

مواصفات زيوت وقود (C.I.O / 19)

GE
Transportation

Recommended Fuel, Oil and Lubricants

Doc No. GEK-76679 (MI-00152), Rev. C

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1. GENERAL INFORMATION

This publication provides information on the recommended fuels, oils, and greases that are approved for use in General Electric products. This publication is primarily intended for locomotive usage; however, the fuels, oils, and greases listed herein are also recommended for marine and stationary diesel engine applications.

2. DIESEL ENGINE OILS

2.1. HEAVY-DUTY ENGINE OILS

The General Electric diesel engine requires a heavy-duty, highly dispersant SAE 40 or multigrade (typical SAE 20W-40) lubricating oil. The minimum new oil kinematic viscosity for SAE 40 oils is 13.9 cSt at 100 C (75 SSU at 210 F) and the viscosity index range for straight weight oils is 65 to 105. The minimum absolute viscosity for multigrade oils is 10.8 centiPoise at 100 C and the viscosity index range for these oils is 108 to 125.

Lubricating oils used in the General Electric diesel engine must meet General Electric's approval criteria which is based on demonstrated performance. Approval letters issued by General Electric are given to the companies who market engine oils to the users of General Electric diesel engines. Customers should contact General Electric for recommendations and a list of GE-approved Generation 4 Long Life Engine oils.

Railroad engine oils are typically categorized by using the Locomotive Maintenance Officers Association (LMOA) Generation Designations. These designations categorize lubricating oils by performance. Total Base Number (TBN) of the engine oils listed below are measured by the American Society for Testing and Materials (ASTM) test method D2896.

2.2. LMOA GENERATION 4 ENGINE OILS (13 TBN)

LMOA Generation 4 engine oils contain additive packages which have demonstrated improved oxidation stability, detergency, dispersancy and alkalinity over the LMOA Generation 3 oils. Generation 4 oils are not currently marketed in the United States for locomotive applications; however, Generation 4 oils are still used internationally. General Electric recommends Generation 4 Long Life oils.

2.3. GE GENERATION 4 "LONG LIFE" ENGINE OILS (13 TO 18 TBN)

General Electric Generation 4 Long Life oils (typically referenced as Generation 5 oils by LMOA) contain the most advanced additive technologies available today. Advances in lubricating oil technology have allowed for increased oil and oil filter life while preserving Generation 4 performance standards in wear control, engine cleanliness and deposit control. Field test data have documented substantial increases in oil life over conventional Generation 4 lubricating oils with no detrimental effect to the engine. Generation 4 Long Life oils are preferred (over LMOA Generation 4 oils) for use in locomotive applications. Generation 4 Long Life oils are currently the only oils marketed for locomotive applications domestically.

2.4. MULTIGRADE ENGINE OILS

Multigrade engine oils (typical SAE 20W-40) are currently approved and acceptable for use in the General Electric diesel engines. Recognizing the fuel efficiency benefits brought about by the special viscosity characteristics of multigrade oils, engine users have had an increasing demand for multigrade oil over the last several years.

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The unique viscosity characteristics of multigrade oils cannot be correctly measured through kinematic viscosity techniques. To qualify new multigrade oils, a minimum absolute viscosity of 10.8 CentiPoise at 100 C is required. An absolute viscosity specification takes into account the permanent and temporary viscosity losses of multigrade oils. These viscosity losses are responses to the high shearing forces existing within the bearing clearances and on the cylinder walls, etc.

The minimum absolute viscosity measurement is found by running the new engine oil through ASTM test method D3945 Procedure B (FISST technique) to factor in permanent viscosity losses. After this test is complete, this same new oil is taken and processed through ASTM test method D6616 (Tapered Bearing Simulator), modified to 100 degrees, or ASTM test method D4741 (Tapered Plug Viscometer at 100 C). The Tapered Bearing Simulator takes into account the temporary viscosity losses of the multigrade oil and measures the absolute viscosity of the engine oil in CentiPoise at 100 C.

2.5. MIXTURE OF ENGINE OILS

All engine oils on the General Electric Approved Lists, for use in GE diesel engines, are fully compatible, and may be mixed in any ratio without causing harm to the engine. However, for optimal performance and prevention of possible unforeseen incompatibility issues, GE recommends single source supply.

When lubricating oils listed in one category are mixed with those of another category, the resulting mixture belongs in the same category as that of the lowest ranking oil used. For example, when lubricating oils listed as "Generation 4" are mixed with oils listed as "Generation 4 Long Life," the resulting mixture is automatically ranked in the lower "Generation 4" category, and should be used only in situations where "Generation 4" oils are approved.

For all lubricants other than engine lubricating oil, the statement "never mix lubricants of different brands or grades" still applies. Since multiple brands and grades of these lubricants are available, thorough testing for compatibility is impossible.

With engine lubricating oils, however, approval is made by brand and grade; thus compatibility is known. An oil is not approved until found to be compatible with all others on the approved list. Approval consists of both factory and field testing.

2.6. ENGINE OIL CONDEMNING LIMITS AND MEASUREMENTS

General Electric recommends frequent testing (every 7-10 days) of lubricating oil for pentane insolubles, viscosity, water content and alkalinity reserve. These tests should be performed in order to detect fuel dilution and water contamination and avoid excessive deposits, corrosion or oxidized oil which could damage engine bearings and other components. Additional tests such as Infrared Spectra may be used to obtain other oil condition information (i.e., oxidation, sulfation, etc.). Elemental analysis may be used for trending any wear metals.

Engine oil condemning limits on viscosity and water contamination as well as alkalinity and insolubles are given in Table 1. This table gives condemnation limits for Generation 4 and GE Generation 4 Long Life engine lubricating oils.

It is suggested that an advanced warning system ("flagging" technique) be used for monitoring oil trend analysis results. If the oil trend analysis trend indicates the oil is approaching or close to exceeding the oil condemning limit(s), a warning should be made to ensure the locomotive does not operate with such an oil beyond the oil's useful life.

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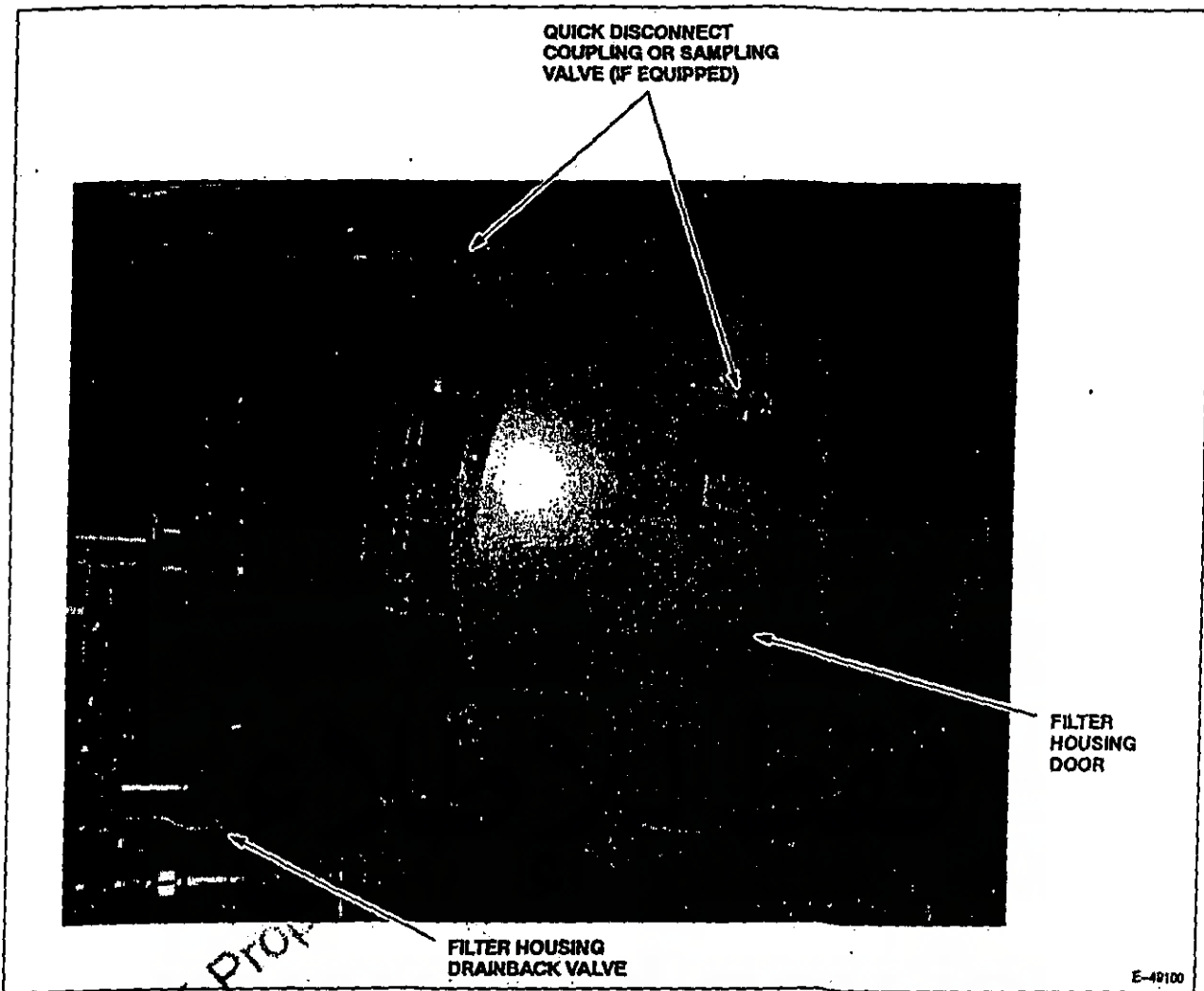


Figure 1. Typical Lube Oil Sampling Valves.

During extraction, if the pump is overstroked and oil is allowed to enter the pump plunger, the device will have to be replaced with a clean pump to extract any following samples.

2.8. ENGINE OIL LIFE

Based on the field data relating engine oil life to engine performance and durability, General Electric recommends a limit of six months maximum on engine oil drains. It should be cautioned that there are severe service applications where more frequent oil changes would be required. Factors influencing the frequency of change include the kind of service, the nature of the terrain over which the locomotive operates, the type of diesel oil used, and the quality of engine oil used. Please refer to the guidelines listed below.

Because of the wide variations in character between lubricating oils of different brands and the varied duty cycle of locomotives, it is recommended the oil supplier and General Electric Service Managers be contacted to assist in the development of an oil renewal schedule and to set forth the limiting factors peculiar to that oil.

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Frequently the locomotive will return to active service before the oil trend analysis has been completed. If the locomotive remains in active service for a continuous period of time before returning to the Backshop, the engine may run with an engine oil that has gone beyond the oil's useful life. An advanced warning system can help in scheduling when the engine oil should be drained so that oil life is not overextended.

TABLE 1. CONDEMNING LIMITS OF ENGINE LUBRICATING OIL

PROPERTY	CONDEMNING LIMIT	TEST METHOD
PENTANE INSOLUBLES (Maximum)	4% (Generation 4 Long Life Oil With Class A Fuel)	LMOA Filtration Membrane Method (0.45 Micron Filter)
KINEMATIC VISCOSITY (SAE 40)	Maximum 25% Increase (Above Fresh Oil Viscosity) Minimum 12.5 cSt @ 100 C	ASTM D445 Kinematic (CentiStokes at 100 C)
TOTAL BASE NUMBER (Minimum)	3.0 (mg. KOH per gm.)	ASTM D4739
TOTAL BASE NUMBER	5.0 (mg. KOH per gm.) SCREENER TEST	ASTM D5984
WATER (Maximum)	0.2%	ASTM D95
SOOT, OXIDATION, SULFATE	Instrument and software dependent; must be correlated to GE lab for reference	Infrared Spectra
WEAR METALS	Trend line	ICP, AA

2.7. ENGINE OIL SAMPLING PROCEDURE

GE recommends that oil samples be collected for analysis every 7 - 10 days. Before beginning to take the sample, be sure to write all pertinent information on the sampling bottle. The preferred method of collecting an oil sample is by using the oil sampling valve (Figure 1). The oil sample should be taken while the engine is at idle.

If the locomotive is not equipped with an oil sampling valve, a suction-type device to extract the oil will have to be used. This should be done through the oil fill pipe while the locomotive is shutdown. The suction device should be fitted with a length of clean tubing to allow the sample to be extracted from the mid-level of the oil, not from the bottom of the oil pan or the top surface of the oil (Figure 2).

If possible, the oil sample should be collected within 15 minutes after shutting down the locomotive.

NOTE: Be careful when using the suction device, not to overstroke the plunger which will cause oil to enter the pump leading to cross-contamination of following oil samples.

The oil sample bottle should be filled between 2/3 to 3/4 full (Figure 3). Keep the pump in a position that the oil sample bottle remains vertical so oil is not allowed to flow from the oil sample bottle into the pump plunger contaminating the pump.

NOTE: If samples are to be extracted from multiple units, a new clean suction tube must be used for each unit. If this is not done, cross-contamination of oil samples will take place.

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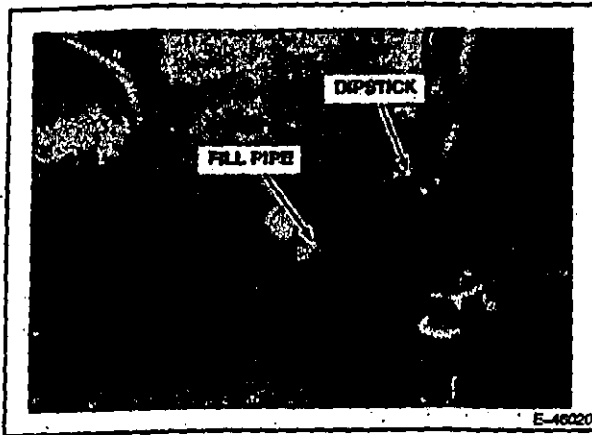


Figure 2. Lube Oil Sampling From Fill Pipe.

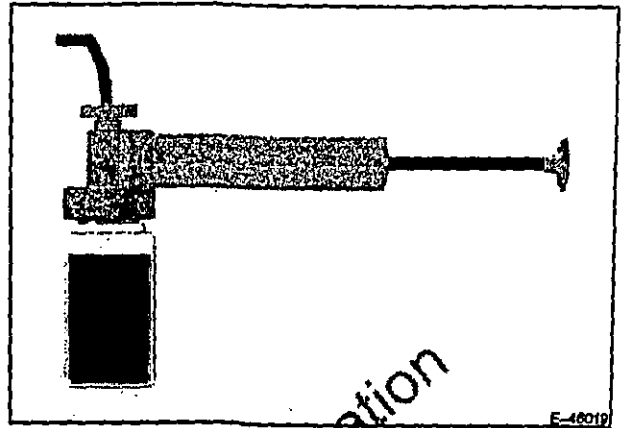


Figure 3. Lube Oil Sample Suction Pump and Bottle.

The following table is a general guideline based on field experience with GE Generation 4 Long Life oils in GE diesel engine applications (using #2-D diesel fuel):

Type Of Service	Oil Change Period	MWHr/Month				
		7FDL16	7FDL12	7HDL16	GEVO16	GEVO12
Severe	3 Months	>400	>300	>600	TBD	TBD
Medium	3-6 Months	300-400	225-300	450-600	TBD	TBD
Moderate	6 Months	<300	<225	<450	TBD	TBD

For all engine applications, GE recommends an oil trend analysis program. If there is no oil trend analysis program, then the oil should be changed every 92 days (three months). However, the engine is at risk if there is no oil trend analysis program (for example, water and fuel leaks would go undetected). If the environment is excessively hot (sustained operation over 90 F) or airborne dust and dirt are prevalent, more frequent oil changes than at three month intervals are recommended.

When engine oil change intervals are overextended, severe engine problems may result which would affect engine component durability and increase unscheduled maintenance. Precautions should be taken to regularly inspect for excessive deposits on the internal engine components to ensure the oil has not gone beyond its useful life.

2.9. ENGINE OIL CHANGEOUT PROCEDURE

Engine oil changes should include the following:

1. Draining engine oil (recommend oil drain when engine is hot).
2. Removing lubricating oil filters.

NOTE: Filters may be replaced at 184 day intervals when Generation 4 Long Life engine oil is used. Under all other conditions filters must be replaced at 92 day intervals.

3. Cleaning the oil filter housing.
4. Installing new filters.

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5. Refill with approved engine oil.
6. Flush the engine with clean engine oil. This procedure may be obtained from the GE Field Service representative.

2.10. GE-APPROVED RAILROAD DIESEL ENGINE OILS

When a specific Generation 4 Long Life oil is approved for locomotive diesel engine use, GE sends a letter to the oil supplier indicating that approval. Oil suppliers must provide a copy of this letter to verify approval prior to use of the oil.

3. FUEL SPECIFICATIONS

NOTE: The frequency with which fuel oil filters must be changed will vary, depending upon the kind of service, the kind of fuel oil, its purity at the time it enters the locomotive fuel tank and the dispersancy capabilities of the engine oil, among other factors. Experience is the best guide on which to base filter renewals in accord with time or mileage. The intervals suggested in TABLE 1 are considered to be average.

3.1. FUEL OILS

Fuel Oil Specifications for GE Diesel Engines are listed in Table 2. This table has three categories:

1. **Class A:** The Class A fuel is the highest quality fuel. It meets the requirements of the American Society for Testing and Materials (ASTM) Specification D-975 for Number 2 Diesel (N2D) fuel.
2. **Class B:** (Defined by broader physical properties than Class A.) This fuel is a lower quality distillate fuel. It represents the extreme limit on the principal fuel properties of cetane number, sulfur content and viscosity. Increased engine maintenance may be required when using Class B fuels when compared to using higher quality fuels.
3. **Class C:** This class fuel specification allows blending up to 10 percent Number 6 heavy black oil with ordinary Number 2 diesel fuel. Class C fuel is the lowest quality approved for use in GE diesel engines. Several additional properties are defined for the Class C fuels than for Classes A or B.

These properties help establish the cleanliness of the fuel. Impurities such as vanadium, sodium, aluminum, iron and nickel can cause high wear and, as a result, limits are placed on them. Further note that only 90% of the Class C fuel need be recovered on distillation.

Potential problems do exist. Some preliminary cautions to the users of Class C fuels are:

- a. Number 6 fuel oil cannot be used in present day locomotive diesel engines. The use of excessively large quantities of Number 6 fuel in the Class C blend can result in a product which will be too heavy for injection without heating.
- b. It is possible that fuelling at multiple points on a railroad may be a problem. Fuels available at one point may not be available at another point. The result would most likely be blocked fuel filters.
- c. Number 6 oil is made up of a dispersion of heavy tar like residual particles. Some Number 6 fuels may not be compatible with some diesel fuels. Incompatibility would result in the tar-like particles coming out of solution which could shorten filter life and foul injection equipment.
- d. Number 6 fuel oil can contain extremely abrasive and potentially corrosive contaminants. If contaminants are present, there could be an increase in wear on injection equipment and other assemblies.

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- e. Class C fuels are more sensitive to improperly tuned engines. Increased attention to the General Electric maintenance recommendations, especially with respect to injection timing, valve clearance, fuel injection equipment and water temperature, is required.
- f. Higher average sulfur levels are likely in Class C fuels. If uncontrolled, this can increase wear on the engine. Use of Generation 4 lubricating oils is required.

NOTES FOR TABLE 2:

1. Low ambient temperatures as well as engine operation at high altitudes may require use of fuels with higher cetane ratings.
2. Use of Class B or Class C fuel requires LMOA Generation 4 lubricating oil to be used.
3. Use of Class B or Class C fuel may cause increased engine maintenance.
4. Blended fuel in Class C must be compatible and stable. Even so, handling problems may be encountered.
5. With Class C fuel, lubricating oil must be changed at TBN at 2, minimum.
6. Cetane Maximum at 48 per EPA Federal Register (Vol. 63--No. 73, Thursday, April 16, 1998; Rules and Regulations; Pages 19016-19017).

TABLE 2. FUEL OIL SPECIFICATIONS FOR GE DIESEL ENGINES.

Property	Class A Limit Meets ASTM Spec. D975-81 No. 2-D	Class B Limit Represents Broader Limits	Class C Limit- No. 2 Distillate Blended with Max of 10% No. 6 Residual Fuel by Volume
Flash point, degrees F (all classes)	Minimum 52 C (125 F) or legal		
Pour Point, degrees F (Both Class A and B)	Max. 10 lower than ambient oper. temp. during coldest weather		Max. 0
Carbon residue on 70 percent bottom, percent	Max. 0.35	Max. 0.35	-
Carbon residue on whole fuel, percent	-	-	Max. 2.0
Water and sediment, percent by volume	Max. 0.05	Max. 0.10	Max. 0.20
Ash, percent by weight	Max. 0.01	Max. 0.02	Max. 0.02
90% Distillation temperature, C (F)	282-338 (540 to 640)	Max. 360 (Max. 680)	Max. 371 (Max. 700)
Final boiling point, degrees F	-	Max. 700	-
Distillation recovery, percent	Min. 99	Min. 99	Min. 90
Viscosity cSt at 40 C (cSt at 100 F)	1.9 to 4.1 (2.0 to 4.3)	1.9 to 7.1 (1.8 to 7.4)	1.9 to 7.1 (2.0 to 7.4)
Viscosity at 100 F, SSU	32.6 to 40.1	32.6 to 50.0	32.5 to 50

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TABLE 2. (Cont'd) FUEL OIL SPECIFICATIONS FOR GE DIESEL ENGINES.

Property	Class A Limit Meets ASTM Spec. D975-81 No. 2-D	Class B Limit Represents Broader Limits	Class C Limit- No. 2 Distillate Blended with Max of 10% No. 6 Residual Fuel by Volume
Sulfur, percent by weight	Max. 0.50	Max. 1.0	Max. 1.0
Copper strip corrosion	Max. No. 3	Max. No. 3	Max. No. 3
Cetane number (see preceding NOTE 1)	Min. 40	Min. 37	Min. 37
Pentane insolubles, percent by volume	-	-	Max. 1.0
Toluene insolubles, percent by volume	-	-	Max. 0.5
Compatibility (by ASTM D2781)	-	-	Max. 1A
Catalyst fines	-	-	Nil
Filtration cleanliness			Max. 1.3 mg per liter of ash residue on 0.80 micron filter
Trace elements, ppm max.			
Vanadium	-	-	20
Sodium	-	-	5
Aluminum	-	-	5
Iron	-	-	10
Nickel	-	-	5
Lubricity (by ASTM 6079)	520 micron, max.	-	-

4. GE SPECIFICATIONS FOR OILS AND GREASES

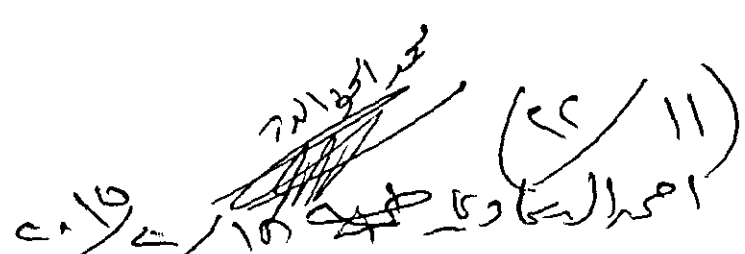
NOTE: The following specifications are for domestic locomotives equipped with GE diesel engines.

Sources of Supply: As a service to railroad customers, sources for various lubricants are listed below by oil company brand name and designation. Specifications for these lubricants have been compared to the pertinent General Electric specification and have been found to comply. They may be considered as suggested sources of supply.

NOTE: This listing is by no means to be considered exclusive. Other lubricants from other oil companies may also comply with the General Electric specification. It is the responsibility of the prospective purchaser and the supplier to obtain approval from GE Transportation Systems prior to use of the lubricant. Approval shall be based on the results of performance testing and field testing.

4.1. GE SPECIFICATION D6A2C4 - BALL AND ROLLER BEARING GREASE

No Longer Available - Use D6A2C10



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4.2. GE SPECIFICATION D6A2C5 - BALL AND ROLLER BEARING GREASE

Worked Consistency, 25 C (77 F), mm/10	265 to 295
Dropping Point, minimum	171 C (340 F)
Mineral Oil Viscosity cSt at 40 C	46 to 93
Thickener (Base - with anti-oxidant)	Lithium
Soap Content, percent	*
Free Alkali, maximum percent	0.35
Free Acid, maximum percent	Nil
Color	Amber
Corrosion	Must pass
Oxidation resistance time to reach 20 psi drop at 98.9 C (210 F), hr., minimum	750
Oil Bleeding, 500 hr., at 100 C (212 F), maximum	10
Evaporation, 500 hr., at 100 C (212 F), maximum percent	6

Sources of Supply:

Shell Oil Products, USA	Alvania RL 2
Chevron Global Lubricants	Multifak AFB-2

4.3. GE SPECIFICATION D6A2C9 - BALL AND ROLLER BEARING GREASE

Worked Consistency, 25 C (77 F), mm/10	240 to 280
Dropping Point, minimum	177 C (350 F)
Mineral Oil Viscosity cSt at 40 C (SSU at 100 F)	105 (525 to 575)
Thickener (Base - with anti-oxidant)	Sodium
Soap Content, percent	*
Free Acid, maximum percent	Nil
Color	Amber
Corrosion	Must pass
Oxidation resistance time to reach 20 psi drop at 98.9 C (210 F), hr., minimum	1000
Oil Bleeding, 500 hr., at 100 C (212 F), maximum	3
Evaporation, 500 hr., at 100 C (212 F), maximum percent	3
Source of Supply: ExxonMobil Oil Company, USA	Andok 260

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*Not Determined

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4.4. GE SPECIFICATION D6A2C10 - BALL AND ROLLER BEARING GREASE

Worked Consistency, 25 C (77 F), mm/10	220 to 240
Dropping Point, minimum	193 C (380 F)
Mineral Oil Viscosity cSt at 40 C (SSU at 100 F)	91.3- 100.5 (475-525)
Thickener (Base)	Lithium
Soap Content, percent	10 to 13
Free Alkali, maximum percent	0.50
Free Acid, maximum percent	*
Color	Amber
Corrosion	Must pass
Oxidation resistance time to reach 20 psi drop at 98.9 C (210 F), hr., minimum	1000
Oil Bleeding, 500 hr., at 100 C (212 F), maximum	3
Evaporation, 500 hr., at 100 C (212 F), maximum percent	4
Source of Supply: Shell Oil Products, USA	Cyprina RA

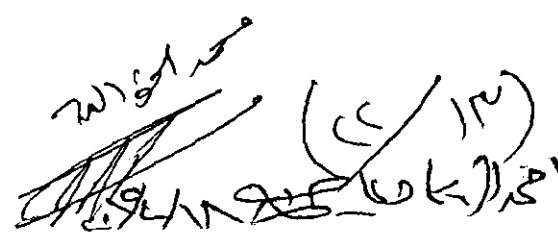
4.5. GE SPECIFICATION D6B11B - HYDRAULIC OIL

No Longer Available - Use D6B11D3 or E3

**4.6. GE SPECIFICATION D6B11D3 - HYDRAULIC OIL
(Gardner-Denver, WABCO and Ingersoll-Rand Air Compressors)**

ISO Viscosity Grade, regular	68
Anti-Wear Characteristics	None
Detergents	None
Flash Point, degrees, min.	204 C (400 F)
Foam Inhibitor	Required
Viscosity, Centistokes at 40 C (SSU at 100 F)	61.2 to 74.8 Nom. (315 Nom.)
Viscosity Index	90 min.
Oxidation Inhibitor	Required
Pour Point, degrees, max.	-6.7 C (20 F)
Rust Inhibitor	Required
<i>Sources of Supply:</i>	
Chevron Global Lubricants	Chevron AIO 68
BP Oil, Inc.	Energol HL-C 68
CITGO Petroleum Corporation	CITGO Pacemaker T68
ExxonMobil Oil Company, USA	TERESSTIC 68
Gulf Oil Limited Partnership	HARMONY R&O AW-68
ExxonMobil Oil Company, USA	Mobil DTE Heavy-Medium
Shell Oil Products, USA	Shell Tellus 68
Chevron Global Lubricants	REGAL OIL R&O 68
Chevron Global Lubricants	RANDO HD ISO 68

*Not Determined

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4.7. GE SPECIFICATION D6B31 - SYNTHETIC ESTER OIL, ISO GRADE 100 VISCOSITY

D6B31A1 is an all synthetic (diester) lubricant without anti-wear additives.

D6B31A1 is formulated to be compatible in contact with nonmetallic materials, as used in seals and other components found in air compressor systems, such as fluorocarbon rubber, high-nitrile rubber, PTFE, epoxy paint, oil resistant alkyd paint, polyamide (nylon) and acetal plastics. (Note: The user is advised that this class of synthetic lubricant may be more aggressive to less resistant polymeric materials and some metallic platings at higher temperatures.)

Properties: (typical) D6B31A1

Viscosity, cSt at 40 °C (ASTM D-445)	96.4
Viscosity, cSt at 100 °C (ASTM D-445)	9.3
Viscosity, SUS at 100 °F (37.8 °C) (ASTM D-445)	509
Viscosity, SUS at 210 °F (98.9 °C) (ASTM D-445)	57.8
Viscosity Index (ASTM D-2270)	62
Neutralization Number, mg KOH/g, max (ASTM D-974 or ASTM D-664)	0.15
Density, lb/gal, at 60 °F (15.6 °C) (ASTM D-4052)	7.89
Specific gravity, at 60 °F (ASTM D-4052)	0.96
Pour point, °F (°C) (ASTM D-97)	-20 (-28.9)
Flash point, C.O.C., °F (°C) (ASTM D-92)	515 (268)
Fire point, C.O.C., °F (°C) (ASTM D-92)	555 (291)
Autoignition temperature, °F (°C), at 1 atmosphere (ASTM E-659)	880 (471)

Sources of Supply:

Gardener Denver AEON AC SY

4.8. GE SPECIFICATION D6B17F10 - GASOLINE ENGINE OIL

API Service	SF
SAE Viscosity Grade	10W-30
Viscosity Index	130
Flash Point, minimum	193 C (380 F)
Fire Point, minimum	216 C (420 F)
Centipoise at -18 degrees C, maximum	2500
Centistokes at 100 degrees C, minimum	9.3
Centistokes at 100 degrees C, maximum	12.5

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**4.9. GE SPECIFICATION D50E8C - GEAR LUBRICANT
(Standard For 5GE752E, AF and AG Traction Motors)**

Physical Properties - Medium Consistency, Sodium Base

<u>Properties</u>	<u>Test Method</u>
Penetration, Unworked, 25 C (77 F) mm/10	340-380
Worked	ASTM D-217
Viscosity, Mineral Oil, minimum cSt at 100 C (SSU at 210 F)	300 (1500)
Thickener	Sodium
Soap, percent	5.0 max.
Water, percent maximum	0.1
Extreme Pressure additives, percent	*
Wear Test	
Timken, pounds, minimum	35
Four Ball EP Test	
LWI, Kg, minimum	*
Weld Point, Kg, minimum	*
Brookfield Viscosity at 200 F, cPs	
No. 6 Spindle at 20 rpm	1500-3500
No. 6 Spindle at 4 rpm	5000-8000
No. 3 Spindle at 4 rpm	*
General Electric Dynamic Oxidation Test	
Brookfield Viscosity at 250 F	Pass
Micro Penetration at 75 F	Pass
<i>Sources of Supply:</i>	
CITGO Petroleum Corporation	CITGO Jet Lubricant TM

4.10. GE SPECIFICATION D50E8E - SPECIAL-PURPOSE GEAR LUBRICANT

(For Locomotives In Heavy Drag Service)

No Longer Available Use D50E8C

4.11. GE SPECIFICATIONS D50E13A, B AND C ARE REPLACED BY GE SPECIFICATION D6B11D3 FOR GARDNER-DENVER, WABCO AND INGERSOLL-RAND AIR COMPRESSORS

*Not Determined

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4.12. GE SPECIFICATION D50E14 - TRACTION MOTOR SUPPORT BEARING OIL

Mineral oils meeting this specification must meet the requirements of AAR-M-963 Specification, and in addition, must contain fatty acid and/or fatty oil additives, or their equivalent, to help lubricate the bearings under all load conditions.

Properties	AAR-M-963	D50E14	Test Method
Flash Point, COC, F	350 min.	350 min.	ASTM D-92
API Gravity at 60 F	-	27-31	ASTM D-287
Pour Point, F	-35 max.	-35 max.	ASTM D-97
Viscosity (Kinematic)			
cSt at 40 C	-	52-66	ASTM D-445
cSt at 100 C	8-9.4	8-9.4	ASTM D-445
SUS at 100 F	-	260-340	ASTM D-2161
Viscosity Index	100 min.	100 min.	ASTM D-2270
Ash, %	0.10 max.	0.10 max.	ASTM D-482
Sulfur, %	-	0.80 max.	ASTM D-129
Load Wear Index, Kg	-	37 min.	ASTM D-2783
Weld Point, Kg	-	200 min.	ASTM D-2783
Lubricity, Four-Ball, mm			
40 Kg, 1 hr., 75 C, 600 RPM	-	0.35 nominal	GE E4B6 **

Sources of Supply:

Chevron Global Lubricants Texaco Code 674 Journaltex HD57
 CITGO Petroleum Corporation Journallube SBO

4.13. GE SPECIFICATION D50E20 - JOURNAL ROLLER BEARING GREASE (AAR SPEC. M-942-75)

Worked Consistency, 60 strokes, 25 C (77 F), mm/10	290 to 320
Dropping Point, degrees F, minimum	325
Mineral Oil Viscosity cSt at 40 C (SSU at 100 F)	140.9-176.1 (750 to 950)
Mineral Oil Viscosity Index, minimum	80
(Viscosity Index Improvers are not approved)	
Mineral Oil Flash Point, COC, minimum	171 C (340 F)

Sources of Supply:

ExxonMobil Oil Company, USA Arapen RB320
 Esso Sekiyu, Japan Arapen RB320
 Shell Oil Products, Canada Shell Alvania EPD-1.5

4.14. GE SPECIFICATION D50E21 - EXTREME PRESSURE GREASE

Worked Consistency, 25 C (77 F), mm/10	265-295
Dropping Point, minimum	171 C (340 F)
Mineral Oil Viscosity cSt at 40 C (SSU at 100 F)	149.8- 218.7 (800 to 1200)
Thickener	Lithium
Rust Test ASTM D-1743	Pass
Timken Test, pounds, pass	40

Sources of Supply:

ExxonMobil Oil Company, USA Mobilux EP2
 Shell Oil Products, Canada Shell Alvania EP2
 Gulf Oil Company, USA Gulfcrown EP2

**Similar to ASTM D-2266

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4.15. GE SPECIFICATION D50E22 - LOCOMOTIVE TAPERED ROLLER BEARING GREASE - EP

Worked Consistency, 60 strokes, 25 C (77 F), mm/10	265 to 305
Dropping Point, minimum	162.8 C (325 F)
Mineral Oil Viscosity cSt at 40 C (SSU at 100 F)	143.3- 227.1 (750 to 1200)
Mineral Oil Viscosity cSt at 100 C (SSU at 210 F)	13.9- 19.7 (75 to 100)
Mineral Oil Viscosity Index, minimum	70
Mineral Oil Flash Point, minimum	171 C (340 F)
Timken Test, pounds, minimum	35
<i>Sources of Supply (Class GG Journal Bearing):</i>	
BP Australia, Australia	BP Energrease LS-EP2
ExxonMobil Oil Company, USA	Ronex MP
Shell Oil Products, Canada	Shell Alvania EP2
<i>Source of Supply (Traction Motor Suspension Bearing):</i>	
ExxonMobil Oil Company, USA	Ronex MP

4.16. GE SPECIFICATION D50E24 - GEAR COUPLING GREASE

Worked Consistency, 25 C (77 F), mm/10	310-340
Dropping Point, minimum	190 F
Mineral Oil Viscosity	
cSt at 40 C (SSU at 100 F)	640-810 (3500-4400)
cSt at 100 C (SSU at 210 F)	33.6- 42.2 (165-205)
Thickener	Polyethylene
Soap	Not Required
Rust and Oxidation Inhibitors	Required
Four-Ball Wear, Scar, mm (ASTM D-2266)	0.50 max.
Load Wear Index, Kg (ASTM D-2596)	45 min.
Weld Point, Kg (ASTM D-2596)	225 min.
<i>Source of Supply:</i> KOP-FLEX Emerson Power Transmission Division	KSG Standard Coupling Grease

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4.17. GE SPECIFICATION D50E25B - TRACTION MOTOR GEAR OIL

<u>Properties</u>	<u>Test Method</u>
API Gravity	26.6 ASTM D-1298
Specific Gravity at 20 C	0.897
Pour Point, C (F)	-15 (+5) ASTM D-97
Flash Point, C (F)	200 (428) ASTM D-1310
<u>Viscosity</u>	
cSt at 40 C	8031 ASTM D-445
cSt at 100 C	357 ASTM D-445
SUS at 100 F	36250 ASTM D-445
SUS at 210 F	1600 ASTM D-445
Viscosity Index	170 ASTM D-2270
ISO VG	6800
Color	0.5
Rust Protection	Pass ASTM D-665
Copper Corrosion	1A/1B
Extreme Pressure additives	Sulfur/Phosphorous
<u>Wear Test</u>	
Timken OK Load, lbs., Min.	60
FZG Rating, Fail Stage	13
Four Ball EP Test	ASTM D-2596
Load Wear Index, Kg., Min.	48
Weld Point, Kg., Min.	250
Four Ball Wear Test	ASTM D-2266
20 Kg at 60 C, 1800 rpm, 1 hr,	
Scar Diam, mm	0.30
General Electric's Dynamic Oxidation Test	Pass (GE 41A330373)
Brookfield Viscosity at 250 F	Viscosity must not exceed 3000 cPs
General Electric's Field Test	Pass
Source of Supply: ExxonMobil Oil Company, USA	Mobilgear SHC 6800

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4.18. GE SPECIFICATION D50E25C - TRACTION MOTOR GEAR OIL

<u>Properties</u>	<u>Test Method</u>
API Gravity	27.5
Specific Gravity at 20 C	0.888
Pour Point, C (F)	-20 (-4)
Flash Point, C (F)	200 (428)
Viscosity	
cSt at 40 C	3023
cSt at 100 C	171
SUS at 100 F	14000
SUS at 210 F	780
Viscosity Index	160
ISO VG	3200
Color	0.5
Rust Protection	Pass
Copper Corrosion	1A/1B
Extreme Pressure additives	Sulfur/Phosphorous
Wear Test	
Timken OK Load, lbs., Min.	90
FZG Rating, Fail Stage	3+
Four Ball EP Test	ASTM D-2596
Load Wear Index, Kg., Min.	48
Weld Point, Kg., Min.	250
Four Ball Wear Test	ASTM D-2266
20 Kg at 60 C, 1800 rpm, 1 hr,	
Scar Diam, mm	0.30
General Electric's Dynamic Oxidation Test	Pass
Brookfield Viscosity at 250 F	Viscosity must not exceed 3000 cPs
General Electric's Field Test	Pass
Source of Supply: ExxonMobil Oil Company, USA	Mobilgear SHC 3200

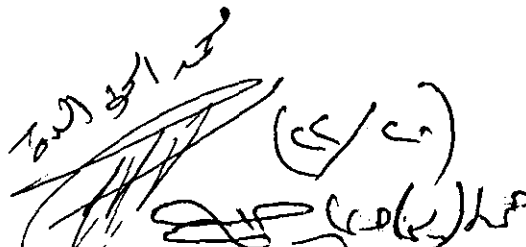
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محمد الخطيب
 (19/11/2015)
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4.19. GE SPECIFICATION D50E28 - TRACTION MOTOR U-TUBE BEARING GREASE

<u>Properties</u>	<u>Test Method</u>
Worked Consistency, 60 strokes (maximum)	325
Dropping Point, minimum, C (F)	246 (475)
Viscosity	
cSt at 40 C	340-460
cSt at 100 C	35.5-46.5
SUS at 100 F	1790-2400
SUS at 210 F	170-215
Rust Protection	Pass
Thickener	Lithium Complex
Wear Test	
Timken OK Load, lbs., Min.	50
Four Ball EP Test	ASTM D-2596
Load Wear Index, Kg., Min.	49
Weld Point, Kg., Min.	250
Four Ball Wear Test	ASTM D-2266
20 Kg at 60 C, 1800 rpm, 1 hr,	
Scar Diam, mm	0.60
Sources of Supply:	
ExxonMobil Oil Company, USA	Mobilith SHC 460
Chevron Global Lubricants	Chevron Ultiplex Synthetic EP

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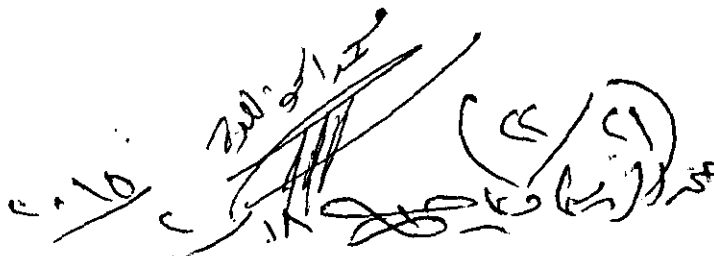
4.20. GE SPECIFICATION D50E32 - AC TRACTION MOTOR GEAR CASE LUBRICANT

High temperature anti-oxidants allow this oil to satisfactorily operate up to 140 C without breaking down. (Reference: oven storage and seal stability test: 140 C for 1000 hours.) Documented bench oxidation testing has shown that this oil can withstand peak temperatures of up to 163 C for 120 hours with little change in viscosity, TAN increase, or the formation of sludge.

D50E32 is a homogeneous, stable, PAO-based lubricant which is free from water, acids, sediment and other impurities and is of a non-corrosive nature.

Base Oil		PAO
Gravity, API		31.4
Specific Gravity		0.867
Pour Point, C (F) max.		-42 (-44)
Flash Point, C (F) min.		250 (482)
ISO VG		460
Viscosity, cSt		
@40 C		414-506
@100 C, typical		45
Viscosity Index		159
Rust Protection, ASTM D665A and 665B, Distilled and Synthetic Sea Water		Pass
Copper Corrosion, 24 hrs @121 C		1B
Chemical Activity Analysis, FEB Test		Pass
Wear Testing, FZG Scuffing Fail Stage		13+
RBOT		1500 min
TOST Life, hrs.		10,000+
TAN, new product, max. mg KOH/g Oil		<1.0
Foaming Characteristics, Seq I, Seq II, and Seq III		0/0/0
Hydrolytic Stability, 2 week test cycle, TAN, mg KOH/g Oil		<1.0
Properties		Test Method
API Gravity	26.6	ASTM D-1298
Pour Point, C (F)	-15 (+5)	ASTM D-97
Flash Point, C (F)	200 (428)	ASTM D-1310
Viscosity		
cSt at 40 C	3023	ASTM D-445
cSt at 100 C	171	ASTM D-445
SUS at 100 F	14000	ASTM D-445
SUS at 210 F	780	ASTM D-445
Viscosity Index	170	ASTM D-2270
Rust Protection	Pass	ASTM D-665
Copper Corrosion		ASTM D-130
Chemical Activity Analysis		FAG FE8
Foaming Characteristics		ASTM D-892
Hydrolytic Stability		ASTM D-2619
TAN		ASTM D-664
TOST		ASTM D-943
RBOT		ASTM D-2272
FZG Scuffing		DIN 51534
Source of Supply: ExxonMobil Oil Company, USA		Mobil SHC 634

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4.21. GE SPECIFICATION D50E6B - SPECIAL PURPOSE GREASE
(Gulf Precision "O" is no longer available, replace with the following)

Source of Supply: Chevron Global Lubricants Texaco Marfak "O" Code 927

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NEW 10-04 GMD
REV 07-05 JB
REV 05-06 GMD
REV 04-07, TLS

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