GENERAL INFORMATION FOR REFINERS OF PETROLEUM REGARDING TESTS OF LUBRICATING OILS, AT THE ENGEENIRING EXPERIMENT STATION, ANNAPOLIS, MD.

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GENERAL INFORMATION FOR REFINERS OF PETROLEUM

REGARDING

TESTS OF LUBRICATING OILS

AT THE ENGINEERING EXPERIMENT STATION, ANNAPOLIS, MD.

ALSO

INFORMATION CONCERNING

TESTS OF GREASES AND SOLUBLE OILS

AT THE LABORATORY OF THE MACHINERY DIVISION, NAVY YARD, NEW YORK

Revised and issued under date of March 1, 1920, by the Bureau of [redacted] Engineering, and subject to change or modification as found desirable

WASHINGTON
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1920

LUBRICATING OILS.

1. *Lubricating oils, U. S. Navy.*—Lubricating oils, set forth in the annual proposal to meet the requirements of the Bureau of Steam Engineering, are divided as follows:

(*a*) Refrigeration—ice machine oil.
(*b*) Force feed and motor cylinder oils.
(*c*) Steam engine oils for wick feed and cylinder.
(*d*) Electrical oils for transformers and switches.

2. *Navy classification.*—To meet the requirements of varied types of machinery throughout the naval service, ashore and afloat, these main divisions of lubricants are subdivided into classifications, according to viscosity or adaptability:

REFRIGERATION.

(1) Ice machine oil.....65–75 Saybolt @ 130° F.

FORCE FEED AND MOTOR CYLINDER OILS.

	Saybolt @ 130° F.	
(2) Light	100–115	Force feed, turbine and reciprocating.
(3) Medium	125–145	
(4) Heavy	180–200	
(5) Extra heavy	240–260	
(6) Ultra heavy	300–320	
(7) Aviation oil, summer	90–100 @ 210° F.	
(8) Aviation oil, winter	75–85 @ 210° F.	

STEAM ENGINE OILS.

(9) Marine engine compound above 65 @ 210° F., Wick feed
(10) Marine engine straight mineral.....Wick feed.
(11) Steam cylinder, mineral....Piston rods and cylinders.
(12) Steam cylinder, mineral, superheat...Shore stations.

ELECTRICAL.

(13) Transformer oil.

3. *Trade name as a specification.*—There are no specifications for these various grades of lubricating oil. The Bureau prefers to rely on the integrity of character of an oil as specified by the manufacturer's trade name which represents an approved standard of lubricating quality.

4. *Test at Engineering Experiment Station.*—In order to establish the merits of a lubricating oil submitted under any one of the above classifications, the Bureau of Steam Engineering conducts a laboratory test at the Engineering Experiment Station, Annapolis, Md., and a subsequent service test under operating conditions afloat. If found acceptable the trade name and the name of the manufacturer and the oil's classification are placed on the Bureau's acceptable list, and remain there permanently so long as the quality of the manufacture is kept standard with the samples submitted for test.

5. *Acceptable list.*—Oils under specified trade name have been submitted by manufacturers from year to year to meet the bureau's requirements. The results of the Bureau's laboratory test and service tests afloat, formulate the Bureau's acceptable list and unacceptable list of lubricating oils.

6. It is to the interest of the oil manufacturer to have on the Bureau's acceptable list at least one oil covering each of the classifications enumerated. The Bureau prefers to have, if possible, one firm to handle the entire contract for one or both coasts, Atlantic and Pacific.

7. *Manufacturer's application for test.*—The company desiring tests of lubricating oil must make written application to the Navy Department, Bureau of Steam Engineering, Washington, D. C., and state the trade name of each oil and the classification under which it is offered.

The Bureau of Steam Engineering will authorize and direct the Engineering Experiment Station to make the test under conditions that follow.

8. *Cost of test.*—

(*a*) All expenses of tests are borne by the company.

(*b*) Cost of test varies with the labor involved and the number of oils tested, the expense being reduced where an oil proves unacceptable in the early stages of the test.

(*c*) In general, a deposit of $50 is required for a test of one oil and $300 for six or eight oils.

9. *Samples for test.*—Samples are furnished without cost to the Government. Usually the quantities required are:

	Gallons.
REFRIGERATION.	
Ice machine oil	5
FORCE FEED AND MOTOR CYLINDER OIL.	
Light	10
Medium	10
Heavy	10
Extra heavy	5
Ultra heavy	5
Aviation	20
STEAM-ENGINE OILS.	
Marine engine compounded	5
Marine engine straight mineral	5
Steam cylinder mineral	1
Steam cylinder mineral superheat	1
ELECTRICAL OIL.	
Transformer oil	1

10. *Shipment instructions.*—Sample quantities of oil are to be shipped, with all express or other charges prepaid, to *Supply Officer*, Naval Academy, Annapolis, Md., plainly marked "*For test at Engineering Experiment Station.*"

11. *Payment of deposit.*—Before the test is started, a check to cover the cost of test, payable to *Superintendent, U. S. Naval Academy*, must be mailed direct to that official at Annapolis, Md. Any unexpended balance will be returned to the exhibitor.

12. *Order of precedence.*—Authorized tests are given a number and are taken up in regular order.

13. *Witnessing a test.*—Representatives of the company for whom tests are being conducted are privileged to be present and witness the methods of testing employed.

14. *Confidential nature of tests.*—All tests are made with the strict understanding that they are for the information of the Government only, and that the results are not to be used for advertising purposes.

15. *Trade name.*—The trade name of an oil is regarded by the Bureau as a permanent specification, representing characteristics and qualifications as tested and supplied throughout. Oils which are subsequently changed without notification to the Bureau are eliminated from further consideration.

Manufacturers are urged to adopt for a particular oil a trade name that is permanent, and which has some indication of its character and use, for example: *Eskimo Ice Machine, Cetus 200, Monogram Medium, Galena Heavy 500, Ocean Marine Engine,* and *600 W. Cylinder.*

It has been found convenient in classifying force feed oils to have companies affix to the name of an oil the Saybolt viscosity at 130° Fahrenheit.

16. *Test at Engineering Experiment Station.*—In so far as possible all tests on lubricating oils are made in accordance with standard or tentative standard tests of the American Society for Testing Materials. A complete test consists of three parts: chemical, physical, and practical.

17. *Chemical analysis.*—To successfully pass the *chemical* tests *all* oils should be neutral in reaction and should not show the presence of moisture, matter insoluble in petroleum ether (hard asphalt), matter insoluble in ether alcohol (soft asphalt), sulphur, charring or waxlike constituents, napthenic acids, sulphonated oils, soap, resin,

or tarry constituents, the presence of which indicates adulteration or lack of proper refining. Except in oil for engines without forced lubrication, no traces of fixed oils (animal or vegetable fats) should be found.

18. In lubricating oil for main engines without forced lubrication, approved fixed oils, such as rapeseed, olive, tallow, lard, and neat's-foot oil may be used. When the above fixed oils are used, they will be well refined with alkalies, unadulterated, containing a minimum of free fatty acids, with no moisture or gumming constituents. Olive oil should not have a high specific gravity. If satisfactory emulsifying results can be obtained with straight mineral oils on engines without forced lubrication they may be submitted for service test.

19. The *physical* tests applied to *each* oil are as follows:

(*a*) Specific gravity—pyknometer. Baumé gravity.

(*b*) *Flash* and *fire point* (Cleveland open cup).

The flash point should not be below 320° F., open cup; and for steam cylinder oil not below 490° F. Aviation oil not below 410° F.

(*c*) *Pour test.*—The pour test should not be above 32° F. The cold test of cylinder oils may exceed 32° F. For ice-machine oils the pour test should be as low as possible, at least low enough for the operating condition of minus 35° F. in a dense-air ice machine. For aviation oil, summer, not above 45° F.; winter, not above 15° F.

(*d*) *Viscosity.*—The Saybolt Standard Universal Viscosimeter is used. The viscosity of the oils must be sufficient for the purpose intended, and, except for ice-machine oils, must not be less than 100 seconds, at 130° F. Viscosity is taken at 100°, 130°, and 210° F.

(*e*) *Carbon.*—Ice-machine oils and light medium and heavy forced feed and motor cylinder oils must not show a carbon residue of over 0.5 per cent, the extra heavy and

ultra heavy force feed and motor cylinder oils not over 1 per cent, and aviation motor oils not over 1.5 per cent; carbon residue to be determined by the Conradson method. The carbon shown must be loose and flaky and must break up easily in the crucible.

(*f*) *Emulsion tests.*—Emulsion tests are made on all straight mineral oils, except cylinder oils. Four emulsion runs are made, using 40 c. c. of oil in each case and—

(1) 40 c. c. of distilled water.
(2) 40 c. c. of 1 per cent sodium chloride solution.
(3) 40 c. c. of normal caustic soda.
(4) 40 c. c. of boiling distilled water.

The mixture is stirred with a paddle for five minutes at 1,500 revolutions per minute, the mixture being kept at a temperature of 130° F. during the stirring and while settling out. On oils used with forced lubrication or on ice machines the oil must completely settle out in less than 30 minutes. Aviation motor oils when stirred as above with distilled water and a 1 per cent sodium chloride solution at 180° F., the bath being maintained at 180° F., shall settle out completely in less than one hour. Compounded marine engine oils when stirred as above with distilled water and a 1 per cent sodium chloride solution at 130° F., the bath being maintained at 130° F., the oils should remain completely emulsified for at least one hour; the emulsion should be of a heavy, creamy nature.

(*g*) *Evaporation test.*—All lubricating oils are tested for evaporation. Into a brass cup $1\frac{5}{8}\frac{1}{2}$ inches outside diameter, $1\frac{3}{8}\frac{9}{2}$ inches inside diameter, and $\frac{1}{5}\frac{1}{2}$ inch in thickness, are weighed 5 grams of oil, which is then heated in a constant temperature electric oven, the temperature being taken by a thermometer whose bulb is just over the cup. Ice-machine oils should not give an evaporation of over 4 per cent. All other oils should not give over 2.5 per cent of evaporation.