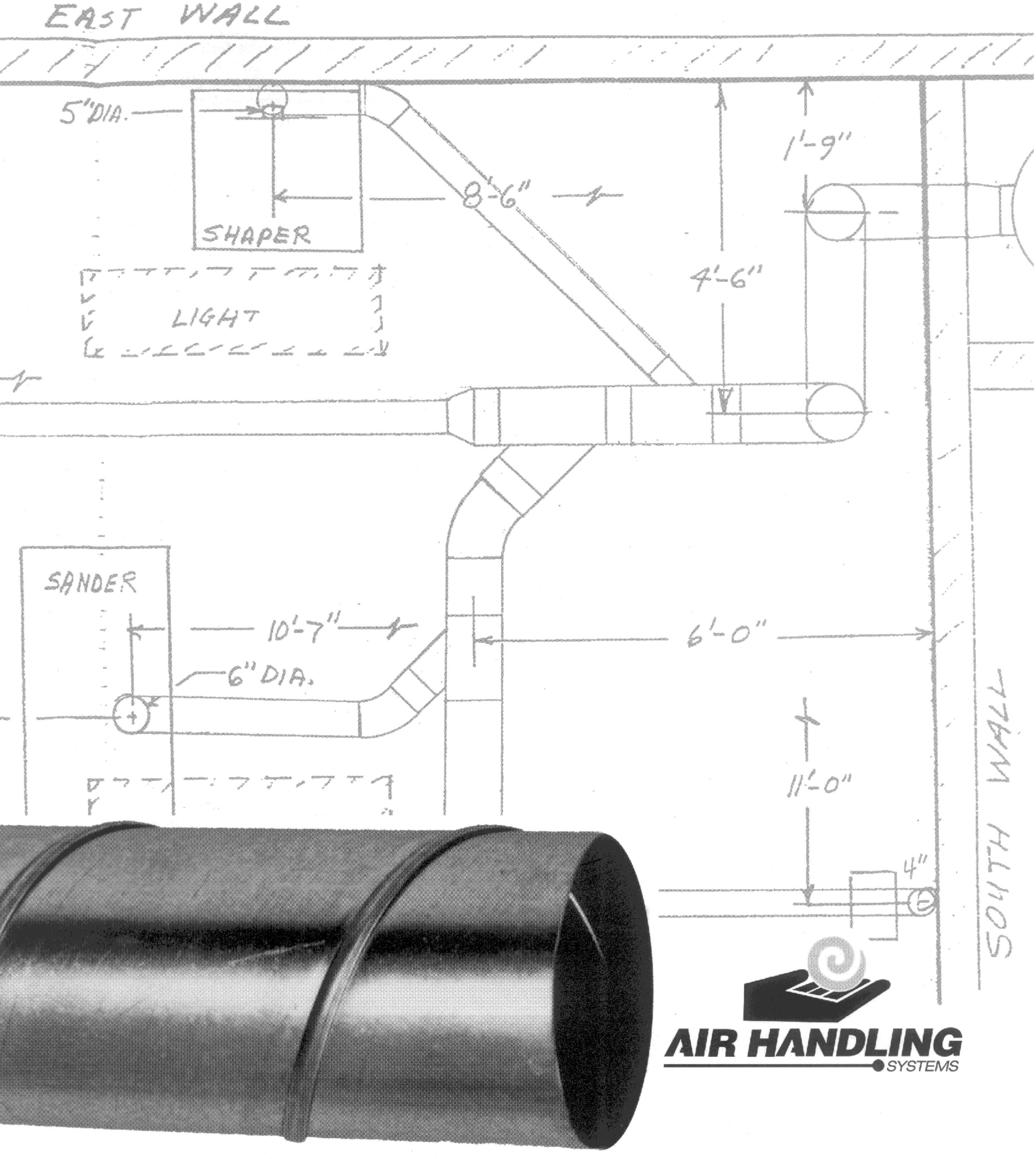
How to Design Your Air Handling System



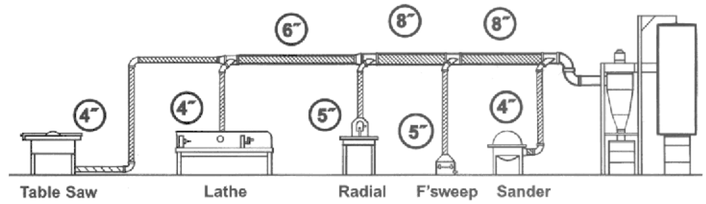
AIR HANDLING
SYSTEMS

Designing Your Air Handling Dust System

In addition to using the following instructions, we recommend reading the "Woodshop Dust Control Book", by professional woodworker Sandor Nagyszalanczy. Sandor gives you practical, shop-tested solutions to total dust control so you can build the right system for your shop-without complex calculations.
Part #: TPBWDC. SOFTCOVER, 192 PAGES, To order call us at (800) 367-3828

The first step in designing your system is to draw a floor plan of your shop area including the following:

1. *Location of dust producing machines: indicate size & location of dust pick-ups on each machine.*
2. *Desired location of dust collector unit.*
3. *Floor to joist measurement.*
4. *Any obstructions that would interfere with the run of the duct.*



You should also familiarize yourself with these terms:

CFM - Air Volume in cubic feet per minute.

FPM - Velocity of Air in feet per minute.

SP - Static Pressure. This is expressed in inches water gauge. It is resistance to air at rest in a duct, and is also commonly called "resistance," friction," "friction loss'" or "pressure loss."

VP - Velocity Pressure: expressed in inches water gauge. It is kinetic pressure in the direction of flow necessary to cause air at rest to flow at a given velocity.

It is best to do the following calculations **BEFORE** you purchase your Dust Collector or the necessary ductwork.

A) Duct Velocity (FPM); B) Determine Diameter of each Branch; C) Determine Diameter of Main Duct; D) System Resistance (SP)

A) Duct Velocity. **(Use the chart below to determine the Velocity of your system.)**

Type of Dust	Velocity in Branches	Velocity in Main
Metalworking Dust	4500 FPM	4000 FPM
Woodworking Dust	4000 FPM	3500 FPM
Other Light Dust	4000 FPM	3500 FPM

B) Determine Diameter of each Branch. There are several ways to determine the diameter of the branches.

1. *If the machine has a factory installed collar, the manufacturer has determined that the machine needs that size branch under normal circumstances.*
2. *If the machine has a metric diameter outlet, convert it into inches, and round off to the nearest inch. When writing up your parts list you may need to order a custom reducer.*
3. *If the outlet is rectangular you need to determine the equivalent round diameter. When you write up your parts list use a rectangular-to-round transition.*
4. *If the branch is smaller than 3" diameter plan using a reducer near the machinery to increase the branch to 3". Figure the CFM for 3" (195 CFM).*

Determine CFM requirements for each branch. Under the proper velocity note the CFM of each branch. If working with wood dust, use 4000 FPM in branches (see Chart 1).

C) Determine Diameter of Main Duct.

1. Determine which machines are your primary machines. A primary machine is the machine(s) that will operate at the same time under the worst conditions. (If you normally operate two machines, but once a week need to operate a third machine at the same time, then you must size your system for all three machines.) It is recommended that you highlight the primary machines on the drawing.
2. Sizing the Main Trunk Line. When sizing the main trunk line start with the primary machine farthest from the dust collector. Run that size duct until the next primary branch enters the main. Increase the main size at that junction to accommodate the C.F.M. total of the two primaries. You will follow this practice all the way to the collector, sizing all primary junctions to accommodate total C.F.M. of all primaries at that point. Do not increase main duct size when a branch other than a primary enters. Your total C.F.M. requirement is the total of all primary branches. When not using a primary machine you will close blastgate and divert suction to a secondary machine.

Example: You have 3 primary machines. You have already assigned the branch diameter and CFM requirements.

Table Saw, Lathe	**4" Diameter**	**350 CFM**
Radial Saw	**5" Diameter**	**550 CFM**

A 4" branch will be run from the Table Saw until it joins with the 4" branch from the Lathe. At this point your main starts and you need to increase the pipe to handle the combined CFM (350+350 = 700). Using the CFM Chart 1 look up 700 CFM under the appropriate velocity (3500 in the main for wood dust), then look at the corresponding diameter (6"). You will run 6" pipe in the main from the Lathe until the branch of the Radial Saw joins the main.

Here again you need to increase your main to handle the total CFM (700+550=1250 CFM). Using the chart again you will see that 1250 CFM is slightly more than volume for 8" diameter. Drop back to 8" diameter so as not to go below transport velocity. Run the 8" duct in your main from the Radial Saw to your Dust Collector.

If you are installing an indoor recirculating dust collector you need not calculate any more duct diameters. If you are attaching ductwork to the exhaust side of your dust collector it is accepted practice to use a duct diameter two inches larger on the exhaust side than on the inlet side, thus minimizing exhaust and duct resistance.

Static pressure of two 4" branches (350 CFM each) and one 5" branch (550 CFM) pulling vacuum simultaneously. (Total 1,250CFM)

Chart 1			
CFM requirements for diameter at specified velocity.			
Dia.	**3500 FPM**	**4000 FPM**	**4500 FPM**
3"	170	195	220
4"	300	350	390
5"	475	550	610
6"	700	785	880
7"	950	1100	1200
8"	1200	1400	1570
9"	1550	1800	1990
10"	1900	2200	2450
12"	2800	3175	3600
14"	3800	4300	4800

Chart 2					
Static Pressure based on 100' of Pipe.				Elbow to Straight Pipe Conversion.	
Dia.	**3500 FPM**	**4000 FPM**	**4500 FPM**	**90 Elbow 1.5 Dia. Rad.**	**45 Elbow 1.5 Dia. Rad.**
3"	7.5	10.0	12.0	5'	2.5'
4"	5.5	7.0	8.5	6'	3'
5"	4.2	5.5	6.5	9'	4.5'
6"	3.5	4.5	5.5	12'	6'
7"	2.8	3.8	4.5	13'	6.5'
8"	2.4	3.2	3.8	15'	7.5'
9"	2.0	2.8	3.4	17.5'	8.75'
10"	1.8	2.4	3.0	20'	10'
12"	1.5	2.0	2.5	25'	12.5'
14"	1.3	1.6	2.0	30'	15'

D) Figure System Resistance (SP) The total static pressure is several factors added together. They are entry loss, dirty filter loss, static pressure of the worst branch duct, static pressure of main duct, and static pressure of the return duct.

1. There are more complicated ways to figure the entry loss of your system, but we find it usually equals a loss of **1"** watergauge. (Use 1" as a constant).
2. If your system has filters, add in a **2"** loss. (If you do not have filters add zero).
3. The Worst Branch, is the branch with the greatest resistance. The branch with the greatest resistance is usually a smaller diameter with the most lineal footage of pipe and elbows. Static pressure of worst branch and main duct can be calculated by using Chart 2. Chart 2 is based on 100 feet of pipe; therefore, you have to convert all elbows to an equivalent of pipe. To convert 90 and 45 degree elbows to equivalent feet of pipe use this chart. When figuring the feet of pipe, count lateral type branches as 45 degree elbows. Flexhose has a lot of resistance depending on the corrugation. For this reason it is suggested that you keep hose to a minimum. Multiply your length of flexhose on your worst branch by 3 for equivalent length of straight pipe.

***Example*: Determine Static Pressure in Worst Branch**

Static Pressure (Inches of Water Gauge) in WORST BRANCH (4" Table Saw).

Description - 4" Diameter	**Equivalent to Straight Pipe**
Straight Pipe	20'
2 - 90° Elbows	12'
1 - 45° Elbows	6'
5' Flexhose (3x)	15'
Total equivalent straight pipe after conversions	**53'**

350 CFM in 4" diameter = 7" S.P. per 100'
350 CFM in 4" diameter = **3.71"** S.P. per 53'

***Example:* Static Pressure in MAIN DUCT 6" and 8"**

The static pressure of the Main Duct is done the same way, except you figure it out for each diameter in the Main, starting farthest away and working toward the collector.

Description - 6" Diameter	**Equivalent to Straight Pipe**
Straight Pipe	20'
Total equivalent straight pipe after conversions	**20'**

700 CFM in 6" diameter = 3.5" S.P. per 100'
700 CFM in 6" diameter = **.70"** S.P. per 20'

Description - 8" Diameter	**Equivalent to Straight Pipe**
Straight Pipe	25'
2 - 90° Elbows	30'
Total equivalent straight pipe after conversions	**55'**

1,250 CFM in 8" diameter = 2.4" S.P. per 100'
1,250 CFM in 8" diameter = **1.3"** S.P. per 55'
(8" Diameter runs to self contained Dust Collector)

Total Static Pressure 1" + 2" + 3.71" + .70" + 1.3" = 8.71" S.P. Water Gauge!
System Requirement - 1,250 CFM at 8.71" SPWG

4. If clean air return duct is required, duct resistance should also be calculated.

Now you have all the information you need to make an educated decision in purchasing your dust collector. You have determined the Velocity, CFM, Static Pressure and the size of the ductwork. To develop your list of materials required, go through the system; this time starting at the dust collector and list each part you will need. Don't forget the assembly equipment such as: pop rivets, hangers, strapping, caulking, and couplings. **For ordering please Call: (800) 367-3828; Fax: (800) 438-7135; or Mail: (Air Handling Systems, 5 Lunar Drive Woodbridge, CT 06525)** us your parts list. If you have any questions while you are designing your system give us a call and we'll be happy to help.

Installation of Spiral Pipe and Fittings

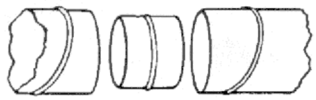
1. Fittings and Small-End couplings are male sized to slip inside pipe and flexhose.
2. Fitting-to-Fitting connections are made by using a Large-End coupling or a short length of spiral pipe.
3. Our duct work is not flared or belled on one end for the "air flow" type of joint.

Continued on next page

Installation of Spiral Pipe and Fittings *Continued*

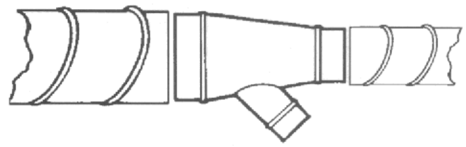
Round duct sections of spiral pipe are connected together by small end coupling (part no. COUP). The coupling as a male part, is slipped into the duct.

Pipe to Pipe Connection, slip coupling for joining pipe.



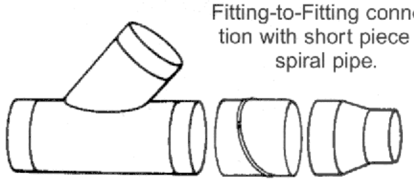
All fittings, unless specially ordered, are sized as a male part. A fitting-to-duct connection is made by slipping the fitting into the duct.

Fitting-to-Duct Connection

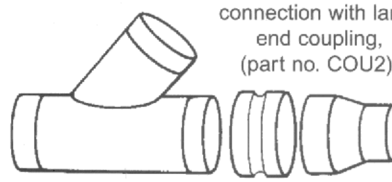


Fitting-to-fitting connections can be made two ways: by cutting, a short length of spiral pipe approximately four inches or longer and using this length of pipe as a female connection; or by using a Large-End Coupling (part no. COU2) which is four inches long.

Fitting-to-Fitting connection with short piece of spiral pipe.



Fitting-to-Fitting connection with large end coupling, (part no. COU2).



Dust Collection Q&A

Why should I buy dust collection?

One important reason is to avoid the health risk. Inhaling fine dust can develop into respiratory illnesses as well as aggravate existing respiratory conditions. There are various types of dust that can also cause irritation to uncovered skin surface. Fine dust can stay suspended for hours. Exposing employees to this type of environment will certainly result in workman's compensation claims or even possibly a law suit. Providing dust collection at machinery as well as self-contained ceiling suspended dust collection units will keep the shop air virtually dust free.

To produce a quality product, the workshop should be as dust free as possible. If you have ever driven in a snowstorm or rainstorm you can feel for a woodworker who has his vision impaired by clouds of sawdust. Making accurate cuts, measurements, assemblies, etc. are extremely difficult under this condition. Also, if a shop has a high concentration of dust in the air, the dust can be drawn into paint booths. The dust will surely create a defective finish on the product. In addition, if dust collection is not provided for machines such as planers, the chips will lay on the boards and create indentations on the planed material. Thus, again creating a defective product. Having spot dust collection on machinery and self-contained air cleaners will surely take care of these potential problems.

Metal and Fumes in the Dust Collection System – I sometimes bore holes into iron at my drill press. It is safe to admit these metal filings and chips into a vacuum drop? Also, can the system be used to remove low-level solvent fumes from the shop?

When setting up an air-handling system, you have to be careful to make sure that whatever it will be handling is compatible.

In general, I don't recommended the mixing of unlike material in an exhaust system because it might start a fire or cause an explosion. Mixing wood with metal chips or filings, especially ones that are very hot from drilling, has the potential to create a spark, and more. When a spark comes in contact with finely divided dust particles or solvent fumes, the spark can cause the two materials to ignite.

Because solvent fumes can contain flammable vapors and often have an explosive nature, they shouldn't be mixed in the average dust-collection system. Volatile fumes, like those from solvents, thinners or lacquers are highly flammable. They have to be handled by a blower that is constructed of non-ferrous metals (usually aluminum) and is explosion proof.

Improperly used, a dust-collection system can defeat the purpose of using it in the first place. Always consult with an Air Handling System's specialist or the National Fire Protection Association (800-344-3555) before mixing materials in an exhaust system.

How does one go about grounding a (PVC) plastic pipe system?

I am not sure your typical plastic pipe system conveying dust can be adequately grounded. As we know, the reason for people attempting to ground pipe is because of the generation of static electricity. Static electricity develops when the dust particles constantly rub the plastic surface. A substantial electrical accumulation may result, which then begins to discharge into fine dust particles. It is likely an explosion will occur at some time under this condition. Interior and exterior grounding has to be considered. If a grounding method was available for this situation, I am sure it would be quite extensive and expensive.

Plastic pipe systems are not designed for dust collection use. A necessary diversity of fittings to meet design requirement does not exist. Also, plastic pipe elbows have a very short radius and plastic tee fittings are improper for dust removal. It is these types of problems that lead to an inefficient dust collection system.

My suggestion would be to convert over to a metal piping system. With a metal dust collection piping system you do not have the concern of static electricity developing. Elbows and other various fittings are properly designed for conveying dust. The diversity of fittings and accessories will enable you to meet design requirements. Inevitably, you will get the best performance from your dust collector.

What is the difference between a single stage and two-stage collector?

Since most woodworking dust contains coarse and fine sized particles, a two-stage dust collection system is generally recommended. A two-stage dust collector consists of a first stage cyclone, a blower and a second stage after filter.

A cyclone separator is a cone shaped vessel into which the dust-laden air enters. The dust particles' inertia causes them to move toward the separators outer wall. As the dust particles proceed towards the outer wall the coarse-sized particles lose momentum. When the velocity drops on the coarse-sized particles, gravity causes them to settle into the container below. The remaining fine dust exits through a central outlet at the top and into the blower. The blower than relays the fine dust to the after filter. It is important to know that the longer the cyclone body and cone, the better the dust separation.

One major reason for using a separator is so the blower unit will only convey fine dust. In a single stage unit, coarse wood dust particles and other debris hitting the blower impeller most likely will result in blower unbalance. The condition will ruin the blower quickly. Also, a separator is used so that the after filter does not receive 100% of the dust-laden air.

Is it a good idea to locate my collector outside my shop?

Yes, it is a good idea to locate your collector in an enclosure on an outside wall of the shop. A couple of benefits are; saving floor space, and most of the noise will be contained in the enclosure. One important factor is that you cut in a filter frame near the ceiling, on the common wall between the enclosure and the shop, and insert a furnace filter. A 20"x20" filter is normally adequate. This will allow air to re-circulate back into the shop. The furnace filter is inexpensive to change and will provide for cleaner air returning to the shop.

I'm a small shop and I need just a few items. Will you sell direct to me?

We sell directly to individuals, and companies of all sizes. We do not have a minimum order/quantity requirement. If just a few parts are required for your Air Handling System, we can service your need. Place your order by calling, submitting a fax, or by mail. We accept all major credit cards: MasterCard, Visa, Discover or American Express. We ship most orders within a 48-hour time frame.

Distributor:

For additional design information or answers to your dust collection questions contact:

Air Handling Systems

5 Lunar Drive, Woodbridge, CT 06525

(800) FOR-DUCT (367-3828) Fax: (800) 438-7135

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