JUNAIR
SPRAYBOOTHS

SPRAYBOOTH OVEN

AUXILIARY AIR MOVEMENT

DESIGN, OPERATION AND BENEFITS

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CONTENTS

1. Conventional Airflow within a Spraybooth

There are three basic types of vehicle spraybooth, they are categorised by a description of their airflow characteristics;

- Cross draught – airflow is generally horizontal, front to rear or side to side. Not common now and mainly used for low cost preparation and priming areas.
- Semi-down draught – airflow is introduced through a roof mounted plenum chamber with ceiling filter and extracted using side mounted or rear extraction chest.
- Down draught – ceiling input as above combined with floor extraction using an excavated pit or raised base arrangement. Airflow is vertical within the cabin.

With all conventional spraybooths the airflow is mostly laminar also called streamline, it moves in a straight line. Air flows through the cabin without lateral mixing.

2. Development of Low VOC Paint Materials

Paint manufacturers are working hard to reduce the amount of Volatile Organic Compounds (VOC) within paint materials and conventional high solvent content paints are gradually being replaced with more environmentally friendly alternatives.

In the UK for example, cars can only be painted using “compliant coatings” where solvent content is limited to values determined under the Environmental Protection Act. Further legislation has meant that paint distributors can only sell compliant coatings for vehicle refinishing.

Paint manufacturers have developed coatings that have very low VOC including waterborne base-coats and high solid clear-coats. These environmentally friendly “compliant products” are excellent; however auto body shops with conventional spraybooths will experience slower process times using compliant coatings over conventional solvent based systems.

The bottle-neck in most bodyshops is the spraybooth and therefore anything that slows down the painting process is not going to win favour with the owner / manager. If the new low VOC paint technology is going to be accepted then the spraybooth must be made more efficient and effectively redesigned to suit the products being used.

It is also worth noting here that water based technologies for primers and clear-coats have been developed and are ready to launch in to the market. These products will take longer to dry when compared to organic solvent based products; booth purchasers should be aware of this and should consider “future proofing” themselves against these changes in technology.

The opportunity for spraybooth manufacturers to help with the environmental revolution lies in being able to speed up the process times associated with:

- Flash off of waterborne base-coat
- Curing high solid and ultra high solid top-coat / clear-coat
- Curing water based primer and clear-coat

3. Changes in Spraybooth Oven Design

A number of spraybooth manufacturers adopted the principle that “high airflow” was the answer to drying waterborne base-coats and as a consequence spraybooth specifications changed to larger fans and larger motors. So in effect we attempt to save the environment by using low VOC paint products and then we make matters worse by using more fuel and electricity to overcome some process difficulties.

In addition, high airflow can be specified on a new booth but what about all the spraybooths already installed? No Bodyshop operator is going to replace existing spraybooths in good condition just to suit the paint system. Existing spraybooths need an upgrade approach in order for the mass market to accept the technology.

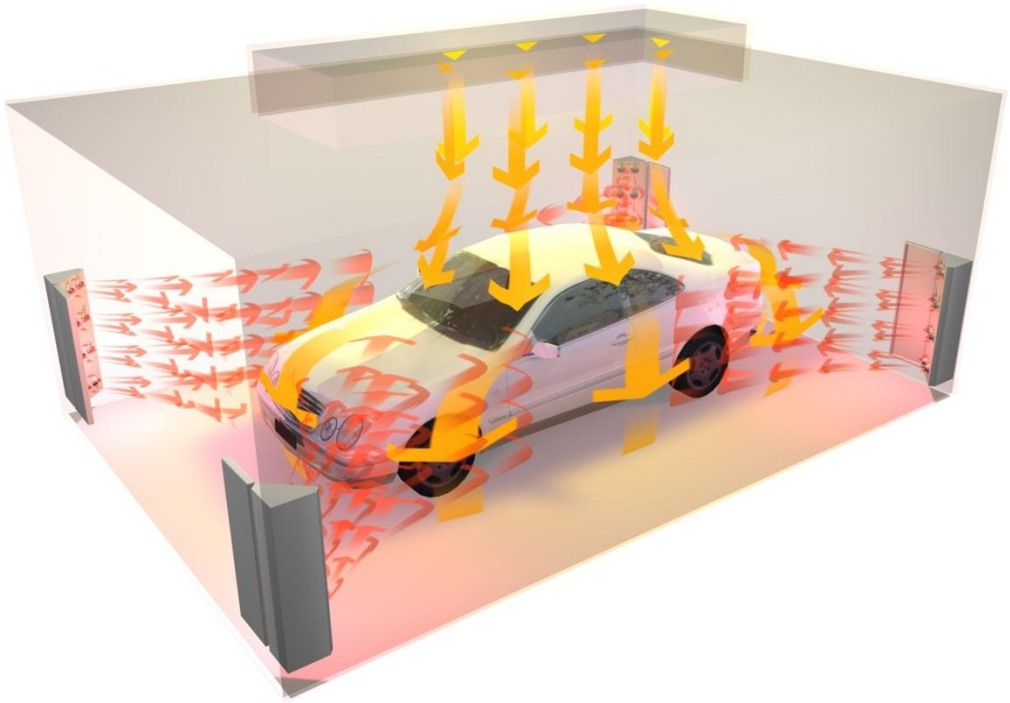
High airflow systems have proven to be inefficient in use and do not greatly reduce flash off or cure times. A high laminar airflow does not break up the insulating boundary layer of air present on the panel surface, resulting in slow water evaporation particularly on flat panels such as roof, bonnet and boot. The centre section of these panels is the hardest to dry and higher airflow can slow the process down by increasing the ‘still air effect’ on the flat surface.

4. Auxiliary airflow within a spraybooth

Spraybooth ovens used to be regarded as “me too” products with little variation in design, however the new “compliant” paint process drove equipment manufacturers to invent better ways to dry and cure paint materials more quickly.

Auxiliary air movement was introduced to spraybooths as early as 1997 as a direct consequence of spraybooth manufacturers looking for ways to make their equipment perform better with the low VOC paint products.

The following diagram shows the basic principle of auxiliary air movement.



A supplementary air flow is introduced into the spraybooth cabin via high velocity nozzles. This air supply is filtered and heated to the same degree as the spraybooth's conventional airflow. The auxiliary air flow only operates during the flash off and curing cycles.

Junair Spraybooths, based in the UK, was one of the first to develop auxiliary air movement technology for new and existing spraybooth ovens and their QAD System was patented in 1998. Other manufacturers followed with variations on the theme and now auxiliary air movement is a standard fit on most booths installed.

Junair's QAD System quickly became the industry standard in Europe, and later in North America, because it could also be installed in any make of existing spraybooth at a realistic upgrade cost.

5. Auxiliary airflow benefits – flash off

Water has a much slower evaporation rate than the organic solvents typically used in automotive paints and therefore, water-borne base-coats will take longer to flash off unless the evaporation rate can be increased.

Auxiliary air movement technology uses a combination of disruptive air movement and increased air temperature to speed up the flash off cycle.

The disruptive airflow breaks up the wet insulating boundary layer of air at the panel surface allowing the water to evaporate faster. The increased air temperature helps to absorb more moisture into the air stream.

Flash off times can be reduced to less than 7 minutes for a full waterborne base-coat application. AAM systems are generally fully automatic; the operator does not need to guess drying times, which in turn promotes higher quality paint jobs, as the drying is guaranteed. No water is trapped when the clear coat is applied.

It is important that the painted panel is not too hot for re-coating after the flash off cycle, or the speed benefits will be reduced. The automatic flash off program should include a cool down element so the clear coat can be applied immediately the 7 minute flash off sequence has completed. Some spraybooth manufacturers advocate raising the Booth temperature to flash-off water-borne basecoats, typically to 40°C, whilst on spray cycle. This is hugely expensive as the air is heated then dumped to atmosphere.

6. Auxiliary airflow benefits – curing

Conventional booths with semi down draught or down draught air movement are inefficient during the curing process. They heat a large volume of air which travels through the cabin, but only a small percentage of the warm air actually passes over the vehicle / panels. The majority of heat energy contained within the air flow is simply returned through the extraction duct, recirculated to the burner, with little impact on the curing process.

Auxiliary air movement systems use more of the heat energy stored in the air by creating a disruptive or turbulent flow of air within the cabin which “scrubs” more heat from the air into the vehicle / panel.

A conventional booth will have a significant time lag between air temperature and panel temperature. For example, air temperature might reach 80°C after 5 minutes on the bake cycle but the panel temperature can take 20 minutes to reach 60°C or longer on lower vehicle body panels; times will vary depending on the booth efficiency and pit design.

Auxiliary air movement reduces the time / temperature difference by making the cure cycle more efficient, using more of the heat available to bring the vehicle body panels up to temperature, including those closest to the floor. Air temperature and panel temperature are much closer together and the cure cycle time can be reduced by at least 30%.

Additionally we find with QADS we can achieve the same bake hardness at lower booth bake / cure temperatures; once again, saving energy.
If the client is baking primer then the savings will be even greater as primer can absorb energy [heat] quicker and typically needs only 15 to 18 minutes for a high build 2 pack primer to cure.

7. Auxiliary airflow benefits – production

Combining the benefits of the AAM system for flash off and bake cycles reduces the overall process time by approximately 35%. A waterborne base-coat and high solid clear-coat job can be processed in less than 60 minutes, saving at least 30 minutes against a conventional system.

The time saved in the spraybooth is a valuable commodity. If it is possible to process an additional 2 jobs per day through the booth the incremental profit will be significant and vehicle return times reduced (job cycle times).

The extra spraybooth efficiency can also help with Bodyshop planning and equipment layout. Some businesses will be able to drop a booth from the plan, lowering capital cost & operating cost whilst maintaining vehicle throughput.

8. Auxiliary airflow benefits – energy saving

Auxiliary air movement systems can reduce spraybooth energy costs by approximately 40%, which is a considerable sum given the price of gas, oil and electricity today. Energy costs are only likely to increase in the future.

Combined with Junair Spraybooths' variable air flow technology (motor VSDs), the energy savings can increase to over 70%.

Auxiliary air movement removes the need for high air movement spraybooths and has set a new standard for spraybooth air handling plant design. Often the basic plant size [m^3/hour] can be reduced when AAMs are part of the design; once again reducing operating costs.

9. Auxiliary air movement designs

Most auxiliary air movement systems use high velocity nozzles to force air into the cabin at an angle to the conventional laminar flow from the ceiling plenum.

The most common systems use nozzles mounted in the corners of the booth or angled at high level near the light system. Nozzles are normally adjustable so that off-car panels can be dried and cured. Retro fit systems are almost all corner mounted towers (see Junair QADs).

It is important that the AAM system is clean in operation or the benefits will be lost in re-working or additional polishing.

Key elements to efficiency and clean operation include:

- Air must be filtered to 10 microns or less. Basically the same as the spraybooth ceiling filter.
- Nozzles should be anti static so as not to attract dirt.
- Nozzles should be protected from overspray, as any build up around the nozzle orifice is likely to blow particles onto the wet paint finish causing contamination problems.
- Nozzles should not point at the floor. The floor of a spraybooth always has some degree of contamination and high velocity air passing over the floor will lift dirt into the airstream and potentially onto a painted surface.
- Nozzles should be adjustable so off car panels can be processed efficiently.
- The flash off cycle should be automatic, therefore repeatable, so that results are repeatable and of high quality
- Nozzles mounted at high level, often between the lights [because this is a simple installation method] do not work well as they cannot access the lower panels such as under wheel arches / front panels or rear valences, boot floors etc.

10. Auxiliary air movement problems in operation

Auxiliary air movement systems have one problem in operation that needs to be addressed by staff training at the time of installation and commissioning…Dirt.

If nozzles are contaminated with overspray or point at the floor of the spraybooth then there is a good chance that some dirt will get into the paint finish and require polishing.

Dirt can easily be avoided by making sure that the AAM system includes the features described above and that operators are trained properly. The system is very simple in operation but some basic do's & don'ts will help staff to get the best from the equipment.

Masking techniques also need to be addressed as part of the training and reorientation of staff as loose masking will "flap" releasing overspray and increasing potential for dirt.