# Engineered Vacuum Systems

HOFFMAN

LAMSON

# Welcome to the World of

ENGINEERED VACUUM SYSTEMS

## Industry Icons: Hoffman and Lamson

For more than 100 years, two names have been synonymous with engineered vacuum system solutions for industrial applications: Hoffman® and Lamson.® Today, those legacies are joined, under one roof, creating the most comprehensive line of Engineered Vacuum Systems in the world.

Anchored in tradition, the Hoffman and Lamson Engineered Vacuum System line-up continues a century long commitment to providing customers with innovative design, a comprehensive product line, quality manufacturing and unparalleled responsiveness to customer requirements.

Today, as the largest manufacturer of blowers/exhausters in the world, our number one priority continues to be developing long-term relationships with our customers. We are continually striving to reduce lead times and costs, while maintaining the highest performance standards in the industry.

Never in the history of blower/exhauster manufacturers has there been a company as capable of delivering great value, exceptional quality and quick turnaround on orders. So, the next time you're evaluating options for an engineered vacuum system, call a Hoffman and Lamson professional sales representative to assist you with your application challenges and requirements. Our factory-trained representatives are conveniently located throughout the United States and around the world.

## Why Hoffman and Lamson?

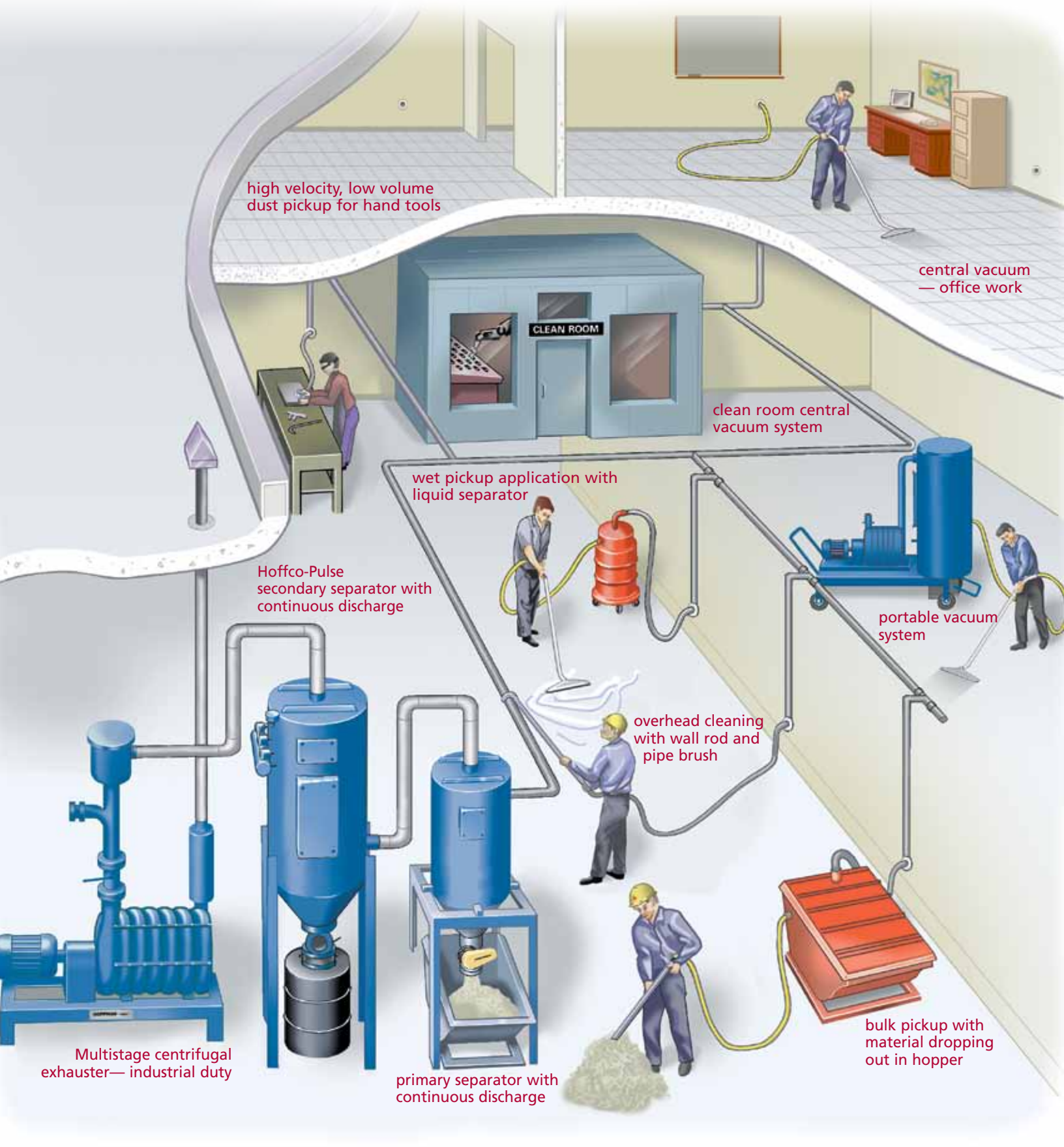
Two companies, each with over 100 years experience create a world of possibilities for the ever-expanding needs of the vacuum marketplace. No other company has the capability, reputation and dedicated engineering staff to deliver the most advanced, efficient and dependable high-quality products available today. Hoffman and Lamson's vacuum expertise includes general housekeeping, pneumatic conveying, product reclamation and hazardous dust control.

Today, it is no longer enough to buy a vacuum system at the best price that will merely do the job. A Hoffman and Lamson Vacuum System is designed to do more. Our field representatives and application engineers will consider other variables, such as efficiency, convenience, future requirements, healthy work environment and even compliance with domestic and international regulations. An engineered vacuum system will result in optimum performance and capability at the lowest operational expense possible.

Nobody offers a more extensive product line, from the rugged industrial portables and the MultiFlow™ and T-Vac™ pre-engineered stationary systems to the custom-designed, engineered vacuum system that services an entire facility using a fabricated or cast multistage centrifugal vacuum producer. Controls are available to protect your vacuum system or to seamlessly integrate the system into a distributed control system. A complete line of Smooth Flow™ tubing and fittings simplify installation and reduce piping loss. Accessories include a complete line of hoses and tools for any requirement, as well as numerous valves, separators and filters to increase the efficiency of your system.

# Hoffman and Lamson Engineered Vacuum System

INDUSTRIAL APPLICATION



# Central Vacuum

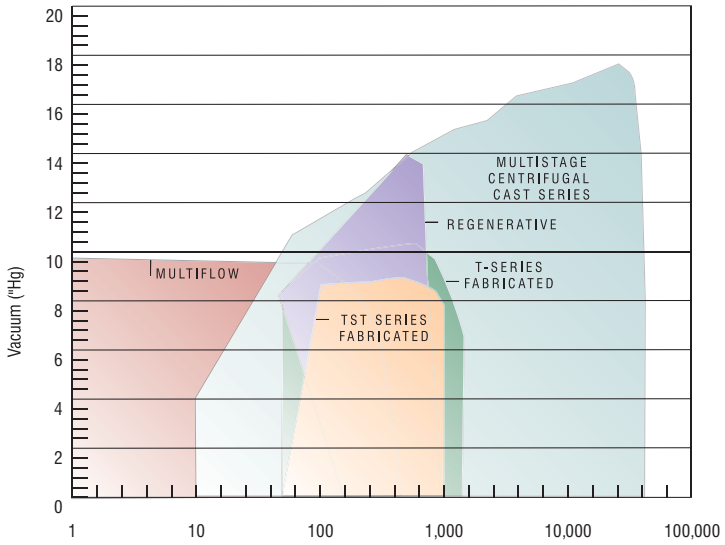
## HOFFMAN AND LAMSON


The heart of any Vacuum System, whether central or portable, is the exhauster. Hoffman and Lamson is in the unique position of offering various types of centrifugal and regenerative exhausters.

## Multistage Centrifugal – Cast Series

Hoffman and Lamson multistage centrifugal exhausters are the culmination of hundreds of years of collective manufacturing and design experience. Over 100,000 machines are in operation, worldwide. Hoffman and Lamson cast centrifugal exhausters represent the highest quality workmanship in the industry using the finest materials and state-of-the-art machining equipment available today. These exhausters represent the broadest range of model sizes and volume of any multistage centrifugal manufacturer.

- **Airflow to 41,000 cfm**
- **Vacuum to 17.6 "Hg**




## Lamson TurboTron Regenerative Half Flow & Full Flow Exhausters

Patented Regenerative Exhausters, the Lamson TurboTron is specifically designed to provide continuous flow, pulse-free air, while delivering quiet (82 dBA @ 3 feet), and clean vacuum, up to 14 "Hg.

The Lamson TurboTron Regenerative exhauster is virtually maintenance free, having only one moving part and no timing gears. The high tensile strength aluminum housing is corrosion resistant and uses a non-binding Teflon® seal in close tolerance areas. The bearings require only occasional greasing and the shaft seals are non-contacting and non-wearing.

- **Airflow to 900 cfm**
- **Vacuum to 14 "Hg**

## T-Series Fabricated Multistage Centrifugal

These durable multistage exhausters have cast aluminum heads for greater efficiency, durability and stability. The four bearing design eliminates excessive load on the inner bearings, increasing bearing life. The four bearing design allows use of a short shaft motor, which is generally stocked at motor shops and is quickly and easily replaced without removing the rotating assembly.

- **Airflow to 1,400 cfm**
- **Vacuum to 11 "Hg**

## TST Series Standard Overhung Fabricated Multistage Centrifugal

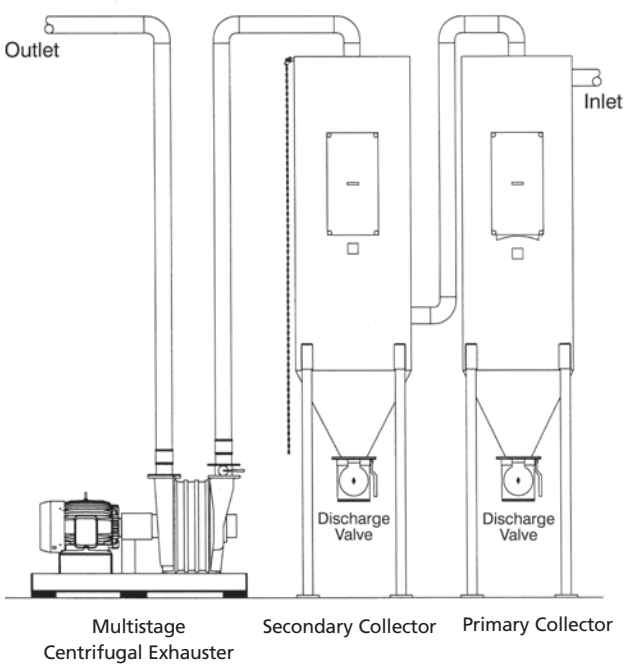
The standard overhung design of the centrifugal exhauster offers most of the advantages of the T-Series and cast multistage at a more economical price. The TST Series is excellent for less demanding applications not requiring a higher vacuum performance.

- **Airflow to 800 cfm**
- **Vacuum to 8.7 "Hg**

## MultiFlow™

Built of lightweight, durable, aluminum alloy castings, Lamson's MultiFlow exhauster comes mounted on a common fabricated steel base on many portable vacuum systems. MultiFlow provides high performance and economy with a 4-stage, belt-driven design. The cast aluminum impellers are backward curved and dynamically balanced to provide years of trouble-free operation.

- **Airflow to 250 cfm**
- **Vacuum to 7 "Hg**




## The Two Basic Collector Classifications

**Primary Collectors** are used when large quantities of bulk solids are part of the collection process. Primary collectors are usually equipped with cone bottoms and often store solid particles for longer periods of time. Dust laden air and heavy particulate enter the collector tangentially at the top, outside a cylindrical baffle plate. Cyclonic action and reduced force precipitate the heavier material to the bottom of the tank. Up to 95% of the material is retained, with the remainder carried to the secondary collector for capture. Gardner Denver collectors can be mounted on legs or saddle supports, may be provided with a cone bottom or dust buckets and are offered with a variety of accessories.

**Secondary Collectors** are designed to capture the remaining material passed on from the primary unit. Secondary collectors are similar to primaries except they use bag or cartridge filters to capture particulate. Low dust applications often use this type of collector without a primary. Various mounting options and accessories are also available with secondary collectors.

### Hoffco-Pulse

Uses reversed airflow to dislodge accumulated dust without disrupting service. Pulse durations are adjustable by means of a timer for optimum bag cleaning. All models are available with cone bottom or dust bucket. Available only as a secondary separator, Hoffco-Pulse models are frequently used to handle all separation needs.

### TurboClean™ Cartridge Style Pulse-Jet Filtration Unit

Filter capacities from four 8" x 16" to thirteen 12" x 36." Reverse jet continuous cleaning, pleated cartridge filter elements, drum lid and connecting sleeve to cone. Filter medias include poly-felt, spunbonded and PTFE membrane.

### S-Type Secondary Collectors

Use multiple tubular dust bags to trap fine particles not captured by the primary collector. Various fabrics are available to provide the most effective filtration for each application. Dust bags may be cleaned manually or automatically with an electrical bag shaker.

### S-Type Primary Collectors

Capture, separate and filter solids directly from the piping system by baffle plates and cyclonic action. Up to 95% of the solids can be continuously discharged or retained for future disposal. Available with cone bottom or dust bucket.

# Self-Contained Vacuum Systems

Hoffman and Lamson's portable vacuum systems are mounted on a common frame and include the exhauster, motor and secondary type collector. The T-VAC portable can be equipped with a Lamson TurboTron Regenerative, a TST-Series fabricated or a T-Series four-bearing fabricated exhauster depending upon the performance desired. The collectors are available with various snap-in bag filters, specifically selected for the application. Self-contained vacuum systems include an inspection door and a dust bucket for easy unloading. They can be stationary, skid mounted for small central systems, or mounted on wheels for complete mobility.


Mobile Unit

Stationary Unit

## Exhauster

Heavy-duty multistage centrifugal vacuum producer standard .5 to 20 Horsepower Ranges handling up to 8 operators simultaneously

## Collector Construction

Heavy gauge carbon steel is standard, with stainless steel and other optional alloys available.

## Dust Bucket Capacity

1.5 to 3.0 cu. ft.

## Options

Electric Bag Shaker or Hoffco-Pulse Bag Cleaning System, in-line HEPA filter, cone bottom with adjustable legs

# Hoses, Tools & Accessories

## Hoses & Tools

To fully realize the benefits of central or portable vacuum systems, it is necessary to have a variety of hoses and tools that are easy and practical to use. We have a complete line to meet your needs. In both 1½" and 2" sizes, there are six varieties of general duty hoses and four heavy-duty hoses with static grounding.

Floor rods, floor tools, bulk conveying tools, hand tools and utility tools are all available in many styles for every job, in 1½" and 2", as well as general duty and heavy-duty. A complete catalog of Hoffman and Lamson hoses, tools and accessories is available.

## Smooth Flow Tubings & Fittings

The majority of industrial vacuum systems and in-plant conveying systems use lightweight, Smooth Flow tubing and fittings in place of heavy cast iron piping and drainage fittings. Hoffman and Lamson's Smooth Flow tubing and fittings provide an efficient and cost effective piping system available in sizes from 2 1/8" to 14" OD and gauges 16 through 11. With the range of fittings available, system design and installation are easily accomplished. Smooth Flow tubing decreases friction loss allowing the most efficient exhauster to be used.

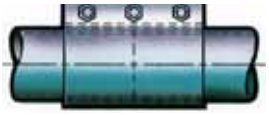
Smooth Flow materials of construction include carbon steel, zinc coated (galvanized) carbon steel, stainless steel and aluminum. Gardner Denver Representatives will facilitate the installation of your system by providing layout drawings and information on the correct method for installation. A full supply of tubing and fittings is available from our stock.

### Expanded Fitting

Enables a straight section to fit inside the fitting. The two are "locked" together by brazing, welding, industrial adhesive or shrink sleeve

### Compression Coupling

Straight tubing or fittings are butted together and the sleeve is tightened around them



### Slip Coupling

Used for joining two straight sections. The two are "locked" together by brazing, welding, industrial adhesive or shrink sleeve

### Shrink Sleeve

A heat shrinkable polyolefin band encircles the connection giving a positive seal. If two straight sections are used, a slip coupling is required.

## Accessories

Gardner Denver offers a complete line of accessories to assure system flexibility and optimum performance.

In-Line HEPA Filter

Drum Top Collector

Control Panel


SmartMeter®

## Air-Lock Valves

8" single or double flanged for controlling material discharge from collectors. Whether manual or air operated, these valves are leakproof and self-compensate for wear. Rotary and slide valves are also available.

## Automatic Air Bleed System

Allows operation of vacuum cleaning system during low demand periods.

## Equalization Line

Allows plastic liners to be securely positioned in collector dust buckets.

## In-Line Filters

All vacuum systems can be fitted with HEPA absolute filters (99.97% effective on 0.3 micron size materials.)

## Collector Options

Wet separators are available to remove moisture from the air stream. Drum Top Separators are excellent for removing materials, prior to the tubing system, utilizing a standard 30 or 55 gallon drum.

## Controls & Instrumentation

Numerous control systems are available to monitor, control and protect your vacuum system. Gardner Denver's SmartMeter® is a microprocessor based digital monitor with two digital displays designed to protect the vacuum producer, capable of two inputs and four alarm outputs. Level controls can shut-down the system when the collector is full. Custom designed control panels are available to control more sophisticated vacuum systems.


A multitude of tasks can be accomplished with an engineered vacuum system, comprised of a vacuum producer, separators and complementary components designed to match the exact application requirements. These applications include general cleaning, material recovery, capture of dangerous or hazardous dust and vacuum conveying of material. This guide will cover engineered vacuum system designs for general cleaning that will pick up and convey dry, free-flowing material that can enter and pass through the vacuum cleaning tool and hose.

# STEP 1

**DETERMINE THE FOLLOWING**

1. The maximum number of operators to be using the system simultaneously.
2. Is any future expansion anticipated?
3. A convenient location for installing the main components - vacuum producer and separators.

## Vacuum Cleaning Hose

The length of the vacuum hose will determine the location of each inlet valve. Vacuum hoses are available in 15, 25 and 50 foot lengths. The best results are obtained from 25 foot hoses. 50 foot hoses tend to be too heavy and cumbersome. As a general rule, with a 25 foot hose, the inlet valves should be 30 to 35 feet apart.

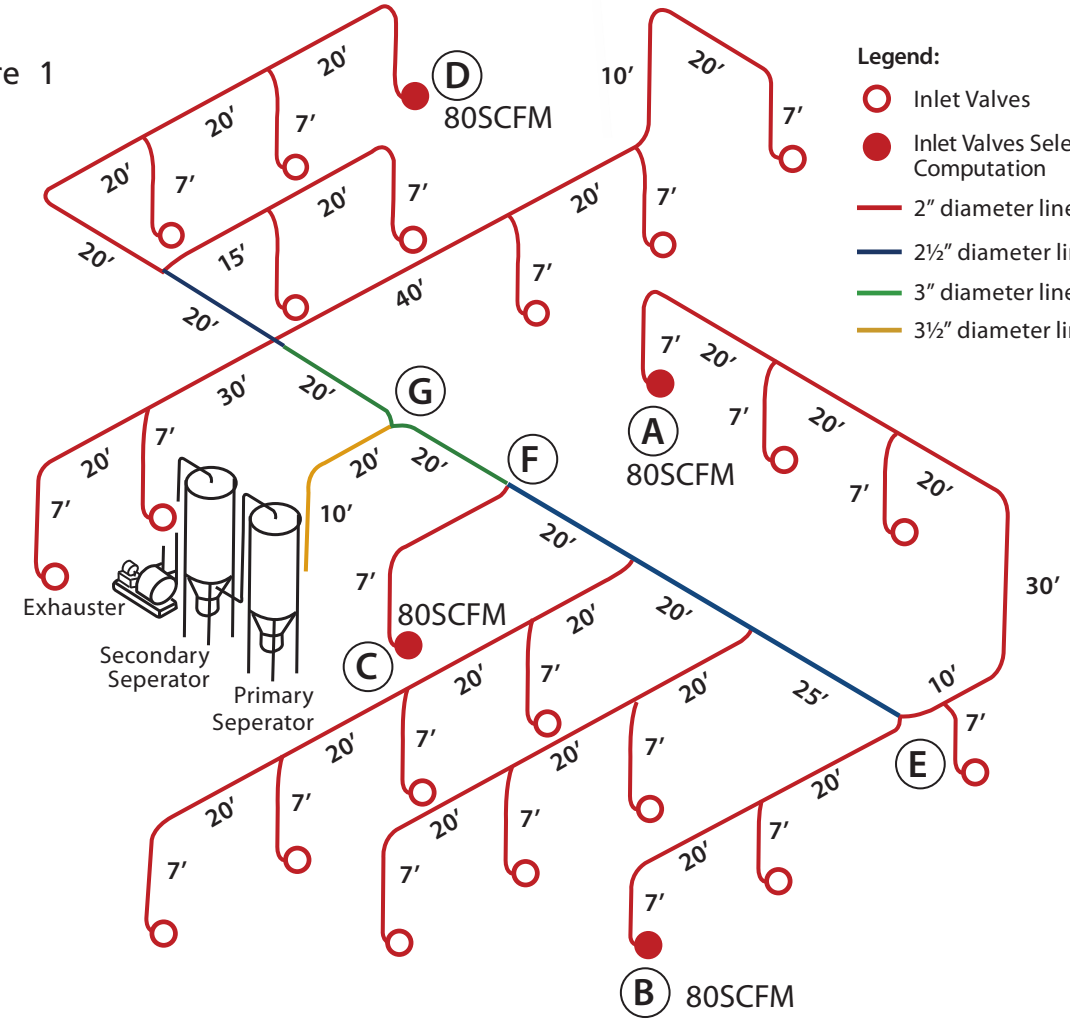
## Inlet Valve Locations

Inlet valves are located at the end of branches coming off of main or sub-main tubing. Inlet valves have spring loaded covers and are used to connect flexible vacuum hose(s) to the system. An inlet valve should be located everywhere necessary to facilitate cleaning every area. The system design will dictate how many inlet valves can be used simultaneously.

## Layout of Piping System

In most cases, piping consists of light gauge steel tubing and fittings. The layout must show the location of the equipment, the length of the tubing runs and the inlet valves. All 45° and 90° elbows should be shown.

Figure 1




## STEP 2

### THE PROCESS OF LINE SIZING BEGINS, BASED ON A NUMBER OF FACTORS

1. The air volume per hose.
2. Number of hoses to be used simultaneously.
3. Correct air velocities for conveying the material through the tubing to the separators.

### AIR VOLUME PER HOSE

The hose diameter, particle size and amount of material to be conveyed determines the air volume. Most systems work well with a minimum of 80 SCFM in a 1.5" diameter hose. Heavier material may require increased airflow, ranging to 120 SCFM or more, for some material. 2" diameter hoses typically require 150 to 200 SCFM, depending upon conditions.

## STEP 3

### SYSTEM LOSSES

To choose the proper vacuum producer, system losses or resistance must be determined. Total loss consists of:

1. Loss through hoses and tools
2. Loss through lines (straight runs and bends)
3. Loss through separators

### CALCULATING LOSSES

1. Chart 3 indicates the loss for a given hose length with tool.
2. Friction loss in the lines or tubing, can be determined from Chart 5.
3. The friction loss through a 90° elbow is equivalent to 12 feet of straight tubing and a 45° elbow is similar to 7 feet of tubing.

See Charts on pages 13, 14 and 15.

To establish friction loss, we chose inlet valve A, farthest from the vacuum producer, and inlet valve C, which is the closest, as active inlet valves. Inlet valves B and D were more or less equidistant from the vacuum producer. From the size of the plant, a 25 foot hose with 1.5" diameter has been selected. Based on the particle size, amount and density of material to be picked up, it was determined that 80 SCFM/1.5" diameter hose would be adequate.

## LOSSES

From Chart 3, "Hose & Tool Friction Loss," 80 SCFM with 25 feet of 1.5" diameter hose and tool will have a total friction loss of 1.75 "Hg. Looking at Figure 1, at point A, 80 SCFM enters the system and flows to point E. The total equivalent tubing loss from point A to E is:

2" dia. line 107 ft in length
5 - 90° elbows = 60 ft equivalent length
Total 167 ft equivalent length

From Chart 5, "Vacuum Line Loss Chart," at 80 SCFM and a 2⅛" diameter line, we read:

0.75 "Hg loss per 100 feet of line

$$\therefore \frac{167 \times .75}{100} = 1.25 \text{ "Hg}$$

At point B, an additional 80 SCFM enters the system. This combines with the flow from point A (80 + 80 SCFM) for a total of 160 SCFM at point E. The total equivalent tubing from point E to F (there are no elbows) is 65 feet. From chart 5 at 160 SCFM and 2.5" diameter tubing, we read:

1.2 "Hg loss per 100 feet of line

$$\therefore \frac{65 \times 1.2}{100} = 0.78 \text{ "Hg}$$

At point C, an additional 80 SCFM enters the system. This combines with the flow from point E (80 + 160 SCFM) for a total of 240 SCFM at point F. The total equivalent tubing (again, there are no elbows) is 20 feet.

From Chart 5 at 240 SCFM and 3" diameter line, we read:

0.9 "Hg loss per 100 feet of line

$$\therefore \frac{20 \times 0.9}{100} = 0.18 \text{ "Hg}$$

At Point G an additional 80 SCFM enters the system and combines with the flow from Point F (80 + 240 SCFM) for a total of 320 SCFM at Point G. The total equivalent tubing from Point G to the Primary Separator is:

3.5" dia. line 30 ft. in length
3 - 90° elbows 36 ft. in length
Total 66 ft. equivalent length

From Chart 5 we read 320 SCFM at 3.5" diameter line:

0.8 "Hg loss per 100 feet of line

$$\therefore \frac{66 \times 0.8}{100} = 0.52 \text{ "Hg}$$

Separator loss is added to our total system loss. The primary separator loss typically does not exceed .25 "Hg and the secondary, .75 "Hg, for a total separator loss of 1.0 "Hg. Line losses between the separators and the vacuum producer are insignificant.

The system's total air volume is determined by:

80 SCFM / 1.5" diameter hose
x 4 operators
320 SCFM

This figure of 320 SCFM (at standard conditions of 29.92 "Hg & 68°F) is then multiplied by the ratio of the standard barometric pressure divided by the site barometric pressure minus exhauster inlet vacuum ("Hg) to obtain the volume under inlet vacuum conditions. We do this because Hoffman and Lamson performance curves are base on ICFM (inlet cubic feet per minute).

$$\therefore 320 \left( \frac{29.92}{29.92 - 5.48} \right) = 391 \text{ ICFM}$$

We therefore require a vacuum producer capable of exhausting 391 ICFM of air at a vacuum of 5.48 "Hg. The Hoffman and Lamson cast multistage centrifugal exhauster model 407 with a 10 HP - 3,600 RPM motor is selected (See Chart 4).

## Designing a System Example of Requirements

| | |
|---|---|
| Type of Plant | Fertilizer |
| Particle size | Fine to .25" granular |
| Total material picked up | Approx. 18 ft³/8 hrs. |
| Operation | General cleaning |
| Simultaneous users | Maximum of four |

## Total Friction Loss for the System: 5.48" Hg

| | |
|---|---|
| Hose & tool loss | 1.75 "Hg |
| Line loss from A–E | 1.25 "Hg |
| Line loss from E–F | .78 "Hg |
| Line loss from F–G | .18 "Hg |
| Line loss from G to separators | .52 "Hg |
| Separator losses | 1.00 "Hg |

## RATIO OF AIR FLOW/FILTER AREA

The particle size and the volume of the material being picked up and the frequency of the bag cleaning (shaking them to dislodge the dust) will determine the ratio of air flow (ICFM) to ft² of filter area.

## HOSE & TOOLS

Always start with a standard set of tools and add any extras required by your specific application, referring to the Gardner Denver Hoses, Tools & Accessories brochure.

## INSTALLATIONS AT ELEVATION

Corrections in vacuum producer performance are necessary at elevations above sea level.

If we take our previous example at 4,000 feet, the air volume was 320 SCFM/ 391 ICFM. On chart 2, we see the new barometric pressure at 4,000.

Air Volume correction:

$$\therefore 320 \text{ SCFM} \left( \frac{29.92}{25.85\text{-}5.48} \right) = 470 \text{ ICFM}$$

"Hg vacuum correction:

$$5.48 \text{ "Hg} \left( \frac{29.92}{25.85} \right) = 6.3 \text{ "Hg}$$

A new vacuum producer capable of exhausting 470 ICFM at 6.3 "Hg vacuum to meet the same requirements at 4,000 foot elevation is required. The horsepower is found to be 10.5 at standard conditions, however, a correction is necessary at 4,000 ft:

$$10.5 \text{ HP} \left( \frac{25.85}{29.92} \right) = 9.1 \text{ BHP}$$

Therefore, a 10 HP, 3,600 RPM motor is required. Note: new performance curve is not shown.

## CONCLUSION

This brief Design Guide does not cover all of the many design variables which might be encountered. It is meant to be used as a tool to give the purchaser an idea of the basic factors involved in system design.

### Chart 1

| Maximum recommended ICFM passing through each square foot of filter area | | |
|---|---|---|
| Material | Manual cleaning | Continuous cleaning |
| Carbon black, talc or other fine fugitive material | 1 | 1–2 |
| Usual dust and debris encountered in shops and industrial work or storage areas | 3 | 6–8 |
| Commercial installation & hospitals (light dust conditions) | 5 | 8–10 |
| Little or no dust, such as clean rooms | up to 8 | 12 |

This chart provides approximate guidelines for adequate air/filter ratio.

### Chart 2

| Average absolute atmospheric pressure | | |
|---|---|---|
| Altitude in feet above sea level | Inches of mercury ("Hg) | Lbs. per Sq. In. (absolute psig) |
| sea level 0 | 29.92 | 14.7 |
| +500 | 29.39 | 14.4 |
| +1,000 | 28.87 | 14.2 |
| +1,500 | 28.33 | 13.9 |
| +2,000 | 27.82 | 13.7 |
| +3,000 | 26.81 | 13.2 |
| +4,000 | 25.85 | 12.7 |
| +5,000 | 24.90 | 12.2 |
| +6,000 | 23.98 | 11.7 |
| +7,000 | 23.10 | 11.3 |
| +8,000 | 22.22 | 10.8 |
| +9,000 | 21.39 | 10.5 |
| +10,000 | 20.58 | 10.1 |

# Lamson Model 407

## PERFORMANCE CURVE

**Chart 3** Hose $ Tool Friction Loss

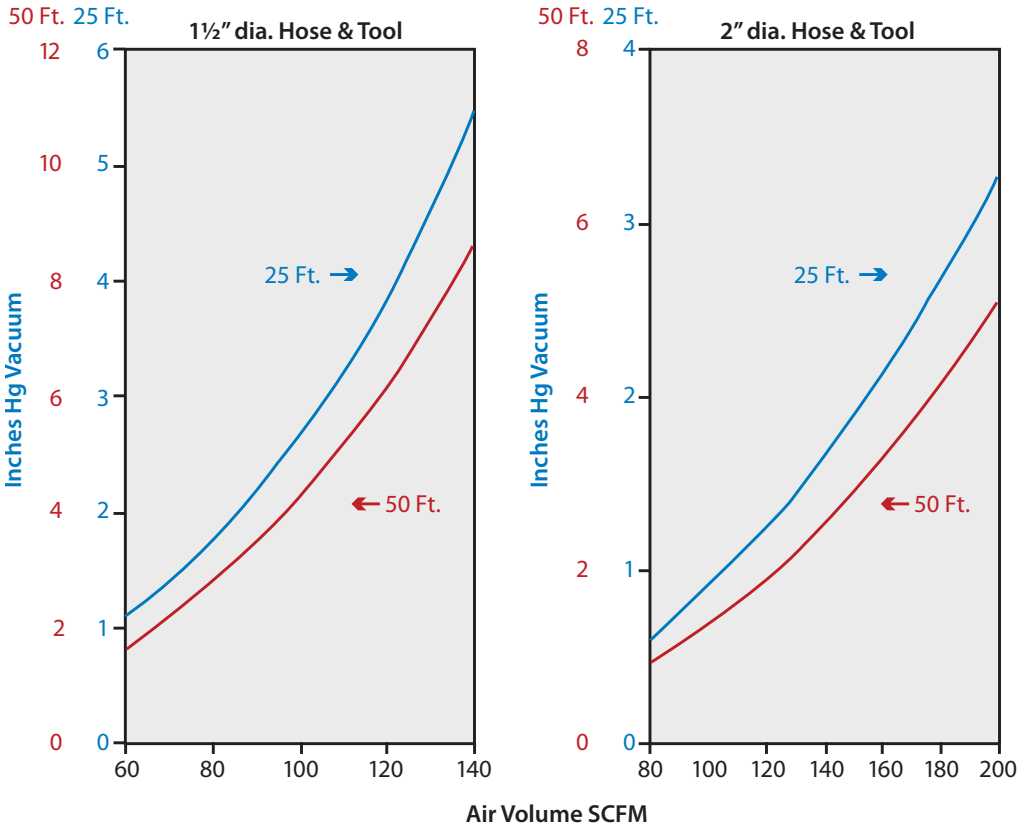
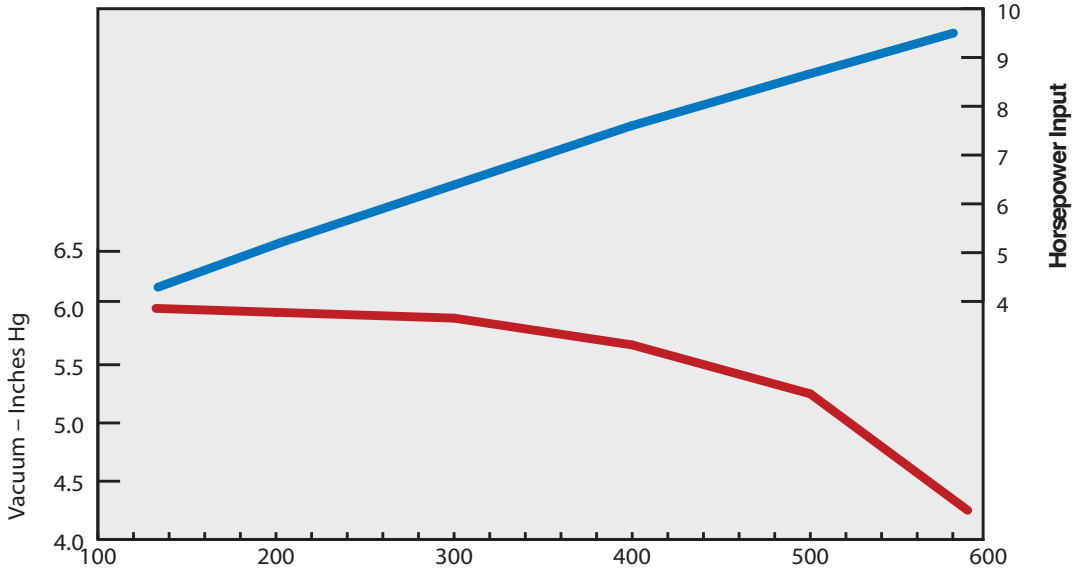
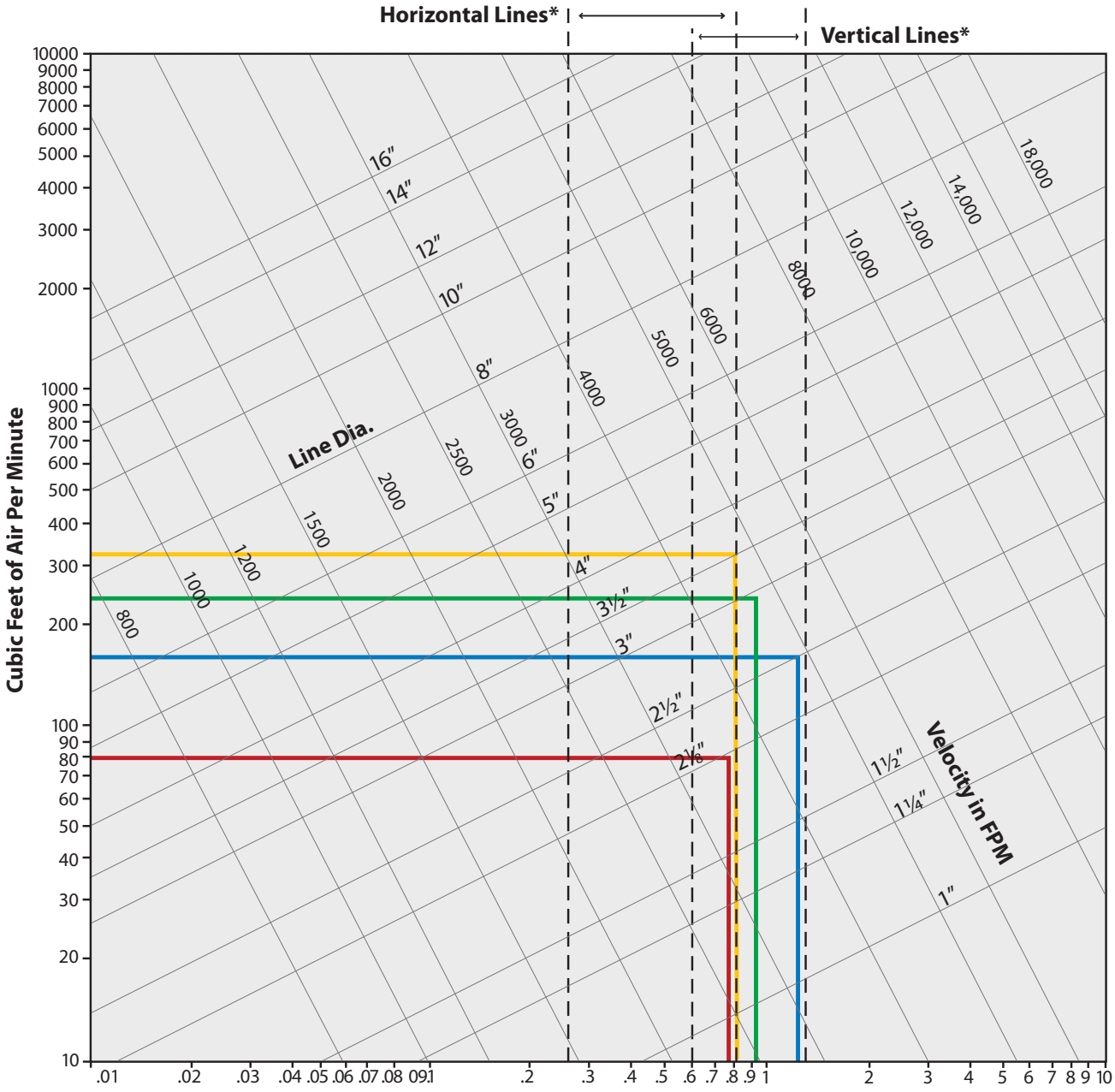



**Chart 4** Performance Curve Lamson Model 407
Atmosphere Conditions 29.92 inches Hg 68˚F



# Vacuum Line Loss Chart

**Chart 5** For Smooth Flow Tubing




Friction loss in "Hg per 100 ft. of line with Inlet Air @ 68˚F and 29.92" Hg.

Maintain Velocities within the parameters shown.
Note: 2⅛ O.D. tubing is commonly referred to in the industry as 2" tubing.


## Hoffman and Lamson Monitoring and Control Systems

Whether you're responsible for a wastewater treatment plant, the smelting operation at a foundry or the precise material handling needs of a manufacturing facility, Hoffman and Lamson offers control systems to properly operate your blowers and exhausters and protect them from conditions that may lead to catastrophic mechanical failure, costly downtime or voiding your manufacturer's warranty. At Hoffman and Lamson we engineer a variety of control systems and monitors capable of providing you with the protection and information you need to keep your operation running at peak efficiency.

Our control systems can monitor a variety of conditions that include motor current, motor temperature, blower vibration, bearing temperature, bearing oil level, discharge air temperature, inlet vacuum and outlet pressure.

## Genuine Hoffman and Lamson Factory Service and Parts

- Factory Trained Service Professionals
- On-site, On-Demand Service
- System Optimization
- Blower Remanufacturing
- Training, Troubleshooting and Consulting
- Warranty Renewal Programs
- Genuine GD Quality Replacement Parts
- Highest Quality Lubricants
  - — AEON® Centrifugal Lubricating Grease
  - — AEON CF-46 Centrifugal Blower Oil

## Accessories

- Engines
- Motors
- Turbines
- Variable Frequency Drives
- Butterfly Valves
- Check Valves
- Filters
- Silencers
- Expansion Joints
- Gauges
- SmartMeter
- Blower Control Panels

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