ORGANIC CHEMICALS DIVISION RESEARCH Report

REPORT NO. P-1564 JOB NO. 2-21-760.01-1113115

TENTATIVE PROCESS
FOR
MCS 999 (PYDRAUL 540A)

DATE - April 29, 1970 WRITTEN BY - P. D. Fowlkes

Monsanto

ST. LOUIS, MISSOURI

DSW 620232

STLCOPCB4094259

1) MCS 999 - (Pydraul 540A) - fire resistant hydraulic fluid
2) Aroclor 5442 - used for blending MCS 999
3) Aroclor 1242 - used for blending MCS 999

MONSANTO COMPANY
Organic Chemicals Division
St. Louis Research Department

M A Terpstra 5/6/70
W G Knapp 5-6-70
L Fowler 5/7/70

FILE: Hydraulic Fluid

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St. Louis Research Report No. P-1564

TENTATIVE PROCESS

FOR

MCS 999 (PYDRAUL 540A)

Job No. 2-21-760.01-1113115

Date: April 29, 1970

Written by: P. D. Fowlkes

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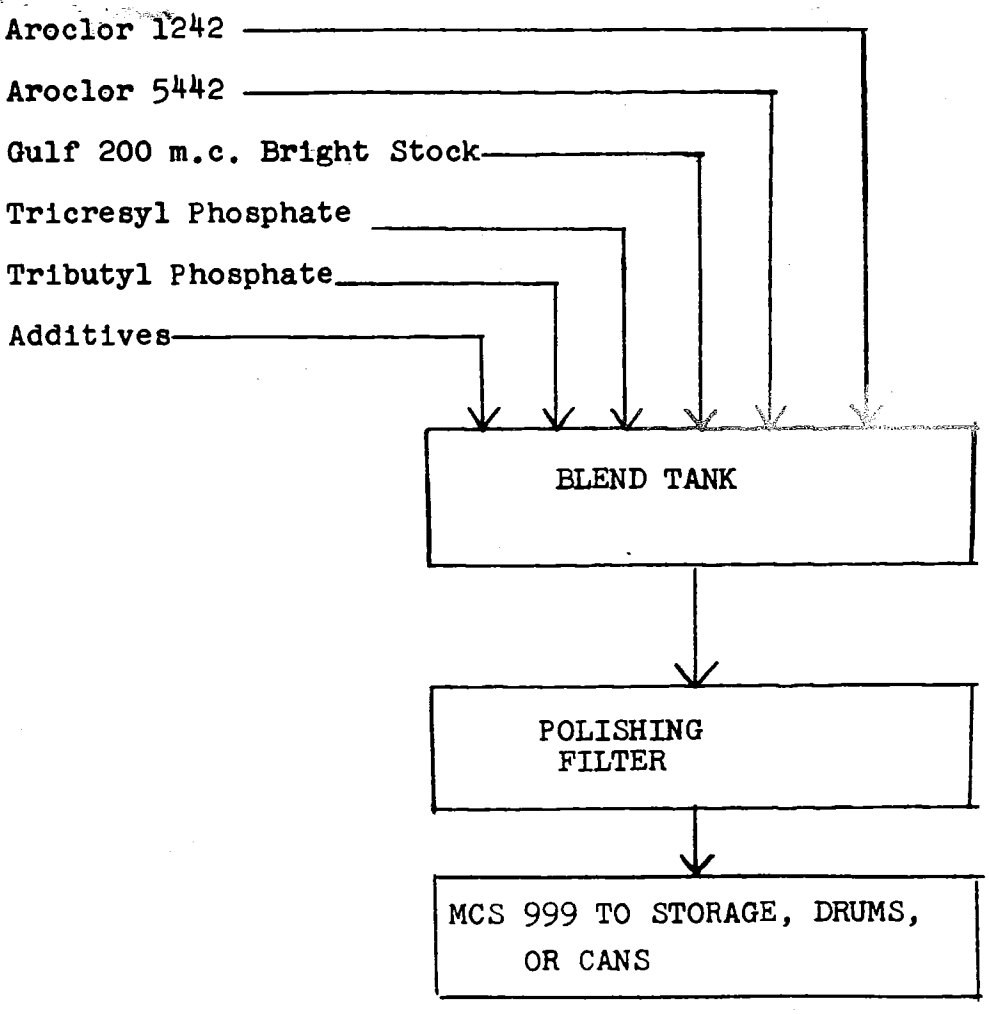
INTRODUCTION

MCS 999 is a fire resistant hydraulic fluid. This formulation was developed to eliminate Aroclor 1254 and 1248 from the Pydraul 540 blend.

SYNOPSIS OF PROCESS

MCS 999 is prepared by blending Aroclor 5442, Aroclor 1242, Petroleum Bright Stock, phosphate esters, and additives. The blended product is filtered to remove any stray debris from raw materials or blending and is transferred to containers or storage.

FLOW SHEET



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BILL OF MATERIALS

Basis, 100 lb. of product

Raw Material	Weight, lb. Alternate A	Alternate B
81101 Aroclor 1242	36.5	38.5
82621 Aroclor 5442	17.6	15.6
44785 Gulf 200 m.c. Bright Stock	32.0	--
44786 Mobil 225 S.R. Bright Stock	--	32.0
80071 Tricresyl phosphate	11.0	11.0
80781 Tributyl phosphate	2.5	2.5
81797 Santolube 70-A	0.3	0.3
60015 Tolyltriazole	0.1	0.1
20640 Dye, Dupont Oil Blue A	0.003	0.003
31100 Dow Corning 200 fluid, 350 cs.	0.002	0.002

PROCESS IN DETAIL

The blending operation may be carried out in any suitable metal or glass-lined vessel. The materials are not corrosive and carbon steel equipment is suitable. An agitator should be provided.

To the clean, dry vessel charge the Aroclor 1242 and petroleum oil bright stock. Warm to 125-150°F (50-65°C) and stir for 1/2 to 1 hour.

While the oil and Aroclor are mixing, add Santolube 70-A, tolyltriazole, Dow Corning fluid, and dye to the tributyl phosphate in a smaller blending tank. The additives will dissolve readily at room temperature or the mixture may be warmed to 125-150°F (50-65°C) and stirred for 15 min-1/2 hr. The amount of these additives should be carefully measured since variations will affect acidity specs, anti-rust performance, and foam.

Add the TBP-additive mixture to the larger tank and finally the tricresyl phosphate. Blend for 1/2 hr-1 hr at 125-150°F (50-65°C).

The batch is then circulated through a polishing filter. Samples are taken as required for analytical purposes. The batch may be held for possible viscosity adjustments or sent to storage. After blending, the temperature should be reduced to 80-130°F (26-49°C). Prolonged exposure at higher temperatures might cause some product deterioration.

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DISCUSSION OF IMPORTANT VARIABLES

The most important specification property of MCS 999 is viscosity. Adjustments in the blend should be made to keep the 100°F viscosity within the required range.

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If the 100°F viscosity is low, add Aroclor 5442. One lb. of 5442 per 100 lbs of mixture will increase the 100°F viscosity about 2.8 cs.

If the 100°F viscosity is high, add Aroclor 1242. One lb. of 1242 per 100 lbs of mixture will decrease the 100°F viscosity about 2.0 cs.

The quantity of dye added should be carefully measured on a suitable small balance or scale. This is important to insure uniform color from batch-to-batch.

Another caution mentioned in the previous section concerned prolonged heating. It is suggested that maximum temperatures of 125 to 150°F be limited to 2 or 3 hours. Also, manner of heating the batch should control film temperatures so there are no significant hot spots. Prolonged heating may cause gradual darkening of the product as well as gradual increase in acidity due to decomposition of the TCP.

MATERIAL SPECIFICATIONS

Raw Materials

Refer to raw material specification sheets included in the Appendix.

Finished MCS 999

Typical analyses and suggested specification limits follow:

Property	Tentative Specification	Typical Value	JFQ Method
Appearance			16-B
Viscosity, cs.			126-A
At 100°F	111-118 cs	113.7	
At 210°F	8.6-9.2	8.95	
Acidity, mgKOH/gm	0.30-0.60	0.48	80-B
Sp. Gr. 25/25°C	1.13-1.17	1.152	116-A
Moisture, KF	0.15 max.	0.02	78-B
Pour Point (each 10th lot)	0°F	0°F	100-A

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ANALYTICAL METHODS

No new or special analytical procedures are required for this product. A cross reference table appears in the Appendix listing standard analytical procedures used at J.F. Queeny Plant, W.G. Krummrich Plant, and at the Anniston Plant. These procedures are currently used on similar products.

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TOXICITY AND HAZARDS

No unusual toxicity or hazards are expected with the raw materials or finished blend. The process is a simple blending procedure and no hazardous reactions should occur between the various components.

Aroclor 5442, 1242 and TCP have been known materials produced by Monsanto for many years. TCP has been used in Pydraul fluid formulations. (NOTE: Current specific toxicity information is being obtained from the Medical Department on these materials and it is suggested these be included in the Appendix of this report.)

General Precautions include the following:

1. Goggles should be worn where splashing or spillage may occur.

2. Any material in contact with the skin should be removed by washing with soap and water.

3. Prolonged or repeated exposure to the skin may cause irritation due to removal of skin oils with resulting dryness and chapping.

4. Material may be irritating to sensitive skin areas and eyes. In case of contact with eye tissue, flush copiously with water and then get medical attention.

5. In case of internal ingestion get immediate medical attention.

6. Avoid inhaling volation material or mists.

POLLUTION CONTROL

No waste by-products are generated by this process. Used filtering material, flushings from the system during cleaning, as well as any spoiled product should be disposed of as dictated by local regulations.

APPENDIX

P. D. Fowlkes

ms
4/29/70

File Copy Approved by
Manager of Research:

W. R. Richard — 5/4/70

W. R. Richard (Date)

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APPENDIX

PHYSICAL CONSTANTS DATA

SUBSTANCE	STRUCTURAL FORMULA
MCS 999 (PYDRAUL 540A)	Blend: 36.5 Aroclor 1242 17.6 Aroclor 5442 32.0 Gulf 200 m.c. B.S. 11.0 TCP 2.5 TBP
COMPILED BY: P. D. Fowlkes	DATE: 4/29/70

NAME		SOURCE & DATE
Formula	Blend	
Molecular Weight		
Appearance	Blue-Green Liquid	
Boiling Point at 760 mm		
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point		
Melting Point		
Solution Point		
Specific Gravity @ 25/25°C	1.13-1.17	
Specific Gravity @		
Pounds per Gal. @ 25 °C	9.60	
Coefficient of Expansion		
Refractive Index @ n_D		
Infra Red Spectrum *(Reference)*		
Ultra Violet Spectrum *(Reference)*		
Viscosity @ 100°F	111-118 cs	
Viscosity @ 210°F	8.6-9.2 cs	
Surface Tension		
Solubility in Water	Nil	
Solubility in		
Solubility in		
Pour Point	0°F	
Moisture (KF)	0.15 max.	
Flash Point °F *(Method)*		
Fire Point °C		
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg/min.)		
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat		
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Acidity, mgKOH/gm	0.48 typ, 0.60 max.	
Other Constants		
Toxicity *(Give Reference)*		

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Analytical Procedures

Property	WGK	JFO	Anniston	ASTM *
Appearance	12809	16-B	G-1	-
Viscosity	12837	126-A	049	D-445
Flash & Fire Point	12803	50-A	114	D-92
Specific Gravity	12804	116-B	052	-
Pour Point	13005	100-A	053	D-97
Cloud Point	-	36-A	-	D-2500
Acidity	12794	80-B	050	D-664/D-974
Moisture	12810	78-B	047	D-1744
Foam	12805	54-A	-	D-892
Refractive Index	13123	104-A	048	D-1218
Distillation Range	10117	-	054	Modified D-20

* Approximate equivalent ASTM method.

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MONSANTO COMPANY
ORGANIC CHEMICALS DIVISION
J. F. QUEENY PLANT
RAW MATERIAL
SPECIFICATION

MATERIAL CODE
81101 or 82612

USING DEPTS.
Pydraul 150

SUPPLIER
Monsanto, WGK or Anniston Plants

ISSUED NOV. 13, 1967
SUPERSEDES [illegible]
APPROVED [illegible]

MATERIAL
AROCLOR 1242 - NON-ELECTRICAL GRADE

CHEMICAL FORMULA

Mixture

MOL WT. -----

SUPERSEDES SPECS OF
October 13, 1964

SAMPLE FOR ANALYSIS
1 x 16-ounce NN Bottle

REQUIRED TESTS*	RESTRICTED INTERNAL LIMITS	JFQ CONTROL LIMITS	PROCEDURES WGK	PROCEDURES JFQ
Appearance	Clear, colorless to light yellow-green liquid	-----	10084	16-B
Color	APHA 100 max.	-----	10084	38-D
Refractive index @ 25°C	-----	1.6240 to 1.6260	10125	104-A
Specific gravity @ 25/15.5°C	1.381 to 1.392	-----	10114	116-A
TREND TESTS*				
Acidity (mg. KOH/g.)	0.010 max.	-----	10087	4-A
Moisture	50 ppm max.	-----	10620	78-C
Viscosity @ 100°F	82 to 92 SUS	-----	10086	126-A
General Tests(made only upon request at producing plant)				
Distilling range:(ASTM D-20 corrected):			10117	
10% distilled by wt.	325°C min.			
90% distilled by wt.	360°C max.			
Fire point	None	-----	10123	50-A
Flash point	338 to 392°F	-----	10123	50-A

*This information will be transmitted to JFQ Plant in accordance with Procedure 928 on all shipments from WGK Plant.

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DSW 620242

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Aroclor 5442		27-S
PLANT	PRODUCT CODE	USE
Anniston	826,21	Sales
DATE EFFECTIVE	SALES CODE	
3-15-66	1040-470-04-009	

APPROVALS

PRODUCTION	RESEARCH
R. G. Moody /s/ 12-29-65	L. R. Stark /s/ 3-11-66
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault /s/ 3-2-66	O. E. Dolin /s/ 12-29-65

GENERAL DESCRIPTION

Mixture

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
4-25-61	1 x 16 oz. Can or W.M. Bottle	J. A. Liddle 11-30-65

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Appearance and Color	Clear, yellow sticky resin	G-1
(R) Color, NPA, Molten	2 Max.	G-4
(R) Softening Point, °C	46 - 52	115
Acid No., mg. KOH/g	0.05 Max.	116

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STLCOPCB4094270

MONSANTO COMPANY
ORGANIC CHEMICALS DIVISION

J. F. QUEENY PLANT

RAW MATERIAL SPECIFICATION

MATERIAL CODE
44785

USING DEPTS.
Pydraul Fluids

APPROVED SUPPLIERS
Gulf Oil Company

ISSUED JUNE 12, 1968
[illegible] DEPARTMENT
John F. Queeny Plant
[illegible]

MATERIAL
OIL, GULF 200 Midcontinent Bright Stock

CHEMICAL FORMULA

MOL. WT. ------

SUPERSEDES SPECS OF
December 9, 1964

SAMPLE FOR ANALYSIS
1 x 16-ounce Bottle

TEST	UNRESTRICTED PURCHASE LIMITS	INTERNAL CONTROL LIMITS	PROCEDURES
On each lot			
Appearance	Clear, brown oily liquid	Clear, brown oily liquid	16-B
Flash point	600°F minimum	*	50-A
Pour point (as is)	+10°F maximum	-----	100-A
Viscosities:			126-A
@ 100°F	-----	850 to 950 cs.	
@ 210°F	42.7 to 47.0 cs.	-----	
Upon request			
Gravity	0.9071 .9256 24.5 to 26.5° API	-----	ASTM D-287
Color (ASTM D-1500)	4.5 to 6.5	-----	38-I

*Gulf published limit 525°F minimum. By 4-9-68 memo to TRR Gulf said: "The Gulf Oil Corp. will accept the responsibility that all 200 M.C. Bright Stock shipped to you will have an open cup flash point in excess of 600°F by ASTM D 92... This note should be entered on all purchase orders."

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STLCOPCB4094271

MONSANTO COMPANY
ORGANIC CHEMICALS DIVISION

J. F. QUEENY PLANT

RAW MATERIAL SPECIFICATION

MATERIAL CODE
44786

USING DEPTS.
80467

APPROVED SUPPLIERS
Mobil Oil Company

ISSUED NOV. 15, 1968
STANDARDS DEPARTMENT
John F. Queeny Plant
By Paul N. Brewer

MATERIAL
OIL, MOBIL 225 SR BRIGHT STOCK

CHEMICAL FORMULA

MOL. WT. -----

SUPERSEDES SPECS OF
June 2, 1965

SAMPLE FOR ANALYSIS
1 x 16-ounce Bottle

TEST	UNRESTRICTED PURCHASE LIMITS	PROCEDURES
On each lot		
Flash point	605°F min.	50-A
Pour point	+10°F max.	100-A
Viscosity @ 210°F	225 - 235 SUS	126-A
Upon request		
Gravity; °API	25 to 27°	ASTM D-287
Viscosity index	95 minimum	126-E

DSW 620245

STLCOPCB4094272

MONSANTO COMPANY
ORGANIC CHEMICALS DIVISION
J. F. QUEENY PLANT
FINISHED PRODUCT SPECIFICATION

PRODUCT CODE: 80071 or 80180	DEPT. OR JOB:
USE: Sales & Internal	W. F. Wavchoff/ R. Pahl, Managers
SALES CODE: 8530-100-04/12-001	

NOV. 6, 1967

Paul N. Briscoe

PRODUCT (Trade Name): TRICRESYL PHOSPHATE — TYPE: A GRADE

PRODUCT (Chemical Name): — TYPE:

CHEMICAL FORMULA: $(CH_3C_6H_4)_3PO_4$

MOL WT. 368.18

SUPERSEDES SPECS OF: December 4, 1963

SAMPLE FOR ANALYSIS: 1 x 16-ounce NN Bottle

TEST	UNRESTRICTED SALES LIMITS	INTERNAL CONTROL LIMITS	PROCEDURES
On each lot			
Acidity	0.20 meq/100 grams max. (=0.01% as H_3PO_4)	0.08 to 0.17 meq/100 grams	4-A
Appearance	Clear, practically colorless to lt. yellow liquid	Clear, practically colorless to lt. yellow liquid	16-B
Color	APHA 75 max.	APHA 30 to 70	38-D
Moisture (By KF in methanol)	0.15% max.	0.04 to 0.10%	78-B
Odor	No foreign odor	No foreign odor	84-A
Specific gravity @ 25/25°C	1.157 to 1.173	1.163 to 1.169	116-B
Stability to $KMnO_4$	65% transmission min.	70 to 80% transmission	118-D

Sampling procedure

1. Circulate storage tank 16 hours before filling shipping containers.
2. While filling drums, tank trucks or tank cars, take one 16-ounce bottle from the filling line and submit to the laboratory for analysis.

General Product Information

The assay of Monsanto Tricresyl Phosphate is essentially 100%, as evidenced by the low acidity and by stability to permanganate solution. Free phenols rapidly destroy the color of permanganate solution. No specification for assay is given because none of the known methods of analysis give an accurate answer. This is true of the Monsanto method, the ASTM method and the methods given in the specifications of various government agencies.

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MONSANTO COMPANY
ORGANIC CHEMICALS DIVISION

PURCHASED FOR RESALE*
FINISHED PRODUCT SPECIFICATION

PRODUCT CODE: 80781*
DEPT. OR JOB:
USE: Sales - W. F. Waychoff, Manager
SALES CODE: 8483-100-04-001

ISSUED MARCH 18, 1969
STANDARDS DEPARTMENT
John F. Queeny Plant
By W. H. Bamman

PRODUCT (Trade Name): TRIBUTYL PHOSPHATE
TYPE:
PRODUCT (Chemical Name):
TYPE:

CHEMICAL FORMULA

$(C_4H_9\text{-}O)_3P = O$

MOL WT. 266.32

SUPERSEDES SPECS OF: February 10, 1966
SAMPLE FOR ANALYSIS: 1 x 16-ounce NN Bottle

*From Stauffer Chemical Company & FMC

TEST	UNRESTRICTED SALES LIMITS	PROCEDURES
On each lot		
Acidity	0.03% max. as phosphoric acid	4-A
Appearance	Clear, mobile liquid	16-B
Color	APHA 25 max.	38-D
Moisture (By KF in methanol)	0.20% max.	78-B
Odor	Characteristic	84-A
Refractive index @ 25°C	1.420 to 1.425	104-A
Specific gravity @ 20/20°C	0.977 to 0.980	116-B

DSW 620247

MONSANTO COMPANY
ORGANIC CHEMICALS DIVISION

J. F. QUEENY PLANT
RAW MATERIAL
SPECIFICATION

MATERIAL CODE
81797

USING OPTS
Fluid Blends

SUPPLIER
Monsanto - Nitro Plant

MAY 9, 1

MATERIAL
SANTOLUBE 70-A

CHEMICAL FORMULA

Blend of: Santolube 70 98.35%
Santolene C 1.65%

MOL. WT.

SUPERSEDES SPECS OF 6-21-67 for Santolube 70; Nitro code 81787

SAMPLE FOR ANALYSIS
1 x 16-ounce WM Bottle

TEST	RESTRICTED INTER-PLANT LIMITS	PROCEDURES NITRO	PROCEDURES JFQ
On each lot			
Appearance	Dark, oily liquid	6-C-01	16-B
Color ASTM Dilute	5.5 max.	6-C-21	38-1
Neutralization No.	51 to 61	6-A-24	80-A
Solubilities: 5%/vol. in PE	Clear	6-V-15	112-B
Specific gravity @ 25/25°C	0.89 to 0.97*	6-D-07	116-B
Upon request			
Emulsification test	40, 40, 0 (30 min.)	6-S-28	-- --
Santolene C presence	Positive phosphorous test	-----	-- --
Viscosity @ 210°F	70 to 300 SUS*	6-X-02	126-A

*Typical ranges submitted by Nitro.

Special requirements

This material is shipped upon invoice certification of compliance with specifications. Prior permission will be obtained to ship non-specification grade material.

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J. F. QUEENY PLANT
MONSANTO COMPANY
ORGANIC CHEMICALS DIVISION

RAW MATERIAL SPECIFICATION

MATERIAL CODE: 31100

USING DEPTS.: Fluid Blends

SUPPLIER: Dow Corning Corporation

[illegible] FEB. 8, 1968
[illegible]
[illegible]
Paul [illegible]

MATERIAL: DOW CORNING 200 FLUID - 350 cs.

CHEMICAL FORMULA:

MOL WT.:

SUPERSEDES SPECS OF: October 28, 1964

SAMPLE FOR ANALYSIS: 1 x 8-ounce Bottle

TEST	UNRESTRICTED PURCHASE LIMITS	METHODS
On each lot		
Appearance	Syrupy liquid	16-B
Refractive index @ 25°C	1.4020 to 1.4040	104-A
Specific gravity @ 25/25°C	0.969 to 0.975	116-A
Viscosity @ 25°C	332.5 - 367.5	126-31100
Upon request		
Color - modified Barrett	1.5 max.	38-H
Flash point	600°F min.	50-A
Neutralization No.	0.01 max.	80-B
Volatility (24 hrs./150°C)	0.5% max.	128-B

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Not To Be Taken From Library

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