

COLLISION REPAIR INFORMATION

FOR THE TOYOTA DEALER

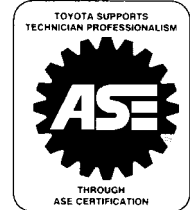
TITLE: DOWNDRAFT SPRAY BOOTH
PURCHASE AND INSTALLATION

PAGE 1 of 13

SECTION: GENERAL INFORMATION BULLETIN #21

MODELS: ALL TOYOTA MODELS

DATE: DECEMBER 1987



In our continuing effort to improve the efficiency, production capability and ultimately increase the profitability of the Toyota Body Shop, we offer the following information regarding the purchase and installation of a downdraft spray booth.

First of all, contrary to popular belief, a spray booth is not merely a necessary evil or simply a means of complying with local fire and safety codes. A spray booth should be considered a profit center just like any other piece of equipment used in a shop. The higher the efficiency, the greater the production and hence the greater the profit. You can't make increased profits today using yesterday's technology. A modern downdraft spray booth can solve many problems that may exist in the today's body shop. Dirt, lint and overspray are the primary causes of inefficiency in any spray booth. A downdraft spray booth, if used properly, can virtually eliminate these and many other problems that normally occur in the older sideflow or endflow spray booths.

With the increase in customer awareness and consumer demands, comes the requirement for better paint appearance and durability. No longer will the consumer accept a paint job that doesn't match the quality of the factory paint, especially if the vehicle is nearly new. In order to match the appearance and durability of original Toyota factory paint, it is recommended that the body shop refinish the vehicle in a quality urethane enamel. This type of enamel paint is by far the most durable and has the best overall appearance of any paint that is currently on the market. The downdraft spray booth facilitates the use of the urethane enamel with the added incentive of maximum efficiency.

How does a body shop owner decide which downdraft spray booth is best suited for his shop? And how does such an owner go about planning for the new spray booth? The answers to these questions and more can be found in the following information.

I. DESIGN THE SHOP AROUND THE SPRAY BOOTH

- The layout of the shop and the location of the spray booth should be placed on a large scale drawing where $(1/4" \text{ to } 3/8") = 1 \text{ ft.}$
- If you are redesigning a body shop, use a drawing with everything removed from the shop except fixed objects such as walls or posts holding up the roof. Note: It is easier to do this on paper than to actually "clean out the shop" to the bare walls. Now, start from the beginning and design the new shop.

AND INSTALLATION (cont'd)

- One of the highest maintenance costs for a spray booth is the replacement of the filters. Don't install a booth in the middle of the dirtiest place in the shop. Remove the paint booth from the main shop entirely. Try to isolate the spray booth away from the metal finishing area and especially the detail area (detail areas usually contain silicones in the various polishes that cause fish eyes in fresh paint jobs.) The control of dust in and around the spray booth is essential for increased efficiency and should not be overlooked.
- Highly efficient production shops are using a separate drying room adjacent to the spray booth. As many as 6 to 8 complete repaints can be run through this type of system in a single day. The latest thinking, however, is to have 2 spray booths since the price of a full spray booth is not much higher than the price of a drying room.
- Always design the inside of the shop before the architect designs the outside of the building because the architect may not be very knowledgeable about what needs to go on the inside of the building. The architect's primary concern is to blend the outside of the new building with nearby structures. In many cases, the building looks great on the outside but is non-functional on the inside.
- Vehicles should move through the shop in a logical production flow. Ideally, all similar labor operations should be done in one location. Example: The spray booth should be at the end of the repair production line, just after the separate prep station. The detail area should be located away from the main shop and the paint booth because of the dust, dirt and silicones in polishes.
- Be prepared for any eventuality. In other words, keep the flow pattern in the shop flexible. You don't want to be out of business if a car is temporarily out of commission in the center of the shop.
- Keep your employees happy and safe. Be considerate of environmental conditions such as air temperature, humidity and airborne contaminants, and comply with all laws and regulations.
- Keep in mind that the body shop designer should try to identify, then eliminate the problems that affect shop efficiency and production.

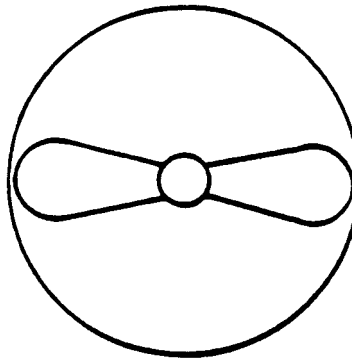
II. CHOOSING THE CORRECT DOWNDRAFT SPRAY BOOTH FOR YOUR SHOP**GENERAL**

- Today there are 20 or more different name brands of downdraft spray booths on the market in the U.S., and many more are on the way.
- The key to an excellent paint job is the system used and not the individual components of the job. Use a system that was designed to be used in your shop.

AND INSTALLATION (cont'd)

AIR MOVING EQUIPMENT (FANS)

- A tube axial or radial fan looks something like an airplane engine with a propeller (see illustration below).



Axial Fan

This fan arrangement has good air flow with very little resistance, making it a very efficient type of fan. The blades can be adjusted (on some models) to meter the proper air flow through the spray booth. The fans are quite durable and relatively easy to clean. The direct drive variety are more common but many are also indirectly driven by belts. The major disadvantage to the tube axial fan is the high noise level generated in and around the spray booth. (Remember the environmental considerations of the employees).

- The circular or squirrel cage fan is the one most commonly used in spray booths, especially when the fan is also used for forcing heated air into the booth for drying purposes.

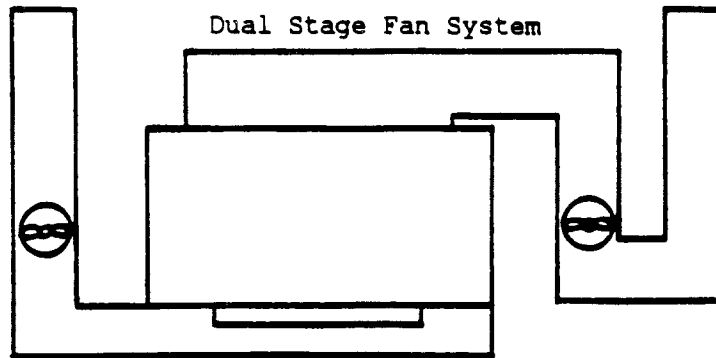
The reverse blade circular fan is the most commonly used in downdraft spray booths because it is very quiet during operation. It is also available in both drive systems. The direct drive method is sometimes preferred because the indirect drive belt occasionally breaks, causing maintenance problems and system shut down. The only disadvantage to using a circular fan is the difficulty of cleaning the blades. Therefore, this type of fan should only be used downwind of a good filter system where the incoming air is very clean.

- As a comparison, 6,000 cubic feet per minute of air flow requires the following fan arrangement:

	<u>Fan size</u>	<u>H.P.</u>	<u>RPM</u>
1. Tube axial fan	24"	1	1300
2. Circular fan	20"	1	400

AND INSTALLATION (cont'd)

- Even though single stage fan systems are available, the dual stage system (one fan in the inlet duct and one fan in the outlet duct) provides a more balanced airflow and the internal booth pressure can be regulated more accurately (see illustration below).



- The exhaust air dampers should not be able to close off more than 75% of the exhaust air flow. (This is a method of preventing accidental over-pressurization of the booth).

AIR FILTRATION SYSTEM

- One of the most important features of a downdraft spray booth is the dual stage filtering system. The inexpensive and easy to replace first stage prefilters prolong the life of the more expensive overhead secondary filters. The more efficient type of spray booth filters are capable of filtering out particles as small as 10 microns. (1 micron = 1/25,000 in.)

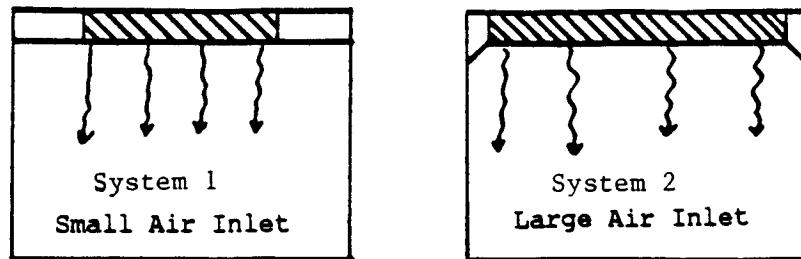
For example:

<u>Particle Size</u>	<u>Appearance</u>	<u>Examples</u>
1–5 (microns)	not visible	
5–10 (microns)	barely visible	dust, pollen, molds
10–20 (microns)	easily visible	heavy dust, fly ash

- Various spray booth manufacturers use different size ceiling filters depending on the rate of flow requirements. The higher the air flow and the larger the booth, the larger the filter must be. As a consequence, each booth manufacturer uses a chart to plot the size of the air inlet and the filter size to match the desired cubic feet per minute of air flow (measured at the top surface of the vehicle).

AND INSTALLATION (cont'd)

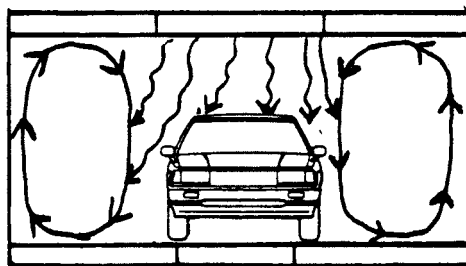
- At first glance, there appears to be very little difference in performance between a spray booth with a large overhead air outlet versus a spray booth with a small overhead air inlet (see diagram below). The differences between the two systems become apparent as soon as the blower fans are turned on.



The larger air outlet will permit a larger volume of air to pass over the surface of the vehicle.

System 1

System 1, shown below, uses a narrow ceiling outlet filter that is typically the same width as the vehicle in the booth. This system has a very positive airflow with a tightly controlled environment including good temperature control. The main disadvantage to this type of system is the movement of air toward the sides of the booth. This in itself does not affect the outcome of the paint job, but it can cause increased maintenance costs because as the air swirls near the sides of the spray booth, paint particles may have a tendency to adhere to the side panels (see air flow diagram below).



Narrow Ceiling Filter

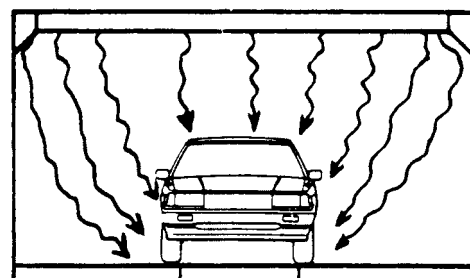
Paint Particles Adhesion to Side Panels

System 2

System 2, shown below, uses ceiling outlet filters that are quite wide (some spray booth manufacturers use ceiling filters that are nearly the full width of the spray booth). The main advantage to this type of ceiling filter is lower maintenance costs because there is little or no movement of the air near the side panels, thus most of the paint particles are drawn under the vehicle into the spray booth's exhaust system (see air flow diagram below).

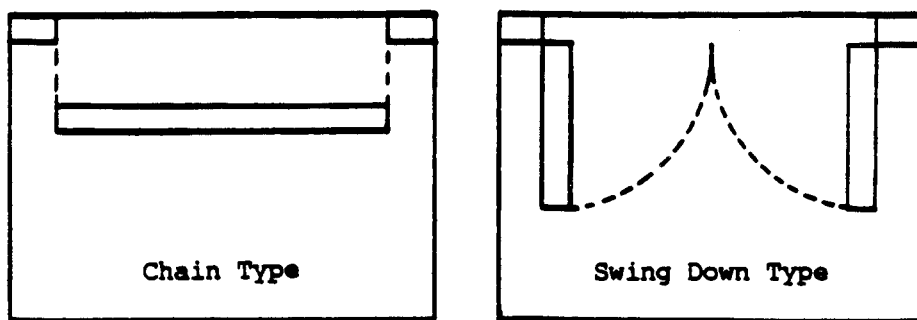
Wide Ceiling Filter

No Paint Adhesion to Side Panels



AND INSTALLATION (cont'd)

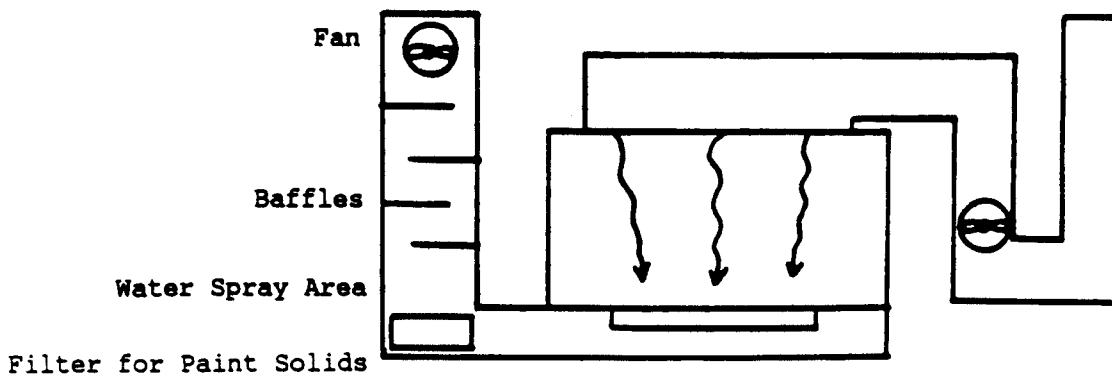
- There are important factors to remember when changing spray booth filters. Each filter manufacturer has its own flow rate for a given size of filter. Each spray booth is designed to use a certain brand, size and flow rate filter. Since the precise flow rate through a booth is critical, it is not recommended to change brand names of filters unless the original rate can be obtained by readjusting the air flow through the spray booth. Note: Proper flow rate through the filters is critical to proper dust particle retention in the filter.
- Filter changing methods should be a consideration when choosing a downdraft spray booth. Some inlet ceiling filter systems are difficult to change and can be very time consuming. Obviously the easier they are to change, the easier they are to maintain. Here are two basic systems that are being used on downdraft spray booths. Both systems work well. The style depends on the spray booth manufacturer (see illustration below).



- Exhaust filters (also called entrapment or containment filters) are of two basic types, water wash, or dry type.

Water Wash System

Contrary to popular belief, the water wash system does not circulate water in the grates below the floor. The system uses water jets that spray a fine mist of water at the outgoing exhaust air as it travels throughout the scrubbing chamber. The clean air then exits the system. (See illustration below).



AND INSTALLATION (cont'd)

The advantage to this system is that there is no interruption of the air flow because there are no filters to become clogged. The moisture in the air traps and neutralizes 10% more isocyanate particles than dry filters. A slight disadvantage to the wet system is that the E.P.A. and certain local air pollution control regulatory commissions may have reservations about water wash systems because the filtering efficiency is greatly reduced if the system is not maintained properly. In addition, the sludge in the bottom of the scrubbing chamber should be considered a hazardous waste and must be disposed of properly.

Dry Filter System

The dry filter system works well as long as the filters are changed at the proper time. Clogged filters reduce airflow which can cause an over pressurization of the spray booth. Inexpensive filters have a tendency to surface load or skin over preventing proper air flow through the filter. Good quality filters tend to load in layers and have a much longer life span. When you consider the extra labor necessary for more frequent filter changes and the extra down time of the spray booth, the lower priced filters may not be less expensive in the end.

The advantage of a dry filter system is the ease of maintenance. Almost anyone can change the filters in the dry air filter system.

The disadvantage to the dry stem is the possibility of overpressurization of the spray booth due to a reduced air flow if the filters are not changed promptly when they are saturated with dirt. In addition, dry filters are also considered hazardous waste material and must be disposed of properly. Throwing spent filters into the trash bin is no longer an acceptable means of disposal. Contact your local authorities for proper disposal methods.

- Prefilters on the inlet side of the spray booth relieve some of the burden on the main ceiling filter. Most prefilters will remove particles of 15 microns or larger. These prefilters also reduce the amount of maintenance and cleaning of the various fans and ducts in the system.
- Secondary extract filters located downwind of the normal exit filters may be needed in the dry filter system depending on future governmental regulation. These filters reduce maintenance on the exit air fan and help protect the environment. There are many different brands of exit filters on the market.
- Fumes from solvents are highly volatile and when they are in large concentrations can produce spontaneous combustion. One effective way of removing these fumes is to use an activated charcoal filter system. However, the prefilter located just ahead of the charcoal filter must be 100% effective at removing paint particles because these particles will permanently damage the charcoal filters if the paint particles contact the surface of the activated charcoal.

AND INSTALLATION (cont'd)

NOTE: When paint solids are exhausted into the air outside the spray booth, the particles will keep paint fumes and paint smell near the spray booth making the surrounding area very unpleasant. Therefore, never remove the exit filters or leave them out of the system. Always replace old filters promptly.

TEMPERATURE CONTROL SYSTEM

Downdraft spray booths usually come equipped with a system to control the internal temperature of the spray booth. In most geographical areas, a furnace (oil, propane or natural gas) is used to heat the interior of the spray booth to the desired temperature. All spray booths take in fresh air and circulate it throughout the booth during the spray cycle. Some spray booths have the added capability of recirculating a portion of the warm inside air and blending it with fresh air from outside the spray booth (this feature can reduce energy costs). Some custom installations utilize an air conditioner or an evaporative cooler located near the inlet air duct to further condition the air inside the spray booth. The air conditioning system is designed to reduce the inside spray booth temperature and humidity (this is helpful in the midwestern, eastern and southeastern states where the outside temperature and humidity are both high). The evaporative cooler system also reduces interior booth temperature and increases humidity (this is helpful in southwestern states where the outside temperature is high and the humidity is low).

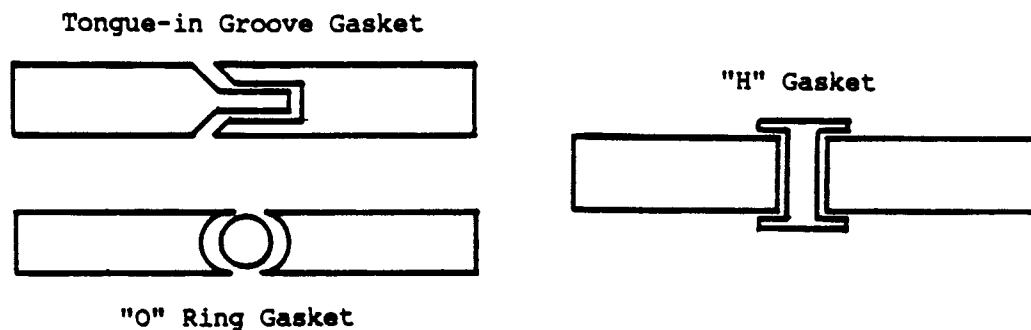
- The size of the burner is dependent on the individual requirements of the spray booth and the climatic condition of the region. The trick is to use the least amount of energy (fuel) to obtain the desired results. Usually 600,000 to 1.5 million BTU's is the heating range that most manufacturers offer. The optimum spraying temperature is near 68 degrees F. while the usual baking cycle is near 160 degrees F. or slightly higher depending on the vehicle or the type of paint to be baked.
- The bake cycle temperature is elevated by redirecting the air from the spray booth back into the burner and then back into the spray booth. Typically, 5% to 20% fresh air is used during the baking cycle. However, there are some manufacturers that offer 100% fresh air baking cycles.
- Manufacturers offer direct fired heating systems where the flame is in direct contact with the air flow, and indirect fired systems where the flame is contained in a metal heat exchanger and is not in direct contact with the air flow.
- Burner maintenance intervals are dependent on the type of fuel being used. An oil burner normally requires maintenance 3 to 4 times a year while propane and natural gas burners usually require much less maintenance, possibly once a year.

AND INSTALLATION (cont'd)

ENCLOSURE BOX

Typically downdraft spray booths are made from modular construction using standard size panels. Many spray booths can be increased in size by merely changing panels. Keep in mind, however, when the size of the spray booth is increased, so must all the related components be increased. The typical spray booth size for most small to intermediate size cars is 24'L X 14'W X 9'H. Most good spray booths have insulation between the steel walls that varies between 1-1/2" to 4" depending on the type of insulation. Remember, use the "R" factor when determining what insulating requirements you need for your shop. Total insulation of all sides (including the ceiling and floor area in colder climates) is very important. There is a tremendous heat loss through the floor and pit area in the colder climates due to ground temperature changes. Insulation can be added to the walls in the pit area to reduce heat loss.

- There are three common types of panel sealing joints: tongue-in-groove, "O" ring gasket, and "H" gasket (see illustrations below).



- Sealers and caulking materials are not usually necessary when wall panels are sealed using one of the methods described above. Manufacturers of some economy spray booths may use wall panel joining techniques that require the use of sealers and caulking materials.
- Many spray booth manufacturers use a zinc (galvanized) coating under rust inhibiting paint on the interior and exterior wall surfaces to inhibit the formation of rust. Unpainted spray booths may be susceptible to accelerated weathering in areas where salt air is present in moderate to heavy concentrations.
- The interior walls are normally white in color because white reflects light better than other colors. Many body shop owners prefer that the walls be of the pre-coated factory baked variety since this type of paint is usually more durable and presumably easier to maintain than the sprayed-in-place variety.

AND INSTALLATION (cont'd)

- Aftermarket peel coat water born interior panel coatings may be used on older end or sidedraft spray booths. The walls of a good quality, well designed downdraft spray booth do not require much maintenance, so aftermarket coatings are not usually necessary. Spills and splatter on walls and floors should be cleaned up immediately.
- Explosion relief panels should be standard equipment in all downdraft spray booths. If there were no relief panels built into the spray booth, an explosion could destroy the spray booth and put you out of business.

DOORS

Generally, most spray booths use bi-fold doors measuring 9' 6" wide and 8' to 9' tall. Look for a solid door arrangement that is easy to open and close. In addition, many states require two separate personnel entrance/exit doors. It may be a good idea to locate the doors on opposite sides of the spray booth.

LIGHTING TUBES AND ILLUMINATION

Color matching tubes (fluorescent tubes) do not provide the best illumination for spray painting. Daylight fluorescent tubes provide the best all around illumination. Be sure to look at a booth in operation before you buy it. If the illumination is not adequate, ask the representative if the manufacturer offers any optional lighting. If so, we suggest viewing the lights in actual operation in order to judge if the lights are adequate for the use intended.

FLOOR DESIGN

Basically, there are two types of floors used in downdraft spray booths: (1) a floor with the exhaust air vent below ground, and (2) a raised floor with the exhaust air vent above ground. When designing a new shop or modifying an existing shop, consider using the below ground air vent because it is somewhat more efficient than the above ground style. The below ground vent chamber should be a minimum of 2 feet deep (finished interior dimension). If the above ground style vent is used, be sure to use one full width ramp leading up to the spray booth.

In addition to the air plenum arrangements, there are different types of grates used in the floor of the spray booth. Some grates are full width (wall to wall) and some are narrow (3' to 4' wide). Both arrangements work well and there seems to be a slight advantage to using the narrow grates because most painters do not like standing on the grates while they are painting (grates are hard on the feet).

AND INSTALLATION (cont'd)

OPERATING CONTROLS

- Many downdraft spray booths have sophisticated control panels that require little monitoring by the painter. Some of the controls commonly used by the painter are: the on/off switch, spray/bake/exhaust switch, timer controls, manometer and a device to lock the panel to prevent accidental start-up.
- The control panel and sub-panel should meet all governmental regulations.
- Safety controls
 1. Compressed Air Safety Interlock – This device provides a means of shutting off the air supply to the spray gun and stops the bake cycle when any door is opened.
 2. Air Flow Monitor – Air flow is monitored in the air ducts and the heater will shut down if the air flow is restricted to a level that is lower than specified.
 3. High Limit Heat Temperature Sensor – If the heat regulating system should fail and the temperature were to rise above the maximum limit, the heat sensor would shut off the burners.
 4. Purge Sequence System – The spray booth air should be purged completely before the bake cycle can begin (3 minutes minimum).

INSTALLATION OF THE BOOTH

How to avoid problems during the installation of a downdraft spray booth.

- Obtain the full technical specification sheet from the manufacturer (not the sales brochure). Normally the specification sheet is 7 – 10 pages long and gives all the pertinent information about the spray booth.
- Know your supplier. Contact people who have dealt with the supplier in the past.
- Understand all the terms of the contract before you sign it.
- Full turn-key operations offer some advantage over other purchase methods – there are no hidden costs that can add to the purchase price. For instance, the following items can add as much as \$10,000 to the original purchase price: Architect, Concrete, Electrical, Plumbing, Roofing, Fire Prevention, Ducting Sheet Metal and Heating.
- Know about the proper service and maintenance of the spray booth. Obtain the information from the spray booth supplier.

AND INSTALLATION (cont'd)

- Obtain a full test report on the booth following completion (this test should be done by an independent contractor and should be included in the price of the spray booth).
 1. Every spray booth should be adjusted to operate within its operating standards.
 2. The typical pressure gauge is called a manometer. Initial pressurization on the water scale (W.C.I. scale) should be .01” to 0.1”. If the pressure should rise above these limits, the filters probably need to be changed.
- Burner test report
 The carbon monoxide, heat output, burner efficiency, smoke gauge and stack temperature should be tested and adjusted if necessary. Most natural gas companies will do the test free of charge (on natural gas systems only).

NOTE: A poorly adjusted flame on any system may cause premature burner failure.

- Temperature test chart
 A temperature reading should be taken just prior to the start of the bake cycle, then at 5, 10, and 15 minute intervals until the coolest part of the car reaches the maximum desired temperature. The readings should be taken at various locations according to the following chart.

NOTE: This test must be done using thermocouples and accurate instrumentation.

	<u>Roof</u>	<u>Hood</u>	<u>Lower Left Side</u>	<u>Lower Right Side</u>	<u>Trunk Lid</u>
Start up	*	*	*	*	*
5 min.	*	*	*	*	*
10 min.	*	*	*	*	*
15 min.	*	*	*	*	*
Max. temp	*	*	*	*	*

AND INSTALLATION (cont'd)

If there is a substantial variation in temperature between several spots on the vehicle, the paint will cure at different rates which may cause longer drying times and problems with the production schedule. Before you purchase a downdraft spray booth, be sure you ask the manufacturer if they will guarantee in writing that the temperature will be uniform during the bake cycle.

PERMITS AND INSPECTIONS

- Present your plans to all state and local governmental regulatory and building code agencies for approval.

MISCELLANEOUS

- One of the most often overlooked cause of problems in the paint shop is the air supply to the spray gun and the painter's hood (if the shop uses fresh air supply for the painter).
- Contamination from water, oil and silicone can cause enormous problems in the painted surface. Use an effective contaminate removing device such as a water trap, freeze dryer, oil separator, etc., for the air supply to the spray gun.
- Use a safety device that monitors carbon monoxide in the air line that supplies fresh air to the painter's breathing apparatus. Better yet, use an oilless compressor as the air supply to the painter's breathing apparatus.

OPERATING COSTS

- Fuel cost (gas, oil, etc.) for a million BTU heater averages approximately \$8.00 per hour (1986 rates).
- Electrical power is based on the consumption rate times the kilowatt hours in your area.
- Ceiling filter replacement is usually done every 750–1000 hours of operation (for a relatively clean shop where the air intake is outside the shop). The prefilters and exhaust filters need to be changed about once a month.
- Routine maintenance.
- Specialized maintenance.

The information provided here on Downdraft Spray Booths is not meant to contain everything you must consider concerning this subject, but should provide you with some background which will enable you to do additional research to determine the best match of a booth to the needs and requirements of the body shop.

NOTE: PLEASE ROUTE THIS BULLETIN TO THE BODY SHOP MANAGER, SERVICE MANAGER OR THE PERSON RESPONSIBLE FOR COLLISION REPAIR INFORMATION!!