

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

1. REPORT DATE (DD-MM-YYYY) July 2004		2. REPORT TYPE Final		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE FIST 2-4, Lubrication of Powerplant Equipment				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Bureau of Reclamation Hydroelectric Research and Technical Services Group Denver, Colorado				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Bureau of Reclamation Denver Federal Center P.O. Box 25007 Denver, CO 80225-0007				8. PERFORMING ORGANIZATION REPORT NUMBER FIST 2-4	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Hydroelectric Research and Technical Services Group Bureau of Reclamation Mail Code D-8450 PO Box 25007 Denver CO 80225-0007				10. SPONSOR/MONITOR'S ACRONYM(S) DIBR	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Available from the National Technical Information Service, Operations Division, 5285 Port Royal Road, Springfield, Virginia 22161					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT The proper selection and use of lubricants, as well as the care and operation of lubricating systems, is an essential part of any powerplant maintenance program. Choosing an appropriate lubricant for a particular application and maintaining the effectiveness of lubricants requires a basic understanding of lubrication theory and the characteristics of lubricants. This document discusses lubrication fundamentals, lubricant characteristics, additives, maintenance of lubrication systems, and the selection of lubricants for common powerplant equipment.					
15. SUBJECT TERMS Lubrication, Lubricants, Grease, Oil, Additives, Friction, Bearings					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UL	18. NUMBER OF PAGES 33	19a. NAME OF RESPONSIBLE PERSON Roger Cline
a. REPORT UL	b. ABSTRACT UL	c. THIS PAGE UL			19b. TELEPHONE NUMBER (include area code) 303-445-2293

DISCLAIMER

This written matter consists of general information for internal Bureau of Reclamation operations and maintenance staff use. The information contained in this document regarding commercial products or firms may not be used for advertising or promotional purposes and is not to be construed as an endorsement of any product or firm by the Bureau of Reclamation.

Contents

	<i>Page</i>
1. Introduction.....	1
2. Fundamentals of Lubrication	1
2.1 Fluid Film Lubrication	1
2.2 Elastohydrodynamic Lubrication.....	3
2.3 Boundary Lubrication	4
3. Lubricant Characteristics	5
3.1 Oil	5
3.2 Grease	8
4. Lubricant Additives.....	10
4.1 Surface Protective Additives.....	10
4.2 Performance Enhancing Additives	11
4.3 Lubricant Protective Additives	11
4.4 Additive Depletion.....	12
4.5 After Market Additives.....	12
5. Maintenance of Lubrication Systems.....	12
5.1 Oil Lubricated Systems.....	12
5.2 Grease Lubricated Systems.....	19
6. Lubricant Storage and Handling.....	20
6.1 Safety	20
6.2 Oil	21
6.3 Grease	22
7. Lubricant Selection.....	22
7.1 Lubricant Standards	22
7.2 Turbine Oil.....	23
7.3 Hydraulic Systems	23
7.4 Hydraulic Governor Systems.....	24
7.5 Wicket Gates, Radial Gates, and Butterfly Valves.....	24
7.6 Gears	24
7.7 Wire Rope	25
7.8 Environmentally Acceptable Lubricants.....	26
8. References.....	27

Figures

	<i>Page</i>
Figure 1 Fluid Film Lubrication.....	2
Figure 2 Pivoting Shoe Thrust Bearing.....	2
Figure 3 Horizontal Journal Bearing.....	3
Figure 4 Fluid Film and Boundary Lubrication.....	4
Figure 5 Viscosity Grading Systems Comparison.....	7

Tables

Table 1 Grease Application Guide.....	8
Table 2 Grease Compatibility.....	21
Table 3 Typical Turbine Oil Specifications.....	23
Table 4 Recommended Grease Properties.....	25

