APPLICATION GUIDELINES

SHOP PRIMER

Revision 8

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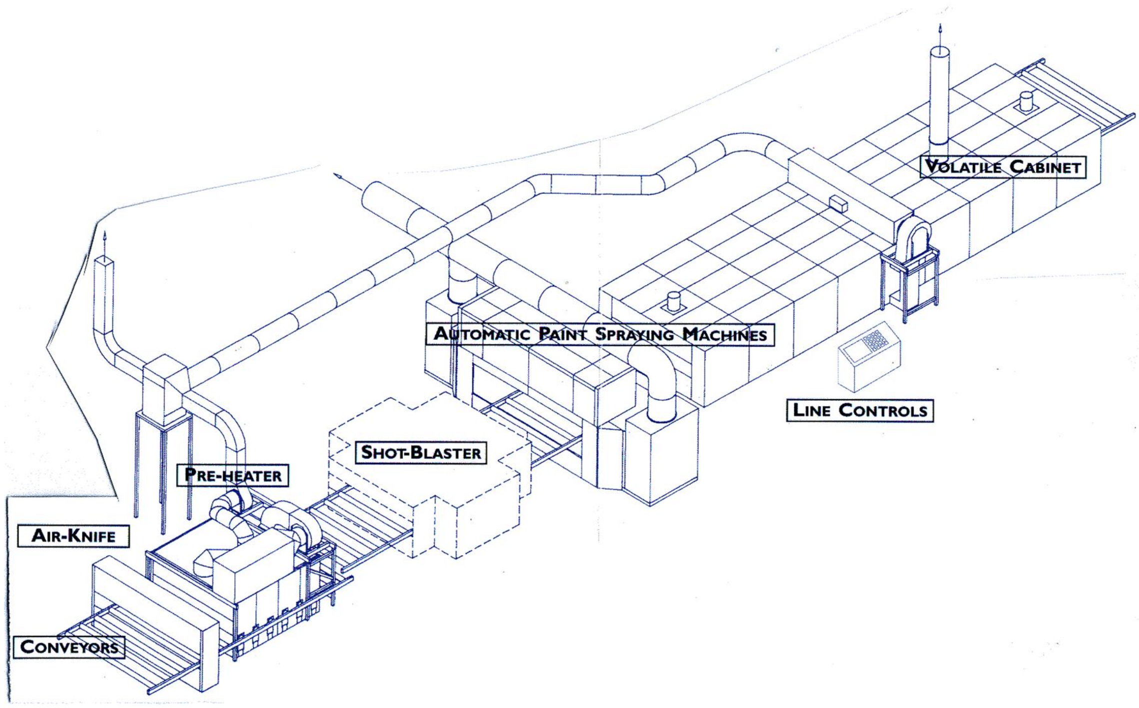
1. SHOP PRIMER APPLICATION GUIDELINES

The use of automatic blasting and priming plants is the most common method used for the application of shop primers. Successful performance of a shop primer is dependent on the standard of surface preparation and application. Substandard blasting, inadequate cleaning, discontinuous films as well as low film thickness can all contribute to premature failure of the shop primer. High film thickness may result in slow drying, excessive roller damage, reduced spreading rate overcoating problems and a reduction in welding and cutting speeds.

The type of automatic shop priming plant is dependant on specification, manufacture and age. The diagram below shows the typical components of a shop priming plant.



Steel plate or profile is fed into a wheelabrator via rollers and is blasted using metal shot and/or grit to remove millscale, corrosion and provide a surface profile. Cleaning is carried out automatically in the same cabinet where all abrasive and dust is removed. After passing over open rollers, the steel plate then enters the spray booth and is painted automatically. The cabinet is often heated to ensure the primer is sufficiently dry to resist roller and transportation damage.

The number of blasting impellers and the number of spray guns above and below the plate can vary. As the spray guns traverse the moving plate, spraying may be in one or two directions.

Automatic Airless Spray

2. SURFACE PREPARATION

2.1 SURFACE CLEANLINESS

Paint only clean, dry surfaces. Remove all grease, oil, soluble salt contamination, corrosion products, and other foreign matter by solvent cleaning.

For optimum performance a minimum of ‘Near White Blast Cleaning’ to Sa2.5 (ISO 8501-1 (2007)) or SSPC SP10 must be carried out.

Levels of substrate salt should be determined. If the result is less than or equivalent to 50mg/m^2 painting can proceed for IMO PSPC MSC.215(82) compliant projects. For non IMO PSPC MSC.215(82) compliant projects, if the result is less than or equivalent to 100mg/m^2 painting can proceed .

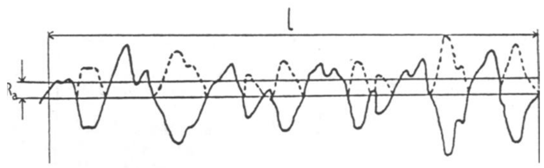
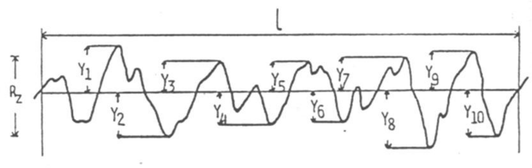
2.2 SURFACE PROFILE

Mechanical properties, adhesion and ultimate corrosion protection are all dependent on the surface profile achieved by abrasive blasting. The minimum surface profile that gives good adhesion and mechanical properties of the primer is required. Rough profiles are acceptable but require increased primer thickness for coalescence and equivalent corrosion resistance.

Surface profile can be measured in a number of ways, the most accurate being by laser profilometer. Obviously, a practical on site method is required and in this respect surface profile comparators are acceptable e.g.:

- Rugotest No.3
- ISO/DIS 8503/1

Definitions of Surface Profile

R_a	The arithmetic mean of the absolute values of the profile departures within the sampling length. Departures from the centre line are all positive. This is best illustrated by flipping the profile valleys so that they are above the centre line.	
R_z	The average value of the absolute values of heights of five maximum profile peaks and five maximum profile valleys within the sampling length.	
R_y	Maximum peak to valley height of the digitally filtered profile within the sampling length.	

Measurement of Surface Profile

Rugotest No. 3

Roughness Number	Nominal R_a (microns)	Nominal R_a (mils)
N9	6.3	0.25
N10	12.5	0.5
N11	25	1.0

For profiles produced from angular abrasives the 'Roughness Number' is preceded by a "B" and for those produced from round (shot) abrasives an "A". As it is possible to produce the rougher profiles using both fine and coarse abrasives roughness numbers N9 to N11 carry a suffix "a" for coarse abrasives and "b" for fine abrasives.

Rugotest No. 3, BN9b describes a surface (to be) blasted to a nominal roughness of 6.3 microns (0.25 mil) using a fine angular abrasive.

ISO/DIS 8503/1 Comparators

There are two comparators, one for grit and one for shot

Each comparator has four segments increasing in profile from I to IV.

Surface profiles are defined as follows:

GRIT		
Fine G	Profiles equal to segment I and up to but excluding segment II	R_y 23-49 microns (typically 25-45 microns) 0.9-2.0 mils (typically 1.0-1.8 mils)
Medium G	Profiles equal to segment II and up to but excluding segment III	R_y 50-84 microns (typically 55-80 microns) 2.0-3.4 mils (typically 2.2-3.2 mils)
Coarse G	Profiles equal to segment III and up to but excluding segment IV	R_y 85-129 microns (typically 90-125 microns) 3.4-5.2 mils (typically 3.6-5.0 mils)
SHOT		
Fine S	Profiles equal to segment I and up to but excluding segment II	R_y 23-34 microns (typically 25-30 microns) 0.9-1.4 mils (typically 1.0-1.2 mils)
Medium S	Profiles equal to segment II and up to but excluding segment III	R_y 35-59 microns (typically 40-55 microns) 1.4-2.4 mils (typically 1.6-2.2 mils)
Coarse S	Profiles equal to segment III and up to but excluding segment IV	R_y 60-84 microns (typically 65-80 microns) 2.4 –3.4 mils (typically 2.6-3.2 mils)

Recommended Surface Profile

Steel shot (S230 type) of particle size 610-1397 microns (24-55 mils) or a mixture of Steel shot (S230 type) and steel grit (G40 type) of particle size 610-991 microns (24-39 mils) are recommended.

The following surface profiles are considered ideal:

	Rugotest No3	ISO 8503/1	Ra	Rz	Ry
SHOT	N10	Coarse S	8-12.5 Microns 0.3-0.5 mil	50-75 Microns 2-3 mils	90 Microns 3.6 mils
GRIT	N9	Medium G	6-10 Microns 0.2-0.4 mil	35-65 Microns 1.4-2.6 mils	75 Microns 3.0 mils

For IMO PSPC MSC.215 (2006) compliant Ballast Tanks the minimum surface preparation for shop primers is Sa2½ (ISO 8501-1:2007) with a blast profile of 30-75 microns (ISO 8503-1/2:1988).

3. INTERPLATE ZERO WATER BASED SHOP PRIMER - RECOMMENDED APPLICATION EQUIPMENT

3.1 AUTOMATIC SPRAY EQUIPMENT

Airless, HVLP and conventional spraying techniques are all recommended for automatic application. For best results careful selection of airless or conventional pumps and guns is necessary to minimise ‘zinc packing’ at moving parts.

3.1.1 Airless Spray Equipment

Unlike conventional water based zinc silicate shop primers **Interplate Zero** **can** be applied by airless spray. To further avoid ‘zinc packing’ it is recommended that pumps and guns are selected which provide the minimum amount of restrictions to fluid flow. It is also recommended that airless pumps with a large volume throughput are used to minimise the strokes per minute and hence wear on packings. The following equipment has been found to give good results.

PUMP	GUN	FLUID LINES
WIWA Magnum 35032 32:1 / 35 litres/min Leather / PTFE(Teflon) packings	WIWA AM300RL WIWA 400 KREMLIN ASI40	6mm (¼ inch) I.D. fluid lines

3.1.2 HVLP Spray Equipment

HVLP is a conventional air spraying technique using atomising air at high volume and low pressure to improve transfer efficiency compared to high pressure conventional spraying.

HVLP spray application using diaphragm pumps gives acceptable results with zinc packing being minimised by the use of low fluid pressures and plastic parts. Paint atomisation by HVLP spray application is inferior to airless spray and therefore the resulting film thickness tends to be higher and the film coverage more uneven.

PUMP	GUN	NEEDLE / TIP	FLUID LINES
Graco Husky 307 or 515 diaphragm pump with Acetal parts.	Accuspray series 55ZZ Delrin gun	Delrin needle assembly and 0.034-0.072” Delrin fluid nozzle with suitable Delrin air cap	6mm (¼ inch) I.D. fluid line with recirculating system should be used to minimise zinc settling.

3.2 MANUAL SPRAY EQUIPMENT

Although manual spray application is possible, to achieve the target dry film thickness and even coverage, manual application is generally not recommended.

4. APPLICATION GUIDELINES FOR INTERPLATE ZERO WATER BASED SHOP PRIMER

4.1 PREPARATION

It is advised that all airless spray pumps and guns are serviced before use. This should include, as a minimum, filters and packings. The use of leather/PTFE (Teflon) mixed packings in pumps is recommended.

Interplate Zero is water-based and should never be introduced into solvented shop primer lines without first thoroughly flushing the lines with water miscible cleaning solvent, then with clean, potable water. For changeover from solvented shop primer to **Interplate Zero:**

1. Flush paint lines with appropriate International Paint cleaning solvent (consult International Paint). Recirculate with clean solvent for 2-3 minutes.
2. Remove and clean filter from pump surge chamber.
3. Flush paint lines with clean, potable water. Recirculate with clean, potable water for 2-3 minutes.
4. Approximately 10 litres (2.5 US gallons) of **Interplate Zero** should be pumped through the lines. To avoid 'zinc packing' due to the effect of dilution It is preferable to do this without tips or filters present since this process may cause blockages.
5. Replace tips and filters.

4.2 MIXING

Interplate Zero is supplied in 2 containers as a unit. Always mix a complete unit in the proportions supplied. Always add Interplate Zero powder to liquid. **DO NOT ADD LIQUID TO POWDER**.

1. Remove the powder part from the 20Ltr container and discard the moisture absorbent package.
2. Pour the binder part into the empty 20Ltr powder container.
3. Agitate binder part with power mixer.
4. Slowly add powder into liquid while agitating with power mixer and mix for 5 minutes.
5. Strain material through a 100-120 mesh screen into a suitable clean container.
6. Continue to agitate at low speed sufficient to keep powder in suspension.

4.3 THINNING

Thinning is not recommended.

4.4 INDUCTION

No induction is required.

4.5 POT LIFE

Do not exceed the stipulated pot life times (see product technical data sheet).

4.6 STOPPAGES

Following any stoppages during application the spray lines and guns should be flushed with clean potable water.

5. APPLICATION GUIDELINES FOR SOLVENT BASED SHOP PRIMERS

Interplate 855, Interplate 937 and Interplate 997 are supplied in 2 separate containers as a unit. Always mix a complete unit in the proportions supplied. Always add binder to paste.

5.1 MIXING

1. Agitate paste component with power mixer.
2. Slowly add binder into paste while agitating with power mixer (60 seconds mixing time for 20 litres (5 US gallon) mix as standard).
3. Strain material through a 100-120 mesh screen into a suitable clean container (a steel mixing vessel is recommended).
4. Continue to agitate at low speed sufficient to keep pigments in suspension.
5. If necessary thin with the recommended thinner.

5.2 THINNING

Thinning may be required depending on application conditions such as temperature and line speed. Do not exceed the recommended level of thinner (see product technical data sheet).

5.3 INDUCTION

No Induction is required.

5.4 POT LIFE

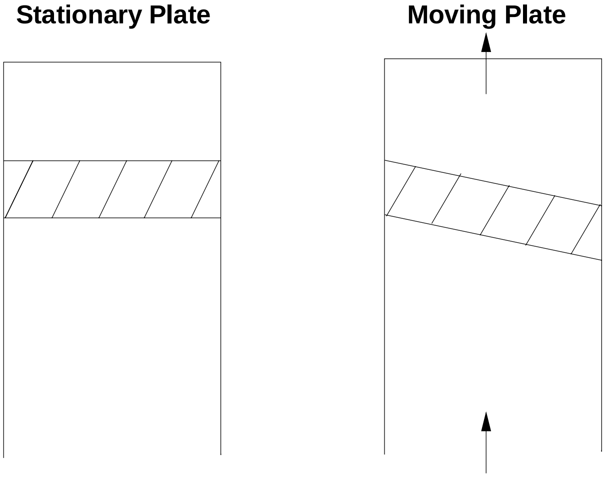
Do not exceed the stipulated pot life times (see product technical data sheet).

5.5 STOPPAGES

Following any stoppages during application, the spray lines and guns should be flushed with the recommended thinner (see product technical data sheet).

6. PRINCIPLES OF AUTOMATIC SPRAY APPLICATION

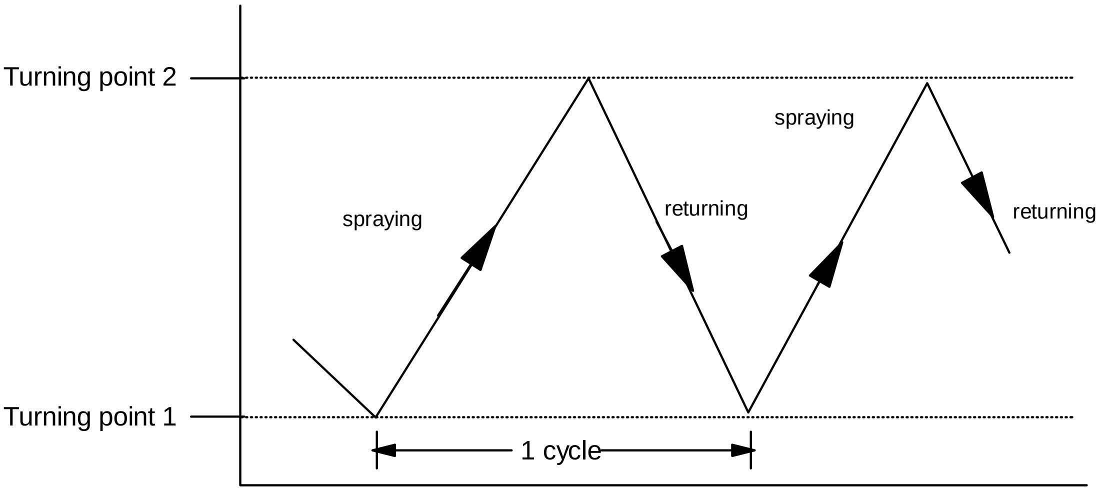
In its most simple form, an automatic spray plant applies a band of primer across the plate:



After completion of the band the gun shuts off and returns.

The movement of the gun(s) can be represented diagrammatically showing their position as a function of time.

Movement of the gun back and forth, at the same speed, and with no delays at the turning points



The movement is cyclic, with a cycle time equal to the time interval between two passes in the same direction. Often the reciprocator speed is expressed in number of **cycles per minute.**

6.1 FAN PATTERNS

For even application the relationship between fan width, traverse rate and line speed can be expressed in the following equation:

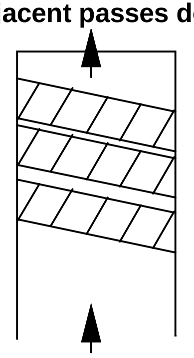
where N = the distance between adjacent spray passes

$$N = \frac{\text{Fan Width x Traverse Rate}}{\text{Line Speed}}$$

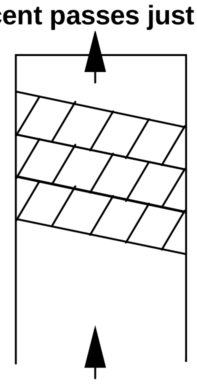
Fan width: effective fan width in metres or feet
Line speed: metres/min or feet/min
Traverse rate: cycles/min

For even application of shop primer N must be an integer (1,2,3).

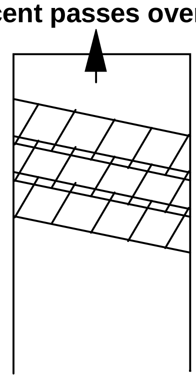
N<1 adjacent passes do not meet



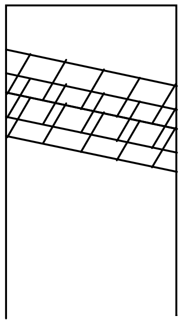
N=1 adjacent passes just butt together



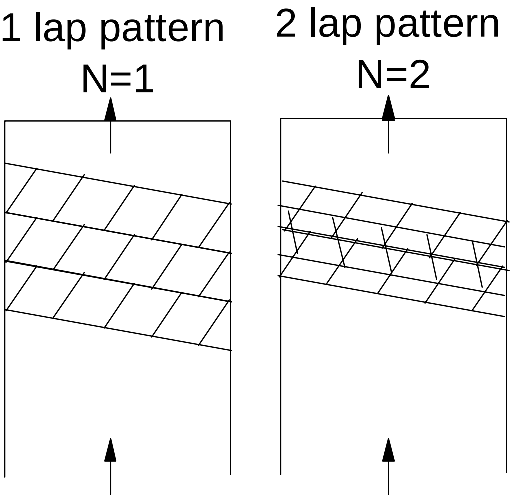
N>1<2 adjacent passes overlap too much



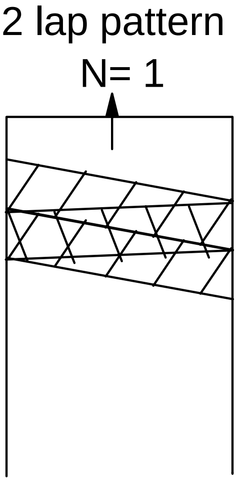
N=2   adjacent passes overlap 50%



A two lap pattern (2 passes) is generally preferred. When spraying is in one direction N=2 is therefore required.



For multi directional spraying providing the spray geometry is the same, the guns spraying in the return direction do exactly the same as in the outward direction. Therefore for a two lap pattern N=1 is required.

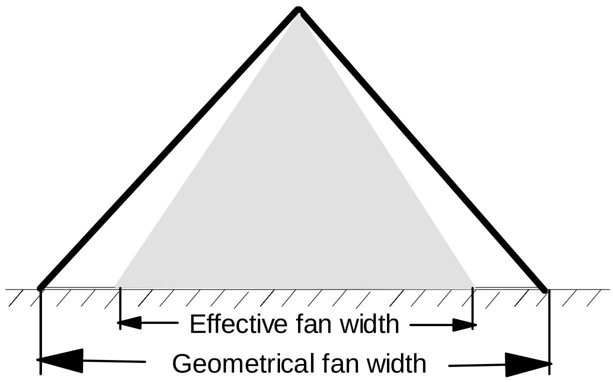


If the geometry of the bottom guns is the same as that on the top, and the traverse rate of the bottom carriage is the same as that of the top one, the spray patterns should be the same.

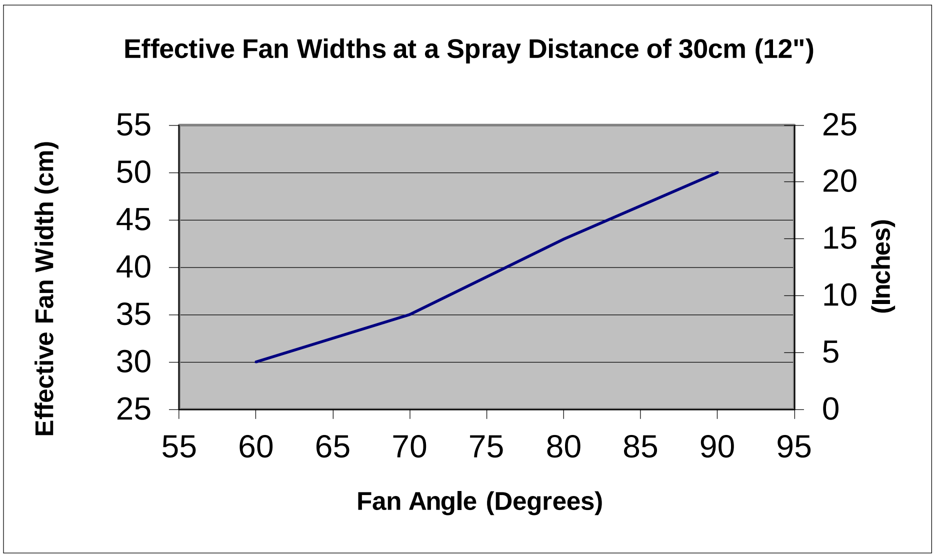
6.2 GUN GEOMETRY AND FAN WIDTHS

The spray fan geometry can be described in two ways: ‘the geometrical fan width’ or the ‘effective fan width’, at a spraying distance from the tip. The **‘geometrical fan width’** assumes that the spray fan is uniform, in practice the fan width is somewhat smaller than this because the paint is applied at a uniform thickness in only part of the fan. At a spray distance of 300mm (approx. 12 inches) the **‘effective fan width’** is approximately 5/6 of the geometrical fan width. This is only a theoretical figure and varies from primer to primer and therefore should only be used as a rough guide. Spray tip manufacturers often provide tables, which may also be used.

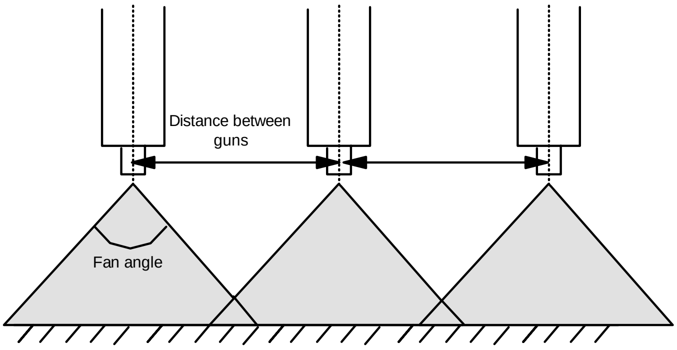
Practical measurement of the effective fan width should always be determined during line set-up.



The table below can be used as a guide:

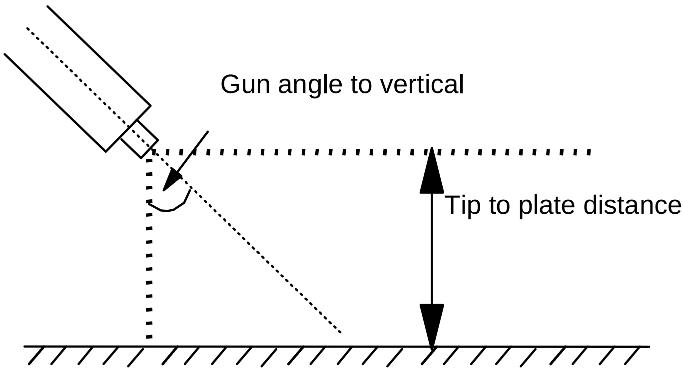


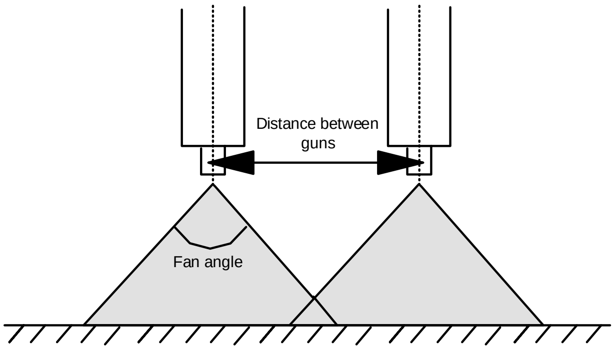
For multiple guns in series, treat as a single gun and use the combined width.



The **'gun geometry'** is critical to the quality of the fan, and the fan width, and is defined by the following variables:-

- vertical tip to plate distance
- actual spray distance
- gun angle to vertical
- distance between guns in series

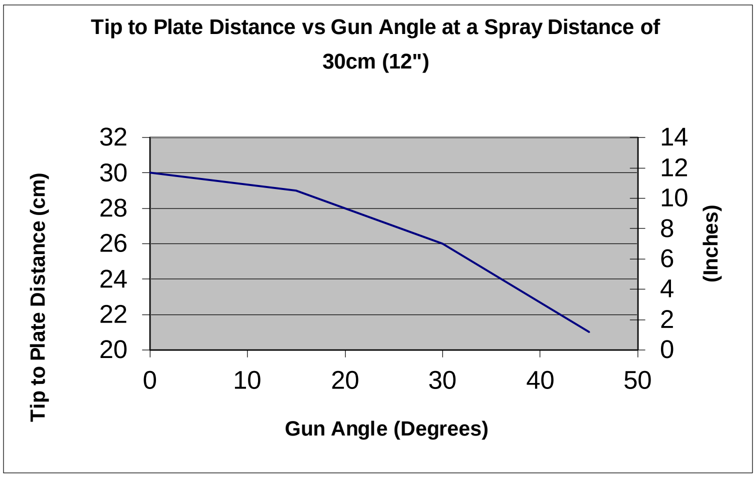




In general spray tips are designed for a spray distance (tip to plate distance) of 30cm (approx. 12 inches). If possible this should be kept within +/- 5cm (approx. 2 inches) to avoid distortion of the fan at longer distances and excessive spray mist from "bounce back" at shorter distances.

The guns are generally set at an angle to reduce paint "bounce back" and to ensure coverage of the edge of the plates or profiles, a 30 - 40° angle is typical either leading or trailing.

The table below can be used to calculate the tip to plate distance to give a spray distance of 30cm (approx. 12 inches) with various gun angles.



6.3 SPRAY TIP SELECTION

The gun geometry and fan width are both important in ensuring even distribution of dry film thickness. The actual dry film thickness can be further controlled by the flow rate of the paint, which is affected by:-

- paint viscosity
- pressure
- orifice size of the spray tip

At the dft range involved with shop primers the effect of **viscosity** is minimal.

6.4 RECIPROCATOR (TRAVERSE) RATES

The quality of the fan will determine the maximum speed of the reciprocator, too fast and the fan will be distorted. Generally the **maximum speed is 75m/min (250 feet/min).**

If the chain length of the reciprocator is approximately 5m (16 feet) the **maximum cycles/min** would be:

1 cycle = 2x5m (16feet) = **10m (32 feet)**
75/10 = **7.5 cycles/min**

Take care with the terminology used to describe traverse rates as the following are often used.

- **Cycles** - the time interval between two passes in the same direction **A→B→A.**
- **Stroke** - the time interval to complete one length of the reciprocator (or width of the spray booth) **A→B.**

Units are either **cycles/min** or **m/min (feet/min).**

7. RECOMMENDED PROCEDURE FOR AUTOMATIC APPLICATION

7.1 **Measure the effective fan width** (metres) by placing, longitudinally on the panel, an acetate strip or adhesive tape on a wooden stick. Apply one spray pass, remove the acetate strip or tape and hold to the light and measure the length of the continuous film.

7.2 If using **multiple guns,** check that the distance between the guns is equal to the effective fan width. Check that the combined fan is even, as above, and measure the combined effective fan width.

7.3 Adjust **line speed and traverse rate** to give the required spray pattern and overlap

7.4 Measure **dry film thickness** as described in section 7. Adjust by changing tip size and/or spray pressure.

7.5 Adjust **pre and/or post heat** to ensure that the applied film is wet and does not contain dry spray. Thin if required. Check coalescence using glass or acetate strips.

8. MEASUREMENT OF DRY FILM THICKNESS

Factors which affect dry film thickness:

- Tip size (orifice size)
- Input pressure
- Tip-tip distance between adjacent guns
- Track / traverse speed and overlap of adjacent fans
- Dry spray
- Thinning

The film thickness of a shop primer can only be accurately determined over smooth steel surfaces.

DRY FILM THICKNESS READINGS SHOULD ONLY BE TAKEN USING AN ELECTROMAGNETIC DFT GAUGE, OR SUITABLE MICROMETER.

Magnetic “banana” gauges are unreliable and should not be used.

The most reliable and accurate method of measuring dft is on smooth cold rolled steel test plates using an electromagnetic gauge as follows:-

8.1 **Zero** the electromagnetic gauge on the smooth steel substrate.

8.2 **Calibrate the gauge** using a maximum 25 micron (1.0 mil) calibrated shim placed on the smooth steel substrate.

8.3 **Place test plates** in at least three locations; for flat panels this should be at the middle and both edges. The test plates should be large enough to measure areas where fans overlap. It is recommended that the smooth steel test pieces are approximately 600mmx100mm (24”x4”) in size. Alternatively Q panels can be used but must be placed so that the dft of the overlaps are determined.

8.4 **Apply primer** and allow to dry.

8.5 **Measure the dft** a number of times and record the highest, lowest and mean values. The reading should be more or less equal along the plate, if not, then the overlap or spray pattern is incorrect and requires adjustment. Be careful of erroneous results due to dry spray or clumps of pigment.

9. TROUBLE SHOOTING GUIDE

9.1 AIRLESS SPRAY APPLICATION

Observation	Cause	Action
Gun will not spray	Needle packings dry or worn Faulty pump	Check tightness of seal nut and packing nut. Lubricate all friction points or replace packings Check pump is not jammed or material is leaking from packings
Blocking at tip	Zinc/pigment packing at tip	Mix thoroughly Filter through 100-200 mesh sieve Stir during application
Lack of coverage	Low film thickness	Increase pressure Use larger tips Reduce reciprocator speed (adjust line speed)
Too high coverage	High film thickness	Reduce pressure Use smaller tips Increase reciprocator speed (adjust line speed)
Distorted spray fan	Blocked tips or needle stop Worn tips Too low pressure	Clean tip with thinner and a soft brush Replace tips Increase pressure
Blurred edge of fan	Too high pressure	Reduce pressure
Curved edge of fan	Too low pressure Too long spray distance	Increase pressure Reduce spray distance
Banding from adjacent fans	Overlap too big	Increase distance between adjacent guns Reduce fan width
Banding from two passes in the same direction	Overlap too big. Fan width too wide relative to line/reciprocator speed.	Increase line speed Reduce fan width Reduce reciprocator speed
Film thickness too low between adjacent guns/passes in same direction	Opposite to banding	Reduce line speed Increase fan width Increase reciprocator speed
Dry spray	Steel temperature and air temperature too high	Reduce pre-heat
Excessive overspray	Inadequate ventilation Dry spray Too high pressure Spray distance too long Too short spray distance (bounce back)	Improve extraction As for 'Dry spray' above Reduce pressure Reduce spray distance Increase spray distance

9.2 HVLP SPRAY APPLICATION

Observation	Cause	Action
Gun will not spray	No pressure to guns Needle packings dry or worn Particle of zinc lodged in fluid nozzle Zinc build up on needle Damaged fluid nozzle or needle	Check air in material lines Check tightness of seal nut and packing nut. Lubricate all friction points or replace packings Remove and clean fluid nozzle and needle Remove and clean needle Replace fluid nozzle or needle
Heavy in centre	Heavy fluid flow Low atomisation	Reduce fluid pressure Increase atomisation pressure
Heavy top or bottom	Air cap clogged Zinc build up on fluid nozzle or needle	Clean air cap Clean fluid nozzle or needle
Light in centre or dry spray	Fluid pressure too low Atomisation pressure too high	Increase fluid pressure Decrease atomisation pressure
Spitting	Fluid container low Agitator too high Worn packings Loose or damaged fluid nozzle Gun material passage blocked	Fill container Reduce agitator speed Replace packings Tighten or replace fluid nozzle Flush gun
Fluid leaking from needle packings	Fluid needle packing worn	Replace fluid needle packing
	Rough or worn fluid needle shaft	Polish the area where the packing makes contact with a very fine emery cloth or replace the needle
Dripping from fluid nozzle	Worn or damaged fluid needle or nozzle	Replace the needle and/or the nozzle
	Piston or spring(s) damaged or deformed	Replace piston or spring(s)

9.3 GENERAL

Observation	Cause	Action
Loss of adhesion or flaking	Insufficient surface preparation Insufficient surface profile Oil or grease contaminated blasting abrasive Contaminated blow-off air	Blast to minimum SSPC SP10, Sa2.5, or ISO 8501-1 (2007) near white metal See section 1.2 Replace blasting abrasive Install adequate oil/water filters
Fish eyes	Oil contamination from gun Oil contamination from air supply	Remove excess lubricant from gun parts Install adequate oil/water filters
Surface cracks in corners, no adhesion loss	Slow drying Cold steel Too high film thickness	Increase post heat Increase pre heat Reduce DFT
Mud cracks with loss of adhesion	Too fast drying Hot steel Excessive surface profile Too high film thickness	Reduce post heat Reduce pre heat See section 1.2 Reduce DFT
Roller damage	Slow drying	Increase pre-heat
Premature corrosion	Low film thickness Poor uneven coverage Dry spray Roller damage	As for 'lack of coverage' above