPERATION

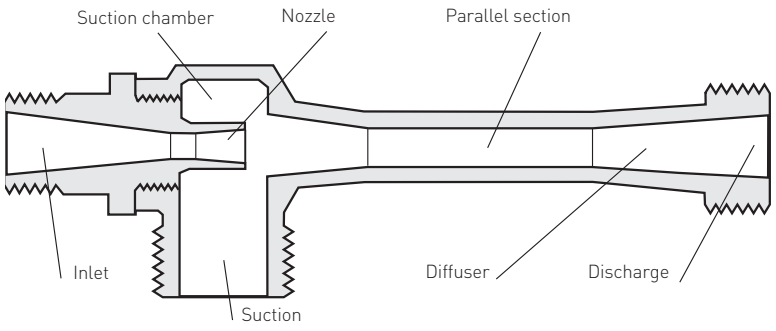
All jet pumps operate on the principle of a fluid entraining a second fluid. Although design and construction may vary, this applies to all jet pumps.

All jet pumps have three common features: inlet, suction and discharge. They function as follows:

Inlet - The operating medium (liquid, steam or air) under pressure enters the inlet and travels through the nozzle into the suction chamber. The nozzle converts the pressure of the operating medium into a high velocity stream, which passes from the discharge side of the inlet nozzle.

Suction - Pumping action begins when vapor, gases or liquid in the suction chamber are entrained by the high velocity stream emerging from the inlet nozzle, lowering the pressure in the suction chamber. The resulting action causes the liquid, gas or vapor in the suction chamber to flow toward the discharge.

Discharge - The entrained material from the suction system mixes with the operating medium and acquires part of its energy in the parallel section. In the diffuser section, part of the velocity of the mixture is converted to a pressure greater than the suction pressure, but lower than the operating medium pressure.



## PUMPING GASES USING LIQUID OPERATING MEDIUM

The LM and ELL jet pumps are used for exhausting, evacuating and priming operations where a liquid operating medium is available in a 20 to 200 psig pressure range.
The maximum vacuum with closed suction is one inch Hg abs. These models are available with suction and discharge fittings ranging from ½" to 12", depending on the type of construction.

Model FL 'fume movers' operate in facilities where the liquid operating medium is available in the 20 to 100 PSIG range. They are identical in principle to the LM and ELL units but differ in their 'water consumption to capacity' ratio. Where the ELL Model requires more than 2 gpm of operating fluid for each scfm of air pumped, the FL with 2 gpm can pump approximately 14 scfm of air. The other distinguishing factor is the capacity of the FL models to move large volumes of air at a suction pressure just slightly below atmospheric.

The ELL is better suited for moving air at a suction pressure of ½ to 1/10 atmospheric pressure - about 13 times the vacuum of the FL fume mover.

FL models are available with suction and discharge fittings ranging from ½" to 4" and nozzle size ranging from ½ to 3, depending on the type of unit selected.

**TABLE 3 - MODEL CONSTRUCTION DATA**

| Model | LM, ELL | Standard materials | FL | Standard materials |
|---|---|---|---|---|
| Sizes available | ½ A-4" | Cast: Low lead bronze, iron, C. steel, 316 STS | 1"A - 4"B | Cast: Iron, carbon steel, 316 STS |
| | 4" and up | Fabricated: Carbon steel, 316 STS | | |
| | ½ A-3" | Non-Metallic: PVC, PP, PVDF (Kynar®) | | |

**NOTE**

Kynar® is a registered trademark of Arkema Inc.

## PUMPING GASES USING LIQUID OPERATING MEDIUM

### Evacuating and priming* (Models LM, ELL)

| First determine: | Example |
|---|---|
| • Volume of space to be evacuated - $ft^3$: | 30 $ft^3$ |
| • Required evacuation time - minutes: | 3 min. |
| • Operating liquid pressure - psig ($h_m$): | 80 psig |
| • Discharge pressure required - psig ($h_d$): (Refer to LM, ELL evacuation time chart) | atmospheric |

Step 1 - Determine evacuation time in minutes per 10 $ft^3$ or 100 $ft^3$ depending on volume of space to be evacuated (in this case, 30 $ft^3$ - otherwise expressed as .3 hundred $ft^3$).

$$\frac{\text{Required time to evacuate (3 mins)}}{\text{Evacuation time/100 ft}^3\text{ (.3)}} = 10\text{ min/100 ft}^3$$

*Priming: The procedure for selecting jet pumps for priming applications is the same as that for evacuation except: It takes twice the time to prime the same volume that can be evacuated with a given jet.

Step 2 - Locate operating water pressure (in this case 80 psig) and suction pressure (in this case 5" hg abs) on the left side of the chart.

Step 3 - Following along the appropriate line into the '100 $ft^3$ evacuated' section, find the evacuation time that's 'equal to or lower than' the evacuation time requirement expressed in minutes/100 $ft^3$ (in this case 10 minutes for ELL 2).

Step 4 - Continuing to the right on the same line, you'll find the operating water used for the selected model (in this case 32.5 gpm for the ELL 1½)
Then multiply this figure times the ELL 2 capacity factor (C.F.) to determine the actual water consumption of the selected unit.

$$\text{32.5 (gpm operating water used)} \times \frac{1.82}{\text{(C.F.)}} = \text{59.2 actual water consumption}$$

### TABLE 4 - LM, ELL EVACUATION TIME

| Operating water pressure ($h_m$) psig | Suction pressure Hg. Abs ($h_s$) | Time in minutes per 10 cubic feet evacuated ½ A LM | ½ A ELL | ½ B LM | ½ B ELL | Time in minutes per 100 cubic feet evacuated ½" LM | ½" ELL | ¾" LM | ¾" ELL | 1" LM | 1" ELL | 1¼" LM | 1¼" ELL | 1½" LM | 1½" ELL | 2" LM | 2" ELL | 2½" LM | 2½" ELL | 3" LM | 3" ELL | Operating water used, gpm ($Q_m$) 1½" LM | 1½" ELL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 25" | 24 | 13 | 15 | 8.3 | 59 | 32 | 34 | 19 | 21 | 11 | 12.00 | 6.4 | 7.10 | 3.9 | 3.90 | 2.10 | 2.20 | 1.20 | 1.20 | 0.66 | 17.5 | 17.2 |
| | 20" | 87 | 50 | 55 | 32 | 215 | 123 | 125 | 72 | 76 | 43 | 43.00 | 24.0 | 26.00 | 15.0 | 14.00 | 8.20 | 8.20 | 4.70 | 4.40 | 2.50 | 18.4 | 18.1 |
| | 15" | 180 | 107 | 114 | 68 | 448 | 264 | 260 | 154 | 157 | 93 | 88.00 | 52.0 | 54.00 | 32.0 | 30.00 | 18.00 | 17.00 | 10.00 | 9.10 | 5.40 | 19.2 | 18.8 |
| | 10" | - | - | - | - | 826 | - | 481 | - | 291 | - | - | - | 100.00 | - | 55.00 | - | 31.00 | - | 17.00 | - | 20.0 | - |
| 40 | 25" | 8.3 | 6 | 5.3 | 3.8 | 21 | 15 | 12 | 8.7 | 7.3 | 5.2 | 4.10 | 2.9 | 2.50 | 1.8 | 1.40 | 0.99 | 0.79 | 0.57 | 0.42 | 0.30 | 24.2 | 23.0 |
| | 20" | 33 | 22 | 21 | 14 | 83 | 55 | 48 | 32 | 29 | 19 | 16.00 | 11.0 | 10.00 | 6.7 | 5.60 | 3.70 | 3.20 | 2.10 | 1.70 | 1.10 | 24.8 | 23.6 |
| | 15" | 83 | 50 | 53 | 32 | 208 | 124 | 121 | 72 | 73 | 43 | 41.00 | 24.0 | 25.00 | 15.0 | 14.00 | 8.20 | 7.90 | 4.70 | 4.20 | 2.50 | 25.4 | 24.2 |
| | 10" | 157 | 90 | 100 | 57 | 392 | 223 | 228 | 130 | 138 | 78 | 77.00 | 44.0 | 47.00 | 27.0 | 26.00 | 15.00 | 15.00 | 8.50 | 8.00 | 4.50 | 26.0 | 24.7 |
| | 5" | 320 | 163 | 204 | 104 | 793 | 405 | 461 | 236 | 279 | 143 | - | 80.0 | 96.00 | 49.0 | 53.00 | 27.00 | 30.00 | 15.00 | 16.00 | 8.30 | 26.6 | 25.3 |
| 60 | 25" | 3.7 | 4.7 | 2.3 | 3 | 91 | 12 | 5.3 | 6.7 | 3.2 | 4.1 | 1.80 | 2.3 | 1.10 | 1.4 | 0.60 | 0.77 | 0.35 | 0.44 | 0.18 | 0.24 | 29.4 | 27.3 |
| | 20" | 17 | 14 | 11 | 9.1 | 41 | 36 | 24 | 21 | 14 | 12 | 8.10 | 7.0 | 5.00 | 4.3 | 2.70 | 2.40 | 1.60 | 1.30 | 0.84 | 0.72 | 30.0 | 27.8 |
| | 15" | 43 | 30 | 28 | 19 | 110 | 74 | 64 | 43 | 39 | 26 | 22.00 | 15.0 | 13.00 | 8.9 | 7.30 | 4.90 | 4.20 | 2.80 | 2.20 | 1.50 | 30.5 | 28.3 |
| | 10" | 97 | 50 | 62 | 32 | 240 | 124 | 139 | 72 | 84 | 44 | 47.00 | 24.0 | 29.00 | 15.0 | 16.00 | 8.20 | 9.10 | 4.70 | 4.90 | 2.50 | 30.9 | 28.7 |
| | 5" | 207 | 87 | 132 | 55 | 512 | 215 | 298 | 125 | 180 | 76 | - | 43.0 | 62.00 | 26.0 | 34.00 | 14.00 | 19.00 | 8.20 | 10.00 | 4.40 | 31.4 | 29.2 |
| 80 | 25" | 2.3 | 3.7 | 1.5 | 2.3 | 5.8 | 9.1 | 3.4 | 5.3 | 2 | 3.2 | 1.10 | 1.8 | 0.70 | 1.1 | 0.38 | 0.60 | 0.22 | 0.35 | 0.11 | 0.18 | 33.8 | 30.9 |
| | 20" | 11 | 11 | 7 | 7 | 27 | 27 | 15.9 | 16 | 9.6 | 9.5 | 5.40 | 5.3 | 3.30 | 3.3 | 1.80 | 1.80 | 1.00 | 1.00 | 0.55 | 0.55 | 34.2 | 31.3 |
| | 15" | 26 | 22 | 17 | 14 | 64 | 54 | 37.5 | 31 | 23 | 19 | 13.00 | 11.0 | 7.80 | 6.5 | 4.30 | 3.60 | 2.40 | 2.00 | 1.30 | 1.10 | 34.7 | 31.7 |
| | 10" | 60 | 37 | 38 | 23 | 153 | 91 | 89 | 53 | 54 | 31 | 30.00 | 17.0 | 18.00 | 11.0 | 10.00 | 5.90 | 5.80 | 3.40 | 3.10 | 1.80 | 35.1 | 32.1 |
| | 5" | 143 | 60 | 91 | 38 | 355 | 149 | 207 | 87 | 125 | 54 | 70.00 | 30.0 | 43.00 | 18.0 | 24.00 | 10.00 | 13.00 | 5.80 | 7.20 | 3.10 | 35.6 | 32.5 |
| 100 | 25" | 2.2 | 3.3 | 1.4 | 2.1 | 5.4 | 8.3 | 3.1 | 4.8 | 1.9 | 2.9 | 1.10 | 1.6 | 0.65 | 1.0 | 0.36 | 0.55 | 0.20 | 0.31 | 0.11 | 0.17 | 37.7 | 34.0 |
| | 20" | 7.7 | 9 | 4.9 | 5.7 | 19 | 22 | 11 | 13 | 6.7 | 7.9 | 3.70 | 4.4 | 2.30 | 2.7 | 1.30 | 1.50 | 0.72 | 0.86 | 0.39 | 0.46 | 38.1 | 34.4 |
| | 15" | 19 | 18 | 12 | 11 | 48 | 44 | 28 | 25 | 17 | 15 | 9.50 | 8.7 | 5.80 | 5.3 | 3.20 | 2.90 | 1.80 | 1.70 | 0.98 | 0.90 | 38.5 | 34.7 |
| | 10" | 40 | 29 | 25 | 19 | 99 | 73 | 58 | 42 | 35 | 25 | 20.00 | 14.0 | 12.00 | 8.8 | 6.60 | 4.80 | 3.80 | 2.80 | 2.00 | 1.50 | 38.9 | 35.1 |
| | 5" | 100 | 50 | 64 | 32 | 249 | 124 | 145 | 72 | 88 | 44 | 49.00 | 25.0 | 30.00 | 15.0 | 17.00 | 8.30 | 9.50 | 4.70 | 5.10 | 2.50 | 39.3 | 35.4 |
| 140 | 25" | 2 | 2.7 | 1.3 | 1.7 | 4.9 | 6.6 | 2.9 | 3.8 | 1.7 | 2.3 | 0.98 | 1.3 | 0.60 | 0.8 | 0.33 | 0.44 | 0.19 | 0.25 | 0.10 | 0.13 | 44.5 | 39.4 |
| | 20" | 4.7 | 7 | 3 | 4.5 | 12 | 17 | 6.7 | 10 | 4.1 | 6.2 | 2.30 | 3.5 | 1.40 | 2.1 | 0.77 | 1.20 | 0.44 | 0.68 | 0.24 | 0.36 | 44.8 | 39.6 |
| | 15" | 11 | 13 | 7.2 | 8.5 | 28 | 33 | 16 | 19 | 9.6 | 12 | 5.50 | 6.6 | 3.40 | 4.0 | 1.90 | 2.20 | 1.10 | 1.30 | 0.57 | 0.68 | 45.2 | 40.0 |
| | 10" | 24 | 23 | 15 | 14 | 59 | 56 | 35 | 33 | 21 | 20 | 12.00 | 11.0 | 7.20 | 6.8 | 4.00 | 3.70 | 2.30 | 2.10 | 1.20 | 1.10 | 45.5 | 40.2 |
| | 5" | 47 | 40 | 30 | 26 | 118 | 99 | 69 | 58 | 41 | 34 | 23.00 | 19.0 | 14.00 | 12.0 | 7.90 | 6.40 | 4.50 | 3.70 | 2.40 | 2.00 | 45.9 | 40.6 |

**Exhausting**

| First determine: | Example |
|---|---|
| Suction load - scfm air ($Q_s$): | 1.3 scfm |
| Suction pressure - inches Hg abs ($h_s$): | 15" |
| Operating liquid pressure, psig ($h_m$): | 60 psig |
| Discharge pressure, psig ($h_d$): | 5 psig |

(Refer to FL exhauster and 1½ LM and ELL exhauster comparative performance chart.)

Step 1 - Locate appropriate suction pressure (in this case 15") on left side of chart and the line that applies to existing water pressure (in this case 60 psig).

Step 2 - Read across the 60 psig line to the 5 psig discharge pressure column noting

| | |
|---|---|
| LM suction capacity: | 1.4 scfm |
| ELL suction capacity: | 3.1 scfm |

Step 3 - Following along the same line you'll note

| | |
|---|---|
| Operating water used: | 28.3 gpm |

Step 4 - Since the ELL 1½ was the unit with the greater suction capacity in comparison to our requirement, we'll use it in computing the ideal capacity factor (C.F.)

$$\frac{\text{Desired capacity (1.3 scfm)}}{\text{Suction capacity - ELL 1½ (3.1 scfm)}} = .419 \text{ (ideal C.F.)}$$

Then using the capacity factor chart, find the size unit that provides a capacity factor that's equal to or greater than .419 (ideal C.F.)

The actual capacity of the selected unit is then determined by multiplying:

| 3.1 | | .613 | | |
|---|---|---|---|---|
| (ELL 1½ scfm per chart) | x | (ELL 1¼ capacity factor) | = | 1.90 scfm |

Step 5 - To determine water consumption of the selected unit, multiply:

| 28.3 | | .613 | | |
|---|---|---|---|---|
| (gpm operating water used) | x | (Selected unit C.F.) | = | 17.3 gpm |

Step 6 - In checking the capacity and consumption of the other unit considered, we find that the LM 1½, with a capacity of 1.4 scfm, has a water consumption rate of 28.3 gpm. It then becomes obvious that the ELL 1¼ is the best unit for this application as it delivers the greatest capacity with the least volume of water consumed.

Step 7 - (FL models only) - The connecting discharge line must be sized to handle both the operating liquid and entrained air without producing more than a few inches of water discharge pressure. If this cannot be done, a box, tank or separator should be provided at the discharge end to separate non-condensable washed gases from the liquid and to vent washed gases to the atmosphere.

**TABLE 5 - LM, ELL capacity factor**

| Size | Factor |
|---|---|
| ½ A | 0.030 |
| ½ B | 0.047 |
| ½ | 0.121 |
| ¾ | 0.208 |
| 1 | 0.344 |
| 1¼ | 0.613 |
| 1½ | 1.000 |
| 2 | 1.820 |
| 2½ | 3.170 |
| 3 | 5.920 |
| 4 | 11.800 |
| 6 | 24.000 |
| 8 | 49.000 |
| 10 | 71.000 |
| 12 | 123.000 |

**TABLE 6 - 1½ LM AND ELL EXHAUSTERS COMPARATIVE PERFORMANCE**

| Suction pressure Hg. Abs. ($h_s$) | Operating water pressure ($h_m$) | Suction capacity in scfm at discharge pressure below ($Q_s$) | | | | | | | | | | Operating water gpm ($Q_m$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 psig | | 5 psig | | 10 psig | | 15 psig | | 20 psig | | |
| | | LM | ELL | LM | ELL | LM | ELL | LM | ELL | LM | ELL | |
| 30" * | 20 | 8.0 | 7.0 | - | - | - | - | - | - | - | - | 16.4 |
| | 40 | 10.0 | 9.0 | 2.5 | 5.0 | - | - | - | - | - | - | 22.5 |
| | 60 | 13.0 | 12.0 | 3.8 | 8.0 | 3.0 | 6.0 | - | - | - | - | 26.9 |
| | 80 | 14.0 | 13.0 | 5.5 | 10.0 | 3.9 | 8.5 | 3.2 | 7.2 | 2.9 | - | 30.6 |
| | 100 | 18.0 | 14.0 | 10.0 | 13.0 | 5.8 | 11.0 | 4.4 | 9.5 | 3.6 | 8.6 | 33.8 |
| | 140 | 19.0 | 18.0 | 13.0 | 16.0 | 8.5 | 15.0 | 6.2 | 14.0 | 5.6 | 13.0 | 39.2 |
| | 200 | 21.0 | 19.0 | 19.0 | 18.0 | 16.0 | 18.0 | 11.0 | 18.0 | 8.6 | 17.0 | 45.0 |
| 25" | 20 | 1.6 | 3.0 | - | - | - | - | - | - | - | - | 17.2 |
| | 40 | 3.6 | 5.6 | 1.7 | 3.5 | - | - | - | - | - | - | 23.0 |
| | 60 | 5.8 | 8.0 | 2.8 | 5.9 | 2.2 | 4.6 | - | - | - | - | 27.3 |
| | 80 | 8.4 | 10.2 | 3.9 | 8.0 | 3.0 | 6.7 | 2.5 | 5.8 | 2.2 | - | 30.9 |
| | 100 | 9.9 | 11.4 | 6.1 | 10.0 | 4.1 | 9.0 | 3.4 | 7.9 | 3.0 | 7.3 | 34.0 |
| | 140 | 12.6 | 14.5 | 8.4 | 13.7 | 6.1 | 13.0 | 5.0 | 11.9 | 4.5 | 11.2 | 39.4 |
| | 200 | 16.7 | 17.4 | 14.3 | 17.0 | 10.7 | 16.8 | 8.7 | 16.1 | 6.9 | 15.7 | 45.1 |
| 20" | 20 | 0.9 | 1.6 | - | - | - | - | - | - | - | - | 18.1 |
| | 40 | 1.9 | 3.6 | 1.2 | 2.4 | - | - | - | - | - | - | 23.6 |
| | 60 | 3.3 | 5.7 | 2.1 | 4.4 | 1.6 | 3.5 | - | - | - | - | 27.8 |
| | 80 | 4.9 | 7.8 | 2.8 | 6.3 | 2.3 | 5.2 | 1.9 | 4.6 | 1.6 | - | 31.3 |
| | 100 | 6.2 | 8.8 | 4.0 | 7.7 | 3.1 | 7.2 | 2.6 | 6.4 | 2.3 | 6.0 | 34.4 |
| | 140 | 8.9 | 11.3 | 5.6 | 10.8 | 4.4 | 10.2 | 3.8 | 9.6 | 3.4 | 9.1 | 39.6 |
| | 200 | 13.0 | 14.0 | 10.3 | 13.7 | 7.4 | 13.4 | 6.4 | 13.0 | 5.2 | 12.7 | 45.4 |
| 15" | 20 | 0.5 | 0.8 | - | - | - | - | - | - | - | - | 18.8 |
| | 40 | 1.1 | 2.4 | 0.8 | 1.5 | - | - | - | - | - | - | 24.2 |
| | 60 | 1.8 | 3.9 | 1.4 | 3.1 | 1.1 | 2.6 | - | - | - | - | 28.3 |
| | 80 | 2.5 | 5.3 | 1.9 | 4.9 | 1.6 | 3.8 | 1.4 | 3.5 | 1.1 | - | 31.7 |
| | 100 | 3.7 | 6.3 | 2.5 | 5.9 | 2.2 | 5.4 | 1.9 | 5.0 | 1.6 | 4.6 | 34.7 |
| | 140 | 5.3 | 8.4 | 3.4 | 8.0 | 3.0 | 7.6 | 2.6 | 7.3 | 2.4 | 7.1 | 40.0 |
| | 200 | 8.8 | 10.5 | 6.5 | 10.3 | 4.8 | 10.1 | 4.3 | 9.9 | 3.6 | 9.7 | 45.7 |
| 10" | 40 | 0.6 | 1.3 | 0.5 | - | - | - | - | - | - | - | 24.7 |
| | 60 | 0.9 | 2.6 | 0.8 | 2.0 | 0.7 | 1.5 | - | - | - | - | 28.7 |
| | 80 | 1.3 | 3.5 | 1.2 | 3.0 | 1.0 | 2.7 | 0.9 | 2.4 | 0.7 | - | 32.1 |
| | 100 | 2.0 | 3.9 | 1.4 | 3.8 | 1.3 | 3.7 | 1.2 | 3.5 | 1.1 | 3.3 | 35.1 |
| | 140 | 2.6 | 5.9 | 2.0 | 5.6 | 1.8 | 5.4 | 1.6 | 5.3 | 1.4 | 5.3 | 40.2 |
| | 200 | 5.1 | 7.0 | 3.7 | 6.9 | 2.8 | 6.8 | 2.4 | 6.7 | 2.2 | 6.6 | 45.9 |
| 5" | 40 | 0.3 | 0.6 | 0.3 | - | - | - | - | - | - | - | 25.3 |
| | 60 | 0.4 | 1.6 | 0.3 | 1.2 | 0.3 | - | - | - | - | - | 29.2 |
| | 80 | 0.7 | 2.0 | 0.5 | 1.7 | 0.5 | 1.5 | 0.4 | 1.0 | 0.2 | - | 32.5 |
| | 100 | 0.8 | 2.2 | 0.6 | 2.1 | 0.6 | 2.1 | 0.6 | 2.0 | 0.6 | 1.9 | 35.4 |
| | 140 | 1.2 | 3.1 | 1.0 | 3.0 | 0.8 | 2.9 | 0.8 | 2.9 | 0.8 | 2.9 | 40.6 |
| | 200 | 2.0 | 3.5 | 1.5 | 3.5 | 1.2 | 3.5 | 0.9 | 3.5 | 0.9 | 3.5 | 46.2 |

* atmospheric

**TABLE 7 - FL 51 capacity factor**

| Size | Factor |
|---|---|
| 1 A | 0.30 |
| 1 B | 0.48 |
| 1½ | 1.00 |
| 2 | 1.60 |
| 2½ | 2.70 |
| 3 | 4.90 |
| 4 | 9.20 |

**TABLE 8 - FL 101 capacity factor**

| Size | Factor |
|---|---|
| 1½ A | 0.69 |
| 1½ B | 1.00 |
| 2 | 1.60 |
| 3 | 3.20 |
| 4A | 5.00 |
| 4B | 9.00 |

**TABLE 9 - FL FUME MOVER COMPARATIVE PERFORMANCE**

| Suction pressure inches water vacuum ($h_s$) | Operating water pressure ($h_m$) | Capacity in scfm at atmospheric discharge ($Q_s$) | | Operating water consumption, gpm ($Q_m$) | |
|---|---|---|---|---|---|
| | | FL 51 1½" | FL 101 1½"B | FL 51 1½" | FL 101 1½"B |
| 0" * | 20 | 24.6 | 21.9 | 10.5 | 3.5 |
| | 40 | 36.5 | 29.3 | 14.0 | 4.8 |
| | 60 | 43.8 | 37.0 | 16.7 | 5.7 |
| | 80 | 51.1 | 41.3 | 18.9 | 6.4 |
| | 100 | 58.6 | 46.9 | 20.8 | 7.0 |
| 5" | 20 | 14.6 | - | 10.5 | - |
| | 40 | 29.6 | 10.0 | 14.0 | 4.8 |
| | 60 | 38.1 | 21.1 | 16.7 | 5.7 |
| | 80 | 46.1 | 29.9 | 18.9 | 6.4 |
| | 100 | 54.2 | 37.1 | 20.8 | 7.0 |
| 10" | 20 | 6.7 | - | 10.5 | - |
| | 40 | 23.0 | - | 14.0 | - |
| | 60 | 32.6 | 6.8 | 16.7 | 5.7 |
| | 80 | 41.2 | 18.5 | 18.9 | 6.4 |
| | 100 | 50.0 | 27.5 | 20.8 | 7.0 |
| 15" | 40 | 16.9 | - | 14.0 | - |
| | 60 | 27.2 | - | 16.7 | - |
| | 80 | 36.6 | 7.0 | 18.9 | 6.4 |
| | 100 | 45.9 | 17.0 | 20.8 | 7.0 |
| 20" | 40 | 11.5 | - | 14.0 | - |
| | 60 | 22.2 | - | 16.7 | - |
| | 80 | 32.2 | - | 18.9 | - |
| | 100 | 41.8 | 7.8 | 20.8 | 7.0 |
| 25" | 40 | 7.0 | - | 14.0 | - |
| | 60 | 17.7 | - | 16.7 | - |
| | 80 | 28.0 | - | 18.9 | - |
| | 100 | 38.7 | - | 20.8 | - |
| 30" | 40 | 3.3 | - | 14.0 | - |
| | 60 | 13.7 | - | 16.7 | - |
| | 80 | 24.3 | - | 18.9 | - |
| | 100 | 34.2 | - | 20.8 | - |
| 35" | 40 | 0.4 | - | 14.0 | - |
| | 60 | 10.5 | - | 16.7 | - |
| | 80 | 20.9 | - | 18.9 | - |
| | 100 | 30.6 | - | 20.8 | - |
| 45" | 40 | - | - | - | - |
| | 60 | 4.8 | - | 16.7 | - |
| | 80 | 14.8 | - | 18.9 | - |
| | 100 | 24.4 | - | 20.8 | - |

* atmospheric

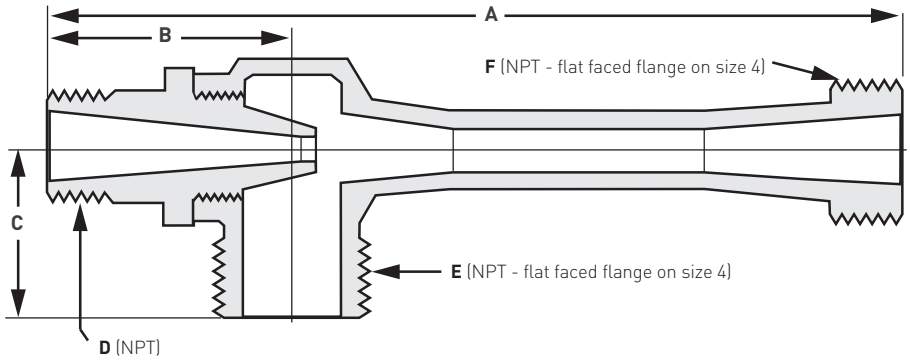



**TABLE 10 - CAST LM, ELL**

| Size | Model | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| ½ A | LM | 4⅜ | 1½ | 1¼ | ¼ | ½ | ½ |
| ½ B | LM, ELL | 4⅜ | 1½ | 1¼ | ¼ | ½ | ½ |
| ½ | LM, ELL | 4½ | 1⅝ | 1¼ | ⅜ | ½ | ½ |
| ¾ | LM, ELL | 5⅞ | 2 | 1½ | ½ | ¾ | ¾ |
| 1 | LM, ELL | 7⅛ | 2¼ | 1¾ | ¾ | 1 | 1 |
| 1¼ | LM, ELL | 9 | 2½ | 2¼ | 1 | 1¼ | 1¼ |
| 1½ | LM, ELL | 11 | 2¾ | 2½ | 1 | 1½ | 1½ |
| 2 | LM, ELL | 14⅜ | 3⅛ | 3 | 1¼ | 2 | 2 |
| 2½ | LM, ELL | 18⅛ | 3½ | 4⅛ | 1½ | 2½ | 2½ |
| 3 | LM, ELL | 23⅞ | 4 | 5 | 2 | 3 | 3 |
| 4 | LM, ELL | 32⅞ | 5 | 6 | 3 | 4❖ | 4❖ |

❖ Flange. Bolting corresponds to ASA 150 lbs.

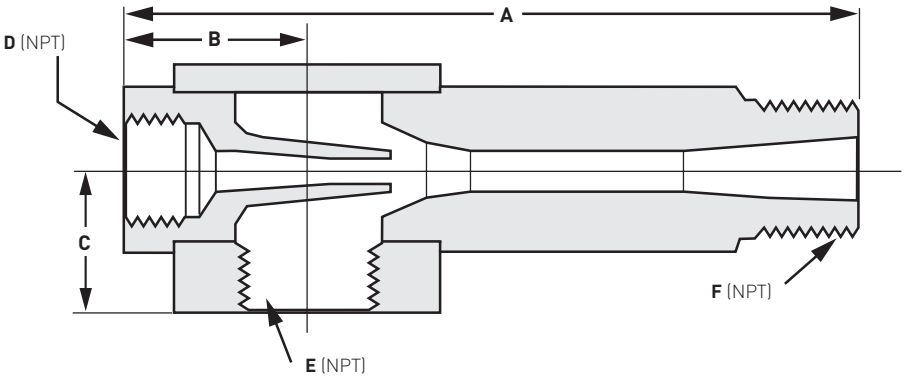



**TABLE 11 - PVC LM, ELL**

| Size | Model | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| ½ A | LM | 3¾ | 1 11/16 | 1 5/16 | ¼ | ½ | ½ |
| ½ B | LM | 3¾ | 1 11/16 | 1 5/16 | ¼ | ½ | ½ |
| ½ | LM | 4⅝ | 1 11/16 | 1 5/16 | ¼ | ½ | ½ |
| ¾ | LM | 5¾ | 1⅞ | 1 | ½ | ¾ | ¾ |
| 1 | LM, ELL | 6⅞ | 2⅛ | 1 5/16 | ¾ | 1 | 1 |
| 1¼ | LM, ELL | 9 1/16 | 2¾ | 1½ | 1 | 1¼ | 1¼ |
| 1½ | LM, ELL | 10 15/16 | 3 | 1¾ | 1 | 1½ | 1½ |
| 2 | LM, ELL | 14 3/16 | 3½ | 1 15/16 | 1¼ | 2 | 2 |
| 2½ | LM, ELL | 18½ | 4 | 2½ | 1½ | 2½ | 2½ |
| 3 | LM, ELL | 24 3/16 | 4½ | 3 | 2 | 3 | 3 |

## MODELS LM, ELL AND FL - DIMENSIONS

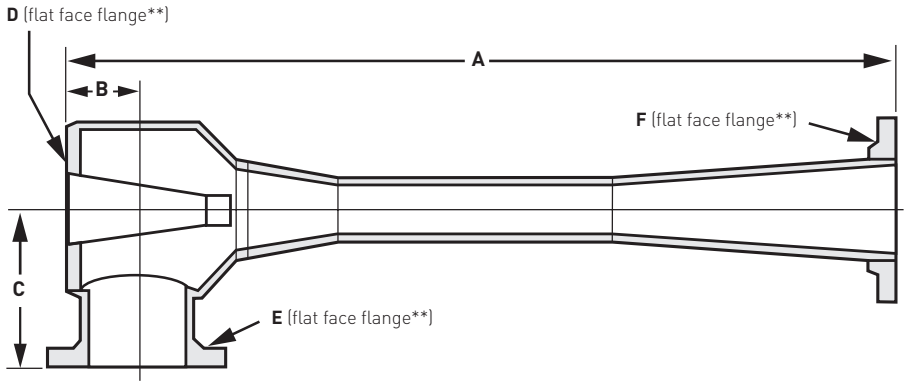



**TABLE 12 - FABRICATED LM, ELL**

| Size | A | B | C | D** | E** | F** |
|---|---|---|---|---|---|---|
| 4 | 38¼ | 5¼ | 8 | 3 | 4 | 4 |
| 6 | 52⅞ | 5⅞ | 9½ | 4 | 6 | 6 |
| 8 | 74 7/16 | 8 7/16 | 13 | 6 | 8 | 8 |
| 10 | 87⅜ | 10⅜ | 14 | 8 | 10 | 10 |
| 12 | 110¾ | 11¾ | 18 | 10 | 12 | 12 |

** Bolting corresponds to ASA 150 lbs. Bolt holes in D flange of all sizes are blind tapped

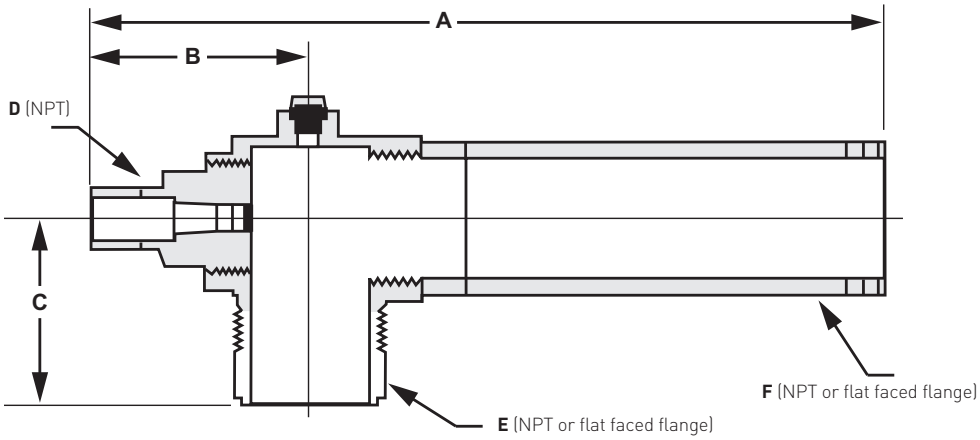



**TABLE 13 - CAST FL51**

| Size | Nozzle sizes | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| 1A | ¾ | 11⅞ | 2½ | 1¾ | ½ | 1 | 1 |
| 1B | 1 | 11⅞ | 2½ | 1¾ | ¾ | 1 | 1 |
| 1½ | 1¼ | 16 9/16 | 3 | 2½ | 1 | 1½ | 1½ |
| 2 | 1½ | 20 11/16 | 3¼ | 3 | 1 | 2 | 2 |
| 2½ | 2 | 25⅞ | 3¾ | 4⅛ | 1¼ | 2½ | 2½ |
| 3 | 2½ | 33 15/16 | 4¼ | 5 | 1½ | 3 | 3 |
| 4 | 3 | 45 | 5 | 6 | 2 | 4 | 4 |

**TABLE 14 - CAST FL101**

| Size | Nozzle sizes | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| 1½ A | ½ | 10 5/16 | 2 13/16 | 2½ | ⅜ | 1½ | 1½ |
| 1½ B | ¾ | 10 5/16 | 2 13/16 | 2½ | ½ | 1½ | 1½ |
| 2 | 1 | 12¾ | 3¼ | 3 | ¾ | 2 | 2 |
| 3 | 1¼ | 17 9/16 | 4 | 5 | 1 | 3 | 3 |
| 4A | 1½ | 26⅛ | 5 | 6 | 1 | 4 | 4 |
| 4B | 2 | 26⅛ | 5 | 6 | 1¼ | 4 | 4 |

**NOTE**
Always specify material, model and unit size.

## PUMPING GASES USING STEAM OR AIR OPERATING MEDIUM

Series G jet pumps include the GL and GH models. They are used for exhausting, evacuating and priming applications.

Model GL uses operating steam or air from 60 to 120 psig. The maximum vacuum with closed suction is 6" Hg abs.

Model GH uses operating steam or air from 20 to 80 psig. The maximum vacuum with closed suction is 6½" Hg abs.

Each model is available in 15 sizes from ½" to 12" suction and discharge. Units are cast construction in sizes ½ through 6. Sizes 4 through 12 are available with fabricated construction. Certain sizes of units are also available in PVC or other polymer constructions.

**NOTE**
Always specify material, model and unit size when ordering.

**TABLE 15 - MODEL CONSTRUCTION DATA**

| Model | GL, GH | Standard materials |
|---|---|---|
| Sizes Available | ½A-4" | Cast: Low lead bronze, iron, C. steel, 316 STS |
| | 4" and up | Fabricated: Carbon steel, 316 STS |
| | ½A-3" | Non-Metallic: PVC, PP, PVDF (Kynar™) |

The capacities of both models are slightly higher when using air as the operating medium instead of steam. The following information is required for selection of both the GL and GH models for exhausting, evacuating and priming:

**Exhausting**
- Suction load, standard cubic feet per minute (scfm) air ($Q_s$)*
- Suction pressure, inches Hg. abs. ($h_s$)
- Operating steam or air pressure, psig ($h_m$)
- Discharge pressure required, psig ($h_d$)

* For suction loads other than air, refer to dry air equivalent section on page 22.

**Evacuating**
- Suction load, in cubic feet of space to be evacuated
- Required time to evacuate, in minutes
- Operating steam or air pressure, psig ($h_m$)
- Final suction pressure, inches Hg abs. ($h_s$)
- Discharge pressure required, psig ($h_d$)

**Priming**
The selection procedure for ejectors in priming applications is the same as that for evacuation, except: The evacuation time must be doubled for priming applications because the priming capacity of any given ejector is half that of the evacuating capacity.

## G SERIES UNIT SELECTION USING PERFORMANCE CHARTS

The following procedures and examples are included for selecting Series G jet pumps.
Refer to the performance curves and tables when determining individual unit sizes.

For air operating medium, use the same performance data as for steam.
To estimate the air consumption in standard cubic ft/minute, divide the listed values by 3.
For example: The GH-1½ steam consumption is 497 lbs/hr at 60 psig. The air consumption at the same pressure would be 497 ÷ 3 = 166 scfm.

**Exhausting - selection procedure**

Step 1 - From the family of performance curves, select the one matching the available operating pressure, psig ($h_m$) and required discharge pressure, psig ($h_d$).
Step 2 - At the point where this curve intersects the suction pressure ($h_s$), read down the line to determine suction capacity ($Q_s$) of 1½" unit.
Step 3 - Compute ideal capacity factor (C.F.) by dividing:

$$\frac{\text{Qs - required}}{\text{Qs - from curve}}$$

Step 4 - Select (from C.F. chart) the unit having C.F. equal to or greater than that determined in Step 3.
Step 5 - To figure steam consumption, refer to steam consumption table. Find the consumption listed for available operating pressure ($h_m$) and multiply this by the C.F. for the selected unit.

**Exhausting - example**

To exhaust 200 scfm:

| | |
|---|---|
| Suction pressure, inches Hg abs. ($h_s$): | 20 |
| Operating steam pressure, psig ($h_m$): | 80 |
| Maximum discharge pressure, psig ($h_d$): | 5 |

Both GL and GH Models are considered in this example to illustrate selection on the basis of operating economy.
Step 1 - Go to the 80 psig curves ($h_m$) and note discharge pressure of each.
Step 2 - These curves intersect suction pressures ($h_s$) at:
35.5 scfm on the GL - 1½ curve
17.0 scfm on the GH - 1½ curve
Step 3 - Ideal capacity factor (CF)

$$\frac{\text{Qs - required}}{\text{Qs - from curve}}$$

$$\text{GL - 1½} = \frac{200}{35.5} = 5.63$$

$$\text{GH - 1 ½} = \frac{200}{17.0} = 11.76$$

Step 4 - From the CF chart
GL - 3 = 5.92
GH - 4 = 11.8
Step 5 - To determine the most economical model of those considered, check steam consumption chart and determine the steam consumption of both under available operating pressure 80 psig:

GL-3 uses 277 lbs/hr x CF 5.92 = 1640 lbs/hr.
Maximum discharge pressure (from curve) = 6 psig
GH-4 uses 623 lbs/hr x CF 11.8 = 7351 lbs/hr
Maximum discharge pressure (from curve) = 21 psig

Therefore: the GL-3, having the lower steam consumption, in the desired range of operation, is the correct unit.

**NOTE**
GL and GH PVC units are for air operation only.

**Evacuating - selection procedure**

Step 1 - Compute time in minutes per hundred cubic feet to complete the required evacuation.
Step 2 - Refer to the GL, GH evacuation time chart. Find the operating pressure ($h_m$) and suction pressure ($h_s$).
Step 3 - Read across to the right and find the unit that will complete the evacuation within the desired time.
Step 4 - To figure steam consumption, multiply the steam used (shown in the right-hand column of the same chart) by the appropriate capacity factor (C.F.).

**Evacuating - example**

To evacuate 200 cubic feet in 30 minutes:

| | |
|---|---|
| Final suction pressure, inches Hg abs. ($h_s$): | 10 |
| Operating steam pressure, psig ($h_m$): | 40 |
| Discharge pressure ($h_d$): | atmospheric |

Step 1 - Determine time in minutes per 100 cubic feet to complete evacuation:

$$\frac{\text{30 minutes total}}{\text{2 (hundred ft}^3\text{)}} = \text{15 minutes per 100 cubic feet}$$

Step 2 - Locate operating steam pressure, 40 psig ($h_m$) and suction pressure, 10 inches Hg. abs. ($h_s$) on evacuation time chart.
Step 3 - Read across to the right and locate unit that will complete evacuation in desired time. The GH-1 will complete the evacuation in 14 minutes.
Step 4 - Find steam used in right-hand column - 366 lbs/hr
Multiply this by the C.F. for the GH-1:
.344 x 366 lbs/hr = 126 lbs/hr

**TABLE 16 - GL, GH EVACUATION TIME**

| Operating water pressure ($h_m$) psig | Suction pressure, in. Hg abs ($h_s$) | Time in minutes per 10 cubic feet evacuated | | | | Time in minutes per 100 cubic feet evacuated | | | | | | | | | | | | | | | | Operating steam used, lbs/hr ($Q_m$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ½" A | | ½" B | | ½" | | ¾" | | 1" | | 1¼" | | 1½" | | 2" | | 2½" | | 3" | | 1½" | |
| | | GL | GH | GL | GH | GL | GH | GL | GH | GL | GH | GL | GH | GL | GH | GL | GH | GL | GH | GL | GH | GL | GH |
| 30 | 25" | - | 2.4 | - | 1.5 | - | 6.0 | - | 3.5 | - | 2.1 | - | 1.20 | - | 0.73 | - | 0.40 | - | 0.23 | - | 0.12 | - | 301 |
| | 20" | - | 4.7 | - | 3.0 | - | 12.0 | - | 6.7 | - | 4.1 | - | 2.30 | - | 1.40 | - | 0.77 | - | 0.44 | - | 0.24 | - | 301 |
| | 15" | - | 8.7 | - | 5.5 | - | 21.0 | - | 12.0 | - | 7.5 | - | 4.20 | - | 2.60 | - | 1.40 | - | 0.82 | - | 0.44 | - | 301 |
| | 10" | - | 15.0 | - | 9.6 | - | 37.0 | - | 22.0 | - | 13.0 | - | 7.30 | - | 4.50 | - | 2.50 | - | 1.40 | - | 0.76 | - | 301 |
| 40 | 25" | - | 1.7 | - | 1.1 | - | 4.1 | - | 2.4 | - | 1.4 | - | 0.81 | - | 0.50 | - | 0.27 | - | 0.16 | - | 0.08 | - | 366 |
| | 20" | - | 4.0 | - | 2.5 | - | 9.9 | - | 5.8 | - | 3.5 | - | 2.00 | - | 1.20 | - | 0.66 | - | 0.38 | - | 0.20 | - | 366 |
| | 15" | - | 8.3 | - | 5.3 | - | 21.0 | - | 12.0 | - | 7.3 | - | 4.10 | - | 2.50 | - | 1.40 | - | 0.79 | - | 0.42 | - | 366 |
| | 10" | - | 15.7 | - | 10.0 | - | 39.0 | - | 23.0 | - | 14.0 | - | 7.70 | - | 4.70 | - | 2.60 | - | 1.50 | - | 0.79 | - | 366 |
| 60 | 25" | 1.0 | 1.7 | 0.64 | 1.1 | 2.5 | 4.1 | 1.4 | 2.4 | 0.87 | 1.4 | 0.49 | 0.81 | 0.3 | 0.50 | 0.16 | 0.27 | 0.09 | 0.16 | 0.05 | 0.08 | 221 | 497 |
| | 20" | 2.3 | 4.7 | 1.50 | 3.0 | 5.8 | 12.0 | 3.4 | 6.7 | 2.00 | 4.1 | 1.10 | 2.30 | 0.7 | 1.40 | 0.38 | 0.77 | 0.22 | 0.44 | 0.12 | 0.24 | 221 | 497 |
| | 15" | 4.0 | 9.3 | 2.50 | 6.0 | 9.9 | 23.0 | 5.8 | 13.0 | 3.50 | 8.1 | 1.90 | 4.60 | 1.2 | 2.80 | 0.66 | 1.50 | 0.38 | 0.88 | 0.20 | 0.47 | 221 | 497 |
| | 10" | 7.7 | 19.0 | 4.90 | 12.0 | 19.0 | 47.0 | 11.0 | 27.0 | 6.70 | 17.0 | 3.70 | 9.30 | 2.3 | 5.70 | 1.30 | 3.10 | 0.72 | 1.80 | 0.39 | 0.96 | 221 | 497 |
| 80 | 25" | 1.0 | 2.0 | 0.64 | 1.3 | 2.5 | 5.0 | 1.4 | 2.9 | 0.87 | 1.7 | 0.49 | 0.98 | 0.3 | 0.60 | 0.16 | 0.33 | 0.09 | 0.19 | 0.05 | 0.10 | 277 | 623 |
| | 20" | 2.0 | 5.0 | 1.30 | 3.2 | 5.0 | 12.0 | 2.9 | 7.2 | 1.70 | 4.4 | 0.98 | 2.40 | 0.6 | 1.50 | 0.33 | 0.82 | 0.19 | 0.47 | 0.10 | 0.25 | 277 | 623 |
| | 15" | 4.0 | 9.7 | 2.50 | 6.2 | 9.9 | 24.0 | 5.8 | 14.0 | 3.50 | 8.4 | 2.00 | 4.70 | 1.2 | 2.90 | 0.66 | 1.60 | 0.38 | 0.91 | 0.20 | 0.49 | 277 | 623 |
| | 10" | 8.0 | 20.0 | 5.10 | 13.0 | 20.0 | 50.0 | 11.0 | 29.0 | 7.00 | 17.0 | 3.90 | 9.80 | 2.4 | 6.00 | 1.30 | 3.30 | 0.76 | 1.90 | 0.40 | 1.00 | 277 | 623 |
| 100 | 25" | 1.0 | 2.0 | 0.64 | 1.3 | 2.5 | 5.0 | 1.4 | 2.9 | 0.87 | 1.7 | 0.49 | 0.98 | 0.3 | 0.60 | 0.16 | 0.33 | 0.09 | 0.19 | 0.05 | 0.10 | 333 | 750 |
| | 20" | 2.3 | 5.3 | 1.50 | 3.4 | 5.8 | 13.0 | 3.4 | 7.7 | 2.00 | 4.6 | 1.10 | 2.60 | 0.7 | 1.60 | 0.38 | 0.88 | 0.22 | 0.50 | 0.12 | 0.27 | 333 | 750 |
| | 15" | 4.7 | 12.0 | 3.00 | 7.4 | 12.0 | 29.0 | 6.7 | 17.0 | 4.10 | 10.0 | 2.30 | 5.70 | 1.4 | 3.50 | 0.77 | 1.90 | 0.44 | 1.10 | 0.24 | 0.59 | 333 | 750 |
| | 10" | 8.7 | 40.0 | 5.50 | 26.0 | 21.0 | 99.0 | 12.0 | 58.0 | 7.60 | 35.0 | 4.30 | - | 2.6 | - | 1.40 | 6.60 | 0.82 | 3.80 | 0.44 | 2.00 | 333 | 750 |
| 120 | 25" | 1.0 | - | 0.64 | - | 2.5 | - | 1.4 | - | 0.87 | - | 0.49 | - | 0.3 | - | 0.16 | - | 0.09 | - | 0.05 | - | 390 | - |
| | 20" | 2.7 | - | 1.70 | - | 6.6 | - | 3.8 | - | 2.30 | - | 1.30 | - | 0.8 | - | 0.44 | - | 0.25 | - | 0.13 | - | 390 | - |
| | 15" | 5.3 | - | 3.40 | - | 13.0 | - | 7.7 | - | 4.60 | - | 2.60 | - | 1.6 | - | 0.88 | - | 0.50 | - | 0.27 | - | 390 | - |
| | 10" | 9.0 | - | 5.70 | - | 22.0 | - | 13.0 | - | 7.80 | - | 4.40 | - | 2.7 | - | 1.50 | - | 0.85 | - | 0.46 | - | 390 | - |

**TABLE 17 - 1½ GL, GH STEAM CONSUMPTION (lbs/hr Qm)**

| Steam pres. (hm) | 20 | 40 | 60 | 80 | 100 | 120 | 150 |
|---|---|---|---|---|---|---|---|
| GL | | | 221 | 277 | 333 | 390 | 474 |
| GH | 236 | 366 | 497 | 623 | 750 | 878 | 1067 |

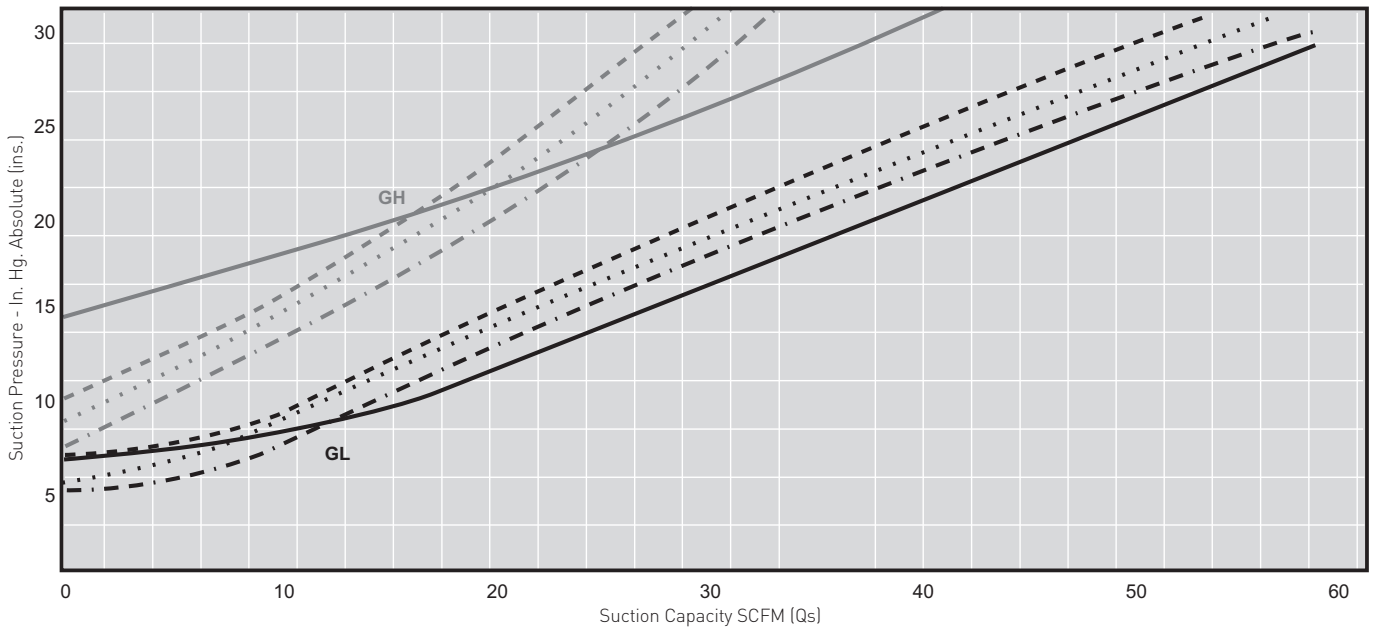
**TABLE 18 - GL, GH capacity factor**

| Size | Factor |
|---|---|
| ½ A | 0.030 |
| ½ B | 0.047 |
| ½ | 0.121 |
| ¾ | 0.208 |
| 1 | 0.344 |
| 1¼ | 0.613 |
| 1½ | 1.000 |
| 2 | 1.820 |
| 2½ | 3.170 |
| 3 | 5.920 |
| 4 | 11.800 |
| 6 | 24.000 |
| 8 | 49.000 |
| 10 | 71.000 |
| 12 | 123.000 |

**TABLE 19 - 1½ GL, GH AIR CONSUMPTION (scfm)**

| Air pres. (hm) | 20 | 40 | 60 | 80 | 100 | 120 | 150 |
|---|---|---|---|---|---|---|---|
| GL | | | 74 | 92 | 111 | 130 | 158 |
| GH | 78 | 122 | 166 | 208 | 250 | 293 | 356 |

### 1½ GL, GH SUCTION AIR LOAD SCFM (Qs) PERFORMANCE CURVES (EXHAUSTING)




**GH**

- 80 psig O.P. with up to 21 psig D.P.
- 60 psig O.P. with up to 14 psig D.P
- 40 psig O.P. with up to 6 psig D.P
- 20 psig Operating Pressure (hm) with 0 psig Discharge Pressure (hd)

**GL**

- 120 psig Operating Pressure (hm) with up to 12 psig Discharge Pressure
- 100 psig O.P. with up to 9 psig D.P
- 80 psig O.P. with up to 6 psig D.P
- 60 psig O.P. with up to 1 psig D.P

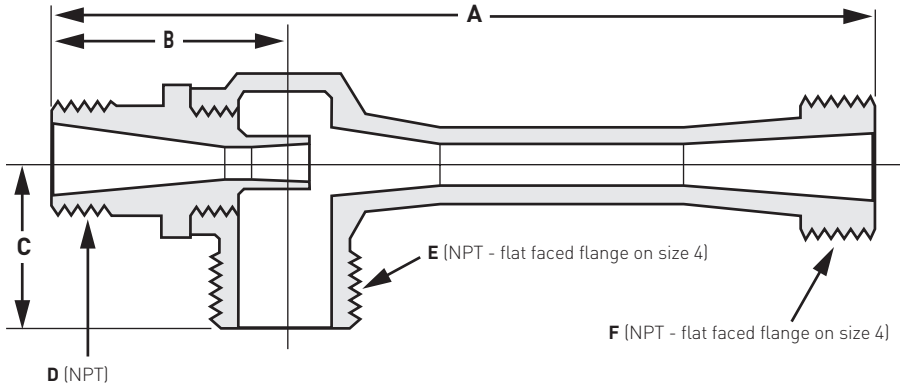



**TABLE 20 - Cast GL, GH dimensions (in inches)**

| Size | A | B | C | D* | E* | F* |
|---|---|---|---|---|---|---|
| ½ A | 4⅜ | 1½ | 1¼ | ¼ | ½ | ½ |
| ½ B | 4⅜ | 1½ | 1¼ | ¼ | ½ | ½ |
| ½ | 4½ | 1⅝ | 1¼ | ⅜ | ½ | ½ |
| ¾ | 5⅞ | 2 | 1½ | ½ | ¾ | ¾ |
| 1 | 7⅛ | 2¼ | 1¾ | ¾ | 1 | 1 |
| 1¼ | 9 | 2½ | 2¼ | 1 | 1¼ | 1¼ |
| 1½ | 11 | 2¾ | 2½ | 1 | 1½ | 1½ |
| 2 | 14⅜ | 3⅛ | 3 | 1¼ | 2 | 2 |
| 2½ | 18⅛ | 3½ | 4⅛ | 1½ | 2½ | 2½ |
| 3 | 23⅞ | 4 | 5 | 2 | 3 | 3 |
| 4 | 32⅞ | 5 | 6 | 3 | 4❖* | 4❖* |

❖ Flange.
* Bolting corresponds to ASA 150 lbs.

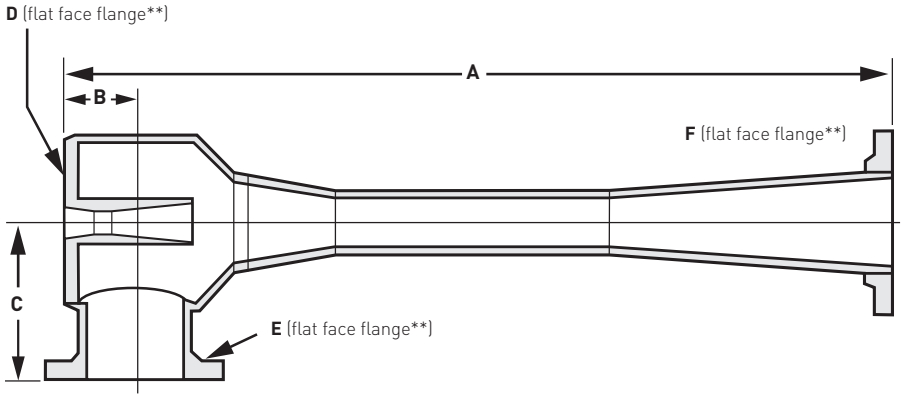



**TABLE 21 - Fabricated GL, GH dimensions (in inches)**

| Size | A | B | C | D** | E** | F** |
|---|---|---|---|---|---|---|
| 4 | 38¼ | 5¼ | 8 | 3 | 4 | 4 |
| 6 | 52⅞ | 5⅞ | 9½ | 4 | 6 | 6 |
| 8 | 74 7/16 | 8 7/16 | 13 | 6 | 8 | 8 |
| 10 | 87⅜ | 10⅜ | 14 | 8 | 10 | 10 |
| 12 | 110¾ | 11¾ | 18 | 10 | 12 | 12 |

** Bolting corresponds to ASA 150 lbs. Bolt holes in D flange of all sizes are blind tapped.

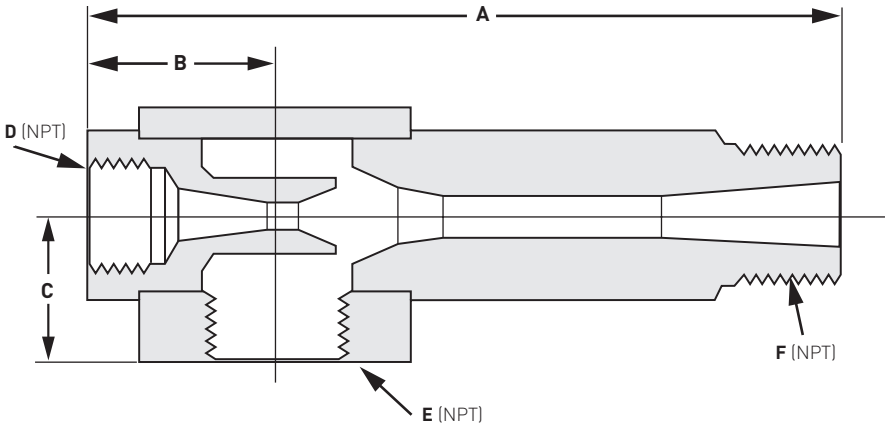



**TABLE 22 - PVC GL, GH - for air operation only dimensions (in inches)**

| Size | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| ½ A | 3¾ | 1 11/16 | 15/16 | ¼ | ½ | ½ |
| ½ B | 3¾ | 1 11/16 | 15/16 | ¼ | ½ | ½ |
| ½ | 4⅝ | 1 11/16 | 15/16 | ¼ | ½ | ½ |
| ¾ | 5¾ | 1⅞ | 1 | ½ | ¾ | ¾ |
| 1 | 6⅞ | 2⅛ | 15/16 | ¾ | 1 | 1 |
| 1¼ | 9 1/16 | 2¾ | 1½ | 1 | 1¼ | 1¼ |
| 1½ | 10 15/16 | 3 | 1¾ | 1 | 1½ | 1½ |
| 2 | 14 3/16 | 3½ | 1 15/16 | 1¼ | 2 | 2 |
| 2½ | 18½ | 4 | 2½ | 1½ | 2½ | 2½ |
| 3 | 24 3/16 | 4½ | 3 | 2 | 3 | 3 |

### SELECTION GUIDE - MODELS ELL, LM, GL, GH

| Example | | | | LM | - 04 | CS | C | NT | NT | NT | - 01 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | | | | | | | | | | | |
| **ELL** | Model ELL | | | | | | | | | | |
| **LM** | Model LM | | | | | | | | | | |
| **GL** | Model GL | | | | | | | | | | |
| **GH** | Model GH | | | | | | | | | | |
| **Jet size** | | | | | | | | | | | |
| **4A** | ½A | **20** | 2½" | | | | | | | | |
| **4B** | ½B | **24** | 3" | | | | | | | | |
| **04** | ½" | **32** | 4" | | | | | | | | |
| **06** | ¾" | **48** | 6" | | | | | | | | |
| **08** | 1" | **64** | 8" | | | | | | | | |
| **10** | 1¼" | **80** | 10" | | | | | | | | |
| **12** | 1½" | **96** | 12" | | | | | | | | |
| **16** | 2" | | | | | | | | | | |
| **Material of construction** | | | | | | | | | | | |
| **BZ** | Bronze | | | | | | | | | | |
| **CS** | Carbon steel | | | | | | | | | | |
| **IR** | Cast iron | | | | | | | | | | |
| **SS** | 316 SST | | | | | | | | | | |
| **HC** | Hastelloy C | | | | | | | | | | |
| **MO** | Monel | | | | | | | | | | |
| **20** | A20 | | | | | | | | | | |
| **PP** | Polypropylene | | | | | | | | | | |
| **PV** | PVC | | | | | | | | | | |
| **CP** | CPVC | | | | | | | | | | |
| **KY** | Kynar® | | | | | | | | | | |
| **Style of construction** | | | | | | | | | | | |
| **C** | Cast metal 2-PC (standard for sizes ½A - 3") | | | | | | | | | | |
| **F** | Metal fabricated (4" - 12") (flanged only) | | | | | | | | | | |
| **B** | Plastic barstock or metal barstock | | | | | | | | | | |
| **W** | Metal weld construction | | | | | | | | | | |
| **Inlet (motive) connection style** | | | | | | | | | | | |
| **NT** | NPT (standard for sizes ½A - 3") | | | | | | | | | | |
| **RS** | Raised face slip on #150 flange (20,CS,IR,SS,HC and MO material only) | | | | | | | | | | |
| **RT** | Raised face threaded #150 flange (20,CS,IR,SS,HC and MO material only) | | | | | | | | | | |
| **FS** | Flat face slip on #150 flange (BZ,PP,PV and KY material) | | | | | | | | | | |
| **FT** | Flat face threaded #150 flange (BZ,PP,PV and KY material) | | | | | | | | | | |
| **FF** | Flat face #150 on fabricated 4" - 12" jet | | | | | | | | | | |
| **RF** | Raised face #150 on fabricated 4" - 12" jet | | | | | | | | | | |
| **Suction connection style** | | | | | | | | | | | |
| **NT** | NPT (standard for sizes ½A - 3") | | | | | | | | | | |
| **RS** | Raised face slip on #150 flange (20,CS,IR,SS,HC and MO material only) | | | | | | | | | | |
| **RT** | Raised face threaded #150 flange (20,CS,IR,SS,HC and MO material only) | | | | | | | | | | |
| **FS** | Flat face slip on #150 flange (BZ,PP,PV and KY material) | | | | | | | | | | |
| **FT** | Flat face threaded #150 flange (BZ,PP,PV and KY material) | | | | | | | | | | |
| **FF** | Flat face #150 on fabricated 4" - 12" jet | | | | | | | | | | |
| **RF** | Raised face #150 on fabricated 4" - 12" jet | | | | | | | | | | |
| **Discharge connection style** | | | | | | | | | | | |
| **NT** | NPT (standard for sizes ½A - 3") | | | | | | | | | | |
| **RS** | Raised face slip on #150 flange (20,CS,IR,SS,HC and MO material only) | | | | | | | | | | |
| **RT** | Raised face threaded #150 flange (20,CS,IR,SS,HC and MO material only) | | | | | | | | | | |
| **FS** | Flat face slip on #150 flange (BZ,PP,PV and KY material) | | | | | | | | | | |
| **FT** | Flat face threaded #150 flange (BZ,PP,PV and KY material) | | | | | | | | | | |
| **FF** | Flat face #150 on fabricated 4" - 12" jet | | | | | | | | | | |
| **RF** | Raised face #150 on fabricated 4" - 12" jet | | | | | | | | | | |
| **Variation** | | | | | | | | | | | |
| **01** | Catalog Standard | | | | | | | | | | |

**SELECTION GUIDE - MODELS FL51, FL101**

| Example | FL5 | 16 | IR | S | NT | NT | NT | - 01 |
|---|---|---|---|---|---|---|---|---|
| **Model** | | | | | | | | |
| **FL5** Model FL51 | | | | | | | | |
| **FL1** Model FL101 | | | | | | | | |
| **Jet size (refer to page 10 for applicable sizes)** | | | | | | | | |
| **FL51** | | | | | | | | |
| **1A** 1" (½" NPT nozzle) | | | | | | | | |
| **1B** 1" (¾" NPT nozzle) | | | | | | | | |
| **12** 1½" | | | | | | | | |
| **16** 2" | | | | | | | | |
| **20** 2½" | | | | | | | | |
| **24** 3" | | | | | | | | |
| **32** 4" | | | | | | | | |
| **FL101** | | | | | | | | |
| **A2** 1½" (⅜" NPT nozzle) | | | | | | | | |
| **B2** 1½" (½" NPT nozzle) | | | | | | | | |
| **16** 2" | | | | | | | | |
| **24** 3" | | | | | | | | |
| **4A** 4" (FL101 w/ 1½" nozzle) | | | | | | | | |
| **4B** 4" (FL101 w/ 2" nozzle) | | | | | | | | |
| **Material of construction** | | | | | | | | |
| **IR** Iron body w/ carbon steel nozzle and carbon steel diffuser (FL51) | | | | | | | | |
| **IR** Iron body and nozzle & carbon steel diffuser (FL101) | | | | | | | | |
| **SS** 316 SST | | | | | | | | |
| **Style of construction** | | | | | | | | |
| **S** Standard | | | | | | | | |
| **Inlet (motive) connection style** | | | | | | | | |
| **NT** NPT | | | | | | | | |
| **Suction connection style** | | | | | | | | |
| **NT** NPT | | | | | | | | |
| **RS** Raised face slip on #150 flange | | | | | | | | |
| **RT** Raised face threaded #150 flange | | | | | | | | |
| **FS** Flat face slip on #150 flange | | | | | | | | |
| **FT** Flat face threaded #150 flange | | | | | | | | |
| **Discharge connection style** | | | | | | | | |
| **NT** NPT | | | | | | | | |
| **RS** Raised face slip on #150 flange | | | | | | | | |
| **RT** Raised face threaded #150 flange | | | | | | | | |
| **FS** Flat face slip on #150 flange | | | | | | | | |
| **FT** Flat face threaded #150 flange | | | | | | | | |
| **Variation** | | | | | | | | |
| **01** Catalog standard | | | | | | | | |

## PUMPING GASES USING STEAM OPERATING MEDIUM

Model U and L single stage ejectors are available in 16 capacities and suction sizes from 1" to 4". Model U operates efficiently in a vacuum range of 6" to 12" Hg abs.; model L in the range of 3" to 6" Hg. abs. These ejectors are used for exhausting and evacuating applications where steam is the operating medium in the range of 80 to 200 psig.

The 2NC two stage non-condensing ejector is also available in 16 capacity ranges for similar applications in a vacuum range of ½" to 3" Hg abs. It uses steam as the operating medium in the range of 100 to 200 psig.

Nozzles supplied with U, L and 2NC ejectors are selected to match the operating steam pressure specified when units are ordered. Nozzles are available for operating steam pressures of 80 (for U and L only), 100, 120, 140, 160, 180 or 200 psig.

Steam consumption data given in charts in this section are valid for any one of these pressures. When the operating steam pressure specified falls between two of these standard pressures, the lower pressure nozzle will be supplied. Steam consumption will be slightly higher for such units unless the operating steam pressure is regulated to match that of the nozzle.

The following information is required for selection of these three steam operated models in exhausting and evacuating applications:

**Exhausting**

- Suction load ($Q_S$) lbs./hr. of dry air at 70°F, or dry air equivalent (DAE)
  (For suction loads other than air, refer to dry air equivalent section on page 28).
  Air - pounds per hour
  Water vapor - pounds per hour
  Molecular weights and quantities of other suction gases - pounds per hour
- Suction pressure, inches Hg abs. ($h_s$)
- Operating steam pressure, psig ($h_m$)
- Discharge pressure, psig ($h_d$) (if greater than 1 psig, contact factory)

**Evacuating**

- Suction load, in cubic feet of air to be evacuated
  Required time to evacuate, in minutes
- Operating steam pressure, psig ($h_m$)
- Final suction pressure, inches Hg abs ($h_s$)
- Discharge pressure required, psig ($h_d$)

For evacuating applications using Model L or Model 2NC, contact the factory

**Sizes available**

Each model is available in 16 sizes from 1 inch to 4 inches suction and discharge. Sizes 1 through 3 are NPT. Size 4 is drilled in accordance with ASA 125 lbs. bolt pattern.

**NOTE**

When ordering, always specify operating steam pressure, for correct nozzle sizing. Also specify material, model and unit size. For available materials, see below.

**TABLE 23 - MODEL CONSTRUCTION DATA**

| Model | U, L, 2NC | Standard materials |
|---|---|---|
| Sizes available | 1H-16H | Cast: Carbon steel, iron body, 316 STS nozzle or all 316 STS |

## U, L, 2NC UNIT SELECTION USING PERFORMANCE CHARTS

The following procedures and examples are included for selecting U, L and 2NC ejectors. Refer to the performance curves and tables to determine individual unit sizes.

### Exhausting - selection procedure

Refer to U, L performance curves on pages 23 and 24.

Step 1 - Determine the unit having a suction pressure within the application range.
Step 2 - Determine the capacity of the selected unit using the following procedure:
a. Refer to the required suction pressure (hs) in the left-hand column.
b. Read across to the operating steam pressure curve (hm).
Read down this line and note the suction capacity at the bottom of the chart.

**NOTE**

Both U and L curves are drawn for U-4 and L-4 units. Capacity factors are used to determine capacities of all other units.

Step 3 - Calculate the ideal capacity factor:

$$\text{Ideal C.F.} = \frac{\text{Desired capacity}}{\text{Capacity from curve}}$$

Step 4 - Choose the unit with the capacity factor equal to or greater than the ideal.
Step 5 - Refer to the capacity factor chart and note the operating steam consumption ($Q_m$) for the selected unit.

The selection procedure for Model 2NC is identical to that for models U and L. Use 2NC performance curves and steam consumption chart.

### Exhausting - Example

To exhaust 55 pounds of 70°F dry air per hour:
Suction pressure, inches Hg abs ($h_s$): 6
Operating steam pressure, psig ($h_m$): 160
Discharge pressure, psig ($h_d$): 1

Step 1 - Consider both U-4 and L-4 units based on suction pressure of 6 inches Hg abs.
Step 2 - Starting at 6 (hs) on curve, read across to required operating steam pressure (hm). Read down this vertical line and note suction capacity (Qs) at bottom.
U-4 capacity is 84 lbs. per hour
L-4 capacity is 85 lbs. per hour
Step 3 - Calculate ideal capacity factor:

$$\frac{\text{Desired capacity}}{\text{Capacity from curve}} = \text{for U} - 4 \quad \frac{55\text{lbs / hr}}{84} = .655$$

$$= \text{for L} - 4 \quad \frac{55\text{lbs / hr}}{85} = .647$$

Step 4 - Choose the exact unit size having a C.F. equal to or greater than the ideal.
Both models U-3 and L-3 have a C.F. of .694.
U-3 Capacity = .694 x 84 (from Step 2) = 58.2 lbs/hr
L-3 Capacity = .694 x 85 = 58.9 lbs/hr

This particular example illustrates the close performance characteristics of both U and L models at the suction pressure of 6" Hg abs. In this case, the model U is operating in the lower end of its application range and its performance improves at suction pressures above 6. The model L, however, is operating in the upper extreme of the application range and performance improves at suction pressures below 6.
Step 5 - Note operating steam consumption (Qm) on capacity factor chart. Model U-3 and L-3 steam consumption = 195 lbs/hr.

## U, L, 2NC UNIT SELECTION USING PERFORMANCE CHARTS

**Evacuating - selection procedure**

Refer to U evacuation time chart.

Step 1 - Figure evacuation time in minutes per hundred cubic feet.

Step 2 - Go to the left-hand column in table, final suction pressure ($h_s$). Read across to find evacuation time equal to or less than that determined in Step 1. Read to the top of the table and note unit number.

Step 3 - Read steam consumption of unit selected off capacity factor chart.

**Evacuating - example**

To evacuate 3000 cubic foot vessel full of air at atmospheric pressure:

| | |
|---|---|
| Operating steam pressure, psig ($h_m$): | 100 |
| Final suction pressure, inches Hg abs. ($h_s$): | 5 |
| Time to evacuate, hrs: | 2.5 |
| Discharge pressure ($h_d$): | atmosphere |

Step 1 - Determine evacuation time in minutes per hundred cubic feet.

$$\frac{2.5 \text{ hours} \times 60}{30 \text{ (hundred) ft}^3} = 5 \text{ minutes/100 cubic feet}$$

Step 2 - Go to the final pressure on left of evacuation time chart (5 in. Hg. $h_s$). Read across and find evacuation time equal to or less than 5 minutes.

The U-2 will evacuate the tank in 5.33 minutes per hundred cubic feet and the U-3 will complete the evacuation in 3.42 minutes per cubic hundred feet.

Step 3 - Read steam consumption of selected unit off capacity factor chart. The unit to select would be the U-3 in this case and its steam consumption is 195 lbs/hr.

**TABLE 24 - U MODEL EVACUATION TIME (in minutes per 100 cu. ft at 100 psig operating steam pressure)**

| Suction press. In. Hg abs ($h_s$) | Model number | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | U-1H | U-2H | U-3H | U-4H | U-5H | U-6H | U-7H | U-8H | U-9H | U-10H | U-11H | U-12H | U-13H | U-14H | U-15H | U-16H |
| 12" | 4.68 | 3.08 | 1.98 | 1.37 | 1.01 | 0.769 | 0.610 | 0.494 | 0.409 | 0.343 | 0.293 | 0.253 | 0.206 | 0.171 | 0.145 | 0.123 |
| 11" | 5.06 | 3.32 | 2.14 | 1.48 | 1.09 | 0.830 | 0.657 | 0.532 | 0.441 | 0.370 | 0.316 | 0.273 | 0.222 | 0.185 | 0.156 | 0.133 |
| 10" | 5.44 | 3.57 | 2.30 | 1.59 | 1.17 | 0.894 | 0.707 | 0.572 | 0.474 | 0.398 | 0.340 | 0.293 | 0.239 | 0.198 | 0.168 | 0.143 |
| 9" | 5.85 | 3.84 | 2.46 | 1.71 | 1.26 | 0.960 | 0.760 | 0.615 | 0.510 | 0.427 | 0.365 | 0.315 | 0.257 | 0.213 | 0.180 | 0.154 |
| 8" | 6.29 | 4.14 | 2.66 | 1.84 | 1.35 | 1.040 | 0.818 | 0.662 | 0.549 | 0.460 | 0.393 | 0.339 | 0.276 | 0.230 | 0.194 | 0.165 |
| 7" | 6.76 | 4.45 | 2.86 | 1.98 | 1.46 | 1.120 | 0.880 | 0.771 | 0.590 | 0.495 | 0.423 | 0.365 | 0.297 | 0.247 | 0.209 | 0.178 |
| 6" | 7.35 | 4.84 | 3.10 | 2.15 | 1.58 | 1.210 | 0.955 | 0.774 | 0.640 | 0.537 | 0.460 | 0.396 | 0.323 | 0.268 | 0.227 | 0.193 |
| 5" | 8.10 | 5.33 | 3.42 | 2.37 | 1.74 | 1.330 | 1.060 | 0.853 | 0.706 | 0.592 | 0.507 | 0.437 | 0.356 | 0.295 | 0.250 | 0.213 |
| 4" | 9.32 | 6.13 | 3.94 | 2.73 | 2.01 | 1.540 | 1.220 | 0.981 | 0.813 | 0.683 | 0.584 | 0.504 | 0.410 | 0.340 | 0.288 | 0.245 |
| 3" | 11.60 | 7.60 | 4.87 | 3.38 | 2.48 | 1.900 | 1.500 | 1.220 | 1.010 | 0.845 | 0.721 | 0.623 | 0.507 | 0.422 | 0.356 | 0.304 |

**TABLE 25 - U AND L CAPACITY FACTOR AND STEAM CONSUMPTION**

| | Model number | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L-1H U-1H | L-2H U-2H | L-3H U-3H | L-4H U-4H | L-5H U-5H | L-6H U-6H | L-7H U-7H | L-8H U-8H | L-9H U-9H | L-10H U-10H | L-11H U-11H | L-12H U-12H | L-13H U-13H | L-14H U-14H | L-15H U-15H | L-16H U-16H |
| * | 0.293 | 0.445 | 0.694 | 1 | 1.36 | 1.78 | 2.25 | 2.78 | 3.36 | 4 | 4.69 | 5.43 | 6.66 | 8.03 | 9.49 | 11.12 |
| ** | 85 | 125 | 195 | 270 | 370 | 480 | 610 | 755 | 910 | 1090 | 1280 | 1480 | 1820 | 2190 | 2580 | 3030 |

* Capacity factor

** Operating steam consumption lb per hour ($Q_m$) (Valid at standard nozzle pressure of 80, 100, 120, 140, 160, 180 or 200 psig)

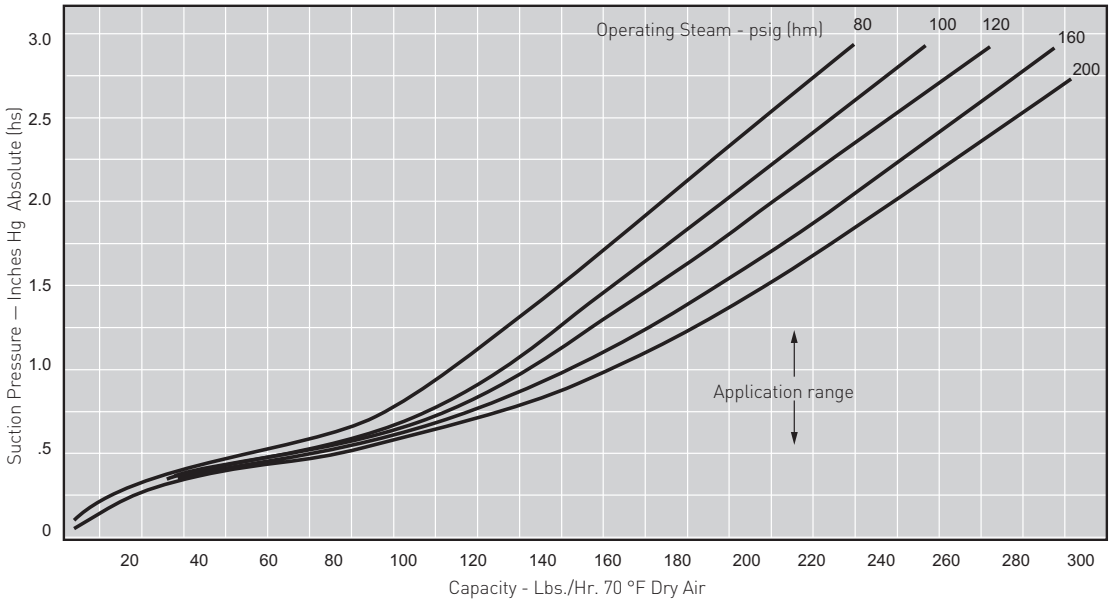
**TABLE 26 - 2NC CAPACITY FACTOR AND STEAM CONSUMPTION**

| | Model number | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2NC 1H | 2NC 2H | 2NC 3H | 2NC 4H | 2NC 5H | 2NC 6H | 2NC 7H | 2NC 8H | 2NC 9H | 2NC 10H | 2NC 11H | 2NC 12H | 2NC 13H | 2NC 14H | 2NC 15H | 2NC 16H |
| * | 0.293 | 0.445 | 0.694 | 1 | 1.36 | 1.78 | 2.25 | 2.78 | 3.36 | 4 | 4.69 | 5.43 | 6.66 | 8.03 | 9.49 | 11.12 |
| ** | 106 | 160 | 240 | 330 | 450 | 590 | 740 | 920 | 1110 | 1320 | 1525 | 1800 | 2200 | 2660 | 3140 | 3660 |

* Capacity factor

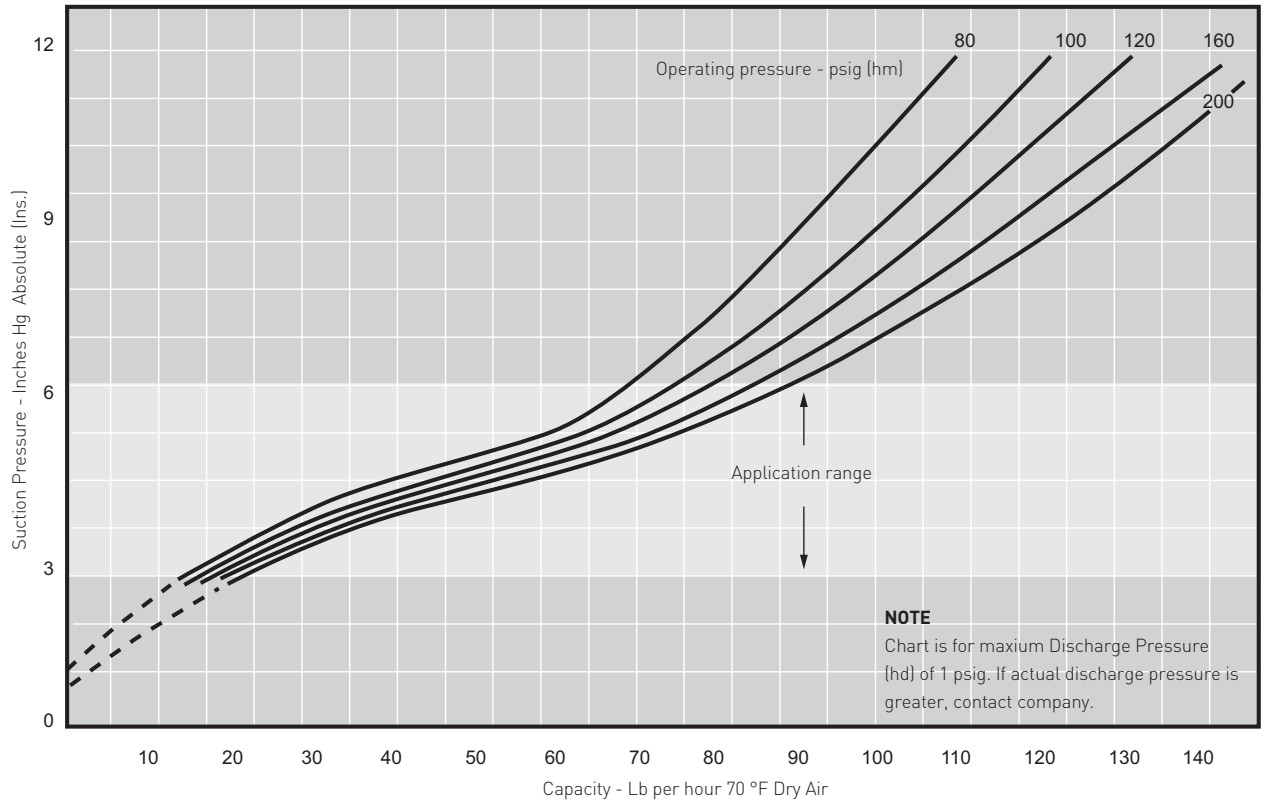
** Operating steam consumption lb per hour ($Q_m$) (Valid at standard nozzle pressure of 100, 120, 140, 160, 180 or 200 psig)

U-4H PERFORMANCE CURVES

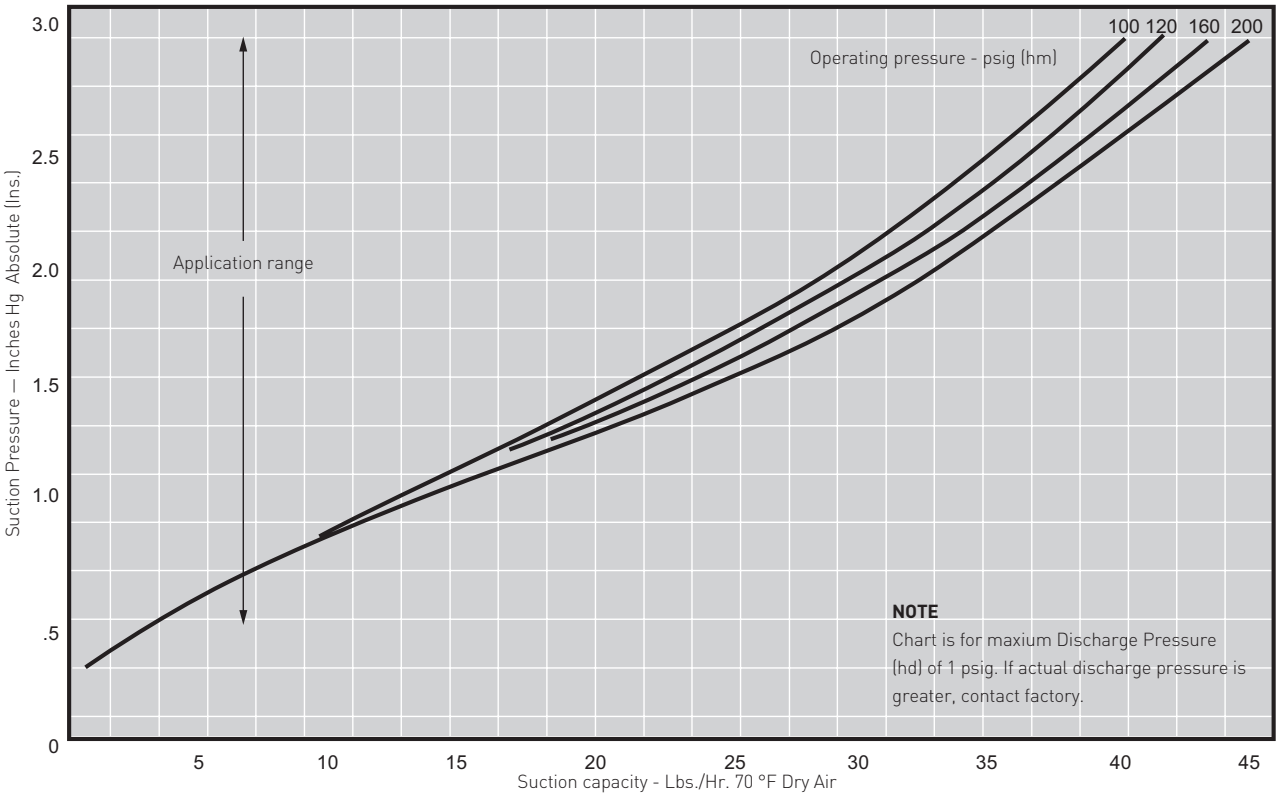


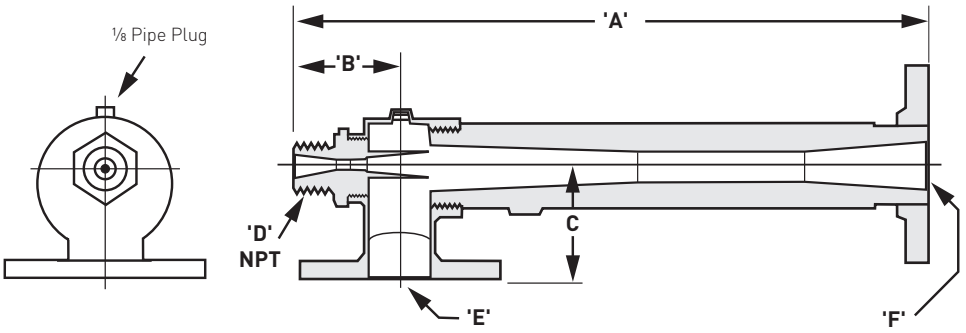

**NOTE**
Chart is for maxium Discharge Pressure (hd) of 1 psig. If actual discharge pressure is greater, contact factory.

L-4H PERFORMANCE CURVES




2NC-4H PERFORMANCE CURVES





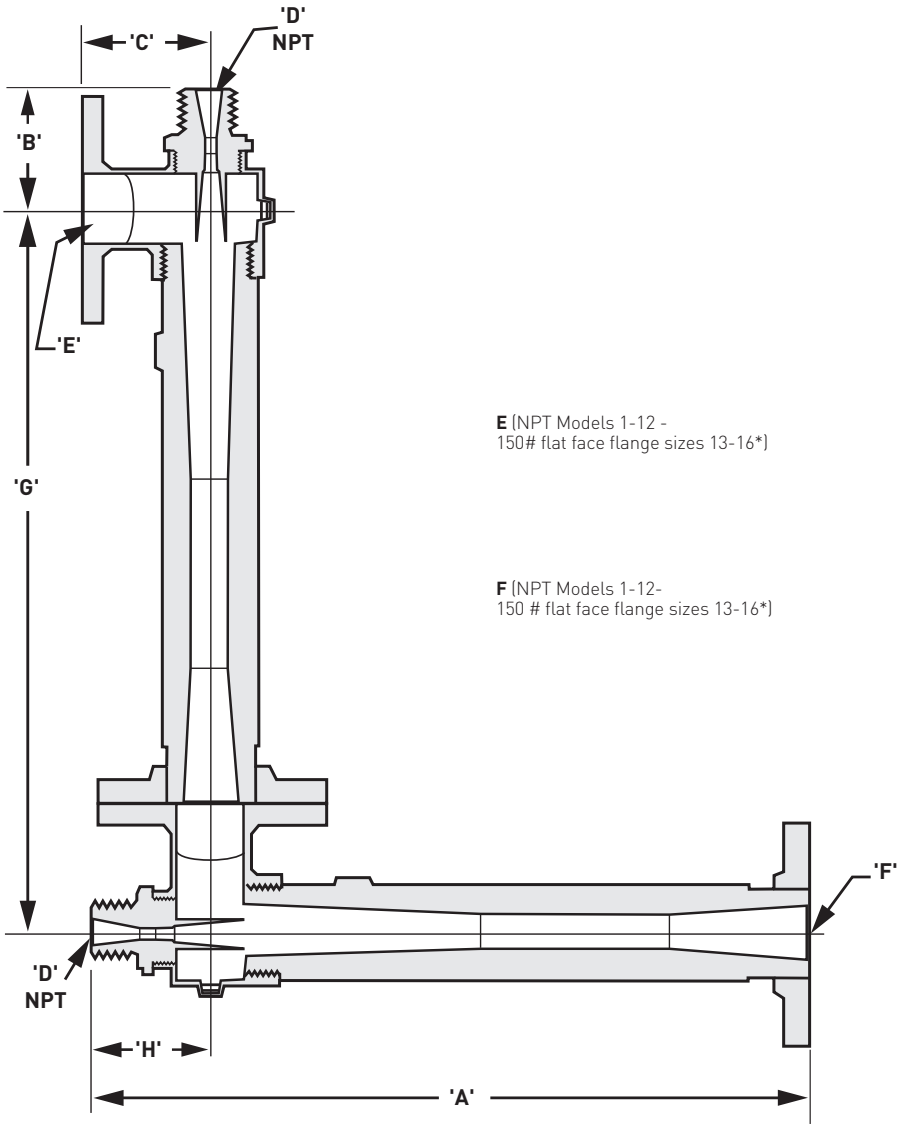

**E** (NPT Models 1-12 -
150# flat face flange sizes 13-16*)

**F** (NPT Models 1-12-
150 # flat face flange sizes 13-16*)

**TABLE 27 - CAST U AND L DIMENSIONS**

| | Dimensions in inches | | | | | |
|---|---|---|---|---|---|---|
| **Model** | **'A'** | **'B'** | **'C'** | **'D'** | **'E'** | **'F'** |
| L-1H, U-1H | 9¼ | 2¼ | 1¾ | ½ | 1 | 1 |
| L-2H, U-2H | 10¾ | 2¼ | 1¾ | ½ | 1 | 1 |
| L-3H, U-3H | 13½ | 2¾ | 2½ | 1 | 1½ | 1½ |
| L-4H, U-4H | 15½ | 2¾ | 2½ | 1 | 1½ | 1½ |
| L-5H, U-5H | 18⅛ | 3⅛ | 3 | 1¼ | 2 | 2 |
| L-6H, U-6H | 20⅛ | 3⅛ | 3 | 1¼ | 2 | 2 |
| L-7H, U-7H | 22¾ | 3½ | 4⅛ | 1½ | 2½ | 2½ |
| L-8H, U-8H | 24¾ | 3½ | 4⅛ | 1½ | 2½ | 2½ |
| L-9H, U-9H | 27½ | 4 | 5 | 2 | 3 | 3 |
| L-10H, U-10H | 29½ | 4 | 5 | 2 | 3 | 3 |
| L-11H, U-11H | 31½ | 4 | 5 | 2 | 3 | 3 |
| L-12H, U-12H | 33½ | 4 | 5 | 2 | 3 | 3 |
| L-13H, U-13H | 38⅛ | 5 | 6 | 3 | 4 | 4 |
| L-14H, U-14H | 41⅛ | 5 | 6 | 3 | 4 | 4 |
| L-15H, U-15H | 45 | 5⅞ | 6 | 3 | 4 | 4 |
| L-16H, U-16H | 47½ | 5⅞ | 6 | 3 | 4 | 4 |

* Bolting corresponds to ASA 125 lbs.




**E** (NPT Models 1-12 -
150# flat face flange sizes 13-16*)

**F** (NPT Models 1-12-
150 # flat face flange sizes 13-16*)

**TABLE 28 - CAST 2NC DIMENSIONS**

| | Dimensions in inches | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Model** | **'A'** | **'B'** | **'C'** | **'D'** | **'E'** | **'F'** | **'G'** | **'H'** |
| 2NC1H | 9¼ | 2¼ | 1¾ | ½ | 1 | 1 | 10⅛ | 2¼ |
| 2NC2H | 10¾ | 2¼ | 1¾ | ½ | 1 | 1 | 11⅝ | 2¼ |
| 2NC3H | 13½ | 2¾ | 2½ | 1 | 1½ | 1½ | 15¼ | 2¾ |
| 2NC4H | 15½ | 2¾ | 2½ | 1 | 1½ | 1½ | 17¼ | 2¾ |
| 2NC5H | 18⅛ | 3⅛ | 3 | 1¼ | 2 | 2 | 19⅞ | 3⅛ |
| 2NC6H | 20⅛ | 3⅛ | 3 | 1¼ | 2 | 2 | 21⅞ | 3⅛ |
| 2NC7H | 22¾ | 3½ | 4⅛ | 1½ | 2½ | 2½ | 25¼ | 3½ |
| 2NC8H | 24¾ | 3½ | 4⅛ | 1½ | 2½ | 2½ | 27¼ | 3½ |
| 2NC9H | 27½ | 4 | 5 | 2 | 3 | 3 | 30¾ | 4 |
| 2NC10H | 29½ | 4 | 5 | 2 | 3 | 3 | 32¾ | 4 |
| 2NC11H | 31½ | 4 | 5 | 2 | 3 | 3 | 34¾ | 4 |
| 2NC12H | 33½ | 4 | 5 | 2 | 3 | 3 | 36¾ | 4 |
| 2NC13H | 38⅛ | 5 | 6 | 3 | 4 | 4 | 39⅛ | 5 |
| 2NC14H | 41⅛ | 5 | 6 | 3 | 4 | 4 | 44⅛ | 5 |
| 2NC15H | 45 | 5 | 6 | 3 | 4 | 4 | 45⅛ | 5⅞ |
| 2NC16H | 47½ | 5 | 6 | 3 | 4 | 4 | 47⅝ | 5⅞ |

* Bolting corresponds to ASA 125 lbs.

**SELECTION GUIDE - MODELS U, L, 2NC**

| Example | | U | 1H | CS | C | NT | NT | NT | - 01 |
|---|---|---|---|---|---|---|---|---|---|
| **Model** | | | | | | | | | |
| **U** | Model U | | | | | | | | |
| **L** | Model L | | | | | | | | |
| **2** | Model 2NC | | | | | | | | |
| **Jet Size (refer to pages 25, 26 for applicable sizes)** | | | | | | | | | |
| **1H** | 1H | | | | | | | | |
| **2H** | 2H | | | | | | | | |
| **3H** | 3H | | | | | | | | |
| **4H** | 4H | | | | | | | | |
| **5H** | 5H | | | | | | | | |
| **6H** | 6H | | | | | | | | |
| **7H** | 7H | | | | | | | | |
| **8H** | 8H | | | | | | | | |
| **9H** | 9H | | | | | | | | |
| **10** | 10H | | | | | | | | |
| **11** | 11H | | | | | | | | |
| **12** | 12H | | | | | | | | |
| **13** | 13H | | | | | | | | |
| **14** | 14H | | | | | | | | |
| **15** | 15H | | | | | | | | |
| **16** | 16H | | | | | | | | |
| **Material of construction** | | | | | | | | | |
| **CS** | Carbon steel (SST nozzle) | | | | | | | | |
| **SS** | 316 SST | | | | | | | | |
| **Nozzle pressure rating** | | | | | | | | | |
| **A** | 80 psig (model U or L only) | | | | | | | | |
| **B** | 100 psig | | | | | | | | |
| **C** | 120 psig | | | | | | | | |
| **D** | 140 psig | | | | | | | | |
| **E** | 160 psig | | | | | | | | |
| **F** | 180 psig | | | | | | | | |
| **G** | 200 psig | | | | | | | | |
| **Inlet (motive) connection style** | | | | | | | | | |
| **NT** | NPT | | | | | | | | |
| **Suction connection style** | | | | | | | | | |
| **NT** | NPT (1" - 12") | | | | | | | | |
| **RF** | Raised face cast #150 flange (13" - 16") | | | | | | | | |
| **Discharge connection style** | | | | | | | | | |
| **NT** | NPT (1" - 12") | | | | | | | | |
| **RT** | Raised face threaded #150 flange (13" - 16") | | | | | | | | |
| **Variation** | | | | | | | | | |
| **01** | Catalog standard | | | | | | | | |

## DRY AIR EQUIVALENT (DAE) CONVERSIONS FOR GL, GH, U, L AND 2NC MODELS

Performance curves for Penberthy steam-air ejectors are plotted in terms of suction pressure and suction gas flow, lb/hr 70°F dry air equivalent (DAE).
Most ejector application data does not include suction gas rate as lb/hr 70°F dry air equivalent, but rather the suction gas rate is presented at some other temperature and for some gas or combination of gases of a composition different from that of air.

Since it is not practical for a manufacturer of steam jet ejectors to maintain facilities for testing ejectors with all the numerous suction gas mixtures and all the many temperatures for which ejectors are used, a method has been devised to permit the design and test of ejectors using air at normal room temperatures or air and steam at any temperature convenient for the manufacturer. The Heat Exchange Institute (HEI) provides a standard that describes the method that is used and accepted by manufacturers and users of ejectors. Material used in this explanation is adapted from the 'Standards for Steam Jet Ejectors' as published by the HEI.

It is important for all persons involved in the application of Penberthy ejectors to be conversant with the method of changing any load gas to its dry air equivalent at 70°F.

**To determine average molecular weight**
Gas mixtures are presented in terms of lb/hr or can be converted to these terms. Steam or water vapor may be contained in a mixture of gases and vapors, however it is treated as a separate component because temperature correction is different from that of other gases. The following example illustrates the most complex conversion that one might encounter:
Given: 100 lb/hr of a mixture of gases and vapor at 200°F temperature, consisting of 20 lb/hr of carbon dioxide gas, 30 lb/hr of air, 5 lb/hr of hydrogen and 45 lb/hr of water vapor.

Molecular weights are as follows:
$CO_2$ = 44 lb/mol
Air = 29 lb/mol
$H_2$ = 2 lb/mol
$H_2O$ = 18 lb/mol
Find average molecular weight of the mixture except for water vapor:

| | | |
|---|---|---|
| 20 lb/hr $CO_2$ ÷ 44 lb/mol | = | 0.455 mol/hr |
| 30 lb/hr air ÷ 29 lb/mol | = | 1.035 mol/hr |
| $\frac{\text{5 lb/hr } H_2 \div \text{2 lb/mol}}{\text{55 lb/hr mixture}}$ | = | $\frac{\text{2.500 mol/hr}}{\text{3.990 mol/hr}}$ |

$$\text{Avg. m.w.} = \frac{55 \text{ lb/hr}}{3.99 \text{ mol/hr}} = 13.8 \text{ lb/mol}$$

Molecular weight conversion factors (29 mw = 1.0)
Use same gas as given above and curve no. 1:
Cmw correction factor for 13.8 mw = 0.7
Cmw correction factor for 18 (H20) = 0.81

Temperature conversion factors (70°F = 1.0)
Use same gas as above and curve no. 2.
Ct temperature correction for 13.8 mw gas at 200°F (use curve for air) = 0.968
Ct temperature correction for steam at 200°F = 0.957

**Actual conversion**
Use factors from above as follows to find the 70°F dry air equivalent of 100 lb/hr of a mixture of gas and water vapor all at 200°F and consisting of 20 lb/hr of $CO_2$ plus 30 lb/hr of air plus 5 lb/hr of $H_2$ plus 45 lb/hr of $H_2O$.

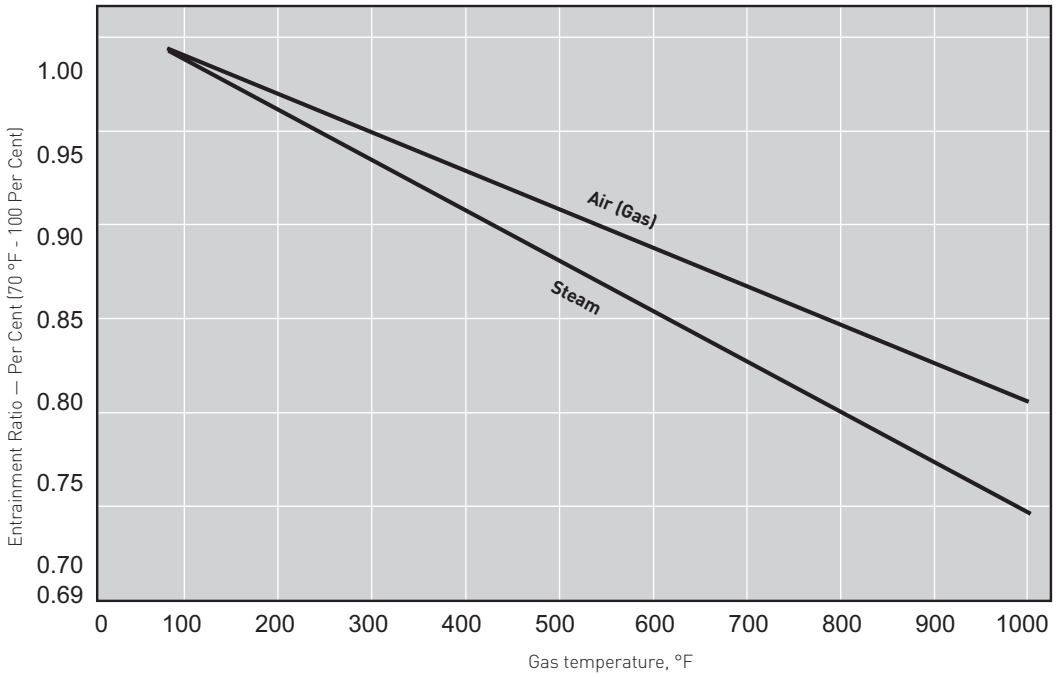
$$\frac{(20 + 30 + 5)}{0.7 \times 0.968} + \frac{45}{0.81 \times 0.957} = 82 + 58 = 140 \text{ lb/hr}$$

Therefore an ejector that will pump the specified gas load of 100 lb/hr at 200°F must also be able to pump 140 lb/hr of air at 70°F.

**NOTE**
Do not confuse DAE with noncondensable gas load.

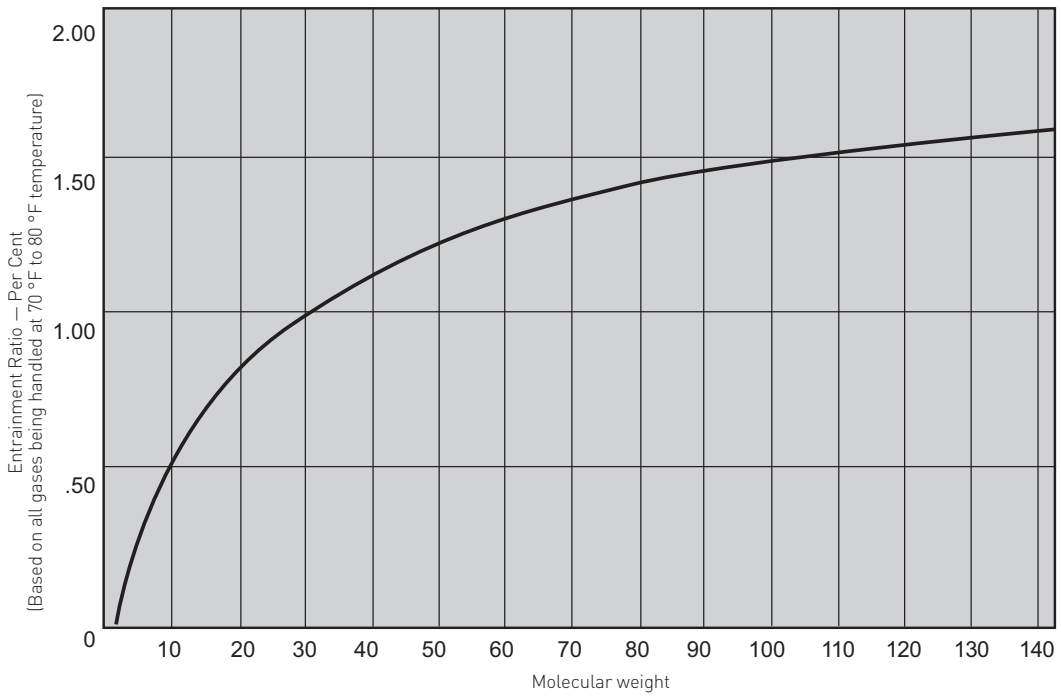
## DRY AIR EQUIVALENT (DAE) CONVERSIONS FOR GL, GH, U, L AND 2NC MODELS

TEMPERATURE ENTRAINMENT RATIO CURVE (NO. 2)*




**NOTE**
Entrainment ratio is the ratio of the weight of air or steam at 70 °F temperature to the weight of air or steam at a higher tepmerature that would be handled by the same ejector operation under the exact same conditions

MOLECULAR WEIGHT ENTRAINMENT RATIO CURVE (NO. 1)*




**NOTE**
Entrainment ratio is the ratio of the weight of gas handled to the weight of air that would be handled by the same ejector operation under the exact same conditions

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