Since the early 1900’s Hoffman has been designing vacuum systems for virtually every commercial and industrial application. The name Hoffman has come to stand for efficient, dependable, high-quality equipment that satisfies requirements worldwide. Typical applications include: dust control, product reclaimation, pneumatic conveying, general housekeeping, food and pharmaceutical production, and electronics manufacturing.

CENTRAL VACUUM SYSTEMS

Our Central Vacuum Systems provide vacuum service throughout an installation. The system consists of a motor-driven centrifugal exhauster interconnected with one, two, or more separators. Smooth-Flow tubing extends the vacuum source to various locations for conveying all collected materials to one central location for convenient and efficient disposal.

The advantages of a Central System are many:

• Quiet operation, since the vacuum source can be located away from occupied areas.

• Easy operation with no moving of heavy equipment required, so personnel requirements can be kept to a minimum.

• Hygienic disposal of dust to a remote location eliminates the possibility of returning contaminants to the working environment.
PORTABLE VACUUM SYSTEMS
If a central system is larger than you need, a Hoffman Portable System will perform the task. Our portables are designed with the same durable industrial components as our central systems, so you can depend on them for continuous use and minimal maintenance. Portable units use standard NEMA design motors to power centrifugal exhausters. All units are four bearing designs, balanced for vibration free operation. Bearings are pre-packed and grease lubricated for years of trouble-free operation. Separators are designed with multiple tubular dust bags to provide generous filter area for efficient dust removal. Hoffman portables range in size from the easily wheeled Solo Vac™ and T-Vac units to larger semi-permanent models.

APPLICATION ASSISTANCE
The combination of Hoffman’s experienced sales Representatives and internal application engineers is unmatched in the industry. Contact Hoffman... you can be certain that all requirements will be met with clear solutions geared to your facility’s needs.

THIS BROCHURE
The following pages feature Hoffman’s vacuum equipment and accessories, types of systems, plus technical data for your information. The last seven pages are titled Hoffman’s Guide to Vacuum Cleaning System Design. This is an extremely helpful guide for sizing your vacuum system.

OUR COMPANY FACILITIES
Hoffman Air and Filtration Systems is a fully ISO 9001 Registered manufacturer dedicated to the highest standards of product quality and customer service. All Hoffman exhausters are assembled with precision, statically and dynamically balanced, and run tested prior to shipment.

Hoffman is an operating unit of the Invensys company. Sales and manufacturing facilities are located in Syracuse, NY and Toronto, Canada. Worldwide, Hoffman serves you through an extensive network of representatives.
The heart of a Hoffman Vacuum System, whether central or portable, is the centrifugal exhauster. Hoffman designs and manufactures quality features into each unit which assure superior performance. Here are a few:

1. The exhauster casing consists of a series of vertically split sections positioned between inlet and outlet heads (constructed of either cast iron heads and sections—Figure A, or cast aluminum heads and sheet metal sections—Figure B). These components are held securely by steel tie rods. The head positions are normally provided with a vertical orientation, but are available in other configurations.

2. Internal features: Centrifugal exhausters have virtually no wearing parts. The rotating assembly is constructed of either cast or fabricated aluminum impellers, keyed and positioned on a carbon steel shaft. Each impeller is statically balanced independently, and the entire rotating assembly is dynamically balanced to assure smooth, vibration-free operation.

3. Antifriction ball bearings support the rotating assembly at each end and are mounted “outboard” in bearing housings bolted to the heads. The bearings are isolated from the air stream by a seal package, assuring long bearing life and minimizing “down” time. The bearings are readily accessible without disassembly of the housing or piping system, and lubrication is accomplished through a simple oil or grease system.
The other component in an effective central vacuum system is the separator or collector. Material such as fine dust, granules, chips, or reclaimed product is removed from the air stream by means of one or more separators. As shown, Hoffman manufactures an extensive line of separators. Each model offers specific benefits and attributes and can be modified for a variety of applications. Hoffman’s engineers will specify a design to handle your requirements best.

**S-Type Separators** are available in both primary and secondary models. Secondary separators of the S-Type utilize a variety of cloth bag materials and are available with either manual or electric bag shakers which operate automatically at system shutdown.

**Hoffco-Pulse Separators** use reversed air flow 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.

**Hoffman Cartridge Collectors** are similar in operation to Hoffco-Pulse units in that they use reverse air-flow pulses to periodically clean cartridge elements. They differ in that they use one or more replaceable cartridges to provide separation. These models are best when dust loadings are low and filtration requirements high.

There are two basic classifications of separators:

**PRIMARY SEPARATORS** are used when large quantities of bulk solids are a part of the collection job. Primary separators are usually equipped with cone bottoms and often store solid particles for extended periods. Dust laden air and heavier particulates enter the separator tangentially at the top, opposite a circular baffle plate. Vortical action and velocity reduction precipitate the heavier materials to the bottom of the tank. Up to 95% of the material is retained, with the remainder carried to the secondary separator for capture. Hoffman primaries can be mounted on either legs or saddle supports, may be provided with dust buckets or cone bottoms, and are offered with a variety of accessories.

**SECONDARY SEPARATORS** are designed to capture any material passed along from the primary unit. Similar to the primary separator in construction, the secondary has an adequate number of doors for bag or cartridge inspection and replacement and leg or saddle support mounting options. Some systems utilize this secondary type only, thus eliminating the need for a primary. This is often the case with low dust concentrations and small particle sizes.
Hoffman’s portable vacuum units provide a complete vacuum system mounted on one common frame and include an exhauster, a motor and a secondary type separator. The separator on portable models offers a multiple snap-in bag arrangement, using bags specifically selected for the application. These portable units are equipped with an inspection door and a dust bucket for easy unloading. They can be supplied as stationary or “skid mounted” units for permanent installation as a small central system, or with wheels for complete mobility.

PORTABLE VACUUM SYSTEMS - TECHNICAL DATA

EXHAUSTER: Heavy-duty multistage centrifugal unit, rugged 4-bearing design, and direct drive by NEMA Standard 3600 RPM electric motor.

HORSEPOWER RANGES: 5 HP to 20 HP (handling up to 8 operators simultaneously).

SEPARATOR CONSTRUCTION: Heavy gauge carbon steel. Stainless steel and other alloys available on request.


DUST BUCKET CAPACITY: 1.5 cu.ft. to 3.0 cu.ft. (special sizes and configurations available).

OPTIONS: Electric Bag Shaker or Hoffco-Pulse Bag Cleaning System, in-line HEPA filter, cone bottom with adjustable legs.
To fully appreciate the benefits of a central or portable vacuum system, the user must have an effective array of hose and tools that are easy and practical to use. Hoffman has a full range for any application. All Hoffman hoses are static-proof, and the tools have been specifically designed to handle the toughest demands. Catalogs displaying the complete line of 1.5” and 2” hose and tools are available from a Hoffman representative.

**HOSE & TOOLS**

3. **DISCHARGE DRUM COVER**: Used with slide valve or hinge valve for uninterrupted collection of materials into 55 gallon drums.

4. **LEVEL INDICATORS**: indicates material levels in separator; for either dry or wet applications.

5. **EQUALIZING LINE**: Required to securely position plastic liners in separator dust buckets.

6. **MANUAL/AIR OPERATED DUMP DOORS**: These doors are for ease of emptying material from separators and can be used for product reclamation.

7. **WEARPLATES**: External/Internal abrasive resistant wearplates are available for both the primary and secondary separators.

8. **AUTOMATIC AIR BLEED SYSTEM**: Allows operation of vacuum cleaning systems during low use periods.

9. **DRUM TOP SEPARATORS**: For pickup and removal of materials (prior to the tubing system) using a standard 55 gallon drum.

10. **ABSOLUTE FILTERS**: All systems can be fitted with HEPA absolute filters (99.97% effective on 0.3 microns).

To assure system flexibility and optimum performance, Hoffman offers a complete line of options, such as:

1. **HINGED DISCHARGE VALVES**: 8” single or double flanged for controlling material discharge from separators. Whether manual or air operated, these valves are self-compensating for wear and are leakproof. (Slide valves and rotary discharge valves are also available.)

2. **DEBRIDGING DEVICE**: Dislodges packed or bridged material from cone bottom separators, allowing convenient dumping of separator.
The majority of central vacuum cleaning and in-plant pneumatic conveying systems effectively utilize lightweight smooth flow tubing and fittings in place of heavy cast iron piping and drainage fittings. Smooth flow provides an efficient and cost-effective piping system available in sizes from 2" to 12", and gauges 16 through 12. With the range of fittings available, system design and installation are easily accomplished. One added benefit: since free air flow decreases friction loss, the most efficient exhauster can be utilized.

Smooth flow materials of construction include plain carbon steel, zinc coated (galvanized) carbon steel, 304 Stainless Steel, and 6061 Aluminum.

Hoffman 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.
The term Vacuum Cleaning System not only refers to cleaning by means of vacuum hose and tools, but to a multitude of tasks which can be accomplished by the same basic system components: vacuum producer and separators.

A central vacuum cleaning system can therefore be installed in many types of plants and buildings to accomplish one or more of the following objectives:

1. **Good house cleaning tool**—a labor saving device.
2. **Material recovery.**
3. **Capture of dangerous and hazardous dust.**
4. **Vacuum conveying of material.**

In this guide, however, we have attempted to cover the vacuum cleaning system as a tool for good housekeeping only.

Such a system is generally designed to pick up and convey dry and free-flowing material that can enter and pass through the vacuum cleaning tool and hose. Further, the system is designed to allow for a selected number of operators.
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.

The above points should be discussed with your Hoffman representative who has the experience and know-how to design and furnish the system. He should be shown all the areas to be served by the system. It is most important that the main components—vacuum producer and separators—are located in an area providing easy disposal of collected material.

LAYOUT OF PIPING SYSTEM

In the vast majority of systems, there is no need for schedule 40 pipe and fittings, as light gauge steel tubing and fittings easily satisfy the requirements.

The layout must show the piping or tubing runs, location of the main equipment, and the inlet valves. The length of runs is to be clearly indicated and all 45° and 90° elbows are to be shown. No line sizing is to be done at this point.

INLET VALVE LOCATIONS

The inlet valves are located at the end of the branches coming off the main or sub-main piping. The inlet valve with a spring loaded cover is a device which allows the connection of a flexible vacuum hose to the piping system. The system should have as many inlet valves as required to facilitate cleaning every area. However, the design of the system dictates the maximum number of inlet valves that can be used simultaneously.

VACUUM CLEANING HOSE

The main factor in locating the inlet valves in this type of system is the length of the vacuum cleaning hose to be used. Hose is available in various designs and lengths of 15, 25, and 50 feet. However, for this type system, the best results are obtained with a basic length of 25 feet. Hoses longer than 50 feet are not recommended, as they are too heavy and cumbersome. As a general rule, a distance of 30 to 35 feet between two inlet valves for use with a 25 foot length of hose is considered ideal.

Step One

Step Two

Once the piping or tubing layout has been checked, the process of line sizing begins. The sizes depend 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 to the separators.

AIR VOLUME PER HOSE

The hose diameter, the particle size and the quantity of material to be conveyed determines the air volume. From actual tests, Hoffman has established that 80 SCFM in 1.5" diameter hose satisfies the needs of most vacuum cleaning systems. However, for light cleaning, such as an office with carpets or wooden floors, the air flow can be reduced to 70 SCFM. For heavier material, the air flow can be increased to suit the system requirements.

Step Three

SYSTEM LOSSES

In order to select the proper vacuum producer for the system, we must establish the total system loss (pressure drop or resistance) measured in inches of mercury ("Hg) vacuum. This total system loss consists of the sum of:
1. Loss through the hose and tools.
2. Loss through the lines (straight runs and bends).
3. Loss through the separator(s).

NOTES ON LOSSES

1. Chart 1 “Hose and Tool Friction Loss” indicates the total loss for a given hose length with tool.
2. The friction loss in the lines (tubing and piping) can be obtained from Chart 2 “Vacuum Line Loss Chart.”
3. The friction loss through 45° and 90° elbows are higher than the loss through the same diameter straight piping and tubing. Hoffman has established that the average friction loss through 45° and 90° elbows is equivalent to 7 ft. and 12 ft. of straight pipe respectively.

For charts see pages 14 and 15.
Designing a System

Requirements
Type of Plant: Fertilizer
Particle Size: Fine to 25" Granular
Total Material Picked Up: Approximately 18 ft³/8 hour day
Operation: General Cleaning
Areas: Maximum of four (4)

After surveying the plant, deciding on the location of the main equipment (vacuum producer and separators) and the inlet valves, we prepare the layout as shown in Figure (1).

Piping Layout Showing Inlet Valve, Locations & System Components

We have selected four inlet valve locations for design purposes, to establish the friction loss as well as line sizes for the system. Inlet Valve (A) is the farthest from the vacuum producer while inlet valve (C) is closest to the vacuum producer. Inlet Valves (B) and (D) can be located in areas or branches more-or-less in equal distance to the vacuum producer. This selection of active inlet valve location will allow us to design a system with proper line sizes to ensure optimum system capability. From actual plant size and observation of building and production facilities, we have decided that a 25 ft. length of 1.5" diameter hose and tool will satisfy the system requirements. Based on the particle size, amount, and density of material to be picked up, it is determined that 80 SCFM/hose would be adequate for our system.

Losses

Tool Entrance and Hose at Point (A)
From Chart 1 “Hose and Tool Friction Loss” when handling 80 SCFM/25 ft. of 1.5" diameter hose and tool we read a total friction loss...1.75" Hg.

Looking at Figure (2) at point (A), 80 SCFM enters the system and flows to point (E) The total equivalent piping length from point (A) to point (E) is:
- 2" line 107 ft. in length
- 5-90° elbows 60 ft. in equivalent length
- Total 167 ft. in equivalent length

From Chart 2 “Vacuum Line Loss Chart,” at 80 SCFM and a 2" diameter line we read:

\[ \text{.75" Hg loss/100 ft. line} \]
\[ \therefore \ 167 \times .75 = 125" \text{ Hg} \]
\[ \frac{125}{100} = 1.25" \text{ Hg} \]

At point (B) an additional 80 SCFM enters the system. This combines with the flow from point (A) (80 SCFM + 80 SCFM) for a total of 160 SCFM at point (E). The total equivalent piping from point (E) to (F) (there are no elbows) is 65 ft. From Chart 2 at 160 SCFM and a 2.5" diameter line we read:

Figure (1) 1.2" Hg loss/100 ft. line
\[ \therefore \ 65 \times 1.2 = .78" \text{ Hg} \]

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

For Chart 2 at 240 SCFM and a 3" diameter line we read: .90" Hg loss/100 ft. line

\[
20 \times .90 = .18" \text{ Hg}
\]

\[
\therefore 100
\]

At the point (G) an additional 80 SCFM enters the system. This combines with the flow from point (F) (80 SCFM + 240 SCFM) for a total of 320 SCFM at point (G). The total equivalent piping length from point (G) to the primary separator inlet is:

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

From Chart 2 we read 320 SCFM at a 3.5" diameter line:

.8" Hg loss/100 ft. line

\[
66 \times .8 = .52" \text{ Hg}
\]

Separator loss is added to our total system loss. The loss will not exceed .25" Hg for the primary and .75" for the secondary separator. \( \therefore \) Total separator losses = 1.00" Hg. In general, the line between the separators and the vacuum producer are generously sized and for all practical purposes, line losses are insignificant.

Therefore, the total friction loss for the system is:

(a) Hose & Tool loss \( 1.75" \text{ Hg} \)
(b) Line loss from (A) to (E) \( 1.25" \)
(c) Line loss from (E) to (F) \( .78" \)
(d) Line loss from (F) to (G) \( .18" \)
(e) Line loss from (G) to separators \( .52" \)
(f) Separators losses \( 1.00" \)

Total system loss \( 5.48" \text{ Hg} \)

The total system air volume is determined by:

- 80 SCFM/1.5" diameter hose
- \( \times 4 \) operators
- 320 SCFM

This figure of 320 SCFM (standard at 29.92" Hg & 68°F) is then multiplied by the ratio of the standard barometric pressure divided by the standard barometric pressure minus exhauster inlet vacuum in inches of Hg to obtain the volume under inlet vacuum conditions. We do this, since all Hoffman performance curves are based at ICFM (inlet cubic ft. per minute).

\[
320 \left( \frac{29.92}{29.92 - 5.48} \right) = 392 \text{ ICFM}
\]

We therefore require a vacuum producer capable of exhausting 392 ICFM of air at a vacuum of 5.48" Hg. Our model 4106B requiring a 10 HP-3600 RPM motor is selected (see Chart 3).

**RATIO OF AIR FLOW/FILTER AREA**

The particle size and volume of material picked up by the system, in addition to the frequency of bag cleaning (shaking them to dislodge the dust) will determine the ratio of air flow (ICFM) to ft² of filter area.
Chart 4 provides approximate guidelines for adequate air/filter ratio.

<table>
<thead>
<tr>
<th>Material</th>
<th>Manual Cleaning</th>
<th>Continuous Cleaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon black talc or other fine fugitive material</td>
<td>1</td>
<td>1 - 2</td>
</tr>
<tr>
<td>Usual dust and debris encountered in shops and similar industrial work or storage areas.</td>
<td>3</td>
<td>6 - 8</td>
</tr>
<tr>
<td>Commercial installation &amp; hospitals (light dust conditions)</td>
<td>5</td>
<td>8 - 10</td>
</tr>
<tr>
<td>Little or no dust as for white rooms</td>
<td>up to 8</td>
<td>12</td>
</tr>
</tbody>
</table>

*Maximum recommended ICFM passing through each square foot of Filter Area*

HOSE & TOOLS

Always start with a standard set of tools and add any extras required by your specific application, by referring to Hoffman Hose & Tool catalog.

PIPING/TUBING INSTALLATIONS

It is important that care be taken in connecting all piping/tubing joints to ensure an air tight installation, as air leakage will decrease system efficiency.

INSTALLATION AT ELEVATION

When a system is to be installed at an elevation above sea level, certain corrections to vacuum producer performance become necessary since exhauster performance curves are based on standard sea level conditions.

EXAMPLE—4000 FT. ELEVATION

Referring to our previous exhauster selection, it was based upon total air volume of 320 SCFM/392 ICFM. For the new barometric pressure of 25.85” Hg (4000 ft. elevation), see Chart 5.

Proceed as follows:

Air volume correction:

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

“Hg vacuum correction:

\[
5.48” \text{ Hg} \left( \frac{29.92}{25.85} \right) = 6.3” \text{ Hg}
\]

Therefore a vacuum producer is selected from the standard performance curve to exhaust 470 ICFM at suction of 6.3” Hg vacuum which will give us the required system air flow and vacuum when operating at 4000 ft. elevation. The horsepower required for this new selection is found to be 10.5 at standard conditions. The horsepower correction for 4000 ft. elevation is:

\[
\therefore 10.5 \left( \frac{25.85}{29.92} \right) = 9.1 \text{ BHP}
\]

thus a 10 HP, 3600 RPM electric motor is required.

Conclusion

It is obvious that this brief Guide to the Design of Vacuum Cleaning Systems does not necessarily cover all the many design factors and variables which can be encountered. However, it is felt that this Guide can serve the purchaser well, by informing him as to the basic factors involved in a System Design and how Vacuum Cleaning as a tool can effectively solve many problems.

Hoffman and its representative sales force are available to assist in every aspect of the system design from concept to installation.
Chart 1

Chart 3
Vacuum Line Loss Chart
(For Smooth Flow Tubing)

Horizontal Lines*  |  Vertical Lines*

Friction Loss in Inches of Hg per 100 ft. of Line
with Inlet Air @ 68°F and 29.92” Hg.

*Cubic Feet of Air Per Minute

*Maintain Velocities within the parameters shown
Note: 2 1/8” O.D. tubing is commonly referred to in the industry as 2” tubing
For additional information, contact your local representative or Gardner Denver Hoffman Products

- Central Vacuum Cleaning Systems
- Portable/Stationary T-Vac Systems

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