



# Dry Film Lubricant - Fluopolymer

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## 1 SCOPE

This procedure covers requirements for the Fluopolymer-based Dry Film Lubricant material application. The procedure describes the method and sequence of dry lubricant coating application to Stainless Steel and Low Alloy Steel, per project drawings.

The process described herein provides extra corrosion coating protection per several standards as required in drawings VS-1-3-1-165, its subsequent VS 1-3-1-169, as well as other documents referring to Dry Lubricant coating application.

Drawing requirements specify Fluopolymer Organic Resin Type I Class 2, with a coating thickness of 5-13 micro meters (metric micron).

Coating color is mandatorily black and the Dry Lubricant Fluopolymer's color will be compared to a standard color coupon.

The coating application instruction is per manufacturer's technical datasheet instruction, and coater must follow the application instructions and paint preparation written there.



## 2 APPLICABLE DOCUMENTS

Document	Standard Name	Publishing Company
Passivation of Corrosion Resistant Steels	AMS 2700E	SAE Aerospace
Standard Practice for Operating Salt Spray (fog) Apparatus	ASTM B 117	ASTM
SCRG-5	Manganese Phosphate Coating	Elbit Systems Material Engineering Land Division
SCRG-3	Stainless Steel Passivation	Elbit Systems Material, Land Division Engineering
Specification for Corrosion Resistant Dry Film Lubricant Coating System (Requirement and Application)	VS 1-3-1-165	VICKERS
Specification for Corrosion Resistant Dry Film Lubricant Coating System (Requirement and Application)	VS 1-3-1-169	VICKERS
Non-destructive Measurement of film Thickness Magnetic & Non-magnetic metals	ASTM D7091	ASTM
Adhesion by Tape Test	ASTM D3359 Procedure B	ASTM
Elbit T- Coat	T-Coat	Elbit Systems Material, Land Division Engineering



### 3 WORKERS QUALIFICATION AND TRAINING

Workers will perform the Dry Lubricant Process after qualification, according to company's procedures and demonstrating proven knowledge and skills.

#### Applicable Procedures

- a. Present Work Instruction (per specific job).
- b. Safety Regulations and Laws (both Local and company).

#### Skills Needed

- a. Equipment Operation training/ certification.
- b. On the job training of at least 400 working hours.

### 4 MATERIALS

No.	Description	Supplier
1.	Alumina 100-120 mesh	Local Suppliers
2.	KG-1144	KAL-GARD South Africa
3.	Black-T	BIRDSONG USA
4.	Xylan 1427	WHITFORD GB

#### NOTE

Materials 2 to 4 are equivalents.

### 5 EQUIPMENT AND FACILITIES

Description	Requirements	Note
Shot-blast Chamber	Separate for each metal processed or see note.	Separate media for each metal
Painting Gun	High pressure or HVLP spray guns can be used but not gravity-fed spray guns.	Nozzle Size: 1.5 for best results.
Curing Oven	Temperature higher than 200 degrees Celsius.	Equipped with timer is preferred; air circulation is a must.



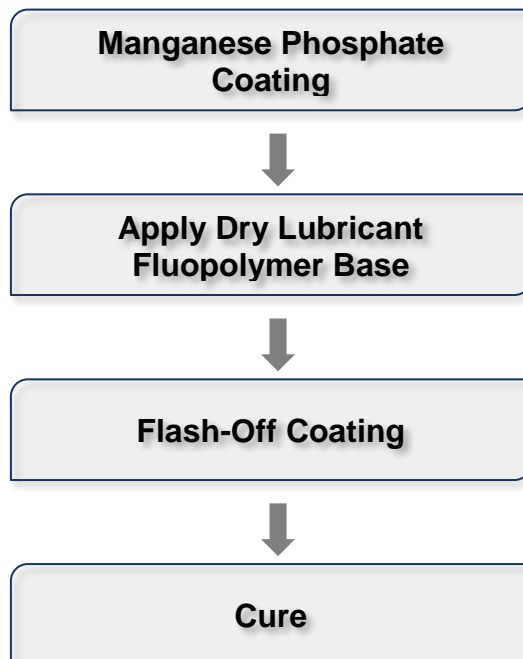
## 6 APPLICATION PROCESS

### 6.1 Process Flowchart for Low Alloy Steel (Normalized SAE 4130)

#### 6.1.1 Preparation



#### 6.1.2 Application



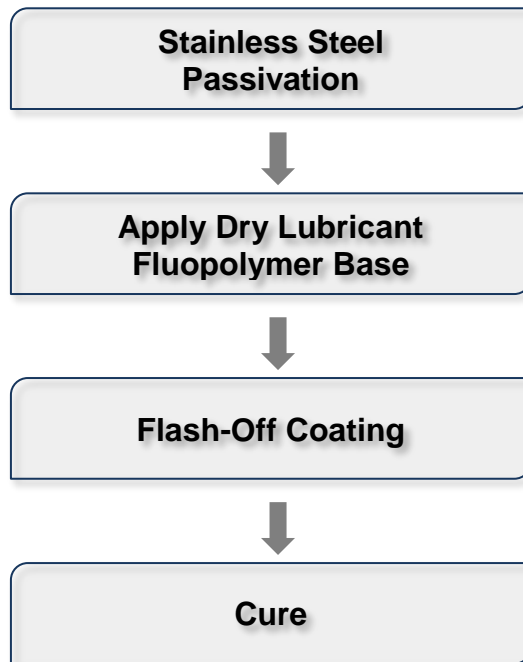


## 6.2 Process Flowchart for Stainless Steel (CRES 303)

### 6.2.1 Preparation



### 6.2.2 Application





### 6.3 Operation Highlights (for both applications)

#### NOTE

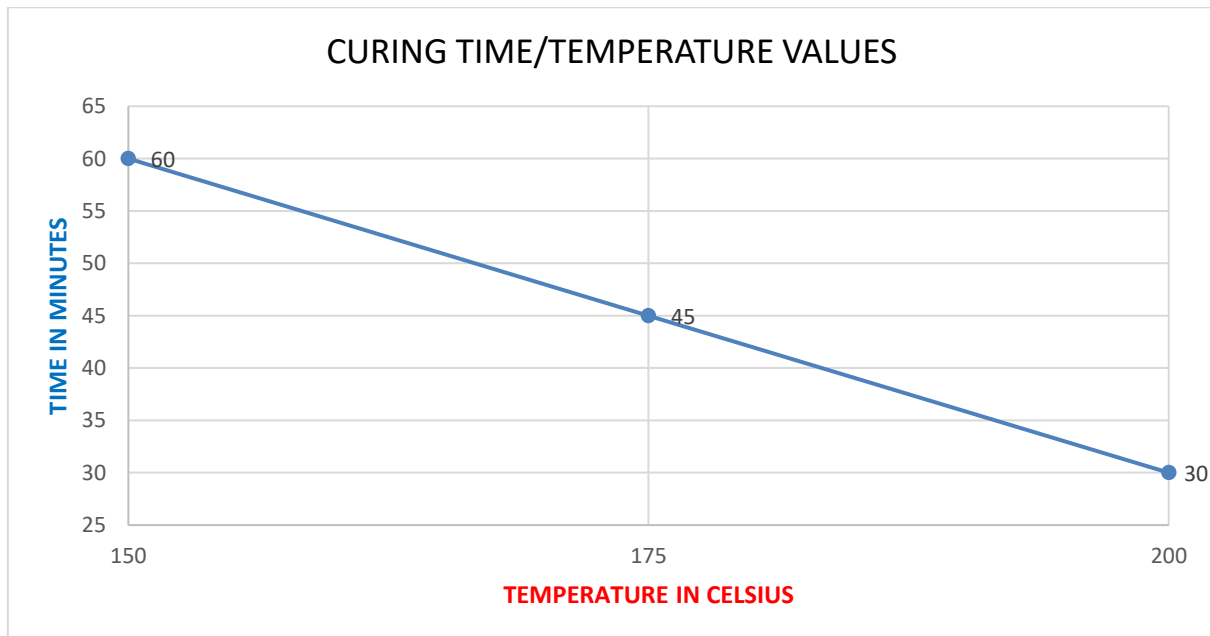
Dry Lubricant application instructions are provided by the material manufacturer.

- a. Degreasing: Degreasing can be done by the pretreatment's Alkaline cleaner (preferred) or using solvent cleaning method vapor degreaser.

#### CAUTION!

Oil residues on the part can cause paint failure.

- b. Shot blast: It is a prerequisite to separate the shot blast media between stainless steel and regular steel. No separation can cause dramatic corrosion of the processed parts.
- c. Coating Flash-off: Components are to be placed in an oven at a temperature of 40-60 °C for a minimum of 10 minutes or must be allowed to be placed for a minimum of 30 minutes at a temperature of above 20 °C ( to allow solvents to evaporate off ) before the temperature is raised to curing temperatures.
- d. Curing (see the graph below).







### NOTE

According to the graph above, at 150 degrees Celsius curing time is 60 minutes and at 200 degrees curing time is 30 minutes. Medium value can be 45 minutes at 175 degree Celsius.

- e. Surface preparation: Low alloy steel surface is prepared per SCRG -5 and for stainless steel the surface is prepared per SCRG-3.
- f. Dry lubricant Fluopolymer mixing: The coatings have solids which can be heavy (an SG of 2.2 to 7.8) and tend to form hard crusts at the bottom of the container. This needs to be broken up first and then mixed in (a paint shaker is not suitable for this, as the solids need to be broken / dug up first). It is recommended to use flattened-end round pipe or a flat bar.
- g. However an agitated pressure pot with a very thin and short hose up to the gun, will provide adequate results. Note: after not spraying for over 30 minutes, it is recommended to first clear the hose of coating (as solids will start to fall out of suspension and clog it).
- h. However, an agitated cup gun is ideal or if care is taken, add two glass marbles in a standard cup gun to help keep the solids in suspension. If gun is not used for more than 30 minutes, the bowl must be removed and stirred to ensure solids return into suspension. If temperature is below 20 °C, we would recommend pre-heating to a temperature of not more than 50 °C first.
- i. The coating is applied in multiple light fog passes, sufficient to just begin to look wet and gloss. Too thick a coating will lead to adhesion problems and a soft coating. When spraying complex components, first coat the hard to get places and then spray the entire component. Dry Film thickness is ideal at 5-13 micron, if permissible.



## 7 LOT CONTROL, QUALIFICATION AND VALIDATION TESTS

7.1 The following table contains Test Matrices AMS 2700 Method 1 Type II requirements:

Standard	Test	Schedule	Parts Type	Panel sizes (mm.)	Sample Size	Section in the Standard
VS 1-3-1-169	Visual inspection	Every batch	Parts	N/A	100%	3.2,5.4.1
	Coating Thickness	Every batch	Panels	75X150X0.5	ANSI Z1.4 Level I AQL 2.5	3.3,5.4.1
	Salt Spray (fog)	Qualification and Half yearly	Panels	75X150X0.5	5	3.4,5.4.2
Elbit T-Coat	Dry Adhesion	Every batch	Panels	75X150X0.5	1	7.3
	Durability to Gun Oil	Qualification and Half Yearly	Panels	75X150X0.5	3	7.8
	Chemical Composition Test	Qualification and New Coating manufacturer	Panels	75X150X0.5	1	7.9



## 7.2 Testing Details

### 7.2.1 Visual Inspection

Inspection will be performed under an appropriately lit area, with the naked eye at a distance of 16"-18" (400-450 mm). In case of doubt, suspected defects will be checked under X10 magnification.

**Requirement:** The appearance shall be uniform with no stains, leaks, bubbles, orange peel or any visual defect, which may impair part function.

Color shade will be close in comparison to the appropriate FED-STD-595 or RAL color chip per drawing requirement, when it exists.

### 7.2.2 Coating Thickness

Test will be performed with a calibrated non-destructive Thickness Gauge. Three tests will be performed on each part or panel. The test report will record minimum and maximum measurements within 5-13 microns thickness per drawing requirements. If thickness is found lower than required in the drawing, the manufacturer will complete coating to the required thickness. If thickness is higher than required, need to inform the customer via MRB to decide whether to approve the parts or perform repainting, after removal of existing T-Coat.

### 7.2.3 Salt Spray Resistance

The test will be performed per ASTM-B-117. Sample size: five (5) steel accompanying panels (Type SAE 1005-1018 is preferred). Panel preparation per SCRG depends on substrate (see Standard). The T-Coat layer thickness will be 5-13 microns, per drawing requirements.

Test time: 500 hours minimum; then test will continue till 1500 hours, until failure appearance, where panels are inspected in intervals of 100 hours. At the end of test / intermediate tests, models will be washed well with distilled water and tested under a magnification of x10.

**Requirement:** no signs of rust, bubbles discoloration, separations in the color, etc. shall be observed.



### 7.2.4 Dry Adhesion Tests

Destructive cross-cut test Method B will be performed on a test panel, per ASTM-D-3359. One representing specimen per lot will be checked by Cross-cut Test 5B Classification criteria - no peeling is allowed.

Classification	Percent Area Removed	Surface of Cross-Cut Area from which Flaking has Occurred for Six Parallel Cuts and Adhesion Range by Percent
5B	0% None	
4B	Less than 5%	

### 7.2.5 Durability to Gun Oil

Three (3) panels will be dipped in gun oil 9105 (gun anti-rust and lubricants oil) for 30 days at a temperature of 40-43 °C.

**Requirement:** After testing, the panels will be thoroughly washed with water and soap to remove the oil. Signs of peeling, bubbles, separations in the color, etc. must not be observed.

### 7.2.6 Chemical Composition Test

Test will be performed using FTIR device, on dried paint powder, to be scratched from painted parts.

Requirement: Test results will indicate that the material is based on the polymer PTFE (PolyTetraFluoroEthylene-Teflon).



## 8 FAILURE OF PROCESS CONTROL

In case of a failure in one of the above tests:

- a. Immediately separate all batch parts in the carnation room and refer to the batch tested.
- b. Stop line operation.
- c. Hold an MRB (material review board) meeting with the personnel involved in the test failure to seek the reason for failure.
- d. Take corrective action after verifying failure reason.

## 9 REWORK

In case painted parts should be reworked, the only way to strip this coating is with paint remover, which can be purchased commercially via paint-remover vendor. Most paint removers will not damage the pretreatment substrate such as Manganese Phosphating for steel parts (especially nonacidic paint remover), and not the passivation treatment regarding Stainless Steel. However, parts must be examined after the paint removal process and tested per relevant SCRG 3 and SCRG-5 quality control documents (salt spray for steel, copper sulphate for stainless steel tests) before repainting dry lubricant on the parts. If those tests fail, remove the pretreatment coating and perform the entire pretreatment again (shot blasting can be omitted). Continue with the coating process.

## 10 SAFETY PRECAUTIONS AND ECOLOGY

Material Safety Data Sheets (MSDS) contain all relevant safety precautions and first aid information. These precautions must be posted in a visible and accessible location in the work area.

**Important:** If medical care is required, the MSDS must accompany the injured person, it is important to request the MSDS from the material's supplier, if it did not come with it.

Manufacturer must meet all health and safety requirements by law, and has full responsibility for employees' safety at a contractor's premises. All sub-contractors must comply with all environmental requirements of local and international authorities.