DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

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No. 1110-2-1424

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Engineering and Design
LUBRICANTS AND HYDRAULIC FLUIDS

1. This change to EM 1110-2-1424, 28 February 1999 revises Appendix C for the sample procurement specification for turbine oils.

2. Substitute the attached pages.

Remove Page	Insert Page
C-1 through C-9	C-1 through C-9

3. File this change sheet in front of the publication for reference purposes.

FOR THE COMMANDER:

YVONNE J. PRETTYMAN-BECK
Colonel, Corps of Engineers
Chief of Staff

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Engineering and Design
LUBRICANTS AND HYDRAULIC FLUIDS

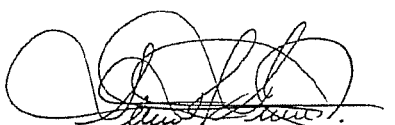
1. Purpose. This manual provides guidance on lubricants and hydraulic fluids to engineering, operations, maintenance, and construction personnel and other individuals responsible for the U.S. Army Corps of Engineers (USACE) civil works equipment.

2. Applicability. This manual applies to all USACE commands having civil works responsibility.

3. Discussion. This manual is intended to be a practical guide to lubrication with enough technical detail to allow personnel to recognize and easily discern differences in performance properties specified in manufacturers' product literature so that the proper lubricant for a particular application is selected. It describes basic characteristic properties of oils, hydraulic fluids, greases, solid lubricants, environmentally acceptable lubricants, and their additives. It examines the mechanics of hydrodynamic, boundary, extreme pressure, and elastohydrodynamic lubrication to protect against surface deterioration. Separate chapters are devoted to lubricant specification and selection, and requirements of lubricants for equipment currently in use at USACE civil works facilities. Because conscientious adherence to lubrication schedules is the best prescription for longevity of component parts, operation and maintenance considerations are also addressed.

4. Distribution Statement. Approved for public release, distribution is unlimited.

FOR THE COMMANDER:



ALBERT J. GENETTI, JR.
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Chief of Staff

2 Appendices
(See Table of Contents)

lower flash temperature. Furthermore, judicious application of lubricant can cool the gears by removing heat.

(b) For synthetics and lubricants containing antiscuff additives, the critical temperature depends on the operating conditions and must be determined experimentally for each case. Antiscuff additives commonly used are iron sulfide and iron phosphate. These additives react chemically with the protected metal gear surface to form very strong solid films that prevent metal contact under extreme pressure and temperature conditions. As previously noted in the discussions of oil additives, the beneficial effects of extreme pressure additives are enhanced as the temperature increases.

(c) The following guidelines should be observed to prevent scuffing in gear units:

! Specify smooth tooth surfaces produced by careful grinding or honing.

! Protect gear teeth during the running-in period by coating them with iron-manganese phosphate or plating them with copper or silver. During the first ten hours of run-in, new gears should be operated at one-half load.

! Use high-viscosity lubricants with antiscuff additives such as sulfur, phosphorus, or borate.

! Make sure the gear teeth are cooled by supplying adequate amount of cool lubricant. For circulating-oil systems, use a heat exchanger to cool the lubricant.

! Optimize the gear tooth geometry. Use small teeth, addendum modification, and profile modification.

! Use accurate gear teeth, rigid gear mountings, and good helix alignment.

! Use nitrided steels for maximum scuffing resistance. Do not use stainless steel or aluminum for gears if there is a risk of scuffing.

9-4. Gear Lubrication

a. Lubricant characteristics. Gear lubricant must possess the following characteristics:

(1) General. The following characteristics are applicable to all gear lubricants. The lubrication requirements for specific gears follow this general discussion:

(a) Viscosity. Good viscosity is essential to ensure cushioning and quiet operation. An oil viscosity that is too high will result in excess friction and degradation of oil properties associated with high oil operating temperature. In cold climates gear lubricants should flow easily at low temperature. Gear oils should have a minimum pour point of 5 ^{0}C (9 ^{0}F) lower than the lowest expected temperature. The pour point for mineral gear oil is typically -7 ^{0}C (20 ^{0}F). When lower pour points are required, synthetic gear oils with pour points of -40 ^{0}C (-40 ^{0}F) may be necessary. The following equation from the ASM Handbook provides a method for verifying the required viscosity for a specific gear based on the operating velocity: