

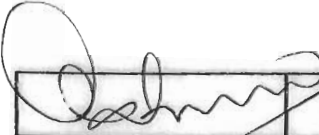
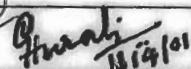
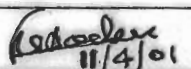
WAP/M/SPECN-1/073/1999/ALT 'a'

**GOVERNMENT OF INDIA
(Ministry of Railways)**

**SPECIFICATION FOR
PHOSPHATE ESTER FLUID
(HOUGHTO -SAFE)**

Issued by

**MECHANICAL DRAWING OFFICE
WHEEL & AXLE PLANT
YELAHANKA, BANGALORE-560 064
I N D I A**

	 11/4/01	 11/4/01
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SPECIFICATION FOR PHOSPHATE ESTER FLUID

1.0 SCOPE:

The specification covers the supply of phosphate ester fluid which will be supplied at Wheel & Axle Plant, Yelahanka, Bangalore, Karnataka State, India as per instructions and conditions of contract and tender papers enclosed.

2.0 GENERAL DESCRIPTION:

Phosphate Ester Fluid as a hydraulic fluid combines fire resistance with excellent lubricant properties. The phosphate ester fluid is approved for operation in all types of pumps and associated hydraulic components.

Phosphate Ester Fluid is made from triaryl phosphate esters plus corrosion and oxidation inhibitors. These inhibitors extend fluid service and insure maximum hydraulic circuit component life with lower maintenance costs.

Phosphate Ester Fluid is particularly suited to applications with high bearing loads and where operating temperatures exceed 54.5 Deg.C. Many years of field experience confirm that this Houghto-Safe fluid excels in fire resistance, component lubrication, thermal stability, and corrosion prevention.

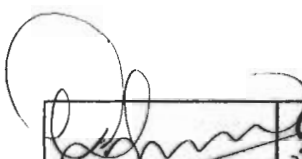
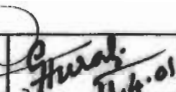
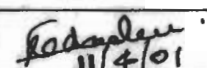
3. JOB REQUIREMENT:

Phosphate ester fluid used in Electric Arc Furnace (EAF) & John More Pouring Pit.

4. TECHNICAL DATA:

4.1 Thermal stability:

Phosphate Ester Fluid is suitable for operation at higher system temperatures than conventional hydraulic fluids.

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4.2 Bearing life:

Phosphate Ester Fluid provides bearing lubrication exceeding that of the best petroleum oils.

4.3 Lubricity:

Phosphate Ester Fluid Lubricates all types and sizes of pumps even at high speeds and pressures.

4.4 Fire Resistance:

Phosphate Ester Fluid has been tested and approved by Factory Mutual Insurance Laboratories.

4.5 Rust protection:

Phosphate Ester Fluids are formulated to provide protection against rust and corrosion due to moisture often found in hydraulic systems.

4.6 Compatibilities:

The Phosphate Ester Fluid is compatible in all proportions with other phosphate ester fluids. Not compatible with water containing fluids such as water glycols, water in oil emulsion and high water content fluids.

5. Metals:


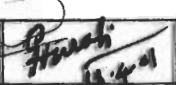
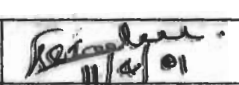
The Phosphate Ester Fluid is compatible with all metals common to hydraulic power circuits which include all Steels, Cast Iron, Copper, Bronze, Brass, Zinc, Cadmium, Aluminum and Magnesium metals.

6. Seal & Hose Materials:

The Phosphate Ester Fluid is compatible with Butyl, Ethylene Propylene (EPR), Fluorocarbon, Silicone and Chlorinated Polyethylene.

7. Storage stability:

Freezing of this fluid causes no permanent damage. It can be thawed out and reused without harm. This products has excellent storage stability and will not separate.

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8. Typical physical properties:

Sl. No.	Particulars for Phosphate Ester Fluid	Required values.	Procedure IS-1448
1.	Kinematic Viscosity at 40°C SUS/Cs	41.4 - 50.6	-
2.	Kinematic Viscosity at 100°C SUS/Cs min.	4	-
3.	Appearance	Clear Green Mobile Fluid	-
4.	Relative Density at 15°C	1.25 max.	Pt-32
5.	Pour Point, °C	-7 max.	Pt-10
6.	Flash Point, °C (Cleveland Open Cup)	180 min.	Pt-69
7.	Fire Point, °C	290 min.	Pt-69
8.	Auto Ignition Point, °C	470 min.	Pt-87
9.	Foam Test at 23.9 °C Tendency ml Stability, Sec.	Foam developed is less than 50 mls Max.time to foam collapse	-
10.	Rust Test, ASTM D-665, Procedure A	PASS - Steel Specimens remain Clean & Bright	-
11.	Total Acid Number, ASTM D-974 mg KOH/gm, max.	0.2	-
12.	Moisture % max.	0.1	-
13.	Solubility of Phosphate Ester in Water	Negligible	-
14.	Solubility of Water in Phosphate Ester Fluid	Negligible	-

<i>[Signature]</i>	<i>[Signature]</i> 11/4/01	<i>[Signature]</i> 11/4/01
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9. Typical properties:

9.1 Thermal Conductivity

37.8 °C - 93 °C	9.76 x 10 ⁻⁶ Cal/Sec cm °C
38 °C - 98 °C	0.0048 Cal/Sec cm °C

9.2 Specific Heat -

@ 77 °F	0.37 BTU/lb °F
@ 170 °F	0.40 BTU/lb °F

9.3 Coefficient of Thermal Expansion -

in ³ /in ³ /°F	3.8 x 10 ⁻⁴
cc/cc/°C	6.9 x 10 ⁻⁴

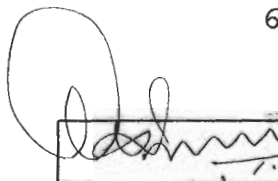
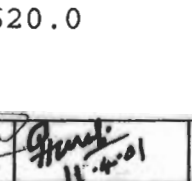
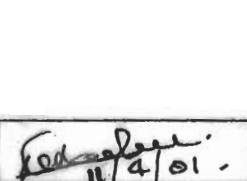
9.4 Bulk Modulus -

@ 1000 psi	2.83 x 10 ⁵ lb/in ²
@ 1500 psi	2.86 x 10 ⁵ lb/in ²
@ 2000 psi	2.89 x 10 ⁵ lb/in ²
@ 3000 psi	2.95 x 10 ⁵ lb/in ²
@ 4000 psi	3.03 x 10 ⁵ lb/in ²
@ 5000 psi	3.08 x 10 ⁵ lb/in ²

9.5 Dielectric Strength - 25.6 KV

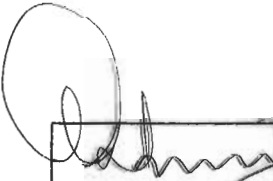
9.6 Vapour Pressure -

<u>Temperature, Deg.C</u>	<u>Vapour Pressure, Torr.</u>
(121.17)	1.35
(148.89)	2.4
(176.67)	4.2
(204.44)	7.0
(232.22)	12.0
(260.00)	23.0
(287.78)	40.0
(315.56)	68.0
(343.33)	120.0
(371.11)	240.0
(398.89)	430.0
(412.78)	620.0

		
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9.7 Viscosity - 230 SUS @ 37.8 C; ISO Grade - 46°

This is the most widely used viscosity grade. It is a medium viscosity fluid extensively used for hydraulic applications in the metals industry. This fluid is also used for air compressor and vacuum pump lubrication.

	<i>Shankar</i> 11-4-99	<i>K. Srinivasan</i> 11/4/01
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