At this point I recommend that you either paint or formica the top to protect the surface from oil and grease.

THE BACKBOARD FRAME

Use 2 X 4 lumber to make the backboard frame. If you are going to use a leaf blower or equivalent fan, assemble a backboard frame as shown in diagram 9A. If you are going to use a fan which pulls about 28" of water at 300 CFM, assemble as shown in 9B.

DIAGRAM 9A: *Backboard Frame*

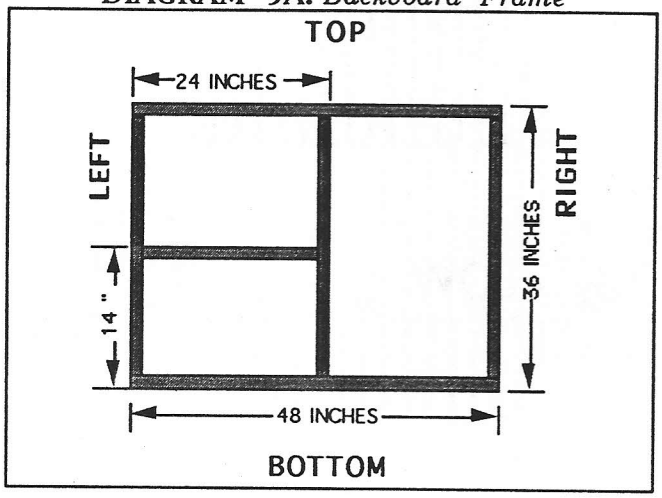
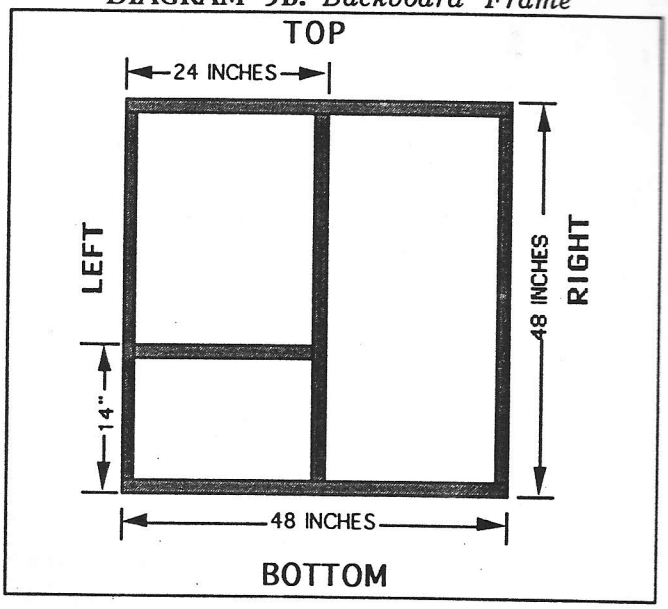


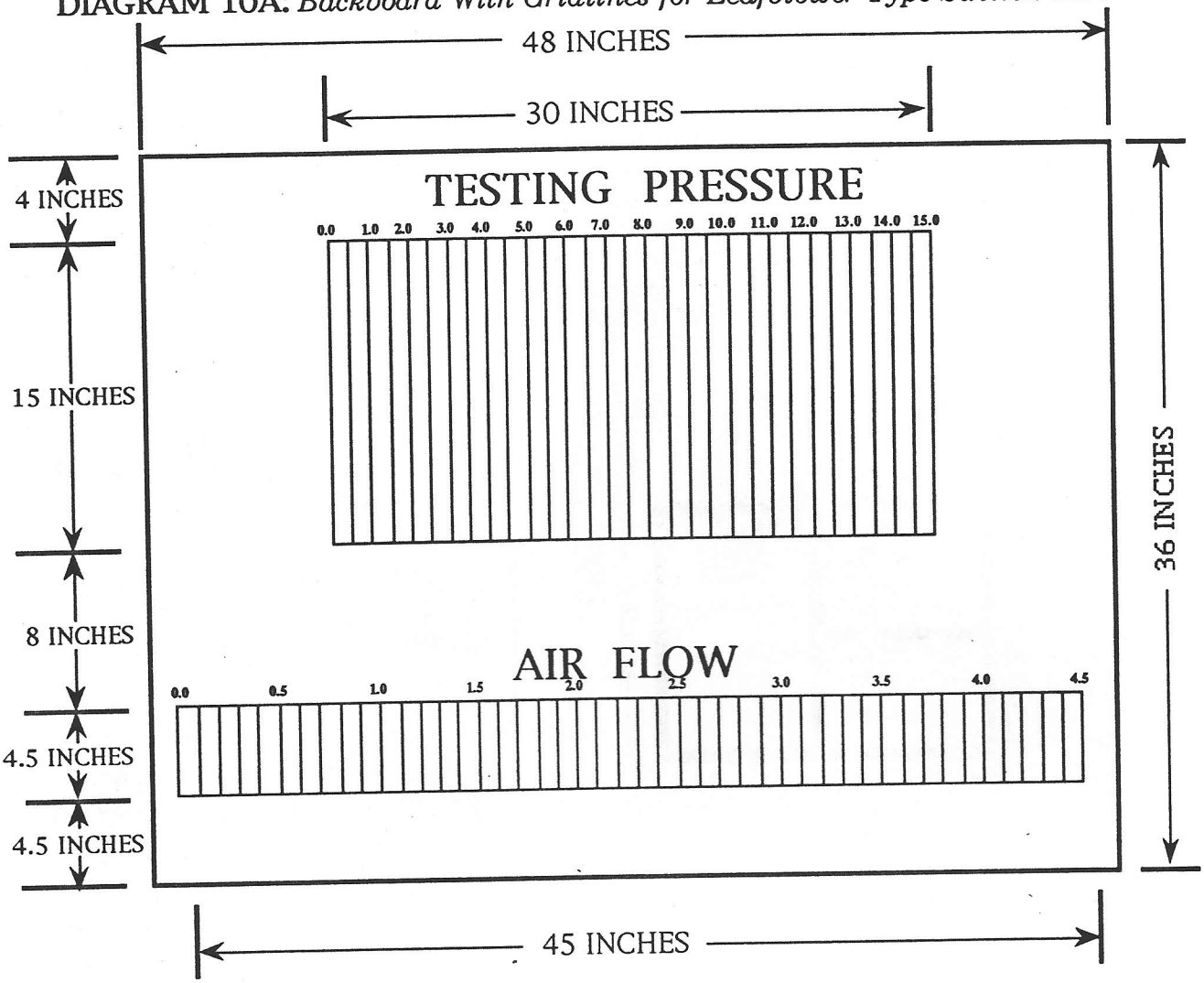
DIAGRAM 9B: *Backboard Frame*



THE BACKBOARD

Use a piece of 1/8" thick hardboard for a backboard. You can purchase this with a preapplied gloss white surface. This is available at building supply stores under the brand name ABITTIBI®. If you purchase an uncolored hardboard you should paint it white. Cut and mark the hardboard as shown in diagrams 10A and 10B.

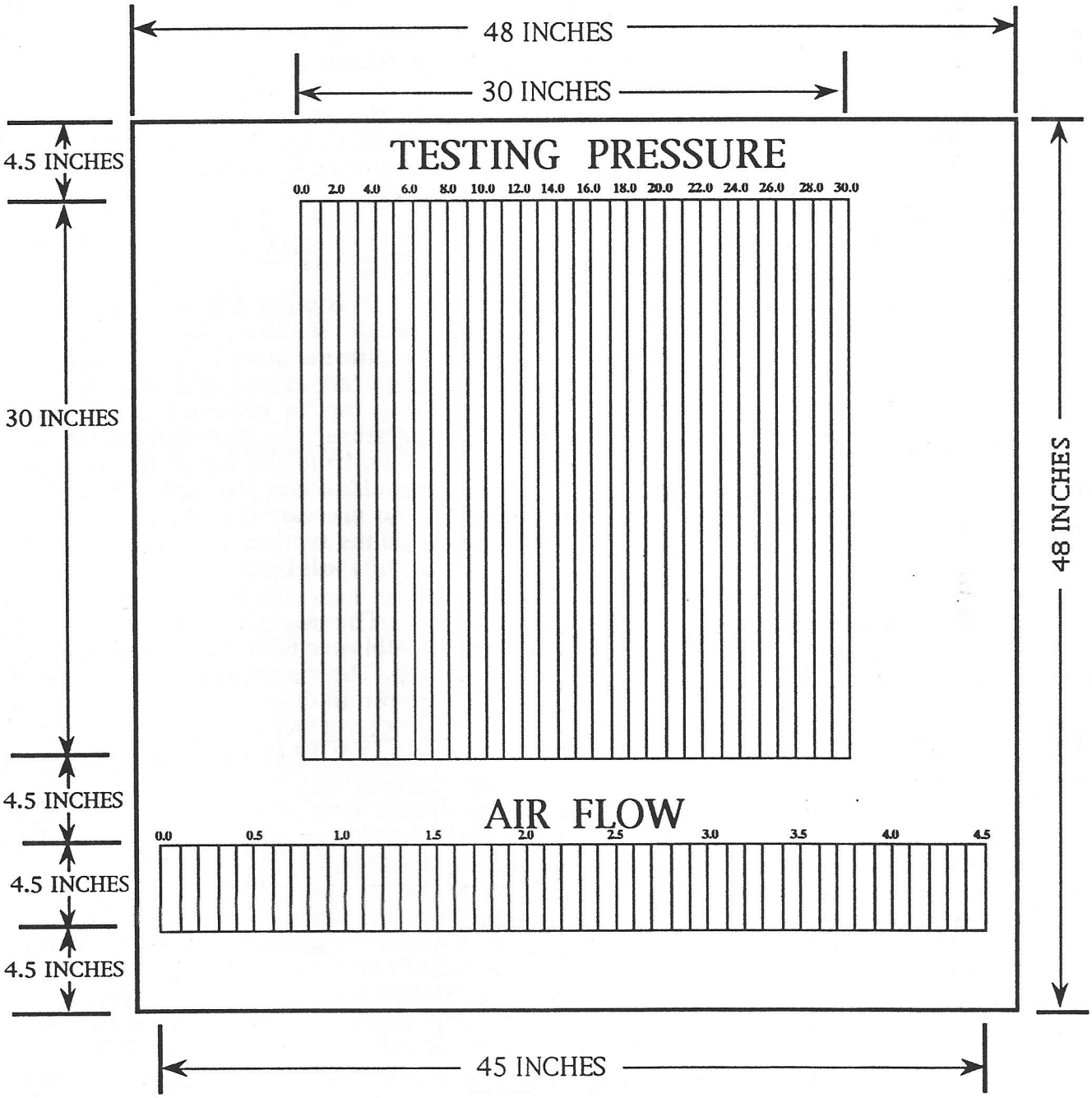
DIAGRAM 10A: *Backboard With Gridlines for Leafblower Type Suction Fan*



Note the following on this diagram:

- Vertical gridlines for the testing pressure gauge and the air flow gauge are to be spaced 1 inch apart
- The testing pressure gauge is numbered from 0.0" to 15.0" in 1.0" increments
- The air flow gauge is numbered from 0.0" to 4.5" in 0.5" increments
- Make sure the horizontal gridlines are parallel to the bottom of the backboard

DIAGRAM 10B: *Backboard With Gridlines for High Power Fans*



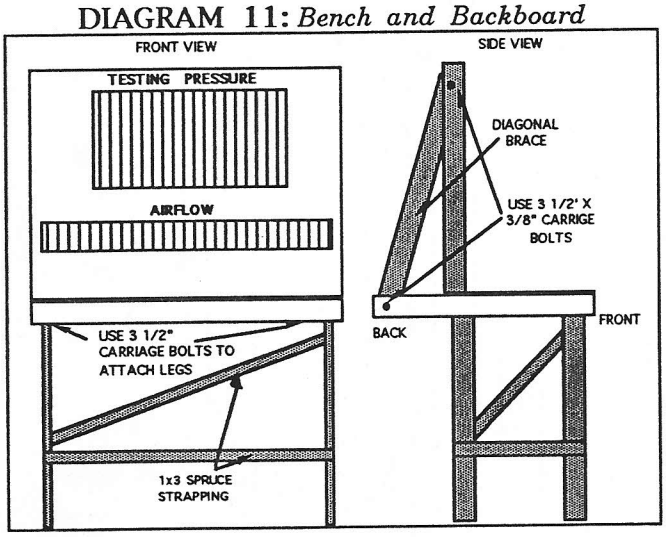
Note the following on this diagram:

- vertical gridlines for the testing pressure gauge and the air flow gauge are to be spaced 1 inch apart
- The testing pressure gauge is numbered from 0.0" to 30.0" in 2.0" increments
- The air flow gauge is numbered from 0.0" to 4.5" in 0.5" increments
- Make sure the horizontal gridlines are parallel to the bottom of the backboard

TIP: A quick neat way of laying out the grid is with 1/8" black pinstriping tape and vinyl stick on characters.

Now take the completed backboard and nail it to the backboard frame. Make sure the bottom edge of the hardboard is accurately aligned with the bottom of the backboard frame. Nail the backboard onto the bench. Next cut two 2x4's for a diagonal brace. Bolt into position as shown in diagram 11.

DIAGRAM 11: *Bench and Backboard*

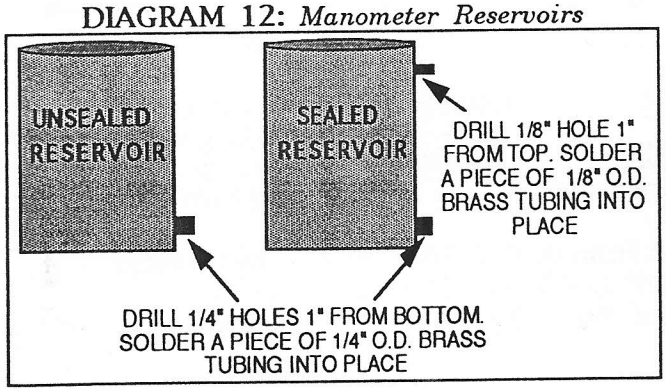


MANOMETER RESERVOIRS

You will need two manometers. One will measure pressure relative to the atmosphere, the other will measure pressure differences between two sources. Both water reservoirs can be made from 16 0z. tin coffee cans. The airflow manometer will need an airtight reservoir.

Drill holes and solder in pieces of brass tubing as shown in diagram 12.

DIAGRAM 12: *Manometer Reservoirs*



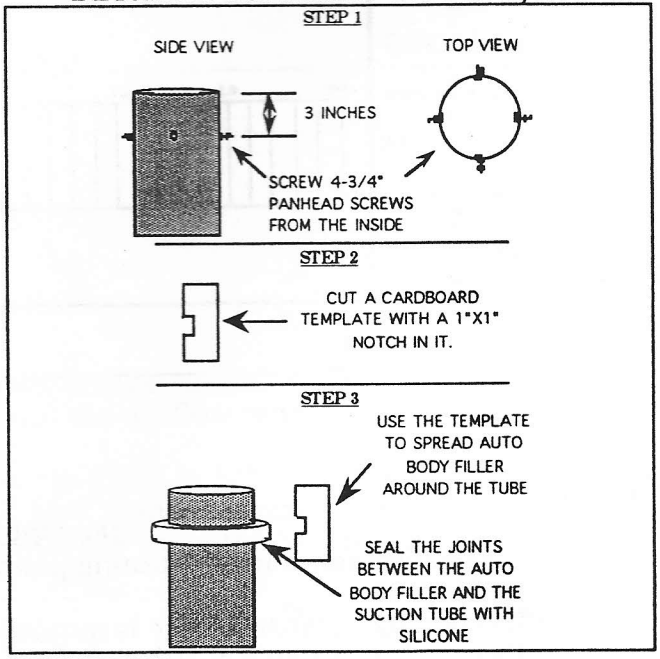
Paint the inside of the cans with waterproof paint. To finish the airtight reservoir you must seal the top. The plastic lid that came with the coffee can is useless, even with silicone. Cut out a piece of sheet metal big enough to cover the top of the can. Glue the sheetmetal piece to the top with epoxy or autobody filler. Make sure there is a continuous seal around the top, it must be air tight.

SUCTION TUBE TAP

This tap is a source of vacuum. It is used to determine the testing pressure. Additionally this is one of the sources required to measure airflow. In diagram 1 this tap is referred to as the "testing pressure" tap. This tap should be located 3" down from the top of the suction tube. You should use a piece of 1/8" O.D. tubing for your pressure tap. The tap must not protrude into the suction tube. If the tap protrudes the results will be in error.

The suction tube supplied with the leafblower is to thin to properly support the tap. The suction tube can be reinforced as shown in diagram 13.

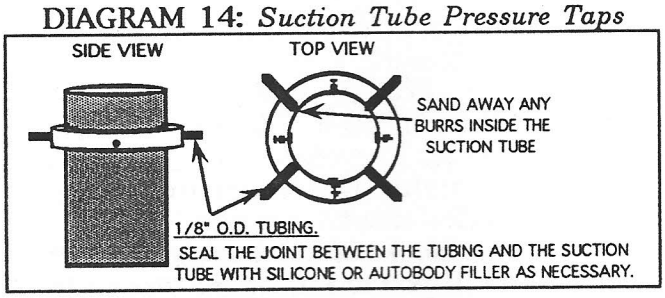
DIAGRAM 13: *Suction Tube Reinforcement*



If you are using a 4" PVC pipe as a suction tube, no reinforcement is necessary. Drill

four 1/8" holes equally spaced around the tube. Press in 2" pieces of 1/8" tubing until it is flush with the inside surface of the suction tube. This should be on airtight fit. Add silicone or additional autobody filler as required. Next sand off any burrs from the inside of the suction tube. See Diagram 14.

DIAGRAM 14: *Suction Tube Pressure Taps*



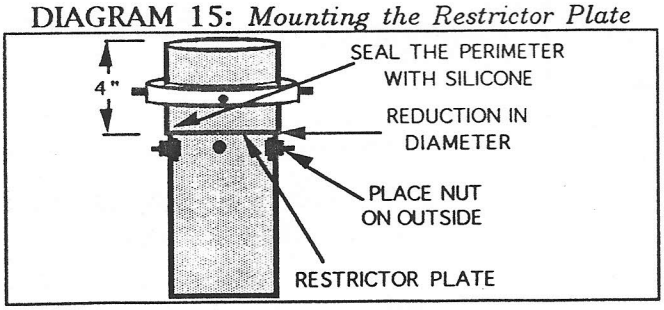
AIRFLOW SENSORS

First you must determine if you are going to construct a flow sensor. As stated earlier it is possible to build a useful flowbench without a flow sensor. If you decide to build a flow sensor you need to determine which type, restrictor plate or venturi. Read the sections below to decide which type is best for you.

RESTRICTOR PLATE SENSOR

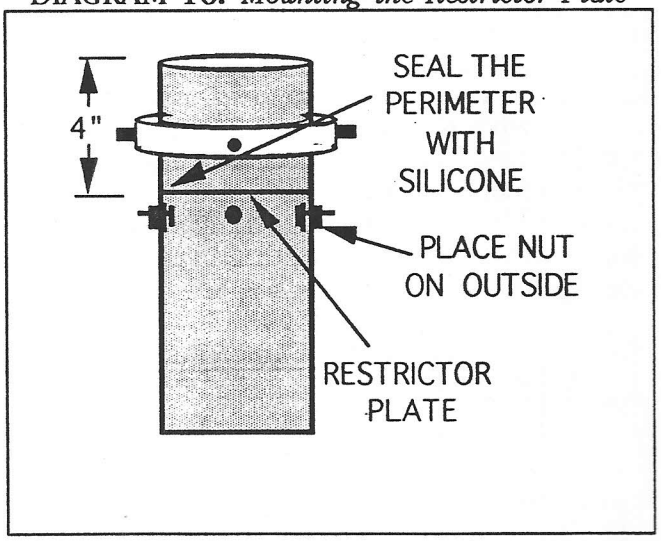
If you are using the suction tube supplied with the Weedeater® leafblower, a 300 CFM restrictor plate template is given in the appendix. The 300 CFM restrictor plate is to be mounted permanently in the suction tube. Cut a piece of sheetmetal using this template. Bend the ears of the restrictor plate 90 degrees. You will notice a small reduction in the diameter of the suction tube 4" from the top. The restrictor plate will be positioned immediately after this reduction in size. Bolt into place as shown in diagram 15.

DIAGRAM 15: *Mounting the Restrictor Plate*



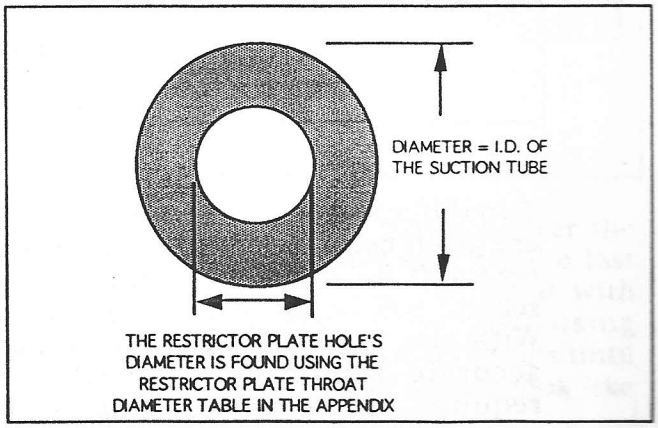
The 300 CFM restrictor plate for all other suction tubes will be built similarly. First you will need to make a template. Use the Weedeater® template as a guide. Alter the outer ring diameter to equal the inside diameter of your suction tube. The diameter of the center hole in the template should be determined using the Restrictor Plate Throat Diameter Table in the appendix. In the left column of this table, find the inside diameter of your suction tube. The template's hole diameter will be equal to the number in the 300 CFM column to the right. With the template as a guide cut a sheetmetal restrictor plate. Bend the ears of the sheetmetal restrictor plate 90 degrees. Mount the restrictor plate as shown in diagram 16.

DIAGRAM 16: *Mounting the Restrictor Plate*



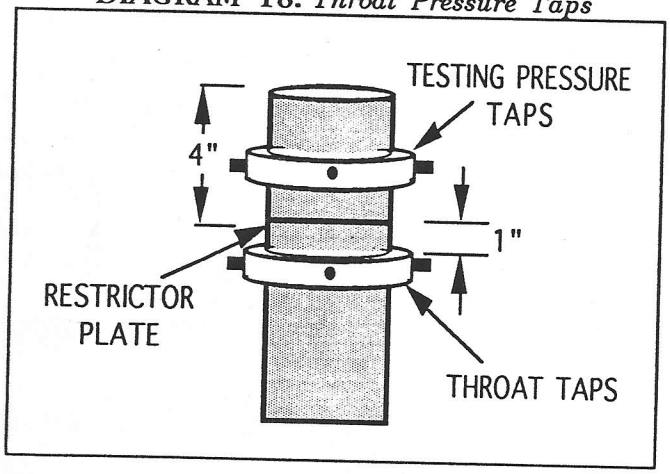
Make the three remaining restrictor plates using Diagram 17 as a guide.

DIAGRAM 17: *Removable Restrictor Plates*



Use the Restrictor Plate Throat Diameter table in the appendix to find the three remaining restrictor throat (hole) sizes. Find the inside diameter of the suction tube you are using in the left hand column of the table. The numbers to the right are the associated hole diameters. For example if you are using the Weedeater® leafblower, the required hole diameters are 1.195" for 50 CFM, 1.684" for 100 CFM, 2.352" for 200 CFM, and 2.824" for 300 CFM. A 4" I.D. suction tube would require hole diameters of 1.194" for 50 CFM, 1.679" for 100 CFM, 2.322" for 200 CFM, and 2.753 for 300 CFM. Label one side of each of the restrictor plates. To change restrictor plate sizes simply set the desired size restrictor plate over the permanently installed 300 CFM plate. Although the plates would appear to flow identically with either side facing up, the reality is that the roundness of the edges can affect the flow rates by as much as +/- 10%. Therefore it is best to be consistent and install the plates with the same side facing up each time they are used. To complete the sensor you will need to add another set of pressure taps. These will be built exactly as those for testing pressure taps. Locate these taps 1" below the top of the restrictor plate See diagram 18.

DIAGRAM 18: *Throat Pressure Taps*

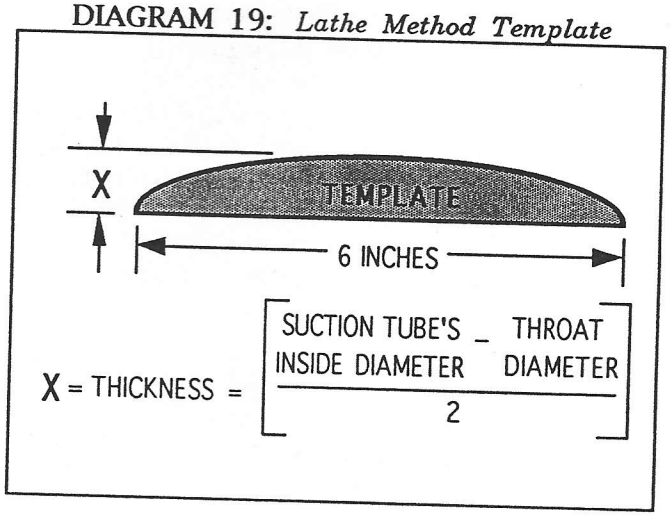


VENTURI SENSOR

Two different ways of making venturi sensors are given below. For lack of a better name the first will be called the lathe method, the second will be called the template method. With the lathe method it is easier to get accurate results. However this method requires use of a wood lathe. If care and patience are taken the template method can be just as accurate. Read both sections and decide which is best for you.

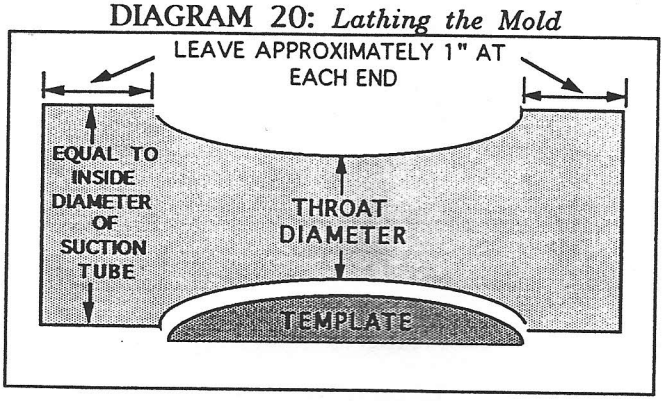
LATHE METHOD The first step will be to build a mold. Four different size molds need to be made. The outside diameter of the molds is equal to the I.D. of the suction tube you are using. If you are using the Weedeater® suction tube, you will notice the suction tube's inside diameter changes. You will be installing the venturi in the smaller section. Therefore the outside diameter of the molds will equal the suction tube's smaller inside diameter. Next you need to lathe blocks of wood using a template to guide you. If you are using the Weedeater® suction tube, templates for the molds are provided in the appendix. For all other suction tubes you need to make similiar templates. To make the templates you need to determine the sensors throat diameter. Use the Venturi Throat Diameter Table in the appendix to determine the throat diameter. Look in the left column of the table for your suction tube's inside diameter. The numbers to the right are the throat diameters for your venturis. For example if you were using a 4" I.D. suction tube, the four throat diameters would be 1.051" for 50 CFM, 1.481" for 100 CFM, 2.066" for 200 CFM, and 2.477" for 300 CFM. Create four templates as shown in diagram 19.

DIAGRAM 19: *Lathe Method Template*



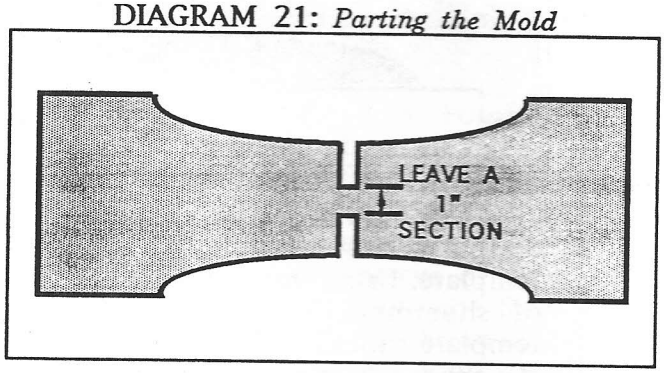
Use the 300 CFM template to lathe a mold as shown in diagram 20.

DIAGRAM 20: *Lathing the Mold*



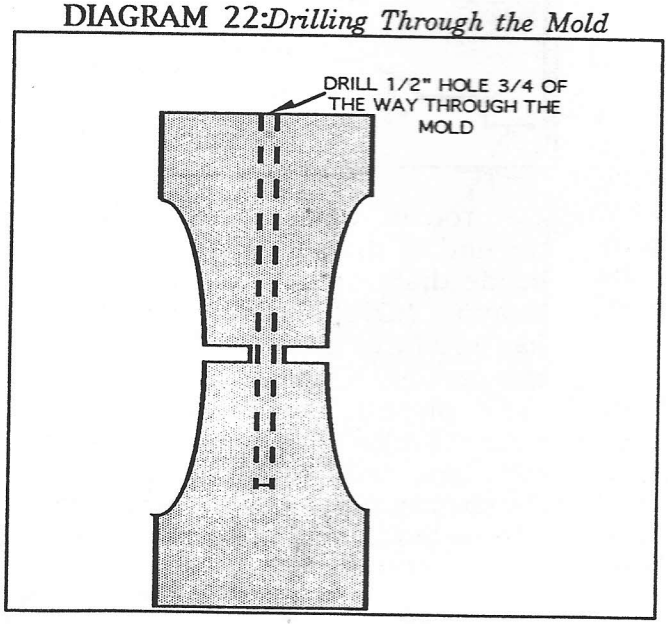
Leave the mold on the lathe, and sand smooth. Once correct take a sharp chisel and cut part way through the center. Cut until a 1" section remains, see diagram 21.

DIAGRAM 21: *Parting the Mold*



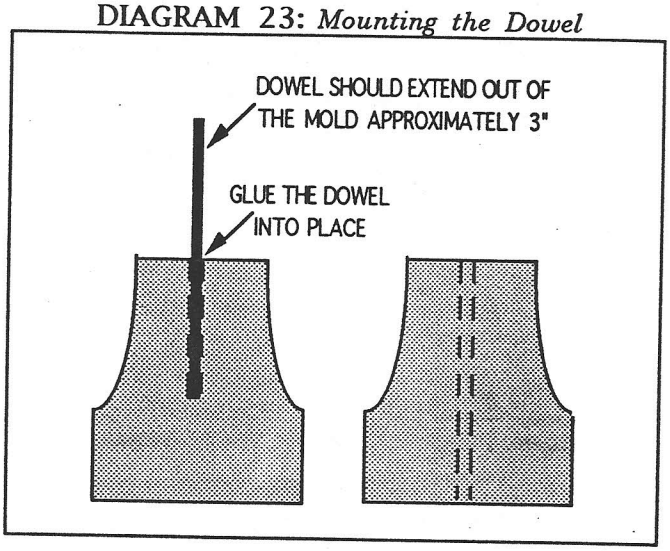
Remove the mold from the lathe and drill a 1/2" hole as shown in diagram 22.

DIAGRAM 22:*Drilling Through the Mold*



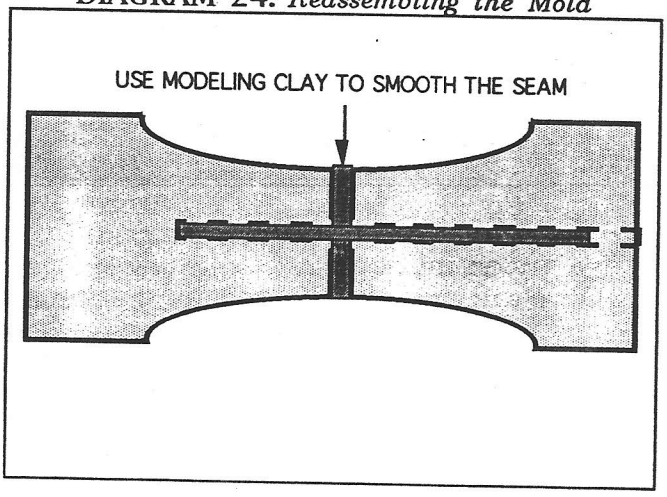
Draw a reference line across the gap. You will use this line to accurately reassemble the mold. Cut the mold in half, glue in a 1/2"x4" dowel as shown in diagram 23.

DIAGRAM 23: *Mounting the Dowel*



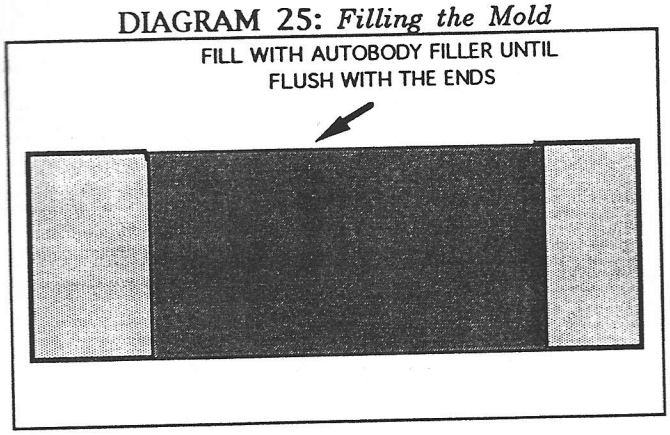
Once dry, put the mold together by sliding the other half over the 1/2" dowel. Do not glue together. Realign the two halves using your reference line. Press in and smooth over molding clay at the parting line. The mold should look like diagram 24.

DIAGRAM 24: *Reassembling the Mold*



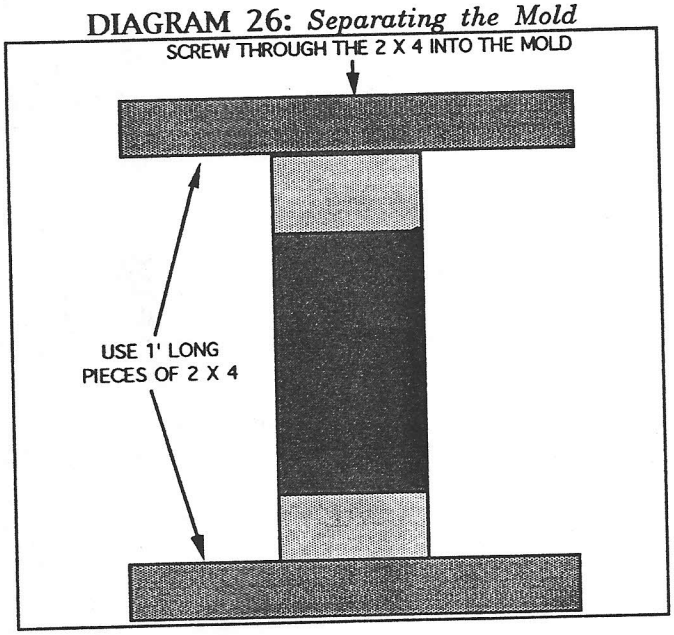
Apply several coats of auto wax over the surface of the mold. Don't wipe off the last coat. Fill the depression in the mold with autobody filler. Build up the mold using several thin coats. Continue to add coats until the mold is filled. The mold should look like diagram 25.

DIAGRAM 25: *Filling the Mold*



Screw two 1' pieces of 2x4 onto the mold as shown in diagram 26.

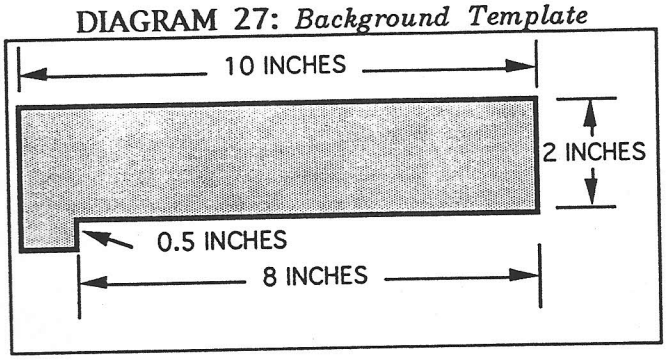
DIAGRAM 26: *Separating the Mold*



Stand on the bottom 2x4 and pull up gently on the other 2x4 while twisting gently. Once the mold is separated tap the remaining half of the mold out of the venturi. Go easy, you don't want to split your venturi. Lightly sand away any irregularities. Repeat the previous steps to make the 50, 100, 200 CFM venturis.

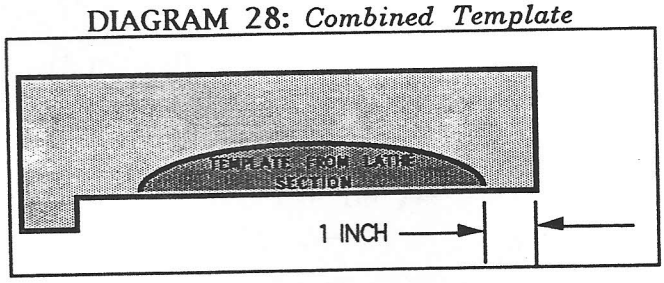
TEMPLATE METHOD As the name implies you will need templates. The templates will be the inverse of the templates used in the lathe method. Therefore you must first create the templates utilized in the lathe method. Superimpose these templates over the one shown in diagram 27.

DIAGRAM 27: *Background Template*



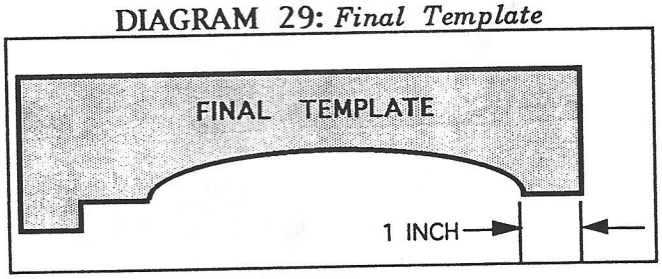
The resultant should look like diagram 28.

DIAGRAM 28: *Combined Template*



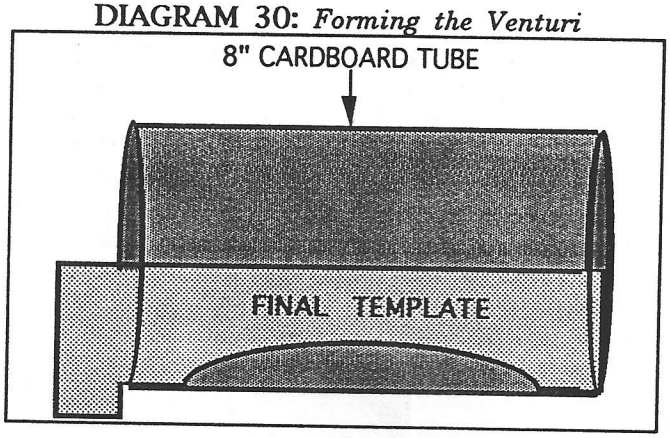
Cut out the section covered by the lathe template. The remaining portion is your final template. Using this template cut out a piece of sheetmetal to the same shape. The template should look like diagram 29. Repeat the process to make all four of the templates.

DIAGRAM 29: *Final Template*



You will be mounting the sensor 4" from the end of the suction tube. Determine the inside diameter of the suction tube at this location. *NOTE: The Weedeater® suction tube has a reduced diameter at this location. Use this reduced diameter for the following steps.* Use a piece of hard cardboard to form an 8" long cylinder. The outside diameter of the cylinder should equal the inside diameter of the suction tube. Use the template to spread autobody filler on the inside of the cylinder. See diagram 30.

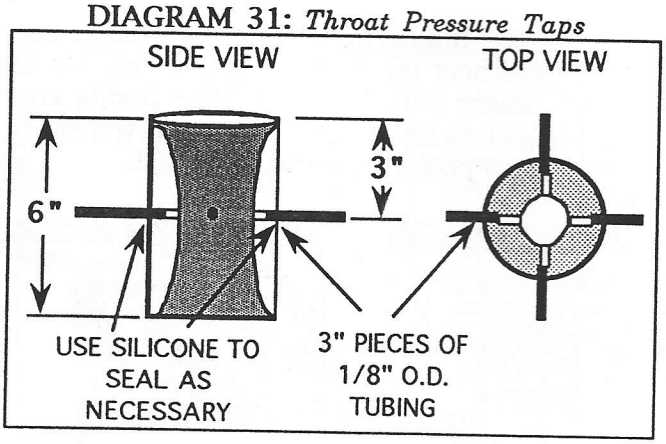
DIAGRAM 30: *Forming the Venturi*



Build up the filler in several thin coats. Continue to sand and fill as necessary. Make sure the filler conforms to the template. When completed, cut off the excess cardboard from the ends. Repeat the above steps to make the three remaining venturi sensors.

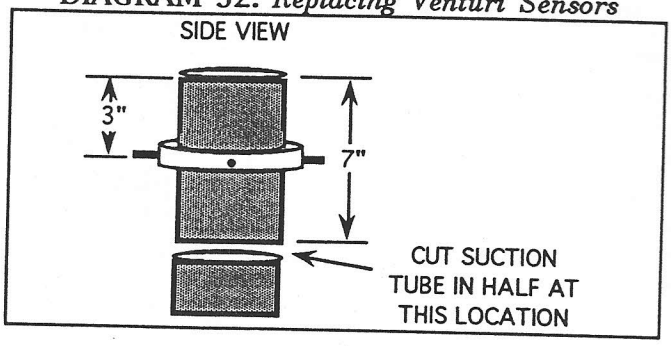
VENTURI THROAT TAPS Four "Throat Pressure" taps need to be made in each of the four venturis. Drill four 1/8" holes equally spaced around the middle of each venturi. These holes should penetrate through the sensor. Take four 3" pieces of 1/8" O.D. tubing and press these into the four holes you just drilled. This should be an airtight fit, use silicone if necessary. Sand away any burrs from the inside of the venturi. See diagram 31.

DIAGRAM 31: *Throat Pressure Taps*



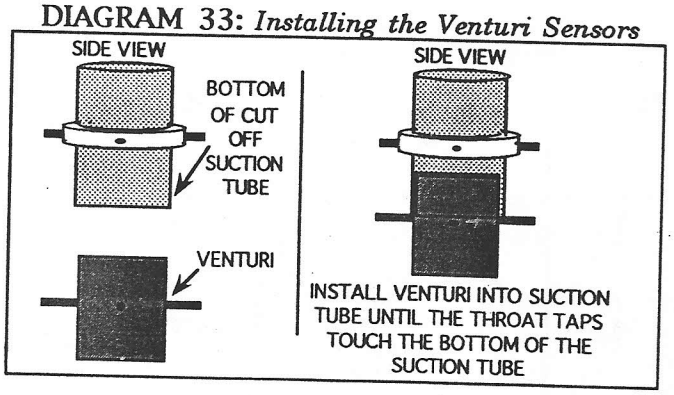
MOUNTING THE VENTURI Unlike the restrictor plates you cannot simply install one sensor over another. To change sensors you must remove one and then install another in its place. To make this easier cut the suction tube in half, 7" from the top. See diagram 32.

DIAGRAM 32: *Replacing Venturi Sensors*



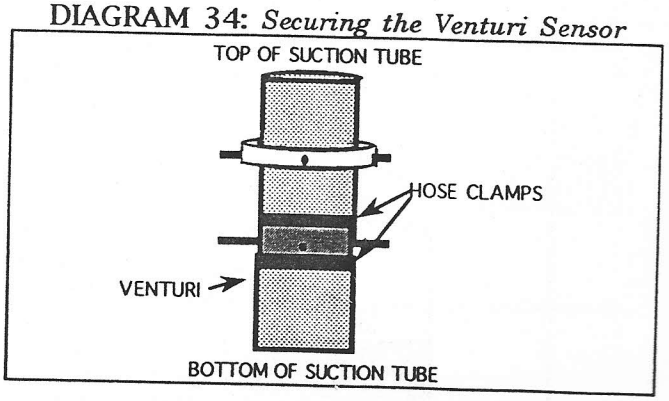
To mount a venturi slide the ventrui up into the top half of the suction tube until the throat pressure taps touch the bottom of the suction tube. See diagram 33.

DIAGRAM 33: *Installing the Venturi Sensors*



The venturi should fit into the suction tube with a "friction" fit. If the venturi is loose (too small) wrap the exterior with masking tape until the venturi fits into the suction tube snugly. Slide the lower half of the suction tube over the bottom of the exposed venturi. Slide the suction tube up until the tube hits the throat taps. Again this should be a friction fit. Once into position, use a hose clamp above and below the throat taps to secure everything into position. See diagram 34.

DIAGRAM 34: *Securing the Venturi Sensor*

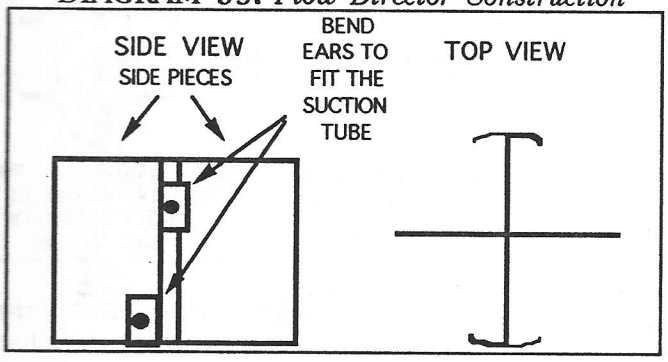


FLOW DIRECTOR

If you are using a centrifugal type fan like the Weedeater® leafblower you will need a flow director. The flow director for the venturi and restrictor plate sensors are constructed identically. If you are using the Weedeater® leafblower model #2560 templates for the flow director is given in the appendix. For other suction tubes alter the templates to fit your suction tube.

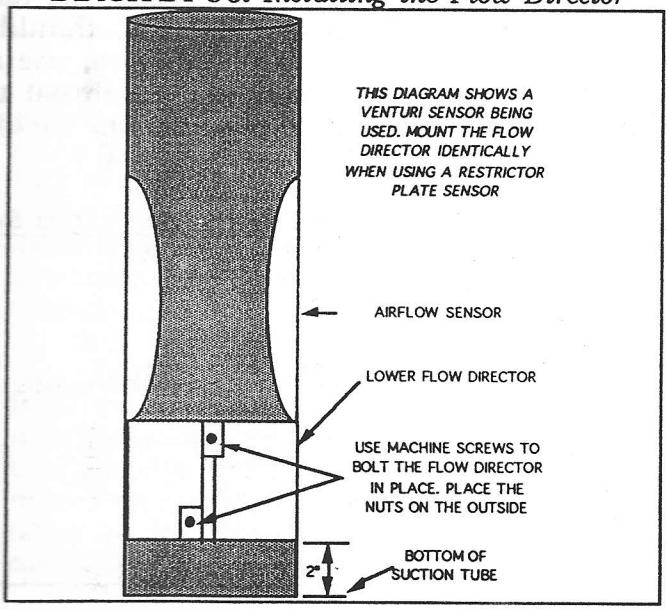
To build the flow director cut out three pieces of sheetmetal using the templates provided in the appendix. Drill the 3/16" holes in the ears of the main piece. Bend the ears 90 degrees. Spot weld or glue the pieces together as shown in diagram 35.

DIAGRAM 35: *Flow Director Construction*



Insert and bolt the flow director in the suction tube as shown in diagram 36.

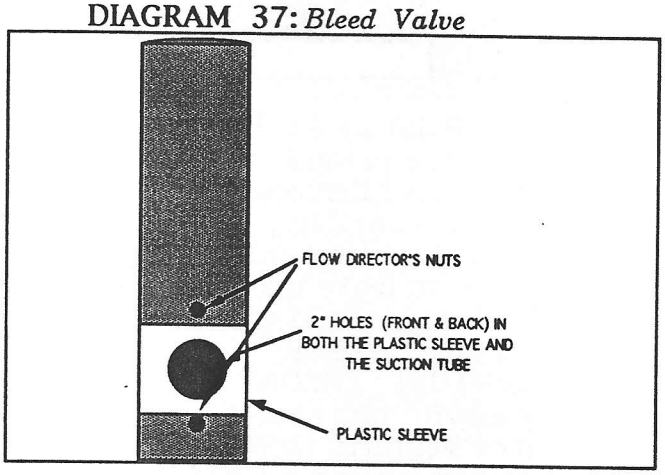
DIAGRAM 36: *Installing the Flow Director*



BLEED VALVE

Cut a piece of sheet plastic 3"x15"(1/16th inch styrene plastic is available at most hobby stores). Wrap the plastic around the suction tube. Tape together the overlapping ends. Drill two 2" holes through the suction tube, and the plastic sleeve. See diagram 37.

DIAGRAM 37: *Bleed Valve*



To decrease the testing pressure rotate the plastic sleeve so the holes of the suction tube and the plastic sleeve are aligned. Rotating the sleeve to cause misalignment will increase the testing pressure.

MOUNTING THE SUCTION TUBE

If a leafblower suction fan is being used, connect the suction fan to the suction tube. Smear silicone around the inside edge of the hole in the bench top. Slide the suction tube into position, see diagram 38.

DIAGRAM 38: *Mounting the Suction Tube*