

## ENGINEERING SPECIFICATION

Hyster-Yale Group, Inc.		Document Control Number:	
Title: MANGANESE PHOSPHATE COATING		HC-402	
Page 1 of 2	Document Author: Caitlin Toohey	Effective Date: 01-Mar-2017	Revision No. 2017-03

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## 1.0 SCOPE

Manganese phosphate conversion coating for lubrication and/or corrosion protection of ferrous base parts (formerly HCE-65).

## 2.0 CITED

See [Master Index](#) or attached [Annex](#) for a complete list of Citing & Cited Documents.

## 3.0 REQUIREMENTS

Standard Grade

MIL-DTL-16232, Type M, Class 2 or ASTM F1137

Coating Weight & Thickness

1. Coating weight shall be 1500 to 4000 mg/ft<sup>2</sup> of surface area.
2. Coating thickness shall be 0.0001 to 0.0004 inches.

Post-Coating Treatment

All parts with a hardness of 34 HRC or greater shall be treated by baking as per HC-411 to minimize the risk of hydrogen embrittlement.

Unless otherwise specified, all phosphate parts shall be treated with oil so as to meet the corrosion resistance requirements listed below. Oils should conform to MIL-PRF-16173, Grade 3 or MIL-PRF-3150.

Corrosion Resistance

Coated parts subsequently treated with oil shall show no sign of corrosion when subjected to salt spray (fog) for 48 hours, in accordance with ASTM B117.

Certification

The supplier shall include with each material lot shipped to Hyster-Yale Group a statement certifying compliance with the HC-402 requirements signed by an authorized representative of the supplier.

## 4.0 ENGINEERING INFORMATION (Not Part of Requirement)

In the referenced military specification, type M refers to manganese phosphate and class 2 refers to oil treatment.

Phosphating of a properly prepared ferrous surface produces a uniform, crystalline, non-metallic, absorbent coating. The treating solution converts or transforms the outer atomic layers of the metal surface into new non-metallic manganese phosphate forms.

Some of the advantages of the coating are:

1. Reduction of galling and seizing under load. The inert coating between mating surfaces acts as an anti-flux, inhibiting localized welding.
2. Increases lubrication efficiency. The oil absorbent properties of the coating provide a continuous film of oil on bearing surfaces.

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3. Promotes rapid and safe break-in. The crystalline coating contains a network of channels for oil retention and promotes a light polishing action to smooth high spots.
4. Improves corrosion resistance. Being inert, the coating prevents the spread of corrosion where nicks or scratches expose bare metal. The absorptive properties of the coating provide a good base for rust inhibiting oils and waxes.

Manganese phosphate coatings are heavy, coarse-grained, and highly absorbent. They are harder than other phosphate types and offer the best wear and break-in characteristics when used with oil. They function well at temperatures up to 250°F. Above 250°F, some deterioration occurs. Used without oil, they offer little lubrication value.

The coating weight range called out in this specification dictates that parts be treated by immersion in a bath. Spray methods are suitable only for light weight coatings. This bath treatment lends itself to close control of coating weights through variation of temperature and solution pH. Thickness is not so easily controlled. There is a rough correspondence between thickness and weight in that each 1000 mg/ft<sup>2</sup> produces about 0.0001 inch thickness. The coating is soft and smears easily; it offers no interference in close fits.

It is important to specify an exact weight and tolerance only when coating thickness must be held to a specified limit under 0.0005 inch. When this is required, weight and tolerance should be arrived at by consultation with the vendor.

As with plating, areas can be masked off to prevent treatment.

Dimensions shown on part drawings should be as required before coating.

Some typical applications include ring and pinion gears, tappets, shafts, piston rings, and pins.

#### Method of Specifying

HC-402

Coating weight: 1500-4000 mg/ft<sup>2</sup>

#### **Annex**

ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM F1137, Standard Specification for Phosphate/Oil Corrosion Protective Coatings for Fasteners

HC-411, Electroplated Parts

MIL-DTL-16232, Phosphate Coating, Heavy, Manganese or Zinc Base