Performance Dynamics

AIRLESS

SPRAYING SYSTEMS

BINKS

BINKS

THE PRINCIPLES OF AIRLESS SPRAYING

SCOPE

This booklet provides an introduction to the principles and systems used in airless spraying. The information given will help users to outline the working parameters of airless equipment and to select airless systems. Operating techniques and associated problems, preventive maintenance and aspects of safety of the apparatus are also described to help define spray application procedures.

Airless spraying is a method of spray application that does not directly use compressed air to atomise the coating material. The fluid is pumped at high pressure, 500 to 4500 psi (33 to 300 bar) through a small orifice in the spray nozzle. As the fluid is released at these high pressures it separates into small droplets resulting in a very fine, or atomised, spray. The high pressure gives sufficient remaining momentum to carry these minute particles to the surface.

Since air is not used to atomise the material, the term 'Airless' is used to describe this method.

The most common methods of achieving this high material pressure use electrically driven or compressed air operated pumps.

Obviously, much of this information is valid for all types of airless systems, but this booklet concentrates on **air operated systems.**

AIRLESS SPRAY SYSTEM COMPONENTS

The basic system components include a compressed air supply (which must be clean and dry), an air hose, a high pressure airless pump, paint supply, an air pressure regulator, a fluid filter, a high pressure hose and an airless spray gun complete with tungsten carbide tip.

AIR SUPPLY

The air supply powers the air motor of the airless spray pump. The quantity of air required is determined by the size of the pump, number of guns, the use of agitation equipment and the size of the spray tip orifice.

Air supply hose must be of a good quality, adequate size and capable of operating under maximum air line pressure.

MATERIAL FEED METHODS

The paint or fluid material is drawn into the pump by four principal methods.

1. The fluid section of the pump is immersed in the fluid and the fluid is drawn in by suction.

2. A syphon hose and syphon tube are connected to the pump. The syphon tube is immersed in the fluid which is drawn in by suction. When a syphon hose is used it must be of a material which is resistant to a wide range of solvents.

3. The airless pump takes fluid directly from a circulating system or pressure container at a relatively low pressure.

4. For more viscous materials the pump may need to be "force-fed". In this case, the pump is mounted on an "extrusion unit" fitted directly into the material drum. The pump is "primed" by means of fluid pressure generated by the weight of the pump. For very viscous materials, an additional pneumatic ram-unit can be used to force the pump and plate into the drum.

DELIVERY HOSE

The fluid delivery hose between pump and gun should have integral connectors and be manufactured to withstand high fluid operating pressures. It should resist the actions of a very wide range of solvents. A conductor wire should be moulded into the outer sheath of hose, and be secured to each hose connector. This eliminates any possibility of static electricity build-up or discharge. High pressure swivels can be attached to the ends of the hose to accommodate the normal twisting action during spraying so that kinking is prevented. A "whip-end", a short section of smaller bore hose, next to the gun may also be used to facilitate spraying.

AIRLESS PUMP

The airless pump converts the air pressure from the compressor to fluid pressure by driving the pump. The air motor piston reciprocates by alternate application of air pressure to the top and bottom of the piston.

A connecting rod couples the air motor to a reciprocating fluid pump which delivers fluid on both the up and the down strokes. This combination of air motor and fluid pump is called a 'reciprocating double acting pump'.

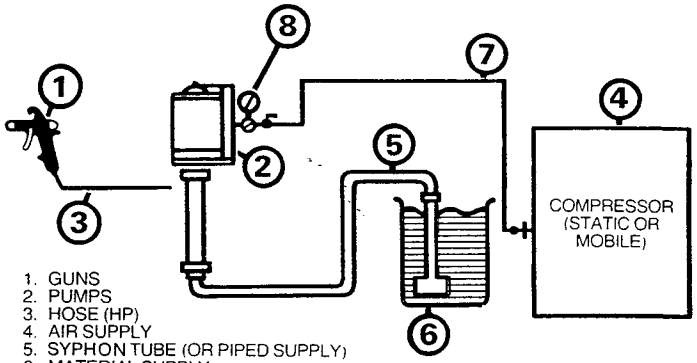
AIRLESS SPRAY GUN

The airless spray gun has to operate at high pressure and often with paints having abrasive qualities. To meet these severe conditions all guns have a tungsten carbide ball and valve seat in the fluid shut off and a tungsten carbide fluid tip for maximum wear-resistance.

DEAD-LEG AIRLESS SYSTEMS

Dead-leg systems are used for the majority of standard quality finishing applications. The gun is connected to the pump fluid section by a single high pressure fluid hose. When the gun is spraying, the pump delivers fluid under pressure adjusted by regulating the air pressure to the pump. When the gun is not spraying, the fluid pressure and air pressure are balanced and the pump stops (stalls). The finish quality depends upon operator skill, fluid, preparation and nozzle size. Dead-leg spraying is usually used with non-heated paint.

DEAD-LEG BASIC AIRLESS



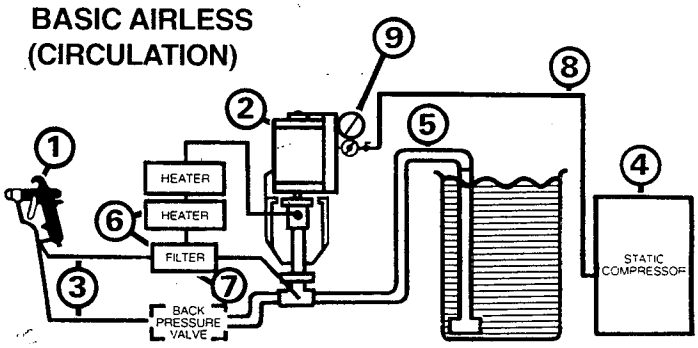
1. GUNS
2. PUMPS
3. HOSE (HP)
4. AIR SUPPLY
5. SYPHON TUBE (OR PIPED SUPPLY)
6. MATERIAL SUPPLY
7. AIR SUPPLY HOSE
8. REGULATOR

DEAD-LEG SYSTEM
USED FOR THE MAJORITY OF STANDARD QUALITY SPRAY FINISHING APPLICATIONS. USUALLY EMPLOYED WITH NON-HEATED METHODS.

CIRCULATING SYSTEMS

Circulating systems are used for high quality, high production finishes. Paint passes from the pump and filter through a high pressure hose assembly up to a gun (or series of guns) and returns to a back pressure valve. This regulating valve maintains a constant pressure and volume for the gun (or guns) when spraying. Constant pressure is maintained at all times even when the gun is not spraying, as the pump is recirculating the paint. Paint is kept at constant temperature, pressure and volume and is less prone to variations in colour, settlement, viscosity and other variations. Quality and economy of finish is less dependent upon the individual operator's skill. When heated paints are applied they are normally passed through a circulating system.

BASIC AIRLESS (CIRCULATION)



HOT CIRCULATING AIRLESS SYSTEM

1. GUNS
2. PUMP
3. HP HOSES
4. AIR SUPPLY
5. SYPHON TUBE (OR PIPED SUPPLY)
6. HEATERS (INCORPORATED IN PUMP)
7. FILTERS (INCORPORATED IN PUMP ASSEMBLY)
8. AIR SUPPLY HOSE
9. REGULATOR

HOT CIRCULATING SYSTEM FOR HIGH QUALITY, HIGH PRODUCTION FINISHES WHERE PIGMENT SETTLING IS A PROBLEM. RECIRCULATING SYSTEMS ARE NORMALLY EMPLOYED WITH HOT AIRLESS SPRAYING.

SELECTION AND SIZING OF AIRLESS EQUIPMENT

Selection of an airless system depends principally on the material to be used, the type of application and the volume of air available.

MATERIAL VISCOSITY

It is essential that the paint is of the correct type and viscosity for airless spray. The paint manufacturer must be consulted if there is any doubt.

Low viscosity materials use small orifice sizes, the higher the viscosity, the larger the tip orifice required – and the higher the ratio of the pump. Check the material against Table 1 to determine air and tip requirements. Material volumes can also be determined on the chart. Allowances required for specific gravity, surface tension and thyxotropy are usually small enough to be disregarded.

VOLUME OF MATERIAL REQUIRED

In the pressure columns of the Airless Nozzle Flow Chart, (Table 1), two sets of figures are shown. A fluid ounce (28 cc) per minute delivery rate and a cfm figure. By dividing the fluid ounce (28cc) per minute figure into 160 (3.8 litres) the number of nozzles of a particular size that can be operated from a 1 GPM (3.8 litres) pump can be determined.

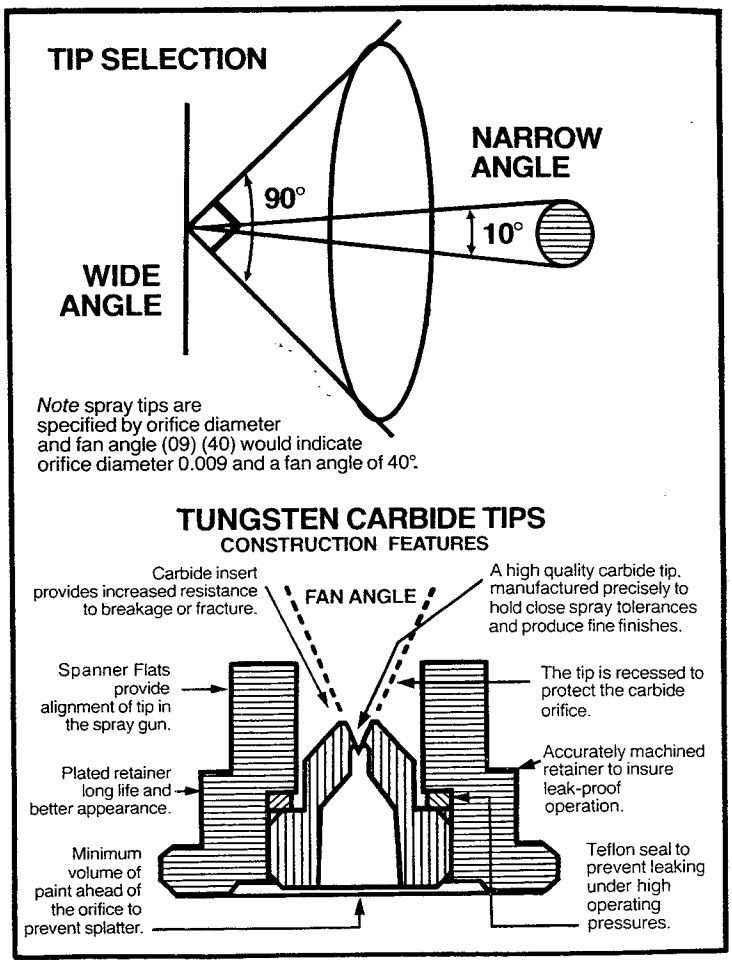
VOLUME OF AIR AVAILABLE

Adequate air supply for efficient operation is determined by multiplying the number of nozzles to be used by the cfm (m^3/hr) figure in the Airless Nozzle Flow Chart (Table 1). Allowance should be made for additional air operated accessories such as agitators, etc.

SELECTION OF SPRAY GUN TIPS

Tips normally available vary in orifice size between 0.007-0.072 inches (.178-1.83 mm) and in fan angle between 10° and 90°. The quantity of fluid delivery is controlled by orifice diameter and the thickness of fluid deposited depends on the fan angle. Spray tip orifices are elliptical and it must be remembered that the size of the fan pattern depends on the angle of the fan.

A good general rule is to determine the smallest orifice and largest fan angle for each application. A wide variety of tips are available but most applications only require two sizes, a larger orifice with a wide fan angle and a smaller orifice with a smaller fan angle. Check the guide charts below to make an initial selection of tips.



TIP SELECTION
AIRLESS SPRAY TIP FLOW CHART

Table 1

Orifice Size (inches)	Flow rate of fluid material at spray tip, oz./min. Air volume requirement of pump per spray tip, CFM. (maximum)									
	Fluid material pressure at spray tip									
	500 PSI		1000 PSI		1500 PSI		2000 PSI		2500 PSI	
	oz./min.	CFM	oz./min.	CFM	oz./min.	CFM	oz./min.	CFM	oz./min.	CFM
VERY THIN – Wash Primers, Dyes, Stains, Solvents, Water, Inks										
.007	4.0	0.5	5.0	0.7	6.0	0.8	6.7	1.4	7.0	1.7
.009	4.5	0.6	5.7	0.8	6.8	0.9	8.4	1.8	10.0	2.7
.011	6.5	0.8	8.5	1.1	12.0	2.0	14.0	2.9	15.0	3.8
THIN – Sealers, Lacquers, Primers, Ink, Zinc Chromate, Acrylics, Lubricants										
.013	12.0	0.8	15.0	1.1	19.0	3.0	22.0	4.5	26.0	6.4
.015	13.0	1.1	19.0	2.5	24.0	4.0	27.0	5.7	32.0	8.0
.016	14.0	1.3	22.0	2.9	29.0	4.8	34.0	7.0	39.0	9.7
MEDIUM – Lacquers, Synthetic Enamels, Varnishes, Shellacs, Fillers										
.018	12.0	1.0	19.0	2.5	26.0	4.2	35.0	7.4	44.0	10.0
.021	14.0	1.2	24.0	3.5	32.0	5.3	46.0	9.5	56.0	13.0
HEAVY – House Paints, Wall Paints, Block Sealers, Block Paints, Mill Whites, Vinyls										
.026			21.0	2.7	34.0	5.7	51.0	11.0	65.0	16.0
.031			26.0	3.3	48.0	7.4	65.0	14.0	85.0	21.0
.036			32.0	4.2	68.0	11.0	95.0	20.0	126.0	31.0
VERY HEAVY – Unaggregated Block Fillers, Texture Coatings, Fire Retardants, Bitumastics										
.043			31.0	4.0	61.0	10.0	105.0	22.0	143.0	36.0
.072			72.0	9.5	112.0	18.0	151.0	32.0	190.0	47.0

Metric conversion figures can be used as follows 1 bar = 15 psi
1 fluid oz = 28cc approx. (specific gravity = 1) 1 cubic foot = .028 cubic metres.

Note: All gallons figures quoted are U.S. gallons. 1 U.S. gallon = 3.785 litres.

Some deviation in the above data may be expected because of variations in equipment and fluids. This does not impair the usefulness of the data, however, in serving as a selection guide.

PUMP SELECTION

The selection of pump sizes depends on the actual flow and operating pressures determined by the viscosity of the fluid and rate of application. Like any other pumping system, longer maintenance-free intervals are given by low pump speeds, i.e. less than 60 cycles per minute (cpm). See example on Page 4.

Naturally, a high viscosity fluid such as a bitumastic would require much more equipment and air volume compared with a low viscosity fluid such as a lacquer.

AIR SUPPLY/COMPRESSOR

An adequate air supply is essential to drive the air motor. The size of compressor or volume and pressure of the air supply depends on a number of factors; pump size, number of guns, the use of agitation equipment and the diameter of the spray tip orifice. Refer to charts and worked example for initial system design calculations.

HOSES AND CONNECTIONS

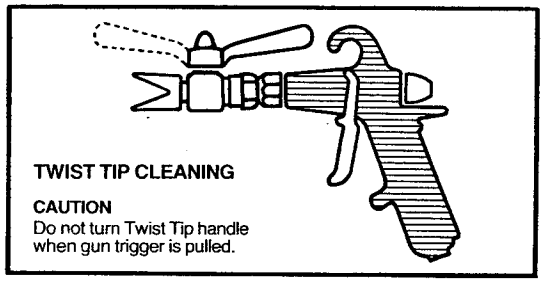
In any high pressure system integrity and correct selection of hoses and connections are important.

AIR HOSE/CONNECTIONS

Naturally, the quality of hose must be suitable for the maximum compressor pressure. At least ⅜ inch (9 mm) bore must be used, lengths of hose over 50 ft (15 m) must be at least 0.5 inch (12 mm) bore and 100 ft (30 m) hose lengths must have a bore of 1.0 inch (25 mm). Large air motors over 5 inches (125 mm) diameter require a minimum air hose bore of ½ inch (12 mm). Air motor inlet connector size should be used as a general indication of bore size of air hose required.

SUCTION/SYPHON HOSE/CONNECTIONS

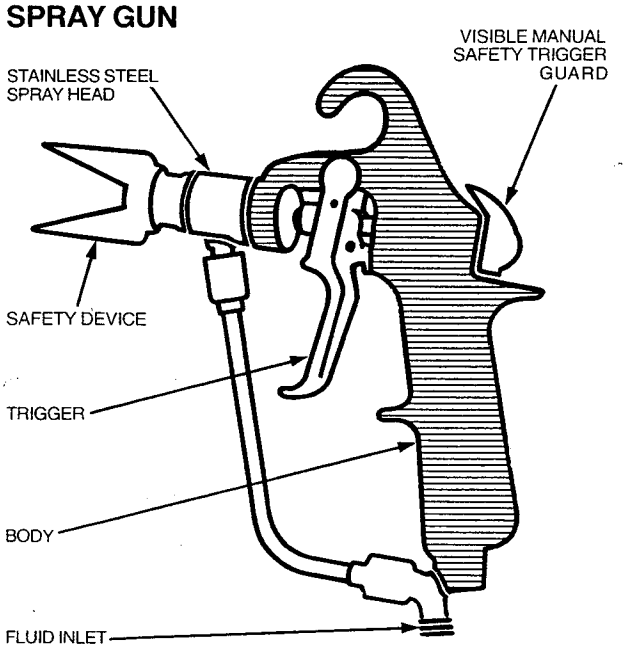
Generally ¾ inch (18 mm) bore or 1 inch (25 mm) bore hose is essential. The hose must be resistant to the appropriate liquid solvents.



TWIST TIP CLEANING

CAUTION
Do not turn Twist Tip handle when gun trigger is pulled.

SPRAY GUN



PAINT DELIVERY HOSE/CONNECTIONS

Like other hoses, paint delivery hoses and connections must withstand the high operating pressures and not be subject to attack by solvents. Each hose should be pressure tested as an assembly and certified for the pressure to be used. This is normally carried out by the supplier or manufacturer.

INITIAL SYSTEM DESIGN

Selection of equipment depends on the viscosity of the fluid to be sprayed, the air pressures available, the quantity of material and thickness of film build required.

Using the application of lacquer at a rate of 150 oz (4.2 litres) per minute as an example, the following calculations can be made.

1. VISCOSITY Check material viscosity on Table 1.

2. ORIFICE SIZE AND FAN ANGLE

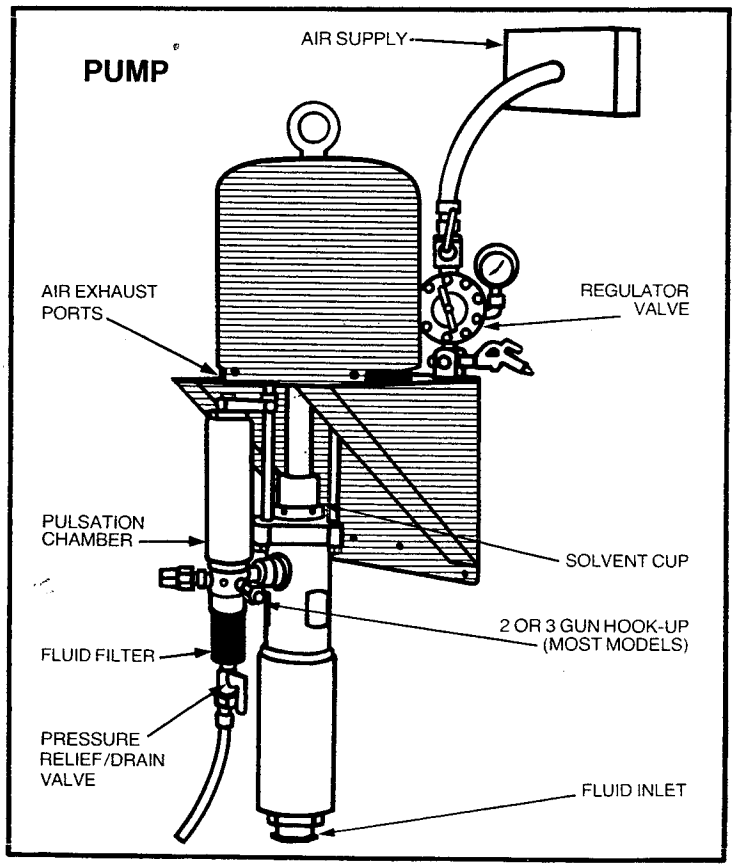
Select possible orifice sizes from the flow chart, Table 1, to give minimum number of orifices i.e. 5×34.0 oz delivery or 4×39.0 oz delivery using 0.016 inch orifice size. This will give an air supply requirement of 5×7.0 cfm=35 cfm or 4×9.7 cfm=38.8 cfm at 2000 and 2500 psi respectively.

Thickness of film build and fan angle required are difficult to judge. Generally, a 10° fan angle will give a deposition band 2 inches wide at 12 inches from the surface while an 90° fan angle will give a deposition band 24 inches wide. Obviously, the smaller the orifice angle the less surface area covered by each gun stroke.

3. PUMP SELECTION

Taking the 2000 psi fluid pressure requirement check the pump selection chart, Table 2 to determine pump ratio required. Air pressure is required only to operate the air motor to drive the fluid pump. The pump develops fluid pressures at a given ratio depending on the size of the air motor piston and the effective area of the fluid piston. An 80 psi air supply and a 29:1 pump will give a fluid pressure of 2320 psi and a fluid delivery of 184 ozs. This is a conservative rating giving a cycle speed of less than 60 cpm.

Note:
Additional calculations will be required to take account of other air operated equipment. The charts are approximate but are sufficiently accurate for equipment selection.



PUMP SELECTION

RATIO	GPM at 60 CPM	GPM at NORM. CONT. RUNNING SPEED	FL. OZ. at NORM. CONT. RUNNING SPEED	CCS at NORM. CONT. RUNNING SPEED	LITRES at NORM. CONT. RUNNING SPEED
32:1	1.0	0.8	102	2897	2.897
32:1	1.0	0.8	102	2897	2.897
18:1	1.8	1.44	184	5226	5.226
29:1	1.8	1.44	184	5226	5.226
29:1	1.8	1.44	184	5226	5.226
41:1	1.8	1.44	184	5226	5.226
41:1	1.8	1.44	184	5226	5.226
21:1	3.6	2.88	368	10451	10.451
21:1	3.6	2.88	368	10451	10.451
37:1	3.6	2.88	368	10451	10.451
37:1	3.6	2.88	368	10451	10.451
31:1	4.2	3.36	430	12212	12.212
31:1	4.2	3.36	430	12212	12.212
20:1	6.7	5.36	686	19482	19.482
57:1	3.6	1.44	184	5226	5.226
48:1	4.2	3.36	430	12212	12.212
30:1	6.7	5.36	686	19482	19.482

NOTE: **Normal continuous running speed is based on a cyclic speed of 48 cpm max. e.g.:– 96 strokes. However, the slower the duty the longer the pump life, so do not overwork the pump if at all possible.**

OPERATING TECHNIQUES

SAFETY

Safe airless spraying, like any other process with high liquid pressures, can only be achieved by constant attention to detail. All operators should read and understand the precautionary notes on Page 11.

PREPARATION

Correct preparation is important if the best results are to be achieved. Careful selection of paint is essential; if there is any doubt consult the manufacturer. It is particularly important to check paint with a high pigment/binder settlement rate in case agitators are required. Viscosity should be checked before use to ensure that it suits the spray tips. If viscosity has to be altered, ensure that a compatible solvent is used in accordance with the manufacturers recommendations. If necessary, the paint should be strained so that foreign particles and paint skins are eliminated. A nylon cloth is often suitable.

All operating units should be checked, hose connections should be tight and, in the case of new units, a solvent should be passed through the system to remove traces of protective grease and oil.

CLEANLINESS

A high standard of cleanliness is essential to avoid poor finish, blocking of fluid tips and excessive wear. Cleanliness checks should be made on all components and materials, including air supply, the airless pump, fluid hoses, guns, filters, the fluid or paint, and associated containers.

AIRLESS SPRAY PAINTING

After opening the air supply and increasing pressure, an adequate jet of paint or fluid will pass through the jet. A detailed description of the procedure is given on Page 9.

Even surface coats are given if the gun movement is PARALLEL to the surface and the axis of the gun is PERPENDICULAR to the surface.

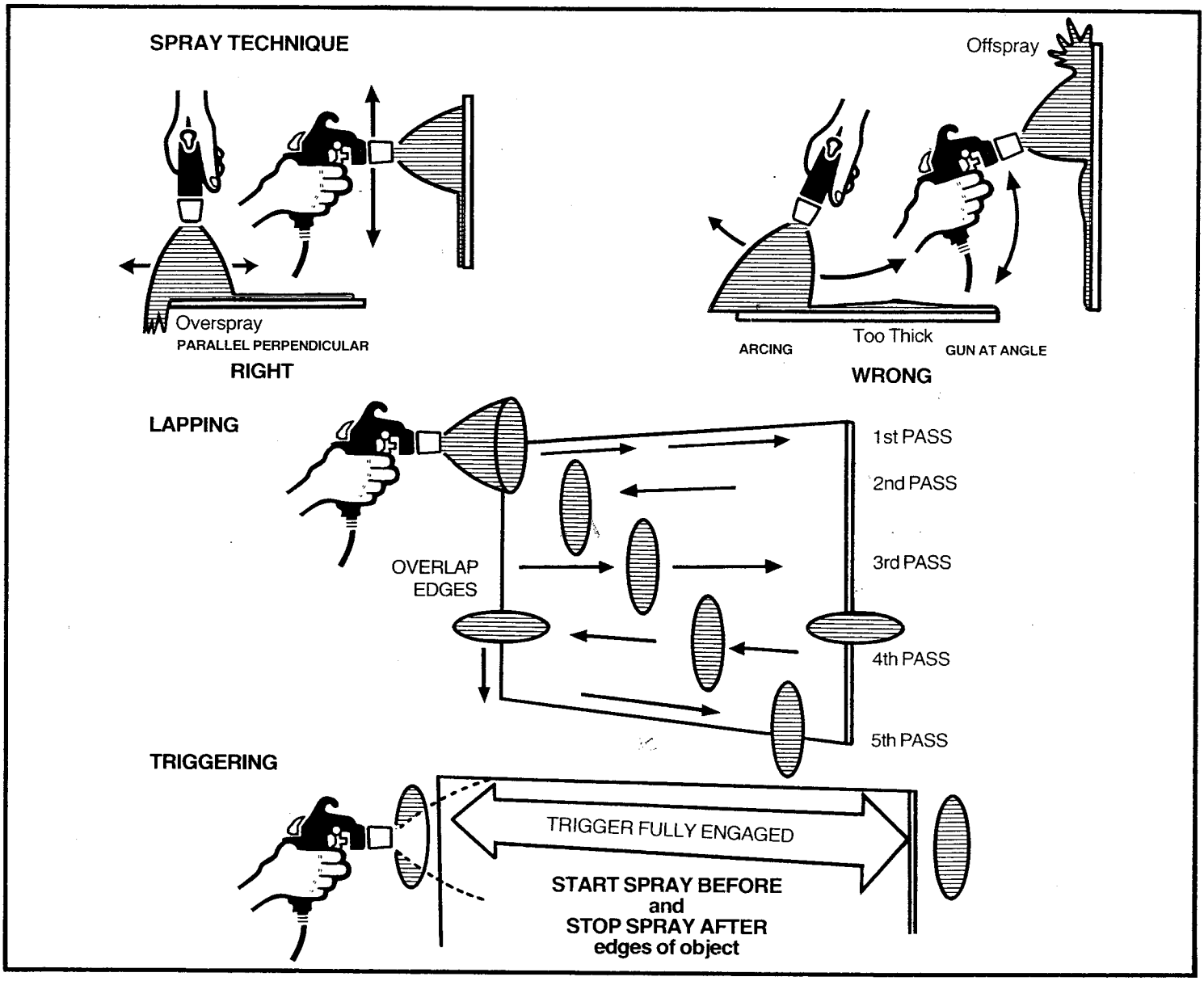
Spray operators should move the gun using wrist, elbow and shoulder to avoid arcing the gun. ARCING the gun by using hand and wrist movements only gives uneven deposit.

Working distance depends on a variety of factors, but the most effective distance is usually between 10 and 15 inches (250 and 375 mm). Operators should aim to keep this optimum distance constant.

Operator speed should provide a full wet coat application with each stroke. If the film thickness is not adequate without runs or sagging other coats can be applied with a flash-off period between each coat.

If the operator has to move too fast to prevent sagging the tip should be changed to one with a smaller orifice or fluid pressure should be reduced. If movement is too slow the opposite applies.

Uniformity of film thickness over the surface is given by correct "lapping". The spray paint area on each stroke should overlap the previous one by not more than 50 per cent. "Triggering" should be used to cut off paint supply after the gun has crossed the edge of the surface and switched on before if maximum economy and effective edge cover is required.



OPERATING PROBLEMS

The most common problems are blockage or plugging of the fluid tips and poor spray patterns.

TIP BLOCKAGE

The most common causes are inclusions of foreign matter, paint skin or residue. This type of problem can only be solved by thorough cleaning and correct maintenance of the filters and strainers. Paint pigment can cause blocking if particles are too large for the tip size. A larger tip may solve the problem. If not, the paint manufacturer must be consulted.

Heavy fluids, like bitumastic paints, should be sprayed using large orifice tips without strainers and filters. Blocking can often by reduced by thinning. This often allows spraying at reduced fluid pressures. Once again, the paint manufacturers should be consulted if thinners do not solve the problem. Check tip cleaning procedure on Page 10.

STRAINER BLOCKING

Sometimes the loss of spray pattern and inadequate tip flow are the result of strainer blocking. Always check the strainer if the spray tip is clean.

SPRAY PATTERNS

A smooth elliptical fan pattern should always be present if the equipment is working properly. Any deviation from that pattern indicates failure or overloading of the system or its components.

FAULT ANALYSIS

An airless spraying system consists of a number of units, generally most faults are associated with guns, pumps or filters. Ten common faults are listed below. Contact your equipment or paint supplier if the tables below do not help you.

FAULT FINDING

SPRAY PATTERN

PROBLEM	CAUSE	REMEDY
Tails 	Inadequate Fluid Delivery	a. Increase fluid pressure. b. Change to larger tip orifice size. c. Reduce fluid viscosity.
	Fluid not Atomising	d. Clean gun and filter(s). e. Reduce number of guns using pump.
Hour Glass 	Inadequate Fluid Delivery	a. Same as a through e, above.
Distorted 	Plugged or Worn Nozzle Tip	a. Clean or replace nozzle tip.
Pattern Expanding & Contracting (Surge) 	Pulsating Fluid Delivery	a. Change to a smaller tip orifice size. b. Install pulsation chamber in system, or drain existing one. c. Reduce number of guns using pump. d. Increase air supply to air motor. e. Remove restrictions in system, clean tip screen or filter if used.
	Suction Leak	a. Inspect for syphon hose leak.
Round Pattern 	Worn Tip	a. Replace tip.
	Fluid too Heavy for Tip	a. Increase pressure. b. Thin material. c. Change nozzle tip.

SPRAY GUN

PROBLEM	CAUSE	REMEDY
Spitting Gun	Air in system.	Inspect for syphon hose leak.
	Dirty gun.	Disassemble and clean gun.
	Cartridge out of adjustment or damaged.	Inspect cartridge. Replace cartridge.
Gun will not shut off	Worn parts.	Inspect gun. Replace defective parts.
	Cartridge out of adjustment.	Inspect cartridge. Replace cartridge.
	Dirty gun.	Disassemble and clean gun.
	Packing gland too tight.	Loosen gland, oil needle, adjust.
Gun does not spray any fluid	Loss of air pressure.	Check for leaks and repair as required.
	Suction leak.	Inspect for syphon hose leak.
	No paint.	Check fluid supply.
	Plugged pump foot valve.	Remove, clean, inspect foot valve.
	Plugged filters or tip.	Clean filters or tip.
	Ball check valve stuck open.	Clean and inspect pump ball check valve.

FAULT FINDING

AIRLESS PUMP

PROBLEM	CAUSE	REMEDY
INSUFFICIENT MATERIAL FLOW (Pump operates but does not stall)	1. No paint. 2. Foot strainer clogged. 3. Pump will not prime. Material too heavy. 4. Leak in spray system. 5. Air leak in siphon hose. 6. Foreign material lodged in foot valve. 7. Dry or worn packings. 8. Broken or worn ball or valve seats. 9. Air motor piston shaft separated from fluid shaft. *10. Back Pressure Recirculating Control Valve open.	1. Check fluid supply. 2. Clean foot strainer. 3. Thin material and operate pump more slowly to get primed. 4. Repair leaks and tighten connections. 5. Tighten connection on siphon hose. Check for damage. 6. Remove pump from paint and clean valve foot. 7. Replace packings in accordance with part sheet. 8. Inspect and replace broken or worn parts. 9. Inspect and repair. *10. Close valve. If closed and still by-passing fluid, repair or replace valve
NO MATERIAL FLOW (Pump not operating)	1. Loss of air pressure. 2. Plugged supply lines, filters or tip. 3. Icing of air motor. 4. After a long period of storage, piston cups may be stuck to cylinder wall. 5. Pilot valve or autocycle stuck. 6. Air valve actuator piston stuck. 7. Trip rod adjustment too loose. Air piston hits on bottom of casting before tripping pilot valve. 8. Malfunctioning or worn air valve	1. Check air supply. 2. Clean hose, filters, and tip. 3. Install an oiler with antifreeze. 4. Increase air pressure until piston cups loosen. then decrease air pressure for normal operation. 5. Remove and check for proper adjustment, plugging, worn or damaged parts, binding or leaking seals. 6. Remove and check for binding, lubricate. 7. Tighten trip rod adjustment screw. 8. Refer to air valve part sheet for proper procedures.
LOSS OF POWER UNDER LOAD, AIR HISSING DURING EXHAUST	1. Insufficient air supply. 2. Air motor piston cups or cylinder wall scored.	1. Check for sufficient air supply. 2. Replace worn or damaged parts.
SLIDE BLOCK OR AUTO CYCLE VALVE MOVE TOO SLOWLY	1. Piston cups swollen and binding. 2. Actuator piston or valve surface plate dirty or binding.	1. Replace piston cups and lubricate. 2. Remove, clean and lubricate.
AIR MOTOR VALVE OR AUTO CYCLE VALVE LEAK UNDER LOAD	1. Surface plates or valve block plate stuck, balls seats scored or dirty. 2. Auto cycle valve out of adjustment.	1. Replace damaged parts. Clean and lubricate. 2. Adjust auto cycle valve. (See part sheet).
PILOT VALVE OR AUTO CYCLE VALVE HISSING CONSTANTLY, LOSS OF PUMP POWER	1. Pilot valve or auto cycle valve seals damaged. 2. Auto cycle valve out of adjustment.	1. Replace damaged parts. 2. Adjust auto cycle valve. (See part sheet).
MATERIAL FLOW SLUGGISH OR PUMPING ON ONE STROKE ONLY	1. Insufficient air pressure or volume (CFM). Too small I.D. hose. Too long a hose. Too small a compressor. Kinked or tangled hose. 2. Fluid piston ball valves not seating or unseating properly.	1 .Check air supply, hose length, hose I.D., pump air requirements. Check hose. 2. Remove fluid section and inspect for wear, stuck or broken parts, and clean or replace. (See part sheet). 3. Replace piston cups or cylinder. (See part sheet).

PREVENTIVE MAINTENANCE

While all airless systems are rugged and designed for use in all environments, lack of maintenance is potentially expensive. If maximum service life is required the operator should regularly carry out the following checks.

1. Check AIR REGULATOR and valve seat for cleanliness and damage.
2. Check HIGH PRESSURE FLUID HOSE for kinking, fractured outer covers, damaged hose connections.
3. Check FLUID FILTER for clogged or damaged openings.
4. Check the gun for damage or wear.
5. Check the FLUID PUMP for damage or wear.
6. Check the AIR MOTOR for damage and cleanliness of pilot valve.

AIRLESS SPRAYING SYSTEMS OPERATING PROCEDURES

START-UP PROCEDURE

1. Connect air supply to air control. Make sure hose size, connections and fittings are large enough to prevent a restricted air supply. Air motor inlet connector size should be used as a general indication of bore size of air hose required.
2. Connect high pressure hose between filter manifold (pump outlet) and spray gun (less nozzle tip). Tighten connections securely.

2a. (Circulating system only).
Connect one end of the high pressure return hose to the remaining spray gun connection and the other end to the back pressure control valve. If two hoses of different sizes are used, the smaller diameter hose is the return.

3. If the unit has siphon hose, connect to the pump. All connections must be tight and the strainer should be clean. Periodically grease fitting with lubricant. Fill solvent cups as required.
4. Air regulator should be shut off (closed).
5. Open air supply valve to regulator, and the tap between the regulator and air motor.
6. Immerse fluid section or siphon tube in solvent compatible with fluid to be sprayed. (Refer to paint manufacturer's recommendations).
7. With trigger held back direct spray gun into solvent container and slowly increase air pressure on the regulator to operate pump slowly. If a drain valve is fitted it is better to prime the pump by opening the drain valve before triggering the gun.

7a. Circulating system only.
Open back pressure control valve.

8. Increase air regulator pressure and run pump for approximately 30 seconds at a moderate speed.
9. Release trigger of spray gun with pressure relief valve closed and wait for pump to stall (stop running).

9a. Circulating system only.
Close back pressure control valve.

10. Remove siphon hose or pump from solvent. Reduce pressure on air regulator.
11. Slowly open drain valve and pump solvent out of system.

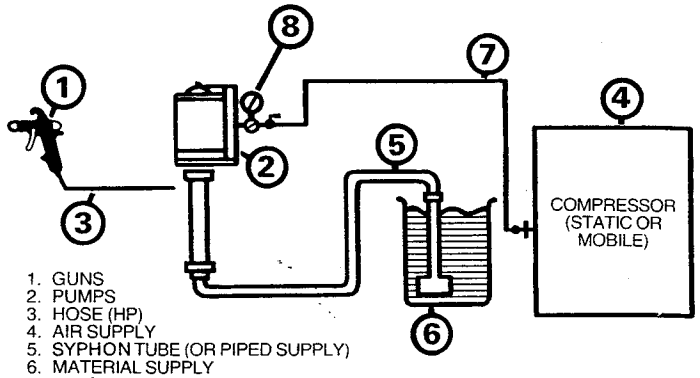
11a. Circulating system only.
Open back pressure control valve.

12. Allow air to flow through system for about ½ minute.
13. Check any air-operated accessories for proper functioning.
14. Shut off air supply by closing regulator.
15. Follow material supplier's recommendations for preparing material to be sprayed.
16. Fill paint container with clean paint.
17. Immerse siphon hose or pump in paint container, and drain valve tube or hose.
18. Select tip and gasket (and insert if needed). Install securely in spray gun.
19. Increase air pressure until pump begins to operate.
20. Prime system with paint.
21. Let pump stall.

21a. Circulating system only.
Close back pressure recirculating control valve.

22. Test spray pattern. Increase air pressure (if required) and test at 5 psi (0.3 bar) increments until desired spray pattern is reached using *minimum* air pressure.

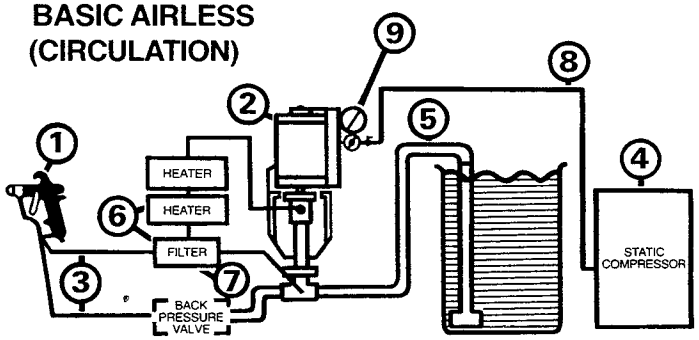
DEAD-LEG BASIC AIRLESS



1. GUNS
2. PUMPS
3. HOSE (HP)
4. AIR SUPPLY
5. SYPHON TUBE (OR PIPED SUPPLY)
6. MATERIAL SUPPLY
7. AIR SUPPLY HOSE
8. REGULATOR

DEAD-LEG SYSTEM
USED FOR THE MAJORITY OF STANDARD QUALITY SPRAY FINISHING APPLICATIONS. USUALLY EMPLOYED WITH NON-HEATED METHODS.

BASIC AIRLESS (CIRCULATION)



HOT CIRCULATING AIRLESS SYSTEM

1. GUNS
2. PUMP
3. HP HOSES
4. AIR SUPPLY
5. SYPHON TUBE (OR PIPED SUPPLY)
6. HEATERS (INCORPORATED IN PUMP)
7. FILTERS (INCORPORATED IN PUMP ASSEMBLY)
8. AIR SUPPLY HOSE
9. REGULATOR

HOT CIRCULATING SYSTEM FOR HIGH QUALITY, HIGH PRODUCTION FINISHES WHERE PIGMENT SETTLING IS A PROBLEM. RECIRCULATING SYSTEMS ARE NORMALLY EMPLOYED WITH HOT AIRLESS SPRAYING.

22a. Circulating system only.
Turn paint heater ON (if so equipped).

NOTE: Control of spray pattern is accomplished by:
a. Proper tip selection for flow rate and fan pattern size.
b. Fluid pressure adjustment.
c. Changing the viscosity of the material.

22b. Circulating system only.
Open back pressure recirculating control valve slowly. The pump should operate at approximately 30 strokes per minute (top to bottom is one stroke).

22c. Circulating system only.
Check for proper spray pattern. When pump is circulating the back pressure control valve gauge should drop 100 to 200 psi when spraying.

COLOUR CHANGE OR SHUT DOWN PROCEDURE

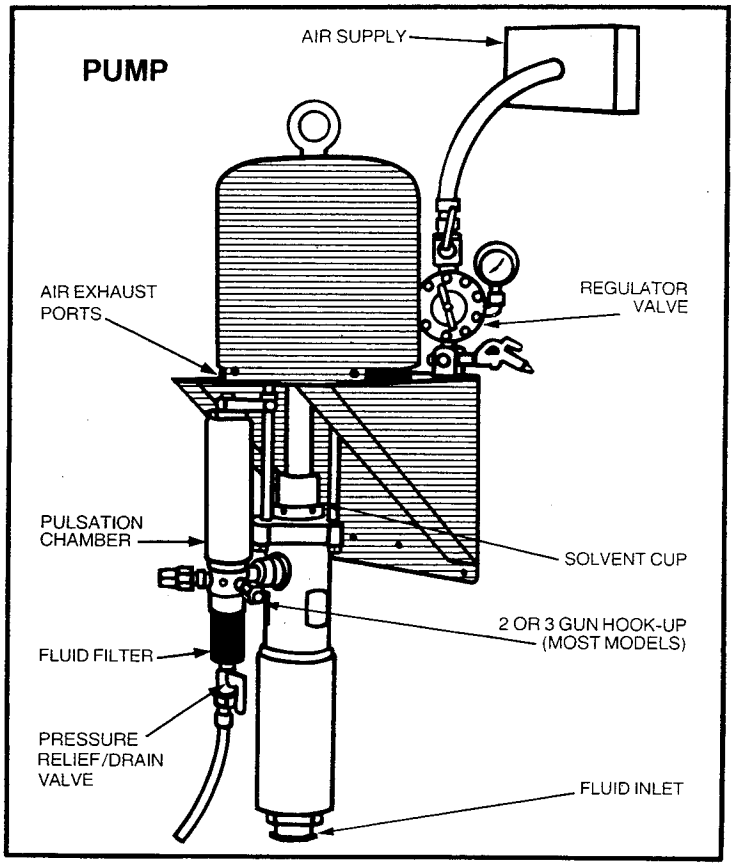
1. Close air pressure valve, shut off air supply, turn air control knob to reduce air pressure to zero.
2. Release fluid pressure by aiming gun into fluid reservoir and pulling trigger, until fluid ceases to flow, or by opening the high pressure release valve.
3. Remove pump or siphon hose from fluid container.
4. Remove nozzle tip, gasket, and insert if used and place in solvent.
5. Insert pump foot valve or siphon hose in container of compatible solvent. Open air valve.
6. Pump paint from system by opening air valve slowly until fluid pours from gun and direct flow into paint container.
7. When solvent flows from the gun, direct the stream into the solvent container. Care should be taken to avoid spray bounce back.
8. Allow the solvent to circulate for several minutes through the gun.
9. Circulate with several short purge cycles, open and close drain valve several times. Short purge cycles with clean solvents are more effective than a long cleaning purge cycle. Continue until system pumps clean solvent during second or third cycle, increase pump pressure 10 psi (0.6 bar) above previous spraying pressure and trigger gun.

9a. Circulating system only.
Close the back pressure circulating control valve.

10. Remove pump or siphon hose from solvent and continue flow until systems pumps air for about 30 seconds.

10a. Circulating system only.
Open the back pressure recirculating control valve.

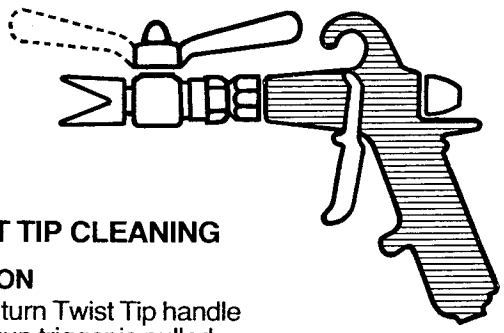
11. Shut off air supply and trigger gun until all pressure is relieved or open the high pressure release valve.
12. Remove filters and clean by flushing with solvent; use soft brush if required, and forcing air from the inside through the filter to remove residual particles. Reassemble when clean.
13. Wipe exterior parts that come in contact with paint until clean using solvent dampened rags.
14. Repeat steps 5 and 7 using a petroleum base solvent (kerosene, mineral spirits or lacquer thinner). Close air supply to pump but keep system filled with solvent. Solvent should be a solution of 4 parts solvent and 1 part 10 weight oil. For overnight shutdown ONLY clean solvent may be left in the system.
15. Operate pump until fluid section piston shaft is in the "down" position (or down stroke). This will prevent paint from hardening on piston shaft and the solvent will keep residual paint pliable.
16. Release excessive pressure from the system.
17. Clean tip (and insert) with solvent and blow air through tip (and insert). Visually check both for obstructions. Tips should be stored in a small solvent filled container.
18. Disconnect air supply, and rotate trigger guard to "off" position. Pump should be stored in normal operation position so that solvent will not drain out of pump.



TIP CLEANING

Many spray guns now incorporate a Twist Tip Nozzle Cleaner. The handle is rotated at 180° to the cleaning position, the tip is purged, then the handle is rotated another 180° to return to the spraying position. DO NOT turn cleaner handle without ensuring that the trigger guard is in the correct position. If a twist tip cleaner is not supplied the following procedure should be adopted, ensuring that the system is isolated with the correct safety devices.

1. Ensure that the trigger safety guard is in the 'off' position.
2. Relieve fluid pressure (by switching off air supply).
3. Remove cap, tip and gasket.
4. Flush nozzle tip with solvent, blow air through tip from front to back and make a visual check against the light for obstructions.
5. Replace cap, tip and gasket.



TWIST TIP CLEANING

CAUTION
Do not turn Twist Tip handle when gun trigger is pulled.

OPERATING PRECAUTIONS

AVOID FIRE RISK

1. GROUND all equipment to avoid static build-up, sparking or arcing. Failure to do so can cause shocks, fire or explosion when spraying flammable liquids. ENSURE that the object being sprayed is grounded (earthed).
2. NEVER SPRAY flammable liquids in the vicinity of any open flame, including cigarettes, or any operating electrical apparatus.
3. NEVER SPRAY flammable solvent through the gun nozzle tip. Always remove the nozzle tip before cleaning the tip or using a solvent flush.

PERSONAL SAFETY

4. NEVER clean, change, or remove the nozzle from the spray gun without first doing the following:
   a. Be sure to set the trigger safety guard on the gun.
   b. Shut off pump. Release fluid pressure in the entire system, from pump to spray gun, by opening the PRESSURE RELIEF VALVE.
5. NEVER remove the fluid hose or spray gun from the system without first releasing the system pressure (see instructions a and b under paragraph 4, above). Remember, the fluid may be under very high pressure (3000 psi or more).
6. AVOID triggering the spray gun to release system pressure: USE PRESSURE RELIEF VALVE IF FITTED (see paragraph 4, b).
7. NEVER handle the spray gun carelessly.
8. NEVER allow the gun's spray to come close to any part of the human body, even when the spray nozzle is removed.
9. NEVER plug a hose leak with your finger, with adhesive tape or other "stop-gap" devices.
10. NEVER operate the airless system with a defective hose. ALWAYS replace the defective hose immediately (see paragraph 5).
11. BEFORE doing ANY maintenance work on the pump, hose, or spray gun, or BEFORE leaving the airless equipment system unattended for ANY length of time, FOLLOW PROCEDURE DESCRIBED IN PARAGRAPH 4.
12. Airless pumps can develop hydraulic pressure of 3000 psi or more. All of the components incorporated into the pump, spray gun, and other elements of the airless system, have been carefully designed and tested to ensure their safe operation under these high pressures, WHEN PROPERLY HANDLED AND MAINTAINED.

    For continuing safety, users are urged to:
    a. ALWAYS handle carefully all hose connections, joints, and seating surfaces on the spray gun to prevent damage.
    b. NEVER kink or bend the fluid hose into less than a four inch radius.
    c. FREQUENTLY check the hose for kinks or abrasions. These may develop into a rupture.
    d. NEVER use standard hardware to modify the airless system. ALWAYS use high pressure fittings only. NEVER use low pressure paint hose.

QUALITY OF FINISH AND EQUIPMENT

13. Keep air compressors as far as possible from the paint area to avoid compressor contamination and to keep equipment clean.
14. Avoid excess fluid pressures. This does not improve the finish but increases fluid tip wear and shortens the life of other equipment.
15. Always keep equipment and fluids clean and free of all types of contamination.

GENERAL COMPARISON

FACTOR	AIRLESS SPRAYING	CONVENTIONAL SPRAYING
1. Means of atomisation	High velocity of fluid using hydraulic pressure through small orifice.	Fluid stream torn apart by jets of compressed air.
2 .Pattern control	Nozzle shape and size – must change nozzle to change pattern.	Control or air and fluid pressure provide complete control of pattern.
3. Air volume	Approx. .25% to .50% of air spray 100 psi (6.6 bar)	4 to 20 CFM (6.7-33.5m³/hr)
4. Air pressure requirements	High pressure up to 100 psi (6.6 bar) required.	Medium to low air pressures best 50 to 70 psi (3.3 to 5 bar).
5. Fluid pressure requirements	600 to 4000 psi (40-267 bar).	Low pressures – generally less than 20 psi (1.3 bar) at nozzle.
6. Fluid delivery	Medium to high delivery. Provides fastest application speeds. Excellent for large areas.	Low to medium delivery. Usually not more than 32 oz (9 kg) per min. Less speed than airless – more control.
7. Air contamination	More overspray (material that misses the object) but less fog and rebound (material that bounces back from the surface).	Less overspray. More fog and rebound. Proportional to the atomizing pressure. Higher – more fog.
8. Materials	Not all materials can be sprayed. Requires uniform fine grinds. Heavy pigmented, fibre filled, abrasive or cohesive materials may not spray.	Materials that flow can be sprayed.
9. Material preparation	Requires considerable care in preparation to ensure proper patterns with no tip plugging blockage.	Less care required. Follow material supplier's recommendations.
10. Maintenance	More required because high pressure pumping equipment and smaller fluid tip orifices are required.	Less required because equipment is more basic.
11. Product contamination	No contamination from air line impurities.	Impurities in the air supply can spoil the finish.
12. Spraying advantage	Materials may be sprayed into cavities and corners with little rebound coming from the opening.	Difficult to spray into cavities and corners because of the large amounts of air required to atomize the materials; create an air cushion which inhibits paint deposition.
13. Atomisation	Generally coarser atomisation.	Fine atomisation for all high-quality finishes.

GLOSSARY OF TERMS

Airless spraying – The method of using high pressure to create high fluid velocity which atomises paint material without using air.

Airless pump – A pump designed to create high fluid pressures which are needed in airless spraying.

Siphon feed pump – A pump that has a hose connected to the foot valve which enables the pump to siphon material out of standard containers.

Solvent cup – A cup put on a pump around the upper packings which will help lubricate the pump and carry off any excess heat caused by the operation of the pump.

Siphon tube – The tube and hose assembly which connects to the foot valve of the pump.

In-line filter – A filter which connects in the paint line of an airless unit before the spray gun.

Spray gun swivel – Connects between the spray gun and hose which makes it easier to work with and prevents tangles with airless hose.

Airless gun – A special gun designed to withstand high pressure and has only one fluid hose connection.

Airless nozzle tip (spray tip) – A nozzle tip made of tungsten carbide with a small hole in it in sizes from .007 to .072 of an inch.

Spray angle – The angle that is cut into a nozzle tip which will determine the spray fan pattern.

Orifice – The size of the hole cut into a nozzle tip.

Insert (Micro spray orifice – pre-orifice) – A tip placed before a nozzle tip with an orifice of the same size or larger which will add velocity to the material – gives consistency and finer atomisation.

Twist tip nozzle cleaner (reverse-a-clean) – Facilitates the cleaning or airless tips by being able to reverse the tip and blow back paint through tip to clean it.

Stall – When pump stops under load.

Compatible solvent – A solvent which has no chemical effect on the material being sprayed and is normally used as a thinner.

Trigger safety guard – A device on the gun to prevent spray operating when trigger is depressed.

BINKS

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