



# Mi-Phos™ M-5

Mi-Phos M-5 is a manganese phosphate for steel, with an average coating weight of 1800 to 2000 mg/ft<sup>2</sup>.

## Features & Benefits

Meets military spec: MIL DTL 16232G and AMS 2481	Can be used in military and aerospace applications
ROHS and REACH compliant	Reduction of hazardous chemicals
Anti-galling feature	Excellent choice for use in automotive and firearm applications

## Typical Applications

- Standard Military Corrosion Protection
- Sporting Arms
- Pre-Paint and Powder Coat
- Automotive
- Hand Tools

## Operating Conditions

Mi-Phos M-5 is formulated to produce a non-metallic, oil adsorptive iron manganese phosphate coating on steel and iron surfaces. The coating is designed to reduce wear on moving surfaces such as pistons, rings, camshafts, tappets and similar bearing surfaces. When used properly, Mi-Phos M-5 meets the requirements for DOD-P-16232.

### Advantages

- Prevent “scuffing” and/or “galling” on moving parts, particularly during a break-in period.
- Increased lubrication of treated surfaces.
- Can be used as a corrosion-resistant finish.
- Levels machine surfaces from scratches from machining operation.



### Equipment

The processing tank, pump and piping (for solution transfer) for the Mi-Phos M-5 solution should be constructed of any of the 300 stainless steel series. The heat exchanger should be Type 316 stainless steel if steam heated. If the unit is gas heated, then the tank and the heating tube should be constructed of mild steel. stainless steel can crack with direct gas heat.

### Processing sequence

- a. Thoroughly clean with the alkaline cleaner recommended by your Hubbard-Hall representative.
- b. Water rinse.
- c. Mi-Phos MGR.
- d. Mi-Phos M-5, 10% by volume in water.
- e. Water rinse.
- f. If a military specification is to be met, then the use of a chrome or non-chrome sealer might be required, contact your Hubbard-Hall representative for a recommendation. (required only for corrosion-resistant finishes).
- g. Metal Guard rust preventive oil recommended by your Hubbard-Hall representative.

### Cleaning

This is a very important step in the operation of Mi-Phos M-5 since the method of cleaning will affect the grain size of the Mi-Phos M-5 coating. It should be noted that the parts must be free from oils, soils, rust and dirt.

### Water rinsing

Rinse waters must be kept clear of any contaminates from the prior solutions.

A hot water rinse prior to the application of the Mi-Phos M-5 coating is beneficial to the operation of the Mi-Phos M-5 since it allows the bath to start coating instantly rather than pickle the parts prior to achieving bath temperature. When a cold rinse is used, pickling occurs until the parts and the Mi-Phos M-5 solution reaches the operating temperatures.

### Mi-Phos M-5

Mi-Phos M-5 operating solution is made up by adding 10 gallons of Mi-Phos M-5 concentrate to 90 gallons of water. The bath is heated to 150°F to 160° F., at which point steel wool (clean) or scrap metal (clean) is introduced into the bath at the rate of 2 lbs. per 100 gallons of solution. Keep the steel wool or scrap iron in the solution for one to two hours.

Remove the spent steel wool or scrap iron after the reaction stops, add water to operating level and then heat to operating temperatures of 200°F to 210° F. Check the solution for Total Acid, Free Acid and Iron content adjust put the bath within the normal operating ranges. See control methods.



### Operating conditions

Properly cleaned parts should be immersed in the Mi-Phos M-5 solution kept at 200°F to 210° F. Complete chemical reaction should be accomplished within the specified 15 minutes as evident by the cessation of gassing. If gassing does not stop within the 15 minutes, excessive etching of the metal surface is likely to take place. This is normally caused by excessive Free Acid and can be corrected by the lowering of the Free Acid by small additions of Mi-Phos M-5 Neutralizer. (See Free Acid Control.)

## Titration Method

### Total Acid

1. Pipet a 2 mL sample of the Mi-Phos M-5 solution into a 150 mL beaker.
2. Add 5 drops of Phenolphthalein indicator and mix well.
3. Titrate using 0.1N Sodium Hydroxide to a pink color.
4. Record mL used.

Note: A solution made up as per specification normally results in a titration of 12.0 mL of 0.1N Sodium Hydroxide solution.

The addition of 1.0 lb of Mi-Phos M-5 concentrate per 100 gallons of solution will increase the Total Acid by approximately 0.1 mL.

### Free Acid

1. Pipet a 2 mL sample of the Mi-Phos M-5 solution into a 150 mL beaker.
2. Add 3 to 4 drops of Bromophenol Blue indicator and mix well.
3. Titrate using a 0.1 N Sodium Hydroxide from a green color to a purple color.
4. Record mL used.

Note: The normal amount of 0.1 N Sodium Hydroxide required to make the color change is 2.0 to 2.2 mL.

The ratio of the Total Acid to the Free Acid is important and should be kept within 1:6 to 1:7.5. In order to figure this ratio, use the following formula:

$$RATIO = Total\ Acid / Free\ Acid$$

Excessive Free Acid in this bath can be caused by heating the solution without processing any work or by only processing a small amount of work in a large volume tank.

Excessive Free Acid is likely to etch the metal surface excessively, fail to produce a complete coating within the normal processing time or produce a smudgy and non-adherent coating, which can be wiped off or give a rough coating.



Excessive Free Acid can be neutralized by the addition of Mi-Phos M-5 Neutralizer. Additions of 4 oz. Per 100 gallons of solution will lower the Free Acid 0.1 mL of 0.1 N Sodium Hydroxide. This material should be made into a slurry prior to the addition to the solution of Mi-Phos M-5. Then the solution should be mixed thoroughly prior to the processing of production. Allow bath to settle.

The Free Acid will normally not get too low.

### Iron

Prior to running a concentration check for iron, make sure iron is present in the bath by dipping a strip of ITP into the operating bath. It should change color to pink or red. If it does not change, then iron must be added to the bath prior to the processing of any production. If it changes to red, proceed to the following concentration check.

1. Pipet a 10 mL sample of Mi-Phos M-5 solution into a 150 mL beaker.
2. Add 2 mL of 50% Sulfuric Acid and mix well.
3. Titrate using 0.2 N Potassium Permanganate to a permanent pink color (20 seconds).
4. Record mL used.

Note: The number of mL of 0.2 N Potassium Permanganate is ten times the percent of iron in the bath.

Example: A 2 mL titration indicates the presence of 0.2% iron in the bath. The normal range is 0.15 to 0.35% iron.

Normally, the iron will get too high and must be reduced in order to obtain good coatings. This is done by using the following procedure:

- To reduce the iron content by 0.5%, add ½ lb of 35% hydrogen peroxide per 100 gallons of solution. Never exceed the 0.5 lb per 100 gallons of solution 35% Hydrogen Peroxide at one time.
- When the Hydrogen Peroxide is added, you will create excessive Free Acid that must be reduced, or you will obtain poor coatings. This is done by adding 2 lb of Mi-Phos M-5 Neutralizer for every 1 lb of Hydrogen Peroxide used.

### Procedure to following when reducing iron

1. Add proper amount of 35% Hydrogen Peroxide. Dilute with water prior to adding to the bath.
2. Let it react for 15 minutes.
3. Add the proper amount of Mi-Phos M-5 Neutralizer. Make it into a slurry prior to adding.



4. Let it react for 15 minutes.
5. Perform another Iron check and repeat procedure if required.

Best operating temperature to perform this procedure is between 200°F and 210°F. Let the sludge created by this procedure settle prior to running any production.

### Iron

A processing bath that is high in iron is likely to result in an incomplete coating in the normal processing time; a non-adherent coating of poor wear resistance as well as poor corrosion resistance; a thin coating that is light gray in color rather than the normal dark gray color; also, an uneven etch of the metal surface.

### Mi-Phos Sealer

Use of Mi-Phos Sealer has little or no effect on the wear resistance on the coating but will increase the corrosion resistance of the coating. Also, if a Military Specification is to be met, then the use of a chrome or non-chrome sealer might be required.

### Metal guard

Various rust preventives are available from Hubbard-Hall and the proper one will be recommended by our representative.

## **Waste Disposal**

During the operation of the Mi-Phos M-5 bath, sludge is formed and must be removed prior to it interfering with the coatings obtained from this solution. Removal can be accomplished by allowing the solution to settle, then decant the solution, clean the sludge and tank, replace the solution, add water and adjust the bath to proper operating conditions.

Dusty work can result when sludge can build up in the solution.



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