

TERRY CORPORATION

LAMBERTON ROAD • WINDSOR, CONNECTICUT U.S.A.
A SUBSIDIARY OF INGERSOLL-RAND

DESIGN
DATA

DESIGN DATA NO 76.02.04
SUBJECT: LUBRICATION - STANDARDS
(REQUIREMENTS FOR SYNTHETIC OILS -
TURBINES & GEARS)

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1. SCOPE

This design data allows for use of certain types of synthetic lubricating oils for steam turbine and/or gear service and is intended as guidance for selection thereof. Requirements are listed below as well as general information on synthetic oils and their suitability for various applications.

2. GENERAL

2.1 Definition: Synthetic oils are oils whose base stocks have been "man-made" by chemical synthesis; as opposed to conventional mineral oils whose base stocks are found in nature. Although most synthetics are derived at least in part from petroleum products, their manufacture goes beyond refining and into molecular restructuring to obtain certain desirable properties not found in conventional oils. The more significant of these properties are as follows:

- a) Long life between oil changes,
- b) Stability at higher operating temperatures,
- c) Remains fluid at very low temperatures,
- d) High viscosity index (less viscosity variation with temperature changes),
- e) Fire resistance,
- f) Resistance to degradation from radiation.

2.1.1 It is important to note that no one synthetic lubricant excels in all of the above areas. Each type has its strong and weak points and selections should be made accordingly-see paragraphs 4. & 5. below for selections, types, and applications. Some types may even be weaker than mineral oils in certain areas.

2.2 Disadvantages: In contrast to advantages described above, most "synthetics" exhibit one or more of the following undesirable characteristics which must also be considered in making selections:

- a) Corrosive to some paints used in housings and oil sumps,
- b) Corrosive to certain materials commonly found in lubrication system components, especially pumps,
- c) Compatibility with mechanical contact seal materials varies,
- d) Some "synthetics" do not lubricate as well as mineral oils,
- e) Hydrolytic instability (forms harmful compounds in presence of moisture,
- f) High cost.

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3. LUBRICANT REQUIREMENTS

3.1 Synthetic lubricating oils for both steam turbine and gear service shall meet the following ASTM test requirements:

- 3.1.1 Viscosity Index: All oils must have a viscosity index of 90 minimum, per ASTM:D2270.
- 3.1.2 Oxidation Characteristics: All oils must pass ASTM:D943, turbine oxidation stability test, with a minimum of 2000 hours to reach a neutralization number of 2.0.
- 3.1.3 Corrosion Tests: All oils must:
a) pass ASTM:D665, rust test, with no rust after 24 hours in the presence of synthetic sea water,
b) pass ASTM:D130 copper corrosion test, with corrosion not exceeding a number 1 strip after a 3 hour run at 250°F (121°C).
- 3.1.4 Foam Test: All oils must pass ASTM:D892, foam test, with volume of foam not exceeding 75 ml. after a 5 minute blow, and 10 mil. after a 10 minute rest, for a three sequence test: sequence one at 75°F (24°C), sequence two at 200°F (93°C), and sequence three at 75°F.
- 3.1.5 Demulsibility: All oils must pass ASTM:D2711, demulsibility test, with a maximum of 0.5 percent water in oil after a 5 hour test; a maximum cuff of 2.0 ml. after centrifuging, and a minimum of 30 ml. of water collected during the entire test.

3.2 Special Requirements

- 3.2.1 Must be compatible with paints used in coating oil containing parts as specified in Terry Specification No. SP-115.
- 3.2.2 Must not be corrosive to any components of the lube system. This should be verified for each specific application utilizing engineering form, K-13371 (see Fig. 1).
- 3.2.3 Product Approval: To obtain Terry approval of any type of synthetic oil not previously approved, manufacturer must show evidence of successful operation in at least one similar machine. In the absence of previous experience in similar applications, a load test with complete tear-down and inspection of parts may be required to ensure that the "synthetic" product has good lubricating qualities. See subparagraph 3.3 for procedure.

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FORM E-162

REV. 1
4/75 GLK

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- 3.3 Product Approval: shall be on an individual application basis by Terry Lubrication Engineer based on the following requirements:
- 3.3.1 Certification by lubricant supplier that product passes requirements of subpara. 3.1, and
 - 3.3.2 Completion of a survey as outlined on form illustrated in Figure 1 to ensure that the provisions of subpara. 3.2.1 and 3.2.2 are met, and
 - 3.3.3 Assurance of application suitability as required in subpara. 3.2.3.
 - 3.3.4 Products listed in subpara. 5.2 as being unsuitable will not be considered.
 - 3.3.5 Any of above requirements may be waived or modified by Terry based on previous experience with similar products.

4. VISCOSITY SELECTION

Selection of lubricating oils is governed primarily by maximum bulk oil temperature as shown in Table 1 below.

Table 1: Viscosity Selection for Turbines & Gears

Max. Bulk Oil Temp (ring oiled brgs). or Max. Drain Temperature °F (°C)	Typical Viscosity: SSU at 100°F (38°C)			
	Turbine Alone		Gear Alone	Combined Oil System
	Ring Oiled Bearings	Forced Lube System		
100 - 125 (38-52)	150	-	-	-
126 - 160 (53-71)	215	150	215 (AGMA No. 1)	215 (AGMA No. 1)
161 - 180 (72-82)	315	215	315 (AGMA No. 2)	315 (AGMA No. 2)
181 - 230 (83-110)	700	-	-	-

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5. AVAILABLE TYPES AND THEIR APPLICATIONS

5.1 Categories: Synthetic oils normally used in industrial applications may be grouped in the following general categories:

- a) Synthetic hydrocarbons,
- b) Esters: monoesters, diesters, polyesters, neopentyl esters, etc.,
- c) Phosphate esters,
- d) Silicate esters,
- e) Fluorinated, chlorinated, and halogenated compounds,
- f) Polyaromatics,
- g) Glycols (polyethers),
- h) Silicones.

5.2 Suitability

5.2.1 Silicones are generally not considered suitable because of their poor lubricating qualities (this does not apply to silicate esters).

5.2.2 Glycols are generally not considered suitable because they are water soluble. The presence of steam or moisture from a heat exchanger leak can cause a catastrophic lubrication failure with no warning.

5.2.3 All remaining categories as listed in subpara. 5.1(a) through (e) are generally considered suitable for industrial applications providing that they are properly formulated to meet the requirements of paragraph 3.

5.3 Properties: Table 2 below lists important lubricant properties of "synthetics" as compared to petroleum based lubricants. It should be noted that properties within a given category may vary considerably; and therefore, the table should be used only as a general guide in initial evaluation. Final selection should be based on merits of individual products.

6. REFERENCES

- 6.1 "Synthetic Lubricants" by Fairbanks, Knap, and Lazarus - Machine Design, July 10, 1969.
- 6.2 "The Facts and Fiction of Synthetic Oils" by W.C. Gergel - Published by Lubrizol Corp. 1975.
- 6.3 "Standard Handbook of Lubrication Engineering" by O'Connor and Boyd McGraw-Hill 1968.
- 6.4 "Industrial Synthetic Lubricants" by R.L. Marinello - Plant Engineering, August 19, 1976.
- 6.5 Terry Specification No. SP-115 (ref. para. 3.2.1)

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TABLE 2: PROPERTIES OF SYNTHETIC OILS AS COMPARED TO PETROLEUM BASE OILS

	Long Life	High Temp. Operation	Low Temp. Operation	Viscosity Index	Fire Resistance	Radiation Resistance	Lubricating Qualities	Affected By Moisture	Corrosive
Synthetic Hydrocarbon	S	S	S	S	C	IND	C	C	C
Esters	S	S	S	S	C	C	C	P	P
Phosphate Esters	C	C	C	C	S	P	S	P	P
Silicate Esters	C	S	S	S	C	P	P	P	P
Fluorinated and Chlorinated Compounds	S	S	C	P	S	IND	IND	IND	IND
Polyaromatics	S	S	P	P	C	S	P	C	P
Glycols	S	S	S	S	C	C	C	P	P
Silicones	S	S	S	S	C	P	P	C	C

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Code: C - Comparable
IND - Indeterminate, wide variations
P - Poorer
S - Superior

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- Form K-13371 -

COMPATIBILITY OF SYNTHETIC LUBRICANT
WITH LUBE SYSTEM COMPONENTS
CHECK OFF SHEET

FILE: _____ LUBRICANT (TYPE & BRAND NAME): _____

BY: _____ DATE: _____

I. GEAR CASE & PIPING:

(a) Oil reservoir paint (ref. SP-115) _____

(b) Spray pipe - copper (Std.) _____ steel _____ stainless _____

(c) Oil piping - CI _____ steel _____ stainless _____

(d) Bearings - bronze _____ babbitt _____ ball or roller _____

(e) Case mat'l. - steel _____ CI _____

II. FITTINGS & INSTRUMENTATION:

(a) Relief valves - mat'l. _____

(b) Check valves - mat'l. _____

(c) Pressure gauges _____

(d) Thermometers & RTD's _____

(e) Vibration pickups _____

(f) Pressure switches _____

(g) Temperature switches _____

(h) Other _____

III. COOLER: Mat'l's. _____

IV. FILTER COMPONENTS:

(a) Filter housing - mat'l. _____

(b) Filter element - type _____

(c) Filter bowl - mat'l. _____

(d) By-pass valve _____

(e) Dirt alarm or gauge _____

(f) Transfer valve _____

V. MAIN PUMP:

(a) Housing - Mat'l. _____

(b) Rotor - Mat'l. _____

(c) Bearings - Mat'l. _____

(d) Seals - Mat'l. _____

VI. AUXILIARY OIL PUMP:

(a) Housing - Mat'l. _____

(b) Rotor - Mat'l. _____

(c) Bearings - Mat'l. _____

(d) Seals - Mat'l. _____

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VII. OTHERS: _____

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Figure 1: Engineering Form K-13371 - Compatibility of Synthetic Lubricant With Lube System Components

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FILE: _____ LUBRICANT (TYPE & BRAND NAME): _____

BY: _____ DATE: _____

I. GEAR CASE & PIPING:

- (a) Oil reservoir paint (ref. SP-115) _____
- (b) Spray pipe - copper (Std.) _____ steel _____ stainless _____
- (c) Oil piping - CI _____ steel _____ stainless _____
- (d) Bearings - bronze _____ babbitt _____ ball or roller _____
- (e) Case mat'l. - steel _____ CI _____

II. FITTING & INSTRUMENTATION:

- (a) Relief valves - mat'l. _____
- (b) Check valves - mat'l. _____
- (c) Pressure gauges _____
- (d) Thermometers & RTD's _____
- (e) Vibration pickups _____
- (f) Pressure switches _____
- (g) Temperature switches _____
- (h) Other _____

III. COOLER: Mat'ls. _____

IV. FILTER COMPONENTS:

- (a) Filter housing - mat'l. _____
- (b) Filter element - type _____
- (c) Filter bowl - mat'l. _____
- (d) By-pass valve _____
- (e) Dirt alarm or gauge _____
- (f) Transfer valve _____

V. MAIN PUMP:

- (a) Housing - Mat'l. _____
- (b) Rotor - Mat'l. _____
- (c) Bearings - Mat'l. _____
- (d) Seals - Mat'l. _____

VI. AUXILIARY OIL PUMP:

- (a) Housing - Mat'l. _____
- (b) Rotor - Mat'l. _____
- (c) Bearings = Mat'l. _____
- (d) Seals - Mat'l. _____

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