



Ventilation Systems for Noxious Fumes and Gases

ENGINEERING HANDBOOK FOR VEHICLE AND WELDING FUME REMOVAL

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VENTAIRE
11900 RIVERWOOD DRIVE
BURNSVILLE, MN 55337
PHONE: (952) 894-6637
FAX: (952) 894-0750
EMAIL: info@ventaire.com
www.ventaire.com



Since 1984, Ventaire has Designed and Manufactured Ventilation Systems and Components for Ventilating Noxious Fumes and Gases in Commercial and Industrial Applications. Ventaire has built a solid reputation from coast to coast for outstanding product quality and service to engineers, architects, contractors and owners.

VENTAIRE
ENGINEERING HANDBOOK FOR
VEHICLE AND WELDING FUME REMOVAL

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SECTION 1: INTRODUCTION

General:

Harmful exposures to vehicle exhaust and welding fumes mandates the need for ventilation systems in enclosed workspaces. Being in the presence of and working around toxic fumes over a long period of time allows harmful chemicals to enter the body faster than it can eliminate them. To control the fumes from vehicle exhaust and welding in the workplace, two methods of ventilation can be used: General ventilation and local ventilation.

In general ventilation, noxious fumes are diluted with large amounts of mixing air to reduce the overall fume concentration to safe levels. This method uses a large roof or wall mounted blower that induces mixing air into and out of the workspace. General ventilation is not always effective in removing noxious fumes and requires larger make-up air units to constantly heat or cool the induced air.

Local ventilation is the capturing of noxious fumes at the point of generation. Local ventilation systems are designed to capture and remove emissions prior to their escape into the workplace environment. Typically, an exhaust fan is used to ventilate the noxious fumes from the source and directs them out of the workspace. This method allows for a positive removal of the fumes and is more economical because it requires far less mixing air than general ventilation.

Vehicle:

In general, vehicle maintenance shops require a local (tailpipe or stack) exhaust system with flexible tubing for each service stall. (A general system must be used to remove the fumes generated as the vehicles are moved into and out of the workspace.) Tailpipe systems are normally sized for ten or less service stalls connected to one exhaust fan. This may require some shops to have more than one tailpipe system. Maintenance shops that have dynamometer test stalls should have a separate tailpipe system for each test stall. Section 8 contains the airflow requirements for various vehicles at different operating conditions. Service stalls for vehicle maintenance vary in size depending on the vehicles being repaired. They are generally 24 feet deep (diesel and military vehicle stalls are often deeper) and are usually the following widths: 14 feet for automobiles, 16 feet for light diesel trucks, and 18 feet for large diesel vehicles and farm implement. Small engines (motorcycle, lawn mower, snowmobile, etc.) and military stalls may vary greatly from these mentioned above. Consultation with vehicle manufacturers and service personnel is strongly recommended.

Welding:

Most local welding ventilation systems control contaminants by having a hood or enclosure that surround the source of the contaminants. The fumes can be directed out of the work place or an air cleaning device can be used. The size of the ducts and fan are determined from the volume and velocity of the airflow required to capture and transport the local welding fumes.

The intended use of this handbook is to assist in the design and specification of local ventilation for the removal of vehicle and welding exhaust fumes. The exhaust systems descriptions and specifications in this handbook can be used in industry. Slight modifications need be taken for: small engines, automobiles, farm implements, diesel vehicles, and military equipment. (**NOTE:** Many states, municipalities, and armed forces have published codes covering the design, construction, and operations of vehicle exhaust systems. Consulting with the above agencies should precede the designing of a system.)



TYPICAL PROJECTS WITH VENTAIRE COMPONENTS

1. New And Used Car/Truck Dealerships.
2. Automobile Service Garage/Repair Shops.
3. City, County, And State Maintenance Garages.
4. Military Maintenance Installations (Army, Navy, Air Force, Marines, Coast Guard, Reserves, etc.).
5. Middle & High Schools, VO-Tech, And Secondary Schools (For Both Industrial Arts And Maintenance Departments).
6. Metro And National Bus Garages.
7. Industrial Welding And Metal Working Shops.
8. Industrial Woodworking Shops.
9. Airport Maintenance Garages.
10. Prison Industrial Shops.

NON-TYPICAL PROJECTS WITH VENTAIRE COMPONENTS

1. Vacuum Hose Reel Used For Metro Bus Garage Cleaning Facility.
2. Air Conditioning Supply Hose Reel To Airplanes During Pre-Board.
3. Cold Air Supply Hose Reel For Beverage Truck During Loading.
4. Temporary Heating Supply Hose Reel For Shipping Container.
5. Explosion Proof Construction for Facilities Containing Volatile Gases such as CNG buses.

*We Can Typically Meet Specs Produced By All National And International Ventilation Companies.

**We Offer An Engineering Staff For All Jobs (Custom Or Not) That Are Capable Of Handling All Types Of Projects Including, But Not Limited To: Handling Extreme Temperature, Explosion-proof Applications, Unique Sizes And Applications.

Ventaire Vehicle Exhaust Questionnaire

1) Job Site Information

Facility Name: _____
Address: _____
City: _____
State: _____
Zip: _____

2) Vehicle Information

Types of vehicles (Check all that apply):

- | | | | |
|--------------------------------------|---|---|---|
| <input type="checkbox"/> Gasoline | <input type="checkbox"/> Motorcycles | <input type="checkbox"/> Semi-Trucks | <input type="checkbox"/> Emergency Vehicles |
| <input type="checkbox"/> Diesel | <input type="checkbox"/> Cars | <input type="checkbox"/> Construction Equipment | |
| <input type="checkbox"/> Propane | <input type="checkbox"/> Pick-Up Trucks | <input type="checkbox"/> Military Equipment | |
| <input type="checkbox"/> Natural Gas | <input type="checkbox"/> Vans | <input type="checkbox"/> Bus | |
- Other: _____

Servicing Conditions:

- | | |
|-------------------------------------|--|
| <input type="checkbox"/> Idle | <input type="checkbox"/> Engine Dynamometer |
| <input type="checkbox"/> High- Idle | <input type="checkbox"/> Chassis Dynamometer |

Location of Exhaust Pipe:

- | | |
|---|--|
| <input type="checkbox"/> Single Undercarriage | <input type="checkbox"/> Single Vertical Stack |
| <input type="checkbox"/> Dual Undercarriage | <input type="checkbox"/> Dual Vertical Stack |
- Other: _____

Largest Engine Serviced:

Engine Manufacturer: _____
Engine Model: _____
Engine Horsepower: _____
Engine Displacement: _____
Max RPM of Engine: _____
Max Exhaust Temp: _____
Air Flow at Max RPM: _____

Are the engines turbocharged? No Yes

3) Building Considerations

- Existing New

Building Construction

- Metal
- Block
- Wood
- Other

Ceiling Height

Electric Requirements

Number of service bays

Overhead Crane No

Yes

4) System Suggestions

Type of system Overhead

Underfloor

Fan location Indoor
 Ceiling

Outdoor
 Wall

Roof

Other Considerations:

SECTION 2: UNDERGROUND VEHICLE EXHAUST SYSTEMS

2.1: Description of Systems

Underground vehicle exhaust systems utilize ductwork that is hidden beneath the floor to remove the exhaust fumes. Floor fixtures are used as transitional pieces between the floor surface and the underground duct. When ducting constructed of PVC, ABS, Fiberglass, etc. is used, a floor fixture with a 45° saddle adapter is used. A hole is cut in the duct and the saddle adapter is clamped, riveted, screwed, or welded over it. The underground ductwork is connected to an exhaust fan that pulls the exhaust fumes out of the workspace and blows them outside through a vent or stack.

Two variations of the underground exhaust system are disappearing and non-disappearing. In the underground disappearing system, the design is such that the flexible tubing assembly is stored within the floor fixture and underground duct when not in use. The flexible tubing assembly has a hose guide at the far end to aid in guiding the tubing in and out of the ductwork. In the non-disappearing system, a 90° elbow is attached to the end of the flexible tubing. The elbow plugs into a receptacle in the floor fixture when in use. When not in use, the flexible tubing set is stored on or near the shop wall or support column.

2.2: Application Guidelines

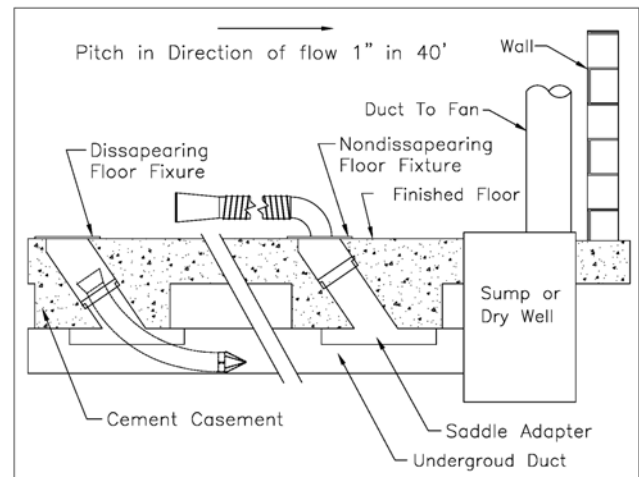
Underground exhaust systems are most often specified in new buildings because they are installed prior to the concrete floor being poured. For existing buildings that are being remodeled or installing a new exhaust system, underground systems are not usually recommended due to the expense of tearing up and resetting of the floor. While underground systems are generally more expensive to install than overhead systems, they are easier to use and are more aesthetically pleasing. There are few operating problems with these systems, provided that care is taken on the handling of the flexible tubing sets (including the removal for the disappearing and the storage for the non-disappearing). Care must also be taken when designing an underground exhaust system in order to make sure that all floor fixtures are properly placed relative to both the service bays and underground duct layout. Therefore, automobiles are not parked over the fixtures, and there is enough duct space to accommodate all of the flexible tubing set for the disappearing systems.

2.3: Underground Disappearing Systems

A: General

The contractor shall supply all of the installation for the complete underground disappearing system. This system includes, but is not be limited to, underground duct work, floor fixtures, flexible tubing sets, above ground duct, fan, sump pump or drywell, and an exhaust stack or vent. All materials and labor required for the complete installation of the system are included in the bid. The underground duct shall be installed at the locations and depths as indicated. The entire underground duct layout shall be installed approximately graded for a minimum 1 inch drop per 40 foot run in the direction of the airflow. A sump or dry well shall be constructed at the lowest point in the underground duct. The underground duct shall be properly bedded with granular materials to prevent settlement and deflection in accordance with national codes regarding underground utilities. The underground duct shall be constructed of PVC, ABS or fiberglass. The floor fixtures shall be connected to the underground duct by cutting into the duct and attaching a saddle adapter over the hole (See Figure 2.1 below).

Figure 2.1 Underground Disappearing Systems



The cut into the duct shall be slightly larger than the hole through the saddle adapter, but less than the outer perimeter of the saddle or tile adapter. The saddle adapter shall be securely mounted to the underground duct by means of clamps, rivets, drive screws, or welds. The contractor shall take all necessary steps to prevent any debris from entering the underground duct.

The floor fixtures shall be fastened to the saddle or tile adapter with the door frame leveled and supported at the desired height using height adjustment screws and staked if necessary. The floor fixtures position will be such that floor drainage will be taken away from the floor fixtures. During the pouring of the concrete slab, care will be taken to prevent damage to the floor fixture, door frame, and underground pipe. The concrete shall be poured such that no voids are left and a seal is formed around and under the floor fixture and door frame.

The underground duct shall be connected to the exhaust fan by means of an above ground rigid duct. A flexible connection shall be attached between the rigid duct and the exhaust fan to minimize noise and vibration. All elbows, fittings, and transitions shall be made according to SMACNA standards. The rigid ducts will be properly mounted and supported as needed.

B: Sample Underfloor Disappearing Systems

Sample 1: Single Underfloor Disappearing System

Item	Qty	Model	Description
1	1	STD	Single Galvanized Floor Fixture
2	1	N2	No Crush Hose - 4" dia x 10'
3	2	HC40	Stainless Steel Hose Clamp
4	1	TS40	S.S. Tailpipe Adapter, w/ clip
5	1	HGS40	Stainless Steel Hose Guide
6	1	RR10	Ram Rod - 10'
7	1		Factory Assembly Charge

Sample 2: Dual Underfloor Disappearing System

Item	Qty	Model	Description
1	1	DTD	Dual Galvanized Floor Fixture
2	1	TSD	Dual Throat Seal
3	2	N2	No Crush Flex - 3" dia x 10'
4	4	HC30	Stainless Steel Hose Clamp
5	2	TS30	S.S. Tailpipe Adapter, w/ clip
6	2	HGS30	Stainless Steel Hose Guide
7	2	RR10	Ram Rod - 10'
8	2		Factory Assembly Charge

C: Standard Single Floor Fixtures (Disappearing)

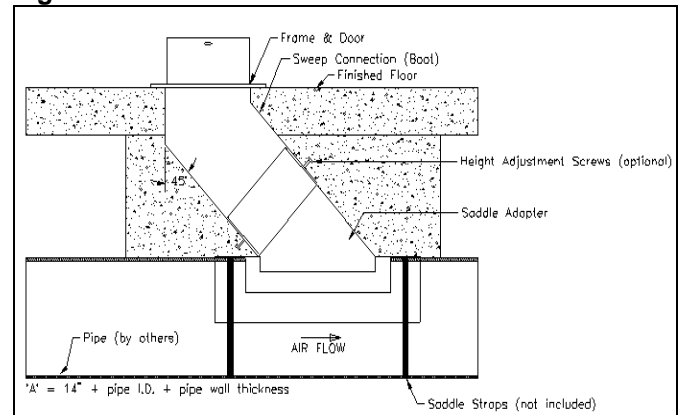
SPECIFICATIONS

- The floor fixture shall be Ventaire model STD (See Figure 2.2).
- Boot & saddle adapter shall be constructed of 20 gauge galvanized steel.
- Door and frame shall be 1/4" galvanized steel with angle iron support.
- Door hinge shall be of continuous type constructed of 304 stainless steel. Hinge shall be attached to frame and door with 304 stainless steel rivets.

FLOOR FIXTURE OPTIONS

- Boot and saddle adapter may be constructed of 20 gauge 304 stainless steel.
- Door and frame may be cast aluminum or stainless steel.
- Ventaire model TSS throat seal may be provided to minimize air leakage between hose and floor fixture inlet.

Figure 2.2 Floor Fixtures



D: Standard Flexible Tubing Assembly for Single Floor Fixtures (Disappearing)

The flexible tubing sets are manufactured by Ventaire. The flexible tubing assembly shall consist of a length of flexible tubing, a tailpipe adapter, a hose guide & a ram rod to aid in guiding the tubing set into its storage position. These components shall be assembled by the manufacturer. Field assembly is not acceptable.

NOTE: The selection of tubing material, diameter and length will depend upon the specific application. Consult Section 8 on flexible tubing for more information. The following specifications are for our most common configuration.

SPECIFICATIONS

- The flexible tubing shall be model N2 no crush flexible tubing. Tubing shall be supplied in standard 10' lengths.
- Vентаire model HGS hose guide shall be constructed of (3) 1/8" diameter 304 stainless steel rods welded to a 304 stainless steel sleeve.
- Vентаire model RR10 ram rod shall be constructed of spring steel and concealed inside the tubing assembly.
- The tailpipe adapter, Vентаire model TS, shall be constructed of 20 gauge 304 stainless steel. The TS model has a gas analyzer slot and a spring clip to attach to tailpipe of vehicle.
- All components of the flexible tubing assembly shall be made by a stainless steel hose clamp that is riveted to establish a permanent connection.

TUBING ASSEMBLY OPTIONS

- Several different hose types can be used for under-floor systems. Consult table 9.2 for recommendations*.
- The hose guide sleeve may be constructed of galvanized steel or cadmium plated steel.
- Optional exhaust adapters include Vентаire model TG, LTS, DSR, or F series. See section 7 for additional info.
- A "J" slot type quick disconnect fitting may be furnished to provide easy connection of other accessories as outlined in Section 7. The male fitting, model MG or MS, is attached to exhaust adapter and the female fitting, FG or FS, to the flexible tubing inlet.

**All permanent connections to metal flexible tubing are made with rivets, drive screws, or welds.*

E: Exhaust Fan

See Section 8 (8.1 through 8.3) for Exhaust Fan specifications.

2.4: Specifications for Underground Non-disappearing Systems.

A: General

The contractor shall supply all of the installation for the complete underground nondisappearing system. The system includes, but is not be limited to, the underground duct, floor fixtures with non-disappearing plate, flexible tubing assemblies, above ground duct,

fan, and exhaust stack or vent. All materials and labor required for the complete installation of the system are included in the bid.

The underground duct shall be installed at the locations and depths as indicated. The entire underground duct layout shall be installed approximately graded for a minimum 1 inch drop per 40 foot run in the direction of the airflow. A sump or dry well shall be constructed at the lowest point in the underground duct. The underground duct shall be properly bedded with granular materials to prevent settlement and deflection in accordance with national codes regarding underground utilities. The underground duct shall be constructed of PVC, ABS or fiberglass. The floor fixtures shall be connected to the underground duct by cutting into the duct and attaching a saddle adapter over the hole. The cut into the duct shall be slightly larger than the hole through the saddle adapter, but less than the outer perimeter of the saddle or tile adapter. The saddle adapter shall be securely mounted to the underground duct by means of clamps, rivets, drive screws, or welds. The contractor shall take all necessary steps to prevent any debris from entering the underground duct.

The floor fixtures shall be fastened to the saddle adapter with the door frame leveled and supported at the desired height using height adjustment screws and staked if necessary. The floor fixtures position will be such that floor drainage will be taken away from the floor fixtures. During the pouring of the concrete slab, care will be taken to prevent damage to the floor fixture, door frame, and underground pipe. The concrete shall be poured such that no voids are left and a seal is formed around and under the floor fixture and door frame.

The underground duct shall be connected to the exhaust fan by means of an above ground rigid duct. A flexible connection shall be attached between the rigid duct and the exhaust fan to minimize noise and vibration. All elbows, fittings, and transitions shall be made according to SMACNA standards. The rigid ducts will be properly mounted and supported as needed.

B: Sample Underfloor Non Disappearing Systems

Sample 3: Single Underfloor Non-Disappearing System

Item	Qty	Model	Description
1	1	STN	Single Galvanized Floor Fixture
2	1	SNP40	Single Nondisappearing Plate
3	1	N2	No Crush Hose - 4" dia x 10'
4	2	HC40	Stainless Steel Hose Clamp
5	1	TS40	S.S. Tailpipe Adapter, w/ clip
6	1	NES40	S.S. Non-Disappearing Elbow
7	1		Factory Assembly Charge

C: Standard Single Floor Fixtures (Non disappearing)

SPECIFICATIONS

- The floor fixture shall be Ventaire model STN.
- Boot & saddle adapter shall be constructed of 20 gauge galvanized steel.
- Door and frame shall be ¼" galvanized steel with angle iron support.
- Door hinge shall be of continuous type constructed of 304 stainless steel. Hinge shall be attached to frame and door with 304 stainless steel rivets.
- The floor fixture shall be furnished with a galvanized steel nondisappearing plate with elbow receptacle.

FLOOR FIXTURE OPTIONS

- Boot and saddle adapter may be constructed of 20 gauge 304 stainless steel.
- Door and frame may be cast aluminum or 304 stainless steel.

D: Underfloor Flexible Tubing Assemblies (Non-disappearing)

The flexible tubing sets shall be manufactured by Ventaire. The flexible tubing assembly shall consist of a length of flexible tubing, a tailpipe adapter and a non-disappearing elbow. These components shall be assembled by the manufacturer. Field assembly is not acceptable.

NOTE: The selection of tubing material, diameter and length will depend upon the specific application. Consult Section 8 on flexible tubing for more information. The following specifications are for our most common configuration.

SPECIFICATIONS

- The flexible tubing shall be model N2 no crush flexible tubing. Tubing shall be supplied in standard 10' lengths.
- The exhaust adapter, Ventaire model TS, shall be constructed of 20 gauge 304 stainless steel. The TS model has a gas analyzer slot and a spring clip.
- A non-disappearing elbow model NES shall be permanently attached to the one end of the hose. The non-disappearing elbow shall be constructed of a 90 degree smooth bore, 20 gauge stainless-steel elbow.
- All components of the flexible tubing assembly shall be made by a stainless steel hose clamp that is riveted to establish a permanent connection.

TUBING ASSEMBLY OPTIONS

- Several different hose types can be used for under-floor systems. Consult table 9.2 for recommendations*.
- A galvanized non-disappearing elbow, model NEG, may be supplied in place of NES.
- Optional exhaust adapters include Ventaire model TG, LTS, DSR, or F series. See section 7 for additional info.
- A "J" slot type quick disconnect fitting may be furnished to provide easy connection of other accessories as outlined in Section 7. The male fitting, model MG or MS, is attached to exhaust adapter and the female fitting, FG or FS, to the flexible tubing inlet.

**All permanent connections to metal flexible tubing are made with rivets, drive screws, or welds.*

E: Exhaust Fan

See Section 8 (8.1 through 8.3) for Exhaust Fan specifications.

SECTION 3: OVERHEAD EXHAUST SYSTEMS

3.1: Description of Systems

There are two basic types of Overhead Exhaust Systems: disappearing and non-disappearing. The overhead disappearing stores the flexible tubing assembly in the rigid overhead duct when not in use. A cable set is then used to extend or retract the flexible tubing set into or out of the rigid duct. The rigid duct is connected to an exhaust fan that draws the fumes out of the workspace.

NOTE: Care must be taken when designing disappearing systems to allow for all of the flexible tubing to be stored in the overhead rigid duct.

The overhead non-disappearing system has a number of different styles. In hanging or simple drops, flexible tubing sets are attached to the overhead rigid duct and allowed to hang down into the service stall. Rope or cable sets may be used to raise the flexible tubing to a safe height for the passage of vehicles, mechanics and/or equipment. These sets may be controlled by a wall cleat system, a winch, an automatic cable reel, or by a balancer (See Figure 3.1).

Another overhead non-disappearing variation utilizes a hose reel to store the tubing completely out of the work space. Hose reels are available in two types: automatic - with a spring rewind package (See Figure 3.2) and motorized - with an electric motor (See Figure 3.3).

A third type of overhead non-disappearing system is the wall box system. The wall box is mounted near the shop floor, on a wall or pillar, and connected to the rigid duct. When in use, the flexible tubing set is attached to the wall box by means of a 'J' slot quick connect fitting. When not in use, the flexible tubing set is stored on or near a wall, and the blast gate on the wall box is shut to conserve energy. More information will be given in section 3.5 part B:3.

For small service shops, there is the economical two bay unit. The two bay system is supplied with a fan stand, a small exhaust fan with an inlet box that accommodates two flexible tubing assemblies. The only ducting required is from the exhaust outlet of the blower to the outside of the building.

The door port system is a unique system due to the omission of an exhaust fan. Instead the system relies on the exhaust pressure to push the exhaust fumes out of the building. The system consists of a flexible

hose connected to a thrust nozzle that fits through a port opening in the garage door or side wall.

NOTE: The door port system is NOT recommended for facilities with more than three service bays or diesel service bays.

3.2: Application Guidelines

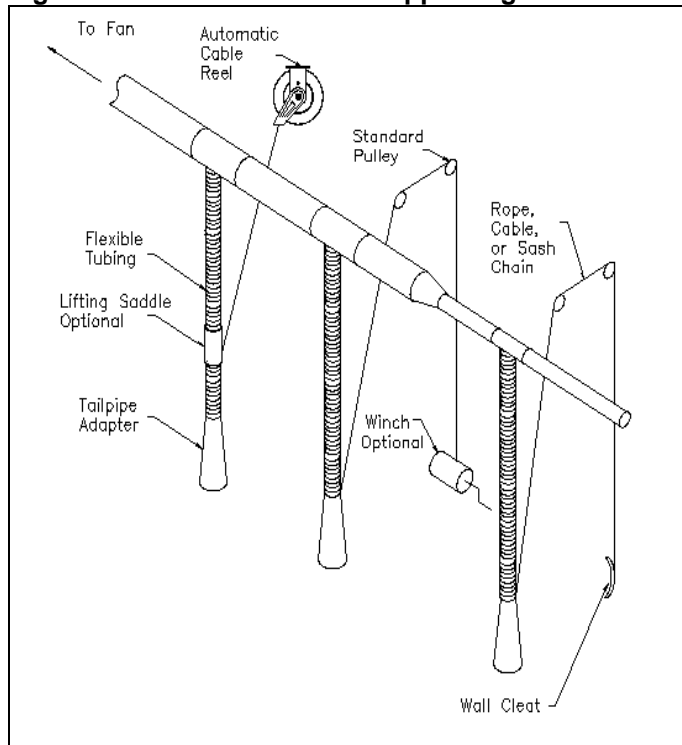
With the numerous types of overhead systems available, they are usually the first choice when designing an exhaust system, especially for existing facilities or additions to an existing system. In new buildings, underground exhaust systems are recommended because they are easy to use and are hidden under the floor to minimize obstructions in the work space. Hanging drop systems are the least expense and most flexible. For facilities that require the exhaust tubing to be completely concealed when not in use, the hose reel system is recommended. If overhead cranes or limited space is available, hose reel or wall box systems are recommended. Smaller facilities can use the two bay or door port systems.

3.3: Overhead Non-disappearing Systems—Hanging Drop System

A: General

The contractor shall supply all of the installation for the complete hanging drop system. This system shall include, but is not limited to, overhead duct and fittings, flexible tubing set, pull up system, exhaust fan and exhaust stack or vent (See Figure 3.1). All materials and labor required for the complete installation of the system shall be included in the bid. The overhead duct shall be installed at the locations as indicated on floor plan. The rigid duct shall be mounted and supported in an approved manner such that it will fully bear the loads placed upon it by the weight of the flexible tubing set. All elbows, fittings, and transitions shall be made according to SMACNA standards. The rigid duct shall be connected to the exhaust fan by means of a flexible connector to minimize noise and vibration. The flexible tubing set shall be attached to the rigid duct using a hose clamp.

Figure 3.1 Overhead Non-Disappearing



B. Sample Hanging Drop System

Sample 4: Overhead Non-Disappearing System

Item	Qty	Model	Description
1	1	SG	Flexible Tubing-6" dia x 25'
2	2	BC60	Stainless Bridge Hose Clamp
3	1	TS60	Tailpipe Adapter, w/ clip
4	1	LSN60	Lifting Saddle
5	1	Assem	Factory Assembly Charge
6	1	MKR	50' Rope & Pulley Set

C: Hanging Drop Flexible Tubing Set

SPECIFICATIONS

- The flexible tubing shall be Ventaire model SG constructed of high temperature silicone coated fiberglass rated to a minimum of 600F (NOTE: The selection of tubing material will depend upon the specific application. Consult table 9.2 on for more information).
- All components of the flexible tubing assembly shall be made by a stainless steel hose clamp model BC or HC that is riveted to establish a permanent connection.
- The exhaust adapter, Ventaire model TS, shall be constructed of 20 gauge 304 stainless steel. The TS model shall be

provided with a gas analyzer slot and a spring clip.

- A model LSN, neoprene rubber lifting saddle, supplied with a lifting ring shall be supplied to attach cable or rope. Saddle shall be constructed of 1/8" thick neoprene rubber and stainless steel gear clamps.

FLEXIBLE TUBING OPTIONS

- Several different hose types can be used for overhead systems. Consult table 9.2 on for more information*.
- A variety of different exhaust pipe adapters and accessories are available to suit almost any need. Consult Section 7 for additional info.

**All permanent connections to metal flexible tubing are made with rivets, drive screws, or welds.*

D: Pull Up Kit

A pull up kit is used to facilitate the movement of the flexible tubing.

SPECIFICATIONS

- The rope & pulley kit shall be Ventaire model MKR. The kit shall consist of rope, a wall cleat, cable clamps, a thimble, S-Hook, ceiling pulley and wall pulley. The nylon braided rope shall be 1/4" diameter and 50' in length.
- The rope shall be constructed of 1/4" diameter braided nylon and be 50' in length.
- The wall cleat, cable clamps, thimble, S-Hook & pulleys shall be constructed of zinc coated steel.

PULL UP KIT OPTIONS

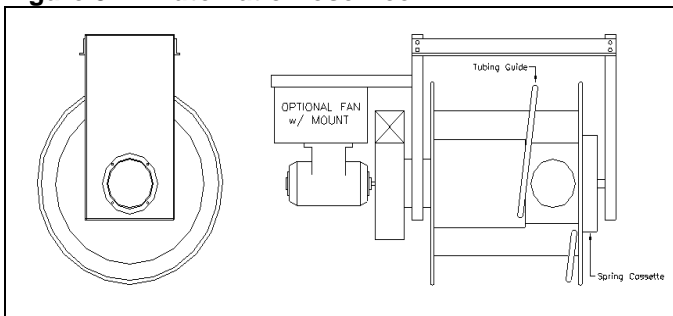
- Cable may be substituted for rope. The MKR will be converted to MKC. The cable is constructed of 1/8" 7x19 strand galvanized steel and 50' in length.
- Ventaire model 5414 single acting winch may be substituted for the wall cleat. The winch shall be constructed of galvanized steel. The winch shall have a 4:1 gear ratio.

3.4: Overhead Non-Disappearing System - Hose Reel System

A: General

The contractor shall supply the installation for the complete hose reel system. This system shall include, but is not limited to, overhead duct and fittings, flexible tubing set, hose reel, exhaust fan and exhaust stack or vent (See Figures 3.2-3.4). All materials and labor required for the complete installation of the system shall be included in the bid. The overhead duct shall be installed at the locations as indicated on floor plan. The rigid duct shall be mounted and supported in an approved manner such that it meets all local and federal guide lines. All elbows, fittings, and transitions shall be made according to SMACNA standards. The rigid duct shall be connected to the exhaust fan by means of a flexible connector to minimize noise and vibration. The flexible tubing set shall be attached to the rigid duct using a hose clamp.

Figure 3.2 Automatic Hose Reel



B. Sample Automatic Hose Reel System

Sample 5: Automatic Hose Reel System, w/ Fan

Item	Qty	Model	Description
1	1	HRA60	Automatic Hose Reel
2	1	HSG	Flexible Tubing-6" dia x 25'
3	2	BC60	Bridge Clamp
4	1	TS60	Tailpipe Adapter, w/ clip
5	1	PRKR	Pull Rope Kit
6	1	Assem	Factory Assembly Charge

C. Automatic Hose Reels:

Ventaire's Automatic Hose Reels are engineered to provide years of simple, dependable performance.

This spring-operated reel includes a ratcheting mechanism, which is used to hold the flexible tubing at the worker's desired height. Because of the spring and ratchet mechanism, no outside power source is required to raise and lower the exhaust hose. Standard reels are designed to handle up to 25 feet of 3" to 8" diameter hose, and can be mounted in a variety of different positions (other diameters and lengths available upon request).

SPECIFICATIONS

- The hose reel shall be Ventaire model HRA spring operated type with flexible tubing set.
- The hose reel shall be supplied with a hose guide will keep the hose uniform over the drum as it retracts.
- The reel shall be constructed of a 14 gauge galvanized steel drum, 16 gauge galvanized steel reinforced side plates, and an 11 gauge galvanized steel frame.
- The locking mechanism shall be constructed of light weight cast aluminum.

HOSE REEL OPTIONS

- The reel frame and drum sides may powder coated.
- Reels capable of handling longer lengths and larger diameters of hose are available (consult Ventaire for maximum capacities).

D: Automatic Hose Reel Flexible Tubing Set

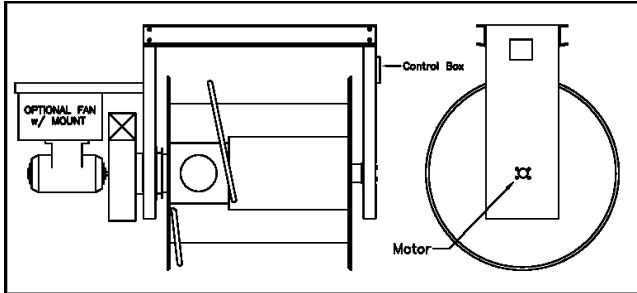
SPECIFICATIONS

- The flexible tubing set shall consist of a length of flexible tubing, hose clamps, hose stop, and exhaust adapter.
- The flexible tubing shall be Ventaire model HSG constructed of high temperature silicone coated fiberglass rated to a minimum of 600F (NOTE: The selection of tubing material will depend upon the specific application. Consult table 9.2 on for more information).
- All components of the flexible tubing assembly shall be made by a stainless steel hose clamp model BC or HC that is riveted to establish a permanent connection.
- The exhaust adapter, Ventaire model TS, shall be constructed of 20 gauge 304 stainless steel and shall be provided with a gas analyzer slot and a spring clip.
- The hose stop shall be constructed of 2.5" dia. rubber material and attached using a stainless steel clamp.

FLEXIBLE TUBING OPTIONS

- Several different hose types can be used for overhead systems. Consult table 9.2 on for more information*.
- A variety of different exhaust pipe adapters and accessories are available to suit almost any need. Consult Section 7 for additional info.

Figure 3.3 Motorized Hose Reel



D. Sample Motorized Hose Reel System

Sample 6: Motorized Hose Reel System

Item	Qty	Model	Description
1	1	TMHR60	Motorized Hose Reel
2	1	HSG	Flexible Tubing-6" dia x 25'
3	2	BC60	Bridge Clamp
4	1	TS60	Tailpipe Adapter, w/ clip
5	1	Assem	Factory Assembly Charge

E. Motorized Hose Reel:

Ventaire motorized hose reels feature a direct-drive motor to raise and lower the flexible exhaust tubing. These hose reels are ideal for applications where full automation is desired, or a particularly long length of exhaust hose is required. Each reel is supplied with a wall-mounted control station. Standard reels are designed to handle up to 25 feet of 3" to 8" diameter hose, and can be mounted in a variety of different positions (other diameters and lengths available upon request).

SPECIFICATIONS

- The hose reel shall be Ventaire model TMHR motorized type with flexible tubing set.
- The reel shall be constructed of a 14 gauge galvanized steel drum, 16 gauge galvanized steel reinforced side plates, and an 11 gauge galvanized steel frame.
- The hose reel shall be supplied with a hose guide will keep the hose uniform over the drum as it retracts.
- A 1/2 horse, 115/1/60 electric motor is used to rotate the drum assembly.

- The motor will be directly mounted to the drum; gear or chain drives are not acceptable.
- The assembly shall have a built in brake and adjustable push button limit switches.
- A wall mounted push button station with 2 momentary switches shall used furnished to activate the electric motor.
- The hose reel will be factory wired except for the incoming voltage lines.

MOTORIZED HOSE REEL OPTIONS

- The reel frame and drum sides may be powder coated.
- Reels capable of handling longer lengths and larger diameters of hose are available (consult Ventaire for maximum capacities).
- Four button wall control station for UP/DOWN/FAN ON/FAN OFF.
- Two or four button hanging pendent.
- Two button Infrared remote control.
- Explosion proof motorized reel. (These reels are similar to the motorized hose reels, except that they also meet class one, division one explosion-proof standards. These reels are very popular for Bus-maintenance and Military base applications)

F: Motorized Hose Reel Flexible Tubing Set

SPECIFICATIONS

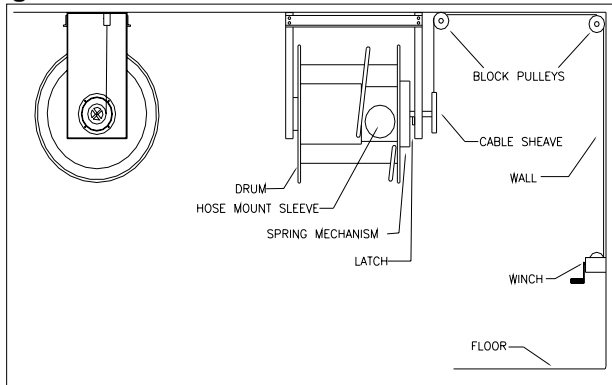
- The flexible tubing set shall consist of a length of flexible tubing, hose clamps, hose stop, and exhaust adapter.
- The flexible tubing shall be Ventaire model HSG constructed of high temperature silicone coated fiberglass rated to a minimum of 600F (NOTE: The selection of tubing material will depend upon the specific application. Consult table 9.2 on for more information).
- All components of the flexible tubing assembly shall be made by a stainless steel hose clamp model BC or HC that is riveted to establish a permanent connection.
- The exhaust adapter, Ventaire model TS, shall be constructed of 20 gauge 304 stainless steel and shall be provided with a gas analyzer slot and a spring clip.

FLEXIBLE TUBING OPTIONS

- Several different hose types can be used for overhead systems. Consult table 9.2 on for more information*.
- A variety of different exhaust pipe adapters and accessories are available to suit almost

any need. Consult Section 7 for additional info.

Figure 3.4 Cable/Winch Hose Reel



G. Sample Cable/Winch Hose Reel System

Sample 7: Cable/Winch Hose Reel System

Item	Qty	Model	Description
1	1	HR60	Cable/Winch Hose Reel
2	1	HSG	Flexible Tubing-6" dia x 25'
3	2	BC60	Bridge Clamp
4	1	TS60	Tailpipe Adapter, w/ clip
5	1	Assem	Factory Assembly Charge

H. Winch Operated Reel:

Ventaire winch operated reels feature a cable & winch system to raise and lower the flexible exhaust tubing. Standard reels are designed to handle up to 25 feet of 3" to 8" diameter hose, and can be mounted in a variety of different positions (other diameters and lengths available upon request).

SPECIFICATIONS

- The hose reel shall be Ventaire model HR winch type with flexible tubing set. The reel shall be furnished with a winch & cable set.
- The hose reel shall be supplied with a hose guide will keep the hose uniform over the drum as it retracts.
- The reel shall be constructed of a 14 gauge galvanized steel drum, 16 gauge galvanized steel reinforced side plates, and an 11 gauge galvanized steel frame.
- The winch shall be dual acting and be supplied with a sprint loaded latch and wall mounting bracket. The winch and wall bracket shall be constructed of galvanized or painted steel.

WINCH OPERATE HOSE REEL OPTIONS

- The reel frame and drum sides may be powder coated.
- Reels capable of handling longer lengths and larger diameters of hose are available (consult Ventaire for maximum capacities).

I: Cable/Winch Reel Flexible Tubing Set

SPECIFICATIONS

- The flexible tubing set shall consist of a length of flexible tubing, hose clamps, hose stop, and exhaust adapter.
- The flexible tubing shall be Ventaire model HSG constructed of high temperature silicone coated fiberglass rated to a minimum of 600F (NOTE: The selection of tubing material will depend upon the specific application. Consult table 9.2 on for more information).
- All components of the flexible tubing assembly shall be fastened using a stainless steel hose clamp model BC or HC that is riveted to establish a permanent connection.
- The exhaust adapter, Ventaire model TS, shall be constructed of 20 gauge 304 stainless steel and shall be provided with a gas analyzer slot and a spring clip.

FLEXIBLE TUBING OPTIONS

- Several different hose types can be used for overhead systems. Consult table 9.2 for more information*.
- A variety of different exhaust pipe adapters and accessories are available to suit almost any need. Consult Section 7 for additional info.

3.5: Overhead Non-Disappearing Systems Wall Box

A: General

The contractor shall supply the installation for the complete hose reel system. This system shall include, but is not limited to, overhead duct and fittings, flexible tubing set, wall box, exhaust fan and exhaust stack or vent (See Figures 3.5A & 3.5B). All materials and labor required for the complete installation of the system shall be included in the bid. The overhead duct shall be installed at the locations as indicated on floor plan. The rigid duct shall be mounted and supported in an approved manner such that it meets all local and federal guide lines. All elbows, fittings, and transitions shall be made according to SMACNA standards. The rigid duct shall

be connected to the exhaust fan by means of a flexible connector to minimize noise and vibration.

Sample 8: Wall Box System

Item	Qty	Model	Description
1	1	WB140	Single Wall Box
2	1	SG	Flexible Tubing-4"dia x 10'
3	2	BC40	Stainless Bridge Clamp
4	1	TS40	Tailpipe Adapter, w/ clip
5	1	MS40	Male Connector
6	1		Factory Assembly Charge

B: Wall Box

Wall boxes are utilized where multiple receptacles are required, but not used at the same time. The units feature special quick connect fittings for attachment of tubing to the box. Therefore, tubing sets can be shared between receptacles.

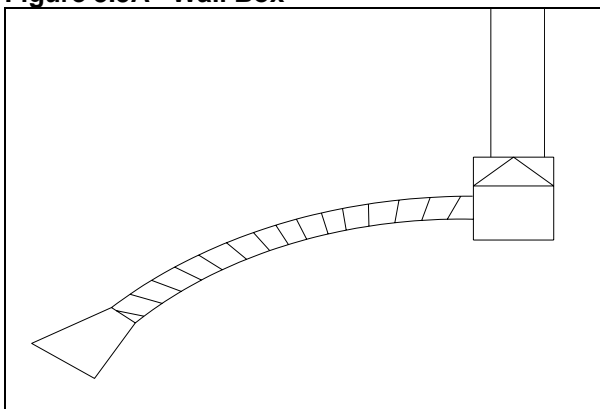
SPECIFICATIONS

- The wall box shall be Ventaire model WB with flexible tubing set.
- The wall box shall be constructed of welded 20 gauge galvanized formed sheet metal with a cast aluminum blast gate and a 20 gauge galvanized sheet metal blade.
- Permanently attached to the blast gate shall be a Ventaire model FG female quick connect fitting. The fitting shall be constructed of 20 gauge galvanized sheet metal with a "J" slot type quick disconnect.

WALL BOX OPTIONS

- Wall boxes may be single or dual wall box systems and are available in either galvanized or stainless steel construction.

Figure 3.5A Wall Box



C: Flexible Tubing Set

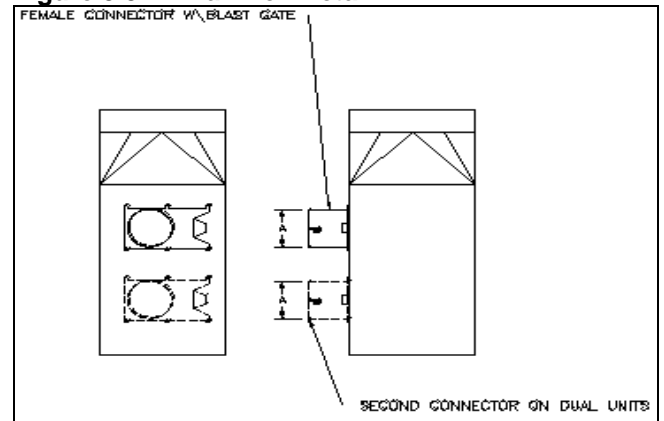
SPECIFICATIONS

- The flexible tubing set shall consist of a length of flexible tubing, hose clamps, exhaust adapter and male quick connect fitting.
- The flexible tubing shall be Ventaire model SG constructed of high temperature silicone coated fiberglass rated to a minimum of 600F (NOTE: The selection of tubing material will depend upon the specific application. Consult table 9.2 on for more information).
- All components of the flexible tubing assembly shall be fastened using a stainless steel hose clamp model BC or HC that is riveted to establish a permanent connection.
- The exhaust adapter, Ventaire model TS, shall be constructed of 20 gauge 304 stainless steel and shall be provided with a gas analyzer slot and a spring clip.
- The male quick connect, Ventaire model FS, shall be constructed of 20 gauge 304 stainless steel with a locking pin.

WALL BOX FLEXIBLE TUBING SET OPTIONS

- The male quick connect fitting may be constructed of 20 gauge stainless sheet metal (model MS).
- Several different hose types can be used for wall box systems. Consult table 9.2 for more information*.
- A variety of different exhaust pipe adapters and accessories are available to suit almost any need. Consult Section 7 for additional info.

Figure 3.5B Wall Box Detail

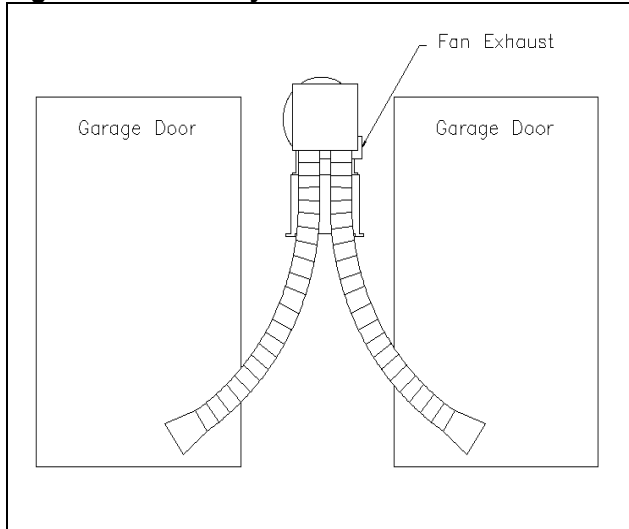


D: Exhaust Fan

See Section 8 (8.1 through 8.3) for exhaust fan specifications.

**3.6: Overhead Non-Disappearing Systems
Two Bay System**

Figure 3.6 Two Bay Unit



A: General

The contractor shall supply the installation for the complete two bay system. This system shall include, but is not limited to, ducting and fittings from fan to exterior of wall, flexible tubing set, exhaust fan and exhaust stack or vent (See Figure 3.6). All materials and labor required for the complete installation of the system shall be included in the bid. The exhaust duct shall be installed at the locations as indicated on floor plan. The rigid duct shall be mounted and supported in an approved manner such that it meets all local and federal guide lines. All elbows, fittings, and transitions shall be made according to SMACNA standards. The rigid duct shall be connected to the exhaust fan by means of a flexible connector to minimize noise and vibration.

B: Two Bay System:

Ventaire two bay systems are ideal for small repair shops with side by side stalls located near an exterior wall.

SPECIFICATIONS

- The two bay system shall consist of an integral volume blower (Ventaire PW series), inlet box, 12 gauge galvanized steel fan stand, and two flexible tubing sets.
- The inlet box shall be constructed of 20 gage galvanized steel.

- The fan stand shall be constructed of 12 gauge galvanized steel.
- The two flexible tubing sets shall be constructed of high temperature “nocrush” hose & tailpipe adapters. The hoses shall be 4” diameter and lengths of 10’ and 20’.
- See Section 8 part B for PW exhaust fan specifications.
- Ventaire model TBU two bay unit shall be series manufactured by Ventaire. (See Figure 3.6).
- The flexible tubing sets consist of flexible tubing and an exhaust adapter.
- The flexible tubing is constructed of N1 or N2 no crush flexible tubing.
- Permanently attached to one end of the tubing is an exhaust adapter. The exhaust adapter (Ventaire model FXXX, RA300, or DSR600 series) is constructed of 1/4” neoprene rubber and has a bumper hook or stack stop.
- The flexible tubing set is permanently attached to the fan inlet box with a hose clamp and rivet.
- The flexible tubing sets are manufactured by Ventaire.

Figure 3.7A Door Port System

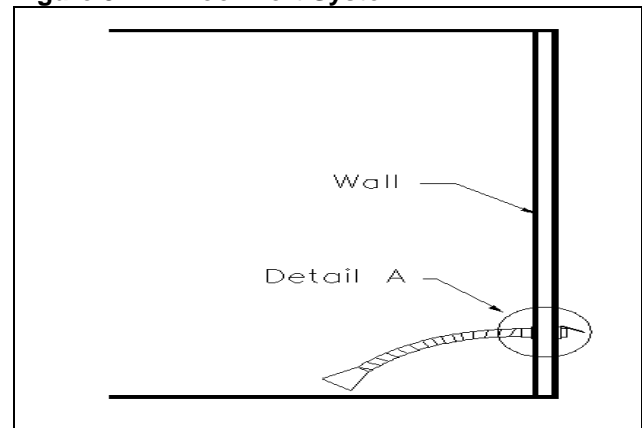
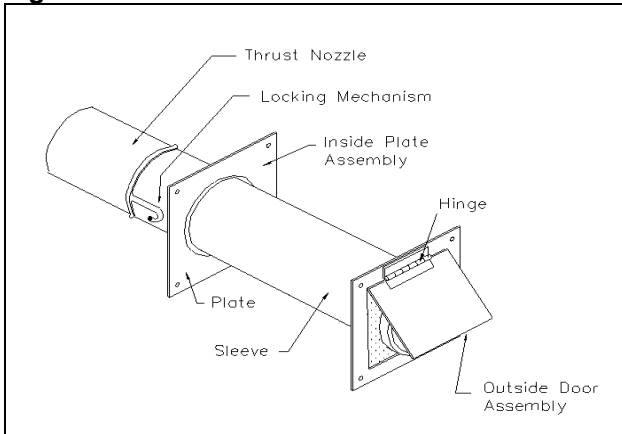


Figure 3.7B Detail A



B: Sample Door Port System:

Sample 9: Door Port System

Item	Qty	Model	Description
1	1	DPA4004	Door Port Assembly
2	1	N2	No Crush Flex-4" dia x 10'
3	2	HC40	Stainless Hose Clamp
4	1	TS40	Tailpipe Adapter, w/ clip
5	1	TNG40	Thrust Nozzle
6	1		Factory Assembly Charge

C: Door Port System:

Our simplest and most economical system, the Ventaire door port uses the force of the vehicle's exhaust instead of a fan to remove harmful fumes.

SPECIFICATIONS

- The contractor will obtain and install a complete door port system.
- The door port system consists of a door port assembly (Ventaire DPA series) and a flexible tubing set.
- The door port assembly is constructed of 10 gauge stainless steel mounting plates and door, with a 20 gauge stainless sleeve of sufficient length to project through the garage door or wall at a location near the shop floor.
- The flexible tubing sets consist of a length of flexible tubing, an exhaust adapter, and a thrust nozzle.
- The flexible tubing is constructed of N1 or N2 no crush flexible tubing.
- Permanently attached to one end of the tubing is a thrust nozzle.
- The thrust nozzle (Ventaire TNG or TNS series) is constructed of 20 gauge galvanized or stainless sheet metal, with a locking male

pin, and be appropriate length to push through the door port assembly and open the exterior door.

- Permanently attached to the other end of the tubing is an exhaust adapter.
- The exhaust adapter (Ventaire model FXXX or RA300 series) is constructed of 1/4" neoprene rubber and has a bumper hook.
- All permanent connections to the no crush flexible tubing sets are made by a hose clamp, which is riveted through the thrust nozzle and flexible tubing.
- The flexible tubing sets are manufactured by Ventaire.

3.7: Specifications for Overhead Disappearing Systems

A: General

The contractor will install a complete overhead disappearing exhaust system. The overhead system includes, but is not limited to, flexible tubing set with exhaust adapter, overhead fixture, cable set, winch, rigid overhead duct, exhaust fan, and exhaust stack or vent. All materials and labor required for the complete installation of the system will be included in the bid.

The contractor will field-fabricate the overhead rigid duct in the sizes shown on the drawings. The rigid duct is mounted and supported in an approved manner such that it will fully bear the loads placed upon it. It must hold the weight of the flexible tubing set and the lateral loads created by the friction between the tubing set and the overhead duct as the tubing set is withdrawn or retracted. All elbows, fittings, and transitions are made according to SMACNA standards (**Optional:** The rigid duct is equipped with roller trays to decrease the friction between the tubing set and the rigid duct (See Figure 3.9B below.) The roller trays are installed by securing the trays to the duct with sheet metal screws or rivets.) A grommet, or hole guide, is installed by the contractor in back of the branch tee to prevent excess wear on the hoisting cable.

The contractor will locate and install a complete pulley and cable set to facilitate the movement of the flexible tubing set (See Figure 3.9A below). The cable running through the pulleys is permanently attached to the hose guide on the tubing set by the use of cable clamps and thimbles. A dual acting winch is mounted at an appropriate level to facilitate the movement of the cable. The rigid duct will be connected to the exhaust fan by means of a flexible connector to minimize noise and vibration.

B: Sample Overhead Disappearing Systems

Sample 9: Overhead Disappearing System (Rear Actuated)

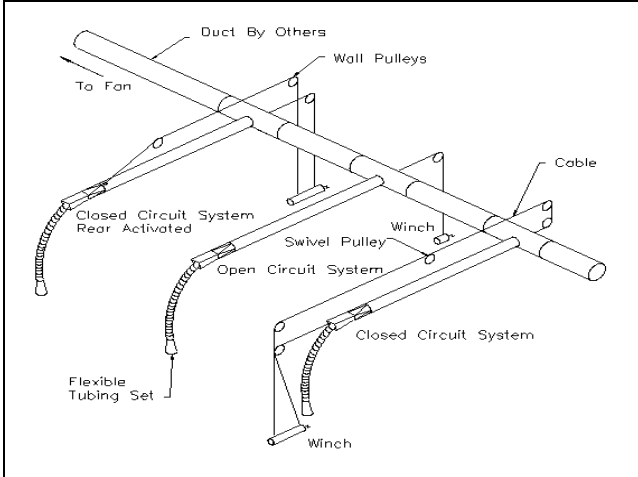
Item	Qty	Model	Description
1	1	DOF60	Disappearing Overhead Fixture
2	1	TZ	Throat Seal
3	1	SK	Self Closing Door
4	1	S12	Stainless Flex-4" dia x 10'
5	1	Cutting Charge	
6	1	TS40	Tailpipe Adapter, w/ clip
7	1	HGS40	Hose Guide
8	1	MKCR	Rear Actuated Cable Set
9	1	DW5414	Dual Acting Winch, w/ Wall Brk.

C: Overhead Fixture

SPECIFICATIONS

- The contractor will install an overhead fixture at the end of each branch duct. The overhead fixture is permanently attached and fully supported by the branch duct and support cables.
- The overhead fixture are constructed of 20 gauge galvanized formed sheet metal and include a self closing door, a throat seal, and a closed circuit pulley as needed for proper use of the system.
- The overhead fixture, a series DOF, is manufactured by Ventaire.

Figure: 3.9A Overhead Disappearing Systems



D: Flexible Tubing Set

SPECIFICATIONS

- The contractor will install a complete flexible tubing set consisting of a length of flexible tubing, exhaust adapter, and an overhead hose guide. The selection of tubing material

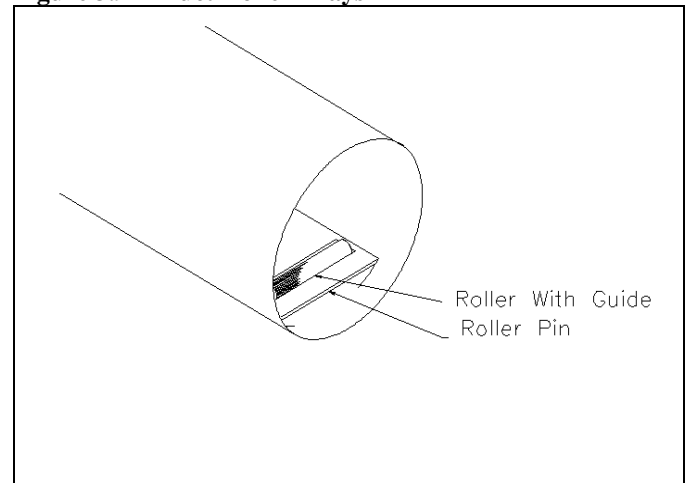
will depend upon the specific application (Consult Section 9 on flexible tubing for more information.)

- An overhead hose guide is permanently attached to the end of the flexible tubing set.
- Permanently attached to the other end is an exhaust adapter. The overhead hose guide (Ventaire model HGS series) is constructed of 20 gauge stainless sheet metal with 1/4" outer and cross rods.
- The exhaust adapter (Ventaire model TS series) is constructed of 20 gauge stainless conical sheet metal and has a gas analyzer slot and spring clip.
- All permanent connections to metal flexible tubing are made with rivets, drive screws, or welds.
- The flexible tubing sets are manufactured by Ventaire.

FLEXIBLE TUBING OPTIONS

- HGG galvanized hose guide.
- TG galvanized tailpipe adapter.
- A "J" slot type quick disconnect fitting may be attached to the flexible tubing, in place of the adapter, in order to allow for the connection of other accessories as outlined in Section 7.

Figure 3.9B Duct Roller Trays



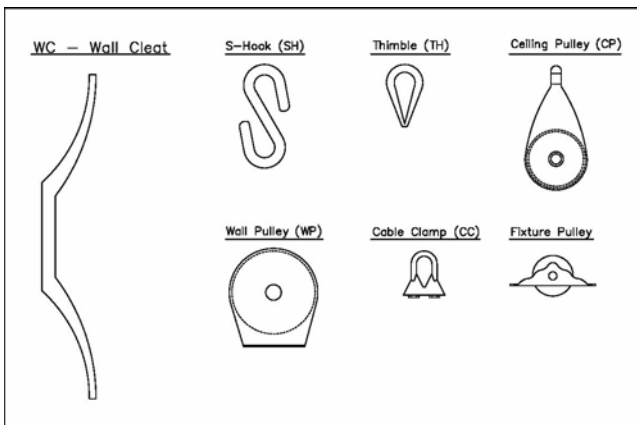
E: Cable Set

SPECIFICATIONS

- The cable set consists of the following: aircraft cable, wall and/or ceiling pulleys, S-Hooks, cable clamps, thimble, and a dual acting winch (See Figure 3.10).
- The cable is 1/8" by 125 feet of 7X19 strand galvanized steel (**NOTE:** Cable length may vary depending on style of system.)

- The wall or ceiling pulleys are all constructed of steel.
- A dual acting winch is supplied for movement of the cable.
- Winch is constructed of steel, has a 4:1 gear ratio, a large 2" drum, a lock mechanism, a no-slip handle, and a wall bracket.

Figure 3.10 Cable Set



F: Exhaust Fan

See Section 8 (8.1 through 8.3) for exhaust fan specifications.

Section 4: Flexible Fume Arms

4.1: Description of System

The contractor will install a complete fume exhaust system at the location as shown on the drawings. The exhaust system includes, but is not limited to, flexible fume arms, rigid overhead duct, and exhaust fan with exhaust stack/vent, or fume collector. All materials and labor required for the complete installation of the system is included in the bid.

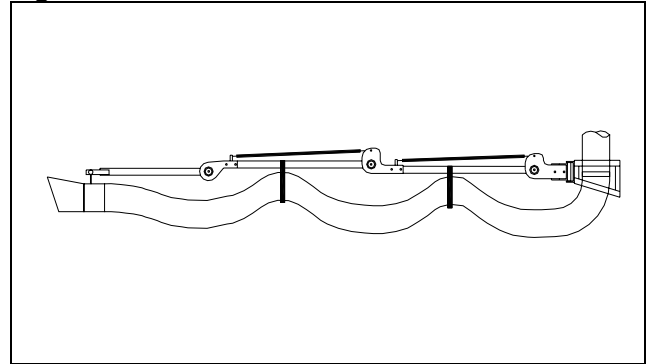
The contractor will field-fabricate the overhead rigid duct in the sizes as shown on the drawings. The rigid duct is mounted such that it is fully supported in an approved manner. All elbows, fittings, and transitions are made according to SMACNA standards. The rigid duct is connected to the exhaust fan or fume collector by means of a flexible connector to minimize noise and vibration.

Flexible fume arms are mounted in two different configurations: wall or ceiling. Wall mounted arms can pivot only 180 degrees while ceiling mounted arms can pivot a full 360 degrees. The overall length of the fume arm may vary between five and twenty feet, depending on the distance from the mount point and fume source. Five to twelve foot arms consist of two arm sections. Fifteen to twenty foot arms consist of three sections with the first section composed of either rigid arm material or a pipe whose diameter is the same as the flexible tube.

4.2: Applications

Flexible fume arm hoods and flexible tubing do not rest on the table which frees up more usable workspace. The fume arms are limited in their overall placement. The first arm section does not deflect greater than 5 degrees below the horizontal and the last section does not deflect below 60 degrees below the horizontal. Therefore, the mounting point for the arm should not be too close or too high above the desired work area. Flexible fume arms are used in the following applications: all welding applications, glue fumes, grinding dusts, most air-borne dusts, soldering fumes, and chemical applications such as laboratories.

Figure 4.1 WAFE SERIES



4.2: Fume Arms

A: Sample Fume Arm System

Sample 10: Fume Arm System			
Item	Qty	Model	Description
1	1	FAFE6100	Flexible Fume Arm
2	1	WMFA	Fan & Arm Wall Mount
3	1	PW11	Exhaust Blower
4	1	RIS4	Vibration Isolator Set

B: WAFE, IAFE, and FAFE

SPECIFICATIONS

- A flexible fume arm consists of a conical hood and flexible tubing connected to a mechanical arm.
- The mechanical arm consists of two or three steel arm sections with adjustable friction joints.
- The extendable spring balancer(s) permits easy fluent motion of the arm.
- The mechanical arm may be inside or outside the flexible tubing.
- The flexible tubing is connected either to a 360 degree pivoting pipe section or directly to rigid duct.
- The rigid duct may be connected to a fume collector or an exhaust fan.
- If a collector is used it will clean the fumes and return the air to the workspace. (Note: See section 5 for fume collector description and specifications.)
- A fan will draw the fumes and discharge them out of the workspace.

C: SIFA

SPECIFICATIONS

- Self supporting fume arms (SIFA) are an excellent method for capturing fumes (See Figure 4.2).
- Fume arm tubes are fabricated of powder coated steel or aluminum with cast aluminum joints, which include a carbon fiber friction disc, and are fully adjustable to the workers desired tension.
- Hood inlet diameters vary from 6" to 14".
- The joints include a 300° F rated hose which is gear clamped to the tube.
- All hoods are equipped for installation of an optional halogen light and/or on/off switch for exhaust fan control.
- A large variety of hoods can be manufactured to suit a particular requirement. Different diameters and construction material are available.

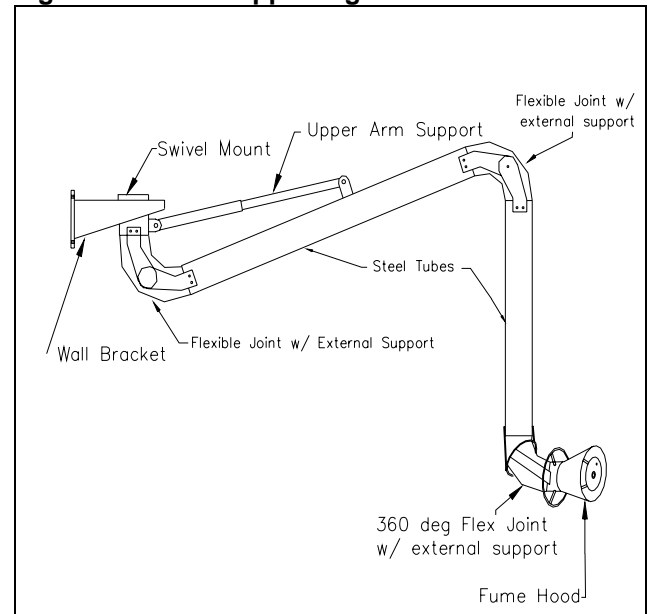
D: Exhaust Fans

See Section 8 (8.1 through 8.3) for Exhaust Fan specifications.

E: Fume Collectors

See section 5 for specifications on fume collectors

Figure 4.2 Self Supporting Fume Arm



Section 5: Fume Collectors

5.1: Description of the System

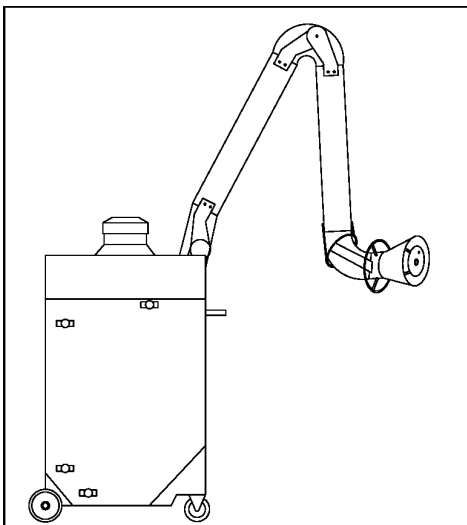
For welding shops that condition their shop air, it is often necessary to filter the weld fumes and return the air to the workspace. The most efficient way of filtering the welding fumes is to have a local ventilation system and incorporate a fume collector. A fume collector consists of a large rectangular unit with metal prefilter, pleated bags, and/or HEPA and Carbon filters arranged in series within the unit. On some collectors, an exhaust fan is also contained in the unit to provided positive pressure across the filters.

There are three basic fume collectors: portable, duct mounted with blower, and duct mounted without blower. Portable units have a 7 ½ ' or 10' arm mounted on the top and casters mounted on the bottom for positioning and mobility. Duct mounted units, both with and without fans, mount to the ceiling of a building. The inlets are connected using rigid duct to the capture opening (fume hood).

5.2: Applications

Portable fume collectors are best used in welding shops that have fewer than five welding areas. They can also be used in shops where the welding is taking place in an area that is not accessible from a table top hood or flexible fume arm. Duct mounted collectors without fans can be used with any new or existing rigid duct system. Duct mounted collectors with fans can be used in existing systems or new systems where the fan is to be mounted in a different location than the collector.

Figure 5.1 Portable Fume Collector (PORT)



5.3: Fume Collectors

A: Portable Units – PORT

SPECIFICATIONS

- The contractor installs a fume collector, as indicated by the drawings, for use in collecting air to be filtered.
- The collector consists of a 20 gauge galvanized housing whose dimensions are as specified on the drawings.
- The housing contains the following: a one-inch deep metal pre-filter, a 65%, 85%, or 95% panel filter, and a wire mesh outlet.
- (Optional: A two-inch Carbon filter and/or twelve-inch deep HEPA filter is included for more positive fume removal. The housing is painted with enamel paint.)
- The Portable Fume Collection System (See Figure 5.1) is designed to be moved with minimal effort to the ideal location for capture of the contaminant.
- It cleans the polluted air and recycles it back into the area, eliminating the need for make up air or costly ventilation systems.
- The portable unit (Vентаire model PORT XXX) includes the following: a 7 ½ ' or 10' internal flexible fume arm, (4) casters, a fan, ON/OFF switch, and a 10 foot cord.
- The diameter of the fume arm is determined by the CFM of the fan.
- The unit has a hinged door to allow access to the filters, and an access panel to get to the fan and motor.
- The PORT unit is manufactured by Vентаire.

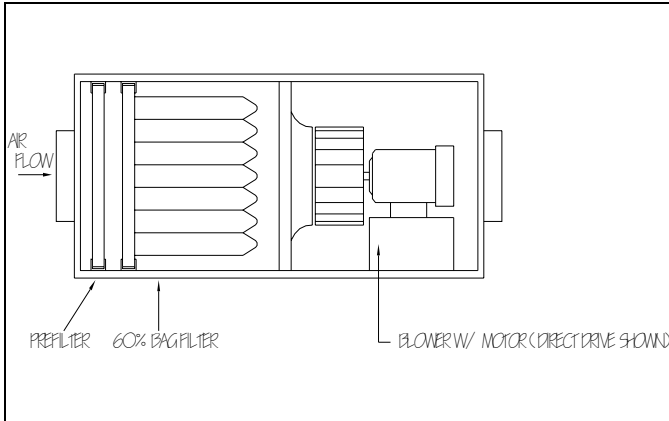
B: Duct Mounted Unit with Fan – BHOR

SPECIFICATIONS

- The contractor installs a fume collector, as indicated by the drawings, for use in collecting air to be filtered.
- The collector consists of a 20 gauge galvanized housing whose dimensions are as specified on the drawings.
- The housing contains the following: a one-inch deep metal pre-filter, a 65%, 85%, or 95% panel filter, and a wire mesh outlet.
- (Optional: A two-inch Carbon filter and/or twelve-inch deep HEPA filter is included for more positive fume removal. The housing is painted with enamel paint.)

- The duct mounted unit (Ventaire model BHOR XXX) shall include a centrifugal type fan, direct drive, single-width, single inlet, with a backward inclined blade wheel to provide economy of operation and non-overloading characteristics.
- The BHOR unit is manufactured by Ventaire.

Figure 5.2 Duct Mounted Unit with Fan (BHOR)



C: BHOR Fan

SPECIFICATIONS

- The exhaust fan is of centrifugal type, direct drive, with straight radial blades of heavy cast aluminum construction.
- The wheel is statically and dynamically balanced to assure quiet operation and maximum efficiency.
- The fan operates at the flow-rate and static pressure as indicated on the drawings.
- The fan housing is constructed of 16 gauge welded steel for rigid durability.
- The motor is Open Drip Proof and of sufficient horsepower to operate the fan under all conditions without operating within its service factor range.
- The motor operates at 60 hertz.
- The fan also is equipped with R.I.S. or spring vibration isolators to minimize vibration and sound.
- The fan, a PW series, is supplied by Ventaire or approved equal.

FAN OPTIONS

- The fan may be equipped with the following accessories: back draft damper, inlet-outlet screens, heat slingers, heresite coating in air-stream, drain connection, disconnect switch

(NEMA1 or NEMA3R), motor starter (NEMA1 or NEMA3R), push button station (NEMA1), TEFC motor, explosion-proof motor, and/or a wall mount.

- A radial blade blower may be substituted for systems with numerous drops.

D: Duct Mounted w/o Fan – NHOR

The NHOR XXXX is designed to be used in new systems where a central fan is used for many welding stations. The NHOR can also be used in existing systems where air filtration is needed.

SPECIFICATIONS

- The duct-mounted NHOR unit includes a hinged door to provide access to the filters.
- The construction of the filter unit facilitates connection to rigid ductwork.
- The size of the unit is determined by the CFM needed in the application and Ventaire submittals.
- The NHOR is manufactured by Ventaire.

Section 6: Slotted Fume Hood Systems

6.1: Description of System

Slotted fume hood systems consist of a large slotted hood connected to rigid duct. The width of the slots are determined by the air velocity required to achieve maximum fume removal. The hood generally is the same width as a welding table or booth. They are mounted on the wall behind the table or booth and draw the fumes away from the welder. The rigid duct may be connected to a fume collector or an exhaust fan. A collector will clean the fumes and return the air to the workspace. (Note: See section 5 for fume collector description and specifications.) A fan will draw the fumes and discharge them out of the workspace.

6.2: Applications

Since they draw the fumes away from the welder, slotted fume hoods are an excellent choice for welding booths or confined workspaces (See Figure 6.1). Slotted hoods are not recommended for use in large open area or for welding on trailers or vehicles.

6.3: Specifications for Slotted Fume Hoods

A: General

The contractor will field-fabricate the overhead rigid duct in the sizes as shown on the drawings. The rigid duct is mounted in such a way that it is fully supported in an approved manner. All elbows, fittings, and transitions are made according to SMACNA standards. The rigid duct is connected to the exhaust fan or fume collector by means of a flexible connector to minimize noise and vibration.

SPECIFICATIONS

- The contractor will install a complete fume exhaust system at the location as shown on the drawings.
- The exhaust system includes, but is not limited to, slotted fume hoods, rigid overhead duct, and exhaust fan with exhaust stack/vent, or fume collector.
- Each slotted hood is constructed of formed 18 gauge galvanized steel.
- The overall dimension of the hood is as indicated on the drawings.
- Side baffles are provided to increase efficiency on the welding table.
- All materials and labor required for the complete installation of the system are included in the bid.

- The slotted fume hoods shall be manufactured by Ventaire.

FUME HOOD OPTIONS

- The hood shall be constructed of 18 gauge stainless steel or aluminum.

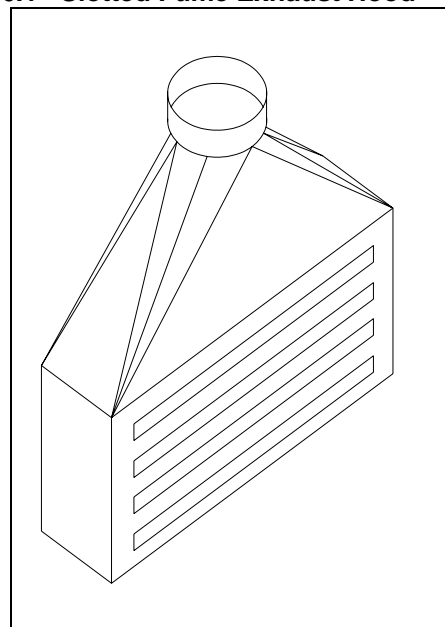
B: Exhaust Fans

See Section 8 (8.1 through 8.3) for Exhaust Fan specifications.

C: Fume Collectors

See section 5 for specifications on fume collectors.

Figure 6.1 Slotted Fume Exhaust Hood



SECTION 7: MISCELLANEOUS SYSTEM COMPONENTS

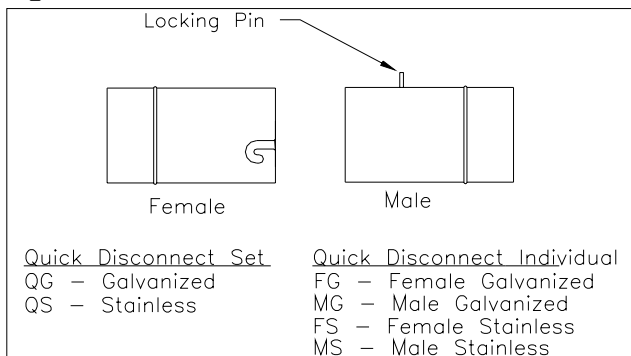
- Ventaire model TG is the same as model TS, but constructed of galvanized steel. Models DSG and DSS series are designed for vertical diesel stacks and are constructed of 20 gauge galvanized or stainless steel. High temperature rubber adapters model F are designed for tailpipe attachment and the model DSR can be supplied for vertical stack attachment. All Ventaire adapters can also be supplied with a bumper hook model BHC, spring clip model SPCLP or debris screen model DS.
- Ventaire model FC flange connections are also available for ease of installation. The flange sets shall be constructed of galvanized steel. A gasket and hardware kit (series GH) is required for each flange set. The kit is constructed with 1/16" non-asbestos gasket material and appropriate zinc plated nut and bolt set.
- A "J" slot type quick disconnect fitting, lifting elbow, or lifting saddle is attached to the flexible tubing in place of the adapter in order to allow for the connection of other accessories as outlined in Section 7.

7.1: Quick Disconnects

A: Description

To create more flexibility with a tubing set, a quick disconnect may be incorporated into the flexible tubing. The most common style for quick disconnects is the "J" style (See Figure 7.1). Quick disconnects come in two pieces: a male and a female piece. Typically, the female piece is attached to the flexible tubing or rigid duct, and the male piece is attached (or incorporated into) to the fittings that are required for the tubing set.

Figure 7.1 Quick Disconnects



B: Specifications

Quick Disconnect:

A quick disconnect is supplied as needed for the attachment of different adapters. The quick disconnect (Ventaire QG or QS series) is constructed of 22 gauge galvanized or stainless sheet metal sleeves. The female piece (Ventaire FG or FS series) has a "J" slot on one end. The male piece (Ventaire MG or MS series) has a pin to lock into the female piece.

7.2: Shut-off Devices

A: Description

In order to control the airflow on unused flexible tubing sets and decrease the amount of conditioned air lost to the exhaust system, shut-off devices are often included in the tubing sets. These devices are often attached to the tubing set between the adapter and the flexible tubing. Three of the most commonly used shut-off devices are quadrant dampers, blast gates, and spring doors. Quadrant dampers offer a smooth looking shut-off device. Blast gates are more cumbersome in appearance but stop the airflow more effectively than quadrant dampers. Spring doors attach to the face of metal adapters and may be used to assist in holding the adapter to the exhaust pipe.

Quadrant Damper:

Permanently attached between the adapter and the flexible tubing is a quadrant damper. The quadrant damper (Ventaire QDG or QDS series) is constructed of a 22 gauge galvanized or stainless sheet metal sleeve with a 22 gauge blade and zinc plated damper mechanism.

Blast Gate:

The blast gate (Ventaire BG series) has a cast aluminum body and a 20 gauge galvanized steel blade. As an option, the blast gate body and blade may be constructed of either 12 gauge galvanized, or 12 gauge 304 or 316 stainless steel.

Spring Door:

Permanently attached to the face of the metal adapter is a spring door. The spring door (Ventaire SDG or SDS series) is constructed to a 16 gauge galvanized or stainless door, mount, and hinge assembly. A galvanized or stainless spring is permanently riveted

to the door and the inside of the adapter to draw the door closed when not in use.

7.3: Ball Joints

A: Description

Due to the limited bend radius of metal flexible tubing, a ball joint is often added to the tubing to give it more flexibility. Ball joints may also be attached between the flange connection and flexible tubing to allow the flexible tubing to rotate without kinking.

B: Specifications

Ball Joint:

Permanently attached to the flexible tubing is a ball joint. The ball joint (Ventaire BJ series) is constructed of spun zinc plated metal. **(OPTIONAL:** The ball joint is constructed of 304 or 316 stainless sheet metal.

7.4: Diesel Fittings

A: Description

Diesel adapters are designed for higher temperatures produced by diesel engines (See Figure 7.2 below). They are available for overhead systems (diesel stack adapter) and underground systems (diesel cane adapter). Diesel stack adapters are available in metal or neoprene construction. Diesel canes are available in light and standard metal versions. All are constructed with a stack stop to prevent the exhaust stack from making contact with the flexible tubing. Metal diesel adapters are also constructed with a slot for opening exhaust stack rain caps.

B: Specifications

Diesel Stack Adapter (Metal):

Diesel stack adapters (Ventaire DSG or DSS series) are constructed of 20 gauge galvanized or stainless sheet metal with a 1/4" cross rod stack stop. **(OPTIONS:** 1) A quadrant damper or blast gate is permanently attached to the diesel stack to control the airflow. 2) A "J" slot type quick disconnect is attached to the diesel stack to allow for the changing between different fittings. 3) A positioning rod fitting is interlocked to the diesel stack with a positioning rod to aid in the placement of the diesel stack adapter onto the exhaust stack. The positioning rod (Ventaire PR8 series) is constructed of 3/4" diameter by 8' conduit with no slip handles. 4) A lift ring is attached to the diesel stack to connect the cable or rope pull up set.)

Diesel Stack Adapter (Neoprene)

Diesel stack adapters (Ventaire DSR-600 series) are constructed of 1/4" high temp rubber with a 1/4" rod stack stop. It can handle up to 500 degrees Fahrenheit exhaust fumes. It has a 6 or 8 inch nominal opening and fits 4 - 6 inch no crush tubing or 6 inch fabric or metal tubing.

Diesel Cane (Standard):

Diesel Canes (Ventaire DCG or DCS series) are constructed of 20 gauge galvanized or stainless sheet metal with 1/4" cross rod stack stop hood, 8 feet of 24 gauge galvanized or stainless spiral pipe, 180 degree elbow, and positioning handles. **(OPTIONS:** A "J" slot type quick disconnect is attached to the diesel stack to allow for the changing between different fittings. An attaching ring is attached to the end of the cane for the connection of the cane to a conical exhaust adapter with bumper hood.

Diesel Cane (Light):

Diesel Canes (Ventaire LCS series) are constructed of 20 gauge stainless sheet metal with a 1/4" cross rod stack stop hood, 10 feet of 304 stainless metal flex with a permanent 180 degree bend, and a positioning rod. The positioning rod is constructed of 3/4" diameter by 10' conduit with no slip handles. **(OPTIONS:** A "J" slot type quick disconnect is attached to the diesel stack to allow for changes between different fittings.)

7.5: Wye Fitting Assemblies

A: Description

Some vehicles have two exhaust pipes or stacks coming from the engine. For these vehicles, a wye fitting assembly is often used instead of tying up two separate flexible tubing sets. Wye fitting assemblies are made up of a wye fitting with two lengths of flexible tubing (generally 5 feet long) and exhaust adapters attached to each branch of a wye.

B: Specifications

Wye Fitting Assemblies:

A wye fitting assembly is provided in the quantities as indicated for vehicles with dual exhaust systems. The wye fitting assembly consists of a wye fitting (Ventaire YG or YS series), two 5 foot lengths of flexible tubing, and two exhaust adapters. The wye fitting is

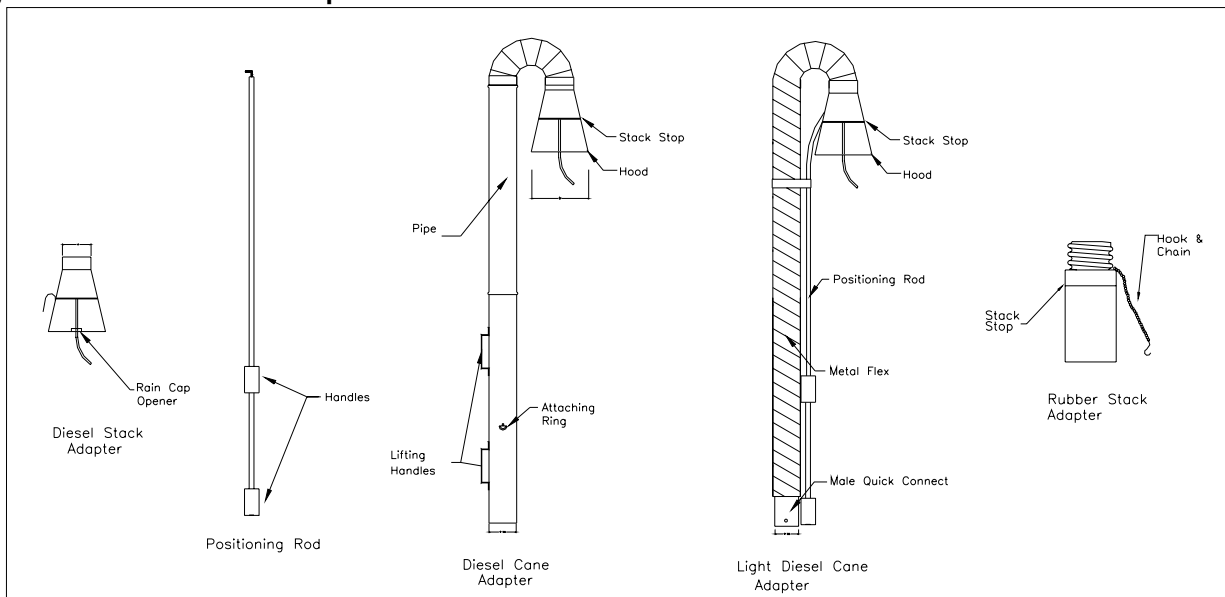
constructed of 20 gauge galvanized or stainless formed sheet metal with branch and main diameters as indicated. (**OPTIONAL:** A "J" slot type quick disconnect is attached to the wye fitting to allow for the changing between different fittings. A lift ring is attached to the wye fitting for the use of attaching the wye fitting to a conical exhaust adapter with bumper hook.)

The flexible tubing is constructed of G12 galvanized, G16 galvanized, S12 stainless, S16 stainless, N1 or N2 no crush, or fabric flexible tubing (SG hi temp. or HTW med temp). (**NOTE:** The selection of tubing material will depend upon the specific application. Consult Section 5 on flexible tubing for information.) The flexible tubing is 5 feet long or as specified on plans. Permanently attached to the other end of the tubing shall be a tailpipe adapter (Ventaire model TG or TS series), diesel stack adapter (Ventaire model DSG, DCG, or DSR series), or a no crush exhaust adapter (Ventaire model F, RA, or DSR series). The exhaust adapter is constructed of 20 gauge galvanized or stainless conical sheet metal having a gas analyzer slot and a bumper hook or spring clip. All permanent connections to fabric or no crush flexible tubing sets are made by a bridge or hose clamp that is riveted to the adapter or wye fitting and flexible tubing. All permanent connections to metal flexible tubing are made with rivets, drive screws, or tack welds.

7.6: Miscellaneous Adapters

A: Descriptions

Figure 7.2 Diesel Stack Adapters



A variety of adapters are available for special applications. They include cast aluminum, locking, and rectangular adapters. Cast aluminum adapters and are most often used in underground systems. Locking adapters are most often used on diesel vehicles. Rectangular adapters are used on automobiles with dual mufflers. Other adapters can be made for special vehicles by consulting Ventaire.

B: Specifications

Locking Exhaust Adapter:

The locking exhaust adapter (Ventaire LTS series) is constructed of a 20 gauge stainless sheet metal sleeve with a 1/4" high temp rubber sleeve, heat resistant handle, and vice grip locking device. (**OPTIONS:** A quadrant damper or blast gate is permanently attached to the diesel stack to control the airflow. A "J" slot type quick disconnect is attached to the locking adapter to allow for the changing between different fittings.)

Rectangular Adapters:

Rectangular adapters (Ventaire RG or RS series) are constructed of 20 gauge galvanized or stainless formed sheet metal having a gas analyzer slot and bumper hook or spring clip. (**NOTE:** A "J" slot type quick disconnect fitting may be attached to the flexible tubing, in place of the adapter, in order to allow for the connection for other accessories. A lift ring is attached to the adapter for the connection of the cable or rope pull up set.)

SECTION 8: EXHAUST FANS

8.1: Utility Vent Set

SPECIFICATIONS

- The exhaust fan is a centrifugal type, belt driven, single-width, single-inlet, with a backward inclined blade wheel to provide economy of operation and non-overloading characteristics.
- The wheel is statically and dynamically balanced before assembly to assure quiet operation and maximum efficiency.
- The fan shall operate at the CFM and static pressure indicated on the drawings.
- The fan housing shall be constructed of heavy gauge welded steel construction for rigid durability. The housing shall be rotatable to eight different standard positions.
- The fan meets AMCA Standard 210 for performance ratings and bears the AMCA seal.
- The bearings are heavy duty, self-aligning, pre-lubricated, and sealed for low friction operation.
- The drive shall be V-belt type with an adjustable pitch sheave, selected for midpoint operation for maximum flexibility.
- The motor shall be Open Drip Proof and of sufficient horsepower to operate the fan under all conditions without operating within its service factor range.
- The motor shall operate at 60 hertz.
- The fan shall be equipped with R.I.S. or spring vibration isolators to minimize vibration and sound.
- The UVS series exhaust fan, shall be supplied by Ventaire or approved equal.

FAN OPTIONS

- For outdoor use, the fan may be equipped with a weather cover constructed of heavy gauge welded steel that totally encloses both drives and the motor.
- For indoor use, the fan may be furnished with a belt guard.
- The fan may be equipped with the following accessories: lift eye, back draft damper, inlet-outlet screens, heat slingers, spark proof construction (AMCA A, B, or C), heresite coating in air-stream, drain connection, bolted access door, disconnect switch (NEMA1 or NEMA3R), motor starter (NEMA1 or NEMA3R), push button station (NEMA1), TEFC motor, and/or an explosion-proof motor.

8.2: Radial Blower

SPECIFICATIONS

- The exhaust fan is a centrifugal type, direct drive, with straight radial blades of heavy cast aluminum construction.
- The wheel is statically and dynamically balanced to assure quiet operation and maximum efficiency.
- The fan can operate at the flow-rate and static pressure as indicated on the drawings.
- The fan housing is constructed of 16 gauge welded steel for rigid durability.
- The motor is Open Drip Proof and of sufficient horsepower to operate the fan under all conditions without operating within its service factor range.
- The motor operates at 60 hertz.
- The fan can also be equipped with R.I.S. or spring vibration isolators to minimize vibration and sound.
- The fan, PW series, is supplied by Ventaire or approved equal.

FAN OPTIONS

- The fan may be equipped with the following accessories: back draft damper, inlet-outlet screens, heat slingers, heresite coating in air-stream, drain connection, disconnect switch (NEMA1 or NEMA3R), motor starter (NEMA1 or NEMA3R), push button station (NEMA1), TEFC motor, explosion-proof motor, and/or a wall mount.

8.3: Inline Exhaust Fan

SPECIFICATIONS

- The exhaust fan is a centrifugal tubular inline type, belt driven, with a backward inclined blade wheel to provide economy of operation and non-overloading characteristics.
- The wheel is statically and dynamically balanced to assure quiet operation and maximum efficiency.
- The fan operates at the CFM and static pressure as indicated on the drawings. The fan housing is constructed of heavy gauge welded steel construction for rigid durability.
- The fan meets AMCA Standard 210 for performance ratings and bears the AMCA seal.
- The bearings are heavy duty, self-aligning, pre-lubricated, and sealed for low friction operation.

- The drive is a V-belt type with an adjustable pitch sheave, selected for midpoint operation for maximum flexibility.
- The motor is Open Drip Proof and of sufficient horsepower to operate the fan under all conditions without operating within its service factor range.
- The motor operates at 60 hertz.
- The fan is equipped with a belt guard constructed of heavy gauge welded sheet metal.
- The fan is also equipped with R.I.S. or spring vibration isolators for ceiling mounting to minimize vibration and sound.

FAN OPTIONS

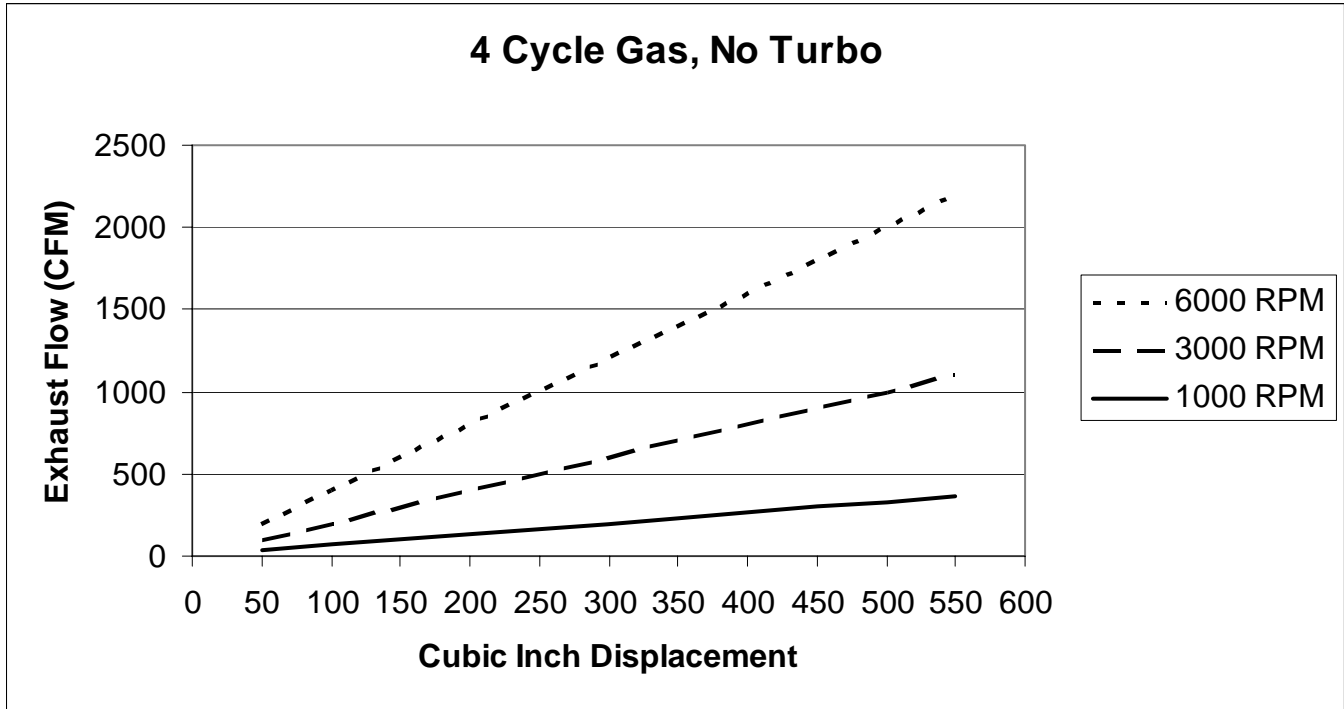
- The fan may be equipped with the following accessories: weather cover, variable inlet vanes, inlet-outlet screens, heat slingers, spark proof construction (AMCA B, or C), heresite coating in air-stream, hinged access door, disconnect switch (NEMA1 or NEMA3R), motor starter (NEMA1 or NEMA3R), push button station (NEMA1), TEFC motor, and explosion proof motor. The fan is from the TSL series as manufactured by Venteire or approved equal.

SECTION 9: EXHAUST SYSTEM DESIGN

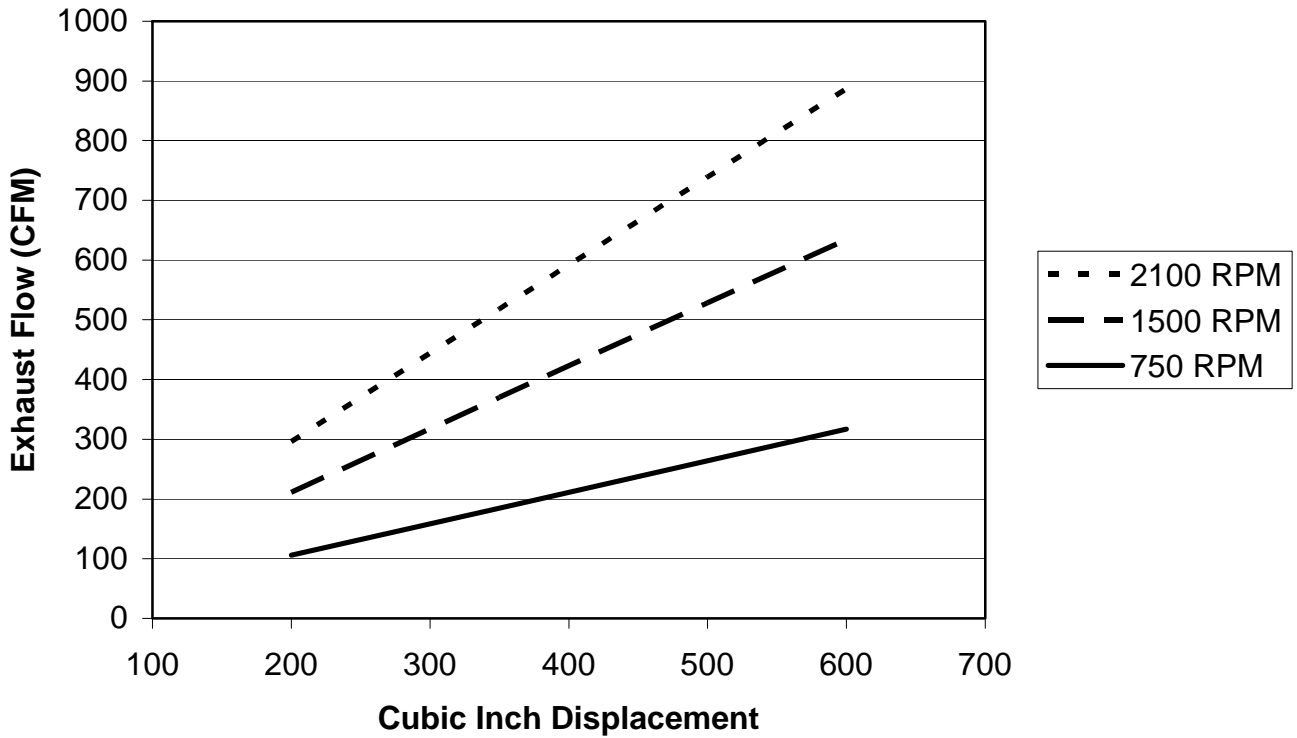
9.1: Recommended Airflow for Local Exhaust Systems

1 liter = 61.025 cubic inches

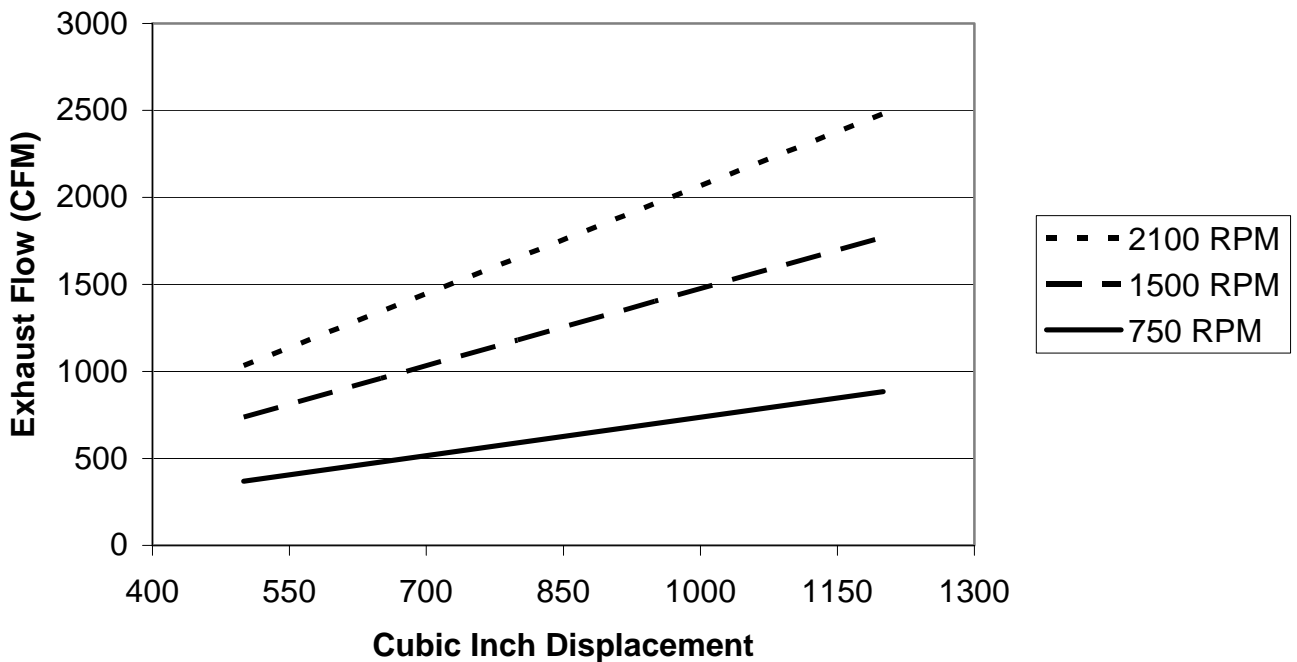
TABLE 9.1: AIRFLOW REQUIREMENTS *

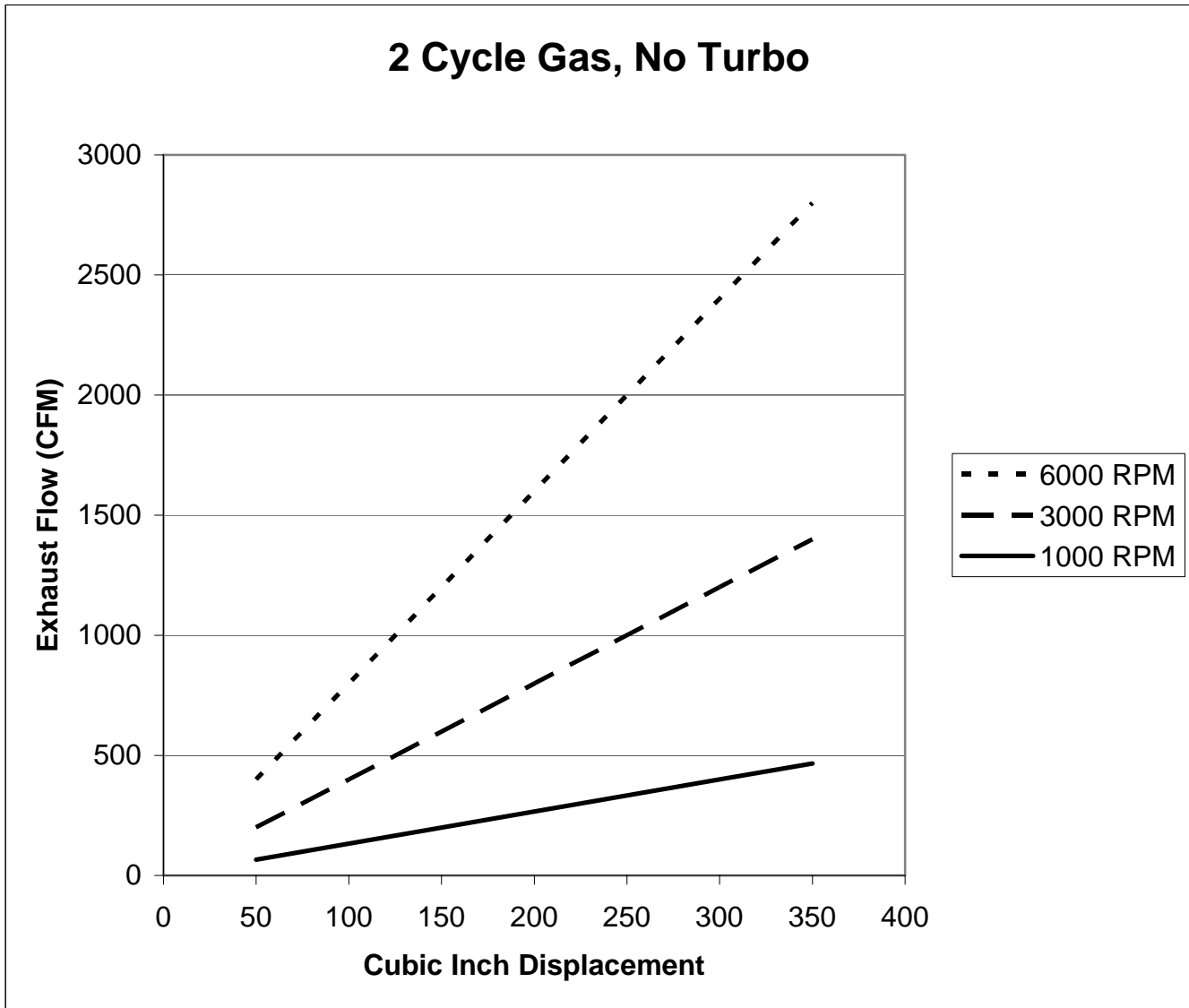


4 Cycle Diesel, No Turbo



4 Cycle Diesel, Turbo





* The above graphs list the general exhaust airflows for different engine types and sizes at three different engine speeds. Please note that the graphs above represent a range of potential operating conditions and may be used only as a guide for developing system requirements. Specific outputs are obtainable by contacting an engine's manufacturer with the model and serial number of a particular engine. Ventaire recommends that an additional 25% be added to all under-floor and over-head disappearing systems. The duct velocity for all local vehicle exhaust systems should be designed with a minimum velocity of 2000 FPM. Determine the range of vehicles to be tested and the specific parameters of testing to develop an accurate system. For extremely large vehicles (strip mine dump trucks, cranes, military tanks, etc.) consult the vehicles' manufacturer or Ventaire for recommended airflow and tubing diameter.

9.2: Expected Exhaust Temperatures

The exhaust tailpipe temperatures vary widely from vehicle to vehicle. The length and diameter of the exhaust pipe, number of exhaust pipes, displacement of the engine, and the speed of the engine greatly affect the temperature of the exhaust fumes leaving the exhaust pipe(s). These temperatures will determine the type of flexible tubing that should be used. Typically, automobile exhaust temperature will normally be 200 to 300 degrees Fahrenheit when connected to a conical exhaust adapter. Conical exhaust adapters are designed to draw mixing air and dilute the exhaust to a level that flexible tubing can handle. With a straight or non-diluting tailpipe, automobile exhaust can run up to 600 degrees. Diesel exhaust temperatures normally are about 400 to 500 degrees when diluted, and up to 1000 degrees when undiluted. When placed in a dynamometer test stall, the exhaust temperature goes up substantially: up to 600+ degrees for diluted automobiles and 1400+ degrees for diluted diesels. For vehicles not listed in Table 8-1 or for stationary engines, equation 8.1 may be used to obtain the expected exhaust temperature.

$$TA = \frac{[(EAF * TEE) + (AF - EAF) * RT]}{AF} \quad (\text{Eq. 9.1})$$

Where:

TA = Average temperature of diluted exhaust in degrees F.
EAF = Airflow produced by engine = (CU x RPM)/3456 in CFM.
CU = Total engine displacement in cubic inches.
RPM = Speed of engine.
AF = Airflow in flexible tubing (should be 25% greater than EAF) in CFM.
TEE = Actual engine exhaust temperature in degrees F.
RT = Temperature of workspace in degrees F.

By varying AF, this formula may be used to find a suitable flexible tubing by obtaining different TA values and comparing them with the specifications listed below. For vehicles (or engines) that do not apply to any of the above listings, consult Ventaire.

9.3: FLEXIBLE TUBING APPLICATIONS AND SPECIFICATIONS

The following pages contain flexible tubing analysis for vehicle exhaust, welding fumes, and material handling. General criteria, uses, and descriptions are shown for each model.

TABLE 9.2

Flexible Tubing Use Chart

Flex Model	System Types						
	HRA	MHR	OHND	OHD	UNDFLR	WLDRP	WB,DPA
PG	5	5	5	-	-	5	-
UR1	6	6	6	-	-	6	-
UR2	7	7	7	-	-	7	-
UR3	8	8	8	-	-	8	-
TG	3,10	3,10	3,10	-	-	10	3
G12,G16,G18	-	-	2	2	2	8,9	2
S12,S16,S18	-	-	3	3	3	8,9	3
STW	1	1	1	-	-	-	1
HTW	2	2	2	-	-	-	2
N1,N2	-	-	2	-	2	-	2
HTC	2	2	2	-	-	-	2
HT	3	3	3	-	-	-	-
HTN	3	3	3	-	-	-	-
HSG	3	3	3	-	3	-	3
HSGS	3	3	3	-	-	-	3
LAG *	4	4	4	-	-	-	4
U15	4	4	4	-	-	-	4
U20	4	4	4	-	-	-	4
HRA Flex	3	3	3	-	-	-	3
NG	6	6	6	-	-	6,9	-
WP	6	6	6	-	-	6,9	-
WPW	6	6	6	-	-	6,9	-
WPN	6	6	6	-	-	6,9	-

Note: Winch recommended for 5" and 6" diameter systems.

System Type Descriptions

- HRA - Automatic Spring Actuated Hose Reel
- MHR - Motorized Hose Reel
- OHND - Overhead Non-Disappearing System
- UNDRFLR - Underfloor Systems (disappearing & non-disappearing)
- WLDRP - Overhead Weld Hood Drops
- WB - Wall Box Systems
- DPA - Door Port Systems
- OHD - Overhead Disappearing Systems

Usage Criteria

- 1-Recommended for small sized vehicles
- 2-Recommended for small & medium sized vehicles
- 3-Recommended for small to large sized vehicles
- 4-Recommended for extremely high temperature applications
- 5-Recommended for transporting fumes with no abrasives.
- 6-Recommended for transportation of light abrasive material.
- 7-Recommended for transportation of moderately abrasive material.
- 8-Recommended for transportation of highly abrasive material.
- 9-Recommended for transportation of welding fumes.
- 10-Recommended for extreme chemical resistance.
- * -Not Recommended for diesel engines.

Table 9.3 Flexible Tubing Size and Weights

	WEIGHT	WEIGHT	WEIGHT	OUTER DIA.	OUTER DIA.	OUTER DIA.	INNER BEND DIA.	INNER BEND DIA.
	(lb/ft)	(lb/ft)	(lb/ft)	(inches)	(inches)	(inches)	(inches)	(inches)
Nominal Inner Dia.	Metal 1	Metal 2	No Crush	Metal 1	Metal 2	No Crush	Metal 1	Metal 2
3.00	1.02	1.65	1.00	3.16	3.25	3.50	22	36
3.50	1.18	1.90	1.30	3.66	3.75	4.00	26	42
4.00	1.35	2.25	1.60	4.16	4.25	4.50	29	50
4.50	1.52	2.45	----	4.66	4.75	----	33	52
5.00	1.68	2.75	2.40	5.17	5.25	5.25	37	54
6.00	2.00	3.25	----	6.17	6.25	----	44	60
7.00	----	3.90	----	----	7.25	----	----	64
8.00	----	4.50	----	----	8.25	----	----	66
9.00	----	5.25	----	----	9.25	----	----	70
10.00	----	6.00	----	----	10.25	----	----	72
12.00	----	7.20	----	----	12.25	----	----	96
14.00	----	11.70	----	----	14.25	----	----	112
16.00	----	14.00	----	----	16.25	----	----	128

****NOTE****

Metal 1 Consists of:

G12 and S12 Flexible Tubing

Metal 2 Consists of:

G16, G18, S16, and S18 Flexible Tubing

No Crush Consists of:

N1 and N2 Flexible Tubing

Fabric 1 Consists of:

SG, SGS, NG, HNG, UR1, UR2, PG, TG, LAG, HT, WP, WPN, and EP Tubing

SG, SGS, NG, HNG, PG, and TG have a 6:1 compression ratio.

9.4: Hood Sizing and Applications

The following is to be used in sizing table weld hoods and slotted fume hoods. Fume arm hoods are equal to table weld hoods in design.

TABLE 9.4: Recommended Table Weld Hood Sizing

Distance to Spark *	Airflow Required	Hood and Tubing Diameter
Up to 6 inches	250 CFM	4 inch
6 to 9 inches	560 CFM	6 inch
9 to 12 inches	1000 CFM	8 inch

* Spark is the point at which the welder contacts the metal and welding begins.

TABLE 9.5: Recommended Slotted Hood Sizing

* Spark is the point at which the welder contacts the metal and welding begins.

Slots -- sized for 1000 FPM each	Q = 350 CFM / linear feet of hood
Hood length = required work space	Bench width = 24 inches maximum
Entry loss = 1.78 slot VP + 0.25 duct VP	

9.5: Rigid Duct Design and Fan Sizing

Once the layout of the facility has been determined, the type and layout of local exhaust system can be selected. The type and layout of the system will depend on the vehicles that are being serviced and the layout of the facility. See Applications Guidelines in sections 2 & 3 for design assistance.

Upon the selection of the type of system, the rigid duct must be laid out and sized. The rigid duct should be laid out such that the frictional losses are kept to a minimum and commonly available materials are used. Vehicle exhaust systems are typically designed with round rigid duct at approximately 4 inches of negative static. Typical underground rigid duct materials are PVC coated steel, spiral, or rigid fiberglass. Typical overhead rigid duct materials are galvanized spiral or lock seamed galvanized. The *Industrial Ventilation* (ACGIH 1992) and *HVAC Duct Construction Standards-Metal and Flexible* (SMACNA 1985) should be consulted for the bases of all Vehicle Exhaust System rigid duct design. All underground ducts should be installed with a slope in one direction, at a depth above the water table. All overhead ducts should be placed such that it does not interfere with overhead cranes, lighting systems, or heating elements. Exhaust fans are typically mounted out of the workspace, either on the roof or on the outside wall, to keep the noise within the workspace down to a minimum.

Typically, all underground and overhead non-disappearing systems are laid out such that the exhaust adapter ends up directly under or over the vehicle's exhaust pipe. Overhead disappearing and wall box systems are generally designed with the rigid duct following the walls of the workspace. Once again, it should be noted that a certain degree of caution must be used when laying out underground systems. Vehicles will not be driven over the floor fixtures and the underground duct is of sufficient length to accommodate all of the flexible tubing. In overhead disappearing systems the rigid duct branch shall be of sufficient length and strength to accommodate all of the flexible tubing. Once the rigid duct is laid out properly, relative to the vehicles and the service stalls, it must be sized. The sizing of the rigid duct and the sizing of the exhaust fan can be done simultaneously. Vehicle exhaust systems are sized with an airflow of 2000 fpm being held constant throughout the ductwork. 2000 fpm has been established in order to keep the majority of the carbon particles from combustion suspended in the ductwork, and to keep the noise of the ductwork down to a minimum. If particles are not being transported, and duct noise is a consideration, keep the duct velocities between 1600 and 2000 fpm. Increasing the duct velocity increases the duct noise as well as the static pressure and the drive requirements. Minimum range duct velocities can be seen in Table 3.2 in the *Industrial Ventilation 20th Edition*¹.

¹ American Conference of Governmental Industrial Hygienists: *Industrial Ventilation*. Cincinnati, OH (1988)

Rigid duct sizing is done by starting at the exhaust outlet the farthest away from the fan and working back towards it. Underground duct normally starts at 8 inches for single floor fixtures (10 inches for dual fixtures) and overhead non-disappearing duct normally starts at 6 inches. The airflow required for each additional stall, with the constant 2000 fpm airflow, will cause the duct size to increase. Consult Figure 9.5 at the end of this section to determine the duct sizes.

Once the sizes of the rigid duct have been determined, the exhaust fan can be sized. The total CFM of all the exhaust outlets and the total static pressure drop of the exhaust system will determine the size of the exhaust fan. The pressure drop of the system is the result of three factors: static drop through flexible tubing, static drop through longest run of rigid duct, and the static drop of fittings on outlet side of fan as well as any other fittings in the system duct. Figures 9.1, 9.2, and 9.3 show the static pressure drops through the most common flexible tubing. Figure 9.4 may be used to obtain the equivalent length of flexible tubing with bends or kinks in it. The static drop through the fittings on the outlet side of the fan should be obtained from the manufacturer of these fittings.

The velocity pressure method for finding the static pressure loss bases all losses in the ducts and hoods as functions of the velocity pressure. The loss is simply a factor multiplied by the velocity pressure. The factors and appropriate losses can be obtained in Figures 9.1 through 9.8 at the end of section eight. The following steps outline the method for obtaining the pressure drop through a rigid duct (both underground and overhead) and flexible hose.

Step #1

Find the actual velocity by dividing the flow rate by the area of the duct. Calculate the velocity pressure by using equation 9.2 below:

$$V = 4005 * \sqrt{VP} \quad (\text{Eq. 9.2})$$

Where V=Velocity (fpm) and VP=Velocity Pressure ("wg).

Step #2:

Determine the static pressure drop through the flexible tubing. If the flexible tubing has bends in it while in use, refer to Figure 9.4 to obtain an equivalent length. Look up the airflow and the tubing diameter to find the corresponding pressure loss for the type of flexible tubing you are dealing with (see Figures 9.1, 9.2, or 9.3). Multiply the obtained pressure loss from the figure by the equivalent length of the tubing to find the total static pressure drop throughout the tubing.

Step #3:

Determine the static drop in the first section of main duct. This is the section of duct between the first exhaust outlet and the second outlet and will have the same CFM in as the exhaust outlet. The static drop is found by multiplying the length of the duct by the value obtained from Figure 9.5.

Step #4:

Determine static drop in first main duct tee. This is found by multiplying the volumetric pressure in the main duct after the tee and the coefficient of the tee from Figure 9.6. (See Section 6 for volumetric pressure equation.)

Step # 5:

Determine the static drop in the next section of main duct. The CFM in this section of duct will equal the total CFM in the exhaust outlet before it. The static drop is found multiplying the length of the duct by the value obtained from Figure 9.5.

Step #6:

Repeat step #4 and #5 until the exhaust fan is reached. If an elbow is reached, use Figure 9.7 or 9.8 for the appropriate elbow and the process used in step #4 to find the static drop in the elbow.

Step #7:

Determine total system static pressure loss by adding the values obtained in steps 2, 3, multiple steps #4 – 6, and the static drop of the fittings on outlet of the fan. If several significant digits were held, then round the final value to solved for in the above steps. For disappearing systems, the total CFM should be multiplied by 1.25, and the total pressure drop should be increased by 1.50 inches, to cover excess leakages possible in disappearing fixtures.)



Flexible Tubing Pressure Loss

Figure 9.1

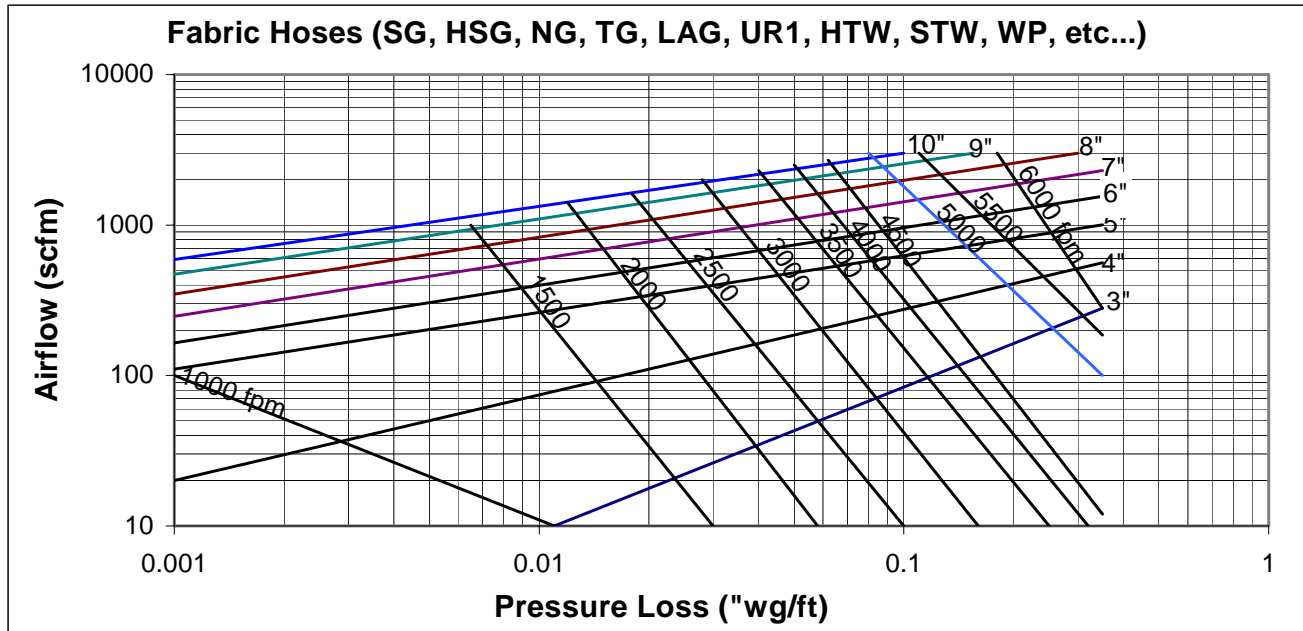
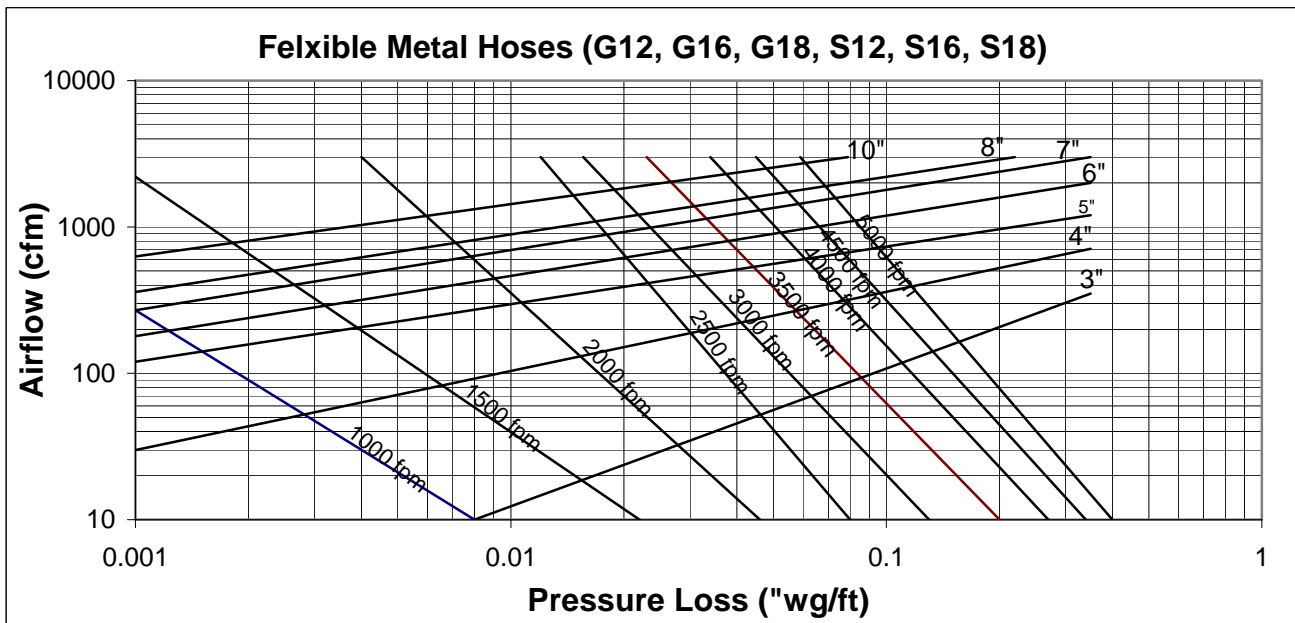


Figure 9.2





Flexible Tubing Pressure Loss

Figure 9.3

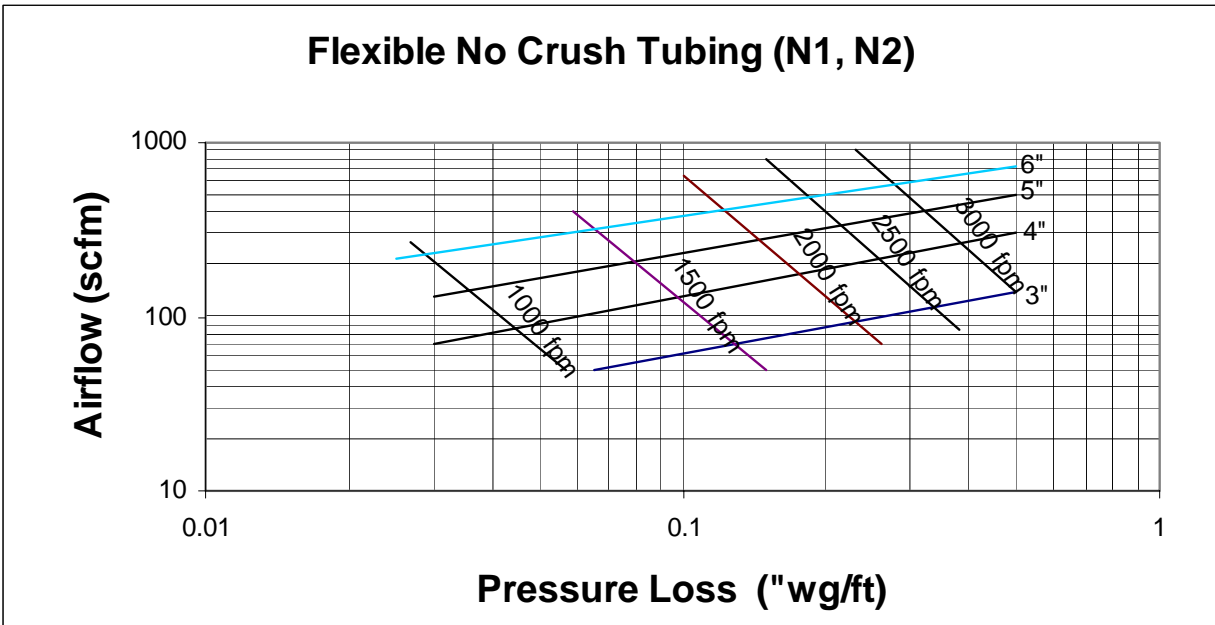


Figure 9.4

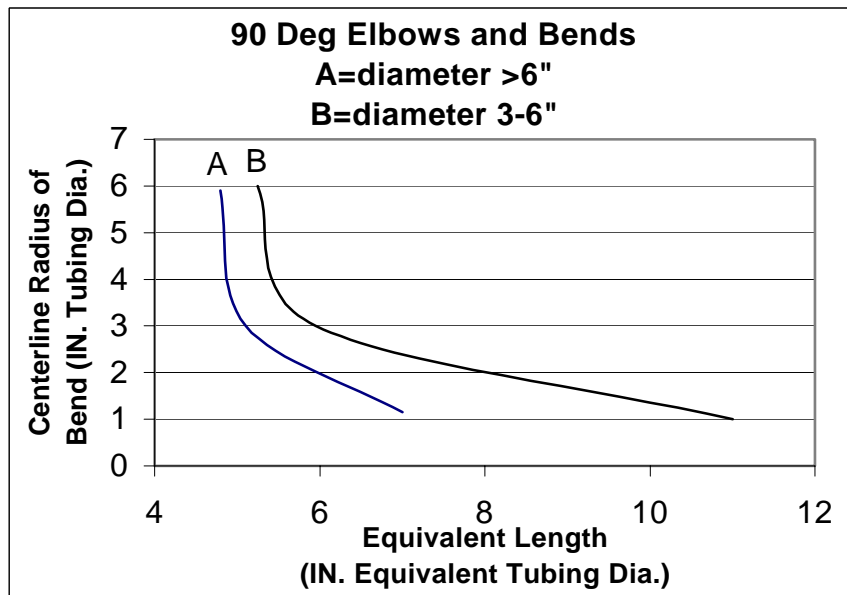
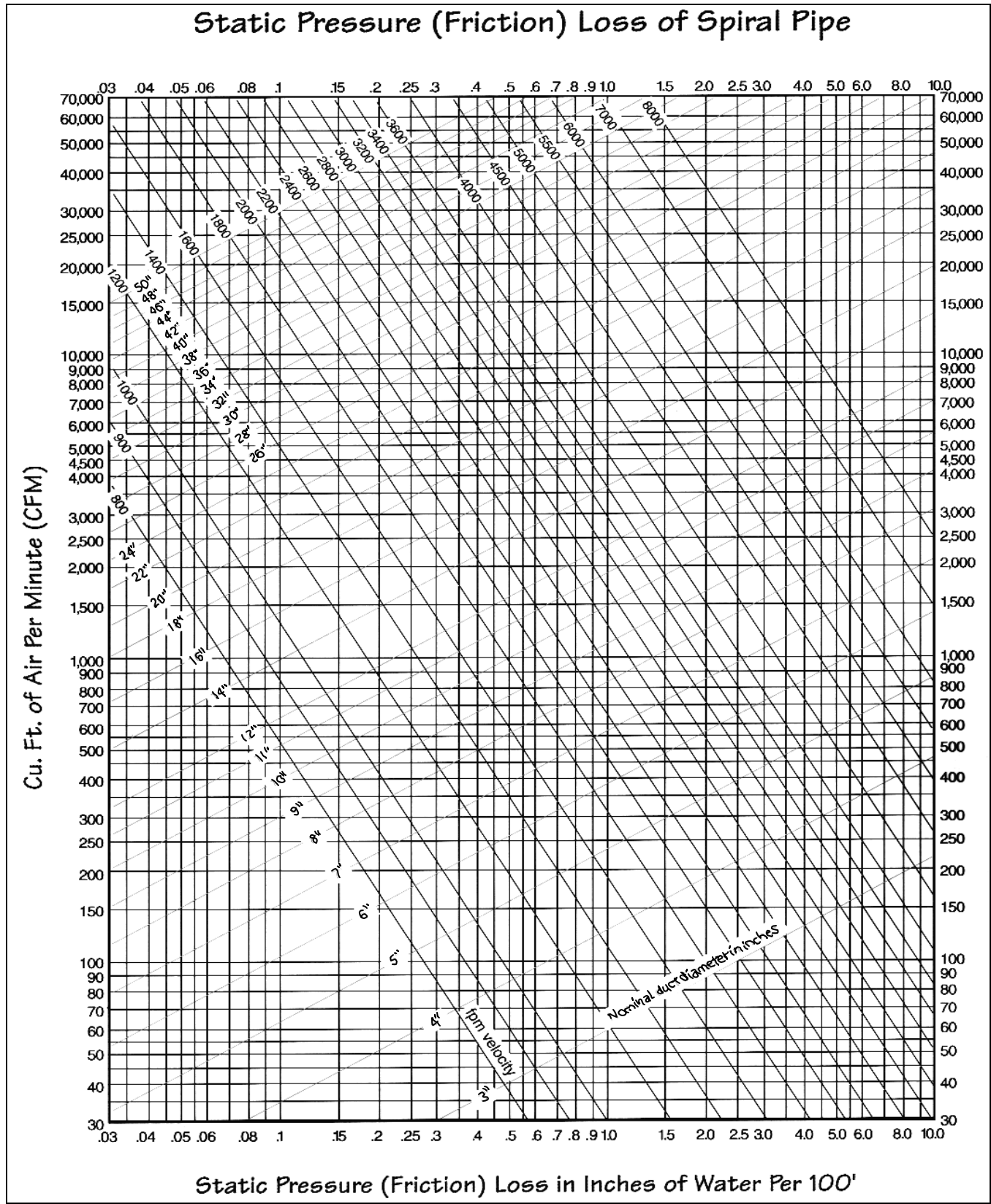


Figure 9.5



Static Pressure Loss in 90° Tees

Example: Main (V_U) = 4000, Branch (V_B) = 6000
 $V_B = \frac{6000}{4000} = 1.5$
 Velocity Ratio = $\frac{V_B}{V_U} = 1.5$
 From Chart: 1.5 Ratio @ 6000 f.p.m. ≈ 2.8 " S.P. loss

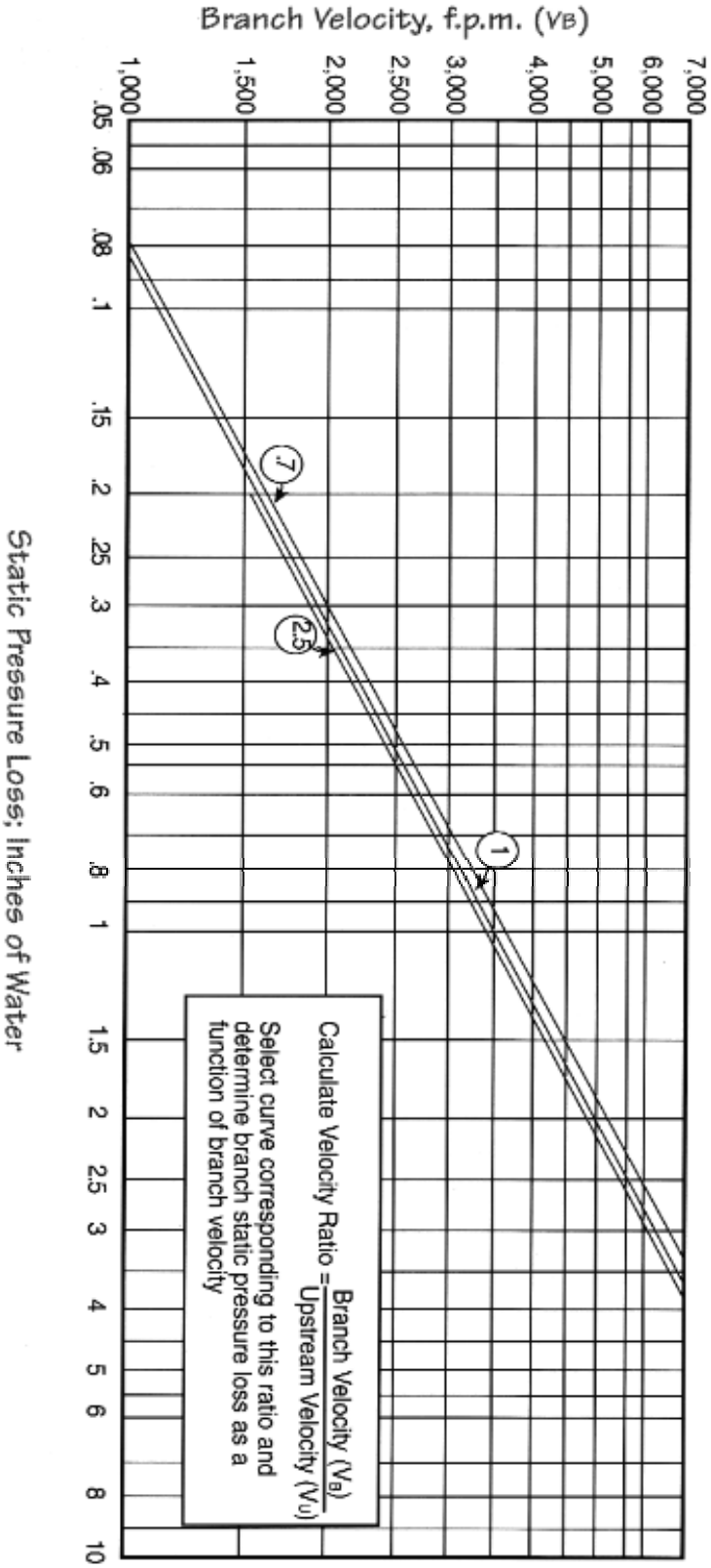
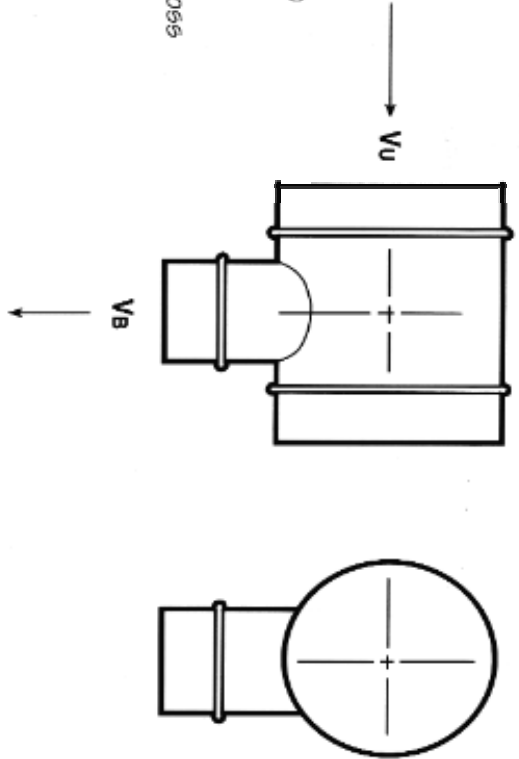


Figure 9.6

Figure 9.7

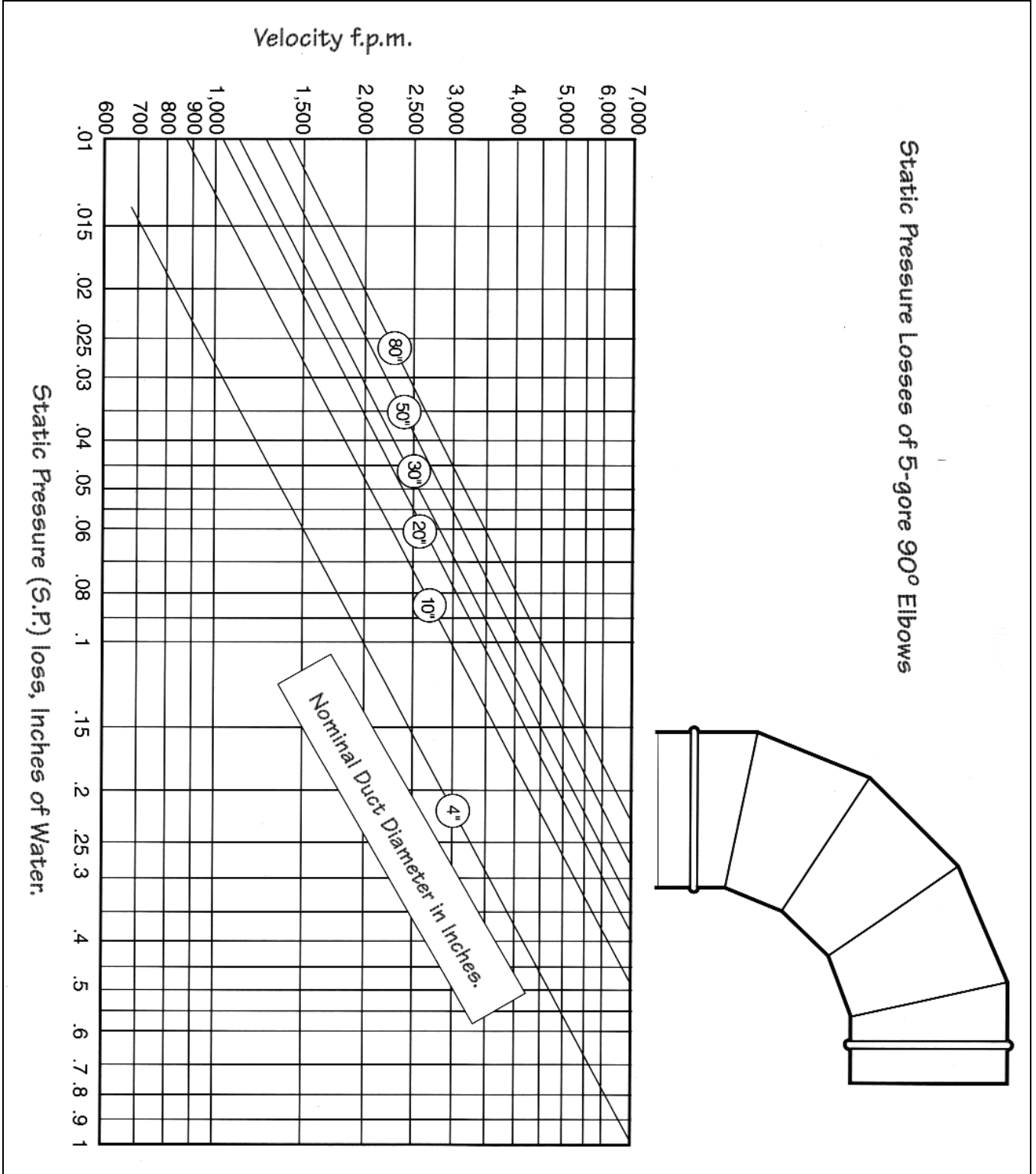
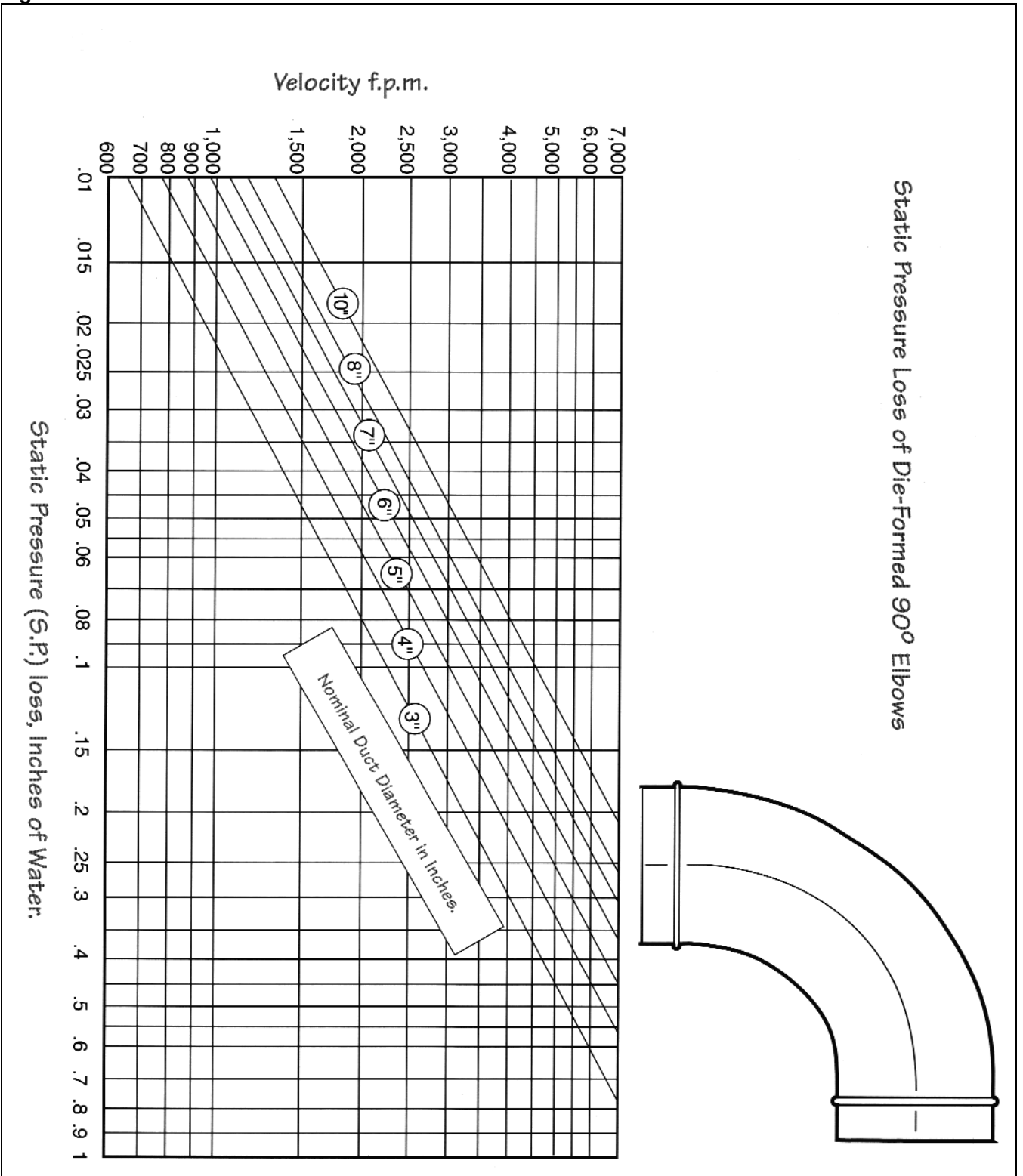


Figure 9.8



Section 10: Systems Exhaust Safety and Standards

10.1: Vehicle Exhaust Standards:

When working with underground and overhead ventilation systems, one can run into several toxic and hazardous substances. Two common substances that people are overly exposed to are carbon monoxide and carbon dioxide. When moving and stationary motor vehicles are operated for a period of time exceeding 10 seconds, the ventilation return air shall be exhausted. If the vehicle is stationary, it shall be provided with a source capture system that connects directly to the motor vehicle exhaust systems. An employee's exposure should be limited to substances found in Table Z-1-A in section 1910.1000 of OSHA's *Code of Federal Regulations*. Listed below are the OSHA limits for carbon monoxide and carbon dioxide.

TABLE 10.1 Limits For Air Contaminants

	Carbon Monoxide	Carbon Dioxide	Nitric Oxide
Time Weighted Average	35 ppm	10,000 ppm	25 ppm
Short Term Exposure Limit	----	30,000 ppm	----
Ceiling Limit	200 ppm	----	----

The time weighted average (TWA) is the average airborne exposure an employee receives in an 8 hour work day of a typical 40 hour work week. The TWA is a limit and should never be exceeded. The short term exposure limit (STEL) is the average airborne exposure limit which an employee receives during a 15 minute period throughout an 8 hour workday. The ceiling limit is an exposure limit that cannot be exceeded at any time of the day. Instantaneous measurements are taken to be sure exposures lie beneath the ceiling limit. To obtain the equivalent exposure for an 8 hour work shift, multiply each different concentration of the contaminant by the time it remained constant and add all of them together. Lastly, divide the sum of all of this by 8.

$$\text{Exposure} = (C_1 \cdot T_1 + C_2 \cdot T_2 + \dots + C_n \cdot T_n) / 8 \quad \text{Eq. 9.1}$$

If the exposure is greater than the TWA, STEL, or the ceiling limit, then controls shall be used to lower the exposure or protective equipment shall be used to keep the exposure to the contaminants within the limits required by OSHA.

In addition to carbon monoxide and carbon dioxide, diesel gas has been known to be a threat to safety. NIOSH recommends that whole diesel exhaust be regarded as a potential occupational carcinogen. There is not sufficient evidence that diesel exhaust causes hazardous risks of cancer, but NIOSH assumes that lowering exposure to diesel exhaust will reduce the risk.

Inadequate ventilation can cause dizziness, nausea, and/or respiratory irritation. Since microscopic dust particles remain suspended in the air for hours, ventilation should continue after operations are complete to ensure employees are not in a contaminated zone. Follow these general guidelines to keep hazardous CO exposure levels down.

1. Exhaust hoses provided at each service bay.

2. Damaged hoses are replaced immediately. (This calls for stocking of replacement hoses for use as needed.)
3. All service personnel are instructed to fit all vehicles and engines running in service bays with exhaust hoses.
4. Exhaust hoses are used at all times, even in warm weather when garage doors are open.
5. The exhaust system should be continued in operation for a time after the work processes stop to ensure removal of harmful contaminants.
6. The powered exhaust venting system is checked daily to make sure it is working and in compliance with exhaust gas venting standards.

10.2 Welding Standards:

Local exhaust ventilation should be used to prevent dispersion of dusts, fumes, vapors, and gas concentrations into the air. It should be used to keep the air contaminants within the permissible limits and prevent harmful exposure. Welding is a common process that may produce gases or fumes that are hazardous to health. For general welding and cutting, mechanical ventilation should be provided for spaces under 10,000 cubic feet per welder with a ceiling height less than 16 feet, or in confined spaces where ventilation is obstructed. A minimum airflow of 2000 cfm per welder should be used, unless approved respirators are provided. If freely movable exhaust hoods are used, then the hood shall be placed as close to the work as possible with a linear flow rate in the direction of the hood of at least 100 feet per minute. The capture velocity must be sufficiently high to maintain control of the contaminant until it reaches the hood. Minimum flow rates for a 3-inch wide flanged suction opening are shown below to obtain the minimum capture velocity.

TABLE 10.2

Welding Zone (inches from arc)	Minimum Air Flow (cfm)	Duct Diameter (inches)
4 to 6	150	3
6 to 8	275	3.5
8 to 10	425	4.5
10 to 12	600	5.5

Several factors can disturb the hood-induced air flow and produce a need for higher air flow rates to overcome the effects. The proper capture velocity depends on some of the following factors: room air currents, toxicity of contaminants, and the size of the hood. Larger or smaller values of these factors can increase the range of the necessary capture velocity. Listed on the following page, are ranges of capture velocities for several different factors².

² American Conference of Governmental Industrial Hygienists: *Industrial Ventilation*. Cincinnati, OH (1988)

TABLE 10.3 Range of Capture Velocities

Condition of Dispersion of Contaminant	Example	Capture Velocity, fpm
Released with very low velocity into quiet air.	Evaporation from tanks; degreasing; etc.	50-100
Released at low velocity into moderately still air.	Spray booths; intermittent container filling; low speed conveyor transfers; welding	100-200
Active generation into zone of rapid air motion.	Spray painting in shallow booths; conveyor loading	200-500
Released at high initial velocity into zone at very rapid air motion.	Grinding; abrasive blasting; tumbling	500-2000

When exhaust system hoods are used, they must be designed and located so dust will fall or be projected into the hood in the direction of the airflow. This is to prevent wheels, discs, straps, or belts from projecting dust or dirt into the operator’s breathing zone. OSHA lists minimum exhaust volumes for several different applications in section 1926.57(g) in the *Code of Federal Regulations*. Grinding wheels on floor stands, pedestals, benches, special-purpose grinding machines, and abrasive cutting-off wheels have a recommended minimum velocity of 4,500 feet per minute in the branch and 3,500 feet per minute in the main duct. Minimum exhaust volumes are shown below for several different methods.

TABLE 10.4

Grinding and Abrasive Cutting-Off Wheels

Wheel Diameter	Wheel Width	Minimum Exhaust Volume
(inches)	(inches)	(cfm)
Up to 9	1.5	220
10 to 16	2	390
17 to 19	3	500
20 to 24	4	610
25 to 30	5	880
31 to 36	6	1200

*Note: Recommended minimum duct velocity of 4,500 feet per minute in branch. Minimum of 3,500 feet per minute in the main.

For wider wheels, increase the exhaust volume by the ratio of the new width to the width shown.

Scratch-brush wheels and all buffing and polishing wheels mounted on floor stands, pedestals, benches, or special purpose machines should have minimum exhaust volumes as shown below:

TABLE 10.5**Buffing and Polishing Wheels**

Wheel Diameter (inches)	Wheel Width (inches)	Minimum Exhaust Volume (cfm)
Up to 9	2	300
10 to 16	3	500
17 to 19	4	610
20 to 24	5	740
25 to 30	6	1040
31 to 36	6	1200

Grinding wheels or discs for horizontal single-spindle disc grinders should be hooded to collect the dust or dirt generated by the grinding operation, and the hoods should be connected to the branch pipes having exhaust volumes as shown below:

TABLE 10.6**Horizontal Single-Spindle Disc Grinder**

Disc Diameter (inches)	Exhaust Volume (cfm)
up to 12	220
13 to 19	390
20 to 30	610
31 to 36	880

Grinding wheels or discs for horizontal double-spindle disc grinders should have a hood enclosing the grinding chamber and the hood should be connected to one or more branch pipes having exhaust volumes as shown on the following page:

TABLE 10.7**Horizontal Double-Spindle Disc Grinder**

Disc Diameter (inches)	Exhaust Volume (cfm)
up to 19	610
20 to 25	880
26 to 30	1200
31 to 53	1770
54 to 72	6280

Grinding wheels or discs for vertical single-spindle disc grinders should be encircled with hoods to remove the dust generated in the operation. The hoods should be connected to one or more branch pipes having exhaust volumes as shown below:

TABLE 10.8

Vertical Spindle Disc Grinder

	Half or More of Disc Not Covered		Disc not Covered	
Disc Dia.	Number	Exhaust	Number	Exhaust
(inches)	(1)	(cfm)	(1)	(cfm)
Up to 20	1	500	2	780
21 to 30	2	780	2	1480
31 to 53	2	1770	4	3530
54 to 72	2	3140	5	6010

NOTE: Number of exhaust outlets around periphery of hood, or equal distribution provided by other means.

Grinding and polishing belts shall be provided with hoods to remove dust and dirt generated in the operations and the hoods shall be connected to branch pipes having exhaust volumes as shown on the following page:

TABLE 10.9

Grinding and Polishing Belts

Disc Diameter	Exhaust Volume
(inches)	(cfm)
up to 3	220
4 to 5	300
6 to 7	390
8 to 9	500
10 to 11	610
12 to 13	740

These are several of the OSHA standards to be followed, and can be further reviewed under *OSHA Dust and Fume Control Requirements* in section 1910.94. Overall, adequately ventilate all welding and cutting confined spaces for the welder and workers in the same environment. If ventilation cannot be provided, use NIOSH/MSHA approved airline respirators or hose masks. When breathing protection is used, be sure to have an outside helper monitor the situation to ensure safety.

10.3 Respirator Standards:

To control injury and illness caused by breathing air contaminated with harmful contaminants, the primary objective is to prevent atmospheric contamination. This is accomplished by substituting different materials or by using general or local ventilation. When these methods do not lower contamination levels to feasible amounts, then appropriate respirators must be used. OSHA issued a new respiratory protection standard during January in 1998. It included the following:

Employers must provide respirators when necessary to protect the health of employees. A respiratory protection program must be established to highlight procedures and reflect any changes in workplace conditions. The program should include procedures for selecting, proper use, cleaning, disinfecting, storing, repairing, maintaining, and testing appropriate respirators. It also should include employee training for proper use of respirators, limitations, maintenance, and training with possible hazards in routine and emergency situations. Selection of the appropriate respirator relies on the severity of the hazard and how much employees are exposed to the contaminant. Once the hazard is identified and evaluated, employers must select an appropriate NIOSH – certified respirator. The compressed breathing air supplied must meet the requirements for Grade D breathing air described in G-7.1-1989, ANSI / Compressed Gas Association Commodity Specification for Air. These requirements include:

1. An oxygen content of 19.5 to 23.5 percent
2. A hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less.
3. A carbon monoxide (CO) content of 10 ppm or less.
4. A carbon dioxide content of 1,000 ppm or less.
5. A lack of noticeable odor.

Following these standards and implementing a respiratory protection program will lead to safe levels of contaminants in the work place. For more information regarding respiratory requirements, see *OSHA Respiratory Protection Requirements on General Industry* in section 1910 of the *Code of Federal Regulations*.